SOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF ENGINEERING & TECHNOLOGY

ELECTRONICS ENGINEERING

Syllabus for

T.E. (Electronics Engineering) w.e.f. Academic Year 2016-17

SOLAPUR UNIVERSITY, SOLAPUR
FACULTY OF ENGINEERING & TECHNOLOGY
Electronics Engineering

Programme Educational Objectives and Outcomes

A. Program Educational Objectives

1. To enable student to achieve immediate employment in Electronics, Communication and IT related industries with appropriate title and compensation.
2. To enable student to analyze and solve Electronics Engineering problems by applying basic principles of mathematics, science, and engineering and also able to use modern engineering techniques, skills, and tools to fulfill societal needs.
3. To enable student to innovate, design and develop hardware and software components.
4. To nurture student to be sensitive to ethical, societal and environmental issues while conducting their professional work.
5. To build strong fundamental knowledge amongst student to pursue higher education and continue professional development in Electronics & other fields
6. To equip student with technical and communication skills in order to be able to function in national/international/multi-cultural corporations and organizations.

B. Program Outcomes

Student attains the following outcomes:

a. an ability to apply knowledge of mathematics, science, and engineering
b. an ability to design and conduct experiments, as well as to analyze and interpret data,
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d. an ability to function on multidisciplinary teams
e. an ability to identify, formulate, and solve engineering problems
f. an understanding of professional and ethical responsibility
g. an ability to communicate effectively
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i. a recognition of the need for, and an ability to engage in life-long learning,
j. a knowledge of contemporary issues
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

SOLAPUR UNIVERSITY, SOLAPUR
FACULTY OF ENGINEERING & TECHNOLOGY
Electronics Engineering

Structure of T.E. (Electronics Engineering) w.e.f. 2016-17

SOLAPUR UNIVERSITY, SOLAPUR

Faculty of Engineering & Technology (Revised from 2014-2015)

Credit System structure of T.E. Electronics Engineering W.E.F. 2016-2017 — *Semester I*

Theory Course Name	Hrs./week			Credits	Examination Scheme			
	L	T	P		ISE	ESE	ICA	Total
Control Systems	3	1	_	4	30	70	--	100
Digital Signal Processing	4	_	_	4	30	70	-	100
Microprocessor and Interfacing	4	-	_	4	30	70	-	100
Electro Magnetic Engineering	4	1	_	5	30	70	25	125
Information Technology & Management	3	_	_	3	30	70	25	125
Self Learning Module I	_	_	_	2	--	50	_	50
Object Oriented Programming with C++	2	-	-	2	--	--	25	25
Sub Total	20	2	_	24	150	400	75	625
Laboratory								
						ESE		
						POE	OE	
Control Systems	_	_	2	1	_	--	--	25	25
Digital Signal Processing	_	_	2	1	_	50	_	25	75
Microprocessor and Interfacing	--	--	2	1	--	50	--	25	75
Object Oriented Programming with C++	_	_	2	1	_	50	_	--	50
Sub Total	--	-	8	4	_	150		75	225
Grand Total	20	2	8	28	150	550		150	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)

(Dr. S. R. Gengaje)
30/07/2015

SOLAPUR UNIVERSITY, SOLAPUR

Faculty of Engineering & Technology (Revised from 2014-2015)

Credit System structure of T.E. Electronics Engineering W.E.F. 2016-2017 — *Semester II*

Theory Course Name	Hrs./week			Credits	Examination Scheme			
	L	T	P		ISE	ESE	ICA	Total
Operating Systems	3	_	_	3	30	70	-	100
Digital Communication	3	_	_	3	30	70	-	100
Microcontrollers	4	_	_	4	30	70	-	100
Industrial Electronics	4	_	_	4	30	70	-	100
VLSI Design	4	_	_	4	30	70	_	100
Self Learning Module II	_	_	_	2	--	50	_	50
Sub Total	18	_	_	20	150	400	_	550
Laboratory/Workshop								
						ESE		
						POE	OE	
Operating Systems	_	_	2	1	_	_	_	25	25
Digital Communication	_	_	2	1	_	_	25	25	50
Microcontrollers	_	_	2	1	_	50	_	25	75
Industrial Electronics	_	_	2	1	_	50	_	25	75
VLSI Design	_	_	2	1	_	_	_	25	25
Mini Hardware Project	_	_	2	1	_	_	_	50	50
Sub Total		_	12	6	_	125		175	300
Grand Total	18	-	12	26	150	525		175	850

Note: 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)

(Dr SR Gengje)
30/07/2015

Note –

- 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.
- Vocational Training (evaluated at B.E. Part-I) of minimum 15 days shall be completed in any vacation after S.E. Part-II but before B.E. Part-I & the report shall be submitted and evaluated in B.E. Part-I
- Appropriate Elective I & II Subjects may be added when required.
- Student shall select one Self Learning Module at T.E. Part I and T.E. Part II each from Technical and Humanities and Social Sciences Group with at least one Self Learning Module from the Humanities and Social Sciences Group
- Curriculum for Humanities and Social Sciences Self Learning Modules is common for all under graduate programmes of faculty of Engineering and Technology
- 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
- Project group for T.E.(Electronics) Part II Mini Project shall not be of more than **three** student
- Project group for B.E.(Electronics) Part I and Part II shall not be of more than **three** student.
- Term work 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

(Dr. S R Gengaje)
30/07/2015

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

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

Examination Scheme
Theory – 100 Marks
Term-work – 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 aware of the basics of control systems, its types and its use in various fields of engineering.
2. Introduction of system transfer function and mathematical modeling of its behavior.
3. Introduction of various components used in a control system.
4. Implementation of block reduction technique and signal flow graph method to determine transfer function of time invariant single input & single output system.
5. Use of stability criteria in determining performance of a control system.
6. Determination of stability of system using different graphical methods like Root locus, Bode plot and polar plot.
7. Introduction to frequency domain and time domain analysis to evaluate system performance.
8. Introduction of different compensations techniques used in control systems.

Course Outcomes:
At the end of this course,
1. Student is able to classify control systems.
2. Student is able to represent the different electrical system mathematically.
3. Student can find transfer function of a system using signal flow graph and block diagram reduction methods.
4. Student can explain application of control system components to form a feedback control system.

5. Student exhibits knowledge of stability, time and frequency domain analysis necessary to find systems performance.
6. Student is able to draw Root locus, Bode plot and Polar plot for a feedback control system which can be further analyzed to find its stability.
7. Student is able to decide the necessary compensation technique to stabilize systems performance.

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 types of control systems.
  2. Representation of electrical system mathematically and to determine its transfer function.
  3. Representations of electrical system using block diagram and to study the block diagram reduction technique.
  4. Representations of system using signal flow method and to study the application of Mason's gain formula.

- **Outcomes:**
  Upon completion of this unit, student is –
  1. Able to classify the system and represent it mathematically.
  2. Able to characterize the system parameters.
  3. Able to find 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, examples of control systems, liquid level control system, servo mechanism, transfer function-definition, pole zero and time constant form, characteristic equation, poles, zeros, order of system and pole zero plot, mathematical modeling of electrical and mechanical system, transfer function of electrical system, transfer function using block diagram reduction techniques and signal flow graph, 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, block

diagram representation technique and signal flow graph, numerical to find out poles, zeros, order of the system, transfer function of the electrical system, block diagram reduction technique and Mason's Gain formula, questions for drawing pole zero plot and signal flow graph of system.

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 make student understand working of control system components used in control system.
  2. Derive transfer function of armature controlled and field controlled DC motor.

- **Outcomes:**
  After completing this unit, student –
  1. Can explain working and use of control system components in feedback control system.
  2. Is able to find out 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 servomotor.

- **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 standard test signals.
  2. To make student understand step response of first order system.
  3. To make student understand step and impulse response of second order system.
  4. To make student understand time domain specifications of second order system.
  5. To introduce to student concept of steady state error, error coefficients for zero, one and type two systems.

6. To make student understand concept of compensation.
7. To introduce to student concept of proportional controllers.

- **Outcomes:**
  After completing this unit, student –
  1. Can describe properties of different test signals as input signal.
  2. Can analyze step response of first order system.
  3. Can analyze step and impulse response of second order system.
  4. Can find time domain specifications of second order system.
  5. Can find steady state error, error coefficients up to type 2 systems.
  6. Able to compensate error of the system up to type 2 systems.
  7. Can describe proportional controller.

