SAVITRIBAI PHULE PUNE UNIVERSITY
FACULTY OF SCIENCE AND TECHNOLOGY

Courses in choice based credit system for Postgraduate Science Programme to be implemented from Academic year 2019-20 for Electronic Science

Subject Name	Year	Sem	Course type	Course code	Course name	Credits
Electronic Science	1	1	Core compulsory Theory Paper	ELUT111	Mathematical methods in Electronics using C	4
				ELUT112	Analog Circuit Design	4
				ELUT113	Digital System Design	4
			Choice based optional paper	ELDT114	Elective Theory Course(Any 1) 1. Basics of optical communication 2. Fundamentals and applications of PIC microcontrollers	2
				ELDP114	Elective Practical Course	2
			Core compulsory practical course	ELUP115	Electronic Sc. Practical Paper	4
					Total Credits	**20**
Electronic Science	1	2	Core compulsory Theory Paper	ELUT121	Applied Electromagnetic, microwaves and antenna	4
				ELUT122	Instrumentation and measurement techniques	4
				ELUT123	Foundation of semiconductor devices	4
			Choice based optional paper	ELDT124	Elective Theory Course(Any 1) 1. Fiber optic communication systems 2. Fundamentals and applications of AVR microcontrollers	2
				ELDP124	Elective Practical Course	2
			Core compulsory practical course	ELUP125	Electronic Sc. Practical Paper	4
					Total Credits	**20**
Electronic Science	2	3	Core compulsory Theory Paper	ELT231	Advanced communication systems	4
				ELT232	Mechatronics and robotics	4
				ELT233	Control systems	4
			Choice based optional	ELT234	Elective Theory Course(Any 1)	2

			paper		1. Wireless communication systems 1 2. Fundamentals of Internet of Things	
				ELP234	Elective Practical Course	2
			Core compulsory practical course	ELP235	Electronic Sc. Practical Paper	4
					Total Credits	**20**
Electronic Science	2	4	Core compulsory MOOC/skill development Paper	ELP241*	Industrial training	4
				ELT241 ELP241	PLC Programming and Applications Practical course in PLC Programming and Applications	2 2
				ELT242	MOOCs courses	4
				ELT243	Technical writing	4
			Core compulsory practical course	ELP244	Project/Internship	8
					Total Credits	**20**
Total credits at M. Sc						**80**

***students can opt either for industrial training course(4 credits) or Theory course of industrial automation(2 credits) and practical course(2 credits)**

Important Note :

- Student has to earn total 80 credits for completion of two years M.Sc. course
- Student has to earn generally 20 credits per semester
- Students can flexibly complete maximum of 24 credits in semester III by offering either MOOCs courses(4 credits) or technical writing course (4 credits) mentioned in semester IV. In that case student has to complete only 16 credits during semester IV. This will facilitate more time for training/internship.
- There is option for students in Semester IV for course of Industrial training (4 credits). Students can opt for Industrial Automation course of Theory(2 credits) and Practical(2 credits)
- In semester IV, student has to attend college (PG centre) for 2 days in a week. Remaining time of the week he/she can attend project/internship and industrial training
- Internship can be completed within college, industry or any other research institute
- Continuous evaluation of industrial training course should be done by respective PG centres in colleges

SAVITRIBAI PHULE PUNE UNIVERSITY

M. Sc. Part II(Electronic Science)

Core Compulsory Theory course

Semester III: ELT231: Advanced Communication systems

Credits: 4

Teaching allotment: 4 lectures/week **Lectures: 60 lectures**

Course Outcomes:

This course provides students in dept knowledge about different types of communication techniques . At the end of this course, student should be able to

CO1	Analyze continuous wave/analog method of communication(AM, FM and PM) considering noise, its generation and demodulation techniques
CO2	Compare different pulse modulation techniques(analog as well as digital)
CO3	Analyze digital modulation techniques and related correction methods
CO4	Distinguish different radio wave propogation techniques
CO5	Understand basic theory of antenna and their types as per applications
CO6	Understand basics of modern communication techniques like satellite communication and mobile communication

