PUNYASHLOK AHILADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF SCIENCE & TECHNOLOGY

E L E C T R O N IC S E N G I N E E R I N G

Syllabus for

T.Y. B. Tech (Electronics Engineering) w.e.f. Academic Year 2020-21

Choice Based Credit System

V0.6

PAH SOLAPUR UNIVERSITY, SOLAPUR
FACULTY OF SCIENCE & TECHNOLOGY
Electronics Engineering

Programme Educational Objectives and Outcomes

A. Program Educational Objectives

Graduate will –

1. Have a successful professional career in Electronics & allied fields.
2. Leverage his fundamental knowledge to pursue higher education and will continue his professional development in Electronics & other fields
3. Exhibit professional ethics, team spirit and effective communication skills to be successful leader and manager with a holistic approach.
4. Be sensitive to ethical, societal & environmental issues while conducting his 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

PAH SOLAPUR UNIVERSITY, SOLAPUR

Faculty of Science & Technology

Choice Based Credit System (CBCS) Curriculum of T.Y.B.Tech Electronics Engineering W.E.F. 2020-21 *Semester I*

Course Code	Theory Course Name	Hrs./week			Credits	Examination Scheme			
		L	T	P		ISE	ESE	ICA	Total
EN311	Digital Communication	3	_	_	3	30	70	--	100
EN312	Digital Signal Processing	4	_	_	4	30	70	-	100
EN313	Microcontrollers	4	-	_	4	30	70	-	100
EN314	Electro Magnetic Engineering	4	1	_	5	30	70	25	125
EN315	Open Elective-I	3	1	_	4	30	70	25	125
SLH31	Self Learning Module I	_	_	_	2	--	50	_	50
EN316	Programming with Python	2	-	-	2	--	--	50	50
Sub Total		20	2	_	24	150	400	100	650
Course Code	**Laboratory Course Name**								
							ESE		
							POE	OE	
EN311	Digital Communication	_	_	2	1	_	--	25	25	50
EN312	Digital Signal Processing	_	_	2	1	_	--	--	25	25
EN313	Microcontrollers	--	--	2	1	--	50	--	25	75
EN316	Programming with Python	_	_	2	1	_	50	_	--	50
Sub Total		--	-	8	4	_	125		75	200
Grand Total		**20**	**2**	**8**	**28**	**150**	**525**		**175**	**850**

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)

PAH SOLAPUR UNIVERSITY, SOLAPUR
Faculty of Science & Technology

Choice Based Credit System (CBCS) Curriculum of T.Y. BTech Electronics Engineering W.E.F. 2020-21 *Semester II*

Course Code	Theory Course Name	Hrs./week			Credits	Examination Scheme			
		L	T	P		ISE	ESE	ICA	Total
EN321	Computer Networks	3	_	_	3	30	70	-	100
EN322	Embedded Systems	4	_	_	4	30	70	-	100
EN323	Electronics System Design	4	_	_	4	30	70	-	100
EN324	VLSI Design	4	_	_	4	30	70	_	100
EN325	Open Elective-II	3	_	_	3	30	70	-	100
EN326	Self Learning Module II	_	_	_	2	--	50	_	50
Sub Total		18	_	_	20	150	400	_	550
Course Code	**Laboratory Course Name**								
							ESE		
							POE	OE	
EN321	Computer Network	_	_	2	1	_	_	25	25	50
EN322	Embedded Systems	_	_	2	1	_	50	_	25	75
EN323	Electronics System Design	_	_	2	1	_	--	50	25	75
EN324	VLSI Design	_	_	2	1	_	_	_	25	25
EN325	Open Elective- II	_	_	2	1	_	_	_	25	25
EN327	Mini Hardware Project	_	_	2	1	_	_	_	50	50
Sub Total		_	_	12	6	_	125		175	300
Grand Total		**18**	**-**	**12**	**26**	**150**	**525**		**175**	**850**

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)

- **Note** –

1. Batch size for the practical /tutorial shall be of 15 students. On forming the batches, if the strength of remaining student exceeds 7, then a new batch shall be formed.
2. Vocational Training (evaluated at Final Year Part-I) of minimum 15 days shall be completed in any vacation after S.Y. Part-II but before Final Year Part-I & the report shall be submitted and evaluated in Final Year Part-I
3. For Self-Learning Module I (HSS) at T.Y. B.Tech. – Semester I
    a. Curriculum for Humanities and Social Sciences (HSS), Self Learning Module – I (SLH31) is common for all under graduate engineering programs
    b. Student shall select & enroll for a Self Learning Module I Course from PAH Solapur University, Solapur HSS Course List given and appear for university examination.

    OR

    c. Student shall select and enroll for university approved minimum eight weeks NPTEL HSS course , complete its assignments and appear for certificate examination conducted by NPTEL. More details about NPTEL are available at *http://nptel.ac.in*
4. For Self-Learning Module II (Technical) at T.Y. B.Tech. – Semester II
    a. Student shall select & enroll for a Self Learning Module II Course (EN326) from PAH Solapur University, Solapur Course List given and appear for university examination.

    OR

    b. Student shall select and enroll for university approved minimum eight weeks NPTEL Technical course, complete its assignments and appear for certificate examination conducted by NPTEL. More details about NPTEL are available at *http://nptel.ac.in*
5. Project group for T.Y.(Electronics) Part II Mini Hardware Project shall not be of more than **three** students
6. Project group for Final Year (Electronics Engg') Part I and Part II shall not be of more than **three** students.
7. ISE assessment shall be a continuous process based on student's performance in – class tests, assignments, homework, subject seminars, quizzes etc
8. ICA assessment shall be a continuous process based on student's performance in laboratory and/or tutorials
9. Open Elective I & II shall be common and open for the students of the branches – Electronics Engineering, Electronics & Telecommunication Engineering and Electrical Engineering. Students of these branches can take any of these Open Electives. Syllabus and university examination question paper will be same for all these branches.

List of Open Electives

Sr.	*Branch Offering Elective*	*Open Elective I*	*Open Elective II*
1	Electronics Engineering	Information Technology & Management	Operating Systems
2	Electronics & Telecommunication Engineering	Business Ethics	Optical Communication
		Managerial Economics	Sensors and Applications
3	Electrical Engineering	Hybrid Electric Vehicle Design	Advanced Control System

List of Self Learning Courses

Self Learning Module – I *Humanities & Social Sciences (SLH31)*		*Self Learning Module – I* *Technical (EN326)*
1. Economics		1. Robotics
2. Intellectual Property Rights for Technology Development and Management		2. Automotive Electronics
3. Introduction to Sociology		3. Electronics Instrumentation
4. Stress and Coping		4. Programming with Java
5. Professional Ethics and Human Values		5. NPTEL Course
6. NPTEL Course		

PAH Solapur University, Solapur
T.Y. B.Tech (Electronics) Semester-I
EN311 DIGITAL COMMUNICATIONS

Teaching Scheme:
Lectures- 3 Hours / week, 3 Credits
Practical – 2 Hours/week, 1 Credit

Examination Scheme
ESE- 70 Marks
ISE - 30 Marks
ICA- 25 Marks
OE – 25 Marks

This course provides a thorough introduction to the basic principles and techniques used in digital communications. The course intends to cover various digital modulation and demodulation techniques at block diagram levels and few at circuit level. The course also introduces analytical techniques to evaluate the performance of communication systems. Basics of information theory along with source and channel coding techniques and numerical problems related to these are also covered.

Course Prerequisite:
Student has completed a course in analog communication and shall have an adept knowledge of various analog modulation and demodulation techniques. Student also has knowledge about signals and systems and basics of digital signal processing. Comprehension of the probability theory is also required.

Course Objectives:

1. To make student understand functions of different components of a digital communication system with sampling theorem & digital pulse modulation techniques.
2. To make student understand the concept of baseband data transmission systems and pass band data transmission system.
3. To prepare mathematical background for communication signal analysis
4. To make student understand information theory and its relevance to digital communication
5. To make student understand different error detection and correction codes
6. To understand concept of spread spectrum communication system.

Course Outcomes:
After completing this course, student shall able to

1. Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.
2. Represent the time and frequency domain signals in a digital communication system.
3. Explain probability, random variable and various statistical analysis methods & derive channel capacity for discrete memory less channel and continuous channel.
4. Explain noise as a random process and its effect on communication receivers.
5. Calculate the performance of different source coding and channel coding schemes for the reliable transmission of digital signals and information over the channel
6. Evaluate techniques of spread spectrum communication system.

Section I

Unit 1 –Digital Pulse Modulation No of lectures – 10

- **Prerequisite:** Concepts of analog communication – general block diagram, need of modulation, concepts of time & frequency domain representation of signals, circuit design using discrete components & op amps, concept of analog pulse modulation

- **Objectives:**
  1. To make student understand- comparison of analog, discrete & digital communication, need of digital communication, general block diagram of digital communication system, advantages & disadvantages, concepts of symbols, words, messages
  2. To make student understand relevance of sampling theory pertaining to discrete communication, effect of over and under sampling using frequency domain representation
  3. To introduce to student concept of quantization, its need, advantages & disadvantages, mathematical analysis for bandwidth requirement, non uniform quantization
  4. To make student understand need & concept of non uniform PCM
  5. To make student understand the block diagram and it's working of different waveform coding techniques.
  6. To make student understand analytical concepts for different waveform coding techniques and their performance

- **Outcomes:**
  After completing this unit, student -
  1. Can compare analog, pulse and digital communication system & can draw and explain various blocks of digital communication system
  2. Can explain significance of sampling along with mathematical analysis
  3. Can compare different quantization schemes
  4. Can explain different blocks of PCM system
  5. Can draw and explain block diagram of different coding modulator and demodulator
  6. Can describe analytical concepts of different waveform coding techniques

- **Unit Content:**
  Digital communication system blocks, advantages of digital communication system, sampling theory, Nyquist rate, aliasing, PCM-Generation and reconstruction, quantization-uniform & non-uniform and Companding, PCM bandwidth requirement, PCM-TDM, eye diagram, Differential pulse code modulation, delta modulation, delta-sigma modulation, adaptive delta modulation

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, MATLAB simulation for eye diagram

- **Assessment Methods:**
  Questions based upon block diagram, circuits for digital modulation and demodulation techniques, mathematical analysis for Nyquist rate, quantization error and bandwidth requirement, descriptive questions to ensure understanding of the basic concepts of digital

communication, quantization, pulse modulation, PCM and baseband signaling, different waveform coding techniques, their advantages and limitations

Unit 2 – Baseband Digital Transmission No of lectures – 06

- **Prerequisite:** concept of digital modulation, baseband signaling

- **Objectives:**
  1. To introduce to student basic concepts of digital line codes
  2. To make student understand concept of Duo binary system & pulse shaping
  3. To make student understand need of synchronization & different levels of synchronization in digital communication

- **Outcomes:**
  After completing this unit, student –
  1. Can compare different line codes and can represent into time and frequency domain.
  2. Can describe Duo-binary baseband system & pulse shaping by digital methods
  3. Can describe frame and symbol synchronization in a typical digital communication system

- **Unit Content:**
  Data formats with spectra, Duo-binary baseband PAM system – use of controlled ISI in duo binary signaling scheme, shaping of transmitted signal spectrum, effect of precoding , pulse shaping by digital methods, equalization, synchronization , scrambler & unscramble.

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

- **Assessment Methods:**
  Questions based upon data formats, Inter-symbol interference and descriptive questions to ensure understanding of the basic concepts of Duo-binary baseband PAM system, pulse shaping by digital methods.

Unit 3 -Information Theoretic Approach to Communication No of lectures – 06

- **Prerequisite:** Pulse modulation, mathematical foundation of probability theory & set theory.

- **Objectives:**
  1. To make student understand relevance of probability theory pertaining to digital communication
  2. To introduce to student measure of information, mathematical analysis for information & entropy with numeric examples
  3. To introduce to student concept of channel capacity, its limitations & different theorems related to it

- **Outcomes:**
  After completing this unit, student –
  1. Can evaluate information as a removal of uncertainty and can solve numerical problems related to information
  2. Can describe analytical concepts related to entropy and information rate and can solve numerical problems related to it
  3. Can calculate theoretical limit of a capacity of a Gaussian channel
  4. Can describe need for source coding and can encode using Shannon- Fano coding and Huffman coding

- **Unit Content:**
  Discrete message and information content, entropy, information rate, mutual Information, source coding to increase average information- Shannon Fano coding, Huffman coding, Shannon's theorem, channel capacity, capacity of a Gaussian channel, bandwidth –S/N trade off.

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

- **Assessment Methods:**
  Numerical questions based upon information, entropy, information rate and coding and descriptive questions to ensure understanding of the basic concepts of channel capacity and theorem

Section II

Unit 4 – Digital Carrier Modulations and Detection No of lectures – 10

- **Prerequisite:** Waveform coding, mathematical foundation of probability theory & set theory.

- **Objectives:**
  1. To make student understand block diagram of different digital carrier modulation techniques
  2. To make student understand need and analytical concepts for different digital carrier modulation techniques and their performance
  3. To introduce to student need, mathematical & analytical concepts of matched & correlation filter receivers

- **Outcomes:**
  After completing this unit, student –
  1. Can describe analytical concepts of different digital carrier modulation techniques
  2. Can compare performance of different digital carrier modulation techniques
  3. Can describe mathematical & analytical concepts of matched & correlation filter receivers

- **Unit Content:**
  Binary ASK, FSK, PSK, methods of generations, signal space representation, spectrum, coherent and non coherent detection, performance, comparison, differential PSK, QPSK, offset QPSK,

M-ary, QAM, MSK, GMSK, OFDM, optimum receiver for digital modulation**:** matched filter receiver, correlation receiver

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

- **Assessment Methods:**
  Questions based upon block diagram of generation and detection of different digital carrier modulation techniques. Also descriptive questions to ensure understanding of the basic concepts of different digital carrier modulation techniques, their advantages, limitations and performance, matched & correlation filter

Unit 5 –Error Control Coding No of lectures – 06

- **Prerequisite:** Information theory, probability theory, matrix operations, digital electronics

- **Objectives:**
  1. To introduce to student concept of error control coding, its need & overheads
  2. To make student understand different error control coding techniques, its rationale, effect on efficiency with numeric examples
  3. To make student understand simple hardware implementation of error control coding techniques

- **Outcomes:**
  After completing this unit, student –
  1. Can explain need of error control coding in a digital communication system
  2. Can draw encoder and decoder for various error control coding techniques
  3. Can solve numerical problems based upon various error control coding techniques

- **Unit Content:**
  Need of error control coding, error probability, block codes, Hadamard code, Hamming code, cyclic codes, encoder and decoder for cyclic codes, convolution codes, encoder and decoder for convolution codes, turbo codes

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

- **Assessment Methods:**
  Numerical questions based upon various error control coding techniques and descriptive questions to ensure understanding of the basic concepts of error control coding techniques

Unit 6 – Spread Spectrum Techniques No of lectures – 04

- **Prerequisite:** Digital carrier modulation, concept of signal bandwidth & spectrum

- **Objectives:**
  1. To introduce to student concept of spread spectrum and pseudo noise sequences
  2. To make student understand different spread spectrum techniques
  3. To introduce to student concept of frequency hopping

- **Outcomes:**
  After completing this unit, student –
  1. Can describe need and analytical concepts of spread spectrum
  2. Can draw and explain block diagram of different spread spectrum modulator and demodulator.
  3. Can describe concept of frequency hopping.

- **Unit Content:**
  Introduction, pseudo noise sequences, a notion of spread spectrum, direct sequence spread spectrum with coherent BPSK, signal space dimensionality & processing gain, concept of jamming, frequency hopping

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

- **Assessment Methods:**
  Descriptive questions to ensure understanding of the basic concepts of pseudo noise sequences, direct sequence spread spectrum, jamming, frequency hop spread spectrum

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- **Internal Continuous Assessment (ICA)**

  ICA consists of minimum ten experiments out of below list. Minimum two experiments shall be of simulation on MATLAB platform

  1. Sampling and reconstruction
  2. PCM system and eye pattern.
  3. Companding
  4. DPCM ,ADPCM
  5. DM,ADM
  6. Data Formats
  7. ASK,FSK, PSK, BPSK
  8. DBPSK
  9. Hamming code
  10. Cyclic redundancy code
  11. Convolution code
  12. Pseudo noise sequences generation
  13. Direct sequence spread spectrum modulation

- **Text Books:**
  1. Taub's Principles of Communication Systems, Herbert Taub, Donald L Schilling, Goutam Saha, 4th edition, McGraw Hill Education (India) Pvt. Ltd.
  2. Digital Communication Systems Design, Martin S. Roden, Prentice- Hall International Inc
  3. Communication Systems, Analog & Digital, R P Sing, S D Sapre, 2nd Edition, Tata McGraw Hill Education Pvt. Ltd

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- **Reference Books:**
  1. Digital Communication, Simon Haykin, John Wilely & Sons (Asia) Pvt. Ltd.
  2. Digital Communications, Fourth Edition, John G. Prokis, McGraw Hill International Edition
  3. Digital Communications Fundamentals and Applications, Bernard Skalar, 2nd Edition, Pearson Education

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PAH Solapur University, Solapur
T.Y. B.Tech (Electronics) Semester-I
EN312 DIGITAL SIGNAL PROCESSING

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

Examination Scheme
ESE- 70 Marks
ISE - 30 Marks
ICA- 25 Marks

The signal for processing is mathematically modeled as a function or a sequence of numbers that represents the state or behavior of a physical system. Examples includes speech, audio, image and video in multimedia systems, electrocardiograms in medical systems, electronic radar waveforms in military applications etc. Signal processing is concerned with the representation, transformation, and manipulation of signals and the information they contain. For example, we may wish to remove the noise in speech to make it clear, or to enhance an image to make it more natural. Signal processing is one of the fundamental techniques to construct modern information systems. The course includes the concept and the classification of discrete-time signal, representations of signals, z transform and discrete frequency transform, representations and analysis of systems, and filter designs.