- **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, proportional controllers, P, PI, PID controllers

- **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, compensations and proportional controllers.

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 introduce to student basic concepts of root locus for determining stability.
  4. To make student understand procedure of plotting root locus.

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

3. Can analyze system by using Rouths's criterion.
4. Able to draw root locus plot of system and can analyze system

- **Unit Content:**
  Introduction**,** concept of stability, absolute, conditional and relative stability, Hurwitz and Routh's criterion for stability, root locus, concept of root locus, 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 of the concept 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 advantages and disadvantages of frequency domain anaysis
  2. To make student understand specifications of frequency domain method.
  3. To make student understand co-relation between time domain and frequency domain specifications.
  4. To make student understand frequency response of sinusoidal input.
  5. To make student understand magnitude and phase plot.
  6. To introduce to student procedure of drawing Bode plot.
  7. To make student understand gain margin, phase margin, gain cross over frequency and phase cross over frequency.

- **Outcomes:**
  After completing this unit, student –
  1. Can describe advantages and disadvantages of frequency domain analysis methods.
  2. Can describe specifications of frequency domain.
  3. Can co-relate time domain and frequency domain specifications
  4. Can analyze the system by drawing frequency response.
  5. Can analyze system by drawing Bode plot.

- **Unit Content:**
  Introduction, advantage, disadvantages and specifications of frequency domain, co-relation between time domain and frequency domain specifications, frequency response to sinusoidal input, Bode plot- magnitude and phase plot, gain and phase margin, stability analysis using Bode plot.

- **Content Delivery Methods:**
  Chalk and talk, power point presentation and MATLAB simulation for Bode 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 and determine stability of system.

Unit 6-Polar plots and compensators No of lectures – 06

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

- **Objectives:**
  1. To introduce to student procedure for drawing polar plot and inverse polar plot.
  2. To make student understand need of compensators.
  3. To make student understand different types of compensators.
  4. To make student understand different compensating networks.

- **Outcomes:**
  After completing this unit, student –
  1. Is able to draw polar plot.
  2. Is able to draw inverse polar plot
  3. Can analyze lag compensators, lead compensators and lag-lead compensator.

- **Unit Content:**
  Polar plots, procedure to sketch polar plot, limitation of polar plot, inverse polar plot, need of compensator, cascade compensation, feedback compensation, combined compensation, lag compensators, lead compensators and lag-lead compensator.

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

- **Assessment Methods:**
  Descriptive questions to ensure understanding of polar plot, compensation technique, lag compensators, lead compensators and lag-lead compensator, questions to draw polar plot.

- **Term work:**
  Term work 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 – integral (PI) mode of control
     Case-II: Proportional – derivative (PD) mode of control
     Case-I: 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

DIGITAL SIGNAL PROCESSING

Teaching Scheme
Lectures – 4 Hours/week
Practical – 2 Hours/week

Examination Scheme
Theory – 100 Marks
Term-work – 25 Marks
Practical & Oral exam – 50 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- and discrete frequency domains, 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 different design methods for digital filter.
4. To introduce to student digital signal processor functional blocks with focus on a typical processor.

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 demonstrates knowledge of different transforms.
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 demonstrates knowledge of basic blocks of a typical digital signal processor.

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, impulse response estimation

- **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 , FIR implementation techniques.

- **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 filter approximation (Butterworth), finite world length effects in IIR filters, Implementation of IIR filters.

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

- **Assessment Methods:**
  Questions based on techniques for converting analog filters into digital, characteristics and properties of Butterworth filters, frequency transformations and finite word length effects, numerical on filter design 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, image processing and communication

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

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

- **Term work:**
  Term work 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

- **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
MICROPROCESSOR AND INTERFACING

Teaching Scheme
Lectures – 4 Hours/week
Practical – 2 Hours/week

Examination Scheme
Theory – 100 Marks
Term-work – 25 Marks
Practical & Oral exam – 50 Marks

This course provides a systematic introduction to the architecture of microprocessor 8085 and different peripherals used in 8085 microprocessor based system. The course also introduces assembly language programming concepts for 8085 and enables student to write programs addressing fundamental programming skills and also for interfacing with different peripherals. The serial communication along with programming is also covered.

Course Prerequisite:
Student has completed a course in digital logic design and shall have an adept knowledge of various digital blocks like gates, flip-flops, registers, counters etc. Student also has knowledge about multiplexers, de-multiplexers, encoders and decoders.

Course Objectives:
1. To make student understand concept of bus based system
2. To develop concept of microprocessor functioning with focus on typical microprocessor.
3. To make student skilled at assembly language programming.
4. To make student understand working of memory and different peripheral ICs.
5. To make student comprehend concept of interfacing with memory and peripherals.
6. To make student understand basics of serial communication.

Course Outcomes:
1. Student can describe 8085 MPU, its peripherals and their various applications.
2. Student can write assembly program for different applications.
3. Student can design 8085 microprocessor based systems.

Section I

Unit 1-Introduction to microprocessor No of lectures – 05

- **Prerequisite:** Operation of different gates and basics of flip-flop and register circuits
- **Objectives:**
  1. To introduce to student microprocessor based system and its need.
  2. To make student aware of different types of memory and its expansion.

3. To make student learn memory and I/O device operations.

- **Outcome:**
  After completing this unit student -
  1. Can explain different blocks of microprocessor based system
  2. Are able to solve memory mapping and memory organization problems
  3. Can explain operation of memory and I/O device

- **Unit Content:**
  Basic microprocessor systems with bus organization, semiconductor memory- types, construction, memory mapping and organization, memory operations, I/O devices and operations

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

- **Assessment Methods:**
  Questions based upon microprocessor based system, problems on memory mapping and organization

Unit 2–8085 microprocessor No of lectures – 15

- **Prerequisite:** Basics of registers, de-multiplexers, decoders and concept of microprocessor and memory and I/O operations.

- **Objectives:**
  1. To make student understand architecture of 8085 microprocessor.
  2. To introduce to student software model of 8085 with basic instructions

- **Outcomes:**
  After completing this unit, student –
  1. Can describe architecture of 8085 microprocessor and explain use of pins of 8085
  2. Can draw instruction cycle for various instructions
  3. Can write assembly language programs for different applications
  4. Can make use of interrupts, stack and subroutine for various applications

- **Unit Content:**
  8085 architecture, pin configuration, 8085 MPU, instruction set, addressing modes, de-multiplexing of address and data, generation of control signals, timing diagram for different instructions, , programming model, addressing modes, instructions, programming ,single cycle and single stepping, stack and subroutine, delay subroutine, interrupts

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

- **Assessment Methods:**
  Questions based upon architecture of 8085 microprocessors, drawing instruction cycles, assembly language programs - using basic instructions, different assembly language programming structures like loop, stack, and subroutine etc, efficient use of different addressing modes, questions based on use of software and hardware interrupts

Unit 3-Interfacing memory No of lectures – 5

- **Prerequisite:** Types of memory, memory operations, memory organization, 8085 MPU, decoders, de-multiplexers

- **Objectives:**
  1. To introduce to student the concept of interfacing and its need.
  2. To make student understand interfacing of RAM and ROM with 8085 MPU
  3. To make student design a 8085 based minimum system

- **Outcomes:**
  After completing this unit, student –
  1. Can interface RAM and ROM to the 8085 microprocessor
  2. Can design a 8085 minimum system

- **Unit Content:**
  Interfacing program and data memory, wait state, interfacing slower memories, interfacing memories with memory expansions

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

- **Assessment Methods:**
  Questions on different memory interfacing

Section II

Unit 4 -Interfacing input/output devices No of lectures – 12

- **Prerequisite:** 8085 MPU, interfacing of memory, latch, buffer, decoders, de-multiplexers

- **Objectives:**
  1. To make student understand various I/O devices and its interfacing.
  2. To introduce to student PPI 8255, interfacing and its applications
  3. To make student able to interface different I/O devices with 8085 MPU through 8255

- **Outcomes:**
  After completing this unit, student –
  1. Can differentiate between I/O mapped I/O and memory mapped I/O
  2. Can interface different I/O devices with 8085 MPU through 8255.

