Deccan Education Society's

FERGUSSON COLLEGE, PUNE
(AUTONOMOUS)

SYLLABUS UNDER AUTONOMY

SECOND YEAR M.Sc. (Electronic Science)

SEMESTER –III

SYLLABUS M.Sc. (Electronic Science)
w.e.f. Academic Year 2017-2018

Deccan Education Society's
Fergusson College (Autonomous), Pune
Faculty of Science
Post Graduate Syllabus (Electronic Science)
Second Year

Semester	Course Code	Title of the Course	Core / Elective	No. of Credits
Sem III	ELS5301	Communication Electronics	**Core**	04
	ELS5302	Power Electronics	**Core**	04
	ELS5303	Embedded Processors	**Core**	04
	ELS5304	Electronic Science Practical Course V	**Core**	04
	ELS5305	Electronic Science Practical Course VI	**Core**	04
	ELS5306	Self Learning: Open source Hardware Platform	**Core**	01
	ELS5307	Programmable Logic Controller	**Elective**	02
	ELS5308	Digital Signal Processing	**Elective**	02
	ELS5309	Python Programming	**Elective**	02
	ELS5310	Digital Image Processing	**Elective**	02
Note : Students should choose Two Elective subjects out of the given three Electives				
Sem IV	ELS5401	Data Communication and Networking	**Core**	04
	ELS5402	Industrial Process Control	**Core**	04
	ELS5403	Mechatronics	**Core**	04
	ELS5404	Electronic Science Project Practical VII	**Core**	08
	ELS5405	Self Learning: Introduction to SCADA	**Core**	01
	ELS5406	Fundamentals of RTOS	**Elective**	02
	ELS5407	Internet of Things	**Elective**	02
	ELS5408	Wireless Sensor Networks	**Elective**	02
	ELS5409	Project Engineering and Management	**Elective**	02
Note : Students should choose Two Elective subjects out of the given three Electives				
			TOTAL	**50**

Extra Credits

Semester	Course Code	Title of the Course	No. of Credits
III	XCS0007	Introduction to Cyber Security-III / Information security-III	1
	XSD0008	Skill Development-III	1
IV	XCS0009	Introduction to Cyber Security-IV / Information security-IV	1
	XSD00010	Skill Development-IV	1
		TOTAL	**4**

PAPER CODE:ELS5301
Communication Electronics
[Credits -4: No. of Lectures 48]

Objectives:

1. To learn communication system and noise
2. To learn Amplitude modulation and Demodulation techniques
3. To learn Angle Modulation Techniques and Demodulation techniques
4. To learn fundamentals of radio wave propagation and Antennas

	Title and Contents	No. of Lectures
Unit -I	**Introduction to communication systems and Noise** Basics of Communication systems, Modulation and Bandwidth requirements **Noise:** External - Atmospheric, Extraterrestrial, Industrial, Internal - thermal agitation, shot, transit time; Noise Calculations, noise figure, signal to noise ratio	8
Unit -II	**Amplitude modulation** Need of modulation, modulation index, frequency spectrum of the AM wave, Representation of AM, Power Relation in the AM wave. Generation of AM, Single sideband techniques-Suppression of carrier (DSBSC), Balance modulator, suppression of unwanted side bands (SSB)-filter method, phase shift method, third method, extensions of SSB.	**12**
Unit - III	**Angle and Pulse Modulation Techniques** Frequency and Phase modulation, modulation index, mathematical representation of FM, frequency spectrum of the FM wave, noise and frequency modulation- effect on noise on carrier, pre-emphasis and de-emphasis, comparison of wideband and narrowband FM, Generation of FM- FM methods, direct methods, Indirect method **Radio Receivers:** tuned radio frequency receiver, superhetrodyne receiver, AM receivers, and FM receivers.	**12**
Unit - IV	**Radio Wave propagation and Antennas** **Electromagnetic radiation:** Fundamental of EM waves, Effects of the environment. **Propagation of waves:** ground waves, sky-wave propagation, ionosphere, space waves, tropospheric scatter propagation **Antennas:** basic considerations, wire radiations in space, terms and definitions, effects of ground on antennas, antenna coupling at medium frequencies, directional high frequency antennas, UHF and microwave antennas, wideband and special purpose antennas, smart antenna analogy, smart antenna benefits and drawbacks	**16**

Text / Reference Books

1. Electronic Communication Systems, George Kennedy and Bernard Davis Publ. Tata McGraw Hill.
2. Electronic communications, Dennis Roddy and John Coolen, Pearson Publ.
3. Communication Electronics Principles and applications, Louis E. Frenzel, Tata McGraw Hill.
4. Advanced Electronic Communication systems, Tomasi W.

