SOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF ENGINEERING & TECHNOLOGY

ELECTRONICS ENGINEERING

Syllabus for

B.E. (Electronics Engineering) w.e.f. Academic Year 2017-18
(Choice Based Credit System)

SOLAPUR UNIVERSITY, SOLAPUR
FACULTY OF ENGINEERING & TECHNOLOGY
Electronics Engineering

Programme Educational Objectives and Outcomes

A. Program Educational Objectives

1. To make students competent for professional career in Electronics & allied fields.
2. To build strong fundamental knowledge amongst student to pursue higher education and continue professional development in Electronics & other fields
3. To imbibe professional ethics, develop team spirit and effective communication skills to be successful leaders and managers with a holistic approach.
4. To nurture students to be sensitive to ethical, societal & environmental issues while conducting their professional work.

B. Program Outcomes

Engineering Graduate will be able to –

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

C. Program Specific Outcomes

13. **Algorithms** : Graduate will able to design, realize and validate algorithms for different analog and digital electronic systems
14. **Systems**: Graduate will able to design, implement and test different analog and digital electronic systems
15. **Self Learning:** Graduate with his sound fundamentals is prepared to comprehend applications of the Electronics engineering through self learning mode

SOLAPUR UNIVERSITY, SOLAPUR

Faculty of Engineering & Technology (Revised from 2017-18)

Credit System structure of B.E. Electronics Engineering W.E.F. 2017-201 8(CBCS) *Semester I*

Course Code	Theory Course Name	Hrs./week			Credits	Examination Scheme			
		L	T	P		ISE	ESE	ICA	Total
EN411	Power Electronics	4	_	_	4	30	70	--	100
EN412	Computer Networks	4	_	_	4	30	70	-	100
EN413	Mobile Technology	4	-	_	4	30	70	25	125
EN414	Electronic System Design	3	1	_	4	30	70	_	100
EN415	Elective - I	3	1	_	4	30	70	25	125
	Sub Total	18	2	_	20	150	350	50	550
	Laboratory								
							ESE		
							POE	OE	
EN411	Power Electronics	_	_	2	1	_	50	--	25	75
EN412	Computer Networks	_	_	2	1	_	_	25	**25**	50
EN414	Electronic System Design	--	--	2	1	--	_	25	25	50
EN416	Project I	_	_	4	2	_	_	_	50	50
EN417	Vocational Training	_	_	_	1	_	_	_	25	25
	Sub Total	--	-	10	6		100		150	250
	Grand Total	**18**	**2**	**10**	**26**	**150**	**450**		**200**	**800**

Abbreviations: L- Lectures, P –Practical, T- Tutorial, ISE- In Semester Exam, ESE - End Semester Exam, ICA- Internal Continuous Assessment
ESE - University Examination (Theory &/ POE &/Oral examination)

SOLAPUR UNIVERSITY, SOLAPUR

Faculty of Engineering & Technology (Revised from 2017-18)

Credit System structure of B.E. Electronics Engineering W.E.F. 2017-2018 (CBCS) *Semester II*

Course Code	Theory Course Name	Hrs./week			Credits	Examination Scheme			
		L	T	P		ISE	ESE	ICA	Total
EN421	Advanced Communication Engineering	4	_	_	4	30	70	-	100
EN422	Audio Video Systems	4	_	_	4	30	70	-	100
EN423	Embedded systems	3	1	_	4	30	70	-	100
EN424	Elective – II	3	1	_	4	30	70	25	125
	Sub Total	14	2	_	16	120	280	25	425
	Laboratory/Workshop								
							ESE		
							POE	OE	
EN421	Advanced Communication Engineering	_	_	2	1	_	50	_	25	75
EN422	Audio Video Systems	_	_	2	1	_	_	_	25	25
EN423	Embedded Systems	_	_	2	1	_	50	_	25	75
EN425	Project II	_	_	8	4	_	_	100	100	200
	Sub Total		_	14	7	_	200		175	375
	Grand Total	**14**	2	**14**	**23**	**120**	**480**		**200**	**800**

Abbreviations: L- Lectures, P –Practical, T- Tutorial, ISE- In Semester Exam., ESE - End Semester Exam, ICA- Internal Continuous Assessment
ESE - University Examination (Theory &/ POE &/Oral examination)

Elective I			*Elective II*	
Course Code	*Course Name*		*Course Code*	*Course Name*
EN415A	Biomedical Instrumentation		EN424A	Broadband Communication
EN415B	Mechatronics		EN424B	Speech Processing
EN415C	Image Processing		EN424C	PLC and Industrial Controllers
			EN424D	Internet of Things

Note –

- Batch size for the practical /tutorial shall be of 15 students. On forming the batches, if the strength of remaining students exceeds 7, then a new batch shall be formed.
- Vocational Training (evaluated at B.E. Part-I) of minimum 15 days shall be completed in any vacation after S.E. Part-II but before B.E. Part-I & the report shall be submitted and evaluated in B.E. Part-I
- Appropriate Elective I & II Subjects may be added when required.
- Project group for B.E. (Electronics) Part I and Part II shall not be of more than **three** students.
- ICA assessment shall be a continuous process based on student's performance in – class tests, assignments, homework, subject seminars, quizzes, laboratory books and their interaction and attendance for theory and lab sessions as applicable

Solapur University, Solapur
B.E. (Electronics) Semester-I
EN411 POWER ELECTRONICS

Teaching Scheme
Lectures – 4 Hours/week, 4 Credits
Practical – 2 Hours/week, 1 Credit

Examination Scheme
ISE–30 Marks, **ESE**-70 Marks
ICA– 25 Marks
Practical & Oral exam – 50 Marks

Power electronics deals with the application of solid-state electronics for the control and conversion of electric power techniques, which require switching on and off of power devices. It provides analysis and design of power electronics applications such as three phase controlled rectifiers, choppers, inverters and cycloconverters. It also deals with application of power electronics converters like closed loop control of AC and DC drives and power factor controlling techniques

Course Prerequisite:
Student shall have completed a comprehensive course covering basics of power devices and its applications for single phase conversion and shall have an ability to analyze circuits containing power devices. Student shall also have knowledge of Fourier series and AC and DC motors.

Course Objectives:
1. To make student understand switching behavior and design of power electronics applications such as controlled rectifiers, choppers, inverters and cycloconverters.
2. To make student understand control scheme for three phase converters using microcontroller.
3. To make student understand operation principles and circuit topologies of various chopper commutation circuits.
4. To make student understand output voltage control of inverter using different harmonic reduction and PWM reduction techniques
5. To make student acquainted with the applications of power electronic converters in AC and DC drives
6. To emphasis student with different power factor controlling techniques.

Course Outcomes:
1. Student can analyze and design power electronics applications such as controlled rectifiers, choppers, inverters and cycloconverters.
2. Student is able to formulate and calculate power consumption by understanding converter and commutation specifications
3. Student can describe control schemes for three phase converters using suitable microcontroller.
4. Student can describe operation principles and circuit topologies of various chopper commutation circuits and select it for suitable application.

5. Student can describe voltage control of inverter using different harmonic reduction and PWM reduction techniques
6. Student can describe power electronics applications to control AC and DC drives.
7. Student can describe the operation principle and characteristics of various power electronics drive systems
8. Student can describe different power factor controlling techniques.

Section I

Unit 1- Three phase controlled rectifiers No of lectures-10

- **Prerequisite:** concepts of single phase controlled rectifiers, Fourier expression

- **Objectives:**
  1. To develop student with an understanding of the switching behavior and design of power electronics circuits such as three phase controlled rectifiers
  2. To make student realize effect of source inductance on performance of three phase controlled rectifiers.
  3. To make student understand operation of three phase dual mode dual converter.
  4. To make student understand control scheme for three phase converters using microcontroller.

- **Outcomes:**
  After completing this unit, student –
  1. Can analyze and design three phase controlled rectifiers with different types of load.
  2. Is able to formulate and calculate power consumption by understanding converter and commutation specifications
  3. Can analyze the effect of source inductance on performance of controlled rectifiers.
  4. Can describe operation of three phase dual converter with energy saving conversion system.
  5. Can explain importance and control schemes for three phase converters using suitable microcontroller.

- **Unit Content:**
  Concepts of three phase, analysis of three phase half wave controlled rectifier with R and RL load, expressions for average output voltage, rms output voltage; bridge converters: analysis of three phase half controlled and full controlled converters with R and RL load, expressions for average output voltage, rms output voltage, effect of source inductance, three phase dual converters, microcontroller/DSP based firing scheme for three phase controlled rectifiers.

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, MATLAB® simulation for three phase converters.

- **Assessment Methods:**
  Questions based upon mathematical expression for average and rms output voltage with different types of load, different waveform and numerical for different types of three phase rectifiers with advantages and limitations, dual converter, microcontroller/DSP based firing scheme for three phase controlled rectifiers

Unit 2- Choppers No of lectures-10

- **Prerequisite:** fundamentals of power devices

- **Objectives:**
  1. To make student understand a practical design consideration and analysis of choppers
  2. To make student classify choppers in terms of their operating envelopes.
  3. To make student understand chopper control using different control strategies.
  4. To make student understand operation principles and circuit topologies of various chopper commutation circuits.
  5. To make student understand operation of multiphase choppers

- **Outcomes:**
  After completing this unit, student –
  1. Can analyze and design different types of choppers.
  2. Can classify choppers in terms of their operating envelopes.
  3. Can describe chopper control using different control strategies.
  4. Can describe operation principles and circuit topologies of various chopper commutation circuits and select it for suitable application
  5. Can describe operation of multiphase choppers.

- **Unit Content:**
  Classification, principle of step-down and step-up chopper, control techniques of chopper (numerical problems expected); converter classification: single quadrant, two quadrant, four quadrant; thyristor chopper circuits: voltage commutated chopper, current commutated chopper, load commutated chopper , single SCR chopper, Jones chopper and Morgan chopper; multiphase choppers, chopper circuit design.

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, MATLAB® simulation for different choppers

- **Assessment Methods:**
  Questions based upon mathematical expression for different parameters, different types of load, different waveform, numerical problems for step-down and step-up chopper with their advantages and limitations and chopper control techniques, descriptive questions based upon circuit diagram and waveforms ensure understanding the operations of thyristor chopper circuits and multiphase choppers.

Unit 3- Cycloconverter No of lectures – 06

- **Prerequisite:** concepts of controlled rectifiers and power devices.

- **Objectives:**
  1. To make student understand need and operative principle of cycloconverter.
  2. To make student analyze switching behavior of single phase and three phase cycloconverter.
  3. To make student understand control scheme for cycloconverter using microcontroller.

- **Outcomes:**
  After completing this unit, student –
  1. Can describe need and operation of cycloconverter.
  2. Can analyze single phase and three phase cycloconverters
  3. Can explain control schemes for cycloconverters using suitable microcontroller.

- **Unit Content:**
  Single phase to single phase cycloconverter - mid-point and bridge type cycloconverter three phase to single phase cycloconverter with R and RL load, three phase to three phase three pulse and six pulse converter, circulating and non circulating mode, expression for output voltage of cycloconverter, reduction of output harmonics in cycloconverter, control scheme for cycloconverter

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, MATLAB® simulation for single phase and three phase cycloconverter

- **Assessment Methods:**
  Descriptive questions based upon circuit diagram and waveforms ensuring understanding of the operation of single phase and three phase cycloconverters, expression for output voltage and control scheme for cycloconverter.

Section II

Unit 4- Inverters No of lectures – 12

- **Prerequisite:** foundation of controlled rectifiers and power devices, Fourier series.

- **Objectives:**
  1. To make student understand switching behavior and analysis of single phase and three phase voltage source inverters
  2. To make student analyze quality of inverters using different performance parameters
  3. To emphasis student with different types of modulation techniques to control output voltage and eliminations of harmonics of inverters
  4. To make student understand the series and parallel inverter.

- **Outcomes:**
  After completing this unit, student -
  1. Can analyze single phase and three phase voltage source inverters
  2. Can analyze quality of inverters using different performance parameters.
  3. Can analyze output voltage control and elimination of harmonics by using different modulations techniques
  4. Is able to explain the operation of the series and parallel inverter

- **Unit Content:**
  Classification of inverters, single phase voltage source inverter: half bridge & full bridge inverter with R and R_L load; Fourier analysis of single phase inverter output voltage; quality of inverters, three phase bridge inverters – 120 & 180 degree conduction modes voltage control in single phase inverters; PWM techniques-Single, multiple and sinusoidal PWM; reduction of harmonics in inverter output voltage: PWM , transformer connection and stepped wave inverters; series inverters - basic series, modified series inverter, parallel inverter with R and RL load

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, MATLAB® simulation for single phase and three phase inverters, series and parallel inverter

- **Assessment Methods:**
  Questions based upon mathematical expression for different parameters, load, and waveform; numerical for single phase and three phase inverters with their advantages and limitations, descriptive questions based upon circuit diagram and waveforms ensure understanding the operations of PWM and harmonics reduction techniques, series and parallel inverter.

Unit 5- Control of DC drive No of lectures – 04

- **Prerequisite:** basics of DC motors, controlled rectifiers and choppers.

- **Objectives:**
  1. To make student understand the various schemes for DC motor speed control.
  2. To make student apply knowledge of controlled converters and choppers for controlling DC drives.
  3. To make student understand closed loop speed control system for DC drive using microcontroller.

- **Outcomes:**
  After completing this unit, student –
  1. Can describe the operation of various schemes for DC motor speed control.
  2. Can apply knowledge of controlled converters and choppers for controlling DC drives.
  3. Can describe importance and closed loop speed control system for DC drive using suitable microcontroller.

- **Unit Content:**
  Concept of electric drive, schemes for DC motor speed control, single phase and three phase drive for separately excited DC motor, DC chopper drives; closed loop control of DC drive - phase locked loop control, voltage and current feedback with microcontroller /DSP controller, fuzzy logic control

- **Content Delivery Methods:**
  Chalk and talk; power point presentation and MATLAB® simulation for closed loop control of DC drive

- **Assessment Methods:**
  Questions based upon different schemes for DC motor speed control, controlling DC drives using controlled converters and choppers, descriptive questions based upon microcontroller based closed loop control of DC drive.

Unit 6- Control of AC drive No of lectures – 06

- **Prerequisite:** basics of AC motors, inverters and cycloconverters

- **Objectives:**
  1. To emphasis student with different methods for AC motor speed control
  2. To apply knowledge of controlled converters, inverters and cycloconverters for controlling AC drives
  3. To make student understand closed loop speed control system for AC drive using microcontroller.

- **Outcomes:**
  After completing this unit, student –
  1. Can describe the operation of different methods for AC motor speed control.
  2. Can select appropriate converter to control AC drive.
  3. Can describe closed loop speed control system for AC drive using suitable microcontroller.

- **Unit Content:**
  Speed control of induction motor - stator voltage control, variable frequency; control of induction motor - voltage source inverter, cycloconverter drive; closed loop speed control of AC drive: single quadrant, four quadrant, speed control using microcontroller /DSP controller, fuzzy logic control, volts hertz control method.

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, MATLAB simulation for closed loop control of AC drive.

- **Assessment Methods:**
  Questions based upon different methods for AC motor speed control, controlling AC drives using inverters and cycloconverters, descriptive questions based upon microcontroller based closed loop control of AC drive.

Unit 7- Power factor improvement No of lectures – 04

- **Prerequisite:** concepts of passive devices and power devices

- **Objectives:**
  1. To make student realize need and importance of power factor improvement.
  2. To make student understand different power factor controlling techniques.

- **Outcomes:**
  After completing this unit, student –
  1. Can describe need and importance of power factor improvement.
  2. Can describe different power factor controlling techniques.

- **Unit Content:**
  Effect of poor power factor, methods of reactive power compensation, static VAR compensator (mathematical analysis is not expected)

- **Content Delivery Methods:**
  Chalk and talk, power point presentation

- **Assessment Methods:**
  Questions based upon different power factor controlling techniques.