- **Unit Content:**
  Input/output ports, I/O mapped I/O, memory mapped I/O, I/O instructions with timing diagram, PPI 8255: Internal block diagram, interfacing with 8085, modes, programming, interfacing through 8255– LEDs, seven segment display, keyboard, stepper motor

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

- **Assessment Methods:**
  Questions based on 8255 architecture, modes, programming, interfacing with 8085, interfacing of peripherals through 8255

Unit 5- Programmable timer/counter 8253 No of lectures – 4

- **Prerequisite:** 8085 MPU, interfacing of I/O

- **Objectives:**
  1. To make student understand operations of 8253 and its applications.
  2. To make student able to interface 8253with 8085 MPU and program it for different applications

- **Outcomes:**
  After completing this unit, student –
  1. Can describe architecture and modes of operation of 8253
  2. Are able to interface 8253with 8085 MPU and write programs for different applications

- **Unit Content:**
  8253 internal block diagram, modes, interfacing with 8085, programming

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

- **Assessment Methods:**
  Questions based on architecture and modes of 8253, interfacing and programs making proper selection of modes for different applications

Unit 6-Serial communication No of lectures – 5

- **Prerequisite:** 8085 MPU, bus based systems, parallel data transfer

- **Objectives:**
  1. To make student understand concept of serial communication using SID and SOD pins of 8085.
  2. To make student understand different modes of operation of 8251 USART
  3. To make student able to interface 8251 with 8085 MPU and to configure 8251 for different serial communication operations.
  4. To introduce to student RS 232 serial communication standard.
- **Outcomes:**
  After completing this unit student-
  1. Can write a program for serial communication using SID and SOD pins of 8085
  2. Can design a serial communication port for 8085 MPU using 8251 USART and RS 232C

- **Unit Content:**
  Basics of serial communication, types, modem, serial communication using SID and SOD, 8251 USART- internal block diagram, interfacing with 8085, modes, programming, RS 232 standard.

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

- **Assessment Methods:**
  Questions based on architecture and modes of 8251, interfacing, RS232C, and programs for various serial communication applications

Unit 7-Data conversion techniques No of lectures – 4

- **Prerequisite:** Concept of digital and analog signal, 8085 MPU, I/O interfacing

- **Objectives:**
  1. To make student understand different types of DAC and ADC techniques and their uses.
  2. To make student able to interface DAC and ADC ICs with 8085 and write program for different applications

- **Outcomes:**
  After completing this unit student-
  1. Can explain different techniques of DACs and ADCs
  2. Are able to interface DAC and ADC ICs with 8085 MPU and write programs for different applications

- **Unit Content:**
  DAC techniques- R2R, ladder network, DAC specifications, ADC techniques – flash, single slope, dual slope, successive approximation, ADC specification, interfacing DAC 8008 and ADC 0808 with 8085.

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

- **Assessment Methods:**
  Questions based on ADC and DAC techniques, interfacing of DAC & ADC ICs and programs for different applications

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- **Term work:**
  Minimum ten experiments as detailed below with minimum four experiments based on interfacing and peripherals and minimum two experiments on PC with IDE/simulator is recommended.

  1. Programs based on addressing modes, arithmetic and logical instructions
  2. Programs based on loops
  3. Program based on code conversion
  4. Program based on 16 bit arithmetic operations & logical operations
  5. Program based on pointers
  6. Program based on advanced instructions
  7. Programs based on stack and subroutine
  8. Program based on interrupt
  9. Hardware interfacing – static display, dynamic display, stepper motor, DAC, ADC, printer, 8253, 8251

- **Text Books:**
  1. Microprocessors architecture, programming and applications with 8085A, Ramesh S. Gaonkar, 5th edition, Penram publication
  2. 8085 Microprocessor: Programming and Interfacing, Srinath N. K; Prentice Hall India Publication

- **Referred Books:**
  1. Microprocessors and peripheral, S.P.Chaudhry, Sumitra Chaudhry, Scitech Publication
  2. Microcomputers and Microprocessors, John Uffenbeck, 3rd Edition, Prentice Hall India Publication
  3. Intel Microprocessor Peripheral Hand Book, Application Notes.

Solapur University, Solapur
T.E. (Electronics) Semester-I
ELECTROMAGNETIC ENGINEERING

Teaching Scheme	**Examination Scheme**
Lectures – 4 Hours/week	**Theory –** 100 Marks
Tutorial – 1 Hour/week	**Term-work –** 25 Marks

This course introduces electromagnetic field theory which deals with electric and magnetic field vectors. The course also introduces theoretical and analytical aspects of electromagnetic wave propagation, transmission lines, antenna wave theory and radiating system.

Course Prerequisite:

Student shall have knowledge of circuit theory. He shall also have basic knowledge of vectors and Del operator.

Course Objectives:

1. To make student understand basics of coordinate systems, significance of divergence, gradient and curl.
2. To introduce to student basic laws of electrostatic and magnetostatic.
3. To make student derive Maxwell's equations under different conditions.
4. To make student understand theory and mathematical background of wave propagation.
5. To enable student understand communication through different types of 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 antennas

Section I

Unit 1–Vector calculus No of lectures – 06

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

- **Objectives:**
  1. Revision of concepts of scalars and vectors.
  2. To introduce to student different coordinate systems.
  3. To make student understand vector transformation techniques.
  4. To make student understand applications of Del operator.

- **Outcomes:**
  After completing this unit, student -
  1. Can apply Del operator to solve numerical.
  2. Can calculate length, surface and volume in different coordinate systems.
  3. Can convert vectors in different coordinate system.

- **Unit Content:**
  Scalars and vectors, vector algebra, coordinate system, differential length, surface and volume, point and vector transformations, DEL operator**.**

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

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

Unit 2–Electrostatics No of lectures – 12

- **Prerequisite:** Vector calculus, basics of electricity.

- **Objectives:**
  1. To make student understand concepts of static electric field and charge distribution.
  2. To make student analyze electric field intensity and density due to various charge distributions.
  3. To make student derive Gauss's law and understand its applications.
  4. To make student apply Del operator to calculate divergence

- **Outcomes:**
  After completing this unit, student –
  1. Can evaluate force using Coulomb's law
  2. Is able to calculate electric filed intensity and density over different charge distributions.
  3. Can derive point form of Gauss's law

4. Can evaluate energy and potential associated with charge distribution.
5. Can analyze boundary conditions at the interfacing of two dielectric media.

- **Unit Content:**
  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 problems and derivation related to Coulomb's law, numerical problems for electric field intensity, electric field intensity due to distributed charges, flux density, numerical problems and proof of divergence theorem, numerical problems based on electrostatic potential, potential gradient, electric dipole, numerical problems related to electrostatic energy density, derivation based on boundary conditions for electrostatic field.

Unit 3–Static magnetic field No of lectures – 09

- **Prerequisite:** Concepts of magnetic field, magnetic flux lines, applications of magnetic field

- **Objectives:**
  1. To make student derive Biot Savart law, Ampere's law
  2. To make student apply Curl, Stroke's Theorem for getting magnetic flux and magnetic flux density, scalar and vector magnetic potentials.
  3. To make student evaluate force on current element and between current elements using Lorentz force equation.
  4. To introduce to student concept of energy stored in magnetic field and inductors.
  5. To make student compare electric field and magnetic field parameters.

- **Outcomes:**
  After completing this unit, student –
  1. Can apply Biot Savart law to finite, infinite and circular current element.
  2. Is able to solve numerical problems to find magnetic field intensity and magnetic flux density with various types of current distributions.
  3. Can apply Ampere's circuit law for symmetrical surface and asymmetrical surface.
  4. Is able to derive magnetic vector potential and boundary conditions.
  5. Can compare between electric and magnetic field.

- **Unit Content:**
  Biot Savarts law, Ampere's circuital law and its applications, 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, videos

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

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 conduction current density
  2. To make student derive mathematical proof of Maxwell's equation.
  3. To introduce to student concept of Maxwell's equations for different fields

- **Outcomes:**
  After completing this unit, student –
  1. Can analyze difference between displacement current and conduction current density
  2. Can derive Maxwell's equation in differential and integral forms.
  3. Can evaluate Maxwell's equations under static, dynamic and harmonically time varying field conditions.

- **Unit Content:**
  Continuity equation for static conditions, displacement current and current density, 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 problems and derivation related to above Content.

Unit 5-Electromagnetic wave 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, solutions and propagation characteristics
  2. To derive equations for wave propagation in free space, in perfect dielectrics and in conducting media.
  3. To make student understand SWR, skin effect, Poynting 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 equations for wave propagation in free space, in perfect dielectrics and in conducting media
  3. Can derive Poynting theorem and can describe power flow in uniform plane wave.

