BHARATHIDASAN UNIVERSITY TIRUCHIRAPPALLI - 620 024.

M.Sc. ELECTRONICS: CHOICE BASED CREDIT SYSTEM -
LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK (CBCS - LOCF)
(Applicable to the candidates admitted from the academic year 2022-23 onwards)

Sem.	Course	Course Title	Ins. Hrs.	Credit	Exam Hrs.	Marks		Total
						Int.	Ext.	
I	Core Course I (CC)	Analog & Digital Circuits Design	6	5	3	25	75	100
	Core Course II (CC)	Electromagnetic Theory	6	5	3	25	75	100
	Core Choice Course I (CCC) (Any one choice)	1. Advanced Electronic Instrumentation 2. Optoelectronic Material and Devices	6	5	3	25	75	100
	Core Practical I (CP)	Analog and Digital Circuits Design	6	3	3	40	60	100
	Elective Course I (EC) (Any one choice)	1. Embedded Systems 2. Digital Communication	6	4	3	25	75	100
	Value Added Course I (VAC)	Industrial Safety and Disaster Management	-	2*	3	25	75	100*
	Total		**30**	**22**	**-**	**-**	**-**	**500**
II	Core Course III (CC)	Radar and Satellite Communication	6	5	3	25	75	100
	Core Course IV (CC)	VLSI Technology	5	5	3	25	75	100
	Core Choice Course II (CCC) (Any one choice)	1. Single Board Processors and Python 2. Mobile Communication	5	5	3	25	75	100
	Core Practical II (CP)	VHDL and Arduino	6	3	3	40	60	100
	Elective Course II (EC) (Any one choice)	1. Nanoelectronics 2. Solar Electrical System	5	4	3	25	75	100
	Non - major Elective I	Industrial Automation	3	2	3	25	75	100
	Total		**30**	**24**	**-**	**-**	**-**	**600**
III	Core Course V (CC)	Digital Signal Processing	6	5	3	25	75	100
	Core Course VI (CC)	Advanced Microcontrollers	5	5	3	25	75	100
	Core Choice Course III (CCC) (At least Two Choices)	1. Control systems 2. Artificial Intelligence	5	5	3	25	75	100
	Core Practical III (CP)	Advanced Microcontrollers	6	3	3	40	60	100
	Elective Course III (EC) (At least Two Choices)	1. PCB Design and CAD 2. Automotive Electronics	5	4	3	25	75	100
	Non - major Elective II	Biomedical Instrumentation**	3	2	3	25	75	100
	TOTAL		**30**	**24**	**-**	**-**	**-**	**600**
IV	Core Course VII (CC)	ASIC & FPGA Design	6	5	3	25	75	100
	Core Course VIII (CC)	Wireless Sensor Networks	6	5	3	25	75	100
	Entrepreneurship / Industry Based Course	Programmable Logic Controller	6	5	3	25	75	100
	Project		12	5	-	20	80	100
	Value Added Course II(VAC)	Cyber Security	-	2*	3	25	75	100*
	TOTAL		**30**	**20**	**-**	**-**	**-**	**400**
GRAND TOTAL			**120**	**90**	**-**	**-**	**-**	**2100**

***The value - added courses credit will not be included in the total CGPA.**
****For other discipline students.**
These courses are extra - credit courses.

SUMMARY OF CURRICULUM STRUCTURE OF PG PROGRAMMES

Sl. No.	Types of the Course	No. of Courses	No. of Credits	Marks
1.	Core Course	8	40	800
2.	Core Choice Courses	3	15	300
3.	Core Practical	3	9	300
4.	Elective Courses	3	12	300
5.	Entrepreneurship/ Industry Based Course	1	5	100
6.	Project	1	5	100
7.	Non - Major Elective Courses	2	4	200
Total		**21**	**90**	**2100**
Value Added Courses *		2*	4*	200*

PROGRAMME OBJECTIVES:

- To inculcate skills those are relevant to the Industry Requirements and for the Research and Development sectors.
- To train the students to use novel ideas in the field of Electronics and provide smart solutions to Electronics Oriented Problems.
- To contribute the new inventions in the field of Electronics.
- To provide better knowledge in the Component Design areas and utilize the knowledge for their Self Employment.

PROGRAMME OUTCOMES:

On the successful completion of the M.Sc. Electronics Programme, the students will

- To understand and apply the knowledge of circuit design and Practical experience in the field of Electronics.
- To identify, analyze and solve the problems in Signal Processing, Control systems and Instrumentation areas.
- To acquire and update the knowledge in the current Industrial trends including the concepts of Solar Electrical Systems and Automotive Electronics.
- To independently carryout new research to fulfill day-to-day Electronics requirements.
- To utilize the knowledge to benefit the society with the innovative applications.

PROGRAMME EMPLOYMENT OPPORTUNITY:

This curriculum is designed to train young minds to develop their fundamental, analytical and problem-solving ability in electronics-oriented fields. In this way, it provides better opportunities to start a new venture, employability in Public and Private Sectors, including ISRO, mainly as Scientific Officers, ground Air Traffic Controllers in Airport Authorities, Technical Officers, and Hardware designers in Private Electronics Companies. Apart from this, A student will become an Entrepreneur and provide jobs to other job seekers.

First Year **CORE COURSE I** **Semester I**

ANALOG & DIGITAL CIRCUITS DESIGN

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To learn the Analog and Digital design methods.
- To develop designing skills in Analog and Digital circuits
- To acquire the skills to Construct the devices

UNIT – I TRANSISTOR AND FET:

Construction of Transistors - Transistor Configurations - Common Base - Common Emitter - Common Collector - CE amplifier Design - Biasing Methods - FET - Types of FET - JFET - Working Principle - Practical JFET Amplifier - MOSFET - Types of MOSFET - Depletion Types - Enhancement Types - Comparison of Transistor and FET.

UNIT – II FEEDBACK AMPLIFIERS AND OSCILLATOR:

Feedback amplifiers - Negative voltage feedback - Negative current feedback - Emitter Follower - Darlington Amplifier - Positive feedback amplifiers - Oscillators - Barkhausen criterion - Types of Oscillators - Colpitts Oscillator - Hartley Oscillator - Phase shift Oscillator - Wien bridge Oscillator.

UNIT – III OPERATIONAL AMPLIFIERS AND THEIR APPLICATION:

Basic Op-Amp configuration - Design, analysis and simulation of Op-Amp - Differential input Voltage - Push - pull output stage - Real world limitations of Op-Amp - Voltage offset - input bias and input offset current - Differential input resistance - Slew rate - Fundamental Op-Amp circuits - Voltage follower - amplifying analog signal - difference amplifier - Summing amplifier - I to V Conversion - Instrumentation Amplifier - Sample and hold circuits - Amplifier design pitfalls.

UNIT – IV K - MAP AND FUNCTION SIMPLIFICATION:

The Karnaugh Map - Plotting Boolean functions on Karnaugh map - Maxterms on the K - Map - Simplifications of Boolean functions - the inverse function - "Don't care' terms - The Quine - McClusky simplification of Boolean functions - Tabular methods for multiple output functions - combinational logic design - Multiplexers and data selection - multiplexer as a Boolean generator - Demultiplexer.

UNIT – V FLIP - FLOPS, COUNTERS & PROGRAMMABLE LOGIC DEVICES:

The controlled SR latch - The controlled D latch - JK flip - flop - master - Slave JK flip - flop - basic counter design - design steps for a synchronous counter - decoding Asynchronous counters - the design of a decade counter - the twisted ring or Johnson counter - ROM - Design of sequential circuits using ROMs - PLDs - PGAs - PLAs - PAL - PLS - FPGAs.

Unit – VI Current Contours (For continuous internal assessment only):

Multiplexing Displays - frequency Counters - Time measurement - Digital voltmeters - A simple Computer design - Building blocks - Register Transfer language - Execution of Instructions, Macro and Micro operations - design of Control Unit - Programming Computer.

REFERENCES:

1. B. Holdsworth and C. Woods, Digital Logic design, 4th Ed. (Elsevier, 2002)
2. N. Balabanian and B. Carlson, Digital Logic Design Principles (John Wiley & Sons, 2000)
3. D. P. Leach, A. P. Malvino, and G. Saha, Digital Principles and Applications, 8th Ed. (McGraw Hill, 2014)
4. M. M. Mano and C.R. Kime, Logic and Computer Design Fundamentals, 5th Ed. (Pearson Education, 2016)
5. https://ocw.mit.edu/circuits-and-electronics
6. www.researchgate/applications

COURSE OUTCOME:

On the successful completion of the course, students will be able to

1. Understand the working principle of Analog and Digital devices
2. Design the Analog and Digital Circuits.
3. Know the various operations of Operational Amplifiers
4. Design the counters
5. Design simple Computer.

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First Year **CORE COURSE II** **Semester I**

ELECTROMAGNETIC THEORY

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To learn the concepts of Electromagnetic fields and its importance.
- To serve as the Prerequisite for understanding Transmission techniques
- To know the principle of using Waveguides

UNIT – I ELECTRO STATISTICS:

Fundamental relations of the Electrostatic field - Gauss's law - The potential function - Field due to a continuous - Distribution of Charge - Equipotential Surfaces - Divergence Theorem - Poisson's Equation and Laplace Equation - Capacitance - Electrostatic Energy - Conditions at boundary between Dielectrics - The Electrostatic Uniqueness Theorem.

UNIT – II MAGNETIC FIELD AND MAXWELL EQUATIONS:

Magnetic induction and Faraday's law - Magnetic flux density - Ampere's Law for a current Element - Volume distributions of Current and the Dirac delta - Ampere's force law - Analogies between Electric and Magnetic field - The equation of Continuity for Time - Varying fields - Maxwell's equations - Conditions at a Boundary Surface.

UNIT – III EM WAVES AND GUIDED WAVES:

Solution for free - space conditions - Uniform plane - wave propagation - The wave Equations for a conducting medium - Poynting theorem - Waves between parallel planes - TE waves - TM waves - TEM waves - Impossibility of TEM waves in Rectangular guides - Velocities of propagation - Attenuation in parallel plane guides - Transmission lines.

UNIT – IV ELECTROMAGNETIC EFFECTS AND HIGH - SPEED ELECTRICAL SYSTEMS:

Distributed systems - Speed and distance - Rise time and length: Lumped Vs. Distributed circuits - Knee frequency - Reflections in the presence of capacitance terminations - Inductance and capacitance - Electromagnetic interference - Desktop PC - CD player on jet aircraft.

UNIT – V BIO – ELECTROMAGNETICS:

Introduction - The Axon: An active, lossless, shielded, noiseless transmission line - Retinal Optic Fibers - Heart dipole field - Defibrillators and pacemakers - Biological fields - Electric eel - Electric field of eel - Electromagnetic hazards and the environment.

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

EM survey unit - Storm fields and thunder cloud potentials - Solar power to food - Solar power problems.

REFERENCES:

1. E. C. Jordan, K. G. Balmain, Electromagnetic Waves and Radiating Systems,2nd Ed. (PHI, 2015)
2. Kraus/Fleisch, Electromagnetics with Applications, 5th Edition (McGraw - Hill Publications, 2017)
3. A.K. Saxena, Electromagnetic Theory and Applications, 2nd Ed. (Narosa Publishing House, 2009).
4. D. J. Griffiths, Introduction to Electrodynamics, 4th Ed. (Pearson Education, 1999)
5. https://ocw.mit.edu/courses/8-311-electromagnetic-theory-spring-2004/
6. www.classcentral.com/swayam-electro-magnetic-theory-5223

COURSE OUTCOME:

On the successful completion of the course, students will be able to

- Acquire in - depth knowledge of Electro statistics and Electromagnetics
- Apply Electromagnetic theory in communication systems
- Familiarize with applications in various fields
- Solve waveguide problems for the transmission of signals
- Utilize EM waves in safer way.

