APPLIED ELECTRONICS AND INSTRUMENTATION DEPARTMENT B.TECH CURRICULUM STRUCTURE

UNDER AUTONOMY

HALDIA INSTITUTE OF TECHNOLOGY

HALDIA
EAST MEDINIPUR

AFFILIATED TO

MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

Values & Ethics in Profession

Course Name: Values and Ethics in Profession	**Category:** Humanities and Social Sciences
Course Code: HM-HU 601	**Semester: VI**
L-T-P: 3-0-0	**Credit: 3**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 24	End Semester Exam.: 70 Marks
Pre-Requisites: No-prerequisite	

Objectives:

To understand the ethical and moral problems faced in the corporate and wider philosophical settings along with social importance and their intellectual challenges are given its due placement.

Course Outcomes:

HM-HU 601. 1. **Understanding** the significance of Indian ethos and culture and analyzing the implementation of ancient Indian thoughts in management today

HM-HU 601. 2. **Evaluating** how the ethical principles guide our moral actions and judgments and identifying how the unethical practices are standing as obstacles for socio-economic development.

HM-HU 601. 3. **Assessing** the ethical challenges and dilemmas of engineering practices and creating norms for administrating ethical management initiatives in an organization

HM-HU 601. 4. **Interpreting** the global principles of corporate social responsibility to design and develop an organization's plan towards societal growth and sustainability

HM-HU 601. 5. **Estimating** the impact of the rapid technological growth and applying varied eco-friendly technologies for sustainable development

HM-HU 601. 6. **Identifying** and **prioritizing** human values as core of our behavior to promote social stability and social progress thereby comprehending the process of living in peace and harmony

Course content:

Module No.	Description of Topic	Contact Hrs.	CO
1	**Being good and responsible** Gandhian values such as truth and non-violence – comparative analysis on leaders of past and present – society's interests versus self interests – Prevention of harassment, violence and terrorism - Personal Social Responsibility: Helping the needy, charity and serving the society, **Essence of harmony in today's world**, **Value Education, Service Learning, Emotional intelligence**	**2**	**6**
2	**Profession and Human Values** Values Crisis in contemporary society, Nature of values: Value Spectrum of a good life, Psychological values: Integrated personality; mental health, **Societal values, Moral and Ethical values, Value based leadership,**Dishonesty - Stealing - Malpractices in Examinations - Plagiarism – Abuse of technologies: Hacking andother Cyber Crimes	**4**	**2, 3, 6**
3	**Indian Ethos in Management** Indian Ethos, Indian Ethos for Management, Work Ethos and values for Indian managers, Impact of values on stakeholders, Value system in work culture, Trans-cultural human values, Importance of Karma to managers, Nishkama Karma and its impact on employees today, Teaching Ethics, Gurukul system of learning	**3**	**1, 6**
4	**Corruption** Corruption: ethical values, causes, impact, laws, prevention –electoral malpractices – white collar crimes - tax evasions – unfair trade practices.	**2**	**3**
5	**Addiction and Health Peer pressure, Drug Abuse** Alcoholism: ethical values, causes, impact, laws, prevention-ill effects of smoking-Prevention of suicides-Sexual Health: Prevention and impact of pre- marital pregnancy and Sexually Transmitted Diseases. Abuse of different types of legal and illegal drugs: ethical values, causes, impact, laws and prevention	**2**	**3**
6	**Ethics of Profession** Engineering profession: Ethical issues and challenges in Engineering practice, Conflicts between business demands and professional ideals. Social and ethical responsibilities of Technologists. Codes of professional Ethics, Ethical governance in business, Whistle blowing and beyond, Case studies, **Corporate Social Responsibility and good corporate**	**5**	**1, 3, 4, 6**

	citizenship, Ethical dilemma in different business areas, Managing ethical dilemmas		
7	**Effects of Technological Growth** Rapid Technological growth and depletion of resources, Reports of the Clubof Rome. Limits of growth: sustainable development, Energy Crisis: Renewable Energy Resources, Environmental degradation and pollution. Eco-friendly Technologies. Environmental Regulations, Environmental Ethics, Appropriate, Technology Movement of Schumacher; later developments, Technology and developing notions. Problems of Technology transfer, Technology assessment impact analysis.	**5**	**2, 4, 5**
	Total	**24**	

Learning Resources

Textbook:

1 Human Values- A.NTripathi.
2 Professional Ethics and Human Values – Premvir Kapoor, Khanna Publishing House
3 Christine E. Gudorf, James Edward Huchingson, 'Boundaries: A Casebook in Environmental Ethics', Georgetown University Press, 2010

References:

1 Ethics- S. Balachandran, K. C. R. Raja & B. KNeir
2 Values and Ethics in Profession-SisirMazumder(Everest)
3 Ethics in Engineering- MartinSchinzinge
4 Mike W Martin & Ronald Schnizinger, Engineering Ethics, New Delhi: Tata Reference McGraw Hill, LatestEdition
5 OC Ferrell, John Paul Frederich, Linda Ferrell; Business Ethics – Ethical Books Decision making and Cases- 2007 Edition, Biz Tantra, NewDelhi
6 L.H. Newton & Catherine K.D., "Classic cases in Environmental Ethics", Belmont: California Wadsworth,2006