- **ICA:**
  ICA shall consist of minimum ten experiments based upon-

  1. Three phase half wave and half controlled converter (feeding DC motor load)
  2. Three phase full controlled converter (feeding resistive and DC motor load)
  3. Step down chopper (feeding DC motor load)
  4. Step up chopper
  5. Jones chopper
  6. Morgan's chopper
  7. Single phase full bridge voltage source inverter
  8. Series / parallel inverter.
  9. Cycloconverter feeding resistive load.
  10. Three phase inverter with resistive/induction motor load
  11. Simulation of three phase converter, chopper using MATLAB
  12. Simulation of PWM inverters using MATLAB
  13. Simulation of speed control of AC or DC drive

- **Text Books:**
  1. Power Electronics; M.H. Rashid; 3rd Edition; Pearson Education
  2. Power Electronics; M D Singh & K B Khanchandani; 2nd Edition; Tata McGraw Hill
  3. Power Electronics; Dr.P.S. Bimbra; Khanna Publishers

- **Reference Books:**
  1. Industrial and Power Electronics; Dr. Maneesha Gupta and G.K.Mithal; Khanna Publishers
  2. Power Electronics and its Applications; Alok Jain; Penram International Publishing Pvt Ltd.
  3. Power Electronics; P.C. Sen; Tata McGraw Hill
  4. Power Electronics; Vedam Subrahmanyam; New Age International Publishers
  5. Power Electronics; Mohan, Undeland, Riobbins; 3rd Edition; Wiley

Solapur University, Solapur
B.E. (Electronics) Semester-I
EN412 COMPUTER NETWORKS

Teaching Scheme
Lectures – 4 Hours/week, 4 Credits
Practical – 2 Hours/week, 1 Credit

Examination Scheme
ISE–30 Marks**, ESE -**70 Marks
ICA – 25 Marks
Oral exam – 25 Marks

This course focuses the increasing demands of information communication. The networks components involved in short distance as well as long distance communication, their connection, performance parameters during information communication are also covered. The knowledge of LAN standards & TCP/IP makes students proficient to provide LAN services as well as internet access services

Course Prerequisite:
The knowledge of analog communication, modulation and channel capacity is required. Awareness of different communication ports and hardware support in computers along with protocol stack to support the communication is useful.

Course Objectives:
1. To make student understand issues related data communication.
2. To introduce to student concept of layered model approach in computer networking, various network topologies and different network components used in data communication
3. To introduce to student different IEEE LAN standards and their analysis.
4. To make student understand network programming and associated services.

Course Outcomes:
At the end of this course,
1. Student can describe types of data communication and their performance parameters.
2. Student can describe benefits of layered model approach, able to select appropriate network device and network topology for the given application.
3. Student is able to create IEEE 802.3 LAN and provide different services to the users.
4. Student is able to implement basic network programming to start server –client communication and various other services.

Section I

Unit 1- Data communication No of lectures – 08

- **Prerequisite:** Telephone networks, telephone network devices, maximum channel capacity, Shannon theorem, and effect of noise on data rate; network operating system, popular NOS used in practical.

- **Objectives:**
  1. To explain student making use of already laid telephone network for data communication and its analysis.
  2. To introduce to student various issues related to data communication, concept of layered reference model, communication across the layers.
  3. To introduce to student serial communication support in PC.

- **Outcomes:**
  After completing this unit, student–
  1. Is able to analyze the performance telephone network during data communication
  2. Is able to utilize serial communication facility in a PC.

- **Unit Content:**
  Uses of computer networks, network hardware , network software , layered model-communication between layers, ISO-OSI reference model, physical layer- band limited signals, maximum data rate of a channel, circuit switching & packet switching, EIA 232 serial interface standard.

- **Content Delivery Methods:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power point presentations, videos.

- **Assessment Methods:**
  Questions based upon issues in networking, layered reference model, channel capacity. Practical based on serial communication to assess concepts of serial standard EIA-232

Unit 2– Data link layer issues No of lectures – 08

- **Prerequisite:** Advantages of bundled data communication; different coding standards, errors in communication and BER

- **Objectives:**
  1. To make student understand parameters contributing to error-free communication.
  2. To introduce to student mechanism for data communication between to computers of different capacities.
  3. To make student understand sharing of a common bandwidth amongst multiple computers during data communication.

- **Outcomes:**
  After completing this unit, student
  1. Is able find error correcting and detection code for error free data communication
  2. Is able to decide necessary parameters for data communication between two dissimilar computers.

- **Unit Content:**
  Frame making methods, error detection -parity, checksum, CRC, error correction- block parity, hamming code method; flow control - stop and wait mechanism, sliding window flow control mechanism–working principle, link utilization efficiency, go back N ARQ , selective repeat – ARQ, medium access control (MAC) – static and dynamic BW allocation, collision based & collision free protocols, CSMA, data link control protocol-HDLC

- **Content Delivery Methods:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power point presentations, videos.

- **Assessment Methods:**
  Questions based upon flow control, error control, bandwidth management and data link control protocols, numerical based on flow control, error control.

Unit 3– IEEE LAN standards No of lectures – 06

- **Prerequisite:** hardware available in computer to support data communication, various important issues like priority in real time services.

- **Objectives:**
  1. To explain student selection of appropriate LAN standard for a particular application.
  2. To make student analyze LAN standard.

- **Outcomes:**
  After completing this unit, student -
  1. Is able to choose appropriate LAN standard based of physical shape of network, type of application.
  2. Is able to create LAN connection and analyze LANs performance for particular application.

- **Unit Content:**
  IEEE 802.3 CSMA/CD- working & performance analysis, megabit LAN, gigabit LAN, IEEE 802.4-token bus, IEEE 802.5-token ring, comparison of LANs

- **Content Delivery Methods:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power point presentations, videos.

- **Assessment Methods:**
  Questions based on various LAN standards and their performance analysis, practical can be considered for assessment.

Unit 4– Network devices No of lectures – 04

- **Prerequisite: v**arious components of computer networks and communication parameters.

- **Objectives:**
  1. To make student understand selection of appropriate network device for a particular network.

- **Outcomes:**
  After completing this unit, student –
  1. Is able choose appropriate network device and install it in network.
  2. Is able to examine the traffic handled by these devices with the help of network sniffers.

- **Unit Content:**
  MODEM, switches, hub, bridges, router, gateway

- **Content Delivery Methods:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power point presentations, videos.

- **Assessment Methods:**
  Questions based on various network devices and their working principle can be considered for assessment

Section II

Unit 5– TCP/IP reference model No of lectures –08

- **Prerequisite:** hardware like network interface card in computer, difference between packet and frame communication, need of protocols to accommodate various applications.

- **Objectives:**
  1. To explain student ways of providing internet services on available computer.
  2. To make student understand different addresses like IP and MAC during data communication.

- **Outcomes:**
  After completing this unit, student –

1. Is able to program IP address and other parameters to computer to avail internet services.
2. Is able to use various networking commands and parameters in different types of communication protocols.

- **Unit Content:**
  TCP/IP protocol suit, TCP & IP header format, encapsulation, IPv4 addressing – sub netting & masking, user datagram protocol (UDP) – transmission control protocol (TCP) - three way handshake – congestion & its control

- **Content Delivery Methods:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power point presentations, videos.

- **Assessment Methods:**
  Questions based on various communication protocols, issues like congestion control.

Unit 6– Network layer No of lectures –10

- **Prerequisite:** concepts of fairness and optimality in routing of data, issues like static & dynamic networks along with changing nature of data traffic on networks.

- **Objectives:**
  1. To explain student selection of appropriate routing protocol for a network.
  2. To make student understand performance analysis of selected routing protocol.

- **Outcomes:**
  After completing this unit, student –
  1. Is able to decide routing mechanism based on the nature of network and traffic flow.
  2. Is able to utilize protocol to assign dynamic IP address and supervise the network.

- **Unit Content:**
  Virtual circuit & datagram approach, routing protocols – shortest path, distance vector routing, link state, DHCP, ICMP. ARP

- **Content Delivery Methods:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power point presentations, videos.

- **Assessment Methods:**
  Questions based on various routing protocols, protocols like DHCP, ICMP.

Unit 7– Network programming No of lectures – 08

- **Prerequisite:** client and server communication, multicast service.

- **Objectives:**
  1. To explain student use of socket to communicate between client and server.
  2. To make student understand client –server communication using standard communication protocol.

- **Outcomes:**
  After completing this unit, student –
  1. Is able to create simple TCP, UDP server and client and start the communication services.
  2. Is able to control multiple clients with the help of single server.

- **Unit Content:**
  Socket, difference between TCP/IP, UDP/IP and multicast sockets, simple server, simple client, client –server communication over sockets, network sniffers, software defined networks

- **Content Delivery Methods:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power point presentations, videos.

- **Assessment Methods:**
  Questions based upon sockets, various services over sockets, practical on client-server communication using various protocols

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- **ICA:**
  ICA shall consist of minimum eight experiments based upon above curriculum.

- **Text Books:**
  1. TCP/IP Protocol Suite; Behrouz A. Forouzan ; 4th Edition
  2. Computer Networks; Andrew S. Tanenbaum; 4th Edition; Prentice Hall
  3. Data Communication and Computer Networks; P. C. Gupta; Prentice Hall India publication
  4. Unix Network Programming- Networking APIs: Sockets & XTI; Richard Stevens; Prentice Hall India Publication

- **Reference Books:**
  1. Internetworking with TCP/IP Vol III; Client-Server Programming & Applications; Douglas E. Comer; 4th Edition; Prentice Hall
  2. Data and Computer Communications; William Stallings- Pearson Education Asia publication
  3. High Speed networks and Internets- Performance and Quality of service; William Stallings; Pearson Education Asia publication

Solapur University, Solapur
B.E. (Electronics) Semester-I
EN413 MOBILE TECHNOLOGY

Teaching Scheme
Lectures – 4 Hours/week, 4 Credits

Examination Scheme
ISE-30 Marks, **ESE**-70 Marks
ICA – 25 Marks

The last decade of 20th century has witnessed a lot of activities in wireless and mobile communication and a convergence of communication technology and information technology. This fundamental course in mobile communication aims at triggering interest of students into two major fields of mobile communication. First section of this course covers cellular mobile communication with major focus on 3G GSM standard. The second section discusses topics related to mobile computing for digital data transfer.

Course Prerequisite:
Student shall boast basic knowledge of digital communication systems and wave propagation theory. Student shall also possess fundamental knowledge of internet and computer networks in general.

Course Objectives:
1. To make student realize effect and challenges for device portability and user mobility towards communication system design
2. To introduce to student cellular communication and frequency reuse concepts
3. To make student comprehend 3G GSM system in detail and CDMA 95 as introductory
4. To introduce to student and to trigger their interest in the fast intensifying filed of Mobile Computing for digital data transfer

Course Outcomes:
1. Student can give details for design challenges for wireless and mobile system development.
2. Student can describe frequency reuse concept and can apply different techniques for improving coverage and capacity
3. Student can describe 3G GSM in detail with architecture, protocol, signal processing and security
4. Student can evaluate CDAMA technique and can describe IS 95 block diagram and channels
5. Student can describe IEEE 802.11 and Bluetooth with architecture and protocol
6. Student can explain mobile TCP/IP

Section I

Unit 1- Fundamentals of mobile communication No of lectures **-**08

- **Prerequisite:** fundamentals of digital communication, wave propagation, basics of data network

- **Objectives:**
  1. To make student understand device portability and user mobility
  2. To introduce to student different signal propagation effects
  3. To make student realize why standard schemes from fixed network fails in wireless environment and how they are modified

- **Outcomes:**
  Upon completion of this unit, student –
  1. Is able classify devices depending upon mobility and wireless
  2. Can evaluate different signal propagation effects
  3. Can analyze few basic wireless MAC schemes

- **Unit Content:**
  Wireless and mobility, applications, mobile radio environment- signal propagation, path loss, fading, other signal propagation effects, frequency hopping spread spectrum, medium access control-hidden and exposed terminal, near and far terminals, MAC for mobile

- **Content Delivery Methods:**
  Chalk and talk, power point presentations

- **Assessment Methods:**
  Questions based upon analysis of signal propagation effects, wireless MAC, examples based upon FHSS

Unit 2- The cellular concepts No of lectures-06

- **Prerequisite:** fundamentals of TDMA, FDMA, wave propagation

- **Objectives:**
  1. To make student understand fundamental cellular concepts of frequency reuse and handover
  2. To introduce to student different strategies adopted for improving coverage and capacity

- **Outcomes:**
  Upon completion of this unit, student –
  1. Is able to evaluate frequency planning schemes
  2. Is able to derive for co channel reuse ratio and able to evaluate relation of cluster size, capacity and S/I
  3. Is able to solve numerical examples based on system capacity
  4. Can explain different handover strategies

5. Can explain different strategies adopted for improving coverage and capacity

- **Unit Content:**
  Frequency reuse, channel assignment strategies, handoff strategies, interference and system capacity, improving coverage and capacity

- **Content Delivery Methods:**
  Chalk and talk, power point presentations

- **Assessment Methods:**
  Questions based upon derivation of channel reuse ratio, numerical examples on system capacity, analysis of channel reuse strategies, explanation of handover strategies and strategies for improving coverage and capacity

Unit 3- Digital cellular system- GSM & CDMA No of lectures-12

- **Prerequisite:** fundamentals of digital modulation schemes, cellular concepts

- **Objectives:**
  1. To make student understand GSM system in detail
  2. To introduce to student salient features of GPRS and system architecture
  3. To introduce to student basics of DSSS
  4. To give student a overview of IS 95

- **Outcomes:**
  Upon completion of this unit, student –
  1. Is able to explain various aspects of GSM system in detail
  2. Can compile features of GPRS
  3. Can express principles of DSSS
  4. Can give a general overview of IS 95
  5. Is motivated to compile information about evaluation of GSM and CDMA and their emerging standards

- **Unit Content:**
  GSM- System architecture, radio subsystem, channels, frame structure, signal processing, protocols, localization and calling, security, services, GPRS- capacity, QOS, system architecture; CDMA- Direct sequence spread spectrum, processing gain, pseudorandom sequences, orthogonal codes, IS 95- frequency and channel specifications

- **Content Delivery Methods:**
  Chalk and talk, power point presentations

- **Assessment Methods:**
  Questions based upon various aspects of GSM system, overview of GPRS and IS 95, numerical examples of DSSS

Section II

Unit 4- Mobile computing No of lectures-04

- **Prerequisite: b**asics of computer network and internet

- **Objectives:**
  1. To introduce to student general architecture for mobile computing and various applications and services associated

- **Outcomes:**
  Upon completion of this unit, student –
  1. Is able to explain multi tier architecture for mobile computing application development and its significance

- **Unit Content:**
  Introduction, functions, devices, environment – middleware and gateways, architecture, applications and services

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, case study

- **Assessment Methods:**
  Questions based upon explanation of multi tier architecture for mobile computing

Unit 5- Wireless LAN- IEEE 802.11 No of lectures-08

- **Prerequisite:** fundamentals of digital modulation schemes, cellular concepts

- **Objectives:**
  1. To make student understand WLAN 802.11 system in detail
  2. To give student a very short review of newer development of 802.11X standards
  3. To give student a very brief overview of Wi Max

- **Outcomes:**
  Upon completion of this unit, student –
  1. Is able to explain various aspects of WLAN 802.11 system in detail
  2. Can compile features of newer development of 802.11X standards
  3. Can present a very brief overview of Wi Max
  4. Is motivated to compile information about evaluation of 802.1X and their emerging standards

- **Unit Content:**
  Advantages, infrastructure and ad hoc architectures, protocol, PHY layer, MAC layer, MAC frames, MAC management, mobility support, applications, brief overview of newer developments, introduction to Wi Max

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, case study

- **Assessment Methods:**
  Questions based upon various aspects of WLAN 802.11 system, overview of Wi Max

Unit 6- Wireless PAN – Bluetooth No of lectures-05

- **Prerequisite:** fundamentals of digital modulation schemes, cellular concepts

- **Objectives:**
  1. To make student understand Bluetooth system in detail

- **Outcomes:**
  Upon completion of this unit, student –
  1. Is able to explain various aspects of Bluetooth system in detail

- **Unit Content:**
  User scenario, architecture, protocol stack, radio layer, baseband layer, physical links

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, case study

- **Assessment Methods:**
  Questions based upon various aspects of Bluetooth

Unit 7- Mobile TCP/IP No of lectures-09

- **Prerequisite:** TCP/IP protocol stack – functionality network layer and transport layer

- **Objectives:**
  1. To make student realize modifications required at network layer and transport layer to support mobility along with challenges
  2. To introduce to student in brief protocols and mechanism developed for the network layer to support mobility with mobile IP
  3. To introduce to student in brief protocols and mechanism developed for the transport layer to support mobility

- **Outcomes:**
  Upon completion of this unit, student –
  1. Is able to analyze requirements for modifications at network layer and transport layer to support mobility
  2. Can explain protocols and mechanism developed for the network layer and transport layer to support mobility

- **Unit Content:**
  Mobile IP- entities, IP packet delivery, agent discovery and registration, tunneling and encapsulation, optimization, dynamic host configuration protocol; mobile TCP- indirect TCP, snooping TCP, mobile TCP

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, case study

- **Assessment Methods:**
  Questions based upon explanation of mobile network and transport layer protocols

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- **ICA:**
  ICA shall be based upon minimum five assignments completed by student based upon above curriculum. It is recommended that assignments shall induce student to compile, compare and evaluate various emerging technologies and standards in cellular communication, mobile computing and their convergence. Student is encouraged to explore various web resources for the same.

