Curriculum and Syllabus

M.Tech

In

ELECTRONICS DESIGN AND TECHNOLOGY

NATIONAL INSTITUTE OF ELECTRONICS AND INFORMATION TECHNOLOGY, AURANGABAD

Department of Electronics and Information Technology

Vision of Department of Electronics and Information Technology

To be the leader in the development of industry oriented quality education and training and be the country's premier Institution in the field of Information, Electronics and Communications Technology (IECT).

Mission of Department of Electronics and Information Technology

Identifying the needs of modern engineering & technology education and providing Quality Technical Education leading to Academic Excellence, creativity and innovation in the areas of Electronics and Information Technology

Programme Educational Objectives (PEOs) and Programme Outcomes (POs): PG Course in Electronics Design and Technology

Programme Educational Objectives (PEOs)

SI No.	Programme Educational Objectives (PEO)
PEO 1	To bring an innovative, entrepreneurial spirit along with excellence in teaching, learning and research to develop leaders in IT and Electronics.
PEO 2	To generate and keep update Industry-ready quality professionals with knowledge-based skill set in IECT and allied fields.
PEO 3	To maintain close links with Industries, R&D and Academic Institutions to promote electronics, IT and industrial design culture.
PEO 4	To develop entrepreneurs, experts and designers, carry out R&D and provide Industrial Consultancy in IECT

Programme Outcomes (POs) & Programme Specific Outcomes (PSOs) of M.Tech.in Electronics Design and Technology

SI. No.	Programme Outcome (PO)
PO 1	Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations
PO 2	Identify, formulate, research literature and solve complex engineering problems reaching substantiated conclusions
PO 3	Demonstrate a knowledge and understanding of contemporary technologies, their applications and limitations, contemporary research in the broader context of relevant fields.

PSO 1	The ability to adapt for rapid changes in tools and technology with an understanding of societal and ecological issues relevant to professional engineering practice through life-long learning
PSO 2	Excellent adaptability to function in multi-disciplinary work environment, good interpersonal skills as a leader in a team in appreciation of professional ethics and societal responsibilities.

Scheme of M.Tech Programme in ELECTRONICS DESIGN and TECHNOLOGY

(With Effect from the Academic Year 2021 onwards)

Semester I

SI. No.	Course Code	Course Title	Hours/ week			Total Credits	Theory Marks		Practical Marks
			L	T	P		ESE Marks	Internal Marks	
1.	M101	Industrial Design of Electronic Equipment	1	0	0	1	30	20	0
2.	M102	Advanced Digital System Design	3	0	0	3	70	30	0
		Elective - 1	3	0	0	3	70	30	100
3.	M103	Electromagnetic Compatibility	3	0	0	3	70	30	0
4.	M104	Electronic Packaging	3	0	0	3	70	30	0
5.	M105	Design for Manufacturability	3	0	0	3	70	30	0
6.	ML101	Industrial Design of Electronic Equipment Laboratory	0	0	6	3	70	30	100
7.	ML102	Advanced Digital System Design Laboratory	0	0	2	1	40	10	50
8.		Elective – 1 Lab	0	0	2	1	40	10	50
Total			16	0	10	21	530	220	200
Elective - 1									
M106		Machine Learning							
M107		Networking and IOT							
Elective – 1 Lab									
ML106		Machine Learning Laboratory							
ML107		Networking and IoT Laboratory							

Examination Pattern

- **Theory Subject**
  - Internal Continuous Assessment: 30 / 20 marks

    Internal continuous assessment is in the form of periodical tests, seminars or a combination of both whichever suits best. There will be two tests per subject. The assessment details are to be announced to the students, right at the beginning of the semester by the teacher.

    Test 1- 15 marks

    Test 2- 15 marks

    Total – 30 marks

    End Semester Examination: 70 marks
- **Laboratory Subject**

Laboratory Experiments & Viva Voce	:	10 Marks
Final Internal Test	:	40 Marks
Total	:	50 Marks

- **Project Work and Seminar**
  - Seminar shall be evaluated by the evaluation committee based on the relevance of topic, content depth and breadth, communication skill, question answering etc on the power point presentation of the topic by the student.