Internet of Things (IoT)

Course Name: Internet of Things (IoT)	**Category:** Open Elective Courses -III
Course Code: OE-EI 601	**Semester: VI**
L-T-P: 3-0-0	**Credit: 3**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: Basic concept of programming	

Objectives:

1. *To understand the application areas of IoT*
2. *To understand building blocks of Internet of Things and characteristics*
3. *To realize the revolution of Internet in Mobile Devices & Sensor Networks*

Course Outcomes (COs):

OE-EI 601.1: **Understand** the application areas of IOT.
OE-EI 601.2: **Realize** the revolution of Internet in Mobile Devices, Cloud & Sensor Networks.
OE-EI 601.3: **Understand** building blocks of Internet of Things and characteristics.
OE-EI 601.4: **Application** of IoT in Industrial and Commercial Building Automation and Real World Design Constraints.
OE-EI 601.5: **Building** state of the art architecture in IoT**.**
OE-EI 601.6: **Design** IoT applications for smart cities and smart houses

Course Details

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	**Introduction** Introduction to IoT, Concept of Smart sensors and actuators	4	**1**
Module: 2	**Basics of IoT** Basic of IoT networking Internet Communications: An Overview MQTT, CoAP, REST Api and gRPC, Different Communication protocols: (RFID, IEEE 802.15.4, Zigbee, 6LoWPAN, Bluetooth), LoRa, Machine-to-Machine (M2M) Communications, MQTT Broker	6	**1, 2, 3**
Module: 3	**Programming with IoT** Introduction to Python programming with IoT modules i.e. Paho MQTT, Web modules: urllib2, Flask, Flask-RESTful	8	**5**
Module: 4	**Sensors Interfacing** Introduction to Arduino Programming, integration of Sensors having analog and i2c. Connecting Arduino with ESP8266 WiFi module	8	**2, 6**
Module: 5	**IoT wit Raspberry Pi** Introduction to Python Raspberry Pi, Implementation of IoT with Raspberry Pi.	8	**5**
Module: 6	**Application** IoT application: Smart Cities and Smart Homes	2	**4, 6**
	Total	36	

Learning Resources

Text books:

1. Adrian McEwen, Hakim Cassimally, “Designing the Internet of Things”, Wiley publication, 1st Edition, November 2013.
2. Jeeva Jose, Internet of Things, Khanna Publishing House, New Delhi (AICTE Recommended – 2018)
3. Michale Miller , “The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World”, Pearson Education
4. Hanes David, Salgueiro Gonzalo, Grossetete Patrick, Barton Rob , “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things” , Pearson Education
5. RMD Sundaram Shriram, K Vasudevan, Abhishek S Nagarajan,“Internet of Things” , Wiley publication,

Reference books:

1. Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L., Smart Sensors at the IoT Frontier, Springer International Publishing
2. Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing

Artificial Intelligence

Course Name: Artificial Intelligence	**Category: Open Elective**
Course Code: OE-EI 602	**Semester: 7th**
L-T-P: 3-1-0	**Credit: 4**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: 1 hrs/week	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: Mathematics	

Objective:

To learn the methods for analyzing the behaviour of nonlinear control systems and the designing of control systems.

Course Outcomes (COs):

At the end of the course, a student will be able to:

OE-EI 602.1. **Compare** AI with human intelligence and traditional information processing and discuss its strengths and limitations.

OE-EI 602.2. **Discuss** the core concepts and algorithms of advanced AI, including various searching, knowledge and reasoning, decision making, various learning process, natural language processing, robotics, and so on.

OE-EI 602.3. **Apply** the basic principles, models, and algorithms of AI to recognize, model, and **solve** problems in the **analysis** and **design** of information systems.

OE-EI 602.4. **Analyze** the structures and algorithms of a selection of techniques related to searching, reasoning, machine learning, and language processing.

OE-EI 602.5. **Design** AI functions and components involved in intelligent systems such as computer games, expert systems, semantic web, information retrieval, machine translation, mobile robots, decision support systems, and intelligent tutoring systems.

OE-EI 602.6. **Explain** various search techniques, knowledge & reasoning, and learnings used in expert systems

Course content

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	**Introduction [2]** Overview of Artificial intelligence- Problems of AI, AI technique, Tic - Tac - Toe problem. **Intelligent Agents [2]** Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents. **Problem Solving [2]** Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.	**6**	**1,3**
Module: 2	**Search techniques** [5] Solving problems by searching: problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies **Heuristic search strategies [5]** Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search, genetic algorithms; constraint satisfaction problems, local search for constraint satisfaction problems. **Adversarial search [4]** Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.	**14**	**2,3,4**
Module: 3	**Knowledge & reasoning [3]** Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation	**3**	**2,3,4**
Module: 4	**Using predicate logic [2]** Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. **Probabilistic reasoning [4]** Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics.	**6**	**2,4,6**
Module: 5	**Natural Language processing [2]** Introduction, Syntactic processing, semantic analysis,	**7**	**2,4,5,6**

	discourse & pragmatic processing. **Learning [2]** Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning. **Expert Systems [3]** Representing and using domain knowledge, expert system shells, knowledge acquisition		
	Total	**36**	