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First Year	CORE CHOICE COURSE I 1) ADVANCED ELECTRONIC INSTRUMENTATION	Semester I
Code:	(Theory)	Credit: 5

COURSE OBJECTIVES:

- To encourage the students to learn various instruments and their working principle.
- The students to get the knowledge to handle new Instruments.
- To learn to take the accurate measurements from the instruments

UNIT – I GALVANOMETER AND ITS APPLICATIONS:

Introduction - Torque and deflection of the dc current Galvanometer - PMMC - Galvanometer sensitivity - Ammeter shunts and Multirange Ammeters - DC voltmeters - Voltmeter sensitivity and Loading effect - The Voltmeter - Ammeter Method - The series - type - and The Shunt - type ohmmeter - Multimeter.

UNIT – II AC AND DC BRIDGES:

The Wheatstone bridge - The Kelvin bridge - The Meg-ohm bridge - The Maxwell bridge - The Hay bridge - The Schering bridge - Wien bridge - The Wagner ground connection - Shielding of Bridge elements.

UNIT – III INSTRUMENTS FOR THE WAVE GENERATION AND ANALYSIS:

Oscillators - Pulse and square wave generators - Signal generators - Function generators - Wave Analysers - Hormonic distortion Analysers - spectrum analysis

UNIT – IV INDUSTRIAL DATA COMMUNICATION:

OSI model-Modbus-HART-SMART-Device network -Industrial network security-Network challenges -Security plan-Authentication-Detection systems-Security issues.

UNIT - V SAFETY INSTRUMENTATION:

IEC 61511 and the safety life cycle - Safety and targets - Sensors and detectors for safety duties - Safety controllers - Programming tools - Machinery safety - Regulations and standards - Zonal classification - Area classification - Explosion production - Intrinsic safety - Testing - Earthing and bonding - Fault finding and repairs

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Measurement performances - Pressure, level, temperature measurements - Thermocouples - Infrared pyrometers - Magnetic flow Meters - Control values.

REFERENCES:

1. W. D. Cooper, Modern Electronic Instrumentation and Measurement Techniques (Prentice Hall of India, 2009)
2. S. Medida, Industrial Automation (IDC Technologies)
3. K. Shawney, A Course in Electrical and Electronic Measurements and Instrumentation (Dhanpat Rai, 2012)
4. H. S. Kalsi, Electronic Instrumentation (Tata Mc Graw - Hill Publications, 2004)
5. https://iln.ieee.org/resources/e-learning
6. https://nptel.ac.in/electic and electronic instrumentation

COURSE OUTCOME:

On the successful completion of the course, students will be able to

- Understand the advanced instrumentation techniques and safety measures
- Handle the instruments as per the procedure
- Ensure to take accurate measurements
- Design smart instruments for industrial applications
- Reduce manual error in the measurements

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First Year **CORE CHOICE COURSE I** **Semester I**

2) OPTOELECTRONIC MATERIAL AND DEVICES

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To learn about the fundamental theory of optical structure.
- To know about the fabrication methods of optoelectronic material
- Identify about the optoelectronic devices.

UNIT – I INTRODUCTION TO OPTICAL STRUCTURE:

Introduction – Fundamental Structure-Property Relationships in Solid-State Materials – Bonding – crystal lattices and crystallographic notation – Surfaces and interfaces – Electronic structure

UNIT – II LASER BASICS:

Introduction – Laser operation – Absorption, Spontaneous Emission and Stimulated Emission – Population Inversion – Two -Three – Four level laser systems – Gain of Laser Medium – Laser Resonator – Longitudinal and Transverse Mode – Types of Laser Resonators – Pumping Mechanism

UNIT – III LASER ELECTRONICS:

Building Blocks of Laser Electronics – Linear Power Supplies – SMPS – Constant current sources – IC Timer circuits -I to V converter – Peak detector- Laser Diode Electronics – Laser Diode Protection -Operational Modes – Laser Diode Driver circuits

Unit – IV: Optoelectronic Devices

Introduction – Classification of Photosensor - Radio Metry and Photo Metry – Photo Conductors – Photo Diodes – Photo Transistors – Photo – FET, SCR and TRIAC -Photo Emissive sensors – Thermal sensors – Opto- Couplers

UNIT – V DISPLAY DEVICES:

Introduction - Photo Luminescence - Cathode Luminescence - Electro Luminescence - Injection Luminescence – LED - Plasma Display - Liquid Crystal Displays -Numeric Displays - Cathode Ray Tube Displays

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Optical Electronics Supporting Application - LED based – Solar cell based– Optical Fiber based– Laser Diode based Applications – Optical Metrology

REFERENCES:

1. S.M. Sze, Physics of Semiconductor Devices, 2nd Ed. (John Wiley & Sons, 2004).

2. Anil K. Maini ,Lasers and Opto Electronics, Fundamentals , Devices and Applications, (Wiley Publications, 2013)
3. Pallab Bhattacharya "Semiconductor Opto Electronic Devices", Prentice Hall of India Pvt., Ltd., New Delhi, 2006.
4. R. Waser, Nanoelectronics and Information Technology, Advanced Electronic Materials and Novel Devices, 2nd edition,(Ed.), Wiley-VCH, 2005.
5. John P. Dakin, Robert G. W. Brown, Hand book of Optoelectronics, 2nd Ed. (CRC Press, 2017)
6. https://www.elprocus.com/optoelectronics-devices-with-their-applications/
7. Sheridan Libraries (JHU) – http://www.library.jhu.edu.
8. http://databases.library.jhu.edu/databases/proxy/JHU03259

COURSE OUTCOME:

Upon completion of the course, the student should be able to know about:

- The fundamental theory of optical structure.
- Fabrication methods of Opto electronic material.
- Different types of spectroscopy techniques.
- Importance of material science

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First Year **CORE PRACTICAL I** **Semester I**

ANALOG AND DIGITAL CIRCUITS DESIGN

Code: **(Practical)** **Credit: 3**

ANY TWELVE EXPERIMENTS

COURSE OBJECTIVES:

Design, construction and analysis of Analog and Digital circuits and verification of characteristics.

1. Construction of Regulated power supply for 5V, 12V and - 12V
2. Analysis of the input and output characteristics of CE amplifier
3. Finding the frequency response of CE Amplifier
4. Design of CB amplifier
5. Design of CC amplifier.
6. Analysis of FET characteristics.
7. Construction of FET amplifier.
8. Construction of the circuits for performing basic operations of Op-Amp.
9. Construction of summing amplifier.
10. Construction of Instrumentation amplifier.
11. Design of three variable Boolean expressions and construct the circuits.
12. Design of Multiplexer and de - multiplexer.
13. Design of controlled SR Flip - flop and D Flip - flop
14. Construction J - K Flip - Flop and Master - slave FF.
15. Design of 4 - bit Synchronous and Asynchronous counter.
16. Design of a Decade counter.
17. Design of PAL.
18. Design of PLA.

REFERENCES:

1. Brian Dean, Introduction to Analog and Digital Circuits, lab Manual, Kendall and Hunt Publishing, 2018
2. Gary E. Ford, Carl M Arri, , Analog Electronics Circuits & Systems, 3rd Ed., Kendall and Hunt Publishing, 2006
3. Paul Schertz and Simon Monk, Practical Electronics for Inventors, Fourth Ed., Mc- Graw Hill, 2016

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

- Design Amplifier Circuits
- Design of Instrumentation Amplifier using Op-Amp
- Know about reduction techniques of Boolean Expressions
- Design Counters and memory devices by using digital circuits

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First Year **ELECTIVE COURSE I** **Semester I**

1) EMBEDDED SYSTEMS

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To gain knowledge in collective system by including various components.
- To get to know ARM basics and its applications
- To specialize to use in real time applications.
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UNIT – I INTRODUCTION TO EMBEDDED SYSTEMS:

Definition - Embedded Systems Vs General Computing Systems - History of Embedded Systems - Classification - Major Application Areas -Purpose of Embedded Systems - Characteristics and Quality Attributes of Embedded Systems.

UNIT – II EMBEDDED C PROGRAMMING:

Data types - General concepts of object-oriented programming: pointers - functions - Dynamic memory allocation and de-allocation - Embedded software development tools - Basics of developing C program for embedded systems

UNIT – III FUNDAMENTALS OF IoT:

Introduction - Definitions - Characteristics of IoT - IoT Architectures - Physical & Logical Design of IoT - Enabling Technologies in IoT - History of IoT - About Things in IoT - The Identifiers in IoT - Internet in IoT - IoT frameworks.

UNIT – IV APPLICATIONS OF IoT:

Home Automation -Smart Cities -Energy -Retail Management - Logistics - Agriculture - Health and Lifestyle -Industrial IoT - Legal challenges - IoT design Ethics - IoT in Environmental Protection.

UNIT – V CLOUD COMPUTING:

IoT Protocols - Communication Protocols -Cloud Platforms for IoT - Virtualization concepts and Cloud Architecture - Cloud computing - Benefits of Cloud services- SaaS, PaaS, IaaS - Cloud providers - Study of IOT Cloud platforms - Thing Speak API and MQTT - Interfacing ESP8266 with Web services.

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Key Concepts of M2M versus IoT- Remote Device Access - Connectivity - Making the choice - Scope in future - Data Collection and sharing - Advantages of IoT and M2M.

REFERENCES:

1. U. Dutta, V. Sharma and A. Passi, Embedded system Design using Atmega: A Practical Approach (Evincepub Publishing, 2018)
2. E. Balaguruswamy, Object Oriented Programming with C++, 6th Ed. (TMH Publishing, 2013)
3. H. Chaouchi, The Internet of Things Connecting Objects to the Web (Wiley Publications, 2013)
4. O. Hersent, D. Boswarthic and O. Elloumi, The Internet of Things: Key Applications and Protocols (Wiley Publications, 2011)
5. R. Singh, A. Gehlot, S. Choudhury and B. Singh, Embedded System Based on Atmega Microcontroller Simulation, Interfacing and Projects (2017)
6. A. Tanenbaum and A. Woodhull, Operating Systems Design and Implementation, (Prentice Hall, 2006)
7. V. Madisetti and A. Bahga, Internet of Things: A Hands-on-Approach (VPT, 2014).
8. J. Biron and J. Follett, "Foundational Elements of an IoT Solution (O'Reilly Media, 2016).
9. P. Raj and A. C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases (CRC Press)
10. I. C. Bertolotti and T. Hu, Embedded Software Development: The Open-Source Approach
11. D. Russell and M. Thornton, Introduction to Embedded Systems Using ANSI C and the Arduino Development Environment
12. https://onlinecourses.nptel.ac.in/noc17_cs22/course

COURSE OUTCOME:

On the successful completion of the course, students will be able to

- Acquire knowledge about the IoT systems
- Apply the ideas for smart home applications
- Use embedded system in automation areas
- Familiarize with system design
- Know about cloud services

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First Year **ELECTIVE COURSE I** **Semester I**

2) DIGITAL COMMUNICATION

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To know the principles of sampling and quantization
- To study the various waveform coding schemes and to learn the various baseband transmission schemes
- To understand the various band pass signaling schemes and to know the fundamentals of channel coding

UNIT – I INFORMATION THEORY:

Discrete Memory less source, Information, Entropy, Mutual Information - Discrete Memory less channels - Binary Symmetric Channel, Channel Capacity - Hartley - Shannon law - Source coding theorem - Shannon - Fano & Huffman codes.