First Semester

Course Code	**M101**
Course Title	**Industrial Design of Electronic Equipment**
Credits	**1-0-0:1**
Pre-requisutes	**Nil**

Objective

- To understand the various processes and systems to address human needs by creating tangible Electronic Products. To pursue learners with emphasis on learning-by-doing and following a comprehensive process of design, engineering and producing products and systems.

Syllabus

- Product development life cycle – various life cycle models. Aesthetics in a product design. Ergonomics. Design for Reliability – failures and solutions. Design for Manufacturability. PCB design – design rules, Schematics, creating Gerber files, etc. Electrical testing of the system. Familiarizing various tools – Shop bot, 3D printer, Laser cutter, PCB fabrication machine & soldering tools.

Course Outcome:

- After undergoing this course, students will be able to:
  - Design electronic products using user centered design process
  - Develop sketches, virtual and physical appearance models to communicate proposed designs
  - Refine product design considering engineering design & manufacturing requirements and constraints.
  - Make mock-up model and working prototype along with design documentation.

References:

1. V.B. Baru R.G.Kaduskar, Electronic Product Design, Wiley India
2. Tony Ward and James Angus, Electronic Product Design, Chapman & Hall

Internal continuous assessment : 20 marks

Test 1- 20 marks

End Semester Examination: 30 marks

Course Plan:

Modules (Theory)	No. of Hours	ESE marks
Module 1: Product development life cycle – various life cycle models.	13	30

Aesthetics in a product design. Ergonomics. Design for Reliability – failures and solutions. Design for Manufacturability. PCB design – design rules, Schematics, creating Gerber files, etc. Electrical testing of the system. Familiarizing various tools – Shop bot, 3D printer, Laser cutter, PCB fabrication machine & soldering tools		

Course Code	**M102**
Course Title	**Advanced Digital System Design**
Credits	**3-0-0: 3**
Pre-requisutes	**Nil**

Objective:

- To prepare students for the design of practical digital hardware systems using VHDL. This course covers the basics of digital logic circuits and introduces the student to the fundamentals of combination logic design and then to sequential circuits (both synchronous and asynchronous). Memory systems are also covered. Students will be provided opportunities to synthesize the designs (using both schematic capture and VHDL) for implementation in FPGAs..

Syllabus:

- Introduction to Digital Design, Combinational and Sequential Circuit Design, State machine design, Design of Asynchronous Sequential Circuit, Designing with PLDs, and CPLDs. HDL, Introduction to Synthesis and Synthesis Issues Testing, Fault Modelling and Test Generation, Test generation for combinational logic circuits, Introduction to Design for Testability. FPGAs, Logic blocks, Routing architecture, Design flow technology, Xilinx and Altera FPGA Architecture.

Course Outcome:

- The students will be able to design, simulate, built and debug complex combinational and sequential circuits based on an abstract functional specification and implement the designs on FPGAs.

TEXT BOOKS:

1. Parag K. Lala, "Digital System Design using programmable Logic Devices", Prentice Hall, NJ
2. Geoff Bestock, "FPGAs and programmable LSI; A Designers Handbook", Butterworth Heinemann

REFERENCES:

1. Miron Abramovici, Melvin A. Breuer and Arthur D. Friedman, “Digital Systems Testing and Testable Design”, John Wiley & Sons Inc.
2. Parag K.Lala “Fault Tolerant and Fault Testable Hardware Design” B S Publications
3. J. Bhasker, "A VHDL Primer", Addison-Weseley Longman Singapore Pte Ltd.
4. Jesse H. Jenkins, "Designing with FPGAs and CPLDs", Prentice Hall, NJ
5. Fundamentals of Logic Design – Charles H. Roth, 5th ed., Cengage Learning.
6. Kevin Skahill, "VHDL for Programmable Logic", Addison –Wesley
7. Z. Navabi, "VHDL Analysis and Modeling of Digital Systems", McGRAW-Hill
8. Digital Circuits and Logic Design – Samuel C. Lee , PHI
9. Smith, "Application Specific Integrated Circuits", Addison-Wesley