Text Books:

1. Artificial Intelligence, Ritch & Knight, TMH
2. Artificial Intelligence A Modern Approach, Stuart Russel Peter Norvig Pearson
3. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
4. Poole, Computational Intelligence, OUP
5. Logic & Prolog Programming, Saroj Kaushik, New Age International
6. Expert Systems, Giarranto, VIKAS
7. Artificial Intelligence, Russel, Pearson

Process Control

Course Name: Process Control	**Category:** Professional Core
Course Code: PC-EI 601	**Semester: VI**
L-T-P: 3-0-0	**Credit: 3**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: To understand this course, the learner must have idea of sensor and transducer, industrial instrumentation and control theory.	

Objectives:

1. To study the operation of different types of industrial processes.

2. To study the different control strategies used in industrial applications.

Course Outcomes (COs):

PC-EI 601.1: Explain the block diagram of different control loop with response curve and demonstrate its various components.

PC-EI 601.2: Describes different process characteristics parameters with suitable examples.

PC-EI 601.3: Compare different types of controllers according to their feature and tuning scheme for practical processes.

PC-EI 601.4: Demonstrate the construction and use of different types of control valves with practical problems.

PC-EI 601.5: Distinguish between different control schemes such as feedforward, ratio, cascade, split, override, adaptive and batch control.

PC-EI 601.6: Describe modern control systems such as PLC, DCS and SCADA communicated by HART protocol..

Course Details

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	**Module Name: Introduction to process control** Details: Introduction, Evolution of process control, process control and automation, classification of process variables, open loop and closed loop systems, servo and regulatory control, compensatory and anticipatory control configuration. Process plant characteristics parameters: self-regulation, Process potential, process quantity and process capacitance, process resistance, process time lag, process characteristics and process reaction rate, process controllability.	**5**	**1,2**
Module: 2	**Module Name: Different control modes** Details: Discontinuous type: On-off, multi-position, floating control mode. Continuous type: proportional, proportional-integral, proportional-derivative, proportional-integral-derivative, inverse derivative control mode. Some special characteristics like integral windup, integral tracking, bump less transfer, derivative overrun etc. Controller selection guideline, offset minimization. Enhance set point tracking and load rejection in process control.	**9**	**1,3**
Module: 3	**Module Name: Tuning of controllers** Details: Controller performance indices, concept of good control, closed loop and open loop tuning methods, comparison of tuning methods. Implementation of Controller: Electronic P, PI, PD, PID controller design. Pneumatic controllers – brief analysis	**6**	**1,3**
Module: 4	**Module Name: Advanced control techniques** Details: schemes, brief analysis and uses (i) Ratio control (ii) Cascade control (iii) Feed forward control (iv) split range control (v) override control (vi) Adaptive control (vii) Continuous control and Batch control	**5**	**1,5**
Module: 5	**Module Name: Final control elements** Details: Classification, actuators: self-operated, pneumatic, electro-pneumatic, hydraulic, electric motor operated and stepper motor operated actuators, valve positioner and	**7**	**1,4**

	transmitter, classification of control valves, performance and application of different control valves, valve type and construction, valve sizing, valve characteristics, Cavitation, Flashing, valve testing, valve selection guidelines, safety valve and their selection. Control valve accessories: Air filter regulator, I/P converter.		
Module: 6	**Module Name: Modern control** Details: Control schemes in industrial processes-distillation columns, heat exchanger, furnaces, reactors, boiler, evaporator, combustion. Introduction to Programmable Logic Controllers – Basic Architecture and Functions; Input-Output Modules and Interfacing; CPU and Memory; Relays, Timers, Counters and their uses; PLC Programming and Applications. Introduction to DCS Hardware and Software.Overview of HART protocol, Introduction to SCADA.	**4**	**6**

Text Books:

1. Curtis D Johnson – Process Control Instrumentation Technology, - Pearson Education/PHI
2. Chemical process control, G. Stephanpoulos, PHI.
3. Process Control-Principles and application, S. Bhanot, Oxford University press.
4. Principle of Process control, D. Patranabis, TMH.
5. Automatic Process Control, D.P. Eckman, John Wiley.
6. Instrumentation and Process Control, D.C. Sikdar, Khanna Publishing House.