- **Text Books:**
  1. Mobile Communications; Jochen Schiller; 2nd edition; Pearson Education
  2. Wireless Communications: Principles and Practice; Theodore S. Rappaport; 2nd edition; PHI Learning Private Limited
  3. Mobile Computing; Asoke K Talukdar, Roopa R Yavagal; Tata McGraw Hill Publishing Company Limited,
  4. Introduction to Wireless & Mobile Systems; Dharma Prakash Agrawal, Qing-An Zeng; 3rd edition; Cengage Learning

- **Reference Books:**
  1. Mobile Communication Design Fundamentals; William C. Y. Lee; 2nd edition; Wiley India
  2. Mobile Cellular Telecommunications: Analog and Digital Systems; William C. Y. Lee; 2nd edition; McGraw- Hill International Edition
  3. Third Generation CDMA Systems for Enhanced Data Services, Giridhar Mandyam, Jersey Lai, Elsevier- Academic Press

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Solapur University, Solapur
B.E. (Electronics) Semester-I
EN414 ELECTRONIC SYSTEM DESIGN

Teaching Scheme	Examination Scheme
Lectures – 3 Hours/week, 3 Credits	**ISE-** 30 Marks, **ESE**-70 Marks
Tutorial – 1 Hour/week, 1 Credit	**ICA –** 25 Marks
Practical – 2 Hours/week, 1 Credit	**Oral exam** – 25 Marks

This course is introduced with an objective to make student realize electronic system design and product design process. This includes power supply design and its management along with signal preprocessing. It also includes hardware and software design and testing. Documentation and reporting is an integral part of industrial process. This course underlines it as well.

Course Prerequisite:

Student shall have an adept knowledge of analog and digital design. He shall also have a sound basis for microcontrollers and interfacing. Student shall also have basic technical report writing skills

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Course Objectives:

1. To make student view electronic product design as a big picture.
2. To develop student to make effective use of basics of analog and digital electronic circuit design for system design with a practical approach.
3. To make student realize industrial product design requirements and then make him aware of product development process accordingly.
4. To introduce to student various documentations associated with electronic products
5. To make student realize various industrial standards and certifications

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Course Outcomes:

1. Student can describe complete electronic product design process as a big picture
2. Student can analyze and design analog circuits which constitutes to final system design of an electronic product
3. Student can analyze and design digital circuits which constitutes to final system design of an electronic product
4. Can implement software design, testing and debugging process for final year project
5. Student can develop various technical documents for final year project
6. Student can prepare and deliver progress presentations and closure presentation at various stages of final year project

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Section I

Unit 1– Design of DC power supply and power management No of lectures – 07

- **Prerequisite:** rectifiers, filters and regulators basics of power supply design.

- **Objectives:**
  1. To make student understand various issues in power supply design according to the system's requirement.
  2. To make student realize the efficient management of the power amongst the various system parts and necessary protections.

- **Outcomes:**
  After completing this unit, student -
  1. Can analyze the power requirements of the system and its distribution and management across the system.
  2. Can decide and implement different protections required in power supply for safe operation.

- **Unit Content:**
  Centralized power architecture versus distributed power, architecture, power management concepts, dc power supply requirements, loading considerations, design of off-the-line power supplies, switch mode converters (SMPS), efficiency improvement & EMI reduction in SMPS, power supply protection- thermal design, overvoltage and over-current protection, protection against input transients, reliability of input/output capacitors, age-related aspects, testing of power supplies.

- **Content Delivery Methods:**
  Chalk and talk, power point presentation

- **Assessment Methods:**
  Questions based upon calculation of power requirement of various system parts and necessary protections

Unit 2– Preprocessing of signals No of lectures – 08

- **Prerequisite:** concepts of signal conditioning network, amplifiers, filters.

- **Objectives:**
  1. To make student understand the necessity of signal preprocessing and various important blocks involved the preprocessing.
  2. To make student design the preprocessors for specific signal range, noise and error considerations.
  3. To make student realize issues related to mixed signal processing.

- **Outcomes:**
  After completing this unit, student –
  1. Can analyze different signal preprocessing stages for required signal ranges, noise & error considerations.
  2. Can explain design considerations in mixed signal processing, video amplifiers and communication amplifiers.

- **Unit Content:**
  Signal range, noise and error considerations, bandwidth, operational amplifiers, instrumentation amplifiers, non linear amplifiers, video and communication amplifiers, filters, switching and multiplexing of the signals, signal isolation

- **Content Delivery Methods:**
  Chalk and talk, power point presentations

- **Assessment Methods:**
  Questions based upon design of signal preprocessing circuits for specified signal range, noise & error requirements.

Unit 3– Hardware design and testing No of lectures – 06

- **Prerequisite:** concept of hardware test points and limits in the circuit, basics of CRO

- **Objectives:**
  1. To make student understand electronic product development stages
  2. To make student recognize importance of modern test and measurement equipments used in debugging the hardware
  3. To make student know the importance of signal integrity and various factors influencing it

- **Outcomes:**
  After completing this unit, student –
  1. Can describe various electronic product development stages
  2. Select appropriate equipment for debugging the hardware
  3. Can explain measurements using modern test and measurement equipments
  4. Can describe applications of modern test and measurement equipments
  5. Can explain signal integrity and factors affecting it

- **Unit Content:**
  Electronic product development basics, stage, customer requirement equipments used for testing- logic analyzer, mixed signal oscilloscope, spectrum analyzer, example measurements using these equipments, applications of these equipments, signal integrity

- **Content Delivery Methods:**
  Chalk and talk power point presentation and demonstrations

- **Assessment Methods:**
  Descriptive questions based upon product development stages, various equipments, measurements and applications, signal integrity

Section II

Unit 4- Software design and testing No of lectures – 06

- **Prerequisite:** basics of structured high level programming language, embedded programming

- **Objectives:**
  1. To make student recognize importance of software design for electronic systems and to make him understand different phases of software design
  2. To make student understand software testing and debugging process

- **Outcomes:**
  After completing this unit, student –
  1. Can describe different phases of software design
  2. Can implement software design, testing and debugging process for final year project
  3. Can select appropriate simulation/ application/PCB design tool for based upon requirement

- **Unit Content:**
  Goals, software design phases, structured programming, testing and debugging, brief overview of simulation / application/ PCB software for electronics

- **Content Delivery Methods:**
  Chalk and talk, power point presentation and casa studies

- **Assessment Methods:**
  Descriptive questions based upon software design phases, testing and debugging

Unit 5- Electronic product testing No of lectures – 08

- **Prerequisite:** Product design flow, hardware testing, software testing

- **Objectives:**
  1. To make student realize need of product testing
  2. To make student understand various environmental testing methods
  3. To make student know various issues related to EMI and EMC
  4. To make student realize importance of CE and UL marketing and certification

- **Outcomes:**
  After completing this unit, student –
  1. Can explain various environmental testing method
  2. Can select appropriate EMI and EMC related testing
  3. Can compare different standards and certifications

- **Unit Content:**
  Introduction, environmental testing, temperature testing, humidity testing, radiated emission test, standards and standard developing organizations, list of some standards, CE certifications, UL marking and certification, IEC standard

- **Content Delivery Methods:**
  Chalk and talk; power point presentations and case studies

- **Assessment Methods:**
  Descriptive questions based upon testing, standards and certification

Unit 6- Product documentation No of lectures – 08

- **Prerequisite:** Hardware and software product design and testing. Student shall also posses basic technical report writing skills

- **Objectives:**
  1. To make student realize need of product documentation
  2. To make student aware of various technical documents used in industry
  3. To nurture presentation skills of student

- **Outcomes:**
  After completing this unit, student –
  1. Can explain various product documents
  2. Can prepare various technical documents for final year project
  3. Can prepare and deliver progress presentations and closure presentation at various stages of final year project

- **Unit Content:**
  Introduction, types of documentation, proposal document, bill of material, document regarding drawing and schematics , document regarding software source listing, brochures, manual, progress / status report, presentation

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, case studies (highly recommended)

- **Assessment Methods:**
  Descriptive questions based on documentation and presentation, outcomes achieved can also be measured with final year project course

- **ICA:**

  ICA consists of tutorials and design of various systems. It shall also contain design and preparing of product catalogue along with all technical specifications.

- **Text and Reference Books:**

1. Electronic Circuit Design-From Concept to Implementation; Nihal Kulratna; CRC Press
2. Electronic Product Design; R.G. Kaduskar, V.B. Baru; Wiley India, 2nd Edition
3. Electronic System Design using Integrated Circuits, B. S. Sonde, New Age International
4. www.datasheet4you.com

Solapur University, Solapur

B.E. (Electronics) Semester-I

ELECTIVE-I

EN415A BIOMEDICAL INSTRUMENTATION

Teaching Scheme	**Examination Scheme**
Lectures – 3 Hours/week, 3 Credits	**ISE-** 30 Marks**, ESE-** 70 Marks
Tutorial – 1 Hours/week, 1 Credit	**ICA –** 25 Marks

This course is introduced with an objective to make student realize electronic instrumentation in the field of biomedical electronics. This course includes selection of appropriate bio sensor and design of necessary instrumentation for therapeutic and prosthetic instruments.

Course Prerequisite:

The student shall have knowledge of different transducers used for physical parameters measurement along with its signal conditioning. Student shall also have basic knowledge of different systems of human body and their working.

Course Objectives:

1. To make student understand electrical activities of human body parts.
2. To introduce to student various biomedical transducers and signal conditioning essential in medical instruments.
3. To introduce to student different biomedical instruments used in diagnosis.
4. To make student aware to human safety against electrical shock hazards.

Course Outcomes:

1. Student can analyze bio electrical signals from various parts of body
2. Student can decide appropriate sensor and necessary instrumentation for physiological parameter measurement
3. Student is able to explain working of basic medical equipments
4. Student is able to plan for protection to biomedical instrument against electrical shocks.

Section I

Unit 1 – The origin of bio-potentials No of lectures – 04

- **Prerequisite:** physiological system of human, transducers for various physical measurements

- **Objectives:**
  1. To introduce to student human anatomy and physiological system.
  2. To introduce to student cell potential and its propagation
  3. To make student understand source and characteristics of different electrical signals generated by human body.

- **Outcomes:**
  Upon completion of this unit, student –
  1. Is able to explain concept of resting and action potential
  2. Is able to explain working of human heart and cardiovascular system
  3. Is able to describe characteristics of ECG, EMG and EEG signals

- **Unit Content:**
  Electrical activity of excitable cells-resting potential, active state, function of the heart, electrical behavior of cardiac cells, normal and abnormal cardiac rhythms, ECG, EEG, EMG

- **Content Delivery Methods:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power point presentations, videos and models.

- **Assessment Methods:**
  Questions based upon cardiovascular system, various electrical signals generated by cells, brain, and muscle activities

Unit 2 – Bio-potential electrodes, sensors and transducers No of lectures – 08

- **Prerequisite:** characteristics of ECG, EMG and EEG signals, basics of transducers, signal conditioning

- **Objectives:**
  1. To introduce to student electrode theory
  2. To make student select sensor for specific body parameter.

- **Outcomes:**
  Upon completion of this unit, student –
  1. Is able to find appropriate electrode specific to physiological parameter measurement.
  2. Is able to choose transducer for the physiological parameter measurement.

- **Unit Content:**
  Need of electrode, electrode and electrolyte interface, polarization, electrode circuit model, body surface recording electrodes- metal plate electrodes, suction electrodes, floating electrodes, internal electrodes, microelectrodes, electric properties of microelectrodes, design specification of bio medical instruments, transducer for

biomedical applications, factors governing the selection of transducer, pressure, temperature, flow, biomedical ultrasonic transducer

- **Content Delivery Methods:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power point presentations, videos.

- **Assessment Methods:**
  Questions based upon electrode theory, different types of electrodes, transducers selection, types of transducers.

Unit 3 – Instrumentation in diagnostic cardiology No of lectures – 09

- **Prerequisite:** human cardiovascular system, Einthoven triangle, characteristics of ECG

- **Objectives:**
  1. To make student understand techniques for blood pressure measurement
  2. To make student understand operational working of ECG machine
  3. To make student make out different ECG lead combinations

- **Outcomes:**
  Upon completion of this unit, student –
  1. Can explain different blood pressure measurement techniques
  2. Can explain functionality of ECG machine
  3. Can demonstrate different ECG lead combinations

- **Unit Content:**
  ECG lead, electrocardiograph machine, ECG signal- various distortion, artifacts from electric transients, interference from other electric devices, transient protection, cardiotachometer, cardiac monitors, radio telemetry system for ECG , blood pressure: systolic, diastolic, direct measurements of blood pressure: extravascular system, intravascular system , indirect measurements of blood pressure-typical indirect blood pressure measurement system, ultrasonic determination of blood pressure, oscillometric method

- **Content Delivery Methods:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power point presentations.

- **Assessment Methods:**
  Questions based on ECG measurement, ECG machine, blood pressure measurement and three channel telemetry.

Section II

Unit 4 - Instrumentation for blood circulation and respiration No of lectures – 05

- **Prerequisite:** functioning of cardiovascular system, invasive & non invasive methods of blood flow measurement.

- **Objectives:**
  - To introduce to student indirect methods of measurement of blood flow and blood volume in a blood pipe
  - To make student understand respiratory system, various gases and their proportion and various techniques for their measurement

- **Outcomes:**
  Upon completion of this unit, student –
  1. Is able to select appropriate electrode and instrumentation for measurement of blood flow and blood volume measurement.
  2. Is able to choose specific sensor and required signal processing for respiratory measurements.

- **Unit Content:**
  Blood flow and blood volume measurement: indicator dilution, thermo dilution method electromagnetic and ultrasound blood flow measurement, blood flow volume , measurement- photoplethysmography, respiratory system-measurable variables in respiratory system, measurement of respiratory pressure, measurement of gas flow rate.

- **Content Delivery Methods:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power point presentations and visit to medical laboratory.

- **Assessment Methods:**
  Questions based on dilution, magnetic & ultrasound methods of blood flow measurement

Unit 5 – Medical imaging systems No of lectures – 08

- **Prerequisite:** human anatomy, basics of instrumentation

- **Objectives:**
  1. To make student realize need of non invasive imaging techniques
  2. To make student understand working principle and functionality of different imaging systems like X ray, CT , ultrasound and MRI

- **Outcomes:**
  Upon completion of this unit, student –
  1. Is able to describe basic principle and functionality of different imaging systems like X ray, CT , ultrasound and MRI
  2. Is able to make out different parts / basic measurement settings of these instruments

- **Unit Content:**
  Information content of an image: resolution, image noise, modulation transfer function; radiography generation, measurement and background radiation of X-ray; X-ray machine, computed tomography, CT scanner, magnetic resolution imaging, ultrasonography

- **Content Delivery Methods:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power point presentations. a visit to medical radiology lab is highly recommended

- **Assessment Methods:**
  Questions based on principle and parameters of images, x-ray machine, CT scan machine and magnetic imaging.

Unit 6 - Therapeutic and prosthetic instruments No of lectures – 05

- **Prerequisite:** human anatomy, basics of instrumentation, a very preliminary knowledge about different irregularities in heart system, cardiac arrest and problems of new born babies.

- **Objectives:**
  1. To make student understand causes of irregularity in signals at SA & AV nodes and corrections essential to regularize them
  2. To make student recognize various infant physiological parameters and its importance in infant health care
  3. To make student understand working principle and functionality of defibrillators, cardioverters, ventilators, infant incubators

- **Outcomes:**
  Upon completion of this unit, student –
  1. Is able to analyze electrical signals from various triggering points in heart system and instrumentation related to re-correct the abnormality.
  2. Is able to analyze infant related parameters and essential instrumentation in infant care systems.

- **Unit Content:**
  Cardiac pacemakers- synchronous and asynchronous pacemakers, defibrillators, cardioverters, ventilators, infant incubators

- **Content Delivery Methods:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power point presentations, videos; a visit to hospital with these facilities is highly recommended

- **Assessment Methods:**
  Questions based on various internal and external pacemakers, defibrillator and ventilator, infant incubators

Unit 7 – Electrical safety No of lectures – 03

- **Prerequisite:** human anatomy, basics of electrical engineering, preliminary knowledge of electrical safety codes and standards

- **Objectives:**
  1. To emphasis to student need of electrical safety of biomedical instruments
  2. To introduce to student hazards due to electric shocks
  3. To make student cognizant to various electrical safety standards and safety codes

- **Outcomes:**
  Upon completion of this unit, student –
  1. Is able to plan for proper grounding and shielding in medical instruments to guarantee patient's safety.
  2. Is able to recognize safe medical equipments according to electrical safety norms.