Course Prerequisite:
A course on basic concepts of signals and systems is desirable. Student shall also have mathematical background of Fourier series, Fourier Transform and Z Transform.

Course Objectives:

1. To make student understand processing of signals in frequency domain using mathematical transforms
2. To make student understand the methods for realization of discrete time systems.
3. To make student understand the design methods for digital IIR & FIR filters.
4. To introduce to student digital signal processor functional blocks with focus on a typical processor.

Course Outcomes:

After completing this course, student shall able to -

1. Analyze a given signal or system using tools such as Fourier transform and z-transform
2. Apply properties of Discrete Fourier Transform and to determine the Discrete Fourier transform, inverse discrete Fourier transform by direct computation & Fast Fourier Transform algorithms.
3. Draw the structure for realization of a given system.
4. Design IIR & FIR digital filters.
5. Describe basic architectural features of digital signal processor.

Section I

Unit 1-Introduction to DSP No of lectures – 03

- **Prerequisite:** Basics of signals and systems, ADC and DAC

- **Objectives:**
  1. To make student understand the significance and benefits of digital signal processing.
  2. To make student aware of the different application areas of DSP.

- **Outcomes:**
  After completing this unit, student–
  1. Can explain a typical DSP system along with the different application areas of DSP.
  2. Can describe the benefits of DSP over analog processing.

- **Unit Content:**
  Introduction to DSP, application areas, typical real time DSP system

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

- **Assessment Methods:**
  Questions based on block diagram of DSP system and applications.

Unit 2–Z Transform Application to Analysis of LTI Systems No of lectures – 04

- **Prerequisite:** Z transform and inverse Z transform, Fourier transform, stability of LTI systems

- **Objectives:**
  1. To make student understand the relation between z plane location of pole and time domain behavior of a signal.
  2. To make student understand the classification of systems based on its transfer function.
  3. To make student know the applications of Z transform in signal processing.

- **Outcomes:**
  After completing this unit, student can
  1. Describe time domain behavior of a signal from its pole location.
  2. Identify the system, given its transfer function.
  3. Determine the stability of a given system from its transfer function.
  4. Compute the frequency response of given LTI system.

- **Unit Content:**
  Overview of Z–transform & its properties, pole location and time domain behavior for causal signals, digital transfer function, stability considerations & frequency response of LTI system

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

- **Assessment Methods:**
  Questions based on pole location and time domain behavior and frequency response, numerical on stability

Unit 3–The Discrete Fourier transforms No of lectures – 12

- **Prerequisite:** Z transform, convolution, Fourier transform

- **Objectives:**
  1. To make student understand the relationship between frequency domain samples and DFT.
  2. To make student know the relationship between Z transform and DFT.
  3. To make student understand various properties of DFT.
  4. To make student apply DFT for linear filtering and frequency analysis.
  5. To make student understand FFT algorithms

- **Outcomes:**
  After completing this unit, student can –
  1. Derive the equation for DFT
  2. Compute the DFT and IDFT using formula and using linear transformation.
  3. Compute DFT making use of transform properties
  4. Compute the circular convolution.
  5. Evaluate difference between circular convolution and linear convolution.
  6. Use DFT and IDFT for filtering of long sequences
  7. Evaluate how FFT reduces the number of computations compared to direct Fourier transform

- **Unit Content:**
  The discrete Fourier Transform (DFT), DFT as a linear transformation, relation between DFT & Z transform properties of DFT, circular convolution, linear filtering methods based on DFT, divide and conquer approach for computation of DFT, Radix -2 FFT algorithms.

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

- **Assessment Methods:**
  Questions based on properties of DFT, circular convolution and fast convolution methods, numerical on computation of DFT, IDFT, using properties, circular convolution and computing DFT using FFT algorithms

Unit 4–Realization of Digital Linear Systems No of lectures – 6

- **Prerequisite:** Differential equation representing LTI system, Z transform, convolution

- **Objectives:**
  1. To make student understand the major factors influencing choice of structure realization.
  2. To make student understand the structure realization for FIR and IIR systems.
  3. To make student understand the computational requirements for each realizations.

- **Outcomes:**
  After completing this unit, student can –
  1. Describe the major factors that influence the choice of structure realization
  2. Draw the structure realization for given FIR and IIR systems.

- **Unit Content:**
  Structures for realization of discrete time systems, structures for FIR filters: direct form, cascade form, structures for IIR filters: direct form, signal flow graph & transposed structure, cascade form & parallel form.

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

- **Assessment Methods:**
  Questions based on realization structures for a given system function.

Section II

Unit 5–FIR Filter Design No of lectures –8

- **Prerequisite:** Fourier transform, convolution, basics of analog filters

- **Objectives:**
  1. To make student understand characteristics of FIR filters.
  2. To make student understand the difference between of FIR and IIR filters.
  3. To make student understand the implications of causality on filter's frequency response.
  4. To make student understand different methods of FIR filter design.
  5. To make student understand the effect of finite word length on frequency response of the filter.
  6. To make student understand the implementation aspects of FIR filters.

- **Outcomes:**
  After completing this unit, student can –
  1. Describe the difference between FIR and IIR filters.
  2. Describe the characteristics of different window functions.
  3. Design the filter and plot the frequency response from the given specifications
  4. Describe the effects of finite word length on the frequency response characteristics of FIR filters.

- **Unit Content:**
  Causality and its implications, characteristics of practical frequency selective filters, symmetric and anti-symmetric FIR filters, FIR filter design using windowing & frequency sampling method, finite word length effects in FIR filters, FIR implementation techniques.

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

- **Assessment Methods:**
  Questions based on characteristics and properties of FIR filters, frequency response of window functions, finite word length effects, numerical on filter design techniques.

Unit 6–IIR Filter Design No of lectures –8

- **Prerequisite:** Fourier transform, z transform, convolution, basics of analog filters

- **Objectives:**
  1. To make student understand IIR filter design techniques based on analog filter design.
  2. To make student understand frequency transformations for designing filters from prototype filters
  3. To make student understand the characteristics of Butterworth filters.
  4. To make student understand the effect of finite word length on frequency response of the filter.
  5. To make student understand the implementation aspects of IIR filters.

- **Outcomes:**
  After completing this unit, student can –
  1. Derive the mapping from s domain to z domain for various design techniques.
  2. Convert the given analog transfer function into corresponding digital transfer function.
  3. Calculate the cutoff frequency and design Butterworth filter from the given frequency response.
  4. Describe the effects of finite word length on the frequency response characteristics of IIR filters.

- **Unit Content-**
  IIR filter design by Impulse invariant technique, IIR filter design by bilinear transformation, frequency transformations, analog Butterworth filter approximation, finite world length effects in IIR filters, implementation of IIR Filters.

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

- **Assessment Methods:**
  Questions based on techniques for converting analog filters into digital, characteristics and properties of Butterworth filters, frequency transformations and finite word length effects, numerical on filter design (Maximum up to 3rd Order) techniques.

Unit 7–Introduction to Programmable Digital Signal Processors No of lectures – 8

- **Prerequisite:** Typical processor architecture

- **Objectives:**
  1. To make student understand architectural features of DSP processor.
  2. To make student understand requirement and importance of special addressing modes of P-DSP.

- **Outcomes:**
  After completing this unit, student can –
  1. Distinguish between conventional microprocessor & programmable DSP.
  2. Describe different building blocks of typical digital signal processors.
  3. Describe the architecture and hardware features of fixed and floating point DSPs.
- **Unit Content:**
  Number formats for signals & coefficients in DSP systems, basic architectural features DSP computational building blocks, bus architecture, special addressing modes, fixed point and floating point digital signal processors, overview of TMS320C54x DSP architecture
- **Content Delivery Methods:**
  Chalk and talk, power point presentation
- **Assessment Methods:**
  Questions based on different blocks of DSP processor architecture, bus architectures.

- **Internal Continuous Assessment (ICA) :**
  ICA consists of minimum eight experiments based on DFT & IDFT, fast convolution, FIR & IIR filter design. One or two experiments on TMS hardware platform are recommended.

- **Text Books:**
  1. Digital Signal Processing – Principles, Algorithms and applications, John G Proakies, Prentice Hall India
  2. Digital Signal Processing – A Practical Approach, Ifeachor E. C. & Jervis B. W., Pearson Education
  3. Digital Signal Processing Implementations using DSP Microprocessors, Avtar Singh & S. Srinivasan, Thomson Education

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- **Reference Books:**
  1. Digital Signal Processing, S Salivahanan, A Vallavaraj & C Gnanapriya, Tata McGraw Hill
  2. Digital Signal Processors – Architecture, Programming and Applications, B Venkataramani & M. Bhaskar, Tata McGraw Hill India
  3. Scientist and Engineering Guide on Digital Signal Processing, Steven W. Smith , California Technical Publishing, California.
  4. Discrete time signal Processing, A.V. Oppenheim & R.W.Schalfer, John Wiley
  5. Digital Signal Processing Fundamentals and applications, Li Tan, Academic Press

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PAH Solapur University, Solapur

T.Y. B.Tech (Electronics) Semester-I

EN313 MICROCONTROLLERS

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

Examination Scheme
ESE- 70 Marks
ISE - 30 Marks
ICA- 25 Marks
POE- 50 Marks

This course provides a thorough introduction to the architecture of microcontrollers 8051 and PIC 16F877. The course also introduces assembly language programming and 'C' language programming concepts for 8051 and PIC 16F877. The course enables student to write programs addressing fundamental programming skills and also interfacing with different peripherals. The SPI and I2C serial communication are also part of the syllabus

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Course Prerequisite:
Student has completed a course in basic electronics and digital logic design. Student also has knowledge of C programming language.

Course Objectives:

1. To introduce to students conception of microcontroller architecture with focus on typical microcontrollers- 8051 and PIC 16F877
2. To make student learn assembly language programming concepts for microcontrollers.
3. To make student learn "C" language programming concepts for microcontrollers.
4. To make student design interfacing of memory and peripherals with 8051
5. To introduce to student RS232, I2C and SPI serial communication.
6. To make student design microcontroller based systems for small applications

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Course Outcomes:

After completing this course, student shall able to -

1. Describe architecture of 8051 and PIC 16F877 microcontrollers.
2. Write assembly language program for different applications with 8051 and PIC 16F877 microcontrollers.
3. Write "C" program for different applications with 8051 microcontroller.
4. Develop the system for different applications using 8051 microcontrollers.
5. Write programs for PIC 16F877 on chip peripherals for different applications.
6. Describe working of serial communication protocols RS232, SPI and I2C.

Section-I

Unit 1 - Fundamentals of Microprocessors No of lectures – 08

- **Prerequisite –** Basics of Boolean algebra, working of basic logic gates

- **Objectives –**
  1. To introduce to student working of computer.
  2. To make student learn working of CPU inside the computer.
  3. To introduce to student different types of memory and memory organization
  4. To make student compare microprocessor and microcontroller

- **Outcomes –**

  After completing this unit student -
  1. Can describe microprocessor based system
  2. Can describe the different memories
  3. Can compare microprocessor and microcontroller

- **Unit Content:**

  Internal organization of computer, fundamentals of microprocessor architecture, addresses data and control bus, internal working of microprocessor with fetch decode and execution cycles, instruction timing diagram, types of memory, memory organization, introduction to microcontroller and its comparison with microprocessor.

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

- **Assessment Methods**:

  Questions based upon microprocessor architecture, types of memory and memory organization

Unit 2 - The 8051 Architecture: No of lectures – 10

- **Prerequisite –** Basics of digital electronics and basic building blocks of microprocessor

- **Objectives –**
  1. To introduce to student architecture of 8051 microcontroller.
  2. To make student understand memory organization in 8051 microcontroller
  3. To make student understand functional block diagram of 8051 microcontroller
  4. To introduce to student software model for 8051 microcontroller with assembly program and "C" programming.

- **Outcomes –**

  After completing this unit student -
  1. Can describe architecture of 8051 microcontroller
  2. Can draw memory organization in 8051 microcontroller
  3. Can describe the functionality of various pins of 8051 microcontroller
  4. Can write assembly and "C" program for different arithmetic and logical operations of 8051

- **Unit Content:**
  8051-features, 8051 architecture- ALU, Boolean processor, oscillator, timing and control, registers in 8051, clock and RESET circuits, stack and stack pointer, program counter, I/O ports, memory structures, data and program memory, pin configuration, addressing modes and instruction set

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

- **Assessment Methods:**
  Questions based upon architecture of 8051 microcontroller, memory organization, pin configuration and assembly language programs and "C" programs - using basic instructions, different programming structures like loop, stack, and subroutine etc, efficient use of different addressing modes.

Unit 3 – 8051 On-chip Peripherals: No of lectures – 08

- **Prerequisite** – 8051 instruction set, concept of timer/counter and serial communication

- **Objectives –**
  1. To make student understand working of on chip peripherals of 8051 microcontroller.
  2. To make student program on chip peripherals of 8051 microcontroller for different applications

- **Outcomes-**
  After completing this unit student –
  1. Can describe working of on chip peripherals of 8051 microcontroller.
  2. Can write programs for on chip peripherals of 8051 microcontroller for different applications

- **Unit Contents-**
  Port structure, timers and counters, serial port, interrupt structure, programming with on chip peripherals

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

- **Assessment Methods:**
  Questions based upon working of on chip peripherals like timer/counter, UART, ports etc. and their modes of operations, writing of programs for different on chip peripherals.

Section-II

Unit 4 - Memory and I/O Interfacing: No of lectures – 07

- **Prerequisite –** 8051 architecture and instruction set, working of ports of 8051

- **Objectives –**
  1. To make student interface data and program memories to the 8051 microcontroller
  2. To make student interface different I/O devices with 8051 microcontroller
  3. To make student design a 8051 based minimum system

- **Outcomes-**

  After completing this unit, student –
  1. Can interface different memories and peripherals to the 8051 microcontroller
  2. Can design a 8051 minimum system

- **Unit Contents-**

  Interfacing of different display devices like switches, LED's, seven segment display and LCD, data RAM and ROM, program memory, ADC 0808, DAC, stepper and DC motor, keypad.

- **Content Delivery Methods:**

  Chalk and talk, power point presentation, simulation software

- **Assessment Methods:**

  Questions based upon memory interfacing, working of I/O devices and their interfacing with 8051 microcontroller

Unit 5 - PIC Microcontroller 16F877A: No of lectures – 08

- **Prerequisite–** Basics of digital electronics and building blocks of 8051

- **Objectives –**
  1. To introduce to student architecture of PIC 16F877 microcontroller.
  2. To make student write assembly language programs for PIC 16F877 microcontroller for different applications.

- **Outcomes-**

  After completing this unit, student –
  1. Can describe architecture of PIC 16F877 microcontroller
  2. Can write assembly language programs PIC 16F877 for different applications.

- **Unit Contents-**

  RISC and CISC architecture, PIC 16F877-features, architecture-CPU registers, memory structures, pin configuration, addressing modes, instruction set, assembly language and 'C' programming

- **Content Delivery Methods:**

  Chalk and talk, power point presentation

- **Assessment Methods:**
  Questions based upon architecture of PIC 16F877 microcontroller, assembly language programs and "C" programs - using basic instructions, different programming structures like loop and subroutine etc, efficient use of different addressing modes

Unit 6 - PIC 16F877 On-chip Peripherals: No of lectures – 07

- **Prerequisite –**PIC 16F877 instruction set, concept of serial communication and interrupt. Knowledge of timer/counter and PWM are also required.

- **Objectives –**
  1. To make student understand working of on chip peripherals of PIC 16F877 microcontroller.
  2. To make student use on chip peripherals of PIC 16F877 microcontroller for different applications.