Reference Books:

1. Harriot – Process zcontrol, MGH
2. Process control instrumentation technology, C.D. Johnson, PHI
3. Process Control, S.K. Singh, PHI.
4. Instrument Engineers Handbook, B.G. Liptak, Chilton Book Co. Philadelphia
5. Elements of Chemical Process Technology, O.P. Gupta, Khanna Publishing House

Electrical Machine

Course Name: Electrical Machine	**Category:** Professional Core
Course Code: PC-EI 602	**Semester:** VI
L-T-P: 3-0-0	**Credit: 3**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: Basic Electrical, Circuit Theory , Electromagnetic Theory	

Objective:

1. To review the concept of magnetic fields and magnetic circuits
2. To learn the principle of production of electromagnetic force and torque.
3. To learn the basic principle of operation of DC machine
4. To learn the principle of operation and characteristics of DC motor and generator
5. To learn the principle of operation, connections and different tests on Transformers
6. To acquire problem solving skills to solve problems of DC machines and Transformers

Course Outcomes (COs):

After study through the course, students will be able to

PC-EI 602.1: **Deascribe** the basic principle of operation of DC machine
PC-EI 602.2: **State** the principle of operation and characteristics of DC motor and generator
PC-EI 602.3: **Understand and Apply** the principle of operation, connections and different tests on Transformers
PC-EI 602.4: **Analyze** the principle of operation and characteristics of single & three phase Induction machines
PC-EI 602.5: **Illustrate** the principle of operation and characteristics of synchronous machine
PC-EI 602.6: **Design** special eletro-mechanical devices

Course details

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	**DC machines:** Basic construction of a DC machine, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.	4	**1**
Module: 2	**DC machine - motoring and generation:** Armature circuit equation for motoring and generation, Types of field excitations – separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines	4	**2**
Module: 3	**Transformers:** Principle, construction and operation of single-phase transformers, Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers.	10	**3**
Module: 4	**Induction Machines:** Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines. Single-phase induction motors: Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications	10	**4**
Module: 5	**Synchronous machines:** Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Parallel operation of alternators - synchronization and load division.	2	**5**
Module: 6	**Special Electromechanical devices:** Principle and construction of switched Reluctance motor, Permanent magnet machines, Brushless DC machines, Hysteresis motor, Stepper motor, Tacho generators.	6	**6**

Text books:

1. Electrical Machines-I, P.S. Bimbhra, Khanna Publishing House (AICTE)
2. Electrical Machinery, P.S. Bimbhra, 7th Edition, Khanna Publishers
3. Electric machines, D.P. Kothari & I.J Nagrath, 3rd Edition, Tata Mc Graw-Hill Publishing Company Limited
4. Electrical Machines, P.K. Mukherjee & S. Chakrabarty, 2nd edition, Dhanpat Rai Publication.

Reference books:

1. Electric Machinery & Transformers, Bhag S. Guru and H.R. Hiziroglu, 3rd Edition, Oxford University press.
2. Electrical Machines, R.K. Srivastava, Cengage Learning
3. Theory of Alternating Current Machinery, Alexander S Langsdorf, Tata Mc Graw Hill Edition.
4. The performance and Design of Alternating Current Machines, M.G.Say, CBS Publishers & Distributors.
5. Electric Machinery & transformer, Irving L Koskow, 2nd Edition, Prentice Hall India

Analog and Digital Communication

Course Name: Analog and Digital Communication	**Category:** Professional Elective Course-II
Course Code: PE-EI 601	**Semester: 6th**
L-T-P: 3-0-0	**Credit: 3**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: Basic knowledge of analog and digital electronic circuits, signals and systems.	

Objectives: This course aims to equip the students with basic concept of communication system. It emphasizes on technical details of different analog and digital modulation and detection techniques, their performance in different noise conditions. The evolution of mobile communication is also introduced.

Course Outcomes (COs):

After study through the course, students will be able to

PE-EI 601.1: **Gain** the knowledge of components of analog and digital communication system.

PE-EI 601.2: **Demonstrate understanding** of various analog and digital modulation and demodulation techniques.

PE-EI 601.3: **Analyze** transmitter and receiver circuits used in communication systems.

PE-EI 601.4: **Evaluate** the performance of modulation and demodulation techniques in various transmission environments.

PE-EI 601.5: **Compare** and **contrast** design issues, advantages, disadvantages and limitations of analog and digital communication systems.

PE-EI 601.6: **Get acquainted** with different generations of mobile communication system and their technicalities.

Course Details

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	**Modulation Techniques:** Introduction to Communication Process, Communication Channels, Modulation advantages, effect of noise in communication system	**2**	**1-5**
Module: 2	**Amplitude Modulation:** 1. Standard Amplitude Modulation Techniques: Mathematical representation of Amplitude Modulation (AM), modulation index, total power, side band power, efficiency, generation of AM, Demodulation of AM, Envelop Detection, Limitations of AM. 2. Introduce DSB-SC, Generation, with non linear device, switching modulator, ring modulator, De-generation of DSB-SC, synchronous demodulation, effect of phase and frequency error. 3. SSB-SC generation, phase shift method; filter method, Hilbart transform, de-generation of SSB-SC, its application. 4. VSB generation and de-generation, uses of it in communication. QAM	**8**	**1-5**
Module: 3	**Frequency Modulation:** 1. Angle Modulation**:** Mathematical representation of Angle modulation, FM & PM Concept of Narrow and Wide-band angle modulation, Calculation of Bandwidth for FM and PM with Narrow and Wide-band modulation. 2. Basic block diagram representation of generation of FM & PM, Concept of VCO & Reactance modulator Angle Modulation, Frequency Modulation (FM), Phase Modulation (PM), Narrowband FM, Generation of FM, 3. Detection of FM, Discriminator circuit. Phased locked Loop.	**6**	**1-5**
Module: 4	**Pulse Modulation:** 1. Sampling process. Types of sampling, Aliasing effect. 2. Pulse Amplitude modulation and Pulse code modulation, Quantization, quantization error, Differential pulse code modulation. Delta modulation.	**8**	**1-5**
Module: 5	**Digital Modulation:** 1. Line coding technique, on-off, polar, bipolar, ISI, Nyquist criterion for zero ISI, eye pattern 2. Digital modulation technique: (Coherent communication with waveforms) ASK, BPSK, FSK, QPSK, DPSK, MSK. 3. Matched filter, Probability of Error evaluations for ASK and BPSK.	**6**	**1-5**
Module: 6	**Mobile Communication:** 1. Wireless Standards: Overview of 2G and 3G cellular	**6**	**6**