- **Unit Content:**
  Wave propagation in dielectric & conducting media, modification in wave equations for sinusoidal time variations, propagation in good conductor, skin effect, reflection coefficient, transmission coefficient and VSWR, Poynting theorem, power flow in uniform plane wave

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, animation on wave propagation

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

Unit 6-Transmission lines No of lectures – 08

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

- **Objectives:**
  1. To make student understand transmission line equations and parameters
  2. To make student understand various impendence
  3. To introduce to student reflection coefficient and VSWR.
  4. To introduce to student Smith Chart and stubs for line equation parameters

- **Outcomes:**
  After completing this unit, student –
  1. Can derive transmission line equations.
  2. Can derive impendence equations and different parameters.

3. Can calculate reflection coefficient, propagation constant, $Z_{x,}$ velocity.

- **Unit Content:**
  Transmission line equations 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, Smith chart

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

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

Unit 7-Antenna & radiating systems No of lectures – 06

- **Prerequisite:** Basics of analog communication, Maxwell's equations

- **Objectives:**
  1. To introduce to student basic antenna parameters, properties and function
  2. To make student understand radiation mechanism and to derive radiation power and resistance of current elements for dipole
  3. To introduce to student concept of polarization
  4. To make student understand 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 equations.
  3. Can calculate different antenna parameters.

- **Unit Content:**
  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 presentations, animation on different types of antennas

- **Assessment Methods:**
  Numerical problems, derivation related to radiation resistance and power radiated, theory questions related to construction and working of various antennas

- **Term Work:**
  Term work consists of minimum ten tutorials based upon above curriculum. Tutorial shall include numerical problems and derivations.

- **Text Books:**
  1. Electromagnetic Engineering, William Hyte, 7th Edition, Tata Mc Graw Hill
  2. Electromagnetic field theory & Transmission Lines, GSN Raju, Pearson Education
  3. Antennas for All Applications, John D. Kraus, 3rd Edition, Mc Graw Hill

- **Reference Books:**
  1. Problems and solutions in electromagnetic, William Hyte, Tata Mc Graw Hill
  2. Electromagnetic waves and Transmission, Rao, Prentice Hall India Publications
  3. Antenna and Wave Propagation, K.D.Prasad, Satya Prakashan

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

Teaching Scheme
Lectures – 3 Hours/week

Examination Scheme
Theory – 100 Marks
Term-work – 25 Marks

This course provides the basic tactical and strategic principles of information technology uses for Management Information Systems and its various applications. 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, overview of project management, activity planning, monitoring and controlling of the software projects.

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

Course Outcomes:
1. Student become aware of changing face of business and importance of management information system for today's business
2. Student can describe features of digital commerce and is aware of social and ethical issues associated with new business practices.
3. Student can describe how companies can gain benefit of E-commerce to enhance business through examples and case studies.
4. Student is able to illustrate and apply software development life cycle and software models
5. Student can apply knowledge of project management process through case study and able to explain methods for monitoring and control of the project.

Section-I

Unit 1-Information systems No of lectures – 06

- **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 and the supply chain.
  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 emphasize 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:**
  Information systems: concepts and definitions, classification and types of information systems, how IT support people, how IT supports supply chain and business process, information system infrastructure, architecture and emerging computing environments, dimensions of information systems, contemporary approach to information system.

- **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 – 05

- **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 aware about major models of E-business.
  4. To make student figure out E-commerce supports services.
  5. To create awareness about ethical and legal issues in E-business.
  6. To make student to gain knowledge about mobile E-commerce.

- **Outcomes:**
  After completing this unit, student –
  1. Exhibits knowledge about E-business and E-commerce.
  2. Can describe major E-commerce mechanisms.
  3. Able to emphasize important applications of B2B and B2C E-commerce.
  4. Able to identify and utilize E-commerce support services.
  5. Can be responsive and devotee for ethical and legal issues in E-business.
  6. 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, 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 – 5

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

- **Objectives:**
  1. To introduce to student importance of data management.
  2. To introduce to student data base management system.
  3. To acquaint student with benefits of data warehouse, data marts and data centers.

4. To make student identify enterprise content management.
5. To make student be familiar with data visualization technologies.
6. To make student aware about data management issues.

- **Outcomes:**
  After completing this unit, student –
  1. Able to describe functions of data base and data base management system.
  2. Can describe the tactical and strategic benefits of data warehouse, data marts and data centers.
  3. Able to make out how enterprise content management supports business.
  4. Able to extract valuable information from data visualization technologies.
  5. Can formulate managerial issues.

- **Unit Content:**
  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.

- **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.

Unit 4–Ethical and social issues No of lectures – 04

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

- **Objectives:**
  1. To make student aware about privacy & workplace monitoring.
  2. To make student act on ethical principles, workplace behavior and care about health.
  3. To make student aware about de-skilling and alienation.
  4. To create awareness about E-waste management.

- **Outcomes:**
  After completing this unit, student –
  1. Can follow and adhere to privacy & workplace monitoring environment.
  2. Able to follow ethical principles, workplace behavior and health policies.
  3. Able to describe de-skilling and alienation.
  4. Becomes aware to E-waste problems and their solutions

- **Unit Content:**
  Privacy, workplace monitoring, power over users, candidate ethical principles, workplace behavior and health, de-skilling and alienation, telecommuting, E-waste

- **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

Section II

Unit 5 – Modern organizational structure No of lectures – 06

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

- **Objectives:**
  1. To aware student about organization, features of organization & organizational structure.
  2. To highlight student about doing business in digital economy.
  3. To make student understand organizational responses and IT support.
  4. To make student aware about business pressure.
  5. To emphasize student to understand how information system impact organizations and business firms.

- **Outcomes:**
  After completing this unit, student –
  1. Able to work in an organization and develop features necessary for organization & organizational structure.
  2. Able to embrace organizational responses and IT support.
  3. Becomes aware about business pressure.
  4. Able to describe how information system impact organizations and business firms.

- **Unit Content:**
  What is an organization, features of organizations, organizational structure, doing business in digital economy, business pressure, organizational responses and IT support, how information system impact organizations and business firms.

- **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, business pressure, organizational responses and IT support, how information system impact organizations and business firms

Unit 6–Project & software development life cycle No of lectures – 05

- **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 design project planning framework.
  3. To make student differentiate software project from other project.
  4. To make student develop project manager abilities.
  5. To make student employ software development life cycle.
  6. To make student practice different software development process models.

- **Outcomes:**
  After completing this unit, student –
  1. Can categorize project and describe its attributes.
  2. Able to represent project planning framework.
  3. Can compare software project with other project.
  4. Able to acquaint with role of project manager.
  5. Able to reveal software development life cycle through case study.
  6. Able to practice software development process models.

- **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.

- **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.

Unit 7–Project management overview No of lectures – 05

- **Prerequisite:** Information system, data management, organizational structure, project and software development life cycle.

- **Objectives:**
  1. To make student understand project management process.
  2. To make student identify project management knowledge areas.
  3. To make student appreciate system view of project management.

4. To make student realize stakeholders and stakeholders management.
5. To aware student about requirement engineering.

- **Outcomes:**
  After completing this unit, student –
  1. Able to describe project management process.
  2. Becomes aware of project management knowledge areas.
  3. Able to relate system view of project management.
  4. Able to identify and describe stakeholders and stakeholder's management.
  5. Can discuss and sort out requirements of a project.

- **Unit Content:**
  Project management process, project management knowledge areas, systems view of project management, understanding organizations, stakeholders and stakeholders management, requirement engineering.

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

- **Assessment Methods:**
  Questions based upon block diagram and descriptive questions to ensure understanding of project management process, project management knowledge areas, systems view of project management, understanding organizations, stakeholders and stakeholders management, requirement engineering.

Unit 8–Activity planning monitoring and control No of lectures – 06

- **Prerequisite:** Project, software development life cycle, project management overview.

