SOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF ENGINEERING & TECHNOLOGY

ELECTRONICS ENGINEERING

Syllabus for

T.E. (Electronics Engineering) w.e.f. Academic Year 2018-19
Choice Based Credit System

SOLAPUR UNIVERSITY, SOLAPUR
FACULTY OF ENGINEERING & 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

SOLAPUR UNIVERSITY, SOLAPUR

Faculty of Engineering & Technology (Revised from 2016-17)

Choice Based Credit System (CBCS) Curriculum of T.E. Electronics Engineering W.E.F. 2018-19 *Semester I*

Course Code	Theory Course Name	Hrs./week			Credits	Examination Scheme			
		L	T	P		ISE	ESE	ICA	Total
EN311	Control Systems	3	1	_	4	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	Information Technology & Management	3	_	_	3	30	70	25	125
SLH31	Self Learning Course I -HSS	_	_	_	2	--	50	_	50
EN317	Programming with Java	2	-	-	2	--	--	50	50
Sub Total		20	2	_	24	150	400	100	650
Course Code	**Laboratory Course Name**								
							ESE		
							POE	OE	
EN311	Control Systems	_	_	2	1	_	--	--	25	25
EN312	Digital Signal Processing	_	_	2	1	_	--	25	25	50
EN313	Microcontrollers	--	--	2	1	--	50	--	25	75
EN317	Programming with Java	_	_	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)

Course Code	***Theory Course Name***	***Hrs./week***			***Credits***	***Examination Scheme***			
		L	***T***	***P***		***ISE***	***ESE***	***ICA***	***Total***
EN321	Operating Systems	3	_	_	3	30	70	-	100
EN322	Digital Communication	3	_	_	3	30	70	-	100
EN323	Embedded Systems	4	_	_	4	30	70	-	100
EN324	Industrial Electronics	4	_	_	4	30	70	-	100
EN325	VLSI Design	4	_	_	4	30	70	_	100
EN326	Self Learning Course II-Technical	_	_	_	2	--	50	_	50
Sub Total		18	_	_	20	150	400	_	550
Course Code	***Laboratory Course Name***								
							ESE		
							POE	***OE***	
EN321	Operating Systems	_	_	2	1	_	_	_	25	25
EN322	Digital Communication	_	_	2	1	_	_	25	25	50
EN323	Embedded Systems	_	_	2	1	_	50	_	25	75
EN324	Industrial Electronics	_	_	2	1	_	50	_	25	75
EN325	VLSI Design	_	_	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 B.E. Part-I) of minimum 15 days shall be completed in any vacation after S.E. Part-II but before B.E. Part-I & the report shall be submitted and evaluated in B.E. Part-I

3. Student shall select one Self Learning Course at T.E. Part I and T.E. Part II each from 'Humanities & Social Sciences (HSS) ' and 'Technical' Group respectively

4. Curriculum for Humanities and Social Sciences (HSS) Self Learning Courses is common for all under graduate programmes of faculty of Engineering and Technology

5. For TE Part I -
   A. Student can select a Self Learning Course from Solapur University, Solapur HSS Course List and appear for its examination as and when conducted by Solapur University, Solapur

   OR

   B. Student can enroll for National Programme on Technology Enhanced Learning (NPTEL) course, complete its assignments and appear for certificate examination as and when conducted by NPTEL.

   For more details about Self Learning Course (HSS) please refer to separate rule document available from Solapur University, Solapur
   More details about NPTEL are available at http://nptel.ac.in

6. Minimum four assignments for Self Learning Modules at T.E. Part I and T.E. Part II shall be submitted by the students which shall be evaluated by a Module Coordinator assigned by institute / department

7. Project group for T.E.(Electronics) Part II Mini Project shall not be of more than **three** student

8. Project group for B.E.(Electronics) Part I and Part II shall not be of more than **three** student.

9. ICA assessment shall be a continuous process based on student's performance in – class tests, assignments, homework, subject seminars, quizzes, laboratory books and their interaction and attendance for theory and lab sessions as applicable

Solapur University, Solapur
T.E. (Electronics) Semester-I
EN311 CONTROL SYSTEMS

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

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

This course provides a thorough introduction to the fundamentals of control systems. The course covers transfer function and mathematical modeling of electrical systems. The course intends the study of stability analysis of the closed loop systems using various mathematical and graphical methods along with necessary compensation techniques to evaluate the performance of electrical systems. Analysis of the linear time invariant single input & single output control system in time domain and frequency domain is included.

Course Prerequisite:
Mathematical background for finding system transfer function and its mathematical model, knowledge of Laplace transform, inverse Laplace transform and electrical circuit simplification methods is necessary.

Course Objectives:
1. To make student determine system transfer function using block diagram reduction method, signal flow graph method.
2. To make student derive transfer function of armature controlled and field controlled DC motor.
3. To make student understand step and impulse response of first & second order system
4. To introduce to student different methods to determine the system stability.
5. To make student understand frequency domain analysis to evaluate system performance.
6. To introduce to student different types of compensators & controllers

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Course Outcomes:
After completion of this course
1. Student is able to determine system transfer function using block diagram reduction method, signal flow graph method.
2. Student is able to derive transfer function of armature controlled and field controlled DC motor.
3. Student can analyze step and impulse response of first & second order system.
4. Student can apply different methods to determine the system stability
5. Student can analyze system performance using frequency domain analysis
6. Student can explain different compensation techniques and controllers

Section I

Unit 1-Basics of control systems and mathematical modeling No of lectures-08

- **Prerequisite:** Knowledge of Laplace transform, inverse Laplace transform and basics of electrical circuit simplification methods.

- **Objectives:**
  1. To make student understand different types of control systems.
  2. To make student represent electrical system mathematically and to determine its transfer function.
  3. To make student determine system transfer function using block diagram reduction method & signal flow graph method

- **Outcomes:**

Upon completion of this unit, student is –

1. Able to classify the system and represent it mathematically.
2. Able to represent electrical system mathematically.
3. Able to determine system transfer function using block diagram reduction method, signal flow graph method.

- **Unit Content:**

Classifications of control systems, open loop and closed loop control system, liquid level control system, servo mechanism, transfer function and related terminologies, mathematical modeling of electrical and mechanical system, transfer function of electrical system, transfer function using block diagram reduction techniques , signal flow graph and Mason's gain formula.

- **Content Delivery Methods:**

Chalk and talk, power point presentations, MATLAB simulation for pole zero plot and transfer function representation.

- **Assessment Methods:**

Descriptive questions to ensure understanding of the basic concepts of control system, types of control systems, transfer function approach, mathematical modeling, numerical to find out poles, zeros, order of the system, transfer function of the electrical system, block diagram reduction technique, signal flow graph and Mason's Gain formula.

Unit 2-Control system components No of lectures-05

- **Prerequisite:** Working of AC and DC electrical motors, Laplace transform and modeling of electrical circuits.

- **Objectives:**
  1. To introduce to student various components used in a control system.
  2. To make student derive transfer function of armature controlled and field controlled DC motor.