	standards 2. Cellular concepts-Cell structure, frequency reuse, cell splitting, handoff, interference. 3. Multicarrier modulation, TDM,FDM,OFDM 4. MIMO and space time signal processing, spatial multiplexing, concept of multipath fading, Performance measures- Outage, average SNR, average capacity, bit error rate.		

Text Books:

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. B.P. Lathi, “Modern Digital and Analog Communication Systems”, Oxford University Press.
4. WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.

Reference Books:

1. Sanjay Sharma, “Communication Systems (Analog and Digital)”, Katson Books.
2. Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
3. AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
4. VK Garg&JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996.

Embedded System

Course Name: Embedded System	**Category:** Professional Elective Course-II
Course Code: PE-EI 602	**Semester: 6th**
L-T-P: 3-0-0	**Credit: 3**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: Microprocessor and Microcontroller	

Objectives:

1. *To have knowledge about the basic working of a microcontroller system and its programming in assemblylanguage.*
2. *To provide experience to integrate hardware and software for microcontroller applications systems.*

Course Outcomes (COs)

PE-EI 602.1. Understand the internal architecture and interfacing of different peripheral devices with Microcontrollers.
PE-EI 602.2. Understand the role of embedded systems in industry.
PE-EI 602.3. Understand the programming techniques of different microcontrollers.
PE-EI 602.4. Design processor and controller based intelligent systems for real life problems.
3.

Module No.	Description of Topics	Contact Hrs
1	**Introduction to Embedded System :** Embedded system VS General computing systems, Purpose of Embedded systems, Design challenge – optimizing design metrics, embedded processor technology, Microprocessor and Microcontroller, Hardware architecture of the real time systems. A/D converter and D/A Converter, RISC vs CISC, Example of Embeddedsystem.	7
2.	**Introduction to AVR microcontroller:** Introduction to AVR (ATmega 328p-pu) microcontroller, pin layout, architecture, program memory, Data Direction register , Port Registers (PORTx), PWM registers (8-bit), ADC registers, basics of communication, overview and interfacing I/O devices with I2C Bus, UART and Serial Peripheral Interchange (SPI) bus, Programming Embedded Systems with AVR (ArduinoAPI).	10

3.	**Introduction to ARM microcontroller:** Architecture of ARM Embedded microcontroller, ARM instruction set, Introduction to ARMv8-A based embedded development board (i.e. Raspberry Pi rev.4), Programming a Raspberry Pi rev.4 using Python 2.7,User defined LED blink using Raspberry Pi GPIOs, communication between an Arduino UNO rev.3 with Raspberry Pi 4 over USB serial.	10
4.	**Embedded operating systems :** Operating system basics, types of operating systems, tasks, process and threads, multiprocessing and multitasking, task scheduling; task communication: shared memory, message passing, remote procedure call and sockets, task synchronization: task communication/synchronization issues, task synchronization techniques, device drivers, how to choose an RTOS.	10
5.	**Case Studies:** i) Interfacing with Temperature Sensor.(AVR microcontroller and ARM microcontroller Based) ii) Interfacing with Servo Motor. (AVR microcontroller and ARM microcontroller Based) iii) Interfacing with Gas Sensor.(AVR microcontroller and ARM microcontroller Based) iv) Interfacing with LDR light sensor.(AVR microcontroller and ARM microcontroller Based)	8

Outcomes:

To acquire knowledge about microcontrollers embedded processors and their applications.

1. Foster ability to understand the internal architecture and interfacing of different peripheral devices withMicrocontrollers.
2. Foster ability to write the programs for microcontroller.
3. Foster ability to understand the role of embedded systems inindustry.
4. Design processor and controller based intelligent systems for real lifeproblems.

Text/References:

1. Raj Kamal, Embedded systems- Architecture, Programming and Design, McGraw Hill Education (India) Pvt.Ltd.
2. DhananjayGadre, “Programming and Customizing the AVR Microcontroller”; McGraw Hill Education, 2014.
3. Elliot Williams, “AVR Programming: Learning to Write Software for Hardware”, Maker Media, Incorporated,2014
4. An Embedded Software Primer – David E. Simon, Pearson Ed.,2005.