- **Objectives:**
  1. To make student identify objectives of activity planning.
  2. To make student draw network planning models.
  3. To make student represent forward and backward pass methods.
  4. To make student find critical path in a network model.
  5. To make student sort-out resource requirements & data collection and reporting.
  6. To make student explain project visualization methods.
  7. To make student understand about controlling slippage & change management

- **Outcomes:**
  After completing this unit, student –
  1. Can describe objectives of activity planning.
  2. Able to draw and explain network planning models.
  3. Can draw and explain critical path.
  4. Able to explain resource requirements & data collection and reporting.
  5. Can describe project visualization methods.
  6. Able to explain slippage and change controls.

- **Unit Content:**
  Objectives, network planning models, rules for precedence network model, forward and backward pass, critical path analysis, resource requirements & scheduling data collection and reporting, visualization methods, dealing with slippage, change control.

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

- **Assessment Methods:**
  Questions based upon block diagram and descriptive questions to ensure understanding of Objectives, network planning models, rules for precedence network model, forward and backward pass, critical path analysis , resource requirements & scheduling data collection and reporting, visualization methods, dealing with slippage , change control.

- **Term Work:**
  Term Work consists of minimum one assignment based on each unit may be comprising of case studies, group discussion and information survey.

- **Text Books:**
  1. Introduction to Information System, Rainer, Turbo, Potter, Wiley Student Edition, Wiley India Pvt. Ltd.
  2. Information Technology for Management, Efraim Turban, Linda Volonino, Wiley Student Edition, Wiley India Pvt. Ltd.

- **Reference Books:**
  1. Information System Management in Business and Development Organization, Harekrishna Misra, Eastern Economic Edition, PHI Learning Pvt. Ltd.
  2. Information System for Modern Management, Robert G. Murdick, Joel E.Rose, James R. Claggett, 3rd Edition, PHI Learning Pvt. Ltd.
  3. Management Information System, Kel Laudon, Jane Laudan, Rajanish Dass, 11th Edition, Pearson.
  4. Management Information System (MIS), Rahul De, Wiley India Pvt. Ltd.
  5. Management Information System, James A.O' Brien, 4th edition, TATA Mc Graw-Hill Edition Pvt. Ltd

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Solapur University, Solapur

T.E. (Electronics) Semester-I

OBJECT ORIENTED PROGRAMMING WITH C++

Teaching Scheme	**Examination Scheme**
Lectures – 2 Hours/week	**Term-work –** 25 Marks
Practical – 2 Hours/week	**Practical & Oral exam –** 50 Marks

C++ is an object oriented language. It's an extension to C with number of features added. The course introduces the concept of class. The fundamental feature of OOP's is 'data hiding' which is implemented using class. The course also introduces other features of C++ like data abstraction, data encapsulation, polymorphism, inheritance, and message passing. Programming related with various features is also covered.

Course Prerequisite:

Student has completed a course in 'C programming' and shall have an adept knowledge of programming with C. Student also has knowledge about data structures using C and know the programming using structures in depth.

Course Objectives:

1. To introduce to student object oriented language.
2. To make student understand the concept of data hiding implemented using class.
3. To introduce to student concept of constructors and destructors.
4. To make student understand different types of inheritance and its related programming.
5. To make student understand run type and compile type polymorphism and its related programming.

Course Outcomes:

1. Student can differentiate between C and C++ in terms of data hiding and class and can implement applications using programming with class.
2. Student can describe significance and implement different types of constructors. He can also explain the difference between a constructor and a destructor.
3. Student can implement the structure, types of inheritance and explain the importance of inheritance.
4. Student can implement types of polymorphism- compile type polymorphism, run type polymorphism and virtual function.
5. Student can use different features of OOP's for efficient programming.

Section I

Unit 1-Beginning with C++ No. of Lectures – 2

- **Prerequisite:** Concepts of C programming– basic data types, loops, functions and structures.

- **Objectives:**
  1. To make student understand the difference between subject oriented programming - C and object oriented programming - C++.
  2. To make student understand different features of object oriented programming.
  3. To make student understand different data types and operators in C++.

- **Outcomes:**
  After completing this unit, student -
  1. Can describe the difference between subject oriented programming and object oriented programming.
  2. Can explain various features of OOP's.
  3. Can write programs using object oriented approach.
  4. Can explain basic data types, user defined data types, and derived data types.
  5. Can explain different operators in C++ and its precedence.

- **Unit Content:**
  Features of OOP's: class, object, encapsulation, data abstraction, inheritance, polymorphism, data hiding; difference between C and C++, structure of C++ program, tokens, keywords, identifiers & constants, basic data types, user defined data types, derived data types, operators in C++, scope resolution operator.

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

- **Assessment Methods:**
  Programming using structure in C

Unit 2-Functions in C++ No. of Lectures – 3

- **Prerequisite:** Concepts of C programming – functions and structures**.**

- **Objectives:**
  1. To make student understand the definition and declaration of a function in C++
  2. To make student understand function calling method.
  3. To introduce to student the concept and declaration of different types of functions like inline functions and friend functions.
  4. To make student understand function overloading and virtual functions.

- **Outcomes:**
  After completing this unit, student -
  1. Can write program using functions with different calling methods.
  2. Can explain the concept of inline functions and friend functions and also can write program using it.
  3. Can implement the concept of function overloading and virtual functions.

- **Unit Content:**
  Declaration of functions, function prototype, call by reference, stream input output functions in C++, Inline functions, concept of function overloading, friend functions, and virtual functions.

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

- **Assessment Methods:**
  Programming on functions with different calling approach, programming on inline functions

Unit 3-Classes and object No. of Lectures – 4

- **Prerequisite:** Concepts of C Programming – basic data types, loops, functions and structures.

- **Objectives:**
  1. To make student understand the structure and declaration of a class.
  2. To introduce to student member functions and scope resolution operator.
  3. To make student understand different visibility labels.
  4. To make student understand the importance of friend functions.
  5. To make student understand static data members and member functions.
  6. To make student to program using class using member functions, static data members and member functions, friend functions.

- **Outcomes:**
  After completing this unit, student -
  1. Can explain the difference between structure and a class.
  2. Can describe the significance of a class with different visibility labels.
  3. Can program using class and inline functions.
  4. Can explain the importance of friend functions and can also program using friend functions.
  5. Can implement static data members and member functions and its related programming.

- **Unit Content:**
  Declaration of a class, defining the member functions, creating the objects, concept of public, private and protected visibility labels, private member functions, arrays within a

class, static data members, static member functions, inline functions, friend functions, friend class.

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

- **Assessment Methods:**
  Programming using Class with different visibility labels, programming on inline functions, programming on static data members and member functions, programming on friend functions

Unit 4-Constructors and destructors No. of Lectures – 3

- **Prerequisite:** Concepts of class, member functions and visibility labels.

- **Objectives:**
  1. To make student understand different types of constructors.
  2. To make student understand the importance and properties of a destructor.
  3. To make student to program using constructors and destructors.

- **Outcomes:**
  After completing this unit, student -
  1. Can explain the importance and the properties of a constructor.
  2. Can implement the different types of constructors.
  3. Can describe the importance and the properties of a destructor.
  4. Can write program using constructors and destructors**.**

- **Unit Content:**
  Structure of a constructor, types of constructor: default constructor, parameterized constructor, default argument constructor, copy constructor, dynamic constructor; destructors

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

- **Assessment Methods:**
  Programming on different types of constructors, programming on destructors

Section-II

Unit 5–Inheritance No. of Lectures – 3

- **Prerequisite:** Concepts of class, member functions, visibility labels, and scope resolution operator**.**

- **Objectives:**
  1. To make student understand the structure and importance of inheritance.
  2. To make student understand different types of inheritance.
  3. To make student understand ambiguity in inheritance and how it is overcome.
  4. To make student understand virtual base class.
  5. To make student to program using different types of inheritance and virtual base class.

- **Outcomes:**
  After completing this unit, student -
  1. Can explain the importance of inheritance and write its structures.
  2. Can implement the different types of inheritance.
  3. Can explain and implement the ambiguity in hybrid inheritance and how it is overcome by virtual base class.
  4. Can write program using different types of inheritance.

- **Unit Content:**
  Structure of inheritance, defining a derived class, types of derivation: public, private and protected; types of inheritance: single, multilevel, multiple, hierarchical and hybrid; virtual base class, constructors in derived class.

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

- **Assessment Methods:**
  Programming on different types of inheritance, programming on virtual base class

Unit 6-Function overloading and operator overloading
(Compile Time Polymorphism) No. of Lectures – 4

- **Prerequisite:** Concepts of member functions in class, different operators in C++.