Unit 1: CW communication system

Communication systems, Modulation, Bandwidth requirements, External and Internal noise, Noise figure

Theory of Amplitude modulation, Modulation index, side bands and frequency domain, Po3wer distribution, Generation of AM, Suppression of carrier, suppression of unwanted side bands, Extensions of SSB, AM receivers

Theory of frequency and Phase modulation, sidebands and modulation index, Noise and frequency modulation, Generation of FM, FM receivers

Unit 2: Pulse Communication systems

Revision of PAM,PPM. PWM. Pulse code modulation, Delta modulation, Adaptive delta modulation, Time division multiplexing, Frequency division multiplexing,

Characteristics Of Data Transmission Circuits - Bandwidth Requirement – Speed - Baud Rate - Noise - Crosstalk – Distortion.

DIGITAL CODES: ASCII Code – EBCDIC Code - Error Detection Codes – Parity Check Codes – Redundant Codes - Error Correction Codes – Retransmission- Forward Error Correcting Code – Hamming Code –

Digital Modulation Techniques – ASK, FSK, PSK, QPSK Modulation/Demodulation Techniques (Only Block Diagram And Operation).

Data link protocols: SDLC, HDLC, XMODM protocols, ASK, FSK, PSK, QAM, telephone modems, cable modems and DSL

Unit 3: Radio wave propagation and Antennas

Propagation in free space, tropospheric, ionospheric propagation, Surface wave, Low and very low, extremely low frequency propagation

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, Cellular radio systems evolution, signal propagation, Smart antenna benefits and drawbacks

Unit 4: Communication Technologies

SATELLITE COMMUNICATION: Satellite system: Kepler's I,II,II laws – orbits – launching orbits – types - Geostationary synchronous satellites - Advantages – Apogee – Perigee - Active and passive satellite - Earth eclipse of satellite. Antenna: Parabolic reflector antenna – cassegrain antenna. Space segment: Power supply- Attitude control- station keeping – Transponders – TT and C subsystem – Antenna subsystem. Earth segment: Block diagram of Transmit receive earth station - Satellite mobile services - Basics of GPS.
MICROWAVE COMMUNICATION: Microwave frequency ranges - microwave devices – Parametric amplifiers –Travelling wave tubes – simple block diagram of microwave transmitter, receiver and microwave link repeater

MOBILE COMMUNICATION: (Qualitative Treatment only) Cellular telephone– fundamental concepts – Simplified Cellular telephone system - frequency reuse – Interference – Co-channel Interference – Adjacent Channel Interference – Improving coverage and capacity in cellular systems - cell splitting – sectoring – Roaming and Handoff – Basics of blue tooth technology.
SATELLITE MULTIPLE ACCESS TECHNIQUES: TDMA, FDMA, CDMA. Digital cellular system – Global system for mobile communications (GSM) –GSM services - GSM System Architecture – Basics of GPRS.

Text / Reference Books

1. Electronic Communication Systems, George Kennedy and Bernard Davis Publ. Tata McGraw Hill.
2. Antenna theory analysis and design, Constantine A. Balanis
3. Electronic communications, Dennis Roddy and John Coolen, Pearson Publ.
4. Communication Electronics Principles and applications, Louis E. Frenzel, Tata McGraw Hill.
5. Digital data communication, Miller
6. Introduction to Fiber optics, A. Ghatak and K. Thyagarajan, Cambridge University press.
7. Advanced Electronic Communication systems, Tomasi W.