POWER ELECTRONICS

Course Name: POWER ELECTRONICS	**Category:** Professional Elective Course-III
Course Code: PE-EI 603	**Semester: VI**
L-T-P: 3-0-0	**Credit: 3**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Continuous Assessment: 25Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites:	

Objectives:

1. To understand the functioning and characteristics of power switching devices.
2. To understand the principle of operation of converters.
3. To understand different triggering circuits and techniques of commutation of SCR
4. To find external performance parameter of converters.
5. To analyze methods of voltage control, improvement of power factor and reduction of harmonics of the converter
6. To understand various applications of converters

Course Outcomes (COs):

PE-EI 603.1.1. To **describe** the functioning and characteristics of power switching devices.
PE-EI 603.1.2. To **state** different triggering circuits and techniques of commutation of SCR
PE-EI 603.1.3. To **apply** the principle of operation of phase controlled rectifier.
PE-EI 603.1.4. To **analyze** the principles of dc to dc converter.
PE-EI 603.1.5. To **illustrate** various types Inverters
PE-EI 603.1.6. To **design** various applications of converters

Course Details

Module No.	Description of Topics	Contact hrs	CO
Module 1	**Introduction:** Concept of power electronics, application of power electronics, uncontrolled converters, advantages and disadvantages of power electronics converters, power electronics systems, power diodes, power transistors, power MOSFETS, IGBT and GTO.	04	1
Module 2	**PNPN devices:** Thyristors, brief description of members of Thyristor family with symbol, V-I characteristics and applications. Two transistor model of SCR, SCR turn on methods, switching characteristics, gate characteristics, ratings, SCR protection, series and parallel operation, gate triggering circuits, different commutation techniques of SCR.	05	2
Module 3	**Phase controlled converters:** Principle of operation of single phase and three phase half wave, half controlled, full controlled converters with R, R-L and RLE loads, effects of freewheeling diodes and source inductance on the performance of converters. External performance parameters of converters, techniques of power factor improvement, single phase and three phase dual converters	06	3
Module 4	**DC-DC converters:** Principle of operation, control strategies, step up choppers, types of choppers circuits based on quadrant of operation, performance parameters, multiphase choppers.	05	4
Module 5	**Inverters:** Definition, classification of inverters based on nature of input source, wave shape of output voltage, method of commutation & connections. Principle of operation of single phase and three phase bridge inverter with R and R-L loads, performance parameters of inverters, methods of voltage control and harmonic reduction of inverters. **Three-phase voltage source inverter:** 180° VSI & 120° VSI ,Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub cycle , **Cyclo-converters ,Ac Voltage Controller and Static Switch**	13	5
Module 6	**Applications:** Speed control of AC and DC motors. HVDC transmission. Static Switch, UPS.	03	6

Text books:

1. Power Electronics, M.H. Rashid,4th Edition, Pearson
2. Power Electronics, P.S. Bhimra, , 3rd Edition, Khanna Publishers
3. Power Electronics, V.R. Moorthi, Oxford.
4. Power Electronics, M.D. Singh and K.B. Khanchandani, Tata Mc Graw Hill.

Reference books

1. Modern Power Electronics & AC drives, B.K. Bose, Prentice Hall
2. Power Electronics, Mohan,Undeland&Riobbins, Wiley India
3. Element of power Electronics, Phillip T Krein, Oxford.
4. Power Electronics systems, J.P. Agarwal, Pearson Education.
5. Analysis of Thyristor power conditioned motor, S.K. Pillai, University Press.
6. Power Electronics, M.S. Jamal Asgha, PHI.
7. Power Electronics : Principles and applications, J.M. Jacob, Thomson

VLSI & MICROELECTRONICS

Course Name: VLSI & MICROELECTRONICS	**Category:** Professional Elective Course-III
Course Code: PE-EI 604	**Semester: 6th**
L-T-P: 3-0-0	**Credit: 3**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Continuous Assessment: 25 Marks
Tutorial: Nil	Attendance: 5 Marks
Total Lectures: 36	End Semester Exam.: 70 Marks
Pre-Requisites: Knowledge in Basic Electronics, MOS, Transistors etc.	

Objectives:

This course aims to introduce with the VLSI technology, IC design through VHDL.

Course Outcomes (COs):

At the end of the course, a student will be able to:

PE-EI 604.1: Tell about the technology, design concepts, design style, design principles, and design domains.

PE-EI 604.2: Explain and distinguish various Microelectronics circuit fabrication process for VLSI circuit design.

PE-EI 604.3: Apply the concepts of digital circuit design for designing VLSI circuits using MOS transistors

PE-EI 604.4: Draw sticks diagram and Layout diagrams to represent VLSI design process.

PE-EI 604.5: Describe the digital VLSI circuit design using VHSL language.

PE-EI 604.6: Design and Develop combinational and sequential digital circuits applying the concepts applying the concept of digital circuit design and VHDL language.