- **Outcomes-**
  After completing this unit, student –
  1. Can describe working of on chip peripherals of PIC 16F877 microcontroller.
  2. Can make use of on chip peripherals of PIC 16F877 microcontroller for different applications

- **Unit Contents-**
  Parallel slave port, timers and counters, capture and compare modes, PWM mode, ADC

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

- **Assessment Methods:**
  Questions based upon working of on chip peripherals and writing of programs for different on chip peripherals

Unit 7 - External Communication Interface No of lectures – 04

- **Prerequisite –** Basics of serial data transfer

- **Objectives –**
  1. To make student understand working of serial communication interface.
  2. To make student understand communication protocols - RS232, SPI and I^2C

- **Outcomes-**
  After completing this unit student-
  1. Is able describe serial communication interface
  2. Is able to compare different communication protocols - RS232, SPI and I^2C

- **Unit Contents-**
  Synchronous and asynchronous communication, introduction to serial communication protocols - RS232, SPI, and I^2C

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

- **Assessment Methods:**
  Questions based upon working of serial communication protocols RS232, SPI, and I^2C.

- **Internal Continuous Assessment (ICA) :**
  ICA consists of minimum 10 experiment based on following with 5 experiments on MCS 51 and 5 experiments on Microchip PIC Microcontrollers

  1. Arithmetic and Logic operations
  2. Interfacing of Switches, LEDs and Buzzer.
  3. Interfacing of Matrix Keyboard
  4. Interfacing of LCD Display.
  5. Interfacing of DAC 0808 and generation of various waveforms.
  6. Interfacing of ADC 0808
  7. Use of Timer for generation of time delays
  8. Use of Timer as counter.
  9. Interfacing of Serial RTC
  10. Interfacing of Stepper motor.
  11. Speed control of DC Motor.
  12. Use of ADC in PIC Microcontrollers.
  13. Use of Interrupts for any Application.
  14. Serial communication.
  15. Use of PWM in PIC Microcontrollers

- **Text Books:**
  1. 8051 and Embedded C Programming, Mazidi , Pearson Education, 2nd edition
  2. Microcontrollers, Ajay Deshmukh, Tata McGRAW HILL

- **Reference Books:**
  1. 8051 Microcontroller Architecture, Programming and Application', 3rd edition, Kenneth Ayala, Penram publication.
  2. Designs with PIC Microcontrollers, John B. Peatman, Pearson Education Asi LPE
  3. Datasheets of Microchip PIC family of Microcontrollers

PAH Solapur University, Solapur

T.Y. B.Tech (Electronics) Semester-I

EN314 ELECTRO MAGTIC ENGINNERING

Teaching Scheme:
Lectures- 4 Hours / week, 4 Credits
Tutorial -1 Hour/week, 1 Credit

Examination Scheme
ESE- 70 Marks
ISE - 30 Marks
ICA- 25 Marks

This course deals with mathematical approach in electromagnetics. It starts with different coordinate system and vector analysis. The course covers different aspects of static electric field and static magnetic field including intensity, density, potential and energy. The course also includes Maxwell equations, wave theory and transmission line theory. It introduces radiating systems with focus on antenna. It is expected that students shall able to solve numerical problems related to all these topics

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Course Prerequisite:

Student has completed a course in mathematics covering vector algebra, trigonometry, derivation and integration .Students also has basic knowledge of electric field theory and magnetic field theory, quantities related to these. Student has completed a basic course in analog communication.

Course Objectives:

1. To introduce to student the concept of vector operations.
2. To introduce to student the fundamentals of static electric field.
3. To introduce to student the fundamentals of static magnetic field.
4. To make student derive Maxwell's equations for time-varying fields and apply it to wave theory
5. To make student calculate the reflection/transmission of plane waves.
6. To introduce to student application of electric and magnetic fields for power transmission lines theory
7. To introduce to student the application of electric and magnetic fields in radiating system with focus on antennas.

Course Outcomes:

After completing this course, student shall able to -

1. Solve numerical problems on coordinate systems, divergence, curl and gradient.
2. Derive laws governing electromagnetic fields and can apply them for different fields.
3. Determine electromagnetic force extended on charge particles, current elements, working principle of various electromagnetic energy conservation devices based on this forces
4. Derive Maxwell's equations under different conditions
5. Deduce and justify electromagnetic wave propagation in different media.

6. Apply Maxwell's equation to problems related to transmission lines and describe radiating system concepts and power flow with focus on antennas

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Section I

Unit 1 – Vector Calculus No of lectures – 06

- **Prerequisite –** Scalar and vector quantities **,**trigonometry, differentiation, integration

- **Objectives –**
  1. To revise the concept of scalars and vectors
  2. To introduce to student the significance of dot product and cross product of vectors.
  3. To introduce to student different coordinate system and the vector transformation techniques.
  4. To make student apply DEL operator with different coordinate systems.
  5. To make student apply Laplacian operator to solve numerical problems on vectors

- **Outcomes –**
  After completing this unit, student -
  1. Can define and represent different coordinate system
  2. Can solve problems using dot product and cross product of vectors.
  3. Can transform vectors in different coordinate system.
  4. Can apply DEL operator in different coordinate & with different operations.
  5. Can apply Laplacian operator to solve numerical problems on vectors

- **Unit Content:**
  Scalars and vectors, vector algebra, coordinate system, differential length, surface and volume, point and vector transformations, DEL operator (gradient of a scalar field ,divergence and curl of the vector field), Laplacian operator

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, animation on coordinate system, 3D models

- **Assessment Methods:**
  Numerical and derivation related to vector distance, unit vector, vector transformation, relation between different coordinate system.

Unit 2 – Electrostatics Field No of lectures – 12

- **Prerequisite –** Concepts of force ,electric field and concepts of communication.

- **Objectives –**
  1. To introduce to student the basics concepts of static electric field and associated quantities.
  2. To make student understand significance of electric charge or point charge.
  3. To make student evaluate the force between two point charges.

4. To make student evaluate the electric field intensity and density over different charge distribution
5. To make student understand the application of Gauss's law.

- **Outcomes-**

After completing this unit, student –

1. Can derive equations for force, static electric field intensity and electric field density.
2. Can derive electric filed intensity and density over different charge distribution.
3. Can state and apply Gauss's law, divergence theorem and its application.
4. Can solve numerical problems related to potential and energy.
5. Can derive different boundary conditions.

- **Unit Contents-**

Coulomb's law & electric field intensity , electric field intensity due to distributed charges, flux density, Del operator, Gauss's law and its applications, divergence theorem, eletric potential, potential gradient, electric dipole, electrostatic energy density, boundary conditions for electrostatic field.

- **Content Delivery Methods:**

Chalk and talk, power point presentations

- **Assessment Methods:**

Numerical and derivation related to above contents.

Unit 3 - Steady Magnetic Field No of lectures – 09

- **Prerequisite –** Concepts of magmatic field, magnetic flux lines, applications of magnetic field.

- **Objectives :**

1. To introduce to student the fundamentals of magnetic field
2. To make student to define and derive different laws and theorem's related to magnetic field
3. To make student understand basics of magnetic flux and magnetic flux density, scalar and vector magnetic potentials.
4. To make student know the force on current element and between current elements, Lorentz force equation.
5. To introduce to student concept of energy stored in magnetic field and inductors.

- **Outcomes:**

After completing this unit, student –

1. Can state and derive Biot Savart law and can solve numerical problems related to it
2. Can derive magnetic field intensity and magnetic flux density with various types of current distributions.
3. Can state and derive Ampere's circuit law and can apply it
4. Can evaluate magnetic vector potential and boundary conditions.
5. Can compare electric and magnetic field.

- **Unit Contents-**
  Biot Savarts law, Ampere's circuital law and its application, Stroke's theorem, magnetic flux density & vector magnetic potential, forces due to magnetic field, magnetic torque and moments, energy stored in magnetic field, magnetic boundary condition.

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

- **Assessment Methods:**
  Numerical and derivation related to above contents.

Section II

Unit 4 - Maxwell's Equations No of lectures – 04

- **Prerequisite:** Faraday's law, Gauss's law, Ampere's law in point form and integral form

- **Objectives:**
  1. To introduce to student concept of displacement current and current density
  2. To make student derive Maxwell's equation using different laws.
  3. To introduce to student Maxwell's equations for different fields

- **Outcomes-**
  After completing this unit, student –
  1. Can evaluate displacement current and conduction current.
  2. Can derive Maxwell's equation in point form and integral form.
  3. Can summarize Maxwell's equations under static, dynamic, harmonically time varying field conditions.

- **Unit Contents-**
  Continuity equation for static conditions, displacement current and current density, Faraday"s law ,Maxwell's equations in integral form and point form, Maxwell's equations for static case, time varying field, harmonically varying field.

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

- **Assessment Methods:**
  Numerical and derivation related to above contents.

Unit 5 - Electromagnetic Waves Propagation No of lectures – 10

- **Prerequisite –** Concepts of electromagnetic waves, Maxwell's equations, field theory and circuit theory.

- **Objectives –**
  1. To make student derive wave equations in different media
  2. To make student define and evaluate parameters like SWR, skin effect, etc.
  3. To make student to state and derive Poynting's theorem and power flow in uniform plane wave.

- **Outcomes-**

  After completing this unit, student –
  1. Can derive wave equation using Maxwell equation for different media.
  2. Can derive reflection by a perfect conductor and normal dielectric.
  3. Can derive the Poynting's theorem.

- **Unit Contents-**

  Wave propagation in free space, lossy dielectric, lossless dielectric & good conducting media, modification in wave equations for sinusoidal time variations, propagation in good conductor, wave polarization , skin effect, reflection of plane wave at normal incidence, reflection of plane wave at oblique incidence, Poynting's theorem.

- **Content Delivery Methods:**

  Chalk and talk, power point presentation

- **Assessment Methods:**

  Numerical and derivation related to above contents.

Unit 6 - Transmission Lines No of lectures – 08

- **Prerequisite –** Wave equations ,concept of circuit theory and field theory.

- **Objectives:**
  1. To make student state and derive transmission line equations and parameters
  2. To make student state and derive various impendence.
  3. To make student understand reflection coefficient and VSWR.

- **Outcomes-**

  After completing this unit, student –
  1. Can derive transmission line equation.
  2. Can derive impendence equations and different parameters.
  3. Can calculate reflection coefficient, propagation constant, Z_x , velocity for transmission lines

- **Unit Contents-**

  Transmission line equation using field theory and circuit theory, transmission line primary constant (R,L,C,G) and secondary (Z_0, γ) constant , the terminated uniform transmission line, reflection coefficient,transmission coefficient , VSWR, group velocity, phase velocity.

- **Content Delivery Methods:**

  Chalk and talk, power point presentation

- **Assessment Methods:**
  Numerical and derivation related to above contents.

Unit 7 - Antenna & Radiating Systems No of lectures – 06

- **Prerequisite:** Fundamentals of analog communication, Maxwells equations, polarization concept

- **Objectives:**
  1. To introduce to student basics of antennas with parameters, properties and function
  2. To make student state and derive radiation mechanism, radiation power and resistance of current elements for dipole
  3. To make student know different antennas and their properties.

- **Outcomes-**
  After completing this unit, student –
  1.Can define different antenna parameters.
  2.Can derive radiation power, radiation resistance using Maxwell's equation.
  3.Can solve numerical problems related to antennas

- **Unit Contents-**
  Review of basic antenna parameters, polarization , the alternating current element, power radiated by current element and its radiation resistance, generalized linear antenna, dipole antenna – directional properties, wire antenna, monopole antenna, uniform liner arrays.

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

- **Assessment Methods:**
  Numerical and derivation related to above contents.

- **Internal Continuous Assessment (ICA)**
  ICA consists of minimum ten tutorials based on above syllabus.

- **Text Books:**
  1. Electromagnetic Engineering, William Hyte, McGraw Hill, Seventh Edition
  2. Problems and Solutions in Electromagnetic,William Hyte, Mc Graw Hill
  3. Electromagnetic Field Theory & Transmission Lines, Raju, Pearson Education

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- **Reference Book –**
  1. Electromagnetic Waves and Transmission, Rao, PHI
  2. Antennas for All Applications, John D. Kraus, Mc Graw Hill, Third Edition
  3. Antenna and Wave Propagation, K.D.Prasad, Satya Prakashan

PAH Solapur University, Solapur

T.Y. B.Tech (Electronics) Semester-I

Open Elective I

EN315 INFORMATION TECHNOLOGY AND MANAGEMENT

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

Examination Scheme
ESE- 70 Marks
ISE - 30 Marks
ICA- 25 Marks

This course provides the basic tactical and strategic principles of information technology uses for management information systems and its various applications to the organizations. It also addresses changing face of business with proliferation of electronic commerce and ethical & social issues arising with it. It also introduces about the software projects, software development models and overview of project management

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Course Prerequisite:
Student shall have basic knowledge of computer hardware, software, programming and communication.

Course Objectives:

1. To introduce to student concepts of information systems and its impact on business and organization
2. To show how e-commerce helps organization to increase productivity and competitive advantage.
3. To give overview of ethical and social issues concerning information systems
4. To make student aware of software project and its attributes
5. To introduce to student software development life cycle and software models

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Course Outcomes:
After completing this course, student shall able to -

1. Present case studies about changing face of business and importance of management information system for today's business
2. Explain different e-commerce mechanisms along with the examples
3. Describe necessity and benefits of data management for business and organizations
4. Present examples of primary and higher organizational applications of information system
5. Illustrate software development life cycle and can describe popular software models
6. Describe various social and ethical issues related to IT

Section-I

Unit 1-Information Systems No of lectures – 07

- **Prerequisite:** Basic knowledge of computer hardware, software, programming and internet.

- **Objectives:**
  1. To introduce to student concepts of information system and describe various types of information system.
  2. To make student relate and contrast transaction processing and functional information system.
  3. To make student analyze support that IT provides to people in different roles in an organization.
  4. To make student understand how IT provides support to business processes
  5. To give student overview of IT infrastructure, architecture and emerging computer environments.
  6. To make student realize dimensions of information systems and contemporary approach to information system.

- **Outcomes:**
  After completing this unit, student -
  1. Can define information system and describe various types of information system.
  2. Able to relate and contrast transaction processing and functional information system.
  3. Can analyze the support that IT provides to people in different roles in an organization.
  4. Able to highlight IT infrastructure, architecture and emerging computer environments through case study.
  5. Able to portray dimensions of information systems and contemporary approach to information system.

- **Unit Content:**
  Business in digital economy & information age, information concepts – data, information & knowledge, information systems: concepts and definitions, classification and types of information systems, how IT support people, information technology, architecture and emerging computing environments.

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

- **Assessment Methods:**
  Questions based upon information system concepts, classification and types of information systems, information system infrastructure, architecture and emerging computing environments, dimensions of information systems, contemporary approach to information system.

Unit 2– E-business and E-commerce No of lectures – 08

- **Prerequisite:** Information system concepts, information system infrastructure, architecture and emerging computing environments

- **Objectives:**
  1. To introduce to student importance and significance of e-business and e-commerce**.**
  2. To make student distinguish business to consumer applications and business to business applications.
  3. To make student understand e-commerce supports services.
  4. To create awareness about ethical and legal issues in e-business.
  5. To make student to gain knowledge about mobile e-commerce.

- **Outcomes:**
  After completing this unit, student –
  1. Can compare e-business and e-commerce.
  2. Can describe major e-commerce mechanisms.
  3. Able to identify e-commerce support services.
  4. Can explain e-payment systems with Indian context
  5. Can describe mobile e-commerce.

- **Unit Content:**
  Overview of e-business and e-commerce, major e-commerce mechanisms, business to consumer applications, business to business applications, major models of e-business, e-commerce supports services, infrastructure support required, e-payment systems, ethical and legal issues in e-business, mobile e-commerce

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

- **Assessment Methods:**
  Descriptive questions based upon e-business and e-commerce, major e-commerce mechanisms, business to consumer applications, business to business applications, major models of e-business, e-commerce supports services, ethical and legal issues in e-business, mobile ecommerce

Unit 3–Data Management No of lectures – 07

- **Prerequisite:** Operating system, information system, e-commerce.

- **Objectives:**
  1. To introduce to student importance of data management.
  2. To introduce to student database management system.
  3. To make student aware about data management issues
  4. To acquaint student with benefits of data warehouse, data marts and data centers.

- **Outcomes:**
  After completing this unit, student is –
  1. Able to compare traditional file system with database management system
  2. Able to describe functions of data base and data base management system.
  3. Can describe the tactical and strategic benefits of data warehouse, data marts and data centers.

- **Unit Content:**
  Data hierarchy, problems with traditional file environment, database approach, database management system, creating database, relational DBMS, logical vs physical view, DBMS components, data warehouse, data mart, data mining

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

- **Assessment Methods:**
  Descriptive questions based upon managing data, database approach, database and data base management system, data warehouse, data marts and data centers, enterprise content management, data visualization technology, managerial issues.