SAVITRIBAI PHULE PUNE UNIVERSITY
M. Sc. Part II(Electronic Science)
Core Compulsory Theory course
Semester III: ELT232: Mechatronics and Robotics

Credits: 4

Teaching allotment: 4 lectures/week **Lectures: 60 lectures**

Course Outcomes:

This course provides through understanding of different systems in mechatronics and robotics. At the end of this course, student should be able to

CO1	Identify different components or blocks in any mechatronic system
CO2	Analyze mechatronic systems using system models and dynamic responses using transformation methods
CO3	Distinguish different sensing and actuating mechanisms used in mechatronics and robotic systems
CO4	Compare different control mechanisms used in robotic systems

Unit-1: Introduction

Basics of mechatronic systems: sensors and transducers: digital sensors for motion measurement, torque and tactile sensors, vibration sensors, control systems

Brief history of robots, types of robots– components and structure, kinematic arrangements (configurations), classification of robots based on various methods of classification such as control method, power source, applications and coordinate systems, Application areas of robots

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.

Unit-2: Systems, responses and transformations

Basic system models: Mechanical (translational and rotational) system building blocks, electrical system building blocks, electrical and mechanical analogies and their use in analysis

Dynamic responses of systems: modeling dynamic systems, terminology of first order and second order system, performance measures for second order system, system identification

Transformations:

Rigid Motions: Rotations – coordinate transformations relating to representation of a point in two different frames, composition law for rotational transformations, rotation about an arbitrary axis, representing an arbitrary rotation using only three independent quantities using axis/angle representation, Euler angle representation and roll-pitch-yaw representation

Homogeneous transformation matrices, skew symmetric matrices, angular velocity and angular acceleration, addition of angular velocities

Unit-3: 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 of rotation-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,

Unit-4: Dynamics and Robot Control

Dynamics: deriving dynamical equations of a manipulator by deriving Euler–Lagrange equations by forming Lagrangian of a system
Trajectory planning and generation, joint space schemes, Joint space schemes with via points. Cartesian straight line motion and circular motion, trajectory planning for orientation, difficulties in trajectory planning
Independent Joint Control: basic structure of feedback control system, dynamics of PMDC motor, DC motor control system, set-point tracking using PD and PID compensator, Drive-train dynamics,trajectory interpolation
Force control– static force / torque relationships, natural and artificial constraints, stiffness and compliance

Text / Recommended 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.
4. Robot Dynamics and Control, Spong and M. Vidyasagar, Wiley Student Edition
5. Robotics: Fundamental Concepts and Analysis, Ashitava Ghoshal, Oxford Higher Education
6. Robotic Engineering: An integrated approach, Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, Prentice-Hall India

SAVITRIBAI PHULE PUNE UNIVERSITY
M. Sc. Part II(Electronic Science)
Core Compulsory Theory course
Semester III: ELT233: Control System

Credits: 4

Teaching allotment: 4 lectures/week **Lectures: 60 lectures**

Course Outcomes:

This course provides application based knowledge of different mathematical methods in design and development of various control systems. At the end of the course, student should be able to

CO1	Compare different control loop systems such as open loop, closed loop, DCS, SCADA etc.
CO2	Analyze the control systems using different mathematical techniques such as transfer function and different stability criterion
CO3	Analyze and Distinguish different types of analog and digital controllers and control modes
CO4	Identify components of control systems
CO5	Design, develop and implement control systems for given applications

Unit-1: Control system basics

Closed loop control and functional elements in it open-loop control, continuous and discrete state control, control strategies such as feedback, feed forward and adaptive control, steady state optional control concept of DCS, evolution of process control, SCADA supervisory control and data acquisition systems, Fuzzy logic direct digital control CDDC

Unit-2: Control system analysis

Mathematical models of systems, concept of transfer function and its use, method of obtaining transfer function, block diagram of control system, rules of block diagram reductions and examples thereof

Concept of stability, Routh stability criterion, Roth- Hurwitz criterion, Root locus steps in drawing root locus, Use of root locus and examples thereof. Frequency response methods of control system analysis, Bode plots method to plot and examples thereof, Nyquist plots, method to plot and examples thereof, process loop tuning and control system evaluation, Open loop transient response method, Zeigler- Nichols method.