PAPER CODE: ELS5302
Power Electronics
[Credits -4: No. of Lectures 48]

Objectives:

1. To study the basic principles and applications of power electronics
2. To understand the solid-state devices required for power electronic circuits
3. To study and understand the power conversion and power transmission principles
4. To study the industrial and domestic applications

	Title and Contents	No. of Lectures
Unit - I	**Introduction to Power Devices and Circuits** Introduction to Power Electronics and linear electronics, power devices, power circuits, concept of load, Application areas, and Basic concepts of electrical and magnetic circuits Power diodes: I-V characteristics, switching characteristics, types, SiC diodes **Power BJT, MOSFET, IGBTs:** Construction, working, steady state and switching characteristics, base /gate drive circuits Thyristors: SCR Characteristics, two-transistor model, turn-on and turn-off methods, thyristor types, gate drive circuits	**8**
Unit - II	**Power Circuits** **Rectifiers:** single phase half-wave, center tapped full wave and bridge rectifiers, three phase rectifiers, performance parameters **Controlled rectifiers:** Single phase and three phase – half-wave, semi-full wave and dual converters, Single phase series converters, 12-pulse converters, Power factor improvement techniques **AC voltage controllers:** ON-OFF control, phase control, single phase Bidirectional controller, 3-phase Bi-directional controller and their types, PWM control, Single phase and 3- phase cycloconverters and their types **DC-DC converters:** step-up and step-down converters; Buck, Boost, Buck-Boost and Cuk regulators **Inverters:** Performance parameters, single-phase bridge inverter, 3 Phase inverters-120° and 180°conduction, voltage control methods, current source inverters **Static Switches:** Single phase and three phase AC switches, AC switches for Bus transfer, DC Switches, Solid state and Microelectronic Relays	**16**
Unit - III	**Applications of Power Electronics** **DC power supplies:** switch mode DC power supplies, flyback, forward, push pull, half bridge, full bridge-converters, resonant DC power supplies, Current mode and voltage mode PWM, resonant power supplies, bidirectional power supplies	**16**

	AC Power supplies (UPS): switch mode AC Power supplies, resonant and bidirectional AC Power supplies **DC drives:** Basic characteristics of DC motors, Operating modes, single phase and 3 phase drives, DC –DC converter Drives **AC drives:** Induction motors drives - squirrel cage and wound rotor motor, Performance characteristics, control methods Synchronous motor drives - cylindrical rotor, sailent pole, Reluctance, Permanent magnet, switched reluctance- motors, control methods **Brushless DC and AC Motors and Stepper Motor:** types and Control **Electric Utility Applications:** High voltage DC transmission, Flexible AC Transmission systems (FACTs), shunt and series var compensators, **Applications:** Integral half cycle/cycle control, space heating and air conditioning, HF fluorescent lightning, modern electric welding	
Unit - IV	**Practical Design Considerations** Snubber circuits - Turn-on and turn-off and over voltage snubbers, isolation methods, Cooling and heat sinks, reverse recovery transients, supply and load side transients, Voltage protections, Current protection methods,EMI standards, sources and shielding methods	**8**

Text / Reference Books:

1. Power Electronics: Circuits, Devices and Applications, Muhammad H. Rashid, 3rd Edition, Pearson.
2. Power Electronics: Converters, Applications, and Design, Ned Mohan, Tore M. Undeland, William P. Robbins, 3rd Edition, Wiley.
3. Power Electronics: A First Course, Ned Mohan, 2012.
4. Power Electronics Handbook, edited by Muhammad Rashid, Elsevier
5. Fundamentals of Power Electronics, Robert W. Erickson, Dragan Maksimovic, Springer
6. Power Electronics, Daniel Hart, Tata McGraw-Hill Education, 2011

PAPER CODE:ELS5303
Embedded Processors
[Credits -4: No. of Lectures 48]

Objectives:

1. To understand need and application of ARM Microprocessors in embedded system
2. To study the architecture of ARM series microprocessor
3. To understand architecture and features of typical ARM7 and ARM CORTEX-M3 Microcontroller.
4. To learn interfacing of real world input and output devices

	Title and Contents	No. of Lectures
Unit - I	**Advanced RISC Machine (ARM-7)** ARM7 CPU Core, Processor Architecture (32-bit), ARM Programmer's Model, ARM Development Tools, Introduction to ARM families, ARM7TDMI Features, Pipelining,Exceptions, Interrupt Vector Table, ARM Instruction Set, Thumb Instruction, programming in assembly language. **System Peripherals:** Bus Structure, Memory Map, Register Programming	**16**
Unit - II	**ARM7 Based Microcontroller LPC2148** Features, architecture (block diagram and its description), system control block (PLL and VPB divider), memory map, GPIO, pin connect block, timer, interfacing with LED, LCD, GLCD, and KEYPAD. GSM and GPS using UART, on-chip ADC using interrupt (VIC), EEPROM using I2C, SDCARD using SPI, on-chip DAC for waveform generation	**10**
Unit - III	**ARM CORTEX Processors** **ARM CORTEX Series:** Introduction, improvement over classical series and advantages for embedded system design; CORTEX A, CORTEX M and CORTEX R processors- series, versions, features and applications. Need of operating system, desired features of operating system and hardware support from processor, firmware development using CMSIS standard for ARM Cortex, survey of CORTEX M3 based controllers, its features and comparison.	**12**
Unit - IV	**ARM CORTEX M3 based Microcontroller** ARM-CM3 based microcontroller LPC1768:- Features, architecture (block diagram), system control, clock and power control, GPIO, pin connect block, interfacing with RGB LED, seven segment, TFTdisplay, motor control using PWM.	**10**

Text / Reference Books:

1. ARM System On Chip Architecture, Steve Furber, Pearson.
2. ARM System Developers Guide –Designing and Optimizing System Software, Andrew Sloss, Dominic Symes and Chris Wright, ELSEVIER.
3. The insider‘s guide to the PHILIPLS ARM7 based Microcontrollers, An Engineer Introduction LPC2100 Series, Trevor Martin, Hitex ltd.
4. The Definitive Guide to the ARM Cortex-M, Joseph Yiu, Newness, ELSEVIER
5. LPC 214x User manual (UM10139) :- www.nxp.com
6. LPC 17xx User manual (UM10360) :- www.nxp.com
7. An Engineers Introduction to the LPC2100 series, Trevor Martin, Hitex (UK) Ltd.