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

1. Can explain use of control system components to form a feedback control system
2. Is able to derive transfer function of armature controlled and field controlled DC motor.

• **Unit Content:**
Working principle, construction, types and applications of following control system components- stepper motor, AC and DC servomotor, synchro, potentiometer and tacho generator, transfer function of field controlled & armature controlled DC motor.

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

• **Assessment Methods:**
Questions based upon working principle, construction, types, applications of control system components and transfer function of armature controlled and field controlled DC motor.

Unit 3-Time response analysis No of lectures – 09

• **Prerequisite:** Laplace transform, inverse Laplace transform, concept of limit, basics of first order and second order system.

• **Objectives:**

1. To make student understand step response of first order system.
2. To make student understand step and impulse response of second order system.
3. To make student understand time domain specifications of second order system.
4. To make student evaluate steady state error, error coefficients for type zero, type one and type two systems.
5. To make student understand concept of compensation.

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

1. Can analyze step response of first order system.
2. Can analyze step and impulse response of second order system.
3. Can find time domain specifications of second order system.
4. Can calculate steady state error, error coefficients up to type 2 systems.
5. Is able to compensate error of the system up to type 2 systems.

• **Unit Content:**
Introduction, standard test signals, unit step response of first order system and speed of response, unit step, impulse response and time domain specifications of second order system, steady state error and error constants of type 0 , type 1 and type 2 systems, dynamic error coefficients, compensations

• **Content Delivery Methods:**
Chalk and talk, power point presentation, MATLAB simulation for step and impulse response.

• **Assessment Methods:**
Numerical and derivations based upon steady state error, error constants and time domain specifications; descriptive questions to ensure understanding of step response, impulse response

Section II

Unit 4-Stability of system and root locus No of lectures – 09

• **Prerequisite:** Pole zero plot, transfer function, determinant.

• **Objectives:**
1. To introduce to student concept of stability
2. To make student understand Hurwitz's criterion and Routh's criterion for determining stability of system.
3. To make student understand root locus for determining stability.

• **Outcomes:**
After completing this unit, student -
1. Can compare absolute, relative and marginal stability.
2. Can analyze system by using Hurwitz's criterion and Routh's criterion
3. Can analyze system stability using root locus.

• **Unit Content:**
Concept of stability, necessary conditions for stability, Hurwitz stability criterion, Routh's stability criterion, relative stability analysis, construction of root locus and stability analysis using root locus

• **Content Delivery Methods:**
Chalk and talk, power point presentations, MATLAB simulation for root locus.

• **Assessment Methods:**
Descriptive questions to ensure understanding the concepts of absolute, conditional, relative stability, Hurwitz's , Routh's criterion and root locus, numerical on Hurwitz's and Routh's criterion for determining stability of system, questions to draw root locus and determine stability of system.

Unit 5-Frequency domain analysis No of lectures – 07

• **Prerequisite:** Pole zero, time constant form of transfer function, time domain specifications, polar and rectangular representation of sinusoidal quantity.

• **Objectives:**
1. To make student understand specifications of frequency domain method.
2. To make student understand magnitude and phase plot.
3. To introduce to student procedure of drawing Bode plot.
4. To make student understand gain margin, phase margin, gain cross over frequency and phase cross over frequency.

5. To introduce to student procedure for drawing polar plot & Nyquist plot.

• Outcomes:

After completing this unit, student –

1. Can describe specifications of frequency domain.
2. Can analyze the system by drawing frequency response.
3. Can analyze system by drawing Bode plot.
4. Is able to draw polar plot & Nyquist plot.

• Unit Content:

Frequency domain specifications-Bode plots, determination of frequency domain specifications and transfer function from the Bode plot – phase margin and gain margin-stability analysis from Bode plots, polar plots, Nyquist stability criterion, Nyquist plot & stability analysis

• Content Delivery Methods:

Chalk and talk, power point presentation and MATLAB simulation for Bode plot, polar plot and Nyquist plot.

• Assessment Methods:

Descriptive questions to ensure understanding of the frequency response specifications, phase plot, magnitude plot and Bode plot, numerical on frequency response and its specifications, questions to draw Bode plot, polar plot and Nyquist plot and determine stability of system.

Unit 6- Compensators & Controllers No of lectures – 06

• Prerequisite: Pole zero, time constant form of transfer function, polar and rectangular representation of sinusoidal quantity.

• Objectives:

1. To make student understand different types of compensators.
2. To introduce to student concept of P,PI &PID controllers.

• Outcomes:

After completing this unit, student –

1. Can analyze lag compensators, lead compensators and lag-lead compensator.
2. Can describe P,PI &PID controllers.

• Unit Content:

Need of compensator, lag compensators, lead compensators and lag-lead compensators, proportional controllers, PI controllers and PID controllers

• Content Delivery Methods:

Chalk and talk, power point presentation, MATLAB/Simulink simulations for P, PI and PID controllers.

• Assessment Methods:

Descriptive questions to ensure understanding of compensation techniques, lag compensators, lead compensators and lag-lead compensator and P,PI & PID controllers.

• Internal Continuous Assessment

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

1. Verification of potentiometer as transducer.
2. Application of potentiometer as an error detector.
3. Verification of synchro as a transducer.
4. Application of synchro as an error detector.
5. AC position control system.
6. DC position control system.
7. Estimation of time response of first order system
8. Step response of second order R, L and C system.
9. Performance analysis of temperature controller application using
    - Case-I: Proportional mode of control
    - Case-II: Proportional – integral (PI) mode of control
    - Case-III: Proportional – integral-derivative (PID) mode of control
10. Effect of lag and lead compensation separately on system performance.
11. Effect of lag-lead compensation on system performance.

• Text Books:

1. Control Systems Engineering, I. J. Nagrath & M Gopal, 5th Edition, New Age International Publication.
2. Control Systems Principals and Design, M Gopal, 3rd Edition, Tata McGraw Hill Education Private Limited.
3. Control Systems Engineering, Rajiv Gupta, Wiley INDIA Private Limited.

• Reference Books:

1. Modern Control Engineering, K.Ogata, 3rd edition, Pearson Education.
2. Feedback & Control Systems, Schaum's Outline Series, Tata McGraw Hill Education Private Limited.
3. Feedback control problems using MATLAB, Dean Fedric and Joe Chow, Thomson learning.

Solapur University, Solapur
T.E. (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
OE- 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 theories and techniques to construct modern information systems. The course content 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.
5. To introduce to student various application areas of Digital Signal Processing.

Course Outcomes:

At the end of this course,

1. Student is able to analyze a given signal or system using tools such as Fourier transform and z-transform
2. Student is able to apply properties of Discrete Fourier Transform and to determine the discrete Fourier transform, Inverse discrete Fourier transform by direct computation & Fast Fourier Transform algorithm.

3. Student is able to draw the structure for realization of a given system.
4. Student is able to design IIR and FIR filters.
5. Student can describe basic building blocks of digital signal processor.
6. Student can explain the applications of digital signal processing in audio processing, biomedical, image processing areas.