Unit-3: Analog and Digital Controllers

Classification of controllers, Controller terms Discontinuous controllers: On-OFF Controller, three position controller

Continuous controllers: Proportional, Integral and Derivative control

Composite control modes: PI, PD and PID controllers. Derivative overrun and integral windup in PID control mode

Design of analog controller circuits for above modes characteristics and applications

Ladder Programming: Basic components such as relays, Design systems using ladder diagram such as conveyer belt monitoring, temperature control systems etc.

DCS hardware and software, distributed process control station (DPCS), SCADA

hardware and software, applications

Unit-4: Control system components and system examples

Principle and characteristics of control values, synchro-servo motors, Solenoids, actuators, annunciators, alarms, recorders, Standard Graphics Symbols for Process Control and Instrumentation

Control system examples: Speed control system, position control systems, temperature and level control systems, reel drives, tension control system for paper

Text / Reference Books:

1. Process control: Principles and applications, Surekha Bhanot, Oxford University Press 2nd Edition.
2. Control Engineering Noel. M. Morris, 3rd Edition Mac Graw Hill.
3. Process control instrumentation technology, C. D Johanson, PHI.
4. Control system engineering, Nagrath and Gopal, New age international limited.
5. Control Systems, U.A. Bakshi and V. U. Bakshi, Technical Publications Pune.
6. Modern Control engineering, Ogata, Prentice Hall, EEE.
7. Control engineering theory and practice, N.M. Bandhopadhyay, PHI.
8. Instrument Engineers' Handbook, Vol. 1: Process Measurement and Analysis, Bela G. Liptak, CRC Press.

SAVITRIBAI PHULE PUNE UNIVERSITY
M. Sc. Part II(Electronic Science)
Elective Theory course

Semester III: ELT234: Fundamentals of Wireless communication system

Credits: 2

Teaching allotment: 2 lectures/week **Lectures: 30 lectures**

Course Outcomes:

This Course provides fundamental knowledge of wireless communication systems. At the end of this course, student should be able to

CO1	Compare different wireless techniques such as mobile, radio, satellite etc
CO2	Understand modern wireless techniques
CO3	Distinguish wireless systems on the basis of performance features

Unit 1:Introduction to Wireless Communication System:

Evolution of mobile communications, Mobile Radio System around the world, Types of Wireless communication System, Comparison of Common wireless system, Trend in Cellular radio and personal communication. Second generation Cellular Networks, Third Generation (3G) Wireless Networks , Wireless Local Loop(WLL),Wireless Local Area network(WLAN), Bluetooth and Personal Area Networks, satellite communication including GPS, wireless local loop, cordless phone, paging systems, RFID.

Unit 2: Recent wireless technologies:

multicarrier modulation, OFDM, MIMO system, diversity multiplexing trade-off, MIMO-OFDM system, smart-antenna; beam forming and MIMO, cognitive radio, software defined radio, communication relays, spectrum sharing.

Wireless Systems: GSM system architecture, Radio interface, Protocols, Localization and calling, Handover, Authentication and security in GSM, GSM speech coding, Concept of spread spectrum, Architecture of IS-95 CDMA system,Air interface, CDMA forward channels, CDMA reverse channels, Soft handoff, CDMA features, Power control in CDMA, Performance of CDMA System, RAKE Receiver, CDMA2000 cellular technology, GPRS system architecture

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Reference Books:

1 Wireless Communication, Theodore S. Rappaport, Prentice hall

2 Wireless Communications and Networking,Vijay Garg, Elsevier

3 Wireless digital communication, Kamilo Feher, PHI

4 Mobile Communications Engineering, William C. Y. Lee, Mc Graw Hill Publications

5 Mobile and personal Communication system and services by Rajpandya, IEEE press (PHI). 6 Wireless Communications-T.L.Singh-TMH 7 Adhoc Mobile Wireless network, C.K.Toh Pearson.