UNIT – II WAVEFORM CODING AND REPRESENTATION:

Prediction filtering and DPCM - Delta Modulation - ADPCM & ADM principles - Linear Predictive Coding - Properties of Line codes - Power Spectral Density of Unipolar / Polar RZ & NRZ - Bipolar NRZ - Manchester

UNIT – III BASEBAND TRANSMISSION AND RECEPTION:

Nyquist criterion for distortion less transmission - Pulse shaping - Correlative coding - Eye pattern - Receiving Filters - Matched Filter, Correlation receiver, Adaptive Equalization

UNIT – IV DIGITAL MODULATION SCHEME:

Geometric Representation of signals - Generation, detection, PSD & BER of Coherent BPSK, BFSK & QPSK - QAM - Carrier Synchronization - Structure of Non - coherent Receivers - Principle of DPSK.

UNIT – V ERROR CONTROL CODING:

Channel coding theorem - Linear Block codes - Hamming codes - Cyclic codes – Convolutional codes - Viterbi Decoder.

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Image and video processing - Data compression - Channel coding – Equalization - Digital Signal Processing - Speech processing – Satellites - Digital audio transmission.

REFERENCES:

1. S. Haykin, Digital Communications (John Wiley, 2005).

2. B. Sklar, Digital Communication Fundamentals and Applications, 2nd Ed. (Pearson Education, 2009)
3. B. P. Lathi, Modern Digital and Analog Communication Systems, 3rd Ed. (Oxford University Press, 2007).
4. H. P. Hsu, Schaum Outline Series - Analog and Digital Communications (Tata McGraw - Hill, 2006)
5. J. G. Proakis, Digital Communication, 4th Ed. (Tata McGraw Hill, 2001).
6. Sanjay Sharma, Digital Communications,(S.K.Kataria and Sons, 201)3
7. Arthur A. Giardano Allen A.Levesque, Modeling of Digital communication Systems using Simulink, (Wiley Publications, 2015)
8. Apurba Das, Digital Communication: Principles and System Modeling, (Springer Publications, 2012)
9. www.classcentral.com/swayam-principles of digital communications-12951
10. www.open.edu/openlearn

COURSE OUTCOME:

On the successful completion of the course, students will be able to

- Analyse various Digital Communication systems.
- Implement base band transmission schemes.
- Design band pass signalling schemes.
- Analyse the spectral characteristics of band pass signalling schemes and their noise performance.
- Evaluate error control coding schemes.

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First Year **VALUE ADDED COURSE I** **Semester I**

INDUSTRIAL SAFETY AND DISASTER MANAGEMENT

Code: **(Theory)** **Credit: *2**

COURSE OBJECTIVES:

- To learn safety measures while handling the instruments in industry.
- To get the knowledge of disaster management.
- To create awareness among the pupil to ensure safety during disasters

UNIT – I ELECTRICAL SAFETY:

Fuse, Circuit breakers and overload relays - Protection against over voltage and under voltage - Safe limits of Amperage - Overload and short circuit protection - No load protection - Earth fault protection - Electrical guards - Personal protective equipment.

UNIT – II FIRE PROTECTION SYSTEMS:

Sprinkler hydrants and stand pipes - Deluge and Emulsifier - Alarm and detection Systems - CO_2 and foam systems - Smoke venting - Portable extinguishers - Tank Farms - Firefighting systems.

UNIT III SAFETY STRANGERS AND WELFARE MEASURES:

Storage tanks and vessel - Venting and relief - LPG storages - Toxic storages - Underground storages - Wave house - Health hazards - Control measures - Personal protective equipment - Health and welfare measures - Special precautions for specific hazardous work places.

UNIT – IV DISASTER PREPAREDNESS:

Disaster preparedness - ways and means - skills and strategies - rescue, relief and reconstruction - Rehabilitation - Preparedness and planning for an urban earthquake disaster.

UNIT V DISASTER PREVENTION PROCEDURES:

Role of remote sensing - Information systems and decision making tools - Voluntary Agencies - Community participation at various stages of disaster Management - School Awareness and safety programme.

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

The need for Training - Training Policy - Types of training and Trainee categories - Implementation of Training - Public Education - The importance of Public awareness - Maintenance of awareness level.

REFERENCES:

1. F. Cooper, Electrical Safety Engineering (Butterworth and Company, London.1986)
2. D. James, Fire Prevention Hand book (Butterworth and Company, London, 1986)
3. W. N. Carter, Disaster Management (Asian Development Bank)
4. Don Hop Wood and Steve Thompson, Work Place Safety, A Guide for small and Midsized companies, (John Wiley & Sons, 2006)
5. C. Ray Asfahi and David W. Rieske, Industrial Safety and Health Management, 7th Ed.(Pearson , 2021)
6. Mirunalini Pandey, Disaster management, Wiley, 2014
7. www.ilo.org/train-your-employees
8. www.onlinenidm.gov.in

COURSE OUTCOME:

On the successful completion of the course, students will be able to

- Know about Industrial safety measures and the preparedness for disaster.
- Learn about the possibility of industrial hazards and preventive measures
- Know the causes for man- made error in industrial safety and disaster
- Create awareness among public
- Design safety policies for the people working in accident prone area.

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First Year | **CORE COURSE III** | **Semester II**

RADAR AND SATELLITE COMMUNICATION

Code: | **(Theory)** | **Credit: 5**

COURSE OBJECTIVES:

- To familiarize the basic principles of radar
- To acquire the knowledge about Satellites.
- To learn the importance of Radar and Satellite in modern Communication era

UNIT – I INTRODUCTION TO RADAR:

Introduction to radar - Radar block diagram and operation - Radar frequencies - Applications of radar - Prediction of range performance - Minimum detectable signal - Receiver noise - Probability density function - SNR - Integration of radar pulses - Radar cross - section of targets - PRF and range ambiguities - Transmitter power - System losses.

UNIT – II RADAR TECHNOLOGY:

Doppler Effect - CW radar, FM CW radar, Multiple frequency CW radar, MTI radar - Delay line canceller - Range gated MTI radar - Blind speeds - Staggered PRF - Limitations to the performance of MTI radar - Non - coherent MTI radar; **Tracking radar:** Sequential lobing - conical scan; **Monopulse:** Amplitude comparison and phase comparison methods - Radar antennas - Radar displays.

UNIT – III INTRODUCTION TO SATELLITE COMMUNICATION:

Orbital aspects of Satellite Communication: Introduction to geo - synchronous and geo - stationary satellites - Kepler's laws - Locating the satellite with respect to the earth - Sub - satellite point - Look angles - Mechanics of launching a synchronous satellite - Orbital effects - Indian scenario in communication satellites.

UNIT – IV SPACECRAFT AND EARTH STATION:

Satellite sub - systems: Attitude and orbit control systems - Telemetry - Tracking and command control system - Power supply system - Space craft antennas - Multiple access techniques - comparison of FDMA, TDMA, and CDMA - Earth station equipment - tracking systems.

UNIT -V SATELLITE LINK DESIGN:

Introduction to satellite link design, basic transmission theory, system noise temperature and G/T ratio, design of down link and uplink, design of satellite links for specified C/N, satellite data communication protocols.

Unit – VI Current Contours (For continuous internal assessment only):

Air borne systems – Space radar systems – Ground to Air systems – Remote sensing applications – Small satellites – Satellite IoT – Nano Sat bases IoT systems -Orbital Transfer Vehicles (OTV)

REFERENCES:

1. M. I. Skolnik, Introduction to Radar Systems, 2nd Ed. (McGraw - Hill, 1981).
2. M. A. Richards, J. A. Scheer and W. A. Holm, Principles of Modern Radar: Basic Principles (YesDee Publishing Pvt. Ltd., 2012).
3. B. Edde, Radar: Principles, Technology, Applications (Pearson, 2008).
4. T. Pratt and C. Bostian, Satellite Communications (John Wiley, 1986).
5. D. Roddy, Satellite Communications (McGraw Hill, 2009).
6. N. Kingsley and J R Guerch, Radar RF Circuit Design (Artech House, 2016)
7. M. Richaria, Satellite Communication Systems (Macmillan Publishers Ltd., 1998)
8. www.ll.mit.edu/outreach/radar-introduction- radar-systems
9. www.jpl.nasa.gov/edu/teach/activity/build-a-satellite

COURSE OUTCOME:

On the successful completion of the course, students will be able to

- Know the fundamentals of Radar system
- Use doppler effect in Radar communication
- Familiarize with different types of Radar
- Know the working principles of satellite
- Utilize this knowledge in designing small satellites

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First Year	CORE COURSE IV VLSI TECHNOLOGY	Semester II
Code:	(Theory)	Credit: 5

COURSE OBJECTIVES:

- To learn the VLSI Technology and VHDL circuit designs
- To design the digital circuits using VLSI techniques
- To know about VHDL programming methods

UNIT – I MOS TRANSISTORS:

Introduction - MOS transistors - The NAND gate - Combinational logic - Compound gates - Pass transistors and Transmission gates - Tristate - multiplexers - latches and Flipflops - MOS transistor theory - ideal I - V characteristics - C - V characteristics - simple MOS capacitance models - Non - ideal I - V effects - Channel length modulation - Body effect - Tunnelling.

UNIT – II PROCESSES AND DESIGN RULES:

N - well process - P - well process - twin well process - triple well process - Layout design rules - Design rule background - Micron design rules - CMOS process enhancements - floating body voltage - SOI advantages and disadvantages.

UNIT – III DATA PATH SUBSYSTEM:

Addition/subtraction - single bit addition - Carry - propagation addition - Manchester carry chain adder - carry look ahead adder - one/zero Detectors - Comparators - Counters - Asynchronous counter - synchronous counter - shifters - Multiplication - Wallace tree multiplication - division - serial - parallel.

UNIT – IV VHDL BASICS:

Introduction-VHDL terms-Entity-Architecture- Concurrent signal Assignment-Statement Concurrency-Structural designs-Sequential Behaviour-Process statements-Sequential statements-Configuration statements- Behavioural modelling-Generics-Block statement-Sequential statements-IF-CASE-LOOP-NEXT-ASSERT-WAIT statements.

UNIT – V SYNTHESIS, MAPPING AND PLACE AND ROUTE PROCESS:

Sub programs - Function - Conversion Functions - Resolution Functions - procedures - packages - package declaration - Sub - program Declaration - Synthesis - Constraints - Attributes - Synthesis Translation - Mapping to gates - Place and Route process - Placing and Routing the device - setting up a Project

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Writing a VHDL program - Addition - Subtraction - Half adder - Full adder - Multiplexer - De - Multiplexer - Flip - Flops - Shift registers - Counter

REFERENCES:

1. N. H. E. Weste, D. Harris, A. Banerjee, CMOS VLSI Design, 3rd Ed. (Pearson Education, 2000)
2. D. A. Pucknell, K. Eshraghian, Basic VLSI Design, 3rd Ed. (PHI, 1985)
3. D. L. Perry, VHDL Programming by Example, 4th Ed. (TMH, 1993)
4. Debaprasad Das, VLSI design. 2nd Ed. Oxford Press, 2015
5. W. Wolf, Modern VLSI design (Pearson Education, 1994).
6. K. L. Kishore, V.S.V. Prabhakar, VLSI Design (I.K International, 2010).
7. https://vlsiresources.com/opensourcevlsi
8. www.testbench.in/vlsi courses

COURSE OUTCOME:

On the successful completion of the course, students will be able to

- Know the components of VLSI design
- Understand the different types of process involved in VLSI design
- Design the detector and Comparator circuits
- Write the VHDL programming
- Know Map, place and Route process

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First Year **CORE CHOICE COURSE II** **Semester II**

1) SINGLE BOARD PROCESSORS AND PYTHON

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To understand the architecture of Single Board Processors
- To develop skills to setup of Arduino boards
- To introduce Python programming for developing applications

UNIT – I INTRODUCTION TO SINGLE BOARD PROCESSORS:

Introduction - history of Single Board Computers - Classification - Comparison - Evolution - Architecture - Applications - Defining open source hardware - Licensing CERN OHL - TAPR OHL - Creative commons - Example of OSH projects - Arduino - Hardware

UNIT – II OVERVIEW OF ARDUINO BOARD:

Introduction Arduino Board- Different types of Arduino boards - Pin configuration and architecture. - Device and platform features. - Concept of digital and analog ports - Familiarizing with Arduino- Arduino Shields- Interfacing Board- Setup the IDE, Writing Arduino Software- The Arduino Sketch- Writing the code on an Arduino Emulator - Extending Arduino- Arduino I/O Functions.