Section I

Unit 1-Introduction to DSP No of lectures – 02

- **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 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. Demonstrate the use of properties for computing the DFT
  4. Compute the circular convolution.
  5. Demonstrate the difference between circular convolution and linear convolution.
  6. Use DFT and IDFT for filtering of long sequences
  7. Demonstrate how FFT reduces the number of computations compared to direct Fourier transform

- **Unit Content:**
  DFT, relation between DFT & Z transform, properties of DFT, circular convolution, fast convolution techniques (overlap add & overlap save), frequency analysis of signals using DFT, FFT algorithms (DIT FFT & DIF FFT)

- **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 realization structures for a given system function.

Section II

Unit 5–FIR filter design No of lectures –7

- **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:**
  Characteristics of FIR filters, properties of FIR filters, symmetric and anti symmetric FIR filters, FIR filter design using windowing & frequency sampling method finite word length effects in FIR filters

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

- **Assessment Methods:**
  Questions based 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 –7

- **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 understand the characteristics of Butterworth filters.
  4. To understand the effect of finite word length on frequency response of the filter.
  5. To 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-**
  Impulse invariant technique, bilinear transformation, frequency transformations, analog Butterworth filter approximation, finite world length effects in 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 techniques.

Unit 7–Introduction to programmable digital signal processors No of lectures – 6

- **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:**
  Basic architectural features multiply and accumulate (MAC) unit, bus architectures, VLIW 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 different blocks of DSP processor architecture, bus architectures.

Unit 8–Applications of DSP No of lectures – 4

- **Prerequisite:** DSP concepts

- **Objectives:**
  To expose student to different DSP application areas

- **Outcomes:**
  After completing this unit, student can describe importance of DSP for various application areas

- **Unit Content:**
  Applications of DSP in audio processing, biomedical and image processing.

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

- **Assessment Methods:**
  Questions based on different applications

- **Internal Continuous Assessment :**
  ICA consists of minimum eight experiments based on correlation, 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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Solapur University, Solapur
T.E. (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 basics 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:

1. Student can describe architecture of 8051 and PIC 16F877 microcontrollers.
2. Student can write assembly language program for different applications with 8051 and PIC 16F877 microcontrollers.
3. Student can write "C" program for different applications with 8051 microcontroller.
4. Student can develop the system for different applications using 8051 microcontrollers.
5. Student can program PIC 16F877 on chip peripherals for different applications.
6. Student can 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. Microprocessor
- **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 – 11

- **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 – 08

- **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 microprocessor
- **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 to 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 :**

  Minimum 10 practical 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(2^{nd} edition)
  2. Microcontrollers, Ajay Deshmukh, Tata McGRAW HILL

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

Solapur University, Solapur

T.E. (Electronics) Semester-I

EN314 ELECTOMAGTIC ENGINNERING

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

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's 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 to calculate the reflection/transmission of plane waves.
6. To make student know 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:

1. Student can solve numerical problems on coordinate systems, divergence, curl and gradient.
2. Student can derive basic laws of electrostatic and magnetostatic and can apply them for different fields.
3. Student can derive Maxwell's equations under different conditions and can derive wave equation from them

4. Student is able to describe and analyze electromagnetic wave propagation in different media.
5. Student can describe transmission lines and their related parameters
6. Student can 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 introduce to student 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 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 to evaluate the force between two point charges.
4. To make student to 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, electrostatic 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 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, current carrying conductors in magnetic fields, torque on loop, energy stored in magnetic field, boundary condition for magneto static field.

- **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 dielectric & conducting media, modification in wave equations for sinusoidal time variations, propagation in good conductor,wave polarization , skin effect, reflection coefficient, transmission coefficient and VSWR, Poynting's theorem, power flow in uniform plane wave.

- **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 –** 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 ,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)**
  Term Work 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

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Solapur University, Solapur
T.E. (Electronics) Semester-I
EN315 INFORMATION TECHNOLOGY AND MANAGEMENT

Teaching Scheme:
Lectures- 3 Hours / week, 3 Credits

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 completion of this course

1. Student can present case studies about changing face of business and importance of management information system for today's business
2. Along with the examples student can explain different e-commerce mechanisms
3. Student can describe necessity and benefits of data management for business and organizations
4. Student can present examples of primary and higher organizational applications of information system
5. Student is able to illustrate software development life cycle and can describe popular software models
6. Student can 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

- **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.

Solapur University, Solapur

T.E. (Electronics) Semester-I

EN 317 PROGRAMMING WITH JAVA

Teaching Scheme:	**Examination Scheme**
Lectures - 2 Hours / week, 2 Credits	**ICA- 50 Marks**
Practical - 2 Hours/week, 1 Credit	**POE - 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. The 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 necessary skills for problem solving using procedural and object oriented programming concepts.

Course Objectives:

1. To introduce to students core Java programming concepts.
2. To make student understand the difference between C++ and core Java
3. 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.
4. To introduce to students various packages and interfaces available within Java.
5. To make student understand the use of exception handling, multithreaded programming and abstract window toolkit (AWT) package.

Course Outcomes:

1. Student can outline basics of core Java programming.
2. Student can relate between C++ and Java in terms of object oriented programming features.
3. Student can employ the concept of classes and methods to solve real world problems.
4. Student can implement different types of inheritance and explain the importance of inheritance.
5. Student can choose an appropriate Java package for different programming tasks.
6. Student can create a GUI-based application using AWT package.

Section-I

Unit 1- Fundamental Aspects of Programming No of lectures – 02

- **Prerequisite:** Concepts of C & C++ programming– basic data types, control structures, functions.

- **Objectives:**
  1. To make student understand the nature of software development.
  2. To make student understand difference between the different types of programming approaches.
  3. To make student understand the similarities and differences between C, C++ and Java.
  4. To make student understand how to edit, compile, and run simple console based applications

- **Outcomes:**
  After completing this unit, student will be able to
  1. Define what is programming
  2. Classify types of programming and distinguish between them
  3. Describe features common to most programming languages
  4. Choose appropriate program structure to solve the given problem

- **Unit Content:**
  What is programming- a brief overview of software development, programming languages, syntax vs. semantics, types of programming**-** console versus windows-based applications, procedural programming, object-oriented programming, event-driven programming, C/C++/ Java language family, the common language core**- c**omments, identifiers, data types, expressions, input & output, program structure**-** functions, control structures, scoping

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

- **Assessment Methods:**
  Programming using functions and control structures in C++

Unit 2- Introduction to OOP and Java Environment No. of lectures – 3

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

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

Unit 3-Java Programming Constructs No. of lectures – 4

- **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 conversion and casting
  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:**
  Chalk and talk, power point presentations, programming through demo

- **Assessment Methods:**
  Programming using different java programming constructs

Unit 4- Classes, Objects and Methods No. of lectures – 3

- **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 created and used
  3. Understand the concepts of polymorphism and 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. Demonstrate how objects are created
  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:**
  Chalk and talk, power point presentations, programming through demo

- **Assessment Methods:**
  Programming using the concepts of class, objects, methods, constructors