SAVITRIBAI PHULE PUNE UNIVERSITY
M. Sc. Part II(Electronic Science)
Elective Theory course

Semester III: ELT234: Fundamentals of Internet of Things

Credits: 2

Teaching allotment: 2 lectures/week **Lectures: 30 lectures**

Course outcomes:

This course enables students to know about basics of Internet of things and technologies used for the same. At the end of this course, student should be able to

CO1	Understand framework of Internet of things
CO2	Identify architecture, structure and security as well as privacy aspects in IoT
CO3	Design and configure RFID and WSN networks considering security issues

Unit 1: Introduction

History of IoT, About IoT, Overview and Motivations, Examples of Applications, Internet of Things Definitions and Frameworks : IoT Definitions, IoT Architecture, General Observations, ITU-T Views, Working Definition, IoT Frameworks, Basic Nodal Capabilities

Unit 2: fundamental IoT mechanisms and key technologies

Identification of IoT Objects and Services, Structural Aspects of the IoT, Environment Characteristics, Traffic Characteristics, Scalability, Interoperability, Security and Privacy, Open Architecture, Key IoT Technologies, Device Intelligence, Communication Capabilities, Mobility Support, Device Power, Sensor Technology, RFID Technology, Satellite Technology**,**

RFID: Introduction, Principle of RFID, Components of an RFID system, Issues EPCGlobal Architecture Framework: EPCIS & ONS, Design issues, Technological challenges, Security challenges, IP for IoT, Web of Things.

Wireless Sensor Networks: History and context, WSN Architecture, the node, Connecting nodes, Networking Nodes, Securing Communication WSN specific IoT applications, challenges: Security, QoS, Configuration, Various integration approaches, Data link layer protocols, routing protocols and infrastructure establishment.

Text/Reference books**:**

1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
2. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer
3. Parikshit N. Mahalle& Poonam N. Railkar, "Identity Management for Internet of Things", River Publishers, ISBN: 978-87-93102-90-3 (Hard Copy), 978-87-93102-91-0 (ebook).
4. Hakima Chaouchi, " The Internet of Things Connecting Objects to the Web" ISBN : 978-1- 84821-140-7, Willy Publications
5. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2 nd Edition, Willy Publications

SAVITRIBAI PHULE PUNE UNIVERSITY
M. Sc. Part II(Electronic Science)
Elective Practical Course: Fundamentals of wireless communication system
Semester III: ELP234: Practical course

Credits: 2

Course outcomes:

This practical course inculcates experiential learning habits in students for wireless communication systems. At the end of the course student should be able to

CO1	Demonstrate wireless communication systems using simulation (MATLAB/SCILAB)
CO2	Evaluate and analyze importance of filters in wireless communication systems
CO3	Configure WSN modules for wireless communication
CO4	Analyze GPRS, GPS and RFID systems and antennas

List of experiments (Any 5)

1. To understand QPSK modulation scheme using MATLAB/SCILAB

2.To understand effects of pulse shaping filters in wireless communication systems using MATLAB/SCILAB

3. Evaluate the impact of path loss and shadowing in estimation of received signal power in mobile cellular communication using fading channel mobile communication virtual lab.

4. Configure ZigBee module as an end device and, set up a communication link with two ZigBee modules.

5. Study of RFID system and its applications.

6. Using GPS system, study the graphical representation of geographical position using Survey plotting.

7. Study the GPRS system and use it for sending an e-mail through WI-GPRS trainer.

8. Study the GSM modem and its different module for phone book, setting up a call, sending SMS and identifying call history using AT commands. 3.

9. Interfacing of GSM modem with control unit.

10. Design a patch antenna using IE3D using different parameters.

SAVITRIBAI PHULE PUNE UNIVERSITY
M. Sc. Part II(Electronic Science)
Elective Practical Course: Fundamentals of Internet of things
Semester III: ELP234: Practical course

Credits: 2

Course outcomes:

This practical course develops practical skills amongst students for use of IoT in various applications. At the end of the course student should be able to

CO1	Install and implement IoT systems using different microcontrollers
CO2	Demonstrate interfacing of LED,Buzzer, button and sensors to microcontrollers
CO3	Design ,develop and implement IoT systems for basic applications such as ON/OFF LED etc
CO4	Understand methodology to design IoT systems