10. P.K. Lala, "Digital Circuit Testing and Testability", Academic Press

Course Plan:

Modules (Theory)	No. of Hours	% ESE marks
Module 1 Introduction to Digital Design Combinational Circuit Design, Synchronous Sequential Circuit Design - Mealy and Moore model, State machine design, Analysis of Synchronous sequential circuit, State equivalence, State Assignment and Reduction, Analysis of Asynchronous Sequential Circuit, flow table reduction, races, state assignment, Design of Asynchronous Sequential Circuit, Designing with PLDs – Overview of PLDs – ROMs, EPROMs – PLA – PAL - Gate Arrays – CPLDs and FPGAs, Designing with ROMs - Programmable Logic Arrays - Programmable Array logic, PAL series 16 & 22 – PAL22V10 - Design examples.	12	25
Module 2 VHDL Basics – Introduction to HDL – Behavioral modeling – Data flow modeling – Structural modeling – Basic language elements – Entity – Architecture – Configurations – Subprograms & operator overloading – Packages and libraries – Test Bench – Advanced Features – Model simulation Realization of combinational and sequential circuits using HDL – Registers – Flip flops – counters – Shift registers – Multiplexers – sequential machine –Multiplier – Divider, Introduction to Synthesis and Synthesis Issues.	12	25
Module 3 Testing, Fault Modelling And Test Generation – Introduction to testing – Faults in Digital Circuits – Modelling of faults – Logical Fault Models – Fault detection – Fault Location – Fault dominance – Logic simulation – Test generation for combinational logic circuits – Testable combinational logic circuit design, Introduction to Design for Testability, BST	8	25
Module 4 FPGA - FPGAs - Logic blocks, Routing architecture, Design flow technology - mapping for FPGAs, Xilinx FPGA Architecture, Xilinx XC4000 - ALTERA's FLEX 8000, Design flow for FPGA Design, Case studies: Virtex II Pro.	10	25

Course Code	**M103**
Course Title	**Electromagnetic Compatibility**
Credits	**3-0-0: 3**
Pre-requisutes	**Nil**

Objective:

- To understand the various techniques for electromagnetic compatibility.
- To understand the need of Electromagnetic compatibility.
- To understand the method of PCB layout and stack up.
- To understand the hazards of ESD and protection against it in equipment design

Syllabus:

- Need for Electromagnetic Compatibility, Two aspects of EMC, Digital circuit power distribution, Radiated emission, Conducted emission, PCB layout and stack up, Electrostatic Discharge (ESD)

Course Outcome:

- Understand basic mitigating techniques in EMC
- Understand shielding mechanisms and electromagnetic coupling.
- Understand the basics and importance of grounding.
- Understand the concept of return path in PCB design.
- Able to apply design considerations for various PCB design.
- Will be able to do PCB layers stacking.
- Understand how to apply proper methods of grounding for ESD protection of device.

REFERENCES:

1. Henry W.Ott, Electromagnetic Compatibility Engineering, John Wiley & Sons
2. Henry W.Ott, Noise Reduction Techniques in Electronic Systems, Second Edition Wiley Interscience Publication
3. Clayton R.Paul, Introduction to Electromagnetic Compatibility, Second Edition , Wiley Interscience Publication
4. V. Prasad Kodali, Engineering Electromagnetic Compatibility-Principles, Measurements, Technologies, and Computer Models Second Edition IEEE Press
5. Ralph Morrison, Grounding and Shielding circuits and interference 5th edition Wiley

Course Plan:

Modules (Theory)	No. of Hours	% ESE marks
Module 1 Need for Electromagnetic Compatibility, Two aspects of EMC – Emission and Susceptibility, Radiation and Conduction, Designing for EMC, EMC regulations, designing for Electromagnetic Compatibility.	18	34