Unit 5- Arrays and Strings No. of lectures – 2

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

- **Assessment Methods:**
  Programming using the concepts of arrays and strings in Java

Section-II

Unit 6–Inheritance No. of lectures – 3

- **Prerequisite:** Knowledge of the concept of inheritance 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:**
  Chalk and talk, power point presentations, programming through demo

- **Assessment Methods:**
  Programming using the concept of inheritance in Java

Unit 7-Packages and Interfaces No. of lectures – 2

- **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, Java wrapper classes

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

- **Assessment Methods:**
  Programming using the concepts of packages and interfaces in Java

Unit 8–Exception Handling, I/O and Multithreaded Programming No. of lectures – 5

- **Prerequisite:** Knowledge of exception handling and input/output streams 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
  4. Understand the basics of file handling
  5. Understand how input/output operation is done in Java
  6. Understand how input is taken from the user
  7. Know what are threads and how they can be implemented in Java
  8. Understand how multiple threads can be created within a Java program
  9. Appreciate the Thread class of *java.lang* package

- **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
  4. Differentiate between byte and character streams
  5. Use byte streams for file I/O
  6. Use character streams for file I/O
  7. Employ the *Thread* class and the *Runnable* interface
  8. Create a thread
  9. Create multiple threads

- **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, input/output (I/O)**-** java.io.File class, reading and writing data, randomly accessing a file, reading and writing files using new I/O package, multithreading**-** multithreading in Java, java.lang.Thread class, main thread, creation of new threads, multithreading

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

- **Assessment:**
  Programming using the concepts of exception handling, I/O and multithreading

Unit 9– Abstract Window Toolkit No. of lectures – 3

- **Prerequisite:** Knowledge about the classes and interfaces available within the java.awt package**.**

- **Objectives:**
    1. To make student know the set of graphical user interface (GUI) components
    2. To make student understand the use of event-handling model for different components
    3. To make student understand the layout managers for flexible window layouts

- **Outcomes:**
  After completing this unit, student will be able to
    1. Create and manage windows, fonts, output texts
    2. Create GUI components such as button, scrollbar, choicebox, list, textfield etc.
    3. Choose appropriate container class
    4. Use *Menu* class to create dropdown menu type of graphical user interface
    5. Employ event delegation model through GUI components

- **Unit Content:**
  Introduction, components and containers, button, label, checkbox, radio buttons, list boxes, choice boxes, textfield and textarea, container class, layouts, menu, scrollbar

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

- **Assessment Methods:**
  Java programs to create different GUI components

- **Internal continuous assessment (ICA) :**
  Minimum 15 Java programming experiments covering:
    1. Programming using functions and control structures in C++
    2. Programming with basic program structure of Java
    3. Programming using different java programming constructs
    4. Programming using the concepts of class, objects, methods, constructors
    5. Programming using the concepts of arrays and strings in Java
    6. Programming using the concept of inheritance in Java
    7. Programming using the concepts of packages and interfaces in Java
    8. Programming using the concepts of exception handling, I/O and multithreading
    9. Programing to create different GUI components

- **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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Solapur University, Solapur
T.E. (Electronics) Semester II
EN321 OPERATING SYSTEMS

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

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

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, 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 interprocess communication.
3. To make student analyze and design algorithm for process scheduling, synchronization and removing deadlock.
4. To make student create directory structure and file system in an operating system
5. To make student analyze memory management during process execution.

Course Outcomes:

After completion of this course

1. Student is able to identify and describe structure, operations and different types of operating system.
2. Student is able to analyze effect of different scheduling criteria on scheduling techniques, thread implementation, synchronization of processes.
3. Student is able to implement concepts like inter process communication and various scheduling algorithm using C programming.
4. Student is able to describe deadlock condition and implement methods to overcome deadlock.
5. Student can make use of file systems, directories and different commands associated to it.
6. Student is able to analyze memory management concepts like logical and physical addressing.

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 operation 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 make student design threads.
  5. To make student write program for inter process communication.

- **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 and inter process communication using C programming.
  4. Is able to implement threads
  5. Is able to implement 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– threading issues

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, C programs on thread and IPC implementation.

- **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:** Process concepts, process scheduling.

- **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 FCFS, SJF, priority scheduling and round robin scheduling 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

Unit4-Deadlock No of lectures –04

- **Prerequisite:** Process &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 investigate 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:** 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-Filesystem No of lectures –07

- **Prerequisite:** 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 directory implementation & 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 demonstrate & describe file access methods, file system mounting and protection.
  3. Can demonstrate & describe directory implementation & file allocation methods.

- **Unit Content:**
  File system concept, file access methods, directory structure, file-system mounting, protection, 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.

- **Internal Continuous Assessment:**

  It consists of minimum eight experiments based on operations on process, system calls, scheduling algorithm, thread, 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, 3rd Edition-Tata McGraw Hill

- **Reference Books:**
  1. Operating Systems Internals and Design Principles- William Stallings- 5th Edition, 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.

Solapur University, Solapur
T.E. (Electronics) Semester-II
EN322 DIGITAL COMMUNICATION

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

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 to know the different components of a digital communication system.
2. To introduce to student sampling theorem & pulse modulation techniques.
3. To make student understand various waveform coding schemes
4. To make student understand information theory and its relevance to digital communication
5. To make student understand different carrier modulation and detection techniques along with their performance analysis
6. To make student understand different error detection and correction codes

Course Outcomes:
After learning the course the students is able to:

1. Explain different waveform coding techniques used to convert analog signal into digital signal
2. Compare various digital modulation techniques
3. Explain probability, random variable and various statistical analysis methods.
4. Derive channel capacity for discrete memory less channel and continuous channel.
5. Evaluate behavior of various modulation-demodulation techniques in presence of noise.
6. Compare various error detection and correction codes.

Section I

Unit 1 -Pulse modulation No of lectures – 09

- **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

- **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 make student understand analytical & mathematical concepts of different pulse modulation techniques.
  4. To introduce to student concept of quantization, its need, advantages & disadvantages, mathematical analysis for bandwidth requirement, non uniform quantization
  5. To make student understand need & concept of non uniform PCM
  6. To introduce to student basic concepts of digital baseband signaling with line codes

- **Outcomes:**
  After completing this unit, student -
  1. Can compare analog, pulse and digital communication system
  2. Can draw and explain various blocks of digital communication system
  3. Can explain significance of sampling along with mathematical analysis
  4. Can explain analytical and mathematical concepts of different pulse modulation techniques.
  5. Can compare different quantization schemes
  6. Can explain different blocks of PCM system
  7. Can compare different baseband signaling codes

- **Unit Content:**
  Digital communication system blocks, need, sampling theory, Nyquist rate, aliasing, PAM modulation and demodulation, PTM modulation and demodulation, direct and indirect method of PTM signal generation, PCM-generation and reconstruction, quantization-uniform & non-uniform and companding, PCM bandwidth requirement, PCM-TDM, baseband signaling codes, baseband receiver, probability of error, ISI, eye diagram

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

- **Assessment Methods:**
  Questions based upon block diagram, circuits for pulse 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

Unit 2 –Waveform coding No of lectures – 07

- **Prerequisite:** Pulse modulation, circuit design using discrete components & op amps

- **Objectives:**
  1. To make student understand the block diagram and its working of different waveform coding techniques.
  2. To make student understand analytical concepts for different waveform coding techniques and their performance

- **Outcomes:**
  After completing this unit, student –
  1. Can draw and explain block diagram of different coding modulator and demodulator
  2. Can describe analytical concepts of different waveform coding techniques
  3. Can compare performance of different waveform coding techniques

- **Unit Content:**
  Differential pulse code modulation, adaptive differential pulse code modulation, delta modulation, delta-sigma modulation, adaptive delta modulation, continuously variable slope, delta-sigma modulation.