Course Details

Module No.	Description of Topics	Contact Hrs.	CO
Module: 1	**Introduction to VLSI Design**: VLSI Design Concepts, Moor's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI – basic idea only), Types of VLSI Chips (Analog & Digital VLSI chips, General purpose, ASIC, PLA, FPGA), Design principles (Digital VLSI – Concept of Regularity, Granularity etc), Design Domains (Behavioral, Structural, Physical), Y-Chart, Digital VLSI Design Steps.	**7**	**CO 1**
Module: 2	**MOS Formation:** Thin and Thick Film Integrated Circuits, Methods of producing film, monitoring and control of film thickness; Design and fabrication of individual components; Processing steps for realization of systems. Monolithic IC Technology : Planner processing steps for realization of integrated circuit using bipolar, MOS and CMOS technology; Epitaxy; Diffusion; Ion-Implantation; Oxidation and passivation; Masking and lithography; Etching; Metallisation and ohmic contacts; Die and wire bonding, packaging and encapsulation; Advantages and disadvantages of bipolar, MOS and CMOS systems.	**8**	**CO 2, 3**
Module: 3	**MOS structure**: E-MOS & D-MOS, Charge inversion in E-MOS, Threshold voltage, Flatband voltage, Potential balance & Charge balance, Inversion, MOS capacitances. **Three Terminal MOS Structure:** Body effect. **Four Terminal MOS Transistor**: Drain current, I-V characteristics. Current-voltage equations (simple derivation). **Scaling in MOSFET**: Short Channel Effects, General scaling, Constant Voltage & Field scaling. **CMOS**: CMOS inverter, Simple Combinational Gates - NAND gate and NOR Gate using CMOS.	**8**	**CO 4,5**
Module: 4	**Micro-electronic Processes for VLSI Fabrication**: Silicon Semiconductor Technology- An Overview, Wafer processing, Oxidation, Epitaxial deposition, Ion-implantation & Diffusion, Cleaning, Etching, Photo-lithography – Positive & Negative photo-resist	**3**	**CO 4,5**
	Basic CMOS Technology – (Steps in fabricating CMOS), Basic n-well CMOS process, p-well CMOS process, Twin tub process, Silicon on insulator **Layout Design Rule**: Stick diagram with examples, Layout rules.	**2**	**CO 4,5**
Module: 5	**Hardware Description Language** – VHDL or Verilog Combinational & Sequential Logic circuit Design.	**8**	**CO 6**

Text Books:

1. Physical design automation of VLSI systems - B. T. Press and M.J. Lorenzetti Benjamin (Eds.)
2. Logic Minimization for VLSI Synthesis - R.K. Brayton et al – Klumer Academic Publisher.
3. VLSI Design - D.P.Das - – Oxford University Press
4. Digital Integrated Circuit, J.M.Rabaey, Chandrasan, Nicolic, Pearson Education.
5. CMOS Digital Integrated Circuit, S.M.Kang&Y.Leblebici, TMH.
6. Modern VLSI Design, Wayne Wolf, Pearson Education.

Reference Books:

1. Advance Digital Design Using Verilog , Michel D. Celliti, PHI
2. Digital Integrated Circuits, Demassa& Ciccone, John Willey & Sons .
3. Modern VLSI Design: system on silicon, Wayne Wolf; Addison Wesley Longman Publisher
4. Basic VLSI Design, Douglas A. Pucknell& Kamran Eshranghian, PHI
5. CMOS Circuit Design, Layout & Simulation, R.J.Baker, H.W.Lee, D.E. Boyee, PHI

Process Control Lab

Name of the Course:Process Control Lab	**Category: Professional Core**
Course Code:PC-EI 691	**Semester: VI**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination scheme: Maximum marks: 100**
Tutorial: Nil	External Assessment:60
Practical: 2 hrs./week	Internal Assessment:40
Credit Points: 1.5	

Course Outcomes:	
CO. 1	**Define** P&I diagram for different types of Process control loops like Temperature, Pressure, Flow and Level.
CO. 2	**Demonstrate** the operations of different types of Process control loops.
CO. 3	**Operate** various field instruments related to different types of Process control loops.
CO. 4	**Compare** the merits and demerits among conventional control action with PLC and DCS.
CO. 5	**Perform** effectively as an individual and as a member in teams at the time of executing laboratory experiments.
CO. 6	**Conclude** the safety and maintenance issues related to those processes.
Pre-Requisite:	
1	Sensor and Transducer
2	Industrial Instrumentation
3	Control Theory

Experiment No.	**Laboratory Experiments**	COs
1	Study of Flow, Level, Pressure, Temperature processes and construction of the P&I diagrams in accordance with ISA guidelines / standards.	1
2	Study of a typical Temperature Control Loop having Furnace, suitable final control element, Temperature transmitter, conventional PID controller or Control System, and data logger/recorder.	1,3,5,6
3	Study of a typical Pressure Control Loop having Pressure source, Pressure Transmitter, Motorized/Pneumatic control valve, and conventional PID controller/Control System.	1,3,5,6
4	Study of a typical Flow Control Loop having suitable Flow meter, Motorized/ Pneumatic control valve, and conventional PID controller/Control System.	1,3,5,6
5	Study of a typical Level Control Loop having Level Transmitter, Motorized/ Pneumatic control valve, and conventional PID controller/Control System.	1,3,5,6
6	Study of a typical Air Duct Flow Monitoring and Control.	1,3,5,6
7	PLC Programming through PC.	4,5,6
8	Study of a PC based Automation Software / Simulation Software.	4,5,6
9	PLC and DCS based instrumentation experiments.	4,5,6

Text and reference books:B. W. Bequette, Process Control – Modeling, Design and Simulation, PHI
W. Bolton, Programmable Logic Controllers, Elsevier
B. G. Liptak, Instrument Engineers Handbook, Chilton Book Co., Philadelphia.