PAPER CODE:ELS5306
Self Learning: Open source Hardware Platform
[Credits -1: No. of Lectures 12]

Objectives:

1. To learn different open source software / hardware platforms for Embedded systems
2. To learn development boards
3. To acquire the programming skill

Title and Contents	No. of Lectures
Need of Open source Hardware Platform, methodology, study of various available hardware and software, development board -Arduino, BeagleBone Black etc. Software toolkit, Applications	12

PAPER CODE:ELS5304
Electronic Science Practical Course - V
[Credits -4: No. of Practical 12]

General Electronics Laboratory + Special Laboratory

Course	Title of Experiment
Communication Electronics	1. Design of AM transmitter and receiver 2. Design of FM transmitter and receiver 3. Delta modulation and demodulation 4. Design PCM encoder and decoder system 5. Design of ASK / FSK transmitter and receiver 6. Time division Multiplexing 7. Telemetry Applications 8. Varactor diode characteristics and its application in FM
Power Electronics	1. Measurement of transformer parameters 2. Buck converter 3. Boost converter 4. Buck- Boost converter 5. Stepper motor control using current mode PWM 6. Emergency light control 7. DC motor speed control using PWM 8. AC and DC static switches applications 9. Firing angle control for ac-dc converter 10. AC motor speed control 11. Study of AC and/ or DC motor drive
Data Communication and Networking	1. Generation and reception of BPSK 2. Generation and reception of FSK 3. Generation and reception of QPSK 4. Quadrature-Amplitudemodulation (QAM) 5. Phase shift keying (PSK) 6. Amplitude shift keying (ASK) 7. Serial communication using RS 232C 8. Ethernet LAN protocol 9. Wireless LAN protocols 10. Transfer of files from PC to PC using Windows / Unix socket processing
Control Systems and Process Instrumentation	1. Signal conditioning circuits for analog controller 2. Design and implement ON-OFF Controller 3. Design and implement P / PI / PID controller 4. To study the position / velocity control of dc servo motor 5. Study of stability of process control system 6. Study of time domain performance of control system 7. Problem solving using root locus method 8. Flow control using solenoid valve

Mechatronics	1. Study of a DC servo motor 2. Study of BLDC motor, its speed control/position control 3. Study of PMDC motor toque speed characteristics 4. Study of AC servo motor, its speed control/position control 5. Set up a flow control system using suitable flow sensor and actuator 6. Implementation of velocity profile of servo control
Note: 1. Each Practical is equivalent to 4 hours duration. 2. Any 12 Practical from core and elective courses.	

PAPER CODE:ELS5305
Electronic Science Practical Course - VI
[Credits -4: No. of Practical 12]

Computer - Microcontroller Laboratory

Course	Title of Experiment
Embedded Processors	**LPC2148 Based Experiments** 1. Basic Assembly level Programmes 2. Interfacing Alphanumeric LCD to 16/32 bit microcontroller 3. Interfacing LPC2148 to LCD/GLCD 4. Interfacing key board to 16/32 bit microcontroller 5. Programming ADC of 16/32 bit microcontroller 6. Programming DAC of 16/32 bit microcontroller 7. Interfacing external interrupt. 8. Programming RTC / EEPROM / I2C of 16/32 bit microcontroller 9. Programming UART of 16/32 bit microcontroller 10. Interfacing SD card to LPC2148 11. Interfacing EEPROM to LPC2148 using I2C protocol 12. Interfacing LPC1768 to Seven Segment / RGB LED 13. Generation of PWM signal for motor control using LPC1768 14. Interfacing TFT display to LPC1768 15. Implementing CAN protocol using LPC1768 16. Implementing ETHERNET protocol using LPC1768 17. Interfacing LPC1768/LPC2148 to GSM/GPS module 18. nterfacing LPC1768/LPC2148 Zigbee / Wi-Fi / Bluetooth module
Programmable Logic Controllers and Applications	1. Relay programming (all logic gates, boolean equation like multiplexer, demultiplexer, encoder, decoder, latch etc.) 2. Temperature controller 3. Conveyor belt control 4. Alarm monitor program 5. Car parking System 6. Vending machine 7. AC motor drive programming Elevator 8. Water level controller
Python Programming	1. Simple programs using Python 2. Python program using variables and scripts. 3. Python programs using loops, functions. 4. Python programs using Tuples, Lists, and Dictionaries 5. Python programs using class.