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

- **Assessment Methods:**
  Questions based upon block diagram and descriptive questions to ensure understanding of the basic concepts of different waveform coding techniques, their advantages and limitations

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, 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

- **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 draw and explain block diagram of different digital carrier modulator and demodulator

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

- **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, descriptive questions to ensure understanding of the basic concepts of different digital carrier modulation techniques, their advantages, limitations and performance

Unit 5 –Error control coding No of lectures – 08

- **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 –Optimum Receiver for Digital Modulation No of lectures – 04

- **Prerequisite:** Digital carrier modulation, detection, correlation, convolution

- **Objectives:**
  1. To introduce to student need, mathematical & analytical concepts of matched & correlation filter receivers
  2. To make student understand need of synchronization & different levels of synchronization in digital communication

- **Outcomes:**
  After completing this unit, student –
  1. Can describe mathematical & analytical concepts of matched & correlation filter receivers
  2. Can describe frame and symbol synchronization in a typical digital communication system

- **Unit Content:**

Matched filter receiver, correlation receiver, synchronization, symbol synchronization, frame synchronization, carrier recovery circuits.

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

- **Assessment Methods:**
  Descriptive questions to ensure understanding of the basic concepts of matched & correlation filter and synchronization.

- **Internal Continuous Assessment (ICA)**

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

  1. Sampling Theorem
  2. PAM
  3. PWM, PPM
  4. PCM & DPCM
  5. Eye pattern and ISI.
  6. Companding
  7. DM and ADM
  8. CVSD and Sigma Delta Modulation
  9. ASK,FSK, PSK
  10. QPSK
  11. Hamming code

- **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

Solapur University, Solapur
T.E. (Electronics) Semester-II
EN323 EMBEDDED SYSTEMS

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
	POE - 50 Marks

This course provides a thorough introduction to the architecture of ARM7TDMI core and microcontroller LPC2148. The course also introduces assembly and C programming for LPC2148 microcontroller and enables student to write programs addressing high level programming skills 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

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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 LPC2148 microcontroller.
4. To make student learn interfacing of different peripherals with LPC2148 microcontroller.
5. To make student learn architecture of real time operating system.
6. To make student learn microcontroller based real time systems.

Course Outcomes:

1. Student can describe hardware and software architecture of embedded system.
2. Student can describe ARM7TDMI core architecture
3. Student can write assembly and C program for different applications for LPC2148 microcontroller.
4. Student can interface different peripherals with LPC2148 microcontroller.
5. Student can build embedded system using real time operating system.
6. Student can describe microcontroller based real time systems for different applications.

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 make student understand basic 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 make student understand hardware fundamentals of ARM7TDMI core.
  2. To make student understand the instruction set of ARM7TDMI core.
  3. To make student 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 using the instruction set.

Unit 3 – LPC2148 Microcontroller Interfacing and Programming No of lectures – 10

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

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

- **Outcomes -**
  After completing this unit, student –
  1. Can describe architecture of LPC2148 microcontroller.
  2. Can describe working of on chip peripherals of LPC2148 microcontroller.
  3. Can write programs for LPC2148 microcontroller for different applications.
  4. Can interface different peripherals to the LPC2148 microcontroller.

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

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

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

Section II

Unit 4 – Real Time Operating System Concepts No of lectures – 10

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

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

- **Outcomes-**
  After completing this unit, student –
  1. Can describe the need of real time systems.
  2. Can describe fundamentals and different issues of real time operating systems.

- **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 on real time systems and concepts like kernel, mailboxes, task management, memory management, interrupts etc.

Unit 5 - RTOS Programming No of lectures – 10

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

- **Objectives –**
  1. To make student understand µC/OS-II as a case study of real time operating system.
  2. To make student 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.

Unit 6 - Case Study of Embedded systems No of lectures – 08

- **Prerequisite –** Embedded software and hardware, and RTOS

- **Objective –**
  1. To introduce to student embedded application case studies making use of RTOS

- **Outcomes-**
  After completing this unit student-
  1. Can describe s different embedded system applications employing RTOS.

- **Unit Contents-**
  Case study of digital camera, smart card, mobile phones - *case study should be demonstrated by suitable hardware and software with or without RTOS.*

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

- **Assessment Methods:**
  Questions based upon case studies of embedded systems.

- **Internal Continuous Assessment :**
  Minimum 8 to10 practical based on following with LPC2148 microcontroller

  1. Program to interface LCD & keypad to LPC2148 microcontroller.
  2. Program to interface analog input devices using on-chip ADC of LPC2148 microcontroller.
  3. Program to generate different waveforms using on-chip DAC of LPC2148 microcontroller.
  4. Program to introduce timer based events for LPC2148 microcontroller.
  5. Program to interface different peripherals using I2C protocol.
  6. Program to introduce interfacing using UART for LPC2148 microcontroller.
  7. Program to interface different peripherals using SPI/SSP protocol.
  8. Multitasking in µC/OS RTOS using different tasks.
  9. Semaphore as signaling & synchronizing on LPC2148 microcontroller.
  10. Mailbox implementation for message passing on LPC2148 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. LPC2148 microcontroller Datasheet.
  2. Embedded systems software primer, David Simon, Pearson.
  3. Embedded Systems: Architecture, Programming and Design, Raj Kamal, McGraw Hill India.

Solapur University, Solapur
T.E. (Electronics) Semester-II
EN324 INDUSTRIAL ELECTRONICS

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

The course intends to cover various types of power devices and their switching characteristics. The course introduces analysis of controlled rectifier and triggering circuits for power devices. It also deals with the application of solid-state electronics for the control and conversion of electric power with high efficiency. It provides analysis and design of power electronics circuits, methods and procedure suitable for variety of power electronics applications to industry. The course also introduces different types and circuit topologies of power supplies.

Course Prerequisite:
Student has completed a comprehensive course in electronic circuit analysis & design and has an ability to analyze circuits containing semiconductor devices. Student also has knowledge of network theory and analysis, differential equations and linear algebra.