- **Objectives:**
  1. To make student understand the concept of compile time polymorphism.
  2. To make student understand concept, structure and advantages of function overloading.
  3. To make student understand concept, structure and advantages of operator overloading.
  4. To make student understand operator overloading using member functions and friend functions for unary and binary operators.

- **Outcomes:**
  After completing this unit, student -
  1. Can explain the concept of compile time polymorphism.
  2. Can implement the structure of function overloading and can explain the advantages of function overloading.

3. Can explain advantages of operator overloading and can implement the structure of operator overloading.
4. Can explain and write program using operator overloading using member functions and friend functions for unary and binary operators.

- **Unit Content:**
  Concept of compile time polymorphism, function overloading, defining operator overloading, overloading unary operators, overloading binary operators, overloading binary operators using friends, manipulation of strings using operators

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

- **Assessment Methods:**
  Programming on function overloading, programming on operator overloading with member functions and friend functions for unary and binary operators

Unit 7–Polymorphism No. of Lectures – 3

- **Prerequisite:** Concepts of member functions in class, function overloading.

- **Objectives:**
  1. To make student understand the types of polymorphism: compile time polymorphism and run time polymorphism.
  2. To make student understand the concept and importance of this pointer.
  3. To make student understand the concept and the insignificance of pointers to derived class.
  4. To make student understand the concept of virtual functions.
  5. To make student write program using this pointer, pointers to derived class and on virtual functions.

- **Outcomes:**
  After completing this unit, student -
  1. Can explain the difference between compile time and run time polymorphism.
  2. Can describe and can program using this pointer.
  3. Can explain and implement the insignificance of pointers to derived class and how it is overcome by virtual functions.
  4. Can write program using pointers to derived class and using virtual functions.

- **Unit Content:**
  Types of polymorphism: compile time polymorphism and run time polymorphism, pointers to objects, this pointer; pointer to derived class, virtual functions, virtual constructors and destructors

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

- **Assessment Methods:**
  Programming on this pointer, pointer to derived class and on virtual functions

Unit 8–Templates and exception handling No. of Lectures – 3

- **Prerequisite:** Concepts of functions, concepts of class.

- **Objectives:**
  1. To make student understand the concept, advantages and the structure of a function template.
  2. To make student understand the concept, advantages and the structure of a class template.
  3. To make student write program using function template and class template.
  4. To make student understand the definition of exception.
  5. To make student understand the different blocks of exception handling viz: try, catch and throw blocks.
  6. To make student write program using exception handling.

- **Outcomes:**
  After completing this unit, student -
  1. Can explain the concept, advantages of function template and class template and implement the structure of function template and class template.
  2. Can write program using function template and class template.
  3. Can explain the importance of exceptions in error handling at run time.
  4. Can explain and implement the different error handling mechanism: try, catch and throw mechanism.
  5. Can write program using exception handling.

- **Unit Content:**
  Declaration of a class template, class template with multiple parameters, function template, function template with multiple parameters, exception handling: exception handling mechanism, throwing and catching mechanism, exception generated by the function, multiple catch blocks

- **Content Delivery Methods:**
  Chalk and talk, programming through demonstration

- **Assessment Methods:**
  Programming on function template and class template; programming on exception handling with try, catch and throw mechanisms.

- **Term Work:**
  Term work shall consist of minimum of ten programming assignments covering various aspects of C++ language. It shall also include a mini project.

- **Text Books:**
  1. Object oriented programming, C++ ,E. Balagurusamy, Tata McGraw Hill Publication, New Delhi
  2. Object – Oriented Programming in C++, Rajesh K. Shukla, Wiley Publications, New Delhi.
  3. Object – Oriented Programming with C++, Rohit Khurana, Vikas Publications.

- **Reference Books:**
  1. Programming with C++, Ravichandran D, 2nd Edition, Tata McGraw Hill Publication, New Delhi.
  2. Turbo C++ Techniques and application, Scoot, Robert Ladd, BPB Publication, New Delhi
  3. Mastering C++, K.R. Venugopal T. Ravishankar, Rajkumar, Tata McGraw Hill Publication, New Delhi

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

Teaching Scheme	**Examination Scheme**
Lectures – 3 Hours/week	**Theory –** 100 Marks
Practical – 2 Hours/week	**Term-work –** 25 Marks

This course provides a thorough introduction to the general operating system and its types used as sole to the computer system, servers and data centers. The course covers operating system view of process, their operations, scheduling & synchronization techniques at block diagram levels, design level and few analytical level. The course also introduces file system, memory management & virtual memory to design level. Basics of input output subsystems are also covered.

Course Prerequisite:

Student has completed a course in basic electronics and microprocessor, shall have an adept knowledge of computer hardware, memory hierarchy, serial communication and general idea about operating system. Student also has programming skills..

Course Objectives:

1. To introduce to student operations of operating system and its different types.
2. To make student realize process concepts and inter process communication.
3. To make student design algorithm and program for process scheduling, synchronization and deadlock.
4. To make student create file system and directory structure in an operating system
5. To make student analyze memory management.
6. To make student handle input output system.

Course Outcomes:

1. Student is able to identify and describe structure, operations of operating system and its different types.
2. Student can design & describe different operations on process, thread implementation, scheduling techniques, synchronization algorithms and also their performance analysis.
3. Student is able to design & describe deadlock condition and methods to overcome deadlock.
4. Student demonstrates file systems, directories and its different terms.
5. Student is able to analyze memory management system and its different aspects.
6. Student is able to handle I/O sub system.

Section I

Unit 1 –Introduction and overview of operating system No of lectures – 05

- **Prerequisite:** Evolution of computer system, evolution of operating system, concepts of basic computer system and its hardware and software architecture, programming languages developments.

- **Objectives:**
  1. To make student aware about an 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 make student analyze architecture of UNIX OS.
  5. 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 multiprogramming 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. Can draw and explain architecture of UNIX operating system.
  6. 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, architecture of UNIX 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 system, real time system, and time sharing system distributed system, system call, block diagram of operating system structure and UNIX architecture.

Unit 2 –Process management No of lectures – 06

- **Prerequisite:** Program execution environment in computer system

- **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 cooperating process.
  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 process.
  4. Is able to implement thread in UNIX environment.
  5. Is able to implement inter process communication facility in UNIX.

- **Unit Content:**
  Process concept, process state diagram and process control block, operations on processes- creation & termination, cooperating processes, inter process communication, communication in client-server systems. case study: IPC in Linux, threads: multi-threading models – threading issues, case study: P-threads library.

- **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, thread and inter process communication.

Unit 3 -Process scheduling & synchronization No of lectures – 06

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

- **Objectives:**
  1. To introduce to student concept of process scheduling and different scheduling criteria.
  2. To make student implement FIFO, SJFS, priority and round-robin scheduling algorithms.
  3. To make student aware about multiple processor scheduling.
  4. To make student identify classical problems of synchronization.
  5. To make student analyze and resolve critical section problem.
  6. 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 draw & describe analytical concepts related FIFO, SJFS, priority scheduling and round robin scheduling.
  3. Can draw and explain multiple processor scheduling.
  4. Is able to examine classical problem of synchronization and to analyze semaphore implementation.
  5. Is able to explain critical section problem.

- **Unit Content:**
  Process scheduling concept, scheduling criteria, scheduling algorithms, multiple processor scheduling, 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 FIFO, SJFS, priority scheduling and descriptive questions to ensure understanding of the process scheduling and their algorithms, classical problems of synchronization and critical section problems.

Unit 4 -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.

Section II

Unit 5 -File system No of lectures – 06

- **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, directory implementation, allocation methods, free-space management, case studies: file system in Linux, file system in Windows XP

- **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.

Unit 6 -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 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 7 -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, 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, analytical problems based on page replacement algorithm

Unit 8 –Input output system No of lectures – 05

- **Prerequisite:** Memory management

- **Objectives:**
  1. To introduce to student basics of input output system & I/O hardware.
  2. To make student aware about application I/O interface.
  3. To make student understand kernel input output subsystem.
  4. To make student aware of I/O request to hardware operation.

- **Outcomes:**
  After completing this unit, student –
  1. Can describe application I/O interface.
  2. Is able to draw & describe kernel I/O subsystem.
  3. Is able to devise I/O request transformation.