UNIT – III ARDUINO SIMULATION ENVIRONMENT:

Arduino Uno Architecture, Setup the IDE, Writing Arduino Software, Arduino Libraries, Basics of Embedded C programming for Arduino, Interfacing LED, push button and buzzer with Arduino, Interfacing Arduino with LCD.

UNIT – IV BASICS OF PYTHON:

Python 3.2 idle - Programming Basics - handling strings - Numbers and Operators - Variables - basic arithmetic operations - Making decisions - Functions - Classes and Objects - Numerical Programming - I/O and shell programming: basics of shell programming - installing and testing GPIO in Python - programming LED - reading a button - using devices with I2C bus - reading analog data using an analog to digital converter - logging and plotting data.

UNIT - V ADVANCED PYTHON:

Creating modules in python idle - audio and video file handling - configuring webcam - Simple CV: installation - testing - displaying an image - modifying an image - accessing the webcam - Case study: Photobooth- connecting real world application on Web.

Unit - VI Current Contours (For continuous internal assessment only):

Raspberry Pi GPIO with an I/O expander. Web application programming**:** creating Web server - downloading data from a web server - configuring Raspberry Pi as web server - introduction to flask - flask basics - connecting real world application on Web.

REFERENCES:

1. R. Santos and L. Perestrelo, Beagle Bone for Dummies (John Wiley & Sons, 2015).
2. M. Richardson and S. Wallace, Getting started with Raspberry Pi (O'Reilly Media, 2012).
3. J. Payne, Beginning Python (Wiley Publishing, 2010).
4. A. M. Ravenscroft and D. Ascher, Python Cookbook, 2nd Ed. (Alex Martelli, 2005.)
5. T. Cox, Raspberry Pi Cookbook for Python Programmers (2014).
6. https://iln.ieee.org/resources/e-learning
7. https://opensource.com/article/resources-raspberry-pi

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

- Understand Arduino's architecture, including inputs and connectors for add-on devices.
- Program to control lights, motors, and other devices with Arduino.
- Add third-party components such as LCDs, accelerometers, gyroscopes, and GPS trackers to extend single board functionality.
- Understand the Python programming languages, from C to drag-and-drop languages.
- Test, debug, and deploy the Python to solve real world problems

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First Year **CORE CHOICE COURSE II** **Semester II**

2) MOBILE COMMUNICATION

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To understand the internal circuits and working principle of mobile Phones.
- To use the knowledge in real time applications.
- To design Mobile Apps for various applications

UNIT – I CELLULAR CONCEPT AND SYSTEM DESIGN FUNDAMENTALS:

Introduction to wireless communication: Evolution of mobile communications - mobile radio systems - examples - trends in cellular radio and personal communications; **Cellular Concept:** Frequency reuse - channel assignment - hand off - Interference and system capacity - tracking and grade of service - Improving Coverage and capacity in Cellular systems

UNIT – II MOBILE RADIO PROPAGATION:

Free space propagation model - reflection, diffraction, scattering - link budget design - Outdoor Propagation models - Indoor propagation models - Small scale Multipath propagation - Impulse model - Small scale Multipath measurements - parameters of Mobile multipath channels - types of small scale fading - statistical models for multipath fading channels.

UNIT – III MODULATION TECHNIQUES AND EQUALISATION:

Modulation Techniques: Minimum Shift Keying - Gauss ion MSK, M-ary QAM, M-ary FSK - Orthogonal Frequency Division Multiplexing, Performance of Digital Modulation in Slow - Flat Fading Channels and Frequency Selective Mobile Channels; **Equalization:** Survey of Equalization Techniques - Linear Equalization, Non - linear Equalization, Algorithms for Adaptive Equalization - Diversity Techniques - RAKE receiver.

UNIT – IV CODING AND MULTIPLE ACCESS TECHNIQUES:

Coding: Vocoders, Linear Predictive Coders, Selection of Speech Coders for Mobile Communication, GSM Codec, RS codes for CDPD. Multiple Access Techniques: FDMA, TDMA, CDMA, SDMA, Capacity of Cellular CDMA and SDMA.

UNIT – V WIRELESS SYSTEMS AND STANDARDS:

Second Generation and Third Generation Wireless Networks – Standards – WLL - Blue tooth - AMPS - GSM -IS - 95 and DECT

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Over view of 5G Technology- Game theory applications for power control and sub carrier allocations- Millimetre wave technology for 5G networks-Energy efficient Mobile network operations for 4G-opportunistic multi- connect networks with P2P wi-fi and cellular networks- beyond 4G

RESOURCES:

1. T. S. Rappaport, Wireless Communications: Principles and Practice, 2nd Ed. (Pearson Education/ Prentice Hall 2003).
2. Books for Reference:
3. R. Blake, Wireless Communication Technology (Thomson Delmar, 2003).
4. W. C. Y. Lee, Mobile Communications Engineering: Theory and applications, 2nd Ed. (McGraw - Hill International, 1998).
5. S. G. Wilson, Digital Modulation and Coding (Pearson Education, 2003).
6. www.classcentral.com/mobile development
7. www.edutopia.org/article/mobile learning resources.

COURSE OUTCOME:

On the successful completion of the course, students will be able to

- Understand the internal parts of Mobile phones
- Analyse the problems involved in the phone and troubleshoot it.
- Use mobile phone for smart home applications
- Develop new mobile app for learning purposes
- Utilise the knowledge to protect the user from mobile phone frauds.

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First Year	CORE PRACTICAL II VHDL AND ARDUINO	Semester II
Code:	(Practical)	Credit: 3

ANY TWELVE EXPERIMENTS

COURSE OBJECTIVES:

To familiarize with VHDL synthesis and Arduino interfacing by performing practical.

1. Writing a VHDL program for Logic gates
2. Writing a VHDL program for Half - adder and full - adder
3. Writing a VHDL program for Combinational circuits
4. Writing a VHDL program for sequential circuits
5. Writing a VHDL program for ALU
6. Writing a VHDL program for Up - Down counter.
7. Interfacing DC motor using VHDL
8. Design of PLA
9. Design of PAL
10. Interfacing Relay using VHDL
11. Interfacing Seven - Segment display
12. Writing a VHDL program for hardware fusing and Testing
13. Study the Characteristics of PN junction diode using Arduino
14. Study the Characteristics of LED using Arduino
15. Construct Half Wave Rectifier using Arduino
16. Control Traffic light using Arduino
17. Measure the distance between objects with ultrasonic sensor using Arduino
18. Construct IR obstacle sensor using Arduino

REFERENCES:

1. J. Ashenden, VHDL Tutorial, Elsevier Science, USA, 2004.
2. VHDL Hand Book Hardi Electronics AB Publications, 2000.
3. Warwick A. Smith, Arduino Uno hardware Manual, A reference and user Guide for the hardware and firmware, WS Publishing.net.

COURSE OUTCOME:

On the successful completion of the course, students will be able to

- Use the practical as a prerequisite for designing ASIC and FPGA boards.
- Design hardware circuits based on VHDL.
- Use Arduino for different applications.
- Perform Arduino interfacing with other devices.

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First Year **ELECTIVE COURSE II** **Semester II**

1) NANOELECTRONICS

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To gain knowledge on comparing Electronics and Nano electronics.
- To recall the basics Electronic Nanomaterial Properties.
- To analyse the concepts of Nano - optics and Nano composite fibers.
- To Evaluate the Operation of Nano sensors used in biomedical field.

UNIT – I NANOELECTRONICS:

Fundamental Types of Electronic Materials and Nanomaterials - Fundamental Kinds of Electronic Devices - The Nano Perspective - Micro - electronics: Introduction to Band Structure - Basic Conductor and Semiconductor Physics - Transistors - Nanoscale Electronics: Background - The Current State of Micro - Electronics and Extensions to the Nanoscale - Nanotechnology - Based Strategies: Single - Electron Tunneling - Nanotechnology - Based Strategies: Molecular Wires

UNIT – II NANOSTRUCTURES AND QUANTUM ELECTRONIC DEVICES:

Low - dimensional structures: Quantum wells, Quantum wires and Quantum dots; Density of states in low - dimensional structures; **Quantum Interference Devices**: Split - Gate Transistor - Electron - Wave Transistor - Resonant tunneling phenomena and its applications in diodes and transistors.

UNIT – II MOSFETS AND NANO – OPTICS:

Limitations of the conventional MOSFETs at Nanoscales, MOSFET Scaling & implications, Introductory concepts of Ballistic transport and Quantum confinement, Differences in Few Electron Devices (as analog version) and Single Electron Devices (as digital version) of Nano - Electronic devices - Nano - Optics - Interactions of Light with Matter - The Nano Perspective - The Surface - Plasmon - The Surface Plasmon Resonance - Scattering - Color Generation from Nanoparticles and Nanostructures - Applications of Nano plasmonics.

UNIT – IV NANO - COMPOSITES AND FIBERS:

Physical and Chemical Properties of Materials - Mechanical Properties - Thermal Properties - Electronic Properties - Chemical Properties - Natural Nanocomposites - Skin of the Sea Cucumber - Hard Natural Nanocomposites - Carbon Fibers and Nanotubes - Types of Fibers, Whiskers, and Nanotubes - Synthesis of Fibers and Nanotubes - Chemical Modification of Carbon Nanotubes - Carbon Nanotube Applications

UNIT – V NANO MACHINES AND DEVICES:

MEMSs – NEMSs – Fabrication – Resonant -tunneling diodes – Potential - effect Transistors – Quantum – Dot Cellular automata – Graphene batteries- Graphene wireless Sensor – Ultra

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Current Nano - Electronic Devices: Quantum Effects in MOSFETs - Strained Silicon - Fully Depleted SOI - MOSFET - Double - Gate MOSFET - Multi - gate MOSFETs

REFERENCES:

1. G. L. Hornyak and J. J. Moore, Fundamentals of Nanotechnology (CRC Press, 2009).
2. S. Oda and D. Ferry, Nanaoscale Silicon Devices (CRC Press, 2015).
3. K. Goser and P. Glosekotter, Nanoelectronics and Nanosystems (Springer, 2005).
4. G. Cao. (Ed.), Nanostructures and Nanomaterials: Synthesis, Properties, and Applications, World Scientific Series in Nanoscience and Nanotechnology (World Scientific, 2011)
5. R. Leach, Fundamental Principles of Engineering Nanometrology (Elsevier, 2014)
6. https://ocw.mit.edu/courses/6-701-introduction-to-nano-electronics
7. https://nanohub.org/resources/series

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

- Gain the concepts of Nano electronics such as ballistic transport and quantum confinement.
- Understand various nanostructures and its applications towards quantum electronic devices.
- Design and simulate various advanced Nano - electronic devices.
- Design Nano – Sensor for Electronic Applications
- Use carbon nanotubes for various applications.