Course Objectives:

1. To make student understand fast switching power semiconductor devices with their construction, working, switching characteristics and their fast control for different applications.
2. To introduce to student different types of protection and commutation circuits for power devices.
3. To make student comprehend switching behavior and design of single phase controlled rectifiers
4. To introduce to student different driver circuits for successful firing of power devices.
5. To make student understand different types of power supplies.
6. To make student understand operation of different industrial power circuits & applications

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Course Outcomes:
After completion of this course-

1. Student can explain the characteristics of power semiconductor devices and identify suitable switching device for given application.
2. Student can explain different types of protection and commutation circuits and identifies suitable circuit for given application.

3. Student can analyze and design single phase controlled rectifiers
4. Student can analyze various firing circuits for power devices.
5. Student can analyze different types of power supplies.
6. Student can analyze different industrial power circuits and implement it for different application.

Section I

Unit 1 - Thyristor: Principles and Characteristics: No of lectures – 10

- **Prerequisite –** Concepts of diodes and transistors, RLC circuits and resonance

- **Objectives –**
  1. To make student understand – construction, two transistor analogy, switching characteristics, gate characteristics of thyristor.
  2. To make student understand turn on and turn off mechanism of thyristor.
  3. To introduce to student different types of protection and commutation circuits.
  4. To introduce to student a practical approach of snubber circuit with a systematic design procedure.
  5. To make student consider power losses and selection of heat sink according to power dissipation.
  6. To make student establish thyristor rating and selection of thyristors according to application.

- **Outcome –**

  After completing this unit, student -
  1. Can describe construction, two transistor analogy, switching characteristics, and gate characteristics of thyristor.
  2. Can describe turn on and turn off mechanism of thyristor
  3. Is able to analyze protection and commutation circuits for thyristor
  4. Is able to explain importance of snubber circuits and design with a systematic design procedure.
  5. Can select heat sink according to power dissipation in an application
  6. Can select thyristor according to need of application

- **Unit Content:**

  Construction, V-I Characteristics, two transistor analogy, switching characteristics, gate characteristics, turn on methods of thyristor, rating & specifications, thyristor protection circuit: dv/dt, di/dt, over voltage and over current protection circuit, gate protection, design of snubber circuit and di/dt inductance, heat sink design, thyristor commutation techniques- class A, class B, class C, class D, class E, class F.

- **Content Delivery Methods:**

  Chalk and talk, power point presentations, MATLAB simulation for commutation techniques

- **Assessment Methods:**
  Questions based upon two transistor analogy, switching characteristics, gate characteristics, turn on methods of thyristor, thyristor protection circuit, design of snubber circuit, heat sink design , protection circuits, commutation techniques with output waveforms

Unit 2 – Single Phase Controlled Rectifier No of lectures –11

- **Prerequisite –** Uncontrolled rectifiers and its different parameters

- **Objectives –**
  1. To make student understand switching behavior and design of power electronics circuits such as controlled rectifiers
  2. To make student understand effect of source inductance on performance of controlled rectifiers.
  3. To make student understand operation of dual converter

- **Outcomes-**
  After completing this unit, student –
  1. Can analyze and design controlled rectifiers with different types of load.
  2. Can analyze the effect of source inductance on performance of controlled rectifiers.
  3. Is able to formulate and calculate power consumption by understanding converter specifications
  4. Can describe operation of dual converter with energy saving conversion system.

- **Unit Contents-**
  Half wave and full wave controlled rectifiers; half controlled and fully controlled bridge rectifiers with R, R-L and RLE load with and without freewheeling diode, effect of source inductance on performance of controlled rectifier, dual converter.

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, MATLAB simulation for single phase converters.

- **Assessment Methods:**
  Questions based upon mathematical expression for different parameters, different types of load, different waveform for different types of controlled rectifiers their advantages and limitations, numerical based on different types of controlled rectifiers.

Unit 3 - Power Semiconductor devices: No of lectures – 06

- **Prerequisite –** Concepts of diodes, transistors, thyristors.

- **Objectives –**
  1. To make student understand fast switching power semiconductor devices with their construction, working, switching characteristics and their fast control facility for different applications.

2. To make student establish rating and selection of power semiconductor devices according to need of application

- **Outcomes-**
  After completing this unit, student –
  1. Can describe the characteristics of power semiconductor devices and identify suitable switch for given application
  2. Is able to select the power devices for conversion, control and conditioning of electronic power according to power ratings.

- **Unit Contents-**
  Construction, characteristics & ratings of MOSFET, IGBT, GTO, DIAC, TRIAC

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

- **Assessment Methods:**
  Descriptive questions based on construction and characteristics of all power devices

Section II

Unit 4 - Gate Drive Circuit: No of lectures – 10

- **Prerequisite –** Concepts of transistor, thyristors, MOSFET, IGBT, GTO.

- **Objectives –**
  1. To make student understand requirement for the successful firing of different power semiconductor devices.
  2. To make student understand operation of triggering circuits.
  3. To make student understand construction, characteristics , operation and application of UJT, PUT, SUS, SBS, SCS,LASCR
  4. To make student learn about the isolation techniques between high level power circuit and low level gate drive circuit
  5. To make student understand various firing schemes for converters.
  6. To make student develop control scheme for single phase converters using microcontroller.

- **Outcomes-**
  After completing this unit, student –
  1. Can explain basic requirement for the successful firing of different power semiconductor devices.
  2. Can explain the operation of triggering circuits.
  3. Can describe and compare construction, characteristics and operation of UJT, PUT, SUS, SBS, SCS and select it according to requirement.
  4. Can explain the importance of isolation between power circuit and control circuit.

5. Can design various firing schemes and control schemes for converters using suitable microcontroller.

- **Unit Content:**
  Triggering devices: UJT, PUT, SUS, SBS, SCS, LASCR device treatment - construction characteristics, ratings, application, isolation of gate and base drive: pulse transformer, optoisolators, thyristor gate triggering circuits:-R, RC firing circuits, gate pulse amplifier, pulse train gating circuit, triggering scheme for controlled rectifiers and microcontroller based firing scheme for single phase controlled rectifiers.

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, MATLAB simulation for microcontroller based firing scheme for single phase controlled rectifiers.

- **Assessment Methods:**
  Questions based upon construction, characteristics, working and applications of triggering devices, driving circuit for power devices, isolation techniques, thyristor gate triggering circuits, triggering scheme for converters and microcontroller based firing scheme for converters.

Unit 5 - Power Supplies: No of lectures – 10

- **Prerequisite –** Concept of power semiconductor devices, triggering circuits, linear voltage regulator

- **Objectives –**

1. To make student comprehend the need and function of uninterruptable power supplies.
2. To make student understand the need and function of A.C. voltage stabilizer and solid state voltage stabilizer
3. To make student understand the need and function of switched mode power supplies.

- **Outcomes-**
  After completing this unit, student –
1. Can analyze uninterruptable power supplies.
2. Can describe the operation of A.C. voltage stabilizer and solid state voltage stabilizer.
3. Can describe analytical concepts of different switched mode power supplies.