Noise and Interference, Typical Noise path, Methods of noise coupling, Non-ideal behavior of electronic components Capacitive and Inductive Coupling, Effect of Shielding on capacitive and inductive coupling, Shielding to prevent magnetic radiation, shielding a receptor against magnetic fields, Shield Transfer Impedance -shielding properties of various cable configurations, coaxial cable and shielded twisted pair, braided shields, ribbon cables, Shield Terminations Safety grounds, signal grounds, single point, multi-point and hybrid grounds, Chassis Grounds, Common Impedance Coupling, Grounding of cable shields, Ground loops and its breaking, Common Mode Choke – Analysis at low and high frequencies, Balancing and Filtering		
Module 2 Digital circuit grounding, internal noise sources, Digital circuit ground noise, minimizing ground impedance and loop area, ground grid, ground plane, Ground plane current distribution, ground plane impedance. Current flow in micro-strip and strip-line routing Digital circuit power distribution- Transient power supply currents, decoupling capacitor design, effective decoupling strategies, decoupling capacitor selection and mounting Radiated emission - Differential mode and common mode radiation – Reasons and controlling methods, Conducted emission – Power line impedance, Line impedance stabilization network, Common mode and differential mode noise sources in SMPS. Power line filters	17	33
Module 3 PCB layout and stack up - General PCB layout Considerations, PCB to chassis ground connections, return path discontinuity, PCB layer stack up, General PCB design procedure, mixed signal PCB layout, Split planes, Ground connection and power distribution, vertical isolation Near fields and far fields, characteristic and wave impedances, shielding effectiveness, absorption and reflection loss, shielding with magnetic material, apertures, conductive gaskets, conductive windows, conductive coating, grounding of shields. Electrostatic Discharge (ESD) -Static generation, human body model, static discharge, ESD protection in equipment design, Transient and Surge Protection Devices, ESD grounding, non-grounded products, software and ESD protection, ESD versus EMC, ESD Testing	17	33

Course Code	**M104**
Course Title	**Electronic Packaging**
Credits	**3-0-0: 3**
Pre-requisutes	**Nil**

Objective:

- The course will discuss all the important facets of packaging at three major levels, namely, chip level, board level and system level. Students masters the fundamental knowledge of electronics packaging including packing styles, hierarchy and method of package necessary for various environment. Sensitize students to the multi-disciplinary area and appreciate the role of packaging in electronics product. Provides pathway for further studies in packaging if the students is inclined to do so.

Syllabus:

- Functions of an Electronic Package, IC Assembly, System Packaging, Printed Circuit Board, Board Assembly, Design Reliability, Thermal management for IC and PWB, Electrical Testing and trends in packaging

Course Outcome:

- The student will able to understand distinguish between engineering performance, economic efficiency and to develop cost efficient high performance packaging approaches. As designer point of view cost efficiency and high performance are very important. It is going to be very difficult to build high performance at low cost; but, a good packaging engineer will strive to achieve these very two extremities in packaging.

REFERENCES:

1. Rao R. Tummala, Fundamentals of Microsystem PackagingMcGraw Hill
2. Richard K. Ulrich &William D. Brown Advanced Electronic Packaging - 2nd Edition : IEEE Press
3. Rao R. Tummala, MadhavanSwaminathan, Introduction to System-on-Package (SOP), McGraw-Hill

Course Plan:

Modules (Theory)	No. of Hours	% ESE marks
Module 1 Functions of an Electronic Package, Packaging Hierarchy, Driving Forces on Packaging Technology. Materials for Microelectronic packaging, Packaging Material Properties, Ceramics, Polymers, and Metals in Packaging. Electrical Anatomy of Systems Packaging, Signal Distribution, Power Distribution, Electromagnetic Interference.	12	31
Module 2	16	41