- **Unit Content:**
  Physiological effect of electricity, important of susceptibility parameters, distribution of electric power, micro-shock hazards, electric safety codes and standards

- **Content Delivery Methods:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power point presentation; use of electrical standards and code book is highly recommended.

- **Assessment Methods:**
  Questions based on electric shock hazards, safety norms, patient's isolation, grounding and shielding

- **ICA:**

  ICA shall be based on minimum six tutorials covering above curriculum. Below activities are recommended for tutorials-

  1. Case study of different medical instruments
  2. Evaluation / comparison of an instrument by different vendors
  3. Analysis of specifications of an instrument through brochure
  4. Actual usage / parameter setting of an instrument and preparing a report for the same
  5. Visit to medical facilities mentioned and report for the same
  6. Compiling a report on state of the art in medical instruments / techniques through information gathered from internet

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- **Text Books:**
  1. Medical Instrumentation- Application and design; John G Webster; Wiley Students Edition; 3rd edition; Wiley Publication
  2. Handbook of Biomedical Instrumentation; R. S. Khandpur; Tata McGraw Hill Publication
  3. Biomedical Instrumentation & Measurement; Leaslie Cromwell; PHI Publication

- **Reference Books:**
  1. Biomedical Instrumentation system; Shakti Chattarjee; Aubart Miller; Cengage Publication

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Solapur University, Solapur

B.E. (Electronics) Semester-I

ELECTIVE-I

EN415B MECHATRONICS

Teaching Scheme
Lectures – 3 Hours/week, 3 Credits
Tutorial – 1 Hours/week, 1 Credit

Examination Scheme
ISE- 30 Marks**, ESE-** 70 Marks
ICA – 25 Marks

Mechatronics is a multidisciplinary field of engineering that includes a combination of mechanical engineering, electrical engineering and electronics engineering. This course aims at providing an overview of the basics of mechatronic systems including the components and characteristics typical for such systems. This course covers detailed aspects of controlling of mechanical systems with sophisticated electronic controllers.

Course Prerequisite:

Student shall have an adept knowledge of basic electrical circuit theory, power devices, digital logic, microcontroller hardware design and interfacing of electrical parts with microcontroller. He shall also possess knowledge about basic mechanical systems

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Course Objectives:

1. To enable student to understand the interdisciplinary fundamentals of mechanical engineering, electrical engineering and electronics engineering
2. To introduce to student understand concept of PLC
3. To introduce to student electromechanical drives for DC motors
4. To make student acquainted with the micro sensors and micro actuators
5. To introduce to student robot end effectors and its peripherals.

Course Outcomes:

1. Student can analyze different types of controllers
2. Student can explain principles and drive techniques for DC motors
3. Student can design programmable motion controllers
4. Student can describe precision mechanical actuation
5. Student can explain the operation, principle and characteristics of MEMS.
6. Student can analyze the mechatronic system as a whole
7. Student can analyze robot and its peripherals

Section I

Unit 1 -Introduction No of lectures – 08

- **Prerequisite:** control system theory, basics of microcontrollers

- **Objectives:**
  1. To make student understand microprocessor/controller based controllers
  2. To make student understand the PC based controller, PID controllers
  3. To make student understand operation of digital controllers and adaptive controller

- **Outcomes:**
  After completing this unit, student -
  1. Can analyze the microprocessor/controller based controllers.
  2. Can describe operation of digital controllers and adaptive controller

- **Unit Content:**
  Definition, trends, control systems, microprocessor/micro controller based controllers and PC based controllers, proportional/integral/differential controllers, PID controllers, digital controllers, adaptive controller.

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, designing assignments as a home work

- **Assessment Methods:**
  Questions based upon designing PID controllers, adaptive controllers

Unit 2 – Electromechanical drives No of lectures – 08

- **Prerequisite:** basics of DC motors, power devices

- **Objectives:**
  1. To introduce to student understand principle and working of four quadrants servo drives
  2. To make student understand principle and working of the bipolar drives
  3. To make student understand MOSFET and SCR drives for DC motors

- **Outcomes:**
  After completing this unit, student –
  1. Can analyze the working of DC servo motors in four quadrant and its breaking methods.
  2. Can explain working of MOSFET, SCR drives and bipolar drives.

- **Unit Content:**
  DC Servo motors, 4-quadrant servo drives, braking methods, bipolar drives, MOSFET drivers, SCR drives, variable frequency drives

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, animation

- **Assessment Methods:**
  Descriptive questions based upon 4-quadrant servo motors its breaking methods, and MOSFET drives

Unit 3 – Programmable logic controllers No of lectures – 05

- **Prerequisite:** concepts of FSD structured programming, interfacing with PLC

- **Objectives:**
  1. To emphasis student necessity of PLC and to make them acquainted with basics of PLC and its hardware
  2. To introduce to student concept of ladder diagram and enable them to draw and analyze ladder diagram for simple PLC applications
  3. To develop amongst student concept of FSD structure programming
  4. To make student interface sensors and actuators with PLC

- **Outcomes:**
  After completing this unit, student –
  1. Can draw and analyze ladder diagrams for simple PLC applications
  2. Can interface sensors and actuators with PLC

- **Unit Content:**
  Introduction to PLC, ladder diagram, FSD structured programming, interfacing of sensors and actuators to PLC

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, case studies

- **Assessment Methods:**
  Descriptive questions based upon PLC and interfacing, questions based upon FSD structural programming, ladder diagram for simple applications

Section II

Unit 4 – Programmable motion control No of lectures – 03

- **Prerequisite:** concepts of interpolation

- **Objectives:**
  1. To make student understand the point to point interpolation
  2. To make student understand the interpolation with B-S plane, record position

- **Outcomes:**
  After completing this unit, student –
  1. Can analyze the interpolation.

- **Unit Content:**
  Interpolation: point-to-point, linear circular, B-S plane, home, record position

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, animation

- **Assessment Methods:**
  Descriptive questions based upon interpolation

Unit 5 – Precision mechanical actuation No of lectures – 08

- **Prerequisite:** basic concepts of mechanical systems

- **Objectives:**
  1. To make student understand the various types of motions
  2. To make student understand actuators and its sub systems

- **Outcomes:**
  After completing this unit, student –
  1. Can describe the operation of various types of actuators
  2. Can describe different types of motions
  3. Can explain working of bearings, motion guides etc

- **Unit Content:**
  Pneumatic actuators, electro-pneumatic actuators, hydraulic actuators, electro hydraulic actuators, types of motions, kinematics, inverse kinematics, timing belts, ball screw and nut, linear motion guides, linear bearings, harmonic transmission, motor/ drive selection

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, animation

- **Assessment Methods:**
  Descriptive questions based upon actuating systems, bearings and motor selection.

Unit 6 – MEMS No of lectures – 05

- **Prerequisite:** electronic devices, basics concepts of mechanical systems

- **Objectives:**
  1. To emphasis student with MEMS & micro system
  2. To make student understand working principles of micro sensors and micro actuators.

3. To introduce to student manufacturing process of micro systems

- **Outcomes:**
  After completing this unit, student –
  1. Can describe the operation and working of micro sensors and micro actuators
  2. Student can select micro sensor and micro actuator for different applications

- **Unit Content:**
  Overview of MEMS & microsystems, typical MEMS & micro system, products and applications, micro sensors and micro actuators: phototransistors, pressure sensors, thermal sensors, micro grippers, micro motors, micro valves, micro pumps, micro manufacturing: bulk manufacturing, surface manufacturing, LIGA process

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, animation

- **Assessment Methods:**
  Questions based upon MEMS and microsystems, descriptive questions on micro manufacturing process

Unit 7 – Design of Mechatronic Systems No of lectures – 05

- **Prerequisite:** basic concepts of conventional, mechatronics systems and system components

- **Objectives:**
  1. To make student realize difference between a conventional system and mechatronic system
  2. To make student aware to mechatronic system design requirements and process with the help of case studies

- **Outcomes:**
  After completing this unit, student –
  1. Can describe difference between conventional system design and mechatronic system design process
  2. Can describe and sketch a mechatronic system
  3. Can list mechatronic systems

- **Unit Content:**
  The design process, traditional and mechatronic designs, case studies like piece counting system pick and place manipulator, simple assembly involving a few parts, part loading, unloading system, automatic tool and pallet changers etc

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, animation, case studies

- **Assessment Methods:**
  Questions based upon mechatronic design process and its different case studies

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- **ICA:**
  ICA shall consist of minimum eight tutorials based upon above curriculum. Suggested list of few tutorials is as below-

  1. Interfacing and control of DC servo motor with microcontroller for position, speed and direction control
  2. PLC programming in ladder, FBD, structured.
  3. Study of graphical PID tuning for X-Y position, study of rotary and conveyor
  4. Pneumatic and hydraulic actuators
  5. Case studies of mechatronics systems
  6. Literature survey, specification analysis and comparative study of various commercially available mechatronic sub systems, PLCs and MEMS sub systems

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- **Text Books:**

  1. Mechatronics; W.Bolton; Addison Wesley, 981-235-874-9, 2nd edition
  2. Mechatronics Integrated Mechanical Electronic Systems; K.P. Ramachandran, G. K. Vijayaraghavan, M.S. Balsundaram; Wiley India Pvt Limited
  3. Mechatronics Principles, Concepts and Applications; N.P. Mahalik; Tata McGraw-Hill, 0-07- 0483744
  4. Mechatronics, Dan Necsulescu; Pearson Education; 81-7808-676-X

- **Reference Books:**

  1. Computer Control of Manufacturing Systems; Yoram Koren; McGraw Hill 0-07-066379-3
  2. MEMS and Microsystems Design and Manufacture; Tai, Ran Hsu; McGraw-Hill Inc., 0-07- 048709
  3. Mechatronics Principles and Applications; Godfrey Onwubolu, Elsevier Butterworth- Heinemann, 0-7506-6379-0
  4. Mechatronics Sourcebook; Neawton C. Braga, Delmar; Cengage Learning, 978-1401814328

Solapur University, Solapur

B.E. (Electronics) Semester-I

ELECTIVE-I

EN415C IMAGE PROCESSING

Teaching Scheme
Lectures – 3 Hours/week, 3 Credits
Tutorial – 1 Hours/week, 1 Credit

Examination Scheme
ISE- 30 Marks**, ESE-** 70 Marks
ICA – 25 Marks

Following the explosion of internet during 1970s and 1980s, the last three decades were characterized by a maturing of the field image processing and reflected into significance growth of active applications in the areas of biometrics, biomedical imaging, remote sensing, technical diagnostics, autonomous vehicle guidance and image analytics. This basic course is designed to provide a thorough grounding and provide material to the beginner and also to allow a more interested student to take further courses/projects this area. This course focuses more on the conceptual understanding of the lower level image processing operations and do not cover computer vision fundamentals

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Course Prerequisite:
Student shall boast basic knowledge of digital signal processing and matrix theory and operations.

Course Objectives:

1. To make student realize different areas and applications of image processing
2. To activate student's interest for computer vision and video processing fundamentals and applications
3. To introduce to student low level image processing operations in spatial and frequency domain
4. To introduce to student preliminary methods for image analysis and description
5. To make student understand necessity and techniques for image compression

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Course Outcomes:

1. Student can describe various application areas and applications of image processing
2. Student can describe and derive for low level operations in spatial and frequency domain
3. Student can write MATLAB® programs for few basic image processing operations in spatial and frequency domain
4. Student can describe and derive for image analysis and description operations
5. Student can explain different image compression techniques
6. Few students decide to take up project in image processing / computer vision

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Section I

Unit 1 – Fundamentals of digital image processing No of lectures – 08

- **Prerequisite:** matrix theory, transforms in digital signal processing

- **Objectives:**
  1. To introduce to student fundamental steps in image processing
  2. To make student aware of various image processing areas and applications
  3. To make student understand concept of digital image in spatial domain and transform domain

- **Outcomes:**
  Upon completion of this unit, student –
  1. Can describe various image processing areas and applications
  2. Can explain basic framework for image processing
  3. Can compare image processing in spatial and transform domain
  4. Can write a MATLAB® program for basic operations in spatial and transform domain

- **Unit Content:**
  Fields of use of digital image processing, fundamental steps in digital image processing, sampling & quantization, representation, spatial & intensity resolution, neighborhood, connectivity of pixels, distance measurement, matrix operations, spatial operations, and basics of transform domain, color models & conversion

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, MATLAB® tutorials

- **Assessment Methods:**
  Questions based upon applications, framework and operations in spatial & transform domain, numerical questions based on operations in spatial & transform domain

Unit 2 – Image transforms No of lectures – 06

- **Prerequisite:** matrix theory, transforms in digital signal processing

- **Objectives:**
  1. To make student understand linear integral transforms applied to image
  2. To introduce to student techniques of eigen analysis, singular value decomposition and principle component analysis applied to image

- **Outcomes:**
  Upon completion of this unit, student is –
  1. Able to compare image processing operation in spatial domain and transformed domain

2. Able to explain significance of eigen analysis, singular value decomposition and principle component analysis for image processing

- **Unit Content:**
  Discrete Fourier transform, discrete cosine transform, wavelet transform, eigen analysis, singular value decomposition, principle component analysis.

- **Content Delivery Methods:**
  Chalk and talk, power point presentations

- **Assessment Methods:**
  Questions based upon mathematical preliminaries of transforms and eigen analysis, singular value decomposition, principle component analysis and its significance

Unit 3 – Image pre processing No of lectures – 08

- **Prerequisite:** matrix theory, spatial operations, transforms

- **Objectives:**
  1. To make student understand lower level image processing operations in spatial and frequency domain
  2. To make student understand image enhancement operations
  3. To make student understand image restoration operations

- **Outcomes:**
  Upon completion of this unit, student –
  1. Can explain various pre processing, restoration and enhancement operations
  2. Can select appropriate pre processing operation for various tasks
  3. Can write MATLAB® programs for few basic image pre processing operations in spatial and frequency domain

- **Unit Content:**
  Pixel brightness transformations, geometric transformations, local pre processing, pre processing in frequency domain, detection of maximally stable regions, image restoration in spatial domain & frequency domain

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, MATLAB® tutorials

- **Assessment Methods:**
  Questions based upon various pre processing, enhancement and restoration operations, numerical examples on spatial operations

Section II

Unit 4 – Image analysis No of lectures – 08

- **Prerequisite:** matrix theory, spatial operations

- **Objectives:**
  1. To introduce to student detection of discontinuity in an image
  2. To make student understand detection of similarities in an image
  3. To make student understand fundamental techniques for edge based segmentation
  4. To make student understand fundamental techniques for region based segmentation

- **Outcomes:**
  Upon completion of this unit, student –
  1. Is able to analyze and compare various image discontinuity and similarity techniques
  2. Can explain and compile different fundamental segmentation techniques
  3. Can write MATLAB® programs for few basic image discontinuity and similarity techniques

- **Unit Content:**
  Edge detection, line detection, corner detection, boundary detection, Hough transform, threshold, edge based segmentation, region based segmentation- splitting, merging, matching

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, MATLAB® tutorials

- **Assessment Methods:**
  Questions based upon various detection and segmentation operations, analysis of detection of discontinuity and similarity techniques

Unit 5 - Image representation & description No of lectures – 08

- **Prerequisite:** matrix theory, spatial operations, transforms, image analysis techniques

- **Objectives:**
  1. To make student realize necessity of image representation and description as an important step for image understanding through examples
  2. To make student understand basic techniques for image representation using external and internal characteristics of an image
  3. To make student understand use of texture as a region descriptor

- **Outcomes:**
  Upon completion of this unit, student –
  1. Is able to select suitable image representation and description technique for various applications
  2. Can compare different image descriptor techniques

3. Can explain texture and its use as a region descriptor

- **Unit Content:**
  Chain code, polygon approximation, signature, skeleton, shape number, Fourier descriptor, regional descriptors, texture and statistical texture description

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, case study

- **Assessment Methods:**
  Questions based upon various image representation and description techniques, numerical questions based on simple descriptors

Unit 6 – Image compression No of lectures – 06

- **Prerequisite:** matrix theory, spatial operations, transforms

- **Objectives:**
  1. To make student recognize need of image compression techniques
  2. To make student understand predictive and progressive compression techniques
  3. To present to student a brief overview of JPEG and MPEG

- **Outcomes:**
  Upon completion of this unit, student –
  1. Is able to express need of image compression techniques and can select an appropriate technique for various applications
  2. Can explain various predictive and progressive compression techniques
  3. Can present a brief overview of JPEG and MPEG

- **Unit Content:**
  Transforms for image compressions, predictive compression, vector quantization, hierarchical & progressive compression, coding, JPEG & MPEG

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, case study

- **Assessment Methods:**
  Questions based upon various compression techniques, overview of JPEG and MPEG

- **ICA:**
  ICA shall be based on tutorials covering MATLAB® implementation of above concepts.