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First Year **ELECTIVE COURSE II** **Semester II**

2) SOLAR ELECTRICAL SYSTEMS

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To encourage the students to learn about solar electrical systems
- To utilize this knowledge for using alternative sources instead non - renewable sources
- To get the knowledge to construct the solar panels

UNIT - I SOLAR ENERGY AND PHOTOVOLTAICS:

Introduction - The need to develop solar energy - A comparison of Solar energy with other renewable forms of energy - The future of Solar energy - Photo - Voltaic Manufacturing - Photovoltaic Technology - Light absorption in the materials and excess carrier generation - Photovoltaic effects and basic solar cell Parameters - Principles of Solar cell construction - Photovoltaic modules.

UNIT – II CONFIGURATIONS AND COMPONENTS OF SOLAR POWER:

Four Configurations - Stand - Alone/off grid - Examples - Grid - tie - Examples - Grid fall back - Example - Grid fail over - Solar panels - Batteries - Controller - Inverter - Electrical devices - Low voltage and High voltage devices - A standalone system - A grid - tie system using single central inverter - using multiple micro - inverters - Design process - Short - cutting the design work.

UNIT – III INORGANIC AND ORGANIC PHOTOVOLTAICS:

Semiconductor Silicon - Crystalline Silicon wafer fabrication - PV cell design and fabrication technology - Crystalline Si Module design - CdTe Solar cell - Layers, Processes - Voltage, doping and substrate cells - Thin film fabrication and formation - Perovskite Solar cell device structure - Device Optimization and stability issues - Organic photovoltaic - Operating Principles - Device structure - Up - Conversion - Down Conversion.

UNIT – IV SOLAR ELECTRICITY AND BATTERIES:

Introduction - Common uses of Solar electricity - The Solar Resource - Converting solar energy - Solar radiation principles - Direct and Diffusion Radiation - Understanding and using Meteorological records - Angles, solar orientation and tracking the sun - - Concentrating solar energy - Trapping solar energy - I - V curve - Output solar cell module. Energy storage - Batteries - Principles and operations - Charge and discharge - State of Charge - Types of Lead - acid batteries - Improved automotive batteries - Stand - by batteries - Lead - Calcium maintenance free batteries - VRLA or Sealed Batteries.

UNIT – V SOLAR PANEL DESIGN:

Calculating solar energy - calculating solar irradiance - Capturing more of the sun's energy - The impact of tilting solar panel on solar irradiance - calculating

the optimum solar tilt - positioning the solar panels - panels and shade - The effect of temperature on solar panels - surveying the site - Ground mounting - Pole mounting - positioning batteries, controllers and inverters - cabling.

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Water - Lithium Bromide Absorption chillers for Solar Cooling - Solar assisted Air - Conditioning systems - Solar food processing and cooking methodologies - Visual comfort Based Algorithmic Control for Roller shade - Solar updraft Tower - A potential for Future Renewable Power Generation.

REFERENCES:

1. T. M. Letcher and V. M. Fthnakis, A Comprehensive guide to Solar Energy Systems (Academic Press, 2018)
2. M. Boxwell, Solar Electricity Handbook (Green Stream Publishing, 2012)
3. H. Tyagi, A. K. Agarwal, P. R.Chakraborthy and S. Powar, Applications of Solar Energy, 1st Ed. (Springer Publications, 2018)
4. Varun Sivaram , Taming the Sun: Innovations to Harness Solar Energy and power the Planet, (MIT Press, 2018)
5. Mukund R. Patel, Omid Beik, Wind and Solar Power Systems: Design, Analysis and Operation, (2nd Ed. CRC Press, 2021)
6. www.edx.org/learn/solar-energy
7. www.nielit.gov.in/solar power -installation

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

- Understand solar energy and its applications in various fields
- Initiate solar power related start - ups in future.
- Design Solar panels for electrical use
- Construct mini solar station for E – Vehicle charging
- Design solar roof for high level electricity generation.

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First Year **NON MAJOR ELECTIVE COURSE I** **Semester II**

INDUSTRIAL AUTOMATION

Code: **(Theory)** **Credit: 2**

COURSE OBJECTIVES:

- To know the need of automation in the industries
- To acquire skills in PLC for automation
- To get the basic knowledge of Electric drives and Special Machines

UNIT - I INTRODUCTION TO INDUSTRIAL AUTOMATION:

Need and benefits of Industrial Automation - Automation Hierarchy - Basic components of automation system, - description of each component - Types of automation system: Fixed, programmable, flexible - Different systems for Industrial automation: PLC – HMI -SCADA – DCS – Drives.

UNIT – II PLC FUNDAMENTALS:

Building blocks of PLC: CPU, Memory organization, Input output modules (discrete and analog). Special I/O Modules, Power supply, Fixed and Modular PLC and their types, Redundancy in PLC module I/O module selection criteria Interfacing different I/O devices with appropriate I/O modules

UNIT – III PLC PROGRAMMING AND APPLICATIONS:

PLC I/O addressing , PLC programming Instructions: Relay type instructions, timer instructions: On delay, off delay, retentive. Counter instructions, Up. Down. High speed, Logical instructions, Comparison Instructions. Data handling Instructions. Arithmetic instructions PLC programming language Functional Block Diagram (FBD). Instruction List, Structured text. Sequential Function Chart (SFC).

UNIT – IV ELECTRIC DRIVES AND SPECIAL MACHINES:

Electric drives: Types, functions, characteristics, four quadrant operation DC and AC drive controls: V/F control, Parameters, direct torque control Drives: working principle, specifications, parameters, types and applications Applications - Speed control of AC motor /DC Motor Unit V Supervisory Control and Data Acquisition System.

UNIT – V ROBOTICS:

Roll of Robotics in Industrial Automation and Airport and Cargo Management Services, Building Automation, Biomedical Industries, Cement Industries / Tiles Industries, Chemical Process Industries / Pharmaceutical Industries, Manufacturing Industries, Pulp and Paper Industries, Power Plants / Steel Industries, Railways, Sugar Plants. Textile Industries / Leather Industries.

Unit – VI Current Contours (For continuous internal assessment only):

Articulated Robots – SCARA Robots – Cartesian Robots – Parallel Robots – Assembly Machines – Inspection and Test Machines – Programming Software – Design software – Analysis Software

REFERENCES:

1. F.D. Petruzella, Programmable logic controllers, 4th Ed. (Tata - McGraw Hill India, 2010).
2. Mitra, Madhuchandra: Sengupta, Samarjit, Programmable logic controllers and Industrial automation An introduction (New Penram International Publication, New Delhi, 2015)
3. G. Dunning, Introduction to Programmable logic controllers (Thomson /Delmar Learning, 2005)
4. S. A. Boyar, Supervisory control and Data acquisition, 4th Ed. (ISA Publication New Delhi)
5. J. Hackworth and F. Hackworth, Programmable Logic Controllers (PHI Learning, 2003)
6. J. Stenerson, Industrial automation and Process Control (PHI Learning)
7. D. Bailey and E. Wright, Practical SCADA for Industry, (Newnes International Edition, 2003)
8. PLC lecture: - https://www.youtube.com/watch?v=pPiXEfBO2qo f.
9. PLC tutorial: - http://users.isr.ist.utl.pt/ - jag/aulas/api13/docs/API_I_C3_3_ST.pdf

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

- Identify different components of an automation system.
- Interface the given I/O device with appropriate PLC module.
- Prepare a PLC ladder program for the given application.
- Select the suitable motor drives for the specified application
- Prepare a simple SCADA application.

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Second Year **CORE COURSE V** **Semester III**

DIGITAL SIGNAL PROCESSING

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To encourage the students to learn the digital techniques in signal processing.
- To Design the Digital filters to reduce noise in the processing.
- Understand *Mathematical Operations on signal Processing*

UNIT – I SIGNALS:

Definition of Signal - Classification of Signals - Linear shift Invariant systems - Stability and causality - Linear constant - Co - Efficient Difference Equations - frequency - domain representation of Discrete - Time systems and signals - Symmetry properties of the Fourier transform - Sampling of continuous Time signals.

UNIT – II THE LAPLACE AND Z – TRANSFORM:

Laplace Transform - Inverse Laplace Transform - Properties of Laplace transform - initial and Final value Theorem - Solution of Differential Equations - Z - transform - inverse Z - Transform - System function - Two dimensional Z - transform - Partial fraction Expansion - Z - Transform theorem and Properties - Simple problems.

UNIT – III DISCRETE FOURIER TRANSFORM (DFT) AND FAST FOURIER TRANSFORM (FFT)

Discrete Fourier Series - Properties of DFT - Circular Convolution - Computation of DFT - Decimation In Time FFT - Bit Reversal - Butterfly Computation - Decimation In Frequency FFT - Example problems - Hilbert Transform - design of Hilbert transformers.

UNIT – IV DIGITAL FILTERS:

IIR filters - Basic network structure of IIR filter - Transposed form - Basic network structure of FIR filter - Design of IIR digital filters from analog filter - Impulse Invariance - Bilinear Transformation - Frequency transformation - FIR filter - Properties of FIR - Window techniques - Comparison of IIR and FIR filters.

UNIT – V DSP PROCESSORS:

Digital signal processing and DSP systems - DSP processors - Data path - Memory Architecture - Addressing modes - Instruction set - Pipelining - Peripherals - Serial ports - Timers - Parallel Ports - Bit I/O ports - Host ports - Communication ports - External interrupts.

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Audio and Speech Processing - Radar, Sonar and other sensor Processing - Statistical sensor Processing - Data compression - Digital Image Processing - Image compression - Signal processing for control systems - Telecommunications - Bio - Medical Engineering.

REFERENCES:

1. V. Oppenheim and R. W. Schafer, Digital Signal Processing (PHI Learning Private Ltd.,)
2. P. Lapsley, J. Bier, A. Shoham and E. A. Lee, DSP Processor Fundamentals (Wiley Edition,)
3. S. Salivahanan, A Vallavaraj and C Gnanapriya, Digital Signal Processing, 2nd Ed. (Tata McGraw Hill, 2010).
4. Stephan W. Smith, A Practical Guide for Engineers and Scientists Digital Signal Processing (IDC Technology, 2002).
5. https://ocw.mit.edu/courses/res-6-008- digital- signal - processing
6. www.github.com/openlists/dspsources.

COURSE OUTCOME:

On the successful completion of the course, students will be able to:

- Analyse the different form of signals
- Differentiate DFT and FFT transform methods for DSP applications
- Develop Speech Processing System
- Use it in a Control System
- Apply in Image Compression

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Second Year **CORE COURSE VI** **Semester III**

ADVANCED MICROCONTROLLERS

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To learn about Hardware parts, architecture of PIC microcontroller
- To write the PIC program for interfacing operations
- To design and test PIC and AVR based applications

UNIT – I PIC MICROCONTROLLERS – ARCHITECTURE:

PIC Microcontrollers - PIC hardware - Processor - Memory - Input and Output - PIC 16F877A pin out - Architecture - PIC Instruction - SFR - Program Counter - Status Register - Ports - Timers - Indirect Addressing - Interrupt Control - Peripheral Control.