- **Unit Contents-**

AC power supplies: block diagram and configuration of UPS, Switched mode AC power supplies, A.C. voltage stabilizer: servo and relay type, constant voltage transformers, solid state voltage stabilizer: thyristor based and TRIAC based, switched mode power supplies: non-isolated SMPS topologies: buck, boost, buck-boost, cuck converters, isolated SMPS topologies- fly back, forward , half bridge , full bridge converters

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

- **Assessment Methods:**
  Descriptive questions based upon block diagram, circuit diagram and waveforms ensure understanding the operations of different power supplies and stabilizers.

Unit 6 - Power circuits & Applications No of lectures – 05

- **Prerequisite –**Basic concept of power devices, triggering circuits and optocouplers

- **Objectives –**
  1. To make student understand the operation of different industrial power circuits.
  2. To make student understand the principle of induction heating, dielectric heating

- **Outcomes-**
  After completing this chapter, student –
  1. Is able to explain the operation of different industrial power circuits and implement it for different application.
  2. Is able to explain the importance of induction heating, dielectric heating

- **Unit Content:**
  Static circuit breakers, single phase preventer, batch counter, temperature controller, battery charging circuit, emergency lighting system, automatic street lighting system, induction heating, dielectric heating.

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

- **Assessment Methods:**
  Questions based upon circuit breakers, single phase preventer, batch counter, temperature controller, battery charging circuit and lighting system descriptive questions to ensure understanding of the principle of induction heating, dielectric heating their advantages and limitations

- **Internal Continuous Assessment (ICA)**

ICA shall consist of minimum ten experiments based upon-

1. VI Characteristics of SCR.
2. Thyristor commutation techniques.
3. Single phase half controlled rectifier.
4. Single phase full controlled rectifier.
5. VI Characteristics of IGBT/ MOSFET
6. Triac as light dimmer
7. SCR Triggering Circuits.
8. Optocoupler
9. Single phase preventer
10. Switched mode AC power supplies
11. A.C. voltage stabilizer
12. Simulation using MATLAB / Simulink.
    a. Thyristor commutation techniques
    b. Controlled rectifier

- **Text Books:**
  1. Power Electronics, M.H. Rashid, Pearson Education, 3rd Edition
  2. Power Electronics , M D Singh & K B Khanchandani,Tata McGraw Hill, 2nd Edition

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- **Reference Books:**
  1. Power Electronics , P.C. Sen, Tata McGraw Hill
  2. General Electric, SCR Manual, Prentice Hall
  3. Power Electronics, Mohan, Undeland, Riobbins, Wiley, 3rd Edition,.
  4. Power Electronics, P.S. Bimbra, Khanna Publishers
  5. Introduction to Thyristor and Their Applications, M. Ramamoorthy Eastwest Press

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Solapur University, Solapur
T.E. (Electronics) Semester-II
EN325 VLSI DESIGN

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

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 can

1. Explain with suitable example VHDL features.
2. Write VHDL code & test bench for modeling and testing combinational and sequential circuits.
3. Describe the architecture of CPLD and FPGA and to implement some functions in FPGA.
4. Discuss steps in the high level design flow.
5. Implement digital functions using CMOS logic and gates.
6. 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, resolution function, 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 , text I/O, 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, substractor, multiplier, barrel shifter; 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 – 07

- **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 counters, 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 – 05

- **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, 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 – 09

- **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 , fan in , fan out) , delays and loading consideration.

- **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, path sensitizing, random tests, design for testability, built in self test, boundary scan test.

- **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, barrel shifter.
  2. Sequential logic: counters with synchronous / asynchronous reset signal, cascading of counters, universal 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

SELF LEARNING COURSES

TECHNICAL

Solapur University, Solapur

T.E. (Electronics)

TECHNICAL SELF LEARNING COURSE- I

EN326 ROBOTICS

Teaching Scheme	**Examination Scheme**
Self learning, 2 Credits	**Theory – 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, electronics workshop and basic programming knowledge.

Course Objectives:

1. To introduce to student basics of robotics.
2. To make student analyze different control methods for robot and end effectors
3. To make student understand different control scheme and types of mobile robots.
4. To make student aware about various sensors for automization 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:

1. Student can describe the concepts of robotics.
2. Student can analyze different control methods of robot and end effectors
3. Student becomes aware about different sensors and can integrate the robot system.
4. Student can describe different control scheme and types of mobile robots
5. Student can express fundamentals of robotic vision
6. Student becomes acquainted with current and future scope of industrial robotics applications.
7. Student can develop innovative atomized robots.

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 co-ordinate 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, hooks, scoops & other miscellaneous devices

- **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 atomization 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 automized 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

- **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

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Solapur University, Solapur

T.E. (Electronics)

TECHNICAL SELF LEARNING COURSE II

EN326 PROGRAMMING IN VISUAL BASIC.NET

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

Visual basic .NET is one of the prominent languages for the .NET framework from Microsoft. As a language, visual basic .NET features like object-oriented including full-blown support for object-oriented concepts, event-driven, .NET framework based, support for generics, anonymous classes, lambda functions, anonymous types that makes it an important language to learn and use for an electronics engineer.

Course Prerequisite:

Student shall have basic understanding and knowledge of programming techniques and their use in effectively writing programs for varied problem scenarios. Also it's expected that student shall have an exposure towards using IDE (Interactive Development Environment) in developing programs.

Course Objectives:

1. Understanding of visual programming language concepts applied to a business environment including: form design, common form tool controls, input-process-output model, arithmetic operations and assignment statements, predefined object methods & functions, decision structures, looping structures, list controls, array and table processing, sub procedures and user-defined functions, and database programming.
2. Implementation of acquired skills for application design specifications to a visual object-oriented, event-driven programming language.

Course Outcomes:

On completion of this course, student will be able to-

1. Implement object oriented concepts in programming.
2. Create form for specific application
3. Access external application using serial communication.

Section I

Unit 1- Introduction to Visual Basic

- **Prerequisite:** Knowledge of basic programming techniques**.**

- **Objective:**
  1. To introduce to student basics of Visual Studio IDE for VB.NET programming

- **Outcome:**
  1. On completion of this course, student will be able to implement simple object oriented programming paradigms using VB.NET language with help of Visual Studio IDE

- **Unit Content:**
  Introduction: Microsoft visual studio and visual basic (.NET version), programming languages, visual studio components, object-oriented programming terminology, getting started with visual studio, the toolbox, set up your work environment, setup the project and form, naming rules and conventions, accessing an event procedure, the assignment statement, opening an existing project, program errors, a clean compile, design time, run time, MSDN

- **Content Delivery Methods:**
  Despite the course being self learning course, use of online interactive power point presentations, hands on demonstration of using language constructs, video tutorials and interactive sessions is highly desirable.

- **Assessment Methods:**
  Student will be evaluated by questions on object oriented programming concepts and visual studio IDE.

Unit 2 -Variables, constants, and calculations

- **Prerequisites:** Knowledge of basic programming techniques**.**

- **Objective:**
  1. To introduce to student basics of VB.NET language.

- **Outcomes:**
  1. On completion of this unit, student will be able to implement simple programs using VB.NET language.