- **Text and Reference Books:**

1. Digital Image Processing; R.C. Gonzalez, R.E. Woods; 2nd Edition; Pearson Education – Chapter 3, 4, 5
2. Digital Image Processing; R.C. Gonzalez, R.E. Woods; 2nd Edition; Pearson Education – Chapter 1
3. Digital Image Processing & Computer Vision; Milman Sonka, Vaclav Hlavac, Roger Boyle; Cengage Learning – Chapter 2, 3, 4, 5, 6
4. Digital Image Processing – An Algorithmic Approach; Madhuri A. Joshi; Prentice Hall of India Pvt Ltd.- Chapter 2

Solapur University, Solapur
B.E. (Electronics) Semester-I
EN416 PROJECT I

Teaching Scheme
Practical – 4 Hours/week, 2 Credits

Examination Scheme
ICA– 50 Marks

Project based learning is a paradigm which is becoming time-honored now a days. To keep abreast with this, Project course is included in the curriculum which is spread over both semesters of final year. For this course students carry out a project as a team that allows them to demonstrate their abilities and to develop skills within their chosen area of interest. Hardware realization as well software simulation projects with focus on design and research aspects are accepted. Also communicating effectively, both in oral and written form is an important skill for engineering graduates in many different contexts. This course also aims to foster these skills

Course Prerequisite:
Student shall have technical competency as well as behavioral facet to carry project as a part of a team. He shall have an adept knowledge of hardware and software architecture and associated programming skills. He shall also posses necessary technical report writing skills, presentation skills and shall have proficiency in office software for word processing and presentation

Course Objectives:

1. To expose student to different project life cycle phases for software or/and hardware projects
2. To impart on student hands on experience for design & development of project
3. To enhance amongst student team working and leadership skills
4. To enhance amongst student presentation and technical documentation skills.

Course Outcomes:

1. Student can select a suitable project based upon requirement analysis and literature survey
2. Student can plan for management and financial aspects of the project
3. Student can design hardware and software architecture of the project
4. Student can apply design concepts for detail design of project
5. Student can validate the results and can also analyze them
6. Student demonstrates leadership and team working behavioral skills
7. Student can write synopsis and project report
8. Student demonstrates presentation skills
9. Student can use programming / simulation software and presentation, word processing software at various stages of project

The project work is carried out in two semesters of B.E. (Electronics). The practical batch for the project will be of 15 students. The batch will be divided into groups each consisting of not more than 3 students.

In semester –I, group will select a project with the approval of guide and submit the synopsis of the project. The group is expected to complete detail system design, high level design and low level design of project in first semester as a part of ICA.

Each student shall deliver a seminar (presentation) preferably on the topic related to project area.

Solapur University, Solapur
B.E. (Electronics) Semester-I
EN417 VOCATIONAL TRAINING

Teaching Scheme

Examination Scheme
ICA – 25 Marks

After graduation, an engineer will be serving society and country by adopting a suitable profession or a carrier. Although, the formal education at college prepares him for this, it is also necessary for him to get an exposure to industrial/organizational environment while he is in college. This is accomplished by a minimum 15 days vocational training / apprenticeship student has to undertake. This vocational training completed in any industry/software development house/any engineering organization will give a student a flavor of tangible industrial environment as well will sharpen his soft skills.

Course Prerequisite:
Student shall have technical competency to understand work process at the industry/ organization of his vocational training. He shall also posses necessary technical report writing skills, presentation skills and shall have proficiency in office software for word processing and presentation

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Course Objectives:

1. To expose student to industrial/ organizational environment & different industrial / organizational practices
2. To cultivate basic management skills
3. To enhance team working skills and other soft skills
4. To enhance technical documentation skills.

Course Outcomes:

1. Student undertakes suitable project based on the learning in vocational training and successfully completes it.
2. Student can write vocational training report
3. Student demonstrates presentation skills
4. Student can use programming / simulation software and presentation , word processing software at various stages of project

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Each student must complete minimum 15 days vocational training in any industry / organization / software development house in any vacation after S.E. Part II but before B.E. Part I and the report prepared and submitted by the student will be evaluated in B.E. Part I. This report evaluation will be done by the respective project guide of the student. Report shall include – certification from the industry / organization about completion of the training, profile of the industry / organization, details of the training, technical skills / soft skills gained, learning from training.

Solapur University, Solapur
B.E. (Electronics) Semester-II
EN421 ADVANCED COMMUNICATION ENGINEERING

Teaching Scheme
Lectures – 4 Hours/week, 4 Credits
Practical – 2 Hours/week, 1 Credit

Examination Scheme
ISE-30 Marks**, ESE-**70 Marks
ICA – 25 Marks
Practical & Oral exam – 50 Marks

This course aims at providing student with an overview of contemporary communication systems such as microwave, radar, satellite communications and optical communication. The basic and under-lying technical concepts, which are essential for the design, implementation, and introductory hands on in the communication systems, are presented in an easy way to understand with discussion on practical examples and solutions to some real-world problems.

Course Prerequisite:
Student shall have completed a course in analog and digital communication and shall have an adept knowledge of various communication techniques. Student shall also possess knowledge about basics of optics, electromagnetic engineering, electric field theory and electronic circuit design.

Course Objectives:
1. To introduce to students with concept of microwave communication with its need, devices and applications
2. To introduce to student radar communication system with it working principle and implementation techniques.
3. To introduce to student satellite communication system with it concepts, working principle and implementation techniques.
4. To introduce to student optical communication system with it theory for implementation, types and devices with its application.
5. To ensure student acquire the ability to integrate telecommunications technologies and engineering systems using their generalist and broader knowledge in multidisciplinary contexts for simple applications.

Course Outcomes:
1. Student is able to compare radio frequency and microwave frequency communication with respect to devices, working principle and applications.
2. Student is able to explain different radar systems
3. Student is able to describe satellite subsystem and earth station block diagram with their working principle.
4. Student is able to apply different modulation techniques and access techniques for wireless communications
5. Student is able to deign radio link models and analyze link budget for satellite.
6. Student is able to apply ray theory for optical communication.

Section I

Unit 1 – Introduction to microwave techniques No of lectures – 10

- **Prerequisite:** concepts of circuits and network, communication and electromagnetic engineering

- **Objectives:**
  1. To introduce to student microwave frequency ranges and their applications
  2. To make student understand electrical characteristics of waveguides and transmission lines through electromagnetic field
  3. To make student compare different transmission lines and waveguides.
  4. To introduce to student microwave components and circuits and scattering parameters.

- **Outcomes:**
  After completing this unit, student –
  1. Can compare different microwave applications based on frequencies
  2. Can evaluate various parameter related to waveguide and transmission line.
  3. Can evaluate equations for different modes for waveguide and can solve related problems
  4. Can compare wave guide and transmission lines
  5. Can derive scattering parameter for various microwave components.

- **Unit Content:**
  Introduction to microwave fundamentals, microwave frequencies and microwave devices, microwave transmission lines- reflection coefficient and transmission coefficient, standing waves , wave guides, rectangular wave guides, TE mode wave, power transmission in wave guide, power losses, excitation of modes in wave guide, microwave components ,microwave cavities, microwave hybrid circuits (E,H.EH plane Tee), directional coupler, circulators and isolators.

- **Content Delivery Methods:**
  Chalk and talk, power point presentation

- **Assessment Methods:**
  Questions based upon microwave fundamentals, derivations related to wave guide and transmission line, derivation of scattering parameters for microwave hybrid circuits (E, H, EH plane Tee) and directional coupler, question based on construction and working of directional coupler, circulators and isolators.

Unit 2 – Microwave devices and antennas No of lectures – 08

- **Prerequisite:** concepts of electric field theory and electronics circuit design

- **Objectives** :
  1. To make student understand high frequency limitations on conventional devices.
  2. To make students understand difference between conventional devices and microwave devices.
  3. To make student understand construction, working principle and mathematical analysis of various microwave devices based on stability, bandwidth, gain, noise figure criteria and efficiency.
  4. To make student understand construction, working principle and mathematical analysis of various microwave solid state devices.
  5. To introduce to students different microwave antennas and it's working.
  6. To make student understand the function, design, and integration of the major components in a wireless transceiver: oscillator, modulator, power amplifier, antenna, low-noise amplifier, filter, and mixer.

- **Outcomes:**
  After completing this unit, student –
  1. Can analyze limitations of conventional devices for high frequency and can compare conventional devices and microwave devices.
  2. Can express working of microwave devices: amplifier and oscillator.
  3. Can explain use of solid state devices for different applications
  4. Can derive equation for various parameter related to microwave devices.
  5. Can describe different antennas used at microwave frequency.
  6. Can describe integration of the major components in a wireless transceiver: oscillator, modulator, power amplifier, antenna, low-noise amplifier, filter, and mixer.

- **Unit Content:**
  Klystrons, reflex klystrons, TWTs, magnetrons, microwave solid state devices – MESFET, varactor diode, PIN diode; tunnel microwave, TED, and avalanche transit time devices, microwave antenna-horn, parabolic reflector slots, and lens and micro strip antennas.

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, animation

- **Assessment Methods:**
  Questions based limitation of conventional devices, construction, working and derivation on Klystrons, reflex klystrons, TWTs, magnetrons, construction and working on –MESFET, varactor diode. PIN diode; tunnel microwave, TED, and avalanche transit time devices, microwave antenna-horn, parabolic reflector slots, and lens and micro strip antennas.

Unit 3 - Radar No of lectures – 08

- **Prerequisite: c**oncepts of microwave techniques and devices, sensitivity, dynamic range, jamming and communication links.

- **Objectives** :
  1. To introduce to student basic mathematical concepts: dB values and equations.
  2. To make student understand radar systems and classification
  3. To make student understand different types of radar systems.

- **Outcomes:**
  After completing this unit, student –
  1. Is able to describe the principle of operation of radar systems.
  2. Is able to derive radar range equation.
  3. Is able to describe different types of radar system.

- **Unit Content**
  Radar fundamentals, radar principle, radar range equation, types of radar pulsed radar system, MTI, radar beacons, FMCW radar, Doppler radar, phased array radar, plane array radar and antenna.

- **Content Delivery Methods:**
  Chalk and talk, power point presentation

- **Assessment Methods:**
  Questions based on derivation of radar range equation, related numerical, block diagram and descriptive questions based on different types of radar system

Section II

Unit 4- Satellite communication: No of lectures – 08

- **Prerequisite:** basics of analog and digital communication, mobile communication

- **Objectives :**
  1. To make student understand the basics of orbital mechanics, the types of satellite orbits, the look angles from ground stations to the satellite.
  2. To make student understand satellite subsystems and working of each subsystem

- **Outcomes:**
  After completing this unit, student –
  1. Can solve problems related to orbital mechanics and look angles.
  2. Can explain working of each block of satellite subsystem
  3. Can analyze different controlling parameter related to each subsystem.

- **Unit Content**
  Introduction, orbital mechanics, look angle determination, satellite subsystem

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, animation

- **Assessment Methods:**
  Questions based on derivation and definition related to orbital mechanics and looks angle determination, block diagram of satellite subsystem, descriptive questions based on different subsystem

Unit 5 – Satellite link design No of lectures – 09

- **Prerequisite:** concepts of microwave techniques and devices, signals and systems descriptions in time and frequency domains, analog and digital modulation, receiver noise calculations, signal to noise ratio and bit error rate calculations.

- **Objective :**
  1. To make student design uplink frequency and downlink frequency equation
  2. To make student derive C/I equation and discuss related parameter.
  3. To make student understand modulation and multiplexing techniques used in satellite communication.
  4. To make student understand working of earth station
  5. To make student list and explain different applications of satellite.

- **Outcomes:**
  After completing this unit, student –
  1. Can solve numerical problems related to design of downlink, link budget and design of uplink
  2. Can evaluate different modulation and multiplex techniques used.
  3. Can explain working and controlling of satellite system in different application.

- **Unit Content:**
  Design of downlink, link budget, design of uplink, modulation techniques, multiplex techniques, earth station, application overview-Radio and satellite navigation, GPS position location, DHS-TV

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, visit to satellite earth station/TV station/radio station is highly recommended

- **Assessment Methods:**
  Questions based on derivation and definition related to downlink, link budget, design of uplink, modulation techniques, multiplex techniques satellite subsystem; questions based upon block diagram on modulation techniques, multiplex techniques satellite subsystem; descriptive questions based on different subsystem.

Unit 6 - Optical communication No of lectures – 09

- **Prerequisite:** Ray theory and related laws

- **Objectives:**
  1. To make student understand basic operating principles of single mode, multimode fibers, light sources, detectors, amplifiers and passive optical devices.
  2. To make student design a simple optical communication link.
  3. To make student analyze and compare optical devices: light sources, fibers and detectors from both physical and system point of view.
  4. To make student understand compare the structural characteristics of different optical fibers and the different fabrication processes of optical fiber cables
  5. To make student interpret the optical losses characteristic in optical fiber such as dispersion, scattering, absorption, nonlinear effects, fiber alignment and splicing that affect the performance of transmission systems.

- **Outcomes:**
  After completing this unit, student –
  1. Can explain operating principles of single mode, multimode fibers, light sources, detectors, amplifiers and passive optical devices.
  2. Can design a simple optical communication link
  3. Can analyze and compare optical devices: light sources, fibers and detectors from both physical and system point of view.
  4. Can compare the structural characteristics of different optical fibers and the different fabrication processes of optical fiber cables.
  5. Can interpret the optical losses characteristic in optical fiber such as dispersion, scattering, absorption, nonlinear effects, fiber alignment and splicing that affect the performance of transmission systems.

- **Unit Content:**
  Introduction to optical communication, advantages and application, nature of light, ray theory, acceptance cone, numerical aperture, optical fiber modes and types, operation of optical source and optical detector

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, animation

- **Assessment Methods:**
  Questions based on derivation and numerical problems related to ray theory, acceptance cone, and numerical aperture, descriptive questions on operation of optical source and optical detector, optical communication system, advantages and application.

- **ICA:**
  ICA shall consists of minimum ten lab sessions based on above curriculum and covering below-
  1. Lab session on microwave frequency measurement
  2. Lab session on calculation of refection coefficient and VSWR
  3. Lab session on power dividing using H,E,E-H plane Tee junction
  4. Lab session on isolator and circulator
  5. Lab session on measurement of coupling factor, isolation and directivity of Directional coupler
  6. Lab session on reflex Klystron
  7. Lab session on Gunn diode
  8. Lab session on Radar communication
  9. Lab session on Satellite communication
  10. Lab session on optical communication
  11. Simulation of microwave, radar, satellite communications and optical communication building blocks

It is also desirable for a student to visit satellite earth station / TV station / radio station and prepare a visit report

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- **Text Books:**
  1. Microwave Devices and Circuits; Liao Samuel Y., Liao; Prentice Hall Publisher.
  2. Microwave and Radar Engineering; M.L. Sisodia; 1st Edition; New Age International Publishers
  3. Satellite Communication; Timothy Pratt; 2nd Edition; Wiley India Pvt. Limited
  4. Optical Fiber Communication; Gerd Keiser; McGraw Hill International.

- **Reference Books:**
  1. Fundamentals of Microwave Engineering; Peter A. Rizzi; Prentice hall of India.
  2. Radar Principles, Technology; Application -EDDE-LPE
  3. Optical fiber communications: principles and practice; John M. Senior; Prentice Hall International
  4. Communication Electronics principle and application; Louis E. Frenzel; 3rd Edition; Tata McGraw Hill

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Solapur University, Solapur
B.E. (Electronics) Semester-II
EN4122 AUDIO VIDEO SYSTEMS

Teaching Scheme	**Examination Scheme**
Lectures – 4 Hours/week, 4 Credits	**ISE-** 30 Marks**, ESE-**70 Marks
Practical – 2 Hours/week, 1 Credit	**ICA** – 25 Marks

This course aims at a complete and balanced view on multimedia field covering three main domains- devices, systems and applications. It includes basic concepts for processing of audio, video and image. It also includes media demand compression and coding methods. This course also covers basic TV principles in depth and gives detailed insight of colour TV systems and standards. It includes chroma processing sub-systems and various receiver designing blocks. It also includes schematic explanation of equipments, devices, circuits involved in modern television systems.