UNIT – II PROGRAM WRITING, DOWNLOADING, TESTING AND TOOLS:

Simple PIC program - Writing the program - Simulation of LED - Downloading and Testing - In - circuit programming and Debugging - ICPD hardware - LED1 Program Testing - Development steps - Assembling Language - Assembler Code - Syntax - MCU Configuration - PIC Instruction set - Processor Directive - CONFIG Directive - Typical Configurations - PIC instruction set - Instruction Type - Program Execution - Program structure - Software Design - C Programming

UNIT – III PIC MICROCONTROLLER DESIGN:

Application Design and test - Schematic Capture - Circuit simulation - Software Debugging - Source Debug window - other debug window - Hardware design - NET list - PCB layout - Hardware requirements - ICPD requirements - ICPD testing PIC 16F877a Electrical Characteristics

UNIT – IV PIC INTERFACING:

Switch inputs - Display outputs - Keypad system - LCD - Analogue Interfacing - Analog input - Op-Amp Interfacing - Relay Interfaces - Serial Communications - USART - I^2C - Network links - USB - CAN bus Ethernet - Wireless links - Wi - Fi - Zigbee

UNIT – V AVR MICROCONTROLLER:

AVR Microcontroller Architecture - Register - ROM space and other Hardware modules - Addressing modes -Assembly Language Programming - Instruction set - Data types - Simple programs - I/O port Programming - Time delay loop - Look - Up table - Programming in C language.

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

AVR Interfacing Programs: Moving On programs - Servo motor - Sensor switches - Intelligent devices - Digitally speaking - Error checking - talking

Tokens - Object models - Implementing a tokenized object model in AVR - Tokenization

REFERENCES:

1. Martin Bates, "Interfacing PIC Microcontrollers, Embedded Design by Interactive Simulation", Newnes Publications , 2nd Edition, 2016
2. Muhammad Ali Mazidi, Sermad Naimi, Sepehr Naimi, "The AVR Microcontroller and Embedded Systems using Assembly and C" Pearson Publications, Second Ed.2017
3. Alan Trevennor, "Practical AVR Microcontrollers" Springer Publications. Apress, I st Edition, 2012
4. John B .Peatman, "Design with PIC Microcontroller "Pearson Publications, India, 2002
5. Julio Sanchez and Maria P. Canton, "Microcontroller Programming, The Microchip PIC", CRC Press, 2018
6. http://www.microchip.com
7. www.circuitstoday.com/avr-microcontroller-tutorial

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

- Understand PIC and AVR Microcontrollers.
- Interface microcontrollers for many applications.
- Know the difference in PIC and AVR programming
- Control DC motor, Servo motor functions using PIC or AVR
- Build different types of projects in Electronics

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Second Year **CORE CHOICE COURSE III** **Semester III**

1. CONTROL SYSTEMS

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To encourage the students to get the insight knowledge of Control systems
- To get the knowledge of Stability, State space equation and root locus.
- To control the system by using digital techniques

UNIT – I CONTROL SYSTEM CONFIGURATION AND TOOLS:

Introduction - Configuration - open loop system - Closed loop system - Transient response - Steady state response - The design process - Computer Tools for control system - Case Study - Antenna Azimuth. Introduction to position Control systems - hybrid vehicle.

UNIT – II MODELLING IN THE FREQUENCY DOMAIN:

Block diagram representation of the system - Laplace transform review - Partial fraction expansion - Solution of differential function - transfer function - Electrical network transfer function - Complex circuits via mesh analysis - Nodal analysis - Transfer function for Inverting and Non - Inverting Op-Amp - Transfer function for system with gears - Transfer function for DC motor and load.

UNIT – III MODELLING IN THE TIME DOMAIN:

The general state space representation - Applying the state space representation - Converting a transfer function to state space - converting from state space to transfer function - Time response - Poles, Zeroes and system response - first order systems - Second order systems

UNIT – IV REDUCTION OF MULTIPLE SUBSYSTEMS AND STABILITY:

Block diagrams - cascade form - parallel form - feedback form - moving blocks to create familiar form - Block diagram reduction by moving blocks - signal flow graph - Mason's rule - signal flow graph for state equations - Routh - Hurwitz criterion - special cases - stability in steady space - case study - Antenna control - Designing a closed loop response.

UNIT – V ROOT LOCUS TECHNIQUES AND DIGITAL CONTROL SYSTEMS:

Defining Root locus - properties of root locus - refining the sketch - jGO - axis crossing - plotting and calibrating root locus - digital control systems - Modelling the digital computer - digital system via the S - plane - Cascade compensation via S - plane - digital compensator.

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Introduction - Using Simulink - Examples - Using Simulink for control system design - Control systems analysis, Design and simulation - Using LabVIEW - Analysis, Design, and Simulation examples.

REFERENCES:

1. N. S. Nise, Control Systems Engineering, (Wiley India, 2018).
2. Richard C. Dorf, Robert H. Bishop, Modern Control Systems, 12th Ed.,(Prentice Hall, 2011)
3. I.J. Nagrath and M. Gopal, Control systems Engineering, 6th Ed. (New Age International, 2018)
4. Joseph J. Distifeno, Allen R. Stubberrud, Ivan J. Williams, Schaum's Outline of Feedback and Control Systems, 3rd Ed. Mc – Graw Hill, 2013
5. www.ieee.org/resources
6. www.classcentral.com/swayam-control systems

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

- Analyse the various aspects open loop and closed loop system
- Apply in real world control system requirements.
- Utilize digital methods
- Design full state control system
- Analyse Time and frequency domain in applications

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Second Year **CORE CHOICE COURSE III** **Semester III**

2. ARTIFICIAL INTELLIGENCE

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To learn the importance of Artificial Intelligence
- To use Artificial Intelligence for Electronics Applications
- To control Robots by using AI techniques.

UNIT – I ARTIFICIAL INTELLIGENCE – INTRODUCTION:

Basics - Intelligence - Artificial Intelligence - Intelligent behaviour - Understanding AI - Hard or Strong AI - Weak or Soft AI - Goals - General Goal - Engineering based Goal - Science based Goal - Logical AI - Search AI - Pattern Recognition - Knowledge representation - Representation, Inference, Common sense knowledge and reasoning - Learning, Planning - Epistemology - Heuristics .

UNIT – II LEARNING SYSTEM:

Definition - learning agents - components of the learning system - Paradigms of machine learning - **Explanation Based Learning** (EBL) - General approach, - EBL architecture - EBL system - Generalization problem - Explanation structure - Clustering Distance functions, K - mean clustering - algorithm - Supervised learning - unsupervised learning - **Reinforcement** Learning RL Problem.

UNIT – III TECHNICAL PLATFORM AND OTHER ESSENTIALS:

Tensor flow - basic building blocks - The tensor Flow graph - Pytorch - Basic Building blocks - Pytorch graphs - Keras - Basic Building blocks - Wrapping up - AWS Essentials - Cloud platform - Cloud storage - Cloud ML machine - CPUs - GPUs**.**

UNIT – IV NETWORK LAYERS:

ANN - Naming and Sizing layers - Activation functions - Historically popular activation functions - Modern activation functions - Weights and Bias functions - MNIST functions - Loss functions - CNN - Convolution layers - Pooling Layers - Fully connected Layers - CNN for Image Tagging - RNN - Building Blocks - Memory units - LSTM - GRUs - Generating Image captions.

UNIT – V AI FOR ROBOTICS:

From AI to Robotics - Agent - Embodied Agents - Design Principles for Autonomous Agent - Control Pardigms - Braitenberg's Vehicles - Engineering behaviour - Delibrating approach - From animals to robots - Reactive approach - Tools for Robocists - Navigation , Path Planning and Mapping - A* and Bug algorithm - Navigation - Nearness Diagram - ROS

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Robot and Robot - Robot - human interactions - Swarm Robotics - Social Robot - CERO - Care - O - bot 3 - Hobbit - Companion Robot and Robot Therapy - Paro - KASPAR - Museum Guide and Receptionist Robot - Functional Robot - Explorer Robot - Search and Rescue Robots.

REFERENCES:

1. Lavika Goel, "Artificial Intelligence :Concepts and Applications", Wiley Edition, 2021
2. Stuart J. Russel, " Artificial Intelligence, A Modern Approach" Third Edition, Pearson ,2015
3. Arkapravo Bhaumik, " from AI to Robotics" CRC Press, 1st Edition, 2020
4. Richard E. Neapolitan, Xia Jiang, Chapman and Hall, CRC Press, 2nd Edition, 2018
5. www.freecodecamp.org/
6. www.ai.google/education

COURSE OUTCOMES:

On the successful completion of the course, students will be able to:

1. Understand the components of the Artificial intelligence system
2. Analyse the various aspects and use it in the real world AI Applications
3. Compare various Analysis methods for AI
4. Simulate different AI applications and verify the performance
5. Develop intelligence systems for automation

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Second Year **CORE PRACTICAL III** **Semester III**

ADVANCED MICROCONTROLLER

Code: **(Practical)** **Credit: 3**

COURSE OBJECTIVES:

To acquire hands on training on PIC Microcontroller and its applications

ANY TWELVE EXPERIMENTS:

1. Arithmetic operations using PIC Microcontroller
2. Logical operations using PIC Microcontroller
3. Square Wave generation using PIC Microcontroller
4. LCD Interfacing
5. Stepper Motor Interfacing
6. Keyboard Interfacing
7. Speed Control of DC Motor
8. Serial Communication
9. Network link Communication
10. Wireless Link communication
11. Relay Interfacing
12. Write your name and any simple Phrase with AVR
13. Perform Large Arithmetic Operations such as (A+B)^2
14. LED pattern generation using AVR
15. Input /Output ports in AVR
16. Matrix Display using AVR
17. ADC Interfacing using AVR
18. PWM interfacing using AVR.

REFERENCES:

1. Anoop B.K. ,PIC Lab Manual, Examples for Experiments using Microcontrollers. 2015, E – Book
2. https://ww1.microchip.com/.../AVR-Instruction-Set-Manual-DS400021 ·
3. Hamid Saghaei, AVR Microcontroller booklet for Laboratory, IAU, Shahrekord Branch 2008

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

- Handle Microcontrollers as per the procedure
- Get the hands -on – Experience with controllers
- Perform arithmetic operations
- Interface Relay, LED, LCD and Keyboard etc.
- Write the Microcontroller programs for different applications

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Second Year **ELECTIVE COURSE III** **Semester III**

1. PCB DESIGN AND CAD

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To learn the basic components of Printed Circuit Boards design
- To get the knowledge to use CAD tools to design PCB
- To know the procedure to transfer the circuit Image on the PCB

UNIT – I DESIGN OF PRINTED CIRCUIT BOARDS:

Layout Planning - General Considerations - PCB sizes - layout Approaches - Documentation - layout, General Rules and Parameters - Resistance - Capacitance - inductance of PCB conductors - Conductor Spacing - Realising supply and Ground Conductors - Component placing and Ground conductors - Cooling requirements and Package density - Layout check.

UNIT – II DESIGN RULES FOR ANALOG AND DIGITAL CIRCUIT PCBS:

Component conductors - Signal conductors - High frequency amplifiers - Oscillators - multistage Amplifiers - Feedback amplifiers - High gain DC Amplifiers - Supply and Ground Conductors - Dividing circuit for high and Low - power part - Copper - Clad laminates - PCB terminal connections and assembly - Conductors - Reflections - Integrated Circuits - TTL - C –MOS - ECL - Elements or with Line - Driver/Receiver - Crosstalk - ground - and - Supply - Line noise

UNIT – III TECHNOLOGY OF PCBS:

Film master Production - Film Emulsion - Dimensional stability - reprographic cameras - Darkroom - Film processing - Increasing and Decreasing line widths - Film Registration - manufacture of Copper - Clad Laminates - Properties of laminates - types of Laminates - Test methods - Board cleaning - manual cleaning processes - machine cleaning processes.