Section II

Unit 4– Modern Organizational Applications No of lectures – 08

- **Prerequisite:** Information system, information system infrastructure.

- **Objectives:**
  1. To make student aware about organization, features of organization & organizational structure.
  2. To make student understand how information system impact organizations and business firms
  3. To introduce to student primary organizational applications like OLAP, TPS
  4. To introduce to student higher organizational applications like ECM, ERP, supply chain management, decision support system
  5. To make student realize importance of data visualization and its applications

- **Outcomes:**
  After completing this unit, student –
  1. Can describe features of modern organizational structure
  2. Can explain with case studies how organization and information system are influencing each other in contemporary business practices
  3. Can explain with case studies primary applications of information system in a typical modern business
  4. Can explain with case studies higher applications of information system in a typical modern business
  5. Can list various commercial tools/ software available for data visualization

- **Unit Content:**
  What is an organization, features of organizations, organizational structure, doing business in digital economy, organizations and information systems, how information systems impact organizational practices, OLAP, TPS, enterprise content management, introduction to ERP and supply chain management, introduction to decision support systems, data visualization

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

- **Assessment Methods:**
  Questions based upon block diagram and descriptive questions to ensure understanding of what is an organization, features of organizations, organizational structure, doing business in digital economy, organizational responses and IT support, how information system impact organizations and business firms, primary and higher organizational applications of information system

Unit 5–Project & Software Development Life Cycle No of lectures – 08

- **Prerequisite:** Information system, data management, organizational structure, basics of programming

- **Objectives:**
  1. To introduce to student about project and its attributes.
  2. To make student realize difference between software project and other projects
  3. To make student understand project planning framework.
  4. To introduce to student need and concept of SDLC
  5. To provide to student a short induction to popular SDLC models used by industry
  6. To make student apprehend role and responsibilities of the software project manager
  7. To make student aware of IT project methodologies

- **Outcomes:**
  After completing this unit, student –
  1. Is able to differentiate software projects and other engineering projects
  2. Can explain major phases in SDLC
  3. Can explain popular SDLC models used by industry
  4. Can list project management knowledge areas
  5. Can describe IT project methodology

- **Unit Content:**
  What is a project? project attributes, project planning framework, software project comparison with other projects, context of project management, role of project manager, project life cycle, software development life cycle, software development process models, project management process and knowledge areas, IT project methodology

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

- **Assessment Methods:**
  Questions based upon block diagram and descriptive questions to ensure understanding project, project attributes, project planning framework, software project comparison with other projects, context of project management, the role of project manager, project life cycle, software development life cycle, software development process models, IT project methodology

Unit 6–Ethical and Social Issues No of lectures – 06

- **Prerequisite:** Information system, data management, E-business.

- **Objectives:**
  1. To make student aware about ethical and social issues evolved because of IT and IS
  2. To make student recognize the respect for intelligent property rights
  3. To make student aware about workplace behavior and health while working in IT industry
  4. To fetch the attention of the student to need and practice of green IT

- **Outcomes:**
  After completing this unit, student –
  1. Can describe ethical and social issues arose because of IT and IS
  2. Can describe trade secrets, copyrights, patents with examples
  3. Can explain issues related to workplace behavior and health and how to overcome them
  4. Can explain green IT practices

- **Unit Content:**
  Ethical and social issues related to systems, moral dimensions of information age, ethical principles, intellectual property rights- trade secrets, copyrights, patents, privacy, workplace behavior and health, de-skilling and alienation, telecommuting, e waste, green IT

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

- **Assessment Methods:**
  Descriptive questions based upon privacy, workplace monitoring, power over users, candidate ethical principles, workplace behavior and health, de-skilling and alienation, telecommuting, e-waste and green IT

- **Internal Continuous Assessment (ICA)**
  ICA consists of minimum one assignment based on each unit - may be comprising of case studies, group discussion and information survey.

- **Text Books:**
  1. Information Technology for Management – Transforming Organizations into Digital Economy, Efraim Turban, Linda Volonino, Wiley Student Edition, Wiley India Pvt. Ltd.
  2. Management Information System, Kel Laudon, Jane Laudan, Rajanish Dass, 11th Edition, Pearson.
  3. Software Project Management, Bob Houghes, Mike Cotterall, Tata McGraw-Hill, 4th Edition

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- **Reference Books:**
  1. Introduction to Information Technology, Turban, Rainer, Potter, Wiley Student Edition, 2nd Edition
  2. Information Systems, Ralph Stair, George Reynolds, Cengage Learning, 10th Edition
  3. Management Information System (MIS), Rahul De, Wiley India Pvt. Ltd.

PAH Solapur University, Solapur
T.Y. B. Tech. (Electronics) Semester-I
EN316 PROGRAMMING WITH PYTHON

Tea **Examination Scheme:**
Lectures – 2 Hours/week, 2 Credits **ICA- 50 Marks**
Practical– 2 Hours/week, 1 Credit **POE – 50 Marks**

This course aims at introducing basics of python programming language. Python is an open source general-purpose programming language with easy syntax. Due to its cross-platform operating systems support, simple, short, readable, intuitive, and powerful programming structure along with object oriented features, python is used to develop and demonstrate applications quickly. Although, Python is an interpreted language unlike C, C++, it allows faster interfaces to the code written in these languages thus speed intensive tasks can also be handled effectively using Python.

Course Prerequisite:
Student shall have basic knowledge of programming with C and C++. Student should have necessary skills for problem solving using procedural and object oriented programming concepts.

Course Objectives:

1. To introduce to student the fundamentals of writing Python scripts.
2. To make student learn core Python scripting elements such as variables and flow control structures
3. To make student write Python functions to facilitate code reuse
4. To make student understand how to work with lists, tuples, sets and dictionaries
5. To introduce to students concepts of object-oriented programming paradigm using Python
6. To introduce to students the notion of data structures using Python

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Course Outcomes:
After completing this course, student shall able to -

1. Set up Python development environment and are able to write Python scripts
2. Employ core Python scripting elements such as variables and flow control structures
3. Use Python functions to facilitate code reuse
4. Evaluate how to work with lists, dictionaries, tuples and sets.
5. Implement concepts of object-oriented programming paradigm using Python to solve real world problems
6. Implement different data structures like linked lists, stack and queue using Python

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Section I

Unit 1- Basics of Python Programming Language No. of Lectures – 04

- **Prerequisite**: Basics of any higher level language such as C, C++

- **Objectives**:
  To make student
  1. Define identifiers, keywords, operators and expressions.
  2. Use different operators, expressions and variables available in Python.
  3. Build complex expressions using operators.
  4. Use indentation and comments in writing Python programs.
  5. Know the basic structure of a Python program
  6. Determine the data types of values.

- **Outcomes:**
  After completing this unit, student will be able to
  1. Write programs that perform simple computations
  2. To use the operators **+**, **-**, ***, /, //, **%**, and ****
  3. Display the datatype of a variable
  4. Install and use Anaconda or PyCharm IDEs

- **Unit Content:**
  Identifiers, keywords, statements and expressions, variables, operators (arithmetic, assignment, comparison, logical and bitwise), operator precedence, data types, indentation, comments, Python software development environments: Anaconda, PyCharm

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

- **Assessment Methods:**
  Programming with basic program structure of Python

Unit 2- Control Flow Statements and Functions No of lectures -05

- **Prerequisites:** Basic program structure of Python and familiarity with control statements in C and C++ language.

- **Objectives:**
  To make student
  1. Understand conditional and looping statements
  2. Understand program flow control using *break* and *continue* statements
  3. Know how to incorporate exception handling to have code robustness

4. Understand the purpose of functions in Python
5. Define and invoke functions
6. Recognize different forms of function arguments

- **Outcomes:**
  After completing this unit, student will be able to
  1. Use *if*, *if..else* and *if..elif..else* statements
  2. Write while and for loops
  3. Use *try..except* blocks for exception handling
  4. Use built-in functions such as *input(), max(), min()* etc.
  5. Use module functions such as *math.log(), math.sqrt()* etc.
  6. Write a function with default arguments and return value

- **Unit Content:**
  If, if.. else, if..elif..else statements, while and for loops, continue and break statements, exception handling using try and except blocks, use of built-in and module functions, defining functions and calling, return keyword, default and keyword arguments

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

- **Assessment Methods:**
  Programming using control flow statements and functions in Python

Unit 3- Strings No. of Lectures – 03

- **Prerequisite:** Knowledge of string declaration in C & C++

- **Objectives:**
  To make student
  1. Know how to use indexing to manipulate and process the string values
  2. Know how to use built-in string methods to manipulate strings
  3. Know search and retrieve a substring from a string

- **Outcomes:**
  After completing this unit, student will be able to
  1. Use the *str()* function to convert the other datatypes into string
  2. Use slicing to get the subset of string
  3. Use *join()* method to to join two strings
  4. Apply various string methods as per the need for problem solving

- **Unit Content:**
  Creating and storing strings, basic string operations, accessing characters in string by index number, string slicing and joining, string methods

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

- **Assessment Methods:**
  Programming using string manipulations using Python

Unit 4- Lists and Dictionaries No. of Lectures – 04

- **Prerequisite:** Knowledge of array declarations as in C & C++

- **Objectives:**
  1. To make student work with Python lists
  2. To make student work with Python dictionaries

- **Outcomes:**
  After completing this unit, student will be able to
  1. Create and manipulate items in lists.
  2. Comprehend indexing and slicing in lists.
  3. Use methods associated with lists.
  4. Create and manipulate *key:value* pairs in dictionaries.
  5. Use methods associated with dictionaries.

- **Unit Content:**
  Creating lists, basic list operations, indexing and slicing in lists, modifying items in list, list methods, creating dictionary, accessing and modifying *key:value* pairs in dictionaries, dictionary methods

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

- **Assessment Methods:**
  Programming using lists and dictionaries in Python

Section-II

Unit 5–Tuples and Sets No. of Lectures – 04

- **Prerequisite:** Knowledge of the concepts of immutable objects such as string class

- **Objectives:**
  To make student
  1. Know the difference between lists and tuples
  2. Know the use of sets in various mathematical operations
  3. Understand how tuples are declared
  4. Understand how sets are declared

- **Outcomes:**
  After completing this unit, student will be able to
  1. Create and manipulate items in tuples.
  2. Use *for* loop to access individual items in tuples.
  3. Apply mathematical operations like union and intersection using sets.

- **Unit Contents:**
  Creating tuples, basic tuple operations, indexing and slicing in tuples, relation between tuples and lists, tuple methods, tuple packing and unpacking, use of zip function, sets, set methods, frozenset

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

- **Assessment Methods:**
  Programming using tuples and sets in Python

Unit 6-Object Oriented Programming No. of Lectures – 05

- **Prerequisite:** Knowledge about concepts of object oriented programming from C++

- **Objectives:**
  To make student
  1. Understand concept behind object oriented programming (OOP) approach
  2. Understand the need of classes and objects in OOP approach
  3. Know about the *class* declaration in Python
  4. Understand encapsulation, polymorphism and inheritance concepts

- **Outcomes:**
  After completing this unit, student will be able to
  1. Write classes and create objects
  2. Recognize data attributes and methods for given objects
  3. Use the dot notation to access data attributes and methods of an object
  4. Write methods and constructors within classes
  5. Implement encapsulation, polymorphism and inheritance concepts through programming

- **Unit Contents:**
  Classes and objects, creating classes in Python, creating objects in Python, constructor declaration, passing objects as function arguments, returning objects, encapsulation, inheritance, polymorphism, operator overloading, magic methods.

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

- **Assessment Methods:**
  Programming using OOP concepts in Python

Unit 7- Data Structures No. of Lectures – 05

- **Prerequisite:** Fundamentals of data structures

- **Objectives:**
  To make student
  1. Understand implementation of stack using Python
  2. Understand implementation of queue using Python
  3. Understand implementation of linked list using Python

- **Outcomes:**
  After completing this unit, student will be able to
  1. Implement stack using Python
  2. Implement queue using Python
  3. Implement linked list using Python

- **Unit Contents:**
  List using array, list using linked list, stack operations, stack applications, queue operations

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

- **Assessment Methods:**
  Programming using data structure concepts in Python

- **Internal continuous assessment (ICA) :**
  ICA consists of minimum 10 Python programming experiments covering:
  1. Control flow statements and functions
  2. String manipulations using built-in functions
  3. Lists
  4. Dictionaries
  5. Tuples
  6. Sets
  7. OOPs
  8. Data structure

- **Text Books:**
  1. Introduction to Python Programming, Gowrishankar S. and Veena A., Chapman and Hall/CRC Press, New Delhi, 2019
  2. Core Python Programming, R. Nageswara Rao, Dreamtech Press; Second edition (2018)
  3. Programming and Problem Solving with Python, Ashok Kamthane and Amit Kamthane, McGraw Hill Education (India) Private Limited
  4. Data Structures and Algorithms Using Python, Necaise Rance D., Wiley India Pvt. Ltd

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- **Reference Books:**
  1. Introduction to Python, Y. Daniel Liang, Pearson publication, 2012.
  2. Python Cookbook, Alex Martelli and David Ascher, O'Reilly Media, 2002
  3. Python How to Program, Harvey M. Deitel, Paul J. Deitel, Jonathan P. Liperi and Ben Wiedermann, Prentice Hall, 2002
  4. Learn Python 3 the Hard Way, Zed A. Shaw, Pearson Education, 2017

PAH Solapur University, Solapur

T.Y. B.Tech (Electronics) Semester-II

EN321 COMPUTER NETWORKS

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

This course is to provide students with an overview of the concepts and fundamentals of data communication, computer networks and installation of networks to connect digital computers. The course will prepare students to plan and implement a network. It also includes peer-to-peer networks, the client-server model, network operating systems and an introduction to wide-area networks.

Course Prerequisite:

The knowledge of analog communication, modulation and channel bandwidth is essential, awareness of different communication ports and hardware support in computers along with protocol stack in operating system to support the communication is useful.

Course Objectives:

To make student

1. Understand fundamental concepts of computer networking.
2. Familiarize with the basic taxonomy and terminology of the computer networking area.
3. Understand network programming and associated services
4. Investigate the fundamental issues driving network design
5. Gain expertise in areas of networking such as the design and maintenance of individual networks

Course Outcomes:

After completing this course, student shall able to -

1. Describe basic computer network technology, layered communication approach and OSI reference model.
2. Describe error control, flow control and other issues related to successful data communication
3. Recognize global standards related to LAN establishment and functioning of LAN, use of different networking devices to enhance scope of network.
4. Illustrate TCP/IP reference model, IPv4 addressing and other issues address translation.
5. Describe different routing issues and routing protocols
6. Describe client server model and establish communication in client server network

Section I

Unit 1-Data Communication No of lectures –05

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

- **Objectives:**
  1. To make student aware of limitations offered by conventional telephone network during data communication
  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 is able to
  1. Analyze limitations of telephone network during data communication
  2. 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- description of each layer, physical layer- band limited signals, maximum data rate of a channel, 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 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 two 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 is able to
  1. Compare error correcting and detection code for error free data communication
  2. Evaluate 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 mechanism– working principle, link utilization efficiency, go back N ARQ , selective repeat ARQ, medium access control (MAC) – static and dynamic BW allocation, MAC protocols-ALOHA, CSMA, bit map, adaptive tree walk, 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 – 07

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

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

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

- **Unit Content:**
  LAN topologies
  IEEE 802.3 LAN- MAC sub layer, megabit LAN, Gigabit LAN
  IEEE 802.4 & IEEE 802.5- architecture, MAC sub layer and maintenance.
  IEEE 802.15 Blue tooth- architecture, applications, protocol stack, frame structure

- **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 –03

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

- **Objective:**
  1. To make student understand selection of appropriate network device for a particular network.
  2. To make student install different network devices in network

- **Outcomes:**
  After completing this unit, student is able to -
  1. Choose appropriate network device and install it in network.
  2. 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–09

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

- **Objectives:**
  1. To make student aware about ways of providing internet services on available computer.
  2. To introduce to student different address schemes like IP and MAC during data communication

- **Outcomes:**
  After completing this unit, student is able to -
  1. Program IP address and other parameters to computer to avail internet services.
  2. Use various networking commands and parameters in different types of communication protocols.

- **Unit Content:**
  TCP/IP reference model, encapsulation, de-capsulation
  Transmission Control Protocol (TCP) – header format, three-way handshake, TCP communication, TCP congestion & its control.
  IPv4- header format, IP communication, addressing – sub netting & masking, numerical over sub-netting, NAT
  User Datagram Protocol (UDP) – header format, checksum, UDP communication

- **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–06

- **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 introduce to 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 is able to -
  1. Decide routing mechanism based on the nature of network and traffic flow.
  2. 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, BGP and OSPF.

- **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 BGP, OSPF.