	6. Python Data Structures and Algorithms 7. Python programs with importing modules. 8. Python programs for File Handling. 9. Python programs for Exception Handling. 10. Python programs using NumPy. 11. Python programs for creating some games. 12. Python Pandas
Digital Signal Processing	**Simulation using Matlab** 1. Generation of signals 2. Impulse, Step, Exponential 3. and Ramp functions 4. Design of FIR filter 5. Design of IIR filter 6. Linear and circular convolution 7. Concept of Aliasing **On DSP Board** 1. DFT computations 2. FFT Computations 3. Convolution of two discrete signals 4. Waveform generation 5. FIR Filter design IIR filter design
Digital Image Processing	1. Implementation of image enhancement techniques in MATLAB 2. Implementation of histogram processing techniques in MATLAB 3. Build a GUI in MATLAB for image noise filtering & edge detection technique in MATLAB 4. Study & implementation of a segmentation algorithm in MATLAB 5. Development of Photoshop type application for image processing
Wireless Sensor Networks	1. Study of 802.15.4-interfacing and configuration 2. Setting up communication between 2 zigbee nodes 3. Home automation- related experiments 4. Study of effect of various modes of Microcontrollers on Network performance. 5. Experiments on crossbow or equivalent platform: 6. Study of network topology 7. Study of various sensors on the nodes 8. Interfacing external sensor to the node 9. Study of other networking parameters of the hardware platform. 10. Simulation study of WSN to Plan a network for given area and given range with various deployment strategies (Random, Cartesian, Radial, Hexagonal) 11. Find critical nodes in the network under consideration

	12. Study the effect of obstacles on the network.

Note:

1. Each Practical is equivalent to 4 hours duration.
2. Any 12 Practical from core and elective courses.

PAPER CODE:ELS5307
Programmable Logic Controller
[Credits -2: No. of Lectures 24]

Objectives:

1. To make the students aware of programmable logic controller hardware
2. To introduce students to PLC programming
3. To study some case studies using PLC and introduce distributed control systems

	Title and Contents	No. of Lectures
Unit - I	**Programmable logic controllers** Historical background, programmable controller and features, principle of operation, architecture, memory, Input/output module with reference to sink or source, output module-relay, transistor, triac, power supply, signal conditioning, remote connections, networks, PLC verses other control e.g. relay logic, PC, PLC product application range, selection of PLC, documentation of PLC, Examples of applications AC mains interfaces, PLC wiring, device wiring, 24V DC input interfaces, sourcing devices, sinking devices, output interface configurations and wiring	**12**
Unit - II	**PLC Programming** Programming methods- ladder diagrams, function blocks, statement list, programming a PLC, programming terminals, ladder relay instructions, ladder relay programming (digital gates, boolean expression, flip flop), timers, counters and shift registers: types of timers, programming timers, off-delay timers, pulse timers, programming examples, forms of counter, programming, up and down counting, timers with counters, sequencer, data handling: registers and bits, data handling, arithmetic functions, closed loop control shift registers, ladder programs	**12**

Text /Reference Books:

1. John W. Webb and Ronald A. Reis, "Programmable Logic Controllers Principles and Applications", Fifth Edition, Prentice Hall Publication, New Delhi, 2002.
2. L.A. Bryan, E.A. Bryan, "Programmable controller theory and Implementations" second edition, An Industrial Text Company Publication.
3. W.Bolton, "Programmable Logic Controllers", Fifth Edition, Elsevier Publication
4. Gary Dunning, "Introduction To Programmable Logic Controllers", Third Edition.
5. John R. Hackworth, Frederick D. Hackworth, "Programmable Logic Controllers Programming Methods and Applications", Pearson Publication.
6. Frank D. Petruzella, "Programmable Logic Controllers", Third Edition, Tata McGraw Hill

Education Private Limited, 2010.

7. John F. Kennedy “Programmable Controllers An engineer’s guide” Third edition.Newnes publications.

PAPER CODE:ELS5308
Digital Signal Processing
[Credits -2: No. of Lectures 24]

Objectives:

1. To get acquainted to fundamental aspects of Digital Signal Processing (DSP)
2. To become aware of mathematical background required for DSP
3. To learn design of digital filters and implementation on digital Signal Processor
4. To study DSP applications

Prerequisites: Laplace,z and inverse z-transforms, ROC, IZT methods

	Title and Contents	No. of Lectures
Unit - I	**DSP Preliminaries** Digital signal processing and its benefits, application areas, Key DSP, operations (convolution, correlation etc), Digital signal processors, real world applications of DSP, Audio applications of DSP, Telecommunication and biomedical applications of DSP, Real time DSP systems, convolution, types of convolution	**8**
Unit - II	**Digital Filter Design** Frame work of digital filter design: introduction, types – infinite impulse response (IIR), finite impulse response (FIR) **FIR filter:** features, filter design steps, design, filter specifications, coefficient calculation methods, window method, optimal method, frequency sampling method, realization structure for FIR filter, finite word length effects, and implementation of FIR filters **IIR Filter:** basic features, design steps, coefficient calculation, poles-zeros placement, impulse invariant method, bilinear transform, Matched z-transform, Nyquist effect, realization structure for IIR filter, finite word length effects, implementation of IIR filters	**16**

Text /Reference Books:

1. Digital Signal Processing: A Practical Approach, Emmanuel Ifeachorand Barrie Jervis, PHI.
2. Digital Signal Processing: S. Salivahan, A. Valuraj, C.Gnanapriya, TMH, , 2006.
3. Digital Signal Processing: A Hands on Approach: Charles Schuller, Mahesh Chugani, Tata McGraw Hill Pub. Co. Ltd. Edn. 2006.
4. Digital Signal Processing: Principles, Algorithms and Applications: John G. Proakis and Dimitris G Monolkis, Person, 2005.
5. Operating Systems Concept, Galvin, John Willey and Sons.
6. Digital Signal Processing and Applications with the C6713 and C6416 DSK, RulphChassaing, a

John Wiley & Sons, Inc.