Course Prerequisite:

A course in analog and digital communication is mandatory. Student shall also have knowledge of analog and digital electronics circuit design and digital signal processing

Course Objectives:

1. To introduce to student fundamentals, need and applications of multimedia.
2. To make student understand essential components of multimedia
3. To explain student concepts of audio and video systems in monochrome and colour television.
4. To make student understand working of NTSC, PAL and SECAM TV systems.
5. To make student understand working principle of digital television, high definition television, satellite television and cable television systems.

Course Outcomes:

1. Student can describe basic components of multimedia.
2. Student can explain and relate audio-video standards based on different applications.
3. Student can identify and analyze various elements of composite video signal.
4. Student can analyze amplitude and frequency of colour composite video signal such as burst cycles, spectrum of bar pattern, etc.
5. Student can explain block diagram of NTSC, PAL and SECAM TV systems.
6. Student can design receiver antenna section of a TV system.
7. Student can describe functional blocks of digital television, high definition television, satellite television and cable television systems.

Section I

Unit 1- Fundamentals of audio systems No of lectures-05

- **Prerequisite:** transducers and measurements, optics

- **Objectives:**
  1. To introduce to student various measuring units of sound
  2. To explain student concepts of acoustics and its effect
  3. To make student understand various parameters of reverberation
  4. To introduce to student working of optical recording and reproduction systems

- **Outcomes:**
  At the end of this unit, student
  1. Can select and convert sound units as per application
  2. Can calculate an absorption coefficient, reverberation time for efficient acoustic effect
  3. Can design acoustic of auditorium and meeting hall
  4. Can compare film and compact disc recording

- **Unit content:**
  Sound waves and its various measuring units; acoustics – reverberation, absorption coefficient, growth and decay of sound, acoustics of auditoriums and studios; optical recording and reproduction of sound – on film and on compact disc

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, animations, demonstrations

- **Assessment Methods:**
  Descriptive questions based on sound, acoustics, optical systems; analytical questions based on audio measurements, reverberation parameters

Unit 2- Multimedia components No of lectures-06

- **Prerequisite:** Fundamentals of analog and digital communication

- **Objectives:**
  1. To make student understand building blocks of multimedia.
  2. To explain student audio and video capture process
  3. To introduce to student concept of animation

- **Outcomes:**
  At the end of this unit, student
  1. Can compare between multimedia and hypermedia
  2. Can select appropriate audio and video systems for various applications
  3. Can classify and differentiate between different file formats of images
  4. Can compare between 2D, 2.5D and 3D types of animation

- **Unit content:**
  Introduction to basic components; multimedia and hypermedia; digital audio capture, levels of digitization, MIDI; image data types and its file formats; digital video capture; animation – principle, types – 2D, 2.5D, 3D, kinematics;

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, demonstrations

- **Assessment Methods:**
  Descriptive questions based on multimedia components, audio and video capture, image and animation

Unit 3- Data coding and compression techniques No of lectures-08

- **Prerequisite:** basics of multimedia, digital signal processing transforms

- **Objectives:**
  1. To introduce to student coding methods for audio and video
  2. To make student understand working principle of MPEG compression algorithms
  3. To present student a brief review of JPEG

- **Outcomes:**
  At the end of this unit, student
  1. Can classify and select proper coding technique for a given audio & video application
  2. Can analyze compression algorithms for audio and video systems
  3. Can compare various MPEG series
  4. Can differentiate and explain lossy and lossless JPEG modes

- **Unit content:**
  Coding requirements, classification of coding techniques, data storage space; MPEG audio – block diagrams of layers, strategy, basic compression algorithm – block diagram of MPEG audio encoder and decoder, bit allocation; MPEG video – MPEG-1 – motion compensation, video bit stream; MPEG-2 – interlaced video, scalabilities, major difference from MPEG-1; JPEG – block diagram of encoder, JPEG modes – lossy sequential DCT, expanded lossy DCT, lossless, hierarchical;

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, demonstrations

- **Assessment Methods:**
  Descriptive questions based on coding techniques, MPEG and JPEG systems; analytical questions based on compression algorithms and JPEG modes

Unit 4- Multimedia applications No of lectures-07

- **Prerequisite:** basics of multimedia, coding and compression, basics of transducers and measurements, electronic circuit design concepts

- **Objectives:**
  1. To explain student different applications of multimedia
  2. To explain student working of audio input and output devices
  3. To make student understand working principle of PA system, facsimile and Xerography machine

- **Outcomes:**
  At the end of this unit, student
  1. Can list applications of multimedia in various fields
  2. Can compare between headphones and headsets
  3. Can explain working of PA system, facsimile and Xerography machine

- **Unit content:**
  Headphones, headsets and hearing aids; public address system for public meeting, auditorium and stadium; Facsimile – block diagram, basic operation; Xerography-schematic of copier, xerox process

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, animations, demonstrations

- **Assessment Methods:**
  Descriptive questions based on audio systems, Fax and Xerography

Section II

Unit 5- Basic television system No of lectures-08

- **Prerequisite:** fundamentals of audio & video systems, analog & digital communication, electronic circuit design concepts

- **Objectives:**
  1. To introduce to student scanning process for picture transmission
  2. To make student understand composite video signal and its components
  3. To make student understand types and working of camera pick up devices
  4. To make student understand various transmission systems for TV

- **Outcomes:**
  At the end of this unit, student
  1. Can explain scanning process and calculate Kell factor for various video systems
  2. Can identify and measure different components of composite video signal
  3. Can explain functions of video standard pulses and intercarrier system

4. Can compare various types of camera pick up devices
5. Can design antenna system for different TV channels

- **Unit content:**
  Introduction to picture transmission; scanning process- eye characteristics, brightness perception, aspect ratio, persistence of vision, flicker, vertical resolution, Kell factor, horizontal resolution, video bandwidth, interlaced scanning; Composite video signal- horizontal and vertical synchronization pulse, blanking standards, video modulation, sound modulation and intercarrier system, complete channel bandwidth; Pick up devices- auto-focus system, vidicon, plumbicon, image orthicon, CCD image sensors, their comparison; TV transmission system- block diagram, antenna requirements

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, demonstrations

- **Assessment Methods:**
  Descriptive questions based on scanning, standard video signals, pick up devices and TV transmission system

Unit 6- Colour television system No of lectures-08

- **Prerequisite:** monochrome television system

- **Objectives:**
  1. To introduce to student colour theory
  2. To explain student working of colour picture tubes
  3. To make student understand working principle of various displays

- **Outcomes:**
  At the end of this unit, student
  1. Can measure and analyze colour spectrum of chrominance signal
  2. Can analyze amplitude and frequency of colour composite video signal such as burst cycles, spectrum of bar pattern, etc.
  3. Can compare and explain working principle of various color picture tubes
  4. Can explain working principle of LCD, flat plasma and large screen projection

- **Unit content:**
  Colour fundamentals – chromaticity diagram, luminance and chrominance signal, frequency interleaving, colour burst signal; colour picture tubes- shadow mask tube, Trinitron, precision-in-line, purity and convergence, automatic degaussing; display devices- flat panel, plasma and LCD screen, large screen display; power supply for TV- EHT and SMPS

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, demonstrations

- **Assessment Methods:**
  Descriptive questions based on chrominance signal, picture tubes and display devices

Unit 7- Television standards No of lectures-04

- **Prerequisite:** monochrome and colour television working**,** analog and digital communication, electronic circuit design concepts

- **Objectives:**
  1. To make student realize necessity of television standard
  2. To explain to student block diagrams of encoder and decoder for NTSC, PAL and SECAM systems

- **Outcomes:**
  At the end of this unit, student
  1. Can differentiate between various television standards
  2. Can derive chroma signals for NTSC, PAL and SECAM systems
  3. Can explain working principle of NTSC, PAL and SECAM systems

- **Unit content:**
  NTSC – I and Q signal generation; PAL – U and V signal generation; SECAM – D_R and D_B signal generation; block designing of encoder and decoder for NTSC, PAL and SECAM system; comparison of above three systems

- **Content Delivery Methods:**
  Chalk and talk, power point presentations

- **Assessment Methods:**
  Descriptive questions based on NTSC, PAL and SECAM; analytical questions based on signal generation

Unit 8- Modern television systems No of lectures-06

- **Prerequisite:** monochrome and colour television working**,** analog and digital communication, electronic circuit design concepts

- **Objectives:**
  1. To introduce to student modification in standard TV systems
  2. To make student understand block diagrams of satellite, digital and cable TV system
  3. To explain student television sub-systems required for transponder communication
  4. To make student understand cable TV concept and their distribution system

- **Outcomes:**
  At the end of this unit, student
  1. Can explain need of modern television systems
  2. Can explain working principle of satellite, digital and cable TV system

3. Can analyze transceiver sub-systems for satellite communication
4. Can compare and explain working principle of CCTV, MATV and CATV

- **Unit Content:**
  Satellite television – elements, communication sub-systems, transponder, block diagram of TV broadcast system; DTH communication; digital television – block diagram of audio transmitter, video production and reproduction, TV receiver; non-radiating system – CCTV, MATV, CATV, cable channels

- **Content Delivery Methods:**
  Chalk and talk, power point presentations

- **Assessment Methods:**
  Descriptive questions based on radiating and non-radiating TV systems

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- **ICA:**
  ICA shall consist of minimum eight experiments based upon-
  1. Optical reproduction system
  2. PA system
  3. Analysis of audio signal using equalizers, sequencers
  4. Designing of SMPS for TV set
  5. Analysis of composite video signal
  6. Voltage and waveform analysis of colour TV signal
  7. Measurement of blanking and synchronizing pulses
  8. Designing antenna systems for TV
  9. Satellite TV transmission and reception system

- **Text Books:**

  1. Fundamentals of Multimedia; Ze-Nian Li, Mark S. Drew; Prentice Hall of India Pvt. Ltd.
  2. Multimedia: computing, communications & applications; Ralf Steinmetz, Klara Nahrstedt; Pearson Education
  3. Television and video engineering; A.M. Dhake; Tata McGraw Hill publication
  4. Consumer Electronics; S.P. Bali; Pearson Publication

- **Reference Books:**

  1. Multimedia-making it work; Tay Vaughan; 6th Edition; Tata McGraw Hill Publication
  2. Television Engineering and Video Systems; R.G. Gupta;2nd Edition, Tata McGraw Hill Publication
  3. Monochrome and Colour Television; R.R. Gulati, Revised 2nd Edition, New Age International Publication
  4. Basic Television and Video Systems; Bernord Grob, 6th Edition, Tata McGraw Hill Publication
  5. Consumer Electronics; R.A. Barapte

Solapur University, Solapur
B.E. (Electronics) Semester-II
EN423 EMBEDDED SYSTEMS

Teaching Scheme	**Examination Scheme**
Lectures – 3 Hours/week, 3 Credits	**ISE-**30 Marks**, ESE-** 70 Marks
Tutorial – 1 Hour/week, 1 Credit	**ICA** – 25 Marks
Practical – 2 Hours/week, 1 Credit	**Practical & Oral exam** – 50 Marks

This course provides a thorough introduction to the architecture of ARM7 core and microcontroller LPC2148. The course also introduces assembly and C programming for LPC2148 microcontroller and enables student to write programs addressing high level programming skills for interfacing with different peripherals. The real time operating system concepts are also introduced.

Course Prerequisite:

Student shall have completed a course in microcontroller and its interfacing and have a good knowledge of assembly language and C language programming. Student shall also have knowledge of interfacing techniques and working of different peripherals.

Course Objectives:

1. To build up student's concept of hardware and software architecture of embedded system
2. To make student understand ARM7 core architecture with LPC2148 microcontroller
3. To make student write C and assembly language programmes for LPC2148
4. To make student interface different peripherals with LPC2148
5. To make student realize need of Real Time Operating System and then introduce to him architecture and various components of RTOS
6. To make student design simple LPC2148 microcontroller based systems.

Course Outcomes:

1. Student can portray hardware and software architecture of an embedded system.
2. Student can describe ARM7 core architecture
3. Student can describe LPC2148 architecture
4. Student can write assembly and C program for different applications for LPC2148
5. Student can interface (design hardware and write software) for interfacing different peripherals with LPC2148
6. Student can apply concepts of Real Time Operating System to organize embedded system.
7. Student can develop (design hardware and write software) LPC2148 based systems for simple applications

Section I

Unit 1 - Introduction to embedded systems No of lectures– 03

- **Prerequisite:** Basics of digital electronics, microcontroller architecture

- **Objectives:**
  1. To introduce to student notion of embedded system
  2. To make student understand a general architecture of embedded system

- **Outcomes:**
  After completing this unit student -
  1. Can describe embedded system and its applications
  2. Can describe a general embedded system architecture

- **Unit Content:**
  Concept of embedded system**,** RISC and ARM design philosophy, embedded system hardware, embedded system software

- **Content Delivery Methods:**
  Chalk and talk, power point presentation

- **Assessment Methods:**
  Questions based upon embedded system architecture

Unit 2 - ARM7 core fundamentals No of lectures – 09

- **Prerequisite:** basics of microcontroller and embedded system architecture

- **Objectives:**
  1. To make student understand hardware architecture of ARM7 core.
  2. To introduce to student programming model and instruction set for ARM7
  3. To make student write C and assembly language programs for ARM7

- **Outcomes:**
  After completing this unit student –
  1. Can depict detailed functionality of hardware blocks of ARM7
  2. Can write assembly language programs making an efficient use of ARM7 instructions for simple tasks
  3. Can write C programs for intricate tasks

- **Unit Contents:**
  ARM7 core programmer's model: data types, processor modes, registers, exceptions, memory format support, unaligned access support, pipeline concept, core extensions and ARM7 instruction set: data processing instructions, branch instructions, load/store

instructions, software interrupt instruction, program status register instructions, and loading constants, arm addressing modes, introduction to thumb instruction set.

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, simulation software

- **Assessment Methods:**
  Questions based upon hardware architecture of ARM7 core, programming model, instruction set; C and assembly language programs

Unit 3 – LPC2148 microcontroller interfacing and programming No of lectures – 09

- **Prerequisite:** basics of ARM7 core architecture and knowledge of C language programming

- **Objectives:**
  1. To introduce to student to LPC2148 microcontroller architecture
  2. To make student understand working of on chip peripherals of LPC2148
  3. To make student to incorporate on chip peripherals of LPC2148 for different applications.
  4. To make student interface different peripherals to LPC2148

- **Outcomes:**
  After completing this unit, student –
  1. Can describe hardware architecture of LPC2148
  2. Can incorporate on chip peripherals of LPC2148 for development of different applications
  3. Can write programs LPC2148 for different applications.
  4. Can design hardware to interface different peripherals to the LPC2148
  5. Can write programs to interface different peripherals to the LPC2148

- **Unit Content:**
  LPC2148 microcontroller architecture: study of on-chip peripherals like I/O ports, timers, interrupts, on-chip ADC, DAC, RTC modules, WDT, PLL, PWM, USB, I2C etc. basic embedded C programs for on-chip peripherals, I/O devices interfacing like led's, switch's, LCD's, and serial communication, analog interfacing and data acquisition, on chip RTC and timer/counter.

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, simulation software

- **Assessment Methods:**
  Questions based upon architecture of LPC2148 microcontroller, working of on chip peripherals, interfacing of different peripherals, and programming on interfacing.

Section II

Unit 4 – Real time operating system concepts No of lectures – 08

- **Prerequisites:** basics of embedded system software development

- **Objectives:**
  1. To emphasis to student need of real time operating systems
  2. To make student understand real time operating systems architecture, its various components and its issues

- **Outcomes:**
  After completing this unit, student –
  1. Can select applications demanding real time operating system
  2. Can describe real time operating systems architecture and its various components
  3. Can analyze various issues associated with real time operating system

- **Unit Content:**
  Concepts of real time operating system, need of real time operating systems, comparison of traditional and embedded OS, foreground/background systems, multitasking, tasks, context switching, kernel structure, schedulers, mailboxes, task management, time management, inter-task communication, messages and memory management, interrupts, clock tick.

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, case studies

- **Assessment Methods:**
  Questions based upon real time systems and upon concepts like kernel, mailboxes, task management, memory management, interrupts etc

Unit 5 - RTOS programming No of lectures – 09

- **Prerequisite:** basic concepts of real time operating system, knowledge of C programming.