IC Assembly – Purpose, Requirements, Technologies, Wire bonding, Tape Automated Bonding, Flip Chip, Wafer Level Packaging. Different types of IC packages – DIP, QFP etc. Systems Packaging – MCM / SoC/ SiP/ SoP. Discrete, Integrated and Embedded Passives. Printed Circuit Board – Anatomy, CAD tools for PCB design, Standard fabrication, Microvia Boards. Board Assembly – Surface Mount Technology, Through-Hole Technology, Process Control and Design challenges.		
Module 3 Design for Reliability – Fundamentals, Induced failures. Thermal Management for IC and PWBs, Cooling Requirements, Electronic cooling methods. Electrical Testing – System level electrical testing, Interconnection tests, Active Circuit Testing, Design for Testability. Trends in packaging.	11	28

Course Code	**M105**
Course Title	**Design for Manufacturability**
Credits	**3-0-0: 3**
Pre-requisutes	**Nil**

Objective:

- The objective of course is identifying the manufacturing constraints that influence the design of parts and part systems.
- Students will be introduced to the Design for Manufacturability (DFM) methodology, and will be motivated to understand infeasible or impractical designs.
- To introduce emerging trends in PCB Design and manufacturing
- To explain design considerations for various PCB circuits like Analog, Digital and high-speed circuit.
- To introduce design rule check in PCB design

Syllabus:

- Product Life cycle, Need for different DFM techniques for different companies, DFM softwares, Design consideration for different types of PCBs, Manual verification

Course Outcome:

- Students will be able to understand the recent trends in DFM.
- Students will get to know the need for DFM in industry.
- Students will get exposure to PCB designs tools in software.
- Students will be able to differentiate between designer and manufacturer.
- Students will get familiar with design considerations for high-speed PCB designs and will be able to implement it wherever required.
- Students will be able to manually find out
- Students will get the knowledge of thermal profiling during SMD/PTH process.

REFERENCES:

1. Michael Orshansky, Sani Nassif, Duane Boning, Design for Manufacturability And Statistical Design: Constructive Approach, Springer
2. Chiang, Charles, Kawa, Jamil, Design for Manufacturability and Yield for Nano-Scale CMOS
3. R S Khandpur, Printed Circuit Boards, Tata McGraw-Hill

Course Plan:

Modules (Theory)	No. of Hours	% ESE marks
Module 1 Product Life cycle – Introduction, Growth, Mature and Saturation, Product life cycle management, What is DFM, Need of DFM – Higher Quality, Lower Cost, Faster Time to market,	13	33

better Yield etc. Designer vs manufacturer. Need for different DFM techniques for different companies – Different applications, Different manufactures, Different equipment and processes. Development of DFM rules, Design Guidelines, exceptions. Simple assembly process vs complex and expensive components, Simple component manufacture vs complex manufacturing process, Simple and inexpensive design vs expensive and complex service and support.		
Module 2 DFM softwares. Emerging manufacturing trends, Lead free design, standard design processes, Certifications. Over view of Design for Testability, Design for Assembly, Design for serviceability, Design for reliability etc. PCB Design and manufacturing process. Design considerations for different types of PCBs – Single layer PCBs, Multilayer PCB, Flexible PCB etc. Design considerations for PCBs for different applications – digital circuits, Analog circuits, High speed circuits, Power circuits etc. Layout rules and parameters. Design rule checks – Signal layer checks, Power/Ground checks, Solder mask check, Drill check etc.	13	33
Module 3 Manual verification – Thermal design, plane split width, isolation, PCB thickness etc. Automated processes, Through Hole vs SMT technologies. Thermal profiling during SMD/PTH assembly. Case studies to understand DFM from design, manufacturing and Assembly Miniaturization and increased complexity of VLSI circuits Functional Yield, Parametric Yield, Reliability, Yield Loss Modules, Yield analysis Higher Yield Cells, Spacing and Width of interconnect wires, Redundancy in the design, Fault Tolerant vias, generation of yield optimized cells, layout compaction, wafer mapping optimization, planarity fill, statistical timing.	13	34

Elective - 1	
Course Code	**M106**
Course Title	**Machine Learning**
Credits	**3-0-0: 3**
Pre-requisutes	**Any object oriented programming language**

Objective:

- The objective of the Machine Learning course is to introduce the basic concepts and techniques of Machine Learning.
- To develop skills of using recent machine learning software for solving practical problems.