List of experiments (Any 5)

1. To get familarize with Raspberri pi /arudino and perform necessary installation procedure

2. To interface LED/buzzer with arudino/raspberi pi and program it to turn ON/OFF for 1 sec after every 2 sec.

3. To interface push button with arudino/respberri pi and program it to turn ON/OFF LED when push button is pressed or released

4. To interface sensor with arudino/raspberi pi and program it to to turn ON/OFF LED for sensor detection

5.To interface DHT11 sensor for recording temperature and humidity readings with

arudino/raspberi pi

6. To interface Bluetooth with arudino/raspberi pi and send sensor data to smartphone

SAVITRIBAI PHULE PUNE UNIVERSITY
M. Sc. Part II(Electronic Science)
Core compulsory Practical Course
Semester III: ELP235: Practical course

Credits: 4

Course outcomes

This course develops abilities in students to design, build and implement different communication circuits as well as mechatronic systems. At the end of this course, student should be able to

CO1	Design and develop AM and FM transmission system
CO2	Design and implement digital modulation systems and pulse modulation techniques
CO3	Set up and implement mechatronic systems such as flow control or servo control using basic components like motors,sensors and actuators
CO4	Design , develop and implement controller circuits for identified applications

Any 10 Practicals from following sections

Advanced communication systems

1. Design of AM transmitter and receiver
2. Design of FM transmitter and receiver
3. Design of Delta modulation
4. Design PCM encoder and decoder system
5. Design of FSK modulator and demodulator
6. Design of telemetry system

Mechatronics and Robotics

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

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SAVITRIBAI PHULE PUNE UNIVERSITY

M. Sc. Part II(Electronic Science)

Core Compulsory Theory course

Semester IV: ELT241: Industrial Training

Credits: 4

Course outcomes:

This course provides students experiential learning method through hands on training. At the end of course student should be able to

CO1	Understand upcoming requirements in industry/institutions
CO2	Adopt to new techniques or upcoming technologies
CO3	Analyze the problem and solve using different techniques
CO4	Requirement of skills in industry environment

Guidelines for evaluation of course

- Teachers of respective PG centres are expected to conduct continous evaluation of this course.
- Note that credits of this course should not considered in 24 credits option of Semester III
- Evaluation of this course is done as follows:

1. Internal continuous examination which includes
    a. Seminar/presentation of work done in industry
    b. Home assignment
    c. Time to time reporting to the concerned teacher
    d. Performance report of student from concerned authority from industry/research institute/college(PG center)
2. University evaluation which includes
    a. Written test
    b. Project examination and presentation of work

SAVITRIBAI PHULE PUNE UNIVERSITY
M. Sc. Part II(Electronic Science)
Elective Theory course
Semester IV: ELT241: PLC Programming and Applications

Credits: 2

Teaching allotment: 2 lectures/week **Lectures: 30 lectures**

Course outcomes:

Due to automation in industry, PLC programming is most demanding skill required in upcoming Engineers. This course builds PLC programming ability in students. At the end of this course student should be able to

CO1	Understand basics of Programmable Logic Controllers, their working and their programming
CO2	Design, modify and troubleshoot such control circuits
CO3	program PLCs to automate the systems for different applications

Unit 1. Introduction to PLC

Concept of PLC, Building blocks of PLC, Functions of various blocks, limitations of relays. Advantages of PLCs over electromagnetic relays. Different programming languages, PLC manufacturer etc. . Working of PLC - Basic operation and principles of PLC , Scan Cycle , Memory structures, I/O structure - Programming terminal, power supply

Basic instructions like latch, master control self holding relays. Timer instruction like retentive timers, resetting of timers. - Counter instructions like up counter, down counter, resetting of counters. - Arithmetic Instructions (ADD,SUB,DIV,MUL etc.) - MOV instruction - RTC(Real Time Clock Function) - Watch Dug Timer - Comparison instructions like equal, not equal, greater, greater than equal, less than, less than equal

Unit 2. PLC Programming and applications

Ladder Diagram Programming :

Programming based on basic instructions, timer, counter, and comparison instructions using ladder program.