UNIT – IV PRINTING ,PLATING AND ETCHING PROCESSES:

Basic processes for Double sided PCBs - Photo film resists - wet - film resists - Coating Processes - Dry film resists - Screen Printing - Screen Fabrics - Screen and Frame Fabrics - Pattern Transfer on to the screen Plating - Immersion Plating - Electroless plating - Electroplating - Principle - Copper plating - Tin plating - Nickel plating - Gold plating - Etching machines - Etchant systems - Ferric Chloride - Cupric Chloride - Chromic acid.

UNIT – V AUTOMATION AND COMPUTERS IN PCB DESIGNS:

Limitations of Manual Designing - Automated artwork designing - Computer aided design(CAD) - Engineering Design - Designer Vs. computer - Computer as design medium - Programming language for CAD - Computer Graphics - Graphics designs - Representation of Images in Computer - Transformations - Segmentation - Geometric modelling - Computer Aided Drafting

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

High - Density Interconnect and Miniaturisation - Greener Manufacturing - PCB automatic placement machine - IOT PCB - Bio - Gradable PCBS

REFERENCES:

1. W. C. Bosshart, Printed Circuit Boards, Design and Technology, (Tata McGraw Hill Ltd., 1983).
2. C.S. Krishnamoorthy, S. Rajeev and A. Rajaraman, Computer Aided Design, 2nd Ed. (Alpha Science International Ltd., 2005).
3. D. Boswell, Surface Mount and Mixed Technology: PCB design Guidelines", Electro mechanical Publications
4. J. A. Scarlett, Printed circuit Boards for Micro Electronics, Van Nostrand Reinhold Company.
5. www.resources.altium .com/p/where-you-can-learn-pcb-design
6. www.udemy.com/circuits

COURSE OUTCOMES:

On the successful completion of the course, students will be able to:

- Apply advance techniques in designing PCB.
- Understand the fabrication processes
- Familiarize with different types of fabric used for screen printing
- Design Printed Circuit Board with Computer Tools.

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Second Year **ELECTIVE COURSE III** **Semester III**

2. AUTOMOTIVE ELECTRONICS

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To develop capacity to analyse and understand the Electronics Systems in modern automobiles
- To understand the operation and function of Automotive Communication protocols
- To familiarize the hybrid and Electric Vehicles

UNIT – I AUTOMOTIVE INDUSTRY:

Introduction to Automotive Industry and Modern Automotive Systems - Vehicle classifications and specifications - need for electronics in automobiles - Application of electronics in automobiles - Current trends in modern automobiles - Component electronic engine management - Electronic management of chassis system - Vehicle motion control - Free scale controller's families.

UNIT – II AUTOMOTIVE SENSORS:

Airflow rate sensor, Strain Gauge MAP sensor, Engine Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Throttle Angle Sensor (TAS), Engine Coolant Temperature (ECT) Sensor, Exhaust Gas Oxygen (O2/EGO) Lambda Sensors, Piezoelectric Knock Sensor.

UNIT – III CAN PROTOCOL:

Controller Area Network (CAN) Protocol: History and foundation of CAN - CAN Applications - Main characteristics of CAN - CAN in OSI Reference Model - CAN Data Link Layer - Principles of data exchange in CAN - Arbitration - Data Frame - Remote Frame - Error detection and management in CAN - CAN physical Layer - bus length - Single wire - twin wire media - CAN repeaters - Protocol handlers - Microcontrollers and line drivers .

UNIT - IV LOCAL INTRA NETWORK (LIN) AND FLEXRAY PROTOCOL:

Introduction to LIN - LIN specification - LIN features - Technical overview, Work flow concept - LIN operation - LIN frame format - Scheduling table - Network management of LIN cluster, LIN Transport Layer - LIN node configuration and identification - LIN physical layer. Flex Ray Protocol - Need for FlexRay - FlexRay Objectives - FlexRay Features - Application requirements, Working of FlexRay Network topologies

UNIT – V HYBRID AND ELECTRICAL VEHICLES:

Battery Technology: Energy density of various energy sources - storage devices - basics of battery - working principle - construction - good practices of battery maintenance - Other Energy Storage Devices for Hybrid Vehicles: Super capacitor

- Ultra capacitor - fly wheel technology; **Electric Vehicle (EV):** Requirement of drive train of EV - various configurations of drive train in EV.

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

AUTOSAR - transmissions systems - motor sizing for EV - transmission requirement - general EV configuration - Energy consumption pattern in EV - driving pattern in EV - control of EV; **Applications:** Collision Avoidance Radar warning Systems, Low tire pressure warning system, Heads Up display, Speech Synthesis, Navigation - Navigation Sensors - Radio Navigation

REFERENCES:

1. T. M. Letcher and V. M. Fthnakis, A Comprehensive guide to Solar Energy Systems (Academic Press, 2018)
2. M. Boxwell, Solar Electricity Handbook (Green Stream Publishing, 2012)
3. H. Tyagi, A. K. Agarwal, P. R.Chakraborthy and S. Powar, Applications of Solar Energy, 1st Ed. (Springer Publications, 2018)
4. Robert Bosch, "Automotive Hand Book" SAE, 5th edition, 2000
5. William B. Ribbens, Understanding Automotive Electronics, 5th Edition, Butterworth,Heinemann Woburn, 1998
6. B. Forouzan, Data Communications and Networking (McGraw - Hill, 2003).
7. James Larminie and John Lowry. (2003) Electric Vehicle Technology Explained, John, Wiley and Sons
8. William B. Ribbens, ―Understanding Automotive Electronics‖, 6th Edition, Elsevier Publishing
9. Robert Bosch Gmbh (Ed.) Bosch Automotive Electrics and Automotive Electronics Systemsand Components, Networking and Hybrid Drive, 5th edition, John Wiley & Sons Inc., 2007.
10. Jorg Schauffele and Thomas Zurawka, Automotive Software Engineering Principles, Processes Methods and Tools, SAE International Publishers
11. Gillespie, T., 1992, Fundamentals of Vehicle Dynamics, Society of Automotive Engineers,
12. www.fvrlorg/resources/automotive electronics
13. www.avnet.com/wps/apac/resources/article

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

- Understand the basic automatic electric system
- Identify the major parts involved in the system
- Calculate Voltage, Current required for the vehicle
- Know the requirements of Electronic Components to design the system

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Second Year **NON MAJOR ELECTIVE II** **Semester III**

BIOMEDICAL INSTRUMENTATION

Code: **(Theory)** **Credit: 2**

COURSE OBJECTIVES:

- To learn the basic theory of life- saving Instruments.
- To familiarize with Bio-medical process
- To acquire the knowledge of the bio-devices

UNIT I: Physiology of Human body:

Nerve Physiology: Basic Properties of Neurons and Axons – Membrane Potential and action Potential – Function of Nerves. Muscle Physiology: Function of Skeleton and smooth muscle- Cardiac muscle and rhythmic contraction

UNIT II: Heart and Nervous System

Dynamics of system blood flow – Electron Physiology of Heart – Einthoven Triangle – Respiration Mechanism – Function of Spinal Chord

UNIT III: Basic Diagnostic Instruments

ECG – EEG – Recording Techniques - Patient Monitoring System – CT scanner – Blood Pressure Monitor – Respiration rate Monitors.

UNIT IV: Wearable Medical devices

Bio – Sensors – Smart Watches – Smart Patches - Fitness Trackers – AI enabled monitoring devices

UNIT V: Applications

Nano Robotics in surgery - Patient Management – Activity Monitoring – Disease Management – Stress Management

UNIT VI: Current Contours (For continuous internal assessment only) :

Security Concerns – Ethics – User Acceptance – Future Trends

REFERENCES:

1. M. Arumugam ,Bio – Medical Instrumentation , Anuradha Publications, 2011 Edition
2. Leslie Cromwell, Fred j Weibell and Erich A Pfeiffer(PHI , 2 nd Edition,1990)
3. **Joseph D. Bransino and Donald R. Peterson ,Bio – Medical Engineering Fundamentals (CRC Press, Fourth Edition)**
4. **Joseph D. Bransino and Donald R. Peterson, Medical Devices and human Engineering (CRC Press, 4th Edition)**
5. www.researchgate/applications

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

- Understand the working principle of Medical devices
- know the Applications of Bio – Medical Instruments
- Get the awareness of recent development in the Bío – Medical field

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Second Year	**CORE COURSE VII**	**Semester IV**
	ASIC & FPGA DESIGN	
Code:	**(Theory)**	**Credit: 5**

COURSE OBJECTIVES:

- To encourage the students to learn design techniques of ASIC and FPGA design
- To get the knowledge to design FPGA boards and using Vivado design suite.
- To familiarize with simulation techniques

UNIT – I ASICS – INTRODUCTION:

ASIC - Types of ASICs - Full custom ASICs - Standard cell based ASICs - Gate - Array based ASICs - Channelled Gate Array - Channel - less Gate array - Structured Gate array - Field Programmable Gate Array - Design flow - Programmable ASICs - Anti - Fuse - Static RAM - EPROM and EEPROM Technology - PLDs - PLA - PAL - CPLD.

UNIT – II INTRODUCING FPGAS:

Basic knowledge to Understand FPGAs - Components of FPGA - Programmable switch using flash memory - Architectures of FPGA - Relation between VHDL and FPGA - Relation between ASIC and FPGA - ASIC Vs. FPGA - Anti - Fuse technology - SRAM based - E^2 ROM or Flash based - Trade - Offs - Fine Grain fabric - Middle grain - Coarse grain

UNIT – III MATH, PARALLELISM AND PIPELINED DESIGN:

Introduction to fixed point numbers - Using fixed - Point arithmetic in Temperature sensor - Temperature conversion using fixed - point arithmetic - Floating point numbers - Fixed point to floating point conversion - Floating point Math Operations - Float to fixed point conversion - Simulation

UNIT – IV ADVANCED ARCHITECTURAL TECHNIQUES:

Tree based FPGA architectures - Interconnect description - Downward network - Upward network - Interconnect Depopulation - Connection with outside - Rent's Rule based model - Switches requirement - Wiring requirements - Configuration flow - Multilevel Partitioning and Routing - Experimental Evaluation - Tree based Architecture optimization - Switch utilization Efficiency - 2D physical design of tree based FPGA

UNIT – V CIRCUITS AND ARCHITECTURES FOR LOW - POWER FPGAS:

Introduction - Power consumption in FPGA - Dynamic Power and Static power - Power and Clock gating for FPGAs - Multi VDD Architectures - Power reduction in FPGA routing structures - Leakage power reduction - Routing buffer power optimization - Glitch Reduction - Ultra low - Power FPGAs

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Reconfigurable Hardware Architectures - MPSoCs - NOCs - Processing elements - Reconfigurable Instruction set - Reconfigurable computing structures - Reconfigurable cache - Architecture Management - Virtualisation Technologies - Scheduling - Application of FPGA - Design of High performance Error correcting codes using FPGA - Low power FPGAs based on Resistive memories.

REFERENCES:

1. Gaillardon, "Reconfigurable Logic, Architecture, Tools and Applications", CRC Press
2. Hideharu amano," Principles and Structures of FPGAs" Springer Publications
3. Neeraj Goel, "FPGA Architecture, Technologies, and Tools",
4. Hugh Jack, "Automatic Manufacturing Systems", 2010, Lulu , Ebook
5. Wayne Wolf, FPGA based system Design, I st Ed., (Prentice Hall,2009)
6. www.oreilley.com/library/view/learning-fpgas

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

- Learn the differences between ASIC and FPGA Devices.
- Understand the components of FPGA and Its memory
- Know about power FPGAs
- Employ FPGAs in interfacing applications
- Design FPGA based resistive

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Second Year **CORE COURSE VIII** **Semester IV**

WIRELESS SENSOR NETWORKS

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To know the basics of wireless sensor networks
- To learn about Medium Access Control Protocol
- To acquire skills in Embedded Operating System

UNIT – I CHARACTERISTICS OF WSN:

Characteristic requirement of WSN – Challenges for WSNs – WSN Vs. adhoc networks -Sensor node Architecture – Commercially available sensor nodes - Imote, IRIS, Mica Mote, EYES nodes - BT nodes, TelosB, Sunspot – Physical layer and transceiver design Considerations – in WSNs, Energy user Profile – Choice of Modulation Scheme -Dynamic Modulation – Scaling – Antenna Considerations.