Syllabus:

- Python, Introduction to NumPy, Data Manipulation with Pandas, Visualization with Matplotlib, Machine Learning Algorithms.

Course Outcome:

- After completion of course, students would be able:
  - To review some common Machine Learning algorithms and their limitations.
  - To apply common Machine Learning algorithms in practice and implementing the same.
  - To perform experiments in Machine Learning using real-world data.

Textbooks:

1. Python Data Science Handbook by Jake VanderPlas (O'reilly publication)
2. Hands on Machine Learning with Scikit Learn and Tensorflow' by Aurélien Géron (O'reilly publication)
3. Neural Networks and Deep Learning by Michael Neilson

Course Plan:

Modules (Theory)	No. of Hours	% ESE marks
Module 1 Launching Jupyter Notebook, Help and Documentation in Python, Keyboard shortcuts in IPython Shell, IPython Magic Commands, Input and Output History, IPython and Shell commands, Errors and Debugging, Profiling and Timing Code		
Module 2 Understanding Data types in Python, The Basics of NumPy array, Computation on NumPy arrays, Aggregations: Min, Max, Computation on arrays, Comparison Mask and Boolean Logic, Fancy Indexing, Sorting Arrays and Structured Data		

Module 3 Introducing Pandas Object, Data Indexing and Selection, Operating on data in pandas, Handling missing data, Hierarchical Indexing, Combining datasets, Aggregation and grouping, Pivot tables, Vectorized string operation, Working with time series, High-performance pandas		
Module 4 General Matplotlib tips, Simple line plots and scatter plots, Visualizing errors, Density and Contour plots, Histogram, binnings and density, Customizing plot legends and colorbars, Multiple Subplots, Text and annotations, 3D plotting in matplotlib, geographic data with basemap, visualization with seaborn		
Module 5 Introducing Scikit Learn, Hyperparameters and Model validation, Feature Engineering, Naïve Bayes classification, linear regression, Support vector machine, decision tree and random forest, Principal Component analysis, manifold learning, K-means clustering, Gaussian mixed model, Kernel density estimation.		

Course Code	**M107**
Course Title	**Networking and IOT**
Credits	**3-0-0: 3**
Pre-requisutes	

Objective:

- To explore the interconnection and integration of the physical world and the cyberspace. To learn different protocols used in IOT, to learn the concepts of smart city development in IOT, to learn how to analyze the data in IOT.

Syllabus:

- IoT an architectural view, Iot Architecture- State of Art, Networking in IoT.

Course Outcome:

- Able to understand the application areas of IOT
- Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
- Able to understand building blocks of Internet of Things and characteristics.
- Able to design and develop smart city using IOT.
- Able to analyze the data received through sensors in IOT.

Textbooks:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press
2. Peter Waher, Learning Internet of Things, Packt publishing Ltd.
3. Dieter Uckelmann, Mark Harrison, Florian Michahelles, Architecting the Internet of Things, Springer, 2011
4. Daniel Minoli, Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications, Wiley.
5. Vijay Madisetti, Arshdeep Bahga, Internet of Things (A Hands-on-Approach),Orient Blackswan Private Limited, 2015

Course Plan:

Modules (Theory)	No. of Hours	% ESE marks
Module 1 IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management	13	33
Module 2	13	33

IoT Architecture-State of the Art – Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints-Introduction, Technical Design constraints-hardware Data representation and visualization, Interaction and remote control.		
Module 3 IOT Data Link Layer & Network layer Protocols PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), ,Wireless Hart mZ-Wave,Bluetooth Low Energy, Zigbee Smart Energy, -Network Layer-IPv4, IPv6, 6LoWPAN, DHCP, ICMP, RPL, CORPL, CARP. Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT-Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4 , 6LoWPAN, RPL, Application Layer	13	34

Course Code	**ML101**
Course Title	**Industrial Design of Electronic Equipment Laboratory**
Credits	**0-0-3: 3**
Pre-requisutes	

Objective:

- Understand the need for PCB Design and steps involved in PCB Design and Fabrication process.
- Understand the fundamental of basic electronic components and basic electronic instruments and equipment.
- To understand the various processes and systems to address human needs by creating tangible Electronic Products. To pursue learners with emphasis on learning-by-doing and following a comprehensive process of design, engineering and producing products and systems.