- **Objectives:**
  1. To introduce to student µC /OS-II as a case study of real time operating system
  2. To make student develop simple applications using µC /OS-II

- **Outcomes:**
  After completing this unit, student –
  1. Can describe µC /OS-II architecture and its system services.
  2. Can develop simple applications by using system services of µC /OS-II

- **Unit Content:**
  Introduction to µC/OS-II real time operating systems, features of µC/OS-II, kernel structure of µC/OS-II, system services related to task management, time management, semaphore management, and mailbox management, programs by using these system services

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, simulation software

- **Assessment Methods:**
  Questions based upon system services of µC/OS-II and writing of programs for different applications by making use of these system services

Unit 6 - Case studies of embedded systems No of lectures – 04

- **Prerequisite:** embedded system software and hardware, real time operating systems

- **Objectives:**
  1. To make student to design simple systems by making the use of LPC2148 microcontroller and real time operating system

- **Outcomes:**
  After completing this unit student-
  1. Can develop simple embedded system by making the use of LPC2148 microcontroller and real time operating system

- **Unit Content:**
  Case study of digital camera, smart card, mobile phones, case study should be demonstrated by suitable hardware and software with or without real time operating system

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, simulation software

- **Assessment Methods:**
  Questions based upon design of embedded systems involving hardware and software design

- **ICA:**
  ICA shall be based on minimum six tutorials and minimum eight lab sessions based on curriculum

  a. Below activities are recommended for tutorials-
     1. Writing assembly and C programs for LPC2148
     2. Case study of different embedded system applications
     3. Evaluation / analysis of µC/OS-II features and services
     4. Comparison of µC/OS-II with other similar real time operating systems

  b. Below are recommended lab sessions -
     1. Interfacing LCD & keypad to LPC2148
     2. Interfacing analog input devices using on-chip ADC of LPC214
     3. Timer based events for LPC2148
     4. Interfacing different peripherals to LPC2148 using I2C protocol.
     5. Interfacing different peripherals to LPC2148 using UART
     6. Interfacing different peripherals to LPC2148 using SPI/SSP protocol
     7. Multi task management using µC/OS RTOS services
     8. Semaphore as signaling & synchronizing for LPC2148
     9. Mailbox implementation for message passing for LPC2148

- **Text Books:**
  1. ARM System Developer's Guide: Designing and Optimizing System Software; Andrew Sloss, Dominic Symes, Chris Wright, The Morgan Kaufmann Series in Computer Architecture and Design
  2. MicroC/OS-II: The Real Time Kernel, Jean J. Labrosse, CRC Press

- **Reference Books:**
  1. LPC2148 Microcontroller Datasheet
  2. An Embedded System Software primer; David E. Simon; Pearson
  3. Embedded Systems: Architecture, programming and Design; Raj Kamal; 2nd Edition; McGraw-Hill Education (India)

Solapur University, Solapur
B.E. (Electronics) Semester-II
ELECTIVE-II
EN424A BROADBAND COMMUNICATION

Teaching Scheme	**Examination Scheme**
Lectures – 3 Hours/week, 3 Credits	**ISE –** 30 Marks**, ESE-** 70 Marks
Tutorial – 1 Hour/week, 1 Credit	**ICA –** 25 Marks

This course is brought in with an objective to realize requirements of high speed networks for broadband applications and services. This course also includes the selection of appropriate network interface to different applications available at the campus over digital network. The course also covers fixed and flexible interface standard for wireless communication

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Course Prerequisite:

The student shall have the knowledge of telephone network, control signaling in circuit switching networks, behavior of packet networks and limitations of packet networks during high speed communication. Student also shall also have basic knowledge of analog communication, digital communication, synchronous & asynchronous communication

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Course Objectives:

1. To make student realize issues affecting speed of communication and limitations of present technologies.
2. To make student aware to contemporary technologies available for high speed communication.
3. To introduce to student combined interface to accommodate applications requiring information communication.
4. To introduce to student modern broadband applications and requirements to support these for communication.

Course Outcomes:

1. Student is able to analyze and plan for different communication parameters to achieve high speeds in communication.
2. Student is able to explain usage of different present networks for high speed communication.
3. Student is able to analyze different protocols to utilize available networks with high efficiency.
4. Student is able to implement different protocols for fixed and adhoc wireless broadband access.

Section I

Unit 1 – Ccommunication networks No of lectures – 06

- **Prerequisite:** concept of circuit, frame and packet switching & their comparison, control and data handling in circuit switched network

- **Objectives:**
  1. To make student aware of parameters affecting speed of communication in computer networks.
  2. To make student aware of issues like switching and multiplexing in computer networks.

- **Outcomes:**
  After completing this unit, student –
  1. Can analyze the communication parameters affecting the speed of communication.
  2. Can apply concept of switching and multiplexing to form intelligent digital networks.

- **Unit Content:**
  Circuit switching**-** routing and control signaling**,** packet switching- basic operation, packet switched network interface protocol X.25- internal operations and external services, packet formats, comparison between circuit and packet switching, digital networks- advantages of digital communication over analog communication, intelligent digital networks (IDN)

- **Content Delivery Methods:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power point presentations, videos.

- **Assessment Methods:**
  Questions based upon various switching technologies, evolution of switching spectrum, performance parameters and multiplexing in intelligent digital networks.

Unit 2 – High speed networks No of lectures – 05

- **Prerequisite:** concepts of managing of data at various network components in communication network, packet processing time and high level data link level protocol.

- **Objectives:**
  1. To make student understand frame communication technique over reliable networks.
  2. To introduce to student t protocols influencing speed and quality of communication.

- **Outcomes:**
  After completing this unit, student –
  1. Can analyze the frame parameters and their processing at routers to enhance the speed of communication.
  2. Can select the protocol according to need of quality and cost of communication.

- **Unit Content:**
  Need for speed and quality of service, frame relay- frame relay operation, frame mode protocol architecture-frame mode bearer services, frame relay, frame switching, call control protocol, link layer core parameters, link layer control parameters, LAPF core protocol, LAPF control protocol.

- **Content delivery method:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power presentations, videos and simulations

- **Assessment Method:**
  Questions based upon issues handled in frame communication to enhance the speed of communication, core & control parameter selection in protocol for quality control.

Unit 3 - Asynchronous transfer mode No of lectures – 08

- **Prerequisite:** basics of synchronous & asynchronous data transfer, benefits of small size cell communication

- **Objectives:**
  1. To introduce to student concept of fixed size cell communication to support high speed
  2. To make student understand different protocols for guaranteed QOS ATM communication.
  3. To make student understand transmission of ATM traffic over available networks

- **Outcomes:**
  After completing this unit, student –
  1. Can utilize various ATM parameters to guaranteed QoS communication.
  2. Student is able to select the appropriate transport mechanism according to available network for the communication

- **Unit Content:**
  Virtual channel, virtual path, call establishment over virtual path, ATM cell formats, generic flow control, HEC operation, transmission of ATM cells- cell based physical layer & SDH based physical layer, ATM adaptation layer- AAL services & protocols

- **Content Delivery Methods:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power point presentations, simulations.

- **Assessment Methods:**
  Questions based upon ATM cell structure, various parameters in cell providing quality in service and those parameters setting, various protocols at transmitter & receiver, different ATM service protocols for guarantee of quality of service.

Unit 4 – Traffic and congestion control in ATM networks No of lectures - 08

- **Prerequisite:** concepts of physical layer in ATM, performance paramètres in the network, basics of congestion and effect of congestion

- **Objectives:**
  1. To make student realize effect of delay on the quality of communication
  2. To make student understand various ATM network management parameters.

- **Outcomes:**
  After completing this unit, student –
  1. Can plan for guaranteed QoS
  2. Can select for appropriate admission control mechanism to control congestion on ATM network.

- **Unit Content:**
  Latency effect, cell delay variation at UNI, ATM service categories, ATM traffic related attributes, traffic management- frame work, connection admission control, PCR algorithm

- **Content Delivery Methods:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power point presentations, videos.

- **Assessment Methods:**
  Questions based upon ATM network management parameters, admission control and congestion control algorithm to obtain better quality of service.

Section II

Unit 5 – ATM switching No of lectures - 08

- **Prerequisite:** concepts ATM network, network components, need of switches for routing of applications

- **Objectives:**
  1. To introduce to student ATM switches and its statistical abilities.
  2. To make student appreciate importance of buffer and its management in the ATM switches

- **Outcomes:**
  After completing this unit, student –
  1. Can analyze the statistics maintained by ATM switch to ensure quality of communication
  2. Can select appropriate buffer size and location for quality requirements.

- **Unit Content:**
  ATM switching building blocks, ATM cell processing in a switch, matrix type switch, input, output buffering, central buffering, performance aspects of buffering switching networks.

- **Content Delivery Methods:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power point presentations, videos.

- **Assessment Methods:**
  Questions based upon ATM switch elements, switching parameters, types of ATM switches & performance of switching, importance of buffers and its placement for fast high speed communication.

Unit 6 – ISDN and BISDN No of lectures – 10

- **Prerequisite:** Need of multiplexed interface for integration of various devices requiring communication

- **Objectives:**
  1. To make student understand various protocols and interfaces to connect different devices over communication network.
  2. To make student aware of standards and specifications for application management on the networks
  3. To introduce student high data rate applications

- **Outcomes:**
  After completing this unit, student –
  1. Can plan for practical implementation of ISDN for campus connectivity
  2. Is able access different services over digital networks

- **Unit Content:**
  ISDN- principles, services, architecture, user network interface, access configuration, protocol architecture, virtual call setup, addressing, interworking, physical layer, frame format for basic rate access, multi-frame structure, contention resolution,
  BISDN- broadband services, BISDN architecture, physical layer- SONET/SDH

- **Content Delivery Methods:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power point presentations, videos and visit to local BSNL office.

- **Assessment Methods:**
  Questions based upon ISDN standard, ISDN user network interface, various reference points and equipments for providing integrated access to different applications at campus

Unit 7 – Wireless broadband networks No of lectures – 08

- **Prerequisite:** Concepts high speed communication in mobile networks, fixed and adhoc wireless networks for broadband communication.

- **Objectives:**
  1. To make student understand wireless technology and associated protocols for broadband access
  2. To make student understand different routing protocols for efficient communication.

- **Outcomes:**
  After completing this unit, student –
  1. Analyze parameters and other variables to provide fixed and ad-hoc wireless network for broadband applications
  2. Is able to select appropriate routing protocol for secure communication.

- **Unit Content:**
  Broadband wireless access standard (IEEE 802.16) - system, architecture, services, MAC layer, physical layer; MANET- characteristics, applications, importance of routing, routing protocols: table driven, AODV, DSR

- **Content Delivery Methods:**
  Along with chalk and talk, the instructor is strongly encouraged to take help of power point presentations, videos.

- **Assessment Methods:**
  Questions based upon IEEE 802.16, MANET, different parameters associated with these protocols to ensure high speed support and various routing protocols in adhoc networks for secured communication

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- **ICA:**
  ICA shall be based on minimum six tutorials covering above curriculum. Below activities are recommended for tutorials-
  1. Case study of different equipments used or providing campus connectivity to various applications
  2. Different performance parameters in frame relay and their management for quality communication
  3. Analysis of x.25 packet standard for network connectivity
  4. Congestion control using protocols like leaky bucket & token bucket
  5. Effect of ATM cell parameters over quality of reception
  6. Visit to local BSNL office which provides ISDN services

- **Text Books:**
  1. ISDN and Broadband ISDN with Frame Relay and ATM- William Stallings, 4th Edition- Pearson Publication
  2. High Speed Networks and Internets- Performance and Quality of Services- Pearson Education Asia publication
  3. Broadband Communications -Balajikumar, Mac-Graw Hill

- **Reference Books:**
  1. Wireless Communications and Networks- William Stallings, Pearson Education Publication
  2. Introduction to Wireless and Mobile Systems- Dharma Agrawal, Quing An Zeng- Cengage Publication.

Solapur University, Solapur
B.E. (Electronics) Semester-II
ELECTIVE-II
EN424B SPEECH PROCESSING

Teaching Scheme	**Examination Scheme**
Lectures – 3 Hours/week, 3 Credits	**ISE-** 30 marks**, ESE-**70 Marks
Tutorial – 1 Hour/week, 1 Credit	**ICA –** 25 Marks

Speech and music are the most basic means of adult communication. With the advancement of technology more sophisticated techniques have became available to use with speech & music signals. With the proliferation of multimedia systems like DTH, speech processing has gained importance now a days. This course is designed to introduce the basic speech processing techniques including speech synthesis and recognition.

Course Prerequisite:

Student shall have basic knowledge of core mathematical concepts like differential equations, probability functions etc. Student shall also have an adept knowledge of digital signal processing.

Course Objectives:

1. To introduce to student need and applications of speech processing
2. To present to student basic principles of speech analysis and speech recognition in time and transformed domain
3. To make student understand speech enhancement, speech coding and speech recognition

Course Outcomes:

1. Can describe need of different speech processing operations and can list applications for each
2. Student can express the speech signal in terms of its time and frequency domain representations and the different ways in which it can be modeled.
3. Student can analyze simple features used in speech classification applications.
4. Student can implement simple speech processing operations like speaker recognition using MATLAB®

Section I

Unit 1- Introduction to speech processing No of lectures-05

- **Prerequisite:** representation of signal in time and frequency domain

- **Objectives:**
  1. To make student familiar with need and applications of speech processing
  2. To make student understand process of human speech production
  3. To introduce to student fundamental steps in speech processing

- **Outcomes:**
  Upon completion of this unit, student –
  1. Can describe various speech processing areas and applications
  2. Can explain basic steps for speech processing
  3. Can explain the process of human speech production.

- **Unit Content:**
  Speech signal, speech processing, digital speech processing, speech synthesis, recognition, applications, sampling, basics of process of human speech production

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, animation for human speech production system

- **Assessment Methods:**
  Questions based upon applications and basics of speech processing.

Unit 2 - Time domain models No of lectures-08

- **Prerequisite:** speech processing basics.

- **Objectives:**
  1. To make student understand the general framework of time domain speech processing.
  2. To introduce to student techniques of silent discrimination and pitch period estimation.

- **Outcomes:**
  Upon completion of this unit, student is –
  1. Able to explain the time domain processing of speech signals.
  2. Able to explain different measurement used in the time domain processing.
  3. Able to explain the techniques for silence discrimination & pitch period detection.

- **Unit Content:**
  Energy, magnitude, zero crossing, silence discrimination, pitch period estimation, autocorrelation, smoothing

- **Content Delivery Methods:**
  Chalk and talk, power point presentations

- **Assessment Methods:**
  Questions based upon mathematical background of different measurements of time domain processing, techniques for silence discrimination, pitch period estimation. Numerical questions on energy computation & autocorrelation.

Unit 3 - Harmonic speech processing No of lectures-08

- **Prerequisite:** LTI systems, Z transform short time Fourier analysis.

- **Objectives:**
  1. To introduce to student concept and mathematical background of homomorphic systems for convolution
  2. To make student understand complex cepstrum of speech.
  3. To make student understand pitch detection based on homomorphic processing.

- **Outcomes:**
  Upon completion of this unit, student –
  1. Can explain homomorphic systems for speech processing
  2. Can explain pitch detection based on homomorphic processing
  3. Can explain homomorphic vocoder, cepstrum computation

- **Unit Content:**
  Homomorphic systems for convolution, complex cepstrum of speech, pitch detection, formant estimation, homomorphic vocoder

- **Content Delivery Methods:**
  Chalk and talk, power point presentations

- **Assessment Methods:**
  Questions based upon homomorphic systems, pitch detection, formant estimation, & homomorphic vocoder, numerical questions on cepstrum computation.

Section II

Unit 4 - Linear predictive coding No of lectures-09

- **Prerequisite:** Speech production model
- **Objectives:**
  1. To introduce to student linear predictive methods for speech analysis.
  2. To make student understand evaluation of LPC parameters
  3. To make student understand relation between various speech parameters
  4. To make student understand speech synthesis technique using LPC
- **Outcomes:**
  Upon completion of this unit, student –
  1. Is able to compare different methods of linear predictive coding for speech analysis
  2. Can evaluate the LPC parameters.
  3. Can explain the relation between different speech parameters
  4. Can explain the LPC based speech synthesis technique
- **Unit Content:**
  Linear predictive analysis by different methods, prediction error signal, evaluation of LPC parameters, interpretation, selective linear prediction, relation between various speech parameters, speech synthesis using LPC, other applications
- **Content Delivery Methods:**
  Chalk and talk, power point presentations.
- **Assessment Methods:**
  Questions based upon different predictive methods, speech parameters, speech synthesis. Numerical questions on LPC parameters evaluations.