Unit 7–Client Server Model - No of lectures –05

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

- **Objectives:**
  1. To introduce to 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 is able to -
  1. Create simple server and client network and start the communication services.
  2. Establish communication between server and multiple clients

- **Unit Content:**
  Client server paradigm- simple server, simple client, client server architecture, client server model characteristics, socket, client server communication

- **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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- **Internal Continuous Assessment (ICA):**
  ICA consists of minimum eight experiments based upon above curriculum.

- **Text Books:**
  1. Computer Networks; Andrew S. Tanenbaum; 4th Edition; Prentice Hall
  2. TCP/IP Protocol Suite; Behrouz A. Forouzan ; 4th Edition
  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

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- **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

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PAH Solapur University, Solapur
T.Y. B.Tech. (Electronics) Semester-II
EN322 EMBEDDED SYSTEMS

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

Examination Scheme
ESE - 70 Marks
ISE - 30 Marks
ICA - 25 Marks
POE - 50 Marks

This course provides a thorough introduction to the architecture of ARM7TDMI core based microcontroller. The course also covers assembly and C programming for microcontroller and enables student to write programs addressing high level programming skills and also interfacing with different peripherals. The real time operating system concepts are also introduced.

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

Course Objectives:
1. To make student aware of hardware and software architecture of embedded system
2. To make student learn architecture of ARM7TDMI core.
3. To make student write assembly and C language programs for ARM7TDMI core based microcontroller.
4. To make student learn interfacing of different peripherals with microcontroller.
5. To make student learn architecture of real time operating system and its services.

Course Outcomes:
After completing this course, student shall able to -
1. Describe hardware and software architecture of embedded system.
2. Describe ARM7TDMI core architecture
3. Write assembly and C program for different applications for microcontroller.
4. Interface different peripherals with microcontroller.
5. Explain and use different services of real time operating system.

Section I

Unit 1 - Introduction to Embedded System No of lectures – 06

- **Prerequisite:** Basics of digital electronics and basic building blocks of microcontroller

- **Objectives:**
  1. To introduce to student fundamentals of embedded systems.
  2. To make student understand software and hardware architecture of embedded system.

- **Outcomes:**
  After completing this unit student -
  1. Can describe basic fundamentals of embedded systems.
  2. Can describe software and hardware architecture of embedded system.

- **Unit Content:**
  Concept of embedded system**,** RISC and ARM design philosophy, embedded system hardware and 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 – 10

- **Prerequisite**: Basics of microcontroller and embedded system architecture.

- **Objectives:**
  1. To introduce to student hardware fundamentals of ARM7TDMI core.
  2. To make student understand the instruction set of ARM7TDMI core & write assembly language program for different tasks.

- **Outcomes:**
  After completing this unit student –
  1. Can describe architecture of ARM7TDMI core.
  2. Can write assembly language program by using of ARM7TDMI core instruction set for different tasks.

- **Unit Contents:**
  ARM7TDMI core programmer's model: data types, processor modes, registers, exceptions, memory format support, unaligned access support, pipeline concept, core extensions and ARM7TDMI 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 ARM7TDMI core, and programming by using the instruction set.

Unit 3 – Architecture of ARM7TDMI based Microcontroller No of lectures – 10

- **Prerequisite:** ARM7TDMI core architecture

- **Objectives:**
  1. To introduce to student the architecture of microcontroller.
  2. To make student understand the working of on chip peripherals of microcontroller.

- **Outcomes :**
  After completing this unit, student –
  1. Can describe architecture of microcontroller.
  2. Can describe working of on chip peripherals of microcontroller.

- **Unit Contents:**
  ARM7TDMI based microcontroller architecture: study of on-chip peripherals like I/O ports, timers, interrupts, on-chip ADC, DAC, RTC, WDT, PLL, PWM, SPI, I2C etc.

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

- **Assessment Methods:**
  Questions based upon architecture of ARM7TDMI based microcontroller, working of on chip peripherals.

Section II

Unit 4 – Microcontroller Interfacing and Programming No of lectures – 08

- **Prerequisite:** ARM7TDMI core architecture and knowledge of C language programming

- **Objectives:**
  1. To make student use on chip peripherals of microcontroller for different applications.
  2. To make student interface different peripherals to microcontroller.

- **Outcomes:**
  After completing this unit, student –
  1. Can write programs for different applications.
  2. Can interface different peripherals to the microcontroller.

- **Unit Contents:**
  Basic embedded C programs for ARM7TDMI based microcontroller's on-chip peripherals of like ADC, DAC, timer/counters etc., I/O devices interfacing like LEDs, switches, LCDs and serial communication, analog interfacing & data acquisition.

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

- **Assessment Methods:**
  Questions based upon interfacing of different peripherals, and programming on interfacing.

Unit 5 – Introduction to Real Time Operating System No of lectures – 10

- **Prerequisite:** Basics of embedded system software development

- **Objectives:**
  1. To make the student realize the need of real time systems (RTOS)
  2. To make the student understand basic concepts of RTOS and its issues.

- **Outcomes:**
  After completing this unit, student –
  1. Can evaluate the need of RTOS for real time applications
  2. Can discuss fundamentals and different issues related to RTOS

- **Unit Contents-**
  Concepts of real time operating system, need of RTOS, 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

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

Unit 6 - RTOS Programming No of lectures – 10

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

- **Objectives:**
  1. To introduce to student µC/OS-II as a case study of real time operating system.
  2. To make student able to use different system services of µC/OS-II.

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

- **Unit Contents-**
  Introduction to µC/OS-II RTOS, 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 above system services.

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

- **Assessment Methods:**
  Questions based upon system services and writing of programs for different applications by making use of system services.

- **Internal Continuous Assessment (ICA):**

  ICA consists of minimum eight to ten experiments based on below list

  1. Interfacing LCD & keypad to microcontroller.
  2. Interfacing analog input devices using on-chip ADC.
  3. Waveform generation using on-chip DAC.
  4. Timer based events for microcontroller.
  5. Interfacing different peripherals using I2C protocol.
  6. Interfacing using UART for microcontroller.
  7. Interfacing different peripherals using SPI/SSP protocol.
  8. Multitasking in µC/OS RTOS
  9. Semaphore as signaling & synchronizing on microcontroller.
  10. Mailbox implementation for message passing on microcontroller.

- **Text Books**
  1. ARM System Developers Guide, Andrew Sloss, Elsevier.
  2. MicroC/OS-II: The Real Time Kernel, Jean J Labrose, CMP Books.
  3. ARM System On Chip Architecture, Steve Furber, Addison-Wesley.

- **Reference Books**
  1. ARM7TDMI based microcontroller's datasheet.
  2. Embedded systems software primer, David Simon, Pearson.
  3. Embedded Systems: Architecture, Programming and Design, Raj Kamal, McGraw Hill India.

PAH Solapur University, Solapur
T.Y. (Electronics Engineering) Semester-II
EN323 ELECTRONIC SYSTEM DESIGN

Teaching Scheme
Lectures – 4 Hours/week, 3 Credits
Practical– 2 Hour/week, 1 Credit

Examination Scheme
ESE – 70 Marks
ISE – 30 Marks
ICA- 25 Marks
OE - 50 Marks

This course is introduced with an objective to make student realize a comprehensive electronic system design and product design process. This includes battery operated power supply design and its management. It also includes other hardware and software design, PCB design, documentation and reporting which is an integral part of industrial process.

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

Course Objectives:

1. To make student realize electronics product design requirements and then make him aware of product development process and various documentation accordingly.
2. To make student design battery charger for LI-ION and Ni-MH batteries
3. To make student design interfacing circuit for different sensors -temperature, pressure, Hall Effect and light sensors.
4. To make student effective use of sensors, serial bus protocols like RS232, RS485, for system design with a practical approach.
5. To make student analyze few application cases like digital camera, smart card, smart attendance monitoring system
6. To make student design PCB for simple electronic circuits.

Course Outcomes:
After completing this course, student shall able to -

1. Describe hardware and software design process and develop various technical documents
2. Design battery charger for LI-ION and Ni-MH batteries etc.
3. Design interfacing circuit for different sensors like temperature, pressure, Hall Effect and light sensors.
4. Use sensors, serial bus protocols like RS232, RS485, for system design with a practical approach.
5. Analyze the electronics systems like digital camera, smart card, smart attendance monitoring system
6. Design the PCB for simple electronic circuits.

Section I

Unit 1 – Introduction to Electronic Product Design: No of lectures – 08

- **Prerequisite:** Fundamentals of electronics circuit design and microcontroller programming.

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

- **Outcome:**
  After completing this unit, student –
  1. Can describe various electronic product development stages
  2. Can describe different phases of software design

- **Unit Content:**
  Electronic product development basics, product development stages, identification of customer requirement, data acquisition system, types of product documentation, EDA tools, software design phases, goals of software design, design of structured program, testing and debugging of program, software documentation

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

- **Assessment Methods:**
  Questions based on product development stages, data acquisition system, product documentation, software design phases, software testing

Unit 2 – Battery Management Systems: No of lectures – 07

- **Prerequisite:** Concepts of batteries and power supply.

- **Objectives:**
  1. To make student understand battery management system, its parts and working.
  2. To make student design battery charger for LI-ION and Ni-MH batteries

- **Outcomes:**
  After completing this unit, student –
  1. Can describe battery management system, its parts and working
  2. Student can design battery charger for LI-ION and Ni-MH batteries

- **Unit Content:**
  General battery management system and its parts, types of batteries ,their working principal and charging mechanisms, battery management systems in low-end and high-end product case studies, design of battery charger for LI-ION and Ni-MH batteries

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

- **Assessment Methods:**
  Questions based on battery management system, working of batteries and design of battery charger

Unit 3 – Sensor Interfacing Circuits No of lectures – 06

- **Prerequisite:** Concept of sensors and signal conditioning circuits

- **Objectives:**
  1. To make student design signal conditioning for sensors PT 100, LM 35, thermocouples
  2. To make student understand the interfacing circuits for pressure, humidity, Hall effect, and light sensors.

- **Outcome:**
  After completing this unit, student –
  1. Can design signal conditioning for sensors PT 100, LM 35, thermocouples
  2. Can describe the interfacing circuits for pressure, humidity, Hall Effect, and light sensors.

- **Unit Content:**
  Signal conditioning for sensors PT 100, LM 35, thermocouples, interfacing circuits for pressure, humidity, Hall effect, and light sensors, interfacing with DS18B2 and MPU6050 (accelerometer).

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

- **Assessment Methods:**
  Questions based on signal conditioning circuit and sensor interfacing.

Section II

Unit 4 –Microcontroller based Design: No of lectures – 09

- **Prerequisite:** Microcontroller architecture and programming

- **Objectives:**
  1. To make student understand microcontroller interfacing techniques for electronic system design

2. To make student interface serial bus protocols like RS232 and RS485 and graphical LCD and touch screen with microcontroller
3. To make student design temperature controller and pressure controller

- **Outcomes:**
  After completing this unit, student –
1. Can describe microcontroller interfacing techniques
2. Can interface serial bus protocols like RS232 and RS485 and graphical LCD and touch screen with microcontroller
3. Can develop systems like temperature controller and pressure controller

- **Unit Content:**
  Microcontroller interfacing techniques, interfacing of serial bus protocols like RS232 and RS485 with microcontroller, graphical LCD and touch screen interfacing, temperature controller, pressure controller designs
- **Content Delivery Methods:**
  Chalk and talk, power point presentations, simulation
- **Assessment Methods:**
  Questions based on product interfacing of RS232 and RS485, graphical LCD and touch screen, design of temperature controller, pressure controller

Unit 5 – Electronics Products- Case Study: No of lectures – 06

- **Prerequisite:** Basics of structured high level programming language, microcontroller programming
- **Objective:**
  To make student analyze digital camera, smart card, smart attendance monitoring system using RFID
- **Outcome:**
  After completing this unit, student –
  Can analyze digital camera, smart card, smart attendance monitoring system using RFID
- **Unit Content:**
  Electronic system design case study: digital camera, smart card system, smart attendance monitoring system using RFID
- **Content Delivery Methods:**
  Chalk and talk, power point presentation
- **Assessment Methods:**
  Questions based on hardware and software design in digital camera, smart card, and attendance monitoring system

Unit 6 – PCB Design No of lectures – 06

- **Prerequisite:** Basics of working of electronic components/devices especially transistors, diodes, op-amps, flip-flops, registers counters etc

- **Objectives:**
  1. To make student understand the fabrication processes of printed circuit boards.
  2. To make student understand the chemical and mechanical processes by using negative/positive masks for PCB
  3. To make students use software for PCB design and have hands on different steps in PCB making - etching/routing, drilling, milling equipments as well as the developer and etcher machines

- **Outcomes:**

  After completing this unit, student –
  1. Is able to explain the fabrication processes of printed circuit boards.
  2. Can perform the chemical and mechanical processes by using negative/positive masks
  3. Is able to use software for PCB design and have hands on different steps in PCB making - etching/routing, drilling, milling equipments as well as the developer and etcher machines

- **Unit Content:**

  Types of PCB, design consideration in PCB design, PCB design for digital circuits, PCB design rules for analog circuits, noise due to ground and supply line, grounds, returns, shields, case study: any practical analog and digital circuits

- **Content Delivery Methods:**

  Chalk and talk, power point presentation, demonstration

- **Assessment Methods:**

  Questions based on design of PCB for analog and digital circuits

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- **Internal Continuous Assessment (ICA):**

  ICA shall consist of practical based upon –
  1. Design of battery chargers
  2. Simulation of interfacing touch screen, graphical LCD etc.
  3. Design of temperature controller and pressure controller
  4. Interfacing of sensors like temperature, pressure, humidity etc with microcontroller
  5. Serial data communication using RS232 and RS485
  6. Data acquisition systems
  7. PCB artwork, layout and schematic design

- **Text and Reference Books:**
  1. Electronic Product Desigin; R.G. Kaduskar, V.B. Baru; 2nd Edition
  2. Printed Circuit Boards, Design and Technology, by Walter C Bosshart, Tata Mc-Graw Hill publication
  3. Handbook of Modern Sensors: Jacob Fraden fourth Edition.
  4. Battery Management Systems : esign by Modeling: H. J. Bergveld Printed by: University Press Facilities, Eindhoven

PAH Solapur University, Solapur

T.Y. B.Tech. (Electronics) Semester-II

EN324 VLSI DESIGN

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

This course provides a thorough introduction to hardware description language (VHDL). The course intends to cover VHDL modeling and testing of various combinational and sequential circuits. The course also introduces the architectures of complex programmable logic device and field programmable gate arrays. CMOS logic, CMOS fabrication and layout and testing of logic circuits are also covered.

Course Prerequisite:

Student has completed a course in digital techniques and has an adept knowledge of various combinational and sequential circuits. Student also has knowledge about PLDs and MOS transistors.

Course Objectives:

1. To introduce to student VHDL language.
2. To make student understand modeling combinational circuits and sequential circuits using VHDL.
3. To make student understand impediments of synchronous design.
4. To introduce to student architecture of CPLD and FPGA.
5. To make student understand CMOS logic and CMOS fabrication.
6. To make student understand the importance and method for digital circuit testing.

Course Outcomes:

After completion of this course, student will be able to

1. Explain VHDL features with suitable example
2. Write VHDL code & test bench for modeling and testing combinational and sequential circuits
3. Elaborate steps in the high level design flow and implement some functions using CPLD/FPGA.
4. Explain the characteristics of CMOS and implement digital functions using CMOS logic and gates.
5. Describe the testing methods and design the minimal test set required for testing the circuits.

Section I

Unit 1 -VHDL No of lectures – 12

- **Prerequisite:** Structured programming language concepts

- **Objectives:**
  1. To make student understand VLSI design flow.
  2. To introduce to student features and capabilities of VHDL, different design units of VHDL.
  3. To make student understand the concept of data flow, structural and behavioral architectures and to learn VHDL statements used in different architectures.
  4. To make student understand the subprograms in VHDL, use of generate statement, use of generics and concept of operator overloading.
  5. To introduce to student concept of test benches – module to test the circuit.

- **Outcome:**
  After completing this unit, student will be able to-
  1. Identify the differences between different coding styles and can select an appropriate one for application.
  2. Explain the difference between signal and variable.
  3. Implement common VHDL constructs.
  4. Use different data types to represent information.
  5. Simulate a basic VHDL design.
  6. Write a VHDL test bench.

- **Unit Content:**
  Introduction, design flow, features & capabilities of VHDL, entity, architectures, configuration, library, package, data types, operators, multi valued logic, transport and inertial delays, concurrent signal assignment, signal driver, process statement, wait statement, sequential statements, signal assignment within sequential construct, signal & variable, subprograms, generate statement, generics, operator overloading, test benches

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

- **Assessment Methods:**
  Questions based upon VHDL architectures, data types, delay models, subprograms. Also questions will be asked on different statements to test the understanding of student.