7. The Scientist and Engineer's Guide to Digital Signal Processing, Steven W. Smith, Second Edition California Technical Publishing.

PAPER CODE:ELS5309
Python Programming
[Credits -2: No. of Lectures 24]

Objectives:

1. Understand data types and the operations that can be applied to each data type.
2. To develop problem solving skills and their implementation through Python.
3. To study real world interfacing through Python

Prerequisites: Laplace transform, z-transform (ZT), inverse z-transform (IZT), ROC, IZT methods - power series, partial fraction expansion, residue and their comparison

	Title and Contents	No. of Lectures
Unit - I	**Introduction to Python** Python, Basic Python language syntax, execute a Python script at the shell prompt, Variables, Data types, assignment statements, numeric and string operations, Data type conversion, exception handling, Selection (If statements, If/else), loops (for, while), Functions, File Handling, mutable and immutable types, strings, working with Lists, Python specific features such as dictionaries, tuples, and sets	**8**
Unit - II	**Programming with Python and implementation on hardware platform** Understand interpreter and compilers: CPython, PyPy, Cython. **Demonstration of IDE's:** IDLE, IPython, IPython Notebook, hosted environments. **Python installation:** windows and linux, Interfacing With Python, Serial and Over the Internet, Role of package managers: easy install, pip, NumPy and SciPy Real world interfacing using hardware platforms: Raspberry pi, Ardiuno or any other equivalent open source hardware platform Examples like LEDs Blink, Inputting data from sensors, Plotting of Data, IOT applications etc.	**16**

Text /Reference Books:

1. Learn Python the Hard Way A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code, Zed A. Shaw, Third Edition, Addison Wesley.
2. THE Official Raspberry Pi Projects Book, Russell Barnes.
3. Learning Python with a Raspberry Pi, Bradley Miles.
4. Raspberry Pi Projects for the Evil Genius, Donald Norris, TMH Education.

PAPER CODE:ELS5310
Digital Image Processing
[Credits -2: No. of Lectures 24]

Objectives:

1. Develop an overview of the field of image processing
2. To make students familiar with different image processing algorithms
3. To provide the students with the knowledge of practically implementing the algorithms for various applications

	Title and Contents	No. of Lectures
Unit - I	**Introduction to Digital Image Processing** Introduction to DIP, examples of application fields that use image processing e.g. Gamma ray imaging, X-ray imaging, UV band imaging, visible and IR band imaging etc., components of an image processing system, introduction to image sensing and acquisition, digital camera working principal, image storage, processing, communication and display, overview of image representation and modeling techniques, Light and electromagnetic spectrum, elements of visual perception, luminance, brightness, contrast, hue, saturation, mach band effect, color image fundamentals.	**8**
Unit - II	**Digital Image Processing Fundamentals** Introduction to theories, algorithms, and practical solutions of digital image perception, acquisition, color representation, quantization, transform, enhancement, filtering, multi-spectral processing, restoration, analysis, feature extraction, segmentation, morphological transform, and compression, Algorithm design, mathematical tools, and practical implementations of various digital image applications. Considerations of practical system requirements (e.g., medical, satellite, consumer, etc)	**16**

Text /Reference Books:

1. Rafel.C. Gonzalez, Richard.E.Woods, “Digital Image Processing”, Pearson,3rd Edition,2008.
2. Rafel.C.Gonzalez, Richard .E.Woods and Steven L. Eddins “Digital Image Processingusing MATLAB”, Pearson 2004.
3. Anil.K.Jain, “Fundamentals of Digital Image Processing”, Pearson, 2002.
4. Keenneth R.Castleman, "Digital Image Processing", Pearson Education, 1995.

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FERGUSSON COLLEGE, PUNE
(AUTONOMOUS)

SYLLABUS UNDER AUTONOMY

SECOND YEAR M.Sc. (Electronic Science)

SEMESTER–IV

SYLLABUS M.Sc. (Electronic Science)
w.e.f. Academic Year 2017-2018

PAPER CODE:ELS5401
Data Communication and Networking
[Credits -4: No. of Lectures 48]

Objectives:

1. To introduce Data Communication and Networking
2. To learn various coding theory and digital modulation techniques
3. To learn Data Link Layer and Network Layer
4. To learn Transport Layer and Applications

	Title and Contents	No. of Lectures
Unit - I	**Introduction to Data Communication and Networking** Data Communication, Networks, Internet, Protocol and standards, OSI Model, TCP/IP Protocol	**8**
Unit - II	**Digital Modulation Techniques** Line coding, Quantization, pulse Code Modulation (PCM), PCM generation and receiver, companding in PCM, Delta Modulation, Adaptive Delta Modulation, Transmission modes, ASK, PSK, FSK, QAM, TDM, FDM	**14**
Unit - III	**Data Link Layer and Network Layer** Types of error, error detection and correction, Framing, Flow and Error Control, HDLC, Point to Point Protocol, IEEE Standards, Ethernet, Fast Ethernet, Gigabit Ethernet, IEEE802.11, Bluetooth, Connecting Devices, Virtual LANs, ATM, Internet protocol, CDMA, 3G, 4G	**14**
Unit - IV	**Transport Layer and Applications** Process-to-Process Delivery, User Datagram Protocol (UDP), TCP, Name Space, Domain Name Space, Electronic mail, File Transfer, WWW, HTTP	**12**

Text / Reference Books

1. Data Communications and Networking, Fourth Edition Behrouz A. Forouzan and Sophia Chung Fegan, 4th Edn., TMH.
2. Digital and Data communications, Michael A. Miller, 10th edition, A Jaico Publishing house.