- **Unit Content:**
  Overview, I/O hardware, application I/O interface, kernel I/O subsystem, transforming I/O request to hardware operation

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

- **Assessment Methods:**
  Descriptive question based I/O hardware, application I/O interface, kernel I/O subsystem, transforming I/O request to hardware operation.

- **Term Work:**
  It consists of minimum eight experiments based on operations on process, system calls, scheduling algorithm, thread, memory management, I/O device using C programming language on Linux platform.

- **Text Book:**
  1. Operating System Concepts, Silberschatz Galvin, 5th Edition, John Wiley
  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
DIGITAL COMMUNICATION

Teaching Scheme
Lectures – 3 Hours/week
Practical – 2 Hours/week

Examination Scheme
Theory – 100 Marks
Term-work – 25 Marks
Oral exam – 25 Marks

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

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

Course Objectives:
1. To make student understand functions of different components of a digital communication system.
2. To introduce to student sampling theorem & pulse communication.
3. To make student understand information theory and its relevance to digital communication
4. To make student understand different carrier modulation and detection techniques along with their performance analysis
5. To make student understand different preliminary source coding and channel coding techniques

Course Outcomes:
1. Student can identify and describe different blocks of a pulse and digital communication systems with relevance.
2. Student can describe different carrier modulation and detection techniques along with their performance analysis.
3. Student can analyze theoretical bounds on the rates of digital communication systems.
4. Student can solve numerical problems based upon source coding and channel coding techniques.

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, PWM modulation and demodulation, introduction to digital communication, PCM-quantization, uniform, non-uniform and differential quantization, quantization error, 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 need and analytical concepts for different waveform coding techniques and their performance

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

- **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 view 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 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. Also 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 view 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.

- **Term Work:**
  Term work consists of minimum ten experiments out of below list. Minimum two experiments shall be on MATLAB platform.
  1. PAM
  2. PWM, PPM
  3. Sampling theorem.
  4. PCM system and eye pattern.
  5. Companding
  6. DPCM
  7. DM
  8. ADM
  9. ADPCM
  10. ASK.
  11. FSK, PSK, BPSK
  12. DBPSK
  13. Hamming code
  14. Cyclic redundancy code
  15. Convolution 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

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

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Solapur University, Solapur
T.E. (Electronics) Semester-II
MICROCONTROLLERS

Teaching Scheme
Lectures – 4 Hours/week
Practical – 2 Hours/week

Examination Scheme
Theory – 100 Marks
Term-work – 25 Marks
Practical & Oral exam – 50 Marks

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

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

Course Objectives:
1. To develop concept of microcontroller functioning with focus on typical microcontrollers – 8051 and PIC 16F877
2. To make student learn C and assembly language programming for microcontrollers.
3. To make student learn interfacing with memory and peripherals.
4. To introduce to student I2C and SPI serial communication.
5. To make student able to design simple microcontroller based systems.

Course Outcomes:
1. Student can describe architecture of 8051 and PIC 16F877 microcontrollers and their various applications
2. Student can write assembly and C program for different applications.
3. Student can develop a simple microcontroller based system for different applications.

Section I

Unit 1 -Introduction to 8051 No of lectures – 10

- **Prerequisite:** Basics of digital electronics and microprocessors
- **Objectives:**
  1. To introduce to student RISC and CISC architecture.
  2. To make student learn architecture of 8051 microcontroller.

3. To introduce software model for 8051 with C and assembly programming

- **Outcomes:**
  After completing this unit student -
  1. Can differentiate RISC and CISC architectures
  2. Can describe architecture of 8051 microcontroller
  3. Can write assembly and C programs for different applications.
  4. Can make use of interrupts, stack and subroutine in 8051 programs

- **Unit Content:**
  Difference between microprocessor and microcontroller, RISC and CISC architecture, 8051-features, architecture, pin configuration, memory organization, addressing modes, instruction set, assembly language and C programming

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

- **Assessment Methods:**
  Questions based upon architecture of 8051 microcontroller, 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 2 –On-chip peripherals No of lectures – 08

- **Prerequisite**: 8051 instruction set, basics of serial communication, timer and interrupt.

- **Objectives:**
  1. To make student understand working of on chip peripherals of 8051 microcontroller.
  2. To make student write programs for 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 able to write a program for on chip peripherals of 8051 microcontroller for different applications.

- **Unit Content:**
  Port Structure, timers and counters, serial port, interrupt structure, programming

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

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

Unit 3 -Interfacing and programming No of lectures –08

- **Prerequisite:** 8051 architecture and instruction set, ports

- **Objectives:**
  1. To make student to interface data and program memories to the 8051 microcontroller
  2. To make student to 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 Content:**
  Interfacing of different display devices like LED's, seven segment and LCD, memory, ADC, DAC, stepper motor, RS232

- **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

Section II

Unit 4 -PIC microcontroller 16F877A No of lectures – 08

- **Prerequisite:** Basics of digital electronics and microprocessors

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

- **Outcomes:**
  After completing this unit, student –
  1. Can describe architecture of PIC 16F877 microcontroller
  2. Is able to program PIC 16F877 microcontroller for different applications.

- **Unit Content:**
  PIC 16F877- features, architecture, 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 and C programming - using basic instructions, different programming structures like loop and subroutine etc, efficient use of different addressing modes

Unit 5 -On-chip peripherals No of lectures – 10

- **Prerequisite:** PIC 16F877 instruction set, basics of serial communication and interrupt; knowledge of timer/counter and PWM

- **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 Content:**
  Parallel slave port, timers and counters, synchronous serial port, interrupt structure, capture and compare modes, PWM mode, ADC, introduction to SPI, I2C

- **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 6 - Interfacing and programming No of lectures – 08

- **Prerequisite:** PIC 16F877 architecture and instruction set, working of ports of PIC 16F877

- **Objectives:**
  1. To make student to interface different memories and peripherals to the PIC 16F877 microcontroller
  2. To make student to design simple controller based project

- **Outcomes:**
  After completing this unit, student-
  1. Is able to interface different memories and peripherals to the PIC 16F877 microcontroller
  2. Can design simple controller based projects

- **Unit Content:**
  Interfacing of devices like keypad, DC motor, LED, 7-segment LED, LCD displays, DAC, minimum system design like temperature controller, traffic light controller

- **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 PIC 16F877 microcontroller

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- **Term work:**
  Minimum ten practical based on following with five experiments on MCS 51 and five 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 0809
  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 of PIC microcontrollers.
  13. Use of interrupts for any application.
  14. Serial communication.

- **Text Books:**
  1. Microcontrollers, Ajay Deshmukh, 1st Edition, Tata McGraw Hill
  2. 8051 and Embedded C Programming, Mazidi, 2nd Edition, Pearson Education
  3. Designs with PIC Microcontrollers, John B. Peatman, Pearson Education Asi LPE

- **Reference Books:**
  1. 8051 Microcontroller Architecture, Programming and Application, Kenneth Ayala, 3rd edition, Penram Publication.
  2. Datasheets of Microchip PIC family of Microcontrollers

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

Teaching Scheme
Lectures – 4 Hours/week
Practical – 2 Hours/week

Examination Scheme
Theory – 100 Marks
Term-work – 25 Marks
Practical & Oral exam – 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 and design and shall have an understanding and the 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 different types of protection and commutation circuits for power devices.
3. To develop student with an understanding for the switching behavior and design of power electronics applications such as controlled rectifiers, switched mode power supplies and stabilizers.
4. To introduce to student different driver circuits for successful firing of power devices.
5. To develop control scheme for single phase converters using microcontroller.
6. To make student understand how to apply the power devices for conversion, control and conditioning of electric power.
7. To make student understand the different power circuits & applications

Course Outcomes:
1. Student can explain the characteristics of power semiconductor devices and identify suitable switching device for given application.
2. Student can analyze and design power electronics applications such as controlled rectifiers, switched mode power supplies and stabilizers.
3. Student can develop control scheme for single phase converters using microcontroller
4. Student can design various firing circuits for power devices.

5. Student describes importance and develops control schemes for converters using suitable microcontroller.
6. Student is able to select appropriate power devices for conversion, control and conditioning of power
7. Student is able to select power devices and firing circuits for special application to industrial processes.

Section I

Unit 1 –Thyristor- principles and characteristics No of lectures – 09

- **Prerequisite:** Basics 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 protection and commutation circuits.
  4. To introduce to student a practical approach of snubber circuit with a systematic design procedure.
  5. To make student aware to power losses and selection of heat sink according to power dissipation
  6. To establish thyristor rating and selection of thyristor according to applications.