Unit 5 - Speech recognition No of lectures-06

- **Prerequisite:** basics of speech signal and elementary mathematics
- **Objectives:**
  1. To make student evaluate the common speech features required for speech recognition
  2. To make student comprehend basics of isolated word recognition & connected word recognition.
- **Outcomes:**
  Upon completion of this unit, student –
  1. Is able to explain and compare different features of speech useful for speech recognition.
  2. Can differentiate the isolated word detection & connected word detection.

- **Unit Content:**
  Common features, dynamic features, robustness, basics of isolated word recognition & connected word recognition

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, simulation models
- **Assessment Methods:**
  Questions based upon speech features & speech recognition techniques.

Unit 6- Speech synthesis No of lectures-06

- **Prerequisite:** Speech signal representation in time and frequency domain, human speech production model

- **Objectives:**
  1. To make student understand different techniques for speech synthesis
- **Outcomes:**
  Upon completion of this unit, student –
  1. Is able to explain and compare different speech synthesis techniques.
- **Unit Content:**
  Formant synthesizer, filter synthesizer, concatenative methods

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, simulation models
- **Assessment Methods:**
  Questions based upon different synthesizers & concanative methods.

- **ICA**
  ICA shall be based on tutorials covering MATLAB® implementation of above concepts.

- **Text & Reference Books**:

  1. Digital Processing of Speech Signals , L.R. Rabiner & R.W. Schafer , Pearson Education
  2. Speech & Audio Signal Processing, Ben Gold & Nelson Morgan, Wiley India
  3. Speech and Audio Processing, Shaila D. Apte, Wiley India

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Solapur University, Solapur
B.E. (Electronics) Semester-II
ELECTIVE-II
EN424C PLC & INDUSTRIAL CONTROLLERS

Teaching Scheme	**Examination Scheme**
Lectures – 3 Hours/week, 3 Credits	**ISE-** 30 marks**, ESE-**70 Marks
Tutorial – 1 Hour/week, 1 Credit	**ICA –** 25 Marks

A programmable logic controller, PLC or programmable controller is a digital computer used for automation of typically industrial electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures. It is also useful for domestic appliances like Washing machine, Elevator systems and machine shop with computer numerical control etc. The objective of this course is to introduce to student functions, interfacing and programming of the PLC. This course also provides a comprehensive theoretical and applied foundation for industrial process control.

Course Prerequisite:
Student preferably shall have completed a comprehensive course in Mechatronics and shall have an understanding and the ability to analyze electronic circuits and design of signal conditioning circuits and power systems.

Course Objectives:

1. To introduce to student the purpose, functions and operations of the PLC in industrial applications
2. To make student understand hardware architecture of PLC
3. To introduce to student PLC ladder logic and basic programming concepts
4. To make student understand interfacing with PLC & troubleshooting controllers with PLC
5. To make student acquainted with the process control, different types of controllers, its tuning and implementation.
6. To introduce to student different types of sensors and actuators for electromechanical applications
7. To emphasis student with different signal conditioning networks required for interfacing sensors and actuators

Course Outcomes:

1. Student can identify applications for PLC
2. Student can identify the basic components of the PLC and explain how they function
3. Able to write and debug ladder diagrams for PLC applications
4. Student can establish communication through interfacing with PLC
5. Student can explain PID controllers with necessary mathematical background and can also describe its tuning control

6. Student can describe the operation principle and characteristics of various sensors and actuating systems for electromechanical applications
7. Student can design signal conditioning circuits for interfacing various sensors and actuating systems

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Section I

Unit 1 – Introduction to programmable controllers No of lectures – 08

- **Prerequisite:** basics of analog and digital electronics, microcontrollers

- **Objectives:**
  1. To introduce to student purpose, functions, and operations of the PLC in industrial applications
  2. To introduce to student hardware architecture of PLC
  3. To make student understand PLC ladder logic and basic programming concepts

- **Outcomes:**
  After completing this unit, student –
  1. Can describe purpose, functions, and operations of the PLC in industrial applications
  2. Can identify and describe various hardware components of PLC
  3. Able to build ladder diagram and rack assembly.
  4. Can analyze the motor control starter circuit.
  5. Can describe operation of PLC programming unit and data addresses to I/O modules.

- **Unit Content:**
  Introduction to PLC, hardware architecture of PLC, Industrial motor control circuits, relay ladder logic circuits, building a ladder diagram, motor control starter circuit, rack assembly, power supply, PLC programming unit, input / output sections, processor unit, addressing, relationship of data addresses to I/O module

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, home work assignments for design

- **Assessment Methods:**
  Questions based upon designing the ladder diagram, motor control circuits, hardware architecture of PLC

Unit 2 – Fundamental PLC programming No of lectures – 08

- **Prerequisite:** concepts of ladder diagram programming

- **Objectives:**
  1. To make student understand a practical approach of PLC program design
  2. To introduce to student relay logic, timer and data manipulation instructions
  3. To make student write the PLC programs for simple applications

- **Outcomes:**
  After completing this chapter, student –
  1. Can write PLC programs for simple applications

- **Unit Content:**
  PLC program execution, ladder diagram programming language, ladder diagram programming, relay logic instructions, timer instructions, counter instructions, data manipulation instructions, arithmetic operations, writing programs for simple applications

- **Content Delivery Methods:**
  Chalk and Board, power point presentation, home work assignments for programming

- **Assessment Methods:**
  Questions based upon writing programs making efficient use of different instructions for simple applications

Unit 3 - Advanced programming, PLC interfacing & troubleshooting No of lectures – 08

- **Prerequisite** – Concepts of PLC hardware, programming, interfacing analog and digital devices with microcontroller

- **Objectives** –
  1. To make student understand concept of 'loop' in programming
  2. To make student safely and correctly wire input and output devices to the PLC
  3. To make student debug/troubleshoot functional circuits interfaced with PLC

- **Outcomes-**
  After completing this chapter, student –
  1. Can write efficient programs making use of 'loop'
  2. Can interface analog and digital devices with PLC
  3. Can debug/troubleshoot functional circuits interfaced with PLC

- **Unit Content:**
  Loop commands, data manipulations, discrete input/output modules, troubleshooting I/O interfaces, analog input and output signals, special purpose modules, troubleshooting programmable controllers

- **Content Delivery Methods:**
  Chalk and Board, power point presentation, animation, case studies

- **Assessment Methods:**
  Questions based upon advanced programming concepts, interfacing analog and digital devices with PLC and its troubleshooting

Section II

Unit 4 - Fundamentals of process control No of lectures – 08

- **Prerequisite** – basics of feedback control systems
- **Objectives-**
  1. To introduce to student mathematical background of on/off and PID controller
  2. To develop student with the designing concept of on/off proportional controller
  3. To make student understand the PID controllers with its tuning and implementation.
- **Outcomes-**
  After completing this unit, student –
  1. Can explain mathematical concepts for on/off and PID controller
  2. Can design on/off and proportional controllers
  3. Can tune PID controller for its implementation
- **Unit Content:**
  Introduction to process control, On/Off, proportional controller, PI &PD controllers, PID controller, tuning and implementation
- **Content Delivery Methods:**
  Chalk and board, power point presentations, simulation
- **Assessment Methods:**
  Questions based upon mathematical foundation of controllers, designing of on/off controllers, PI & PD controllers, tuning of PID controllers

Unit 5 – Sensors and actuators No of lectures – 08

- **Prerequisite**: basics of sensors
- **Objectives:**
  1. To make student understand working of different sensors required in industrial process
  2. To make student understand actuators required in industrial process
- **Outcomes:**
  After completing this unit, student -
  1. Can describe the operation of various types of sensors required in industrial process
  2. Is able to select appropriate sensors in different industrial applications
  3. Can describe components of hydraulic and pneumatic actuating system

- **Unit Content:**
  Flow sensors, pressure sensors, temperature sensors, semiconductor sensors, actuators: control valves, directional control valves, switches & gauges, hydraulic actuation system, pneumatic actuators

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, animation, case studies

- **Assessment Methods:**
  Descriptive questions based upon sensors and actuating systems and their applications

Unit 6 – Signal conditional networks No of lectures – 04

- **Prerequisite:** basic concepts of data acquisition systems, op amp, electronic circuit design

- **Objectives:**
  1. To emphasis student with V to I and I to V converters
  2. To make student apply knowledge of these converters in floating load and grounded load applications
  3. To make student design DAS using microcontroller

- **Outcomes:**
  After completing this unit, student -
  1. Can describe the operation of V to I and I to V converters for floating load and grounded load.
  2. Student can design simple DAS using microcontroller

- **Unit Content:**
  I to V, V to I for floating load and grounded load, Data Acquisition System using microcontroller

- **Content Delivery Methods:**
  Chalk and talk, power point presentation

- **Assessment Methods:**
  Descriptive / design questions based upon designing of V to I and I to V, microcontroller based DAS

- **ICA:**
  ICA shall consist of minimum eight tutorials based upon above curriculum. Suggested list of few tutorials is as below-

  1. PLC Programming in ladder
  2. Pneumatic and hydraulic actuators
  3. Case studies of electromechanical system like CNC machine
  4. Analog on/off controller
  5. PI Controller, PD & PID
  6. Signal conditioning network.
  7. Literature survey, specification analysis and comparative study of various commercially available PLCs

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- **Text Books:**
  1. Industrial & Process Control, C.D. Johnson, John Wiley & Sons Inc, Eight Edition
  2. Industrial Electronics: Circuits, instruments and control techniques, Terry Bartelt , Delmar Learning India Pvt
  3. Programmable Logic Controllers, Frank Petruzella, McGraw-Hill Higher Education
  4. Programmable Logic Controllers Gray Durming, Third Edition

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- **Reference Books:**
  1. Programmable Logic Controllers and applications; John W Webb Ronald A. Reis, PHI Learning
  2. Programmable Logic Controllers; Bolton, Elsevier-Newnes; 3rd Edition
  3. Programmable Logic Controllers Programming Methods and Applications; John R. Hack Worth , Frederick D. Hackworth, Jr.; Prentice Hall India

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Solapur University, Solapur
B.E. (Electronics) Semester-II
Elective II
EN424D Internet of Things

Teaching Scheme	Examination Scheme
Lectures – 3 Hours/week, 3 Credits	ESE - 70 Marks
Tutorial – 1 Hours/week, 1 Credit	ISE - 30 Marks
	ICA - 25 Marks

The Internet of Things (IoT) refers to the system in which different devices equipped with sensors and signal processing are connected through a network to communicate with each other and/or with central servers. This course provides a thorough introduction to the different components of an IoT System. The course also introduces cloud platforms of IoT and different communication protocols. Introduction to Cortex M Series ARM architecture is also a part of this course.

Course Prerequisite:

Student has completed a course in microcontroller and interfacing and has an adept knowledge of assembly and C language programming. Student also has knowledge of interfacing techniques and working of different peripherals

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Course Objectives:

1. To make student aware of different components of an IoT System
2. To make student learn the architecture of Cortex M3 series ARM microcontroller.
3. To make student learn interfacing of different peripherals with microcontroller.
4. To make student learn different communication technologies and application protocols used in IoT.
5. To introduce to student different cloud platforms of IoT.

Course Outcomes:

1. Student can elaborate different components of an IoT System.
2. Student can describe the architecture Cortex M3 series ARM microcontroller
3. Student can write interfacing program for different applications with ARM microcontroller.
4. Student can describe different communication technologies and application protocols used in IoT.
5. Student can elaborate different cloud platforms of IoT.

Section I

Unit 1 - Introduction to Internet of Things No of lectures – 05

Introduction to IoT, different components of an IoT system: embedded systems, sensors, communication systems, cloud, applications of IoT in various domains.

Unit 2 – Embedded Systems for IoT No of lectures – 07

Introduction to embedded systems, different components of an embedded system, and basics of microcontroller based embedded systems; basics of Linux based embedded systems, role of embedded systems in IoT.

Unit 3 – Introduction to ARM No of lectures – 10

Introduction to ARM architecture, cortex series classification (A, R, M series), ARM Cortex-M series family, ARM Cortex-M3 processor overview, block diagram, registers, memory map, instruction set: data accessing, processing, arithmetic, program flow control etc., exception handling, low-power features, requirements, sleep mode, development of low-power applications, basic embedded C programs for on-chip peripherals, interfacing I/O devices like led's, switch's etc., serial communication, analog interfacing and data acquisition, concepts of application programming interface (API).

Section II

Unit 4 – Communication technologies for IoT No of lectures – 08

Basics of the communication technologies like Bluetooth Low Energy (BLE), Zigbee, Wifi, RFID, their architecture, characteristics, limitation, power consumption parameters and applications

Unit 5 - Application protocols for IoT No of lectures – 07

Basics of application protocols like MQTT and CoAP, their features, framework, message formats, implementations and applications

Unit 6 - Cloud platforms for IoT No of lectures – 07

Cloud architecture for IoT, concept of APIs, survey of various IoT cloud platforms, understanding the costing structure of cloud for IoT services, performance metrics for cloud platforms in IoT

- **Internal Continuous Assessment :**
  ICA consists of minimum 8 to 10 tutorials based on following with Cortex M3 microcontroller
  1. Interfacing general purpose I/O devices like LED's, switches
  2. Interfacing motors
  3. Reading sensor values and plotting them on the PC through UART
  4. Interfacing BLE/Wifi modules with ARM based platforms
  5. Sending sensor data to the cloud using Wifi
  6. Sending sensor data to cell phone using BLE.
  7. Implement an interrupt handler to illustrate low power feature
  8. Implement Bluetooth Low Energy connection between the microcontroller kit and smart devices.

- **Text Books**
  1. Internet of Things by Raj Kamal
  2. The Definitive Guide to the ARM Cortex-M3 by Joseph Yiu
  3. Internet of Things for Architects by Perry Lea
  4. Analytics for the Internet of Things (IoT) by Andrew Minteer
  5. Embedded Systems Fundamentals with ARM Cortex-M based Microcontrollers: A Practical Approach, Embedded Systems Fundamentals with ARM Cortex-M based Microcontrollers: A Practical Approach, Alexander G. Dean

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- **Reference Books**
  1. Internet-of-Things (IoT) Systems: Architectures, Algorithms, Methodologies by Dimitrios Serpanos, Marilyn Wolf
  2. MQTT Essentials - A Lightweight IoT Protocol by Gaston C. Hillar
  3. Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3 by Peter Waher.
  4. Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed by Perry Xiao

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- **Recommended Online Free Courseware**

  1. Udemy.com
  2. Introduction to ARM mbed : playlist on Youtube

Solapur University, Solapur
B.E. (Electronics) Semester-II
EN425 PROJECT II

Teaching Scheme
Practical – 8 Hours/week, 4 Credits

Examination Scheme
ICA – 100 Marks
Oral exam – 100 Marks

Project based learning is a paradigm which is becoming time-honored now a days. To keep abreast with this, Project course is included in the curriculum which is spread over both semesters of final year. For this course students carry out a project as a team that allows them to demonstrate their abilities and to develop skills within their chosen area of interest. Hardware realization as well software simulation projects with focus on design and research aspects are accepted. Also communicating effectively, both in oral and written form is an important skill for engineering graduates in many different contexts. This course also aims to foster these skills

Course Prerequisite:
Student shall have technical competency as well as behavioral facet to carry project as a part of a team. He shall have an adept knowledge of hardware and software architecture and associated programming skills. He shall also posses necessary technical report writing skills, presentation skills and shall have proficiency in office software for word processing and presentation

Course Objectives:
1. To expose student to different project life cycle phases for software or/and hardware projects
2. To impart on student hands on experience for design & development of project
3. To enhance amongst student team working and leadership skills
4. To enhance amongst student presentation and technical documentation skills.

Course Outcomes:
1. Student can select a suitable project based upon requirement analysis and literature survey
2. Student can plan for management and financial aspects of the project
3. Student can design hardware and software architecture of the project
4. Student can apply design concepts for detail design of project
5. Student can validate the results and can also analyze them
6. Student demonstrates leadership and team working behavioral skills
7. Student can write synopsis and project report
8. Student demonstrates presentation skills
9. Student can use programming / simulation software and presentation, word processing software at various stages of project

The project work is carried out in two semesters of B.E. (Electronics). The practical batch for the project will be of 15 students. The batch will be divided into groups each consisting of not more than 3 students.

In semester –I, group will select a project with the approval of guide and submit the synopsis of the project. The group is expected to complete detail system design, high level design and low level design of project in first semester as a part of ICA.

Each student shall deliver a seminar (presentation) preferably on the topic related to project area.