Unit 2 – VHDL Modeling No of lectures – 07

- **Prerequisite:** Concepts of combinational logic, functionality of different combinational circuits.

- **Objectives:**
  1. To make student understand modeling of combinational circuits using VHDL.

2. To make student understand testing the model using test benches.
3. To make student understand VHDL modeling of RAM & ROM.

- **Outcomes:**
  After completing this unit, student will be able to–
  1. Write VHDL code using different architectures for modeling of combinational circuits.
  2. Write VHDL test bench for testing simple combinational circuits.

- **Unit Content:**
  VHDL modeling of combinational circuits such as decoder, encoder, tri state buffer, multiplexer, parity checker, parity generator, comparator, adder, multiplier, VHDL modeling of RAM & ROM.

- **Content Delivery Methods:**
  Chalk and talk, power point presentation
- **Assessment Methods:**
  Questions based upon writing VHDL code for modeling combinational circuits and test bench.

Unit 3 – Synchronous Design No of lectures – 06

- **Prerequisite:** Concepts of sequential logic, functionality of different sequential circuits, basics of FSM design, state table & state diagram representation of sequential circuit

- **Objectives:**
  1. To make student to derive the state table/state diagram for given sequential circuit.
  2. To make student to create VHDL model for different sequential circuits.
  3. To make student understand Mealy and Moore machines, able to write VHDL code for different Mealy and Moore state machines.
  4. To make student understand different factors to consider while designing synchronous circuits.

- **Outcomes:**
  After completing this unit, student will be able to–
  1. Design state table for simple Mealy and Moore FSM.
  2. Write VHDL code for different types of counters, shift registers, LFSRs.
  3. Write VHDL code for Mealy and Moore FSM.
  4. Explain the importance of considering clock skew, clock jitter in synchronous design

- **Unit Content:**
  Review of FSM design, VHDL modeling of flip flops, counters, and shift registers, LFSRs, Mealy and Moore machines

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

- **Assessment Methods:**
  Questions based upon writing VHDL code for modeling sequential circuits, Mealy and Moore machines. Also questions to test the understanding of concepts of synchronous design.

Section II

Unit 4 – Programmable Logic Devices No of lectures – 06

- **Prerequisite:** Basics of digital design

- **Objectives:**
  1. To introduce to student Xilinx 9500 complex programmable logic device architecture.
  2. To introduce to student architecture of Spartan FPGA architecture.
  3. To make the student understand difference between CPLD and FPGA.
  4. To make the student to implement small functions in FPGA.

- **Outcomes:**
  After completing this unit, student will be able to –
  1. Draw the block diagram of CPLD and FPGA architectures.
  2. Explain how the functions are implemented in CPLD.
  3. Draw the schematic showing implementation of small functions on FPGA.

- **Unit Content:**
  Xilinx 9500 series CPLD architecture, Xilinx Spartan 4000 FPGA architecture, programmable logic block architectures, implementing functions in FPGAs

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

- **Assessment Methods:**
  Questions based upon CPLD and FPGA architectures.

Unit 5 – High Level Design Flow No of lectures – 05

- **Prerequisite:** VHDL basics

- **Objectives:**
  1. To introduce to student synthesis process and how to write synthesizable designs.
  2. To make student understand the complete high level design flow from VHDL capture to VITAL simulation.

- **Outcomes:**
  After completing this unit, student will be able to –
  1. Analyze the simulation waveforms and verify the functionality.
  2. Write code for simulation and synthesis.
  3. Explain the difference between functional simulation and timing simulation.

- **Unit Content:**
  RTL simulation, synthesis, gate level verification, place and route, post layout timing simulation

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

- **Assessment Methods:**
  Questions based upon RTL simulation, synthesis and design flow.

Unit 6 – CMOS No of lectures – 07

- **Prerequisite:** Concepts of MOS transistors (NMOS & PMOS), logic gates.

- **Objectives:**
  1. To introduce to student CMOS logic, building basic gates, compound gates, multiplexers using CMOS transistors.
  2. To make student understand characteristics of CMOS inverter, different operating regions of inverter, effect of β ratio on characteristics.
  3. To make student understand CMOS fabrication process.
  4. To make student understand operation of transmission gate and its advantages over pass transistors.
  5. To make student understand concepts of noise margin, fan in, fan out, factors affecting power dissipation.

- **Outcomes:**
  After completing this unit, student will be able to –
  1. Draw the schematic for given function using CMOS logic.
  2. Explain the different regions of operation of CMOS inverter along with equations.
  3. Sketch the stick diagram and to estimate the area requirement.
  4. Derive the equations for power dissipation, timing parameters and noise margin

- **Unit Content:**
  MOS transistors, CMOS logic, CMOS fabrication and layout, CMOS inverters- DC characteristics, beta ratio effects, transmission gates, characteristics of digital circuits (power dissipation, noise margin, and fan in, fan out)

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

- **Assessment Methods:**
  Questions based upon CMOS logic, fabrication process, DC characteristics, beta ratio and characteristics of digital circuits.

Unit 7 – Testing of Logic Circuits No of lectures – 07

- **Prerequisite:** Basics of combinational & sequential circuits.

- **Objectives:**
  1. To make the student aware of need to test the circuits.
  2. To make the student conversant with basic aspects of testing.
  3. To make student understand difference between testing of combinational & sequential circuits.

- **Outcomes:**
  After completing this unit, student will be able to –
  1. Derive the test set for the given circuit for detecting faults.
  2. Draw and explain the schematic arrangement for testing sequential circuit.
  3. Design the built in self test arrangement for testing sequential circuit.

- **Unit Content:**
  Fault model, complexity of a test set, path sensitizing, random tests, testing of sequential circuits, built in self-test, boundary scan

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

- **Assessment Methods:**
  Questions based upon fault modeling, path sensitizing. Also questions on deriving test using random tests, sequential circuit testing.

- **Internal Continuous Assessment :**
  ICA consists of minimum ten experiments based on following designs. Student shall test the designs using VHDL test bench.

  Simulation, synthesis and implementation of:
  1. Combinational logic: decoder, priority encoder, comparator, adder, multiplier, multiplexer
  2. Sequential logic: counters with synchronous / asynchronous reset signal, cascading of counters, shift registers, Melay & Moore state machines
  3. RAM & ROM
  4. A mini-project to implement one of the processor peripherals in FPGA / CPLD

- **Text Books:**
  1. Fundamentals of Digital Logic with VHDL Design, Stephan Brown and Z Vranesic, TMH
  2. Digital Systems Design using VHDL, Charles H Roath, Lizy John, Cengage Learning Second Edition
  3. VHDL Programming by Example ,Douglas Perry, TMH
  4. CMOS VLSI Design A Circuits and Systems Perspective, Neil Weste, David Haris, 3rd Edition, Pearson Education

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- **Reference Books:**

  1. Digital Design, Principles and Practices, John F Wakerly, PHI
  2. The Designer's Guide to VHDL, Peter J. Ashenden, Morgan Kaufmann Publishers
  3. A VHDL Primer , Jayaram Bhasker

PAH Solapur University, Solapur

T.Y. B.Tech (Electronics) Semester-II
Open Elective II
EN325 OPERATING SYSTEMS

Teach
Lectures – 3 Hours/week, 3 Credits
Practical– 2 Hours/week, 1 Credit

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

This course covers the classical internal algorithms and structures of operating systems, including CPU scheduling and memory management. It also includes the unifying concept of the operating system as a collection of cooperating sequential processes. It also covers topic such as file systems, memory management, virtual memory and deadlocks.

Course Prerequisite:
Student shall possess knowledge of data structure, microprocessors and microcontrollers. Elementary knowledge of computer architecture, algorithms and serial communication concepts is desirable. A strong programming skill is necessary.

Course Objectives:

1. To introduce to student structure of operating system and its types.
2. To make student realize importance of processes and inter process communication.
3. To make student analyze and design algorithm for process scheduling, synchronization and removing deadlock.
4. To make student analyze memory management during process execution
5. To make student create directory structure and file system in an operating system

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Course Outcomes:
After completion of this course, student is able to -

1. Identify and describe structure, operations and different types of operating system.
2. Describe the concept of process and inter process communication.
3. Analyze effect of different scheduling criteria on scheduling techniques.
4. Evaluate deadlock condition and implement methods to overcome deadlock
5. Analyze memory management concepts like logical and physical addressing
6. Make use of file systems, directories and different commands associated to it.

Section I

Unit 1–Introduction and Overview of Operating System No of lectures –05

- **Prerequisite:**
  Evolution of computer system and operating system, concepts of basic computer system-hardware & software architecture, programming languages

- **Objectives:**
  1. To make student aware about operating system, its goals and various operations supported by it.
  2. To make student acquaint with different types of operating systems and their significance.
  3. To introduce to student structure of operating system.
  4. To introduce to student operation of system call.

- **Outcomes:**
  After completing this unit, student -
  1. Is able to explain goals and services provided by operating system.
  2. Can draw and explain simple batch system and multi programming system.
  3. Is able to explain significance of time sharing system, real time operating system and distributed operating system.
  4. Can draw and explain structure of general operating system.
  5. Is able to explain the concept of system call.

- **Unit Content:**
  Operating system, goals of an operating system, services of an operating system, classes of an operating system -simple batch system, multiprogramming system, time sharing system, real time system, distributed operating systems, structure of OS, system call and its uses.

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

- **Assessment Methods:**
  Questions based upon goals and services of an operating system, descriptive questions to ensure understanding batch processing, real time system, and time sharing system distributed system, system call, block diagram of operating system structure.

Unit 2–Process Management No of lectures – 06

- **Prerequisite:**
  Program execution environment in computer system, concepts of queue and buffer

- **Objectives:**
  1. To make student understand how to create a process.
  2. To make student analyze operations on process.
  3. To introduce to student concept of cooperation between processes.
  4. To introduce student the notion of threads.
  5. To make student understand inter process communication and its types.

- **Outcomes:**
  After completing this unit, student –
  1. Is able to describe concepts of process.
  2. Can draw and explain different states of process and process control block.
  3. Can demonstrate operations on processes and implement the concepts like process creation using C programming.
  4. Is able to describe the notion of threads
  5. Can explain different types of inter process communication.

- **Unit Content:**
  Process concept, process state diagram and process control block, operations on processes-creation & termination, cooperating processes, inter process communication, threads: multi-threading models and threading issues

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, C programs on threads

- **Assessment Methods:**
  Questions based upon block diagram and descriptive questions to ensure understanding of the process state diagram and PCB, process creation and termination, threads and inter process communication.

Unit 3–Process Scheduling & Synchronization No of lectures – 10

- **Prerequisite:** Concept of system call and process concepts

- **Objectives:**
  1. To introduce to student concept of process scheduling and different scheduling criteria
  2. To make student implement FCFS, SJF, SRTF, priority and round-robin scheduling algorithms using C programming
  3. To make student identify classical problems of synchronization
  4. To make student analyze and resolve critical section problem.
  5. To make student use synchronization tool: semaphore to avoid critical section problems

- **Outcomes:**
  After completing this unit, student –
  1. Is able to design an algorithm for process scheduling and scheduling criterions.
  2. Can describe analytical concepts related to FCFS, SJF, priority scheduling and round robin scheduling algorithms along with their implementation using C programming.

3. Is able to examine classical problem of synchronization and to analyze semaphore implementation.
4. Is able to explain critical section problem

- **Unit Content:**
  Process scheduling concept, scheduling criteria, scheduling algorithms- non pre-emptive, pre-emptive, different scheduling algorithm- FCFS, SJF, SRTF, priority based, round robin , classical problems of synchronization- the critical section problem, semaphore as synchronization tool

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

- **Assessment Methods:**
  Numerical questions based upon process scheduling and descriptive questions to ensure understanding of the process scheduling and their algorithms, classical problems of synchronization and critical section problems.

Section II

Unit 4-Deadlock No of lectures – 04

- **Prerequisite:** Basics of process and synchronization
- **Objectives:**
  1. To introduce to student concept of deadlock characterization.
  2. To make student understand different methods for handling deadlocks
  3. To make student investigate deadlock states.

- **Outcomes:**
  After completing this unit, student –
  1. Is able to evaluate deadlock and its characterizations
  2. Is able to design & describe resource allocation graph to handle deadlock.
  3. Can analyze and describe deadlock prevention methods to avoid deadlock.

- **Unit Content:**
  Introduction to deadlock, deadlock characterization, methods for handling deadlocks, dead lock prevention, deadlock avoidance, deadlock detection , recovery from deadlock.

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

- **Assessment Methods:**
  Questions based upon deadlock and deadlock characterization, descriptive question based on deadlock prevention and deadlock avoidance and detection methods.

Unit 5-Memory Management No of lectures – 05

- **Prerequisite:** Memory storage schemes, primary memory, secondary memory, RAM partitioning

- **Objectives:**
  1. To make student realize logical versus physical address space mapping.
  2. To introduce to student concept of process swapping for effective utilization of memory.
  3. To make student understand contiguous allocation of memory.
  4. To make student explore paging & segmentation

- **Outcomes:**
  After completing this unit, student –
  1. Can illustrate logical versus physical address mapping.
  2. Is able to draw & describe need and procedure of process swapping.
  3. Can portray types of memory allocation scheme along with memory fragmentation.
  4. Is able to draw & describe paging and segmentation.

- **Unit Content:**
  Background of memory, logical versus physical address space, swapping, contiguous memory allocation, paging, segmentation, segmentation with paging

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

- **Assessment Methods:**
  Descriptive questions based on logical versus physical address mapping, swapping, contiguous memory allocation, paging & segmentation.

Unit 6- Virtual Memory No of lectures – 05

- **Prerequisite:** Basics of memory management

- **Objectives:**
  1. To introduce to student basics of virtual memory management and demand paging
  2. To make student analyze page replacement policy and solve problems related to it.
  3. To make student realize frame allocation & thrashing
  4. To make student understand demand segmentation.

- **Outcomes:**
  After completing this unit, student –
  1. Can describe concept of virtual memory.
  2. Is able to draw & describe demand paging.
  3. Is able to describe and analyze page replacement algorithm.
  4. Can draw and explain frame allocation & thrashing.

- **Unit Content:**
  Background, demand paging, need of page replacement, page replacement algorithms, allocation of frames, thrashing concept, demand segmentation

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

- **Assessment Methods:**
  Descriptive question based upon demand paging, page replacement techniques & algorithm, allocation of frames, thrashing, and demand segmentation, page replacement -analytical problems based on page replacement algorithm

Unit 7- File System No of lectures – 07

- **Prerequisite:** Basics of disk input output system & direct memory access

- **Objectives:**
  1. To introduce to student concept of file system and directory.
  2. To make student comprehend file system mounting and protection.
  3. To make student apply file allocation methods.
  4. To introduce to student concept of file system in Linux.

- **Outcomes:**
  After completing this unit, student –
  1. Is able to demonstrate file system.
  2. Can describe and implement file access methods, file system mounting and protection
  3. Can describe and implement file allocation methods.

- **Unit Content:**
  File system concept, file access methods, directory structure, file-system mounting, protection, directory implementation, allocation methods, free-space management

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, animation, Linux file system utilities

- **Assessment Methods:**
  Questions based upon file access method, file directories, file allocation methods, procedure description of file system mounting and protection, directory implementation

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- **Internal Continuous Assessment (ICA):**

  It consists of minimum eight experiments based on operations on process, system calls, scheduling algorithm, threads, memory management using C programming language over Linux platform

- **Text Books:**

1. Operating System Concepts -Silberschatz Galvin- JohnWiley Publications
2. Operating System Concept Based Approach-Dahanjay M. Dhamdhare, 3rdEdition- Tata McGraw Hill

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- **Reference Books:**

1. Operating Systems Internals and Design Principles- William Stallings-5thEdition, Prentice Hall India
2. Operating System with Case Studies in UNIX, Netware and Windows NT-Achyut S. Godbole,- Tata McGraw Hill
3. Operating System in Depth- Thomas W. Doeppner- Wiley Student Edition, Wiley India Pvt. Ltd.

PAH Solapur University, Solapur
T.Y. B.Tech. (Electronics) Semester-II
Technical Self Learning Module - II
EN326.1 ROBOTICS

Teaching Scheme **Examination Scheme**
Self learning, 2 Credits **ESE – 50 Marks**

The course aims at introducing basics of robotics. It also intends to cover various control methods and grippers of robotics. The course acquaint about function, specification and types of mobile robots. It introduces large number of sensors with special emphasis on practical aspects of these. Various components of vision system & programming methods are also discussed so that student will be able to take a set of given specifications and actually come up with a simple but potential robot design.

Course Prerequisite:
Student has completed a comprehensive course in basic mechanical engineering and shall have an understanding of small mechanical systems. Student also has knowledge of basic electronics and basic programming knowledge.