- **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 design 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 for various applications

- **Unit Content:**
  Thyristor- construction, V-I characteristics, two transistor analogy, switching characteristics, gate characteristics, turn on methods, series-parallel operation, 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, zero-voltage switching, zero-current switching, 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, series-parallel operation, thyristor protection circuit, design of snubber circuit, zero-voltage switching, zero-current switching, heat sink design , protection circuits, commutation techniques with output waveforms

Unit 2 –Single phase controlled rectifier No of lectures –10

- **Prerequisite:** Uncontrolled rectifiers and its different parameters, Fourier expression

- **Objectives:**
  1. To develop student with an understanding for the 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 mode 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 and commutation specifications
  4. Can describe operation of dual mode dual converter with energy saving conversion system.

- **Unit Content:**
  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; analysis of single-phase bridge converters: average and RMS output voltage, performance parameters: THD, displacement factor, input power factor, TUF, ripple factor and efficiency (numerical are expected); effect of source inductance on performance of controlled rectifier, dual converter- circulating and non-circulating current mode (derivations & numerical are expected)

- **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, dual converter.

Unit 3 -Power semiconductor devices No of lectures – 05

- **Prerequisite:** Basics 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. Able to select the power devices for conversion, control and conditioning of electronic power according to power ratings.

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

- **Content Delivery Methods:**
  Chalk and talk, power point presentation, PROTEOUS simulation for characteristics.

- **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:** Basics of transistor, thyristors, MOSFET, IGBT, GTO.

- **Objectives:**
  1. To make student understand the basic requirement for the successful firing of different power semiconductor devices.
  2. To make student understand the 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:**
  Driving circuit of: TRIAC, MOSFET; triggering devices: UJT, PUT, SUS, SBS, SCS, LASCR, device treatment should deal with 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, digital firing scheme, 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, PROTEOUS simulation for triggering circuits.

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

Unit 5 - Power supplies: No of lectures – 08

- **Prerequisite:** Basics of power semiconductor devices, triggering circuits, linear voltage regulator.

- **Objectives:**
  1. To make student understand the need and function of uninterruptable power supplies.
  2. To make student understand the types and circuit topologies of AC power supplies
  3. To make student understand the need and function of AC voltage stabilizer and solid state voltage stabilizer
  4. To make student understand the need and function of switched mode power supplies.

- **Outcomes:**
  After completing this unit, student –
  1. Can design uninterruptable power supplies
  2. Can describe the types and circuit topologies of AC power supplies

3. Can describe the operation of AC voltage stabilizer and solid state voltage stabilizer and able to design stabilizers
4. Can describe analytical concepts of different switched mode power supplies and able to design switched mode power supplies

- **Unit Content:**
  AC power supplies: block diagram and configuration of UPS, switched mode AC power supplies, resonant AC power supply, bidirectional AC power supply; AC voltage stabilizer: relay and servo type, constant voltage transformers; solid state voltage stabilizer: relay based and triac based; switched mode power supplies: fly back, forward, half bridge, full bridge converters ,control circuits of SMPS

- **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 – 06

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

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

- **Outcomes:**
  After completing this unit, student –
  1. Is able to explain the operation of power circuits and will be able to design power circuit according to need of application.
  2. Is able to explain the importance of induction heating, dielectric heating

- **Unit Content:**
  SCR flasher circuits, AC power flasher using triac, AC power control using triac, light dimmer using triac and diac, static circuit breakers, single phase preventer, batch counter, proximity detector circuit, emergency lighting system, automatic street lighting system, induction heating, dielectric heating

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, PROTEOUS simulation for power circuits.

- **Assessment Methods:**
  Questions based upon different flasher circuits, circuit breakers, single phase preventer, SCR flasher circuits, batch counter, descriptive questions to ensure understanding of the principle of Induction heating, dielectric heating their advantages and limitations

- **Term Work:**
  Term work 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. SCR triggering circuits.
  7. Optocoupler
  8. Single phase prevention
  9. Switched mode AC power supplies
  10. AC voltage stabilizer
  11. Triac as light dimmer
  12. Simulation using MATLAB / Simulink.
      a. Thyristor commutation techniques
      b. Controlled rectifier

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

- **Reference Books:**
  1. Power Electronics , P.C. Sen, Tata McGraw Hill
  2. General Electric, SCR manual, Prentice Hall
  3. Power Electronics, Mohan, Undeland, Riobbins, 3rd Edition, Wiley
  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
VLSI DESIGN

Teaching Scheme	**Examination Scheme**
Lectures – 4 Hours/week	**Theory –** 100 Marks
Practical – 2 Hours/week	**Term-work –** 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:

Student will be able to-

1. Use VHDL language for modeling with all its features
2. Write VHDL code for modeling combinational and sequential circuits.
3. Describe the architecture of CPLD and FPGA and to implement some functions in FPGA.
4. Implement digital functions using CMOS logic and gates.
5. Design the minimal test set required for testing the circuits.

Section I

Unit 1 -VHDL No of lectures – 10

- **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 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–
  1. To write VHDL code using different architectures for modeling combinational circuits.
  2. To 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, impediments to synchronous design: clock skew, clock jitter.

- **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, advantage of it 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 fabrication process, DC characteristics, beta ratio and characteristics of digital circuits.

Unit 7 – Testing of logic circuits No of lectures – 05

- **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.

- **Term work:**
  Term work 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 sync. / async. reset signal, cascading of counters, universal shift registers, LFSR, Melay & Moore state machines
  3. RAM & ROM
  4. A mini-project to implement one of the processor peripherals in FPGA and 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

- **Reference Books:**

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

Solapur University, Solapur
T.E. (Electronics) Semester-II
MINI HARDWARE PROJECT

Teaching Scheme
Practical – 2 Hours/week

Examination Scheme
Term-work – 50 Marks

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

Course Prerequisite:
Electronic component testing and their measurement, fundamentals of electronic circuit designing, concepts in digital designing, knowledge of various sensors, knowledge of control systems fundamentals

Course Objectives:
1. To encourage student in selection, understanding of electronic components specifications and their testing.
2. To make student acquaintance with computer aided PCB designing tool
3. To develop electronic hardware assembly, soldering and testing skills amongst student
4. To nurture technical report witting skills amongst student
5. To foster team working aptitude amongst student.

Course Outcomes:
1. Student is able to select an appropriate project in applied area
2. Student can design circuit, select and test required components
3. Student can use modern software tools for PCB designing and circuit simulation
4. Student can test completed circuit / project
5. Student can write technical report of the project
6. Student can estimate costing of the project and also demonstrates social and safety aspects associated with project
7. Student is able to complete project in a team with proper sharing of responsibilities and work

Course Curriculum:

The mini hardware project is mainly focused on circuit selection, component selection, pre-testing of electronic circuit on bread board, making of PCB for proposed project, project assembly and its testing. It also includes technical report writing for the project. These acquired skills may be useful in final year project work. It is preferable to select project in applied area and project shall use ICs. Some of the recommended (but not mandatory) areas are VLSI, embedded system, telecommunication, digital design, computer interfacing. The project shall be carried out with a group of not more than three students.

Assessment Methods:

Below scheme is recommended for assessment of term work marks –

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

SELF LEARNING MODULES

TECHNICAL

Solapur University, Solapur

T.E. (Electronics)

TECHNICAL SELF LEARNING MODULE- I

ROBOTICS

Teaching Scheme
Self learning

Examination Scheme
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 atomization of robots.
5. To introduce to student very basics of vision system used in robotics
6. To make student responsive towards current and future scope of industrial robotics applications.

Course Outcomes:

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 atomized robots.

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

- **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 MODULE II

PROGRAMMING IN VISUAL BASIC.NET

Teaching Scheme	**Examination Scheme**
Self learning	**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:**
  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:**
  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:**
  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:**
  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 of 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 MODULE III
AUTOMOTIVE ELECTRONICS

Teaching Scheme	**Examination Scheme**
Self learning	**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 MODULE IV
ELECTRONIC INSTRUMENTATION

Teaching Scheme	**Examination Scheme**
Self learning	**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 have in dept 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. Are able to select relevant analyzer as monitoring device depending upon applications.

- **Unit Content:**
  Distortion types – harmonic and intermodulation; 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.