UNIT – II MEDIUM ACCESS CONTROL PROTOCOL:

Fundamentals of MAC Protocols – Low duty Protocols – Wake up Concepts – Contention based Protocol - Schedule – based Protocol – SMAC -BMAC- Traffic – Adaptive medium access Protocol (TRAMA) – The IEEE 802.1.4 MAC Protocol

UNIT – III ROUTING AND DATA GATHERING PROTOCOLS:

Routing challenges and Design issues in WSN – Flooding and Gossiping – Data centric Routing – SPIN – Directed Diffusion – Energy aware routing – Gradient – based Routing – Rumor Routing - COUGAR – ACQUIRE – Hierarchical Routing – LEACH, PEGASIS – Location based Routing - GF, GAF, GEAR, GPSR – Real Time Routing Protocols -TEEN , APTEEN, SPEED, RAP – Data aggregation - Aggregation operations – Aggregate Queries – Techniques – TAG, Tiny DB

UNIT – IV EMBEDDED OPERATING SYSTEMS:

Operating Systems for WSN – Operating system design issues – Examples of Operating Systems – Tiny OS – Mate – Magnet OS – MANTIS -OSPM – EYES OS – SenOS – EMERALDS – Pic OS – Introduction to Tiny OS – Nes C – Interfaces and Modules -Configurations and Wiring – Generic Components – Programming in Tiny OS using Nes C, TOSSIM .

UNIT – V APPLICATIONS OF WSN:

WSN Applications – Home Control – Building Automation – Industrial Automation – Medical Applications – Reconfigurable Sensor Networks – Highway Monitoring – Military Applications -Wildfire Instrumentation – Habitat Monitoring – Nanoscopic Sensor Applications

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

IEEE 802.1.4 LR – WPANs Standard – Target detection and Tracking – Contour / Edge detection – Field Sampling.

REFERENCES:

1. Kazem Sohraby, Daniel Minoli and Taieb Znati, Wireless Sensor Networks Technology, Protocols, and Applications, John Wiley & Sons, 2007
2. Holger Kari and Andreas Wiling, Protocols and Architectures for Wireless Sensor Networks, John Wiley & Sons, 2005
3. Anantram Swamy, Hing Zhao, Yah - Win Hong, Lang Tong, Wireless Sensor Networks, Signal Processing and Communication Perspectives(Wiley India Pvt. Ltd . , 2009)
4. K. Akkaya and M. Younis, A Survey of Routing Protocols in Wireless Sensor Networks, Elsevier Ad Hoc Network Journal, Vol. 3, No.3, pp 325 – 349
5. Philip Levis, David Gay,Tiny OS Programming, (Cambridge University Press, 2009)
6. Anna Hac, Wireless Sensor Network Designs, (Wiley Blackwell, 2003)
7. www.researchgate.net/publication/228092464
8. www.ieeexplore.ieee.org/document

COURSE OUTCOMES:

After Completing this course, the students will be able to:

- Identify the challenges involved in Wireless adhoc and sensor networks
- Study about various Protocols employed in network
- Understand the applications of Wireless Sensor Networks
- Utilize the knowledge of MAC protocol to develop WSN
- Analyse different applications possibility with WSN

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Second Year | **ENTREPRENEURSHIP/ INDUSTRY BASED COURSE PROGRAMMABLE LOGIC CONTROLLER (Theory)** | **Semester IV**

Code: | **Credit: 5**

COURSE OBJECTIVES:

- To encourage the students to learn the requirements of Programmable Logic Controller in the Industry.
- To familiarize with the main parts and functions of PLC.
- Understand the basic concepts of Ladder diagram

UNIT – I INTRODUCTION OF PLC:

Programmable logic controller - PLC - Parts of a PLC - Principles of operation - Modifying the operation - PLC vs computers - PLC size and Applications - PLC Hardware Components - The I/O Section - Discrete I/O Modules - Analog I/O Modules - Special I/O Modules - I/O Specifications.

UNIT – II CPU AND FUNDAMENTALS OF LOGIC:

The Central Processing unit (CPU) - Memory Design - Memory Types - Programming Terminal Devices - Recording and retrieving Data - Human Machine Interfaces(HMIs) - Fundamentals of Logic - Boolean Algebra - Developing Logic Gate circuits from Boolean expressions - Producing the Boolean Equation for a given Logic circuit - Hardwired Vs. Programmed Logic - Programming word level logic instructions.

UNIT – III PLC INSTRUCTIONS:

Basics of PLC Programming - Processor Memory Organizations - Program Scan - PLC Programming Languages - Relay - type Instructions - Instruction Addressing - branch Instructions - Internal relay Instructions - Programming examine If closed and examine If open Instructions - Entering the Ladder Diagram - Modes of Operation

UNIT – IV PLC WIRING AND LADDER DIAGRAMS:

Fundamental PLC wiring diagrams and ladder Logic diagrams - Electromagnetic Control relays - Latching Relays - Converting relay Schematics into PLC Ladder programs - Writing ladder programs - Programming Counters - Counter Instructions - Up - Counter - Down - Counter - Cascading Counters - Incremental Encoder - Counter Applications - combining Counter and Timer Functions.

UNIT – V INSTALLATION AND PROGRAMMING SOFTWARE:

PLC Installation Practices - PLC Enclosures - Electrical Noise - Leaky inputs and outputs - Grounding - Voltage variations and Surges - Program Editing and Commissioning - Programming and Monitoring - Preventive Maintenance - Troubleshooting - PLC Programming software - Control Logic Controllers - Memory and Project Organization - Bit - level programming.

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

PLC Applications: Washing Machines - Elevators and Traffic Light Controllers - Programming Applications with PLC

REFERENCES:

1. Frank D. Petruzella, Programmable Logic Controllers, Mc Graw Hill Publications, Fourth Edition
2. Dunning, G, Thomson, Introduction to Programmable logic controllers, Delmar learning. New Delhi
3. Hugh Jack, Programmable Logic controller,
4. Max Rabiee, "Programmable Logic Controllers", The Good Heart - Willcox Company, Ireland, 2018
5. www.ieee.org/resources/plc

COURSE OUTCOMES:

After completing this course, students should able to

- Identify the components of PLCs.
- Familiarize with the ladder diagram
- Use the PLC in Control systems
- write PLC program to perform the various operations
- Use PLC in Electronic Applications

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Second Year **PROJECT** **Semester-IV**

Code: **Credit: 5**

Each candidate shall be required to take up a Project Work and submit it at the end of the final year. The Head of the Department shall assign the Guide who, in turn, will suggest the Project Work to the student in the beginning of the final year. A copy of the Project Report will be submitted to the University through the Head of the Department on or before the date fixed by the University.

The Project will be evaluated by an internal and an external examiner nominated by the University. The candidate concerned will have to defend his/her Project through a Viva-voce.

ASSESSMENT /EVALUATION /VIVA-VOCE:

1. PROJECT REPORT EVALUATION (Both Internal & External):

I. Plan of the Project - 20 marks

II. Execution of the Plan/collection of Data / Organisation of Materials / Hypothesis, Testing etc and presentation of the report. - 45 marks

III. Individual initiative - 15 marks

2. VIVA-VOCE / INTERNAL& EXTERNAL - 20 marks

TOTAL **- 100 marks**

PASSING MINIMUM:

	Vivo-Voce 20 Marks	**Dissertation 80 Marks**
Project	40% out of 20 Marks (i.e. 8 Marks)	40% out of 80 marks (i.e. 32 marks)

A candidate shall be declared to have passed in the Project work if he/she gets not less than 40% in each of the Project Report and Viva-voce but not less than 50% in the aggregate of both the marks for Project Report and Viva-voce.

A candidate who gets less than 40% in the Project must resubmit the Project Report. Such candidates need to defend the resubmitted Project at the Viva-voce within a month. A maximum of 2 chances will be given to the candidate.

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Second Year **VALUE ADDED COURSE II** **Semester IV**

CYBER SECURITY

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To know about safeguarding measures
- To protect from cyber threat.
- To learn preventive measures on the mobile and the wireless devices

UNIT – I INTRODUCTION:

Cybercrime - Definition and Origins of the world - Cybercrime and information security - Classification of Cybercrimes - Cybercrime - A legal perspectives - An Indian perspective - Global perspective - Survival Mantra for netizens.

UNIT – II CYBER OFFENSES AND METHODS USED IN CYBERCRIME:

Social Engineering - Cyber Stalking - Cyber Café and cybercrime - Botnets - Attack Vector - Tools and Methods - Proxy servers and Anonymizers - Phishing - Password cracking - Keyloggers and Spywares - Virus and worms - Trojan horses and Backdoors - Attacks on wireless networks.

UNIT – III CYBERCRIME: MOBILE AND WIRELESS DEVICES:

Proliferation of Mobile and wireless devices - Trends in mobility - Credit card frauds and wireless Computing - Security Challenges—posed by Mobile devices - Authentication service security - Attacks on Mobile/Cell phones - Mobile Devices: Security implications for Organization - Organizational Measures for Handling Mobile - Laptops.

UNIT – IV THREATS AND SOLUTIONS:

Threats - Information Security - Systems Security - Security Vs. Safety - Security as a Risk Management - Approaches for attack and Dependence - Defences - Threat and solutions in Data security - Unauthorized disclosure of Information - Unauthorized Modification and fabrication - The benefits asymmetric cryptography - Case study: secure HTTP - Finding and Handling Vulnerabilities.

UNIT – V CORE VALUES AND ETHICS IN CYBER SECURITY:

Values and Value cores - value clusters in Cyber security - Privacy - Fairness - Accountability - Value Conflicts - Value conflicts in cyber security - Security Vs. Privacy - Privacy Vs. Fairness - Privacy Vs. Accountability - Security Vs. Fairness - Ethical Frameworks - Principlism - Human Rights - From Principlism and Human rights to the ethics of risk - Cyber security and Ethics of risk - The Maximum rule - Contextual Risk.

UNIT – VI CURRENT CONTOURS (For continuous internal assessment only):

Cyber security in Health care - Principles, Moral values and Technical aims - Technical aim mapping to Ethical Principles - Other moral values - case study: Cardiac pace makers and other Implantable Medical devices - Value conflicts Identified in Literature - Cyber security of an Industrial control systems - AI and cyber security of critical infrastructure.

REFERENCES:

1. Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives", Wiley India Pvt. Ltd, 2011.
2. Markhus Christen, Berk Gordijin, Mitchel Loi "The Ethics of Cybersecurity(The International Library of Ethics, Law and Technology book)" Springer Publication.
3. Nilakshi Jain, Ramesh Menon , Cyber Security and Cyber Laws (Wiley India, 2020)
4. Michael Sikorski and Andrew Honig , Practical Malware Analysis, 1st Ed. (No Starch Press, 2012)
5. www.edx.org/learn/cybersecurity

COURSE OUTCOMES:

After completing this course, students should able to

- Get confidence to face any unexpected cyber threats.
- Know the preventive measures to avoid wireless devices ,credit and debit card frauds
- Review and Practice cyber security methods and ethics in online
- Evaluate best practices in cyber security concepts

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