Name of the Course: Instrumentation System Design Lab	**Category:Professional Core Courses**
Course Code:PC-EI 692	**Semester:6th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination scheme:**
Tutorial: Nil	External Assessment:60
Practical: 2 hrs./week	Internal Assessment:40
Credit Points: 1.5	

Course Outcomes:	
CO. 1	Learn the issues related to practical implementation of applications using electronic circuits.
CO. 2	Design sensors and suitable signal conditioning circuit.
CO. 3	Design process control loop.
CO. 4	To design various controllers and compensators to improve system performance.
CO. 5	To develop the ability to communicate effectively with fellow group members for dividing and sharing the assignments among themselves.
Pre-Requisite:	
1	Sensors, Process Control , Analog Electronics

Experiment No.	**Laboratory Experiments**	COs
1	Design of sensors for measurement of process parameters	1 - 5
2	Design of appropriate signal conditioning circuit for different sensors.	1 - 5
3	Design of PID controllers.	1 - 5
4	Design of PC based instrumentation system.	1 - 5
5	Electronic system design employing microcontrollers.	1 - 5
6	Electronic circuit design using PCB layout with suitable software	1 – 5

References:

1. Johnson, C.D., 2014. *Process control instrumentation technology*. Pearson.

Internet of Things Lab (IoT)

Course Name: Internet of Things Lab(IoT)	**Category: Open Elective -II**
Course Code: OE-EI691	**Semester: Sixth**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination scheme: Maximum marks:**
Tutorial: Nil	External Assessment:60
Practical: 3 hrs./week	Internal Assessment:40
Credit Points: 1.5	

Laboratory Experiments:

Exp. No.	Name of the Experiment	COs
1	Familiarization with Python and writing programs in PyCharm IDE using Anaconda Framework.	
2	Program to implement Paho MQTT client in Python.	1-6
3	Program simple web server in Python using Flask framework.	1-6
4	Familiarization with Arduino IDE and writing a program using Arduino IDE for LED blinking.	1-6
5	Study of LM35/DHT-11 temperature sensors and write programs to monitor them with Arduino with Thing Speak.	1-6
6	Setup Raspbian on the Raspberry Pi and write a program to blink an LED using Python.	1-6
7	Interfacing digital sensors and relay boards with Raspberry Pi	1-6
8	Familiarization with Python and writing programs in PyCharm IDE using Anaconda Framework.	1-6

Course Outcome:

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

1. Gather engineering knowledge related to IoT.
2. Students can analysis the problem and able to design/develop the solutions
3. Implement basic IoT applications on embedded platform
4. Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
5. AbletounderstandbuildingblocksofInternetofThingsandcharacteristics.
6. Design IoT applications in different domain and be able to analyze their performance

Artificial Intelligence Lab(AI)

Course Name: Artificial Intelligence Lab(AI)	**Category: Open Elective -II**
Course Code: OE-EI692	**Semester: Sixth**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination scheme: Maximum marks:**
Tutorial: Nil	External Assessment:60
Practical: 3 hrs./week	Internal Assessment:40
Credit Points: 1.5	

Laboratory Experiments : Solve the problems Using Prolog/LISP	
1	**Concepts on number**: Factorial, GCD,LCM, Digit count.
2	**Concept on list**: Maximum, Minimum, Palindrome Searching, Union, Intersection
3	**Sorting of list**: Selection sort, Quick sort,
4	**Knowledge Base**: Create KB and apply rules.
5	**Graph Searching algorithms**: DFS,BFS
6	**Implement Puzzle**: Wolf Goat cabbage, Monkey Banana Problem.

Course Outcome:

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

1. Apply Artificial Intelligence techniques for problem solving.

Seminar

Name of the Course: Seminar	**Category: Seminar**
Course Code: EI 681	**Semester: Sixth**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination scheme: Maximum marks:**
Tutorial: Nil	External Assessment:60
Practical: 2 hrs./week	Internal Assessment:40
Credit Points: 2	

Course Outcomes:	
CO. 1	Graduates will demonstrate knowledge of Applied Sciences substrate with Allied field of engineering/technology.
CO. 2	Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.
CO. 3	Graduate will be able to communicate effectively in both verbal and written form through critical thinking process which will assist them in the preparation of their proposal and dissertation.
CO. 4	Pursue new and enriched understandings of the texts through sustained inquiry and reevaluate initial hypotheses in light of evidences.
CO. 5	Express, articulate, discuss and defend well formed arguments within a group or to an audience or to different engineering communities.
CO. 6	Graduate will develop confidence for self education and ability for life-long learning.