- **Unit Content**:
  Variables, constants, and data storage, variables, types of data, naming rules for variables and constants, naming conventions, declaring variables, declaring constants, scope of variables and constants, converting input data types, converting variable values to output data types, arithmetic operators, order of precedence, assignment operators and formulas, option explicit

and option strict, rounding numbers, formatting data for output, handling exceptions, enabling and disabling controls, reset button click event, exit button click event the exception class – multiple catch blocks.

- **Content Delivery Methods:**
  Despite the course being self learning course, use of online interactive power point presentations, hands on demonstration of using language constructs, video tutorials and interactive sessions is highly desirable.

- **Assessment Methods:**
  Student will be evaluated by questions on basics language constructs in VB.NET like variables, data types, operators, event handling.

Unit 3: Decisions and conditions

- **Prerequisites:** Basic programming techniques knowledge and control flow structures.

- **Objective:**
  1. To introduce conditional programming structures in VB.NET

- **Outcomes:**
  On completion of this unit, student will be able to implement programs using conditional structures in VB.NET

- **Unit Content:**
  Decision structures and commands, if statements, decimal vs. single vs. double data types, conditions and condition symbols, single condition if statement, block if statement with else branch, VB editor, if statement – comparing string data, to upper and to lower methods, logical operators

- **Content Delivery Methods:**
  Despite the course being self learning course, use of online interactive power point presentations, hands on demonstration of using language constructs, video tutorials and interactive sessions is highly desirable.

- **Assessment Methods:**
  Student will be evaluated by questions on conditional constructs and their syntax in VB.NET.

Section-II

Unit 4: Lists and loops

- **Prerequisites:**
  1. Looping constructs in programming techniques methodology and knowledge of Visual Studio UI.

- **Objective**:
  1. To understand use of loop and list controls in writing iterative logic for applications in VB.NET.

- **Outcomes:**
  1. On completion of this unit, student will be able to implement iterative programs using loops in VB.NET

- **Unit Content:**
  List box, checked list box, and combo box, controls to list items, the items collection, filling the list, coding list box and combo box controls, list box and combo box events, loops, the Boolean data type, do loops, searching a list box or combo box, for, next loops, nested loops, exit statement, selecting control entries, selecting a textbox entry, selecting a list box or combo box entry, coding a text changed event.

- **Content Delivery Methods:**
  Despite the course being self learning course, use of online interactive power point presentations, hands on demonstration of using language constructs, video tutorials and interactive sessions is highly desirable.

- **Assessment Methods:**
  Student will be evaluated by questions on using loops in writing programs and their syntax in VB.NET.

Unit 5: Arrays

- **Prerequisites:** Arrays and multidimensional data structures in programming techniques**.**

- **Objective:**
  1. To introduce the concept of arrays and their use in writing applications in VB.NET.

- **Outcomes:**
  1. On completion of this unit, student will be able to implement programs which use arrays and will be able to work on multidimensional arrays.

- **Unit Content:**
  Single-dimension arrays, declaring an array, array subscript errors, for each, next loops, using array elements for accumulators, multidimensional arrays, a two-dimensional string table

- **Content Delivery Methods:**
  Despite the course being self learning course, use of online interactive power point presentations, hands on demonstration of using language constructs, video tutorials and interactive sessions is highly desirable.

- **Assessment Method:**
  Student will be evaluated by questions on declaring single and multidimensional arrays and using them in writing simple programs in VB.NET.

Unit 6: User interface and UI controls, case study applications

- **Prerequisites:** Knowledge of general user interface**.**

- **Objective:**
  1. To introduce skills necessary for creating GUI based forms in VB.NET

- **Outcomes:**
  On completion of this unit, student will be able to,
  1. Explore and use the .NET framework APIs for implementing various functionalities of an application using VB.NET.
  2. Define and create GUI for applications using VB.NET language.

- **Unit Content:**
  Introduction: in-class project, group box control, textbox and label controls, masked textbox control, rich textbox control, radio button control, checkbox control, picture box control, application design, adding a professional touch, multiple controls, user interface features, color, grouping and border style, fonts, form's accept button and cancel button properties, tab order, keyboard access keys, click event, masked textbox, and label controls, selecting and unselecting radio buttons and checkboxes ,setting the focus, the WITH and END WITH statements

  Case Study:
  1. Creating forms for library management information system.
  2. Creating forms for student information management system for a college.
  3. Creating a GUI application for serial communication.

- **Content Delivery Methods:**
  Despite the course being self learning course, use of online interactive power point presentations, hands on demonstration of using language constructs, video tutorials and interactive sessions is highly desirable.

- **Assessment Methods:**
  Student will be evaluated by questions on creating forms for a specific case study and standard UI controls in VB.NET.

- **Text Book:**
  1. Visual Basic .NET Black Book by Steven Holzner- Dreamtech Press

- **Reference Books:**
  1. Beginning VB.NET by Richard Blair, Jonathan Crossland, Mathew Reynolds, Thearon Willis- SPD Publication
  2. Visual Basic .NET The Complete Reference by Jeffrey R. Shapiro- TMH Publication

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Solapur University, Solapur
T.E. (Electronics)
TECHNICAL SELF LEARNING COURSE III
EN326 AUTOMOTIVE ELECTRONICS

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

Automotive sector has emerged as one of the major application area 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 poses some background for transducers, electronic circuit design, microprocessors/microcontrollers and control systems.

Course Objectives:
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 environmental friendly vehicles

Course Outcomes:
1. Student can describe basics of working of automobile engines and transmission
2. Student get acquainted with different electronic circuits used in automobiles
3. Student can describe communication and diagnostic systems used in automobiles
4. Student realizes importance of environmental friendly vehicles

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 / environmental 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); alternators and charging, battery technology: electronic ignition systems

- **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

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

- **Outcomes:**
  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. Position sensing e.g. crankshaft, throttle plate
  3. Pressure sensing e.g. manifold, exhaust differential, tyres
  4. Distance sensing e.g. anti-collision
  5. Velocity sensing e.g. speedometer, anti-skid
  6. Torque sensing e.g. automatic transmission
  7. Vibration sensing, accelerometer e.g. airbags
  8. Flow sensing and measurement e.g. fuel injection, air mass flow.

- **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

- **Objectives:**
  1. To apply different sensors used for instrumentation in typical automobile through proper interfacing and signal conditioning

- **Outcomes:**
  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 and limitations of all sensors covered in the above,(Unit 2) to in-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, functions and objectives of the systems mentioned above; specification and identification of micro-controllers for above control 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 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: interfacing techniques and interfacing with infotainment gadgets; relevance of communication protocols for automotive applications; automotive buses: use of various buses such as CAN, LIN, Flex-Ray; 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; a systems review; 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

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- **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

Solapur University, Solapur
T.E. (Electronics)
TECHNICAL SELF LEARNING COURSE IV
EN326 ELECTRONIC INSTRUMENTATION

Teaching Scheme **Examination Scheme**
Self learning, 2 Credits **Theory –** 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

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Course Outcomes:

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, recorders to assemble a measuring instrument for different applications.
6. Student can identify different sensors and explain interfacing circuits for these.
7. Student can explain data acquisition system for various applications

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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

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- **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.