PAPER CODE:ELS5402
Industrial Process Control
[Credits -4: No. of Lectures 48]

Objectives:

1. To understand different control strategies
2. To develop problem solving attitude
3. To impart information about control instrumentation
4. To make students familiar with latest trends in industrial control / production systems

	Title and Contents	No. of Lectures
Unit - I	**Introduction to Process Control** **Control strategies:** Feedback, feed-forward, adaptive- control, Evolution of process control, open-loop control and closed-loop control; block diagram and function of its parts, Continuous and discrete state control; control and steady state optimal control.DCS, supervisory control and data acquisition systems, direct digital control.	**8**
Unit - II	**Analog and Digital Controllers** Classification of controllers, ON-OFF and three position controllers. Continuous controllers- Proportional, integral and derivative controllers, and their applications, Composite mode controllers- PI, PD and PID controllers, derivative overrun and integral windup in PID controller. Characteristics and applications of DCS, distributed process control station, SCADA hardware and software and its applications.	**12**
Unit - III	**Sensors and Final Control** Thermal, mechanical and optical sensors for process control. **Final control:** Final control operations, signal conversions. Industrial electronics, actuators, control elements such as control valves, motors, solenoids, alarms, recorders and annunciators. Standard graphic symbols for process control instrumentation.	**12**
Unit - IV	**Control System Examples** Speed control system, Position control system, Temperature and level control systems, Reel drives, tension control system for paper. **Control system evaluation:** Stability, steady state regulation, transient regulation, evaluation criteria	**16**

Text / Reference Books

1. Process control instrumentation technology, C.D. Johnson, PHI
2. Process control: Principles and applications, SurekhaBhanot, Oxford University Press
3. Control system engineering, Nagrath and Gopal, New age international Ltd

PAPER CODE:ELS5403
Mechatronics
[Credits -4: No. of Lectures 48]

Objectives:

1. To introduce the students of electronic science to the subject of mechatronics
2. To review the concepts of sensors, transducers and actuators, with a view to use them in mechatronic systems
3. Enable the learner to acquire basic knowledge of mechanical systems to be used with electronic systems
4. To introduce the concept of models for electrical and mechanical systems and their combinations for building system models for predicting the behavior of electromechanical systems
5. To provide a quick overview of the communication systems and protocols used in Mechatronics

	Title and Contents	No. of Lectures
Unit - I	**Introduction to Mechatronics, Sensors and Transducers** **Introduction**: What is mechatronics, an overview of - the design process, various systems in mechatronics such as embedded systems, modeling systems, measurement systems, control systems, examples of mechatronic systems **Sensors and Transducers:** Introduction to sensors and transducers, sensitivity analysis, effect of component variation, measurement of motion, digital sensors for motion measurement, force, torque and tactile sensors,vibration- acceleration sensors, flow measurement, temperature sensors and devices, applications of sensors	**10**
Unit - II	**Mechanical and Electrical Actuation Systems** Mechanical actuation systems: mechanisms and their role in mechatronic systems, translational and rotational motion – degrees of freedom, kinematic chains – examples of links, toggle linkage, slider-crank etc. cams, gears – types, gear trains, gear ratios, uses ofrotation-to-translational motion – rack and pinion, ball screw and links, Ratchet and pawl, belt and chain drives, bearings– types and uses, consideration of moment of inertia and torque for motor selection Electrical actuation systems: Relays and applications with driver circuits Solid state switches- diodes, thyristors, BJTs and MOSFETs and their applications as switches and driver circuits, solenoids DC Motor- types, basic construction and working, brushed and brushless DC motor driver circuits, and speed control AC motors- basic idea of single phase and three phase motors and their speed control Stepper motors- types, construction, features, specifications, control of drives.	**16**

Unit - III	**System Models and Dynamic responses of systems** **Basic system models:** Mechanical (translational and rotational) system building blocks, electrical system building blocks, electrical and mechanical analogies and their use in analysis, basic idea of fluid system building blocks and thermal system building blocks System models- Engineering system models, rotational-translational systems, electromechanical systems, linearity **Dynamic responses of systems:** modeling dynamic systems, terminology of first order and second order system, performance measures for second order system, system identification	**12**
Unit - IV	**Mechatronic System Design** **Artificial intelligence:** basic ideas, meaning, perception and cognition, reasoning and learning **Mechatronic systems:** Mechatronic designs and case studies	**10**

Text / Reference Books

1. Mechatronics by W.Bolton, 4th Edition, Pearson.
2. Mechatronics System Design, by DevdasShetty and Richard Kolk, 2nd Edition, Cengage Learning.
3. Robotics Engineering – An integrated approach. By Richard W. Klafter, Thomas A. Chmielewski and Michael Negin, PHI Learning Pvt. Ltd.