Syllabus:

- The students need to implement the prototype model of an electronic product undergoing different stages of product development life cycle, which include:
    - Requirements/market study/feasibility study
    - Finalizing the Specifications
    - Mechanical design
        - Ergonomics and Aesthetics
    - Hardware Design
        - Component selection
        - Schematic Entry
        - Layout Design
        - PCB manufacturing and assembly
    - Assembly
    - Software Design
    - Testing.

Course Outcome:

- Need and evolution of PCB, types and classes of PCB.
- Understand the steps involved in schematic, layout, fabrication and assembly process of PCB design.
- Understand basic concepts of Fundamental electronic components &instruments value measurements & standard testing procedure.
- Design electronic products using user centered design process.
- Develop sketches, virtual and physical appearance models to communicate proposed designs

Course Plan:

SI. No.	Practicals (at least 10 nos)	No. of Hours	% ESE marks
1.	Exercises on sketching and drawing, use of colors.	2	10
2.	Practice use of model making materials and processes.	2	10
3.	To study various IC packages and Create component library with proper dimensions and specifications as per datasheet on Grid paper.	2	10
4.	Practice methods and techniques of prototype making using sheet metal and plastic fabrication	2	10
5.	Design the DC TO DC 5V Voltage regulator circuit using LM317 IC into schematic editor and draw the PCB layout for the same in Autodesk EAGLE software, generate Gerber files for top electrical and bottom electrical.	2	10
6.	To learn the process of generating files (HPGL, ISEL, Excellon) for CNC drilling and milling machine	2	10
7.	To develop the artwork on photo films using photoplotter machine, installation of films on machine and developing of the photo films using developer bath and fixer bath.	2	10
8.	Study the various format settings done in photoplotter machine. Learn about artwork generation software, the concept of importing PCB Gerber file and converting files to photoplotter format.	2	10
9.	Learn about PCB cleaning Process, study the operation and working of PCB brushing machine and perform brushing operation on FR-4 copper clad.	2	10
10.	To learn the process of galvanic plated through hole machine, and study the operation and working of through hole plating machine and perform operations on double sided PCBs.	2	10

Laboratory Experiments & Viva Voce	:	20 Marks
Final External Test	:	50 Marks
Internal marks	:	30 Marks
Total	:	100 Marks

Course Code	**ML102**
Course Title	**Advanced Digital System Design Laboratory**
Credits	**0-0-1: 1**
Pre-requisutes	

Objective:

- This lab is specially designed and developed for modelling of combinational and sequential logic circuits using VHDL/ Verilog and implementation of digital circuits on Xilinx FPGAs. This lab is well provided with equipment Xilinx Vivado 2017 and Altera FPGA Deployment boards. At the end of the lab student will be able to Design Digital Logic circuit modeling using 7 series FPGA and Digital system modelling using VHDL/ Verilog and implementation on Basys3 Board

Syllabus:

- The students need to implement the digital IC on the available and advance development board, which include:
- Finite State Machines
- ALU Design
- Design of all Combination Circuits
- Design of all Sequential Circuits
- Case Study for the latest topics

Course Outcome:

- Students understand the use standard digital memory devices as components in complex subsystems
- Technical knowhow to design simple combinational logic circuits and logic controllers
- Acquire skill set to develop the necessary software for basic digital systems

Course Plan:

SI. No.	Practicals	No. of Hours	% ESE marks
1.	Implement One Bit Full Adder	1	10
2.	Implement Two Input all basic gates	1	10
3.	Implement 32Bit carry ripple adder	1	10
4.	Implement CMOS inverter	1	10
5.	Implement Counters	1	10
6.	Implement Combinational Circuit	1	10
7.	Implement Sequential Circuit	1	10
8.	Implement UART Tx	1	10
9.	Implement UART Rx	1	10
10.	Implement ALU	1	10

Course Code	**ML106**
Course Title	**Machine Learning Lab**
Credits	**0-0-1: 1**
Pre-requisutes	

Objective:

- The objective of the Machine Learning course is to introduce the basic concepts and techniques of Machine Learning.
- To develop skills of using recent machine learning software for solving practical problems.

Syllabus:

- Python, Introduction to NumPy, Data Manipulation with Pandas, Visualization with Matplotlib, Machine Learning Algorithms.

Course Outcome:

- After completion of course, students would be able:
  - To review some common Machine Learning algorithms and their limitations.
  - To apply common Machine Learning algorithms in practice and implementing the same.
  - To perform experiments in Machine Learning using real-world data.

Course Plan:

SI. No.	Practicals (at least 10 nos)	No. of Hours	% ESE marks
1.	Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file	2	10
2.	For a given set of training data examples stored in a .CSV file, implement and Demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.	2	10
3.	Write a program to demonstrate the working of the decision tree based ID3 Algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample	2	10
4.	Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.	2	10
5.	Understating of Linear Regression , Naive Bayes	2	10

	methods		
6.	Understating of Support Vector Machine Tree Models methods	2	10
7.	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	2	10
8.	Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set	2	10
9.	Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.	2	10
10.	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.	2	10
11.	Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.	2	10
12.	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.	2	10

Course Code	**ML107**
Course Title	**Networking and IoT Lab**
Credits	**0-0-1: 1**
Pre-requisutes	

Objective:

- To learn different protocols used in IOT, to learn the concepts of smart city development in IOT, to learn how to analyze the data in IOT.

Syllabus:

- Wifi , BLE, CoAP, MQTT, GATT, Sensor Network

Course Outcome:

- Able to understand the application areas of IOT.
- Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks.
- Able to understand building blocks of Internet of Things and its characteristics.
- Able to design and develop smart city in IOT.
- Able to analyze the data received through sensors in IOT.

Course Plan:

SI. No.	Practicals	No. of Hours	% ESE marks
1.	Scanning the available SSID's in the range of Wi-Fi.	1	5
2.	Connect to the SSID of choice.	1	5
3.	Demonstration of a peer-to-peer network topology.	1	5
4.	Check the connectivity to any device in the same network.	1	5
5.	Send hello world to TCP server existing in the same network	1	5
6.	Reading Temperature and Relative Humidity value from the sensor.	1	5
7.	Transmitting the measured physical value from the sensor over the air.	1	5
8.	Reading sensor data from sensor and sending into UART.	1	5
9.	BLE beacon: Experiment involves initializing BLE stack, advertising packet/beacon (Eddystone frame format may be used) and starting the advertisement.	1	5
10.	Experiment is to understand BLE GATT protocol and develop profiles based on GATT services.	1	5
11.	Point to point communication of two C-Motes over the radio frequency.	1	5
12.	Multi-point to single point communication of C-	1	5

	Motes over the radiofrequency.		
13.	Reading Temperature, Relative Humidity, Light intensity value from light sensor, Proximity detection with IR LED value from the sensor.	1	5
14.	Transmitting the measured physical value from the sensor over the air.	1	5
15.	Demonstration of a peer-to-peer network topology using Coordinator and End Device network device types.	1	5
16.	Demonstration of peer-to-peer communication between Coordinator and End Device through Router.	1	5
17.	Demonstrate CoAP Protocol using Terminal	1	5
18.	Demonstrate MQTT protocol using Terminal	1	5
19.	Demonstrate IOT Gateway.	1	5
20.	Demonstrate DHT11 Sensor using free cloud services.	1	5