Applications of PLCs : Object counter - On-off control , Car parking , Sequential starting of motors , Traffic light control ,Motor in forward and reverse direction - Filling of Bottles , Room Automation

Text/Reference Books:

1. Programmable logic controller, Dunning
2. Programmable Logic Controller by Job Dan Otter; P.H. International, Inc, USA
3. Introduction to PLCs by Gary Dunning. McGraw Hill
4. Module on PLCs and their Applications by Rajesh Kumar, NITTTR Chandigarh

SAVITRIBAI PHULE PUNE UNIVERSITY
M. Sc. Part II(Electronic Science)
Elective Practical course
Semester IV: ELP241: PLC Programming and Applications

Course outcomes:

At the end of this course student should be able to

CO1	Explain the use of industrial grade components in automation
CO2	Understand relay logic diagram and its use in different applications

List of Experiments: (Any 5)

1. To Identify Components/sub-components of a PLC, Learning functions of different modules of a PLC system available in laboratory
2. To understand programming a PLC (a) using a Hand held programmer (b) using computer interface
3. To understand ladder diagram and instruction list syntax
4. To program and implement basic logic operations, AND, OR, NOT functions
5. Sequence control system e.g. in lifting a device for packaging and counting
6. Use of PLC for any one application of the following (Object counter - On-off control , Car parking , Sequential starting of motors , Traffic light control ,Motor in forward and reverse direction - Filling of Bottles , Room Automation)
7. Industrial visit report/Workshop /hands on training on PLC programming

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M. Sc. Part II(Electronic Science)
Core Compulsory Theory course
Semester IV: EL242: MOOCs Courses

Credits: 4
Lectures: 60 lectures

Course outcomes:

MOOCs courses provide students new and modern learning platform for topics which are not in curriculum or on advanced topics in respective subjects. At the end of these course student should be able to

CO1	manage their own time in order to develop their intrinsic motivation and commitment to the course
CO2	Ensure that the duration of the course is no longer than 8 weeks and remain in and complete shorter MOOCs
CO3	transfer credits from MOOCs into institutional degree programs
CO4	Foster self-directed learning environments to expand students' autonomy, encourage them to complete their weekly assignments, and provide opportunities for students with limited computer and language skills.

- Student has to complete MOOCs course of total 60 hours(4 credits)
- Evaluation is based on Certificate/course completion document and CIE

MOOCs courses

For registration to MOOCs Courses, the students shall follow NPTEL Site http://nptel.ac.in/ as per the NPTEL policy and norms. The students can register for these courses through NPTEL directly as per the course offering in Odd/Even Semesters at NPTEL. These NPTEL courses (recommended by the University) may be cleared during the Semester III and Semester IV of M. Sc. Electronic Science(not necessary one course in each semester). After successful completion of these Moocs courses the students, shall, provide their successful completion NPTEL status/certificates to the University (COE) through their college of study only.

Name of the Course	Name of instructor/teacher	Credits	Resource
User-centric Computing for Human-Computer Interaction	Prof. Samit Bhattacharya	04	IIT Guwahati
Neural Networks for Signal Processing I	Prof. Shayan Srinivasa Garani	04	IISc Bangalore
Deep Learning	Prof. P.K. Biswas	04	IIT Kharagpur
Numerical Methods And Simulation Techniques For Scientists And Engineers	Dr. Saurabh Basu	04	IIT Guwahati
Introduction to Industry 4.0 and Industrial Internet of Things	Prof. Sudip Misra	04	IIT Kharagpur
VLSI Circuits	Prof. S. Srinivasan	04	IIT Madras
Biomedical signal processing	Prof. Sudipta Mukhopadhyay	04	IIT Kharagpur
Electric Vehicles: Part 1	Amit Kumar Jain	02	IIT Dehli
Introduction to hybrid and electric vehicles	___	02	IIT Guwahati