PAPER CODE: ELS5404
Electronic Science Project Practical VII
[Credits -8]

- Candidate should carry out a project equivalent to 8 credits in the semester IV.
- The student should report about a progress of a project to the guide at least twice in the week.
- Log book of the continuous progress of the work should be maintained by candidate.
- The assessment of the project work is a continuous process.
- Assessment will be done weekly in the respective batch by project guide/ Incharge.
- Evaluation will be on the basis of weekly progress of project work, progress report, oral, results and documentation and demonstration.
- Student should fill the status of the project work on the progress report and get the signature of project guide regularly.
- A one copy of project report should be submitted to the department.

PAPER CODE:ELS5405
Self Learning: Introduction to SCADA
[Credits -1: No. of Lectures 12]

Objectives:

1. To introduce students to SCADA
2. To study some case studies using PLC and introduce distributed control systems

Title and Contents	No. of Lectures
History of Automation, Details Of Automation Industries, Introduction of SCADA, Introduction to SCADA Software, Creating a Project /Application in SCADA, Security layers to application, Fault finding troubleshooting of application, Real & Historical timing trading, Events & Alarms,	12

PAPER CODE:ELS5406
Fundamentals of RTOS
[Credits -2: No. of Lectures 24]

Objectives:

1. To get acquainted to fundamentals of operating system
2. To get familiar with real time operating system (RTOS)
3. To introduce one of RTOS in detail

	Title and Contents	No. of Lectures
Unit - I	**Introduction to Operating Systems and RTOS** Operating system basics and types of operating systems, theBIOS and Boot Process: BIOS Actions, Operating System, Boot Process, Memory Management: segmentation and paging, Memories- virtual, cache etc. **Real time Systems Concepts**: foreground / background systems, critical section of code, resources, shared resources, task, process and threads, multiprocessing and multitasking, taskscheduling.IPC mechanism shared memory, context switches (or task switches), kernels schedulers, preemptive and non-preemptive kernels, reentrant functions, round-robin scheduling, priorities (task, static, dynamic), priority inversions, deadlock, semaphores, inter task communication, message mailboxes, message queues, interrupt, clock tick, real time system, issues in real time computing, structure of a real time system, hard real time system vs. Soft real time system, advantage and disadvantages of real-time kernels	**12**
Unit - II	**Real time operating system** **Kernel structure:** critical sections, task control blocks, task level context switch. **Task Management:** creating a task, task stacks, stack checking, deleting a task, suspending a task, resume a task. **Semaphore Management:** creating and deleting a semaphore, waiting on asemaphore, creating a Mutex, deleting Mutex, waiting on Mutex. **Message Mailbox Management:** crating a mailbox, deleting mailbox, waiting for a messageat a mailbox porting an operating system like µC/OS II / RTLinux / Free RTOS or any other equivalent on an Embedded Platform	**12**

Text /Reference Books:

1. Operating System Concepts and Techniques,M.Naghibzadeh.
2. Operating Systems Concept, Galvin, John Willey and Sons
3. Operating Systems, AchyutGodbole, TMH
4. MicroC/OS-II The Real-Time Kernel, Jean J. Labrosse, Elsevier

PAPER CODE:ELS5407
Internet of Things
[Credits -2: No. of Lectures 24]

Objectives:

1. To introduce Internet of Things (IoT) technology to the students.
2. To understand IoT Market perspective.
3. To learn data and knowledge management and use of devices in IoT Technology.
4. To understand State of the Art – IoT Architecture.
5. To study Real World IoT Design Constraints, Industrial Automation

	Title and Contents	No. of Lectures
Unit - I	**Introduction to the IoT:** **Introduction:** Importance of IoT, elements of an IoT, ecosystem, technology drivers, business drivers, typical IoT applications, trends and implications. **Sensors and sensor nodes:** Sensing devices, Sensor modules, nodes and systems. **Connectivity and networks:** Wireless technologies for the IoT, edge connectivity and protocols, wireless sensor networks.	**12**
Unit - II	**Applications of IoT:** **Analytics and applications:** Signal processing, real-time and local analytics. Databases, cloud analytics and applications. Industry perspective Business considerations Legal challenges Local processing on the sensor nodes, connecting devices at the edge and to the cloud, Processing data offline and in the cloud. **Case study:** Designing an IoT system (group exercise).	**12**

Text /Reference Books:

1. J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media, 2016.
2. Keysight Technologies, “The Internet of Things: Enabling Technologies and Solutions for Design and Test”, Application Note, 2016.
3. Charles Bell, “Beginning Sensor Networks with Arduino and Raspberry Pi”, Apress, 2013.
4. D. Evans, "The Internet of Things: How the Next Evolution of the Internet Is Changing Everything", Cisco Internet Business Solutions Group, 2011
5. McKinsey & Company, "The Internet of Things: Mapping the value beyond the hype", McKinsey Global Institute, 2015
6. European Alliance for Innovation (EAI), "Internet of Things: Exploring the potential", Innovation Academy Magazine, Issue No. 03, 2015
7. Digital Greenwich, "Greenwich Smart City Strategy", 2015
8. ITU and Cisco, "Harnessing the Internet of Things for Global Development", A contribution to the UN broadband commission for sustainable development