Course Objectives:
1. To introduce to student basics of robotics.
2. To make student define basic components of robot system.
3. To make student understand different control scheme and types of mobile robots.
4. To make student aware about various sensors for atomization of robots.
5. To introduce to student very basics of vision system used in robotics
6. To make student responsive towards current and future scope of industrial robotics applications.

Course Outcomes:
After completion of this course -
1. Student can describe the concepts of robotics.
2. Student is able to identify the major components of robot system.
3. Student can describe different control scheme and types of mobile robots
4. Student can compare different sensors and can integrate them into robot system.
5. Student can express fundamentals of robotic vision
6. Student can evaluate current and future scope of industrial robotics applications.

Section I

Unit 1 – Robot Fundamentals

- **Prerequisite:** Concepts of basic mechanical engineering
- **Objectives:**
  1. To introduce student about fundamentals of industrial robot.
  2. To make student classify the different types of robot.
  3. To make student analyze different control method of robotics.
  4. To make student understand types of end effectors.
- **Outcomes:**
  After completion of this unit, student-
  1. Is able to describe fundamentals of robots.
  2. Can classify different types of robot.
  3. Can describe different control methods of robotics.
  4. Can explain different types of end effectors.
- **Unit Content:**
  Fundamental of industrial robots, classification of robot by co-ordinate system-cylindrical co-ordinate robots, spherical coordinate robots, jointed arm robots, Cartesian coordinate robots; classification by control method- non servo controlled robots, servo controlled robots, point to point servo controlled robots, continuous path servo controlled robots; types of end effectors-mechanical gripper, vacuum grippers, magnetic grippers, adhesive grippers.
- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation, self learning tutorials and models
- **Assessment Methods:**
  Descriptive questions based upon classification of robot, classification by control methods and different types of end effectors

Unit 2 – Overview of a Robot System

- **Prerequisite:** Robot fundamentals
- **Objectives:**
  1. To make student define basic components of robot system.
  2. To make student understand robot system in an application.
  3. To make student realize robot systems for real world application.
- **Outcomes:**
  After completion of this unit, student-
  1. Is able to identify the major components of robot system.
  2. Can describe functionality of robot system.
  3. Realizes real world applications of robots

- **Unit Content:**
  Basic component of robot system, robot system in an application: cell controller, peripheral device and defining robot position, function of robot system, specification of robot system.

- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation, self learning tutorials and models

- **Assessment Methods:**
  Descriptive questions based upon basic component of robot system, robot system in an application, function and specification of robot system

Unit 3– Mobile Robots

- **Prerequisite:** Robot fundamentals and robot systems.

- **Objectives:**
  1. To introduce to student about fundamentals of mobile robotics.
  2. To make student classify the different control scheme for mobile robots.
  3. To make student analyze different types of mobile robots

- **Outcomes:**
  After completion of this unit, student-
  1. Is able to describe fundamentals of mobile robotics
  2. Can classify different control schemes for mobile robots
  3. Can describe different types of mobile robots

- **Unit Content:**
  Introduction, control scheme for mobile robots, key issues for locomotion, legged mobile robots, wheeled mobile robots

- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation, self learning tutorials and models

- **Assessment Methods:**
  Descriptive questions based upon control scheme for mobile robots and different types of mobile robots

Section II

Unit 4 – Sensors in Robotics

- **Prerequisite:** Concepts of robot fundamentals, robot system and mobile robots.

- **Objectives:**
  1. To make student aware of the sensor classification.
  2. To make student select sensor as per requirement.
  3. To make student aware about various sensors for automization of robots.

- **Outcomes:**
  After completion of this unit, student-
  1. Can classify sensors.
  2. Is able to select the sensors depending on requirement.
  3. Can realize sensors and integrate the robot system

- **Unit Content:**
  Transducers and sensors, tactile sensor, proximity and range sensor, miscellaneous sensors and sensor based system, position sensor, encoders and velocity sensors, sensors in mobile robot-wheel/motor sensors, heading sensors, vision-based sensors

- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation, self learning tutorials and models

- **Assessment Methods:**
  Descriptive questions based upon different types of sensors and sensors in mobile robot

Unit 5 – Robot Vision & Programming

- **Prerequisite:** Basic programming knowledge.

- **Objectives:**
  1. To make student acquainted with basic visual sensing system.
  2. To make student realize the operation and function of machine vision.
  3. To make student recognize machine vision applications.
  4. To make student understand robot programming method.

- **Outcomes:**
  After completion of this unit, student-
  1. Can describe basic visual sensing system.
  2. Can describe operation and function of machine vision.
  3. Is able to recognize machine vision applications
  4. Is able to write simple robot programs

- **Unit Content:**
  Visual sensing, machine vision- image acquisition, image digitization, image processing, image analysis, image interpretation; robot programming, programming methods

- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation, self learning tutorials and models

- **Assessment Methods:**
  Descriptive questions based on visual sensing, machine vision and different programming methods

Unit 6 – Robot Applications

- **Prerequisite:** Robot fundamentals , robot system and types of robot

- **Objectives:**
  1. To make student responsive towards current and future scope of industrial robotics applications.
  2. To make student develop an innovative atomized robots.

- **Outcome:**
  After completion of this unit, student-
  1. Is acquainted with current and future scope of industrial robotics applications.
  2. Can develop innovative automized robots.

- **Unit Content:**
  Welding, spray painting, grinding, other applications involving a rotary tool, parts handling/transfer, assembly operations, parts sorting, parts inspection, robot application in the future.

- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation, self learning tutorials and models

- **Assessment Methods:**
  Descriptive questions based on different applications.

- **Text Books:**
  1. Robotic Engineering, R.D.Klafter, T.A.Chmielewski, Michael Negin, Prentice Hall of india private limited.
  2. Robot Technology Fundamentals, James G.Keramas, Cengage learning india private limited

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- **Reference books:**
  1. Robotics , K.S.Fu, R.C.Gonzalez, C.S.G.Lee, McGraw Hill international Edition
  2. **I**ndustrial Robotics, Mikekell Groover, Mitchell Weiss, Tata McGraw Hill international Edition
  3. Autonomous mobile robots, Roland Siegwart, Illah R. Nourbakhsh

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Note - Being self learning course, the purpose of this course is introduction of Robotic and detailed analytical treatment is not expected

PAH Solapur University, Solapur
T.Y. B.Tech. (Electronics) Semester-II
Technical Self Learning Module II
EN326.2 : AUTOMOTIVE ELECTRONICS

ıe **Examination Scheme**

Self- learning, 2 Credits **Theory –** 50 Marks

Automotive sector has emerged as one of the major application areas for electronics engineering. This self -learning elective is designed with two objectives. First objective is to introduce to the student basic automotive aspects like working of engine and power train. Second is exposing the student with electronics technology pertinent to automotive sector like sensors, actuators, control and communication. If required, this course can be delivered in association with concerned faculty from mechanical/automobile engineering.

Course Prerequisite:

Student shall have knowledge of basic two stoke and four stroke IC engines, hydraulics and pneumatics. Student shall also pose some background for transducers, electronic circuit design, microprocessors/microcontrollers and control systems.

Course Objectives:

After completion of this course -

1. To introduce concepts of basics of automotive- engine, transmission, braking
2. To illustrate how today's automobile, make use of different electronic circuits for ignition, instrumentation, control etc.
3. To provide basic understanding of automotive communication and diagnostic systems
4. To persuade for use of environmentally friendly vehicles

Course Outcomes:

After completion of this course -

1. Student can describe basics of working of automobile engines and transmission
2. Student can describe different electronic circuits used in automobiles
3. Student can describe communication and diagnostic systems used in automobiles
4. Student can evaluate importance of environmentally friendly vehicles

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Section I

Unit 1 - Power Train Engineering and Fundamentals of Automotive

- **Prerequisite:** Working of two stroke and four stroke engines, DC and AC power supply

- **Objectives:**
  1. To introduce to student working of petrol, diesel and gas engines
  2. To introduce to student working of transmission system
  3. To highlight on use of electronics for automotive – battery, ignition, electrical motors
  4. To emphasize on use of hybrid / environmentally friendly vehicles

- **Outcomes:**
  After completing this unit, student –
  1. Can explain basics of different auto engines and transmission
  2. Can recognize use of electronics for different automotive applications
  3. Realizes the importance of environmental friendly vehicles and also possible technologies leading to it

- **Unit Content:**
  Fundamentals of internal combustion engines; petrol, diesel and gas engines; basic components of engines and their significance, evolution of electronics in automotive; basic automotive system, system components; basic transmission systems; electric motors and control systems used for electric automotive; introduction to existing engine forms and alternatives, hybrid designs (solar power, electric/gasoline, LPG, fuel cells);

- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation, animations, actual auto parts and models

- **Assessment Methods:**
  Questions based upon working of engines, transmissions etc; questions related to circuit diagrams of different subsystems like ignition systems, battery charging systems, questions related to concepts of hybrid vehicles and electric motor control.

Unit 2 – Sensor Technologies in Automotive

- Prerequisite: Basics of transducers and electronic circuit design

- **Objective:**
  1. To introduce to student different sensors used for instrumentation in typical automobile

- **Outcome:**
  After completing this unit, student –
  1. Can select an appropriate sensor for various auto parameters

- **Unit Content:**
  In-vehicle sensors: working principles, characteristics, limitations and use within the automotive context of the following:
  1.Temperature sensing e.g. coolant, air intake
  2.Pressure sensing e.g. manifold, exhaust differential, types
  3.Distance sensing e.g. anti-collision
  4.Velocity sensing e.g. speedometer, anti-skid
  5.Torque sensing e.g. automatic transmission
  6..Vibration sensing, accelerometer e.g. airbags
- **Content Delivery Methods:**
  Although self-learning course, some interactive sessions shall be conducted with power point presentation, actual auto parts and models
- **Assessment Methods:**
  Descriptive questions based upon working for sensors.

Unit 3 - Interfacing Principles of Sensors

- **Prerequisite:** Sensors and transducers, op amp circuits, electronic circuit design
- **Objective:**
  1. To apply different sensors used for instrumentation in typical automobile through proper interfacing and signal conditioning
- **Outcome:**
  After completing this unit, student –
  1. Can explain how to use an appropriate sensor for various auto parameters with proper signal conditioning
- **Unit Content:**
  Interfacing principles: operation, topologies ,vehicle processing or communications nodes; interfacing electronics, operational amplifier circuits, instrumentation amplifiers, comparators; level shifting, wave- shaping, filters; noise mechanisms and reduction; ADCs and DACs (all the topics should be with automotive context)
- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation, actual auto parts and models
- **Assessment Methods:**
  Descriptive questions based upon interfacing and signal conditioning for the sensors; design of small instrumentation system for various parameter measurements.

Section II

Unit 4 – Actuators in Automotive Systems

- **Prerequisite:** Basics of hydraulics and pneumatics, electromagnetic theory

- **Objectives:**
  1. To introduce different actuators used in a typical automobile

- **Outcomes:**
  After completing this unit, student –
  1. Can describe different types of actuators used in automobiles

- **Unit Content:**
  Actuators - types, working principle, characteristics, limitations and use within the automotive context of each type: hydraulic actuators and pneumatic actuators; electromagnetic actuators, types of solenoid valves; basic drive circuits for solenoid valves and hydraulic and pneumatic actuators

- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation, actual auto parts and models

- **Assessment Methods:**
  Descriptive questions based upon actuators and their selection and drive circuits.

Unit 5 – Electronic Control Unit and Automotive Control System

- **Prerequisite**: Basics of control systems, microprocessors/microcontrollers

- **Objectives:**
  1. To highlight on and explain different control systems required in a typical automobile
  2. To explain preliminary idea to realize these control systems using appropriate microcontroller

- **Outcomes:**
  After completing this unit, student –
  1. Can describe different control systems used in automobiles and their necessity
  2. Can devise very basic control systems using appropriate microcontroller

- **Unit Content:**
  Control system approach in automotive: analog and digital control methods, various control systems in automobile: engine control system, transmission control system, cruise control system, traction control system, vehicle braking and ABS; block diagrams, systems components

- **Content Delivery Methods:**
  Although self-learning course, some interactive sessions shall be conducted with power point presentation, actual auto parts and models

- **Assessment Methods:**
  Descriptive/ block diagram questions based upon various control systems, simple design using micro-controller

Unit 6 – Automotive Communication and Diagnostic Systems

- **Prerequisite:** Serial and parallel communication protocol, microprocessors/ microcontrollers

- **Objectives:**
  1. To bring light to various diagnostic, safety and comfort systems present in today's automobile and role of electronics in it
  2. To explain various communication buses/protocols used in today's automobiles and their features

- **Outcomes:**
  After completing this unit, student –
  1. Can describe different diagnostic, safety and comfort systems used in automobiles and electronics drawn in it.
  2. Can describe various communication buses/protocols used in today's automobiles and their features

- **Unit Content:**
  Communication interface with ECUs: relevance of communication protocols for automotive applications; automotive communication bus: CAN
  fundamentals of diagnostics: basic wiring system and multiplex wiring system; self-diagnostic system, diagnostic procedures and sequence; recent trends in automotive diagnostic systems- on- board-diagnostics and off-board diagnostic systems
  safety in automotive: requirements and constraints; passenger comfort and security systems

- **Content Delivery Methods:**
  Although self-learning course, some interactive sessions shall be conducted with power point presentation, actual auto parts and models
- **Assessment Methods:**
  Descriptive/ block diagram questions based upon various diagnostic, safety and comfort systems, applications and comparison of buses and protocols

- **Text Books**:
  1. Understanding Automotive Electronics, Williams. B.Ribbens, 6th Edition, Elsevier Science, Newness Publication.
  2. Mechatronics: Integrated Mechanical and Electronic System, K.P.Ramchandran, G.K.Vijayraghavan, M.S. Balsundaram Wiley India, 2010

- **Reference Books**:
  1. Automotive Electronics Handbook, Ronald K Jurgen, 2nd edition, McGraw-Hill, 1999.
  2. Automotive Electricity and Electronics, James D Halderman, PHI Publication 2005.
  3. Automotive Electronics Handbook, Robert Bosch, John Wiley and Sons, 2004.

Note - Being self learning course, the purpose of this course is introduction of Automotive Electronics and detailed analytical treatment is not expected

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PAH Solapur University, Solapur
T.Y.B Tech (Electronics)-Semester-II
Technical Self Learning Module II
EN326.3 ELECTRONIC INSTRUMENTATION

Teaching Scheme **Examination Scheme**
Self learning, 2 Credits **ESE – 50 Marks**

The course intends to cover fundamentals of electronic instruments and measurements providing in-depth understanding of indicators, display devices, analyzers and sensors. This course also covers static and dynamic error analysis. It also covers various types of interference and their reduction techniques. In this course student will be learning basic building blocks of data acquisition system, recorders and data logging systems.

Course Prerequisite:
Student has completed course on basic electronic components and has in depth knowledge of active and passive components. Student also has knowledge about digital circuits, transducers, linear integrated circuits and network theory.

Course Objectives:
1. To make student understand working of different measuring and monitoring instruments.
2. To make student analyze type of errors and signal conditioning systems used for measurement.
3. To introduce to student effects of environmental interference with measuring signal.
4. To introduce to student with different sensors used in measuring instruments.
5. To develop interfacing and testing circuits for smart sensors.
6. To make student understand data acquisition system used in process industries

Course Outcomes:
After completion of this course -
1. Student can identify type of errors occurring in measuring instruments.
2. Student is able to convert measuring quantity into different standard units.
3. Student can describe various shielding methods for reducing signal interference.
4. Student can describe designing aspects for electronic counters, measuring meters of different ranges.
5. Student can select proper transducers / sensors, recorders to assemble a measuring instrument for different applications.
6. Student can explain data acquisition system for various applications

Section I

Unit 1 – Qualities of Measurement

- **Prerequisite:** International standard units, signal types, differential equations

- **Objectives:**
  1. To make student understand performance characteristics of measurement.
  2. To make student identify errors and correct them.
  3. To explain dynamic response of zero order, first order and second order instrument.

- **Outcomes:**
  After completing this unit, student -
  1. Can calculate and analyze type of error present in measurement.
  2. Can calculate accuracy and precision for given set of measurements.

- **Unit Content:**
  Performance characteristics – static and dynamic, sources of error, types of static errors – gross, systematic and random; statistical analysis – arithmetic mean, average deviation and standard deviation, dynamic response of an instrument – zero, first and second order; classification of standards – international, primary, secondary and working standards

- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation

- **Assessment Methods:**
  Numerical questions based upon errors, statistical analysis; descriptive questions based upon performance characteristics, standards.

Unit 2 – Signal Interference

- **Prerequisite:** Basic electronic components, linear circuit theory

- **Objectives:**
  1. To introduce to student design issues in electronic instruments.
  2. To make student understand AC and DC signal conditioning circuits.
  3. To make student understand capacitive, inductive and electromagnetic interference.
  4. To make student understand ground-loop interference and its effects.
  5. To introduce to student shielding methods to reduce interference.