References

1. **www.nptel.com**
2. **www.moocs.org**

SAVITRIBAI PHULE PUNE UNIVERSITY
M. Sc. Part II(Electronic Science)
Core Compulsory Theory course
Semester IV: ELDT243: Technical Communication

Credits: 4

Course Outcomes :

This course strenghtens technical writing and presentation skills of students. At the end of the, student should be able to

CO1	Utilize the technical writing for the purposes of Technical Communication and its exposure in various dimensions.
CO2	Understand the nature and objective of Technical Communication relevant for the work place
CO3	Imbibe inputs by presentation skills to enhance confidence in face of diverse readers.
CO4	Evaluate and present gist of the books in the form of book review
CO5	Prepare documents for thorough understanding of applications and promote their technical competence

Unit -1 Fundamentals of Technical Communication

Technical Communication: Features; Distinction between General and Technical Communication; Language as a tool of Communication; Dimensions of Communication: Reading & comprehension; Technical writing: sentences; Paragraph; Technical style: Definition, types & Methods; The flow of Communication: Downward; upward, Lateral or Horizontal; Barriers to Communication.

Unit – 2 Forms of Technical Communication:

Technical Report: Definition & importance; Thesis/Project writing: structure & importance; synopsis writing: Methods; Technical research Paper writing: Methods & style; Seminar & Conference paper writing; Key-Note Speech: Introduction & Summarization; Expert Technical Lecture: Theme clarity; Analysis & Findings; 7 Cs of effective business writing: concreteness, completeness, clarity, conciseness, courtesy, correctness, consideration.

Unit – 3 Technical Presentation:

Strategies & Techniques Presentation: Forms; interpersonal Communication; Class room presentation; style; method; Individual conferencing: essentials: Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear: Confident speaking; Audience Analysis & retention of audience interest; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections.

Unit - 4 Technical Communication Skills:

Interview skills; Group Discussion: Objective & Method; Seminar/Conferences Presentation skills: Focus; Content; Style; Argumentation skills: Devices: Analysis; Cohesion & Emphasis; Critical thinking; Exposition narration & Description; effective business communication competence: Grammatical; Discourse competence: combination of

expression & conclusion; Socio-linguistic competence: Strategic competence: Solution of communication problems with verbal and non verbal means.

Reference Books

1. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2007, New Delhi.
2. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
3. Practical Communication: Process and Practice by L.U.B. Pandey; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2014, Delhi.
4. Modern Technical Writing by Sherman, Theodore A (et.al); Apprentice Hall; New Jersey; U.S.
5. A Text Book of Scientific and Technical Writing by S.D. Sharma; Vikas Publication, Delhi.

SAVITRIBAI PHULE PUNE UNIVERSITY

M. Sc. Part II Electronic Science

Core compulsory Practical Course

Semester IV: ELDP244:Project/Internship

Credits: 08

Course Outcomes:

Internships are educational and career development opportunities, providing practical experience in a field or discipline. They are structured, short-term, supervised placements often focused around particular tasks or projects with defined timescales. An internship may be compensated, non-compensated or some time may be paid. The internship has to be meaningful and mutually beneficial to the intern and the organization. After completion of this course student should be able to

CO1	Gain experience in writing Technical reports/projects
CO2	Expose to the responsibilities and ethics in industrial enviorment
CO3	Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control.
CO4	Attain academic, professional and/or personal development
CO5	Develop as future employers/entrepreneurs
CO6	Understand the social, economic and administrative considerations that influence the working environment of industrial organizations
CO7	Understand the psychology of the workers and their habits, attitudes and approach to problem solving

- **Intership/Project credits**

Number of credits allotted to:08

It should include

1. Timely attendance report of student at project/interships
2. Progress report signed by industrial author/project guide
3. Presentations
4. Project report preparation
5. Demonstrations
6. Voce Viva

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