PAPER CODE:ELS5408
Wireless Sensor Network
[Credits -2: No. of Lectures 24]

Objectives:

1. To familiarize with wireless sensor network.
2. To provide a background of single-node architecture and wireless networking protocols
3. To study currently available sensor platforms and tools

	Title and Contents	No. of Lectures
Unit - I	**Introduction and Overview of Wireless Sensor Networks** Introduction, background of sensor network technology, challenges and hurdles **Examples of WSN applications:** home control, industrial automation, medical applications. Radio technology primer: propagation and propagation impairments, modulation, ISM band,Specifications of WSN devices	**12**
Unit - II	**Architecture Considerations and Networking Sensors** Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture - Sensor NetworkScenarios, Optimization Goals and Figures of Merit, Gateway Concepts Physical Layer and Transceiver Design considerations, Introduction to protocols, Overviewof Communication Protocols for Sensor Networks, wireless networking protocols (IEEE802.11, 802.15, 802.16, GPRS, MAC) Introduction to the RF Modules, architecture of the Zigbee module,Topology Control, Clustering, Time Synchronization, Localization. **Introduction to Simulators**: NS2, OPNET, OMNET etc.	**12**

Text /Reference Books:

1. KazemSohraby, Daniel Minoli and TaiebZnati, " Wireless Sensor Networks Technology-Protocols and Applications", John Wiley & Sons, 2007.
2. Ananthram Swami, Qing Zhao, Yao-Win Hong, Lang Tong, "Wireless Sensor Networks-Signal Processing and Communications Perspectives" John Wiley & Sons,2009
3. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks", ELSEVIER publications, 2005.
4. KavehPahlavan and Prashant Krishnamurthy, "Principle of Wireless network- A unified approach", Prentice Hall, 2006.
5. "Theoretical and algorithmic aspects of sensor, Ad Hoc Wireless and Peer to Peer Networks", Edited by Jie Wu, Auerbach Publications.
6. Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems, CRC PRESS Publication, Edited by Mohammad Ilyas and ImadMaugoub.

PAPER CODE:ELS5409
Project Engineering and Management
[Credits -2: No. of Lectures 24]

Objective:

To impart industry knowledge on detail engineering and project management for students who would want to join organizations dealing in project engineering related to instrumentation field.

Prerequisites: Detailed study of Industrial Process Control and Programmable Logic Controller

	Title and Contents	No. of Lectures
Unit - I	**Conceptualization of Project Engineering and Management** Standards applicable to instrumentation and control engineering, brush-up on instruments used, introduction to the process symbols on P&ID, introduction to a "project", basics of Project Management, project life cycle, project organization structure.	**6**
Unit - II	**Project engineering tools** Introduction to process industry types, introduction to project engineering phase, project engineering workflow, Process Flow Diagram, P & I diagram, Process Data sheet, Instrument Index, Specification sheet for Instruments, plant layouts, cable schedules, Loop wiring diagrams, Bill of Material, instrument installation and hook-ups, project engineering softwares (INTools, MS-Projects, Primavera).	**6**
Unit - III	**Detailed engineering** System architecture design, hardware engineering, software engineering, third party interfaces engineering, system integration, control room engineering, factory acceptance tests, site installation and commissioning, cable engineering, cable laying, instrument hook-up to system, functional tests and plant start-up.	**6**
Unit - IV	**Project Management** Project Management, Planning and scheduling, project specification, work breakdown structure, cost estimations, project management softwares.	**6**

Text /Reference Books:

1. "Standard and recommended practices for Instrumentation and Control", ISA Publications.
2. "Instrumentation Installation", John Bacon, ISA Publications.
3. "Instrument & Control system documentation", Fredrick A. Meier, ISA Publications.
4. "Engineers Hand book", B. G. Liptak, CRC press.
5. "Applied instrumentation in process industries", Andrew & Williams, Gulf Publications.

Guidelines

- 1 credit is equivalent to 15 clock hours**.**
- **Evaluation**

1. ELS5304 and ELS5305 (Electronic Science Practical Course V and VI)

Continuous Evaluation (CE)		
1	Journal	10Marks
2	Viva	15 Marks
3	Internal test – for skill assessment	15 Marks
4	Attendance + Active participation	10 Marks
	Total (CE)	50 Marks
End Semester Assessment (ESE)		50 Marks
	Total (CE + ESE)	**100 Marks**

2. ELS5404 (Electronic Science Project Practical VII):

The guidelines of the assessment of the project for Continuous Evaluation as well as End-Semester Examination are as follows.

Evaluation of CE

Sr. No.	**Performance Criteria**	**Max. Marks**
1.	Selection of Project	10
2.	Planning and Implementation	20
3.	Quality of Performance	20
4.	Regularity of Work carried	10
5.	Report Writing Skills	10
6.	Communication Skill, Self-Expression and Presentation	10
7.	Viva-Voce	20
	TOTAL (CE)	**100**

Evaluation of ESE: Evaluation of ESE will be done by One Internal and One External Examiners Project work will be evaluated for 100 Marks.

Total Marks (CE + ESE) = 100 + 100 = 200

3. Evaluation of Theory courses

Credits	**CE Marks**	**ESE Marks**
4	50	50
2	25	25
1	25	-