- **Outcomes:**
  After completing this unit, student –
  1. Can illustrate signal conditioning circuits like attenuators, wave shapers etc.
  2. Can identify type of interference present in systems.
  3. Can calculate internal noise present in systems.
  4. Can illustrate shielding process for different interferences.

- **Unit Content:**
  Block diagram of signal conditioning systems – AC and DC; capacitive interference, inductive interference, electromagnetic interference, input shielding, input guarding to reduce ground-loop interference, internal noise.

- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation

- **Assessment Methods:**
  Descriptive questions based on signal conditioning systems, guarding techniques, noise, ground-loop interference; analytical questions based on shielding, interference of capacitance, inductance.

Unit 3 – Measuring Instruments and Display Devices

- **Prerequisite:** Galvanometer, linear circuit theory, digital circuits –flip-flop, modulus counters

- **Objectives:**
  1. To make student understand basic block diagram of electronic counter for measurement of frequency, time interval and period.
  2. To introduce to student working principle of measuring instruments – tachometer, pH meter and phase meter.
  3. To introduce to student working principle of display devices – LED, LCD and plasma

- **Outcomes:**
  After completing this unit, student –
  1. Can describe designing scheme for electronic and universal counters to measure basic signal parameters.
  2. Can illustrate designing steps for various non-electrical measuring instruments.
  3. Can identify and describe various types of display.

- **Unit Content:**
  Block diagram and working principle of electronic counters, universal counter, tachometer, pH meter and phase meter; classification of display devices, structure and applications of display devices – LED, LCD and plasma.

- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation

- **Assessment Methods:**
  Descriptive questions based on block description of electronic counters, universal counters, measuring meters and structure of display devices

Section II

Unit 4 – Signal Analyzers

- **Prerequisite:** Concepts of modulation, sample and hold circuits, loop filters, voltage controlled oscillators, fast fourier transform, memory devices

- **Objectives:**
  1. To introduce to student concept of signal distortion and its types
  2. To make student understand functional blocks of distortion measuring analyzers
  3. To make student understand functional blocks and applications of spectrum analyzer, FFT analyzer, vector analyzer and logic analyzer
  4. To make student understand difference between spectrum analyzer and logic analyzer.

- **Outcomes:**
  After completing this unit, student –
  1. Can identify different distortions and can calculate it.
  2. Can compare between spectrum analyzer and logic analyzer
  3. Is able to select relevant analyzer as monitoring device depending upon applications.

- **Unit Content:**
  Distortion types – harmonic and inter modulation; distortion measuring analyzers – distortion analyzer, wave analyzer, inter-modulation analyzer; spectrum analyzer, FFT analyzer, vector analyzer; logic analyzer – logic timing analyzer, logic state analyzer

- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation

- **Assessment Methods:**
  Descriptive questions based on distortion types, block diagram of types of analyzers

Unit 5 – Sensors:

- **Prerequisite:** Concepts of digital circuits, concepts of ultrasonic waves

- **Objectives:**
  1. To introduce to student basic blocks of sensors system.
  2. To make student understand working principle of ultrasonic sensor and its transmission.
  3. To introduce to student concept of multi-sensing using smart sensors.
  4. To make student understand steps for integration and testing of sensors

- **Outcomes:**
  After completing this unit, student–
  1. Can identify different types of sensors
  2. Is able to describe transmitter circuit using ultrasonic sensors for various applications
  3. Can illustrate multi-sensing systems using smart sensors
  4. Can develop designing steps for integration and testing of sensors

- **Unit Content:**
  Introduction to basic sensor system, ultrasonic sensors – transmission of ultrasound, equivalent circuit of transmitter, measurement of ultrasound, applications; smart sensors – logical function, integration of signal processing, self-testing of smart sensors, multi-sensing, applications

- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation

- **Assessment Methods:**
  Descriptive questions based upon functional blocks of ultrasonic and smart sensors, their measurements, testing and multi-sensing

Unit 6 – Data Acquisition System

- **Prerequisite:** Digital electronics, transducers, ADC, DAC

- **Objectives:**
  1. To explain to student the basic requirement and objectives of data acquisition system
  2. To make student understand basic blocks of data acquisition system and its types
  3. To explain to student requirement of recorders and data loggers
  4. To explain to student working of recorders for slow and fast varying signals
  5. To make student understand basic blocks of data logger and its applications

- **Outcomes:**
  After completing this unit, student –
  1. Is able to identify and describe basic blocks of data acquisition for different applications.
  2. Can describe designing steps for single channel and multi channel data acquisition systems.
  3. Can identify various types of recorders and develop steps to interface converters with recorders.
  4. Is able to describe data logging systems for relevant applications.

- **Unit Content:**
  Introduction, generalized data acquisition system, types –single channel and multi channel; requirement and classification of recorders, recorders for slowly varying signals- strip chart and XY recorders; recorders for fast varying signals- magnetic tape recorders, general block diagram of data logging system

- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation

- **Assessment Methods:**
  Descriptive questions based upon objectives and types of data acquisition system, classification and types of recorders, block schematic of data logger

- **Text Books:**
  1. Electrical and Electronic Measurement and Instrumentation, Sawney A.K, Dhanpatrai And Co.
  2. Fundamentals of Industrial Instrumentation, Dr. Alok Barua, Wiley India Pvt. Ltd.
  3. Instrumentation for Engineering Measurements, James W. Dally, William F. Riley, 2nd Edition, Wiley India Pvt. Ltd.

- **Reference books:**

  1. Electronic Instrumentation and Measurement Techniques, W.D. Cooper, 3rd edition, Prentice Hall of India Pvt. Ltd.
  2. Electronic Instrumentation & Instrumentation Technology, M.M.S. Anand, Prentice Hall of India Pvt. Ltd.
  3. Electronic Instrumentation, H.S. Kalsi, 2nd Edition, Tata McGraw-Hill publishing company Ltd.

PAH Solapur University, Solapur
T.Y. B. Tech. (Electronics) Semester-II
Technical Self Learning Module II
EN326.4 PROGRAMMING WITH JAVA

Teac... Scheme: **Examination Scheme**
Self learning, 2 Credits **Theory – 50 Marks**

Java is a key programming language for the software development in today's network-centric environment such as internet. Its popularity and applicability stems from its inherent object oriented programming (OOP) structure along with ability to provide platform independent programming environment. This self learning course introduces the transitional development of programming to students by beginning with the procedural approach towards focusing on the pure object oriented programming approach. Important features related to any OOP language such as data abstraction, data encapsulation, polymorphism, inheritance are also introduced along with additional packages and interfaces available within the Java development environment.

Course Prerequisite:
Student shall have an adept knowledge of programming with C and C++. Student should be acquainted with the basics of procedural and object oriented programming concepts.

Course Objectives:

1. To introduce to students core Java programming concepts.
2. To make student understand the concept of methods and classes in Java perspective and using the same for implementing various OOP features such as Inheritance etc.
3. To introduce to students various packages and interfaces available within Java.

Course Outcomes:
After completion of this course -

1. Student can outline basics of core Java programming.
2. Student can employ the concept of classes and methods to solve real world problems.
3. Student can implement different types of inheritance and explain the importance of inheritance.
4. Student can choose an appropriate Java package for different programming tasks.

Section I

Unit 1- Introduction to OOP and Java Environment

- **Prerequisite**: Concepts of object oriented programming in C++

- **Objectives**:
  1. To make student understand clearly the difference between object-oriented and procedural languages
  2. To make student comprehend the problems in procedural programming and how OOP overcomes them
  3. To make student learn the applications of OOP
  4. To make student understand the features of Java and its runtime environment
  5. To make student know the basic structure of a Java program
  6. To make student know the details about JDK installation

- **Outcomes:**
  After completing this unit, student will be able to
  1. Explain the foundational principles of object-oriented programming
  2. Summarize Java's contribution to the Internet
  3. Explain the importance of bytecode
  4. Create, compile, and run a simple Java program

- **Unit Content:**
  Introduction to OOP - need for object oriented programming**,** principles of object-oriented programming languages, procedural language vs. OOP, applications of OOP, the Java environment- history of Java, Java essentials, Java virtual machine, Java features, program structure, differences between Java and C++, installation of JDK, Java integrated development environment

- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation, self learning tutorials and videos.

- **Assessment Methods:**
  Student will be evaluated by questions on basic program structure of Java

Unit 2-Java Programming Constructs

- **Prerequisites:** Basic program structure of Java, C, C++ programming constructs

- **Objectives:**
  To make student
  1. Understand how variables are used in Java

2. Know the basic data types
3. Learn expressions and conditional statements
4. Use all the available operations in Java
5. Know the basics of type conversion and typecasting
6. Understand loops and branching statements

- **Outcomes:**
  After completing this unit, student will be able to
  1. Use literals and initialize variables
  2. Use the arithmetic operators
  3. Use the relational and logical operators
  4. Use shorthand assignments
  5. Implement type conversion in assignments
  6. Use the *switch* statement, the *while***,** the *do while* loop

- **Unit Content:**
  Variables, primitive data types, identifier, literals, operators, expressions, precedence rules & associativity, primitive type conversion & casting, flow of control

- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation, self learning tutorials and videos.

- **Assessment Methods:**
  Student will be evaluated by questions on Java programming constructs

Unit 3- Classes, Objects and Methods

- **Prerequisite:** Knowledge about important OOP concepts and features such as class, object, function, constructor, polymorphism and overloading**.**

- **Objectives:**
  To make student
  1. Know how classes and objects are created and applied in Java
  2. Know how methods are implemented and used
  3. Understand the concepts of polymorphism and function overloading
  4. Understand what is a constructor
  5. Establish familiarity with *static* keyword

- **Outcomes:**
  After completing this unit, student will be able to
  1. Illustrate the fundamentals of the class
  2. Can create objects

3. Create methods, return values, and use parameters
4. Create parameterized constructors
5. Utilize garbage collection
6. Use the keywords *new* and *this*

- **Unit Content:**
  Classes, objects, class declaration in Java, creating methods, constructors, cleaning up unused objects, use of *static* and *this* keywords, command line arguments, nested classes

- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation, self learning tutorials and videos.

- **Assessment Methods:**
  Student will be evaluated by questions on the concepts of class, objects, methods, constructors

Unit 4- Arrays and Strings

- **Prerequisite:** Knowledge of array and string declarations as in C & C++

- **Objectives:**
  1. To make student work with Java arrays
  2. To make student work with Java string objects

- **Outcomes:**
  After completing this unit, student will be able to
  1. Create and use multidimensional arrays
  2. Write alternative array declarations
  3. Use Java string objects
  4. Employ different string methods

- **Unit Content:**
  Java arrays, array constants, using arrays, copying array elements, string objects, string methods, string concatenation, converting objects to strings, converting strings to numbers

- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation, self learning tutorials and videos.

- **Assessment Methods:**
  Student will be evaluated by questions on the concepts of arrays and strings in Java

Section-II

Unit 5–Inheritance and Polymorphism

- **Prerequisite:** Knowledge of the concepts of inheritance and polymorphism in C++

- **Objectives:** To make student
  1. Know the difference between inheritance and aggregation
  2. Understand how inheritance is done in Java
  3. Learn polymorphism through method overriding
  4. Learn the keywords: *super* and *final*
  5. Understand the basics of abstract class
  6. Understand the difference between shadowing and overriding

- **Outcomes:**
  After completing this unit, student will be able to
  1. Use *super* keyword to access superclass members
  2. Create a multilevel class hierarchy
  3. Demonstrate superclass references to subclass objects
  4. Illustrate polymorphism through method overriding
  5. Use abstract classes
  6. Use final keyword to prevent overriding, inheritance

- **Unit Contents:**
  Inheritance vs. aggregation, overriding method, *super* keyword, *final* keyword, abstract class, shadowing vs. overriding

- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation, self learning tutorials and videos.

- **Assessment Methods:**
  Student will be evaluated by questions on the concept of inheritance and polymorphism in Java

Unit 6-Packages and Interfaces

- **Prerequisite:** Knowledge about how to use Java application programming interface (API) document

- **Objectives:** To make student
  1. Understand what interfaces are and how they are different from abstract classes
  2. Understand the concept behind packages and how they are used
  3. Know about the *java.lang* package
  4. Understand object class and wrapper class

- **Outcomes:**
  After completing this unit, student will be able to
  1. Create packages
  2. Import Java's standard packages
  3. Apply the *protected* access specifier
  4. Implement an interface
  5. Extend interfaces

- **Unit Contents:**
  Interfaces- **v**ariables in interface, extending interfaces, interface vs. abstract class, packages- creating packages, using packages, access protection, java.lang.Object class

- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation, self learning tutorials and videos.

- **Assessment Methods:**
  Student will be evaluated by questions on the concepts of packages and interfaces in Java

Unit 7–Exception Handling

- **Prerequisite:** Knowledge of exception handling in C++

- **Objectives:**
  To make student
  1. Understand the concepts and applications of exception handling
  2. Understand all the keywords used for exception handling
  3. Create user-defined exceptions

- **Outcomes:**
  After completing this unit, student will be able to
  1. Use *try* and *catch* statement
  2. Demonstrate how to throw an exception
  3. Use *finally* and *throws* keywords

- **Unit Contents:**
  Exception handling- exception handling techniques**,** try…catch, throw keyword, throws, finally block, try-with-resources statements, multi catch, improved exception handling in Java, user-defined exception

- **Content Delivery Methods:**
  Although self learning course, some interactive sessions shall be conducted with power point presentation, self learning tutorials and videos.

- **Assessment:**
  Student will be evaluated by questions on the concepts of exception handling

- **Text Books:**
  1. Programming with Java: A Primer, E. Balagurusamy, Tata McGraw Hill Publication, New Delhi
  2. Programming in Java, Sachin Malhotra and Saurabh Choudhary, Oxford University Press, New Delhi
  3. Core Java: An Integrated Approach, R. Nageswara Rao, Dreamtech Press

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- **Reference Books:**
  1. Java: A Beginner's Guide, Herbert Schildt, McGraw-Hill Education
  2. Core Java 2: Volume-I Fundamentals, Cay S. Horstmann and Gary Cornell, Prentice Hall PTR
  3. Java 2: The complete Reference, Patrick Naughton and Herbert Schildt, McGraw-Hill

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PAH Solapur University, Solapur

T.Y. B. Tech (Electronics) Semester-II

EN327 MINI HARDWARE PROJECT

Te **Examination Scheme**
Practical – 2 Hours/week **ICA – 50 Marks**
Credit: 1

This course encourages student for project based learning through development of hardware mini project in applied areas. The course aims to apply acquired skills of electronic circuit designing, digital design, instrumentation, microcontroller, electronic components specifications and their testing. The hardware project also provides experience of working in a team with set target. The project report writing allows student to gain knowledge of technical documentation of certain product. The entire experience in the project may be useful for entrepreneurship development.

Course Prerequisite:

Electronic component identification and their testing, fundamentals of electronic circuit designing, concepts in digital designing, knowledge of various sensors, knowledge of control systems fundamentals, microcontrollers

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Course Objectives:

1. To encourage student to undertake and execute mini hardware project in a group which includes selection of appropriate hardware components, understanding their specifications and testing procedures.
2. To make student acquaintance with computer aided PCB designing tool
3. To develop electronic hardware assembly, soldering and testing skills amongst student
4. To nurture technical report witting skills amongst student
5. To understand the product development cycle through mini project.

Course Outcomes:

After completion of this course,

1. Student can plan and execute a mini project with team.
2. Student can device electronic hardware by implementing knowledge and skill of PCB design techniques, soldering techniques and hardware debugging techniques
3. Student can prepare technical report based on the mini project
4. Student can estimate cost of the mini project, deliver technical seminar over mini project.

- **Course Curriculum:**
  The mini hardware project is mainly focused on circuit selection, component selection, pre-testing of electronic circuit on bread board, making of PCB for proposed project, project assembly, debugging, testing and technical report writing.

- **Guidelines:**
  Project group shall consist of not more than 3 students.
  The mini project plan shall include phases group formation , mini project topic selection, circuit component selection, pre-testing of project over breadboard, PCB artwork designing using EDA tool, simulation, hardware assembly, testing, enclosure design, testing and analysis, presentation and report writing

- **Domains for mini projects** (***but not limited to following***) :
  1. Instrumentation and control systems
  2. Electronics communication systems
  3. Embedded systems
  4. Internet of Things
  5. Audio and video systems
  6. Renewable Energy systems
  7. Mechatronics systems
  8. Disaster management systems

- **Assessment Methods:**

  Below scheme is recommended for assessment of mini project –

  1. Selection of the project and pre circuit testing 20 %
  2. Circuit design, simulation, PCB and assembly 30%
  3. Results / Output from final assembly 10%
  4. Mini project presentation seminar 10%
  5. Project report 20%
  6. Viva-voce of individual student 10%