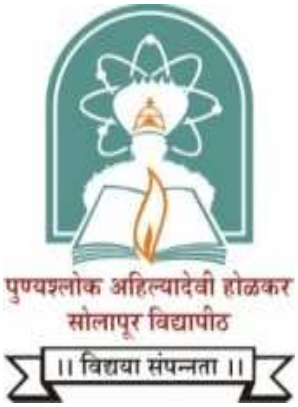
Punyashlok Ahilyadevi Holkar Solapur University, Solapur



NAAC Accredited-2015
'B' Grade (CGPA 2.62)

Name of the Faculty: Science & Technology

CHOICE BASED CREDIT SYSTEM

Syllabus: ELECTRONICS ENGINEERING

Name of the Course: S.Y. B.Tech. Sem. (III & IV)

(Syllabus to be implemented from w.e.f. June 2019)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

FACULTY OF SCIENCE & TECHNOLOGY

Electronics Engineering

Programme Educational Objectives and Outcomes

A. Program Educational Objectives

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

B. Program Outcomes

Engineering Graduate will be able to –

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

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

C. Program Specific Outcomes

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

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science & Technology (Revised from 2018-19)

Credit System structure of S.Y. B.Tech. Electronics Engineering W.E.F. 2019-20 *Semester I*

Course Code	Theory Course Name	Hrs./week			Credits	Examination Scheme			
		L	T	P		ISE	ESE	ICA	Total
EN211	Engineering Mathematics – III	3	1	_	4	30	70	25	125
EN212	Electronic Circuit Analysis and Design	4	_	_	4	30	70	-	100
EN213	Network Theory and Analysis	4	-	_	4	30	70	-	100
EN214	Digital Logic Design	4	_	_	4	30	70	-	100
EN215	Analog Communication	3	_	_	3	30	70	-	100
Sub Total		18	1	_	19	150	350	25	525
ENV21	Environmental Studies	1	-	-	-	-	-	-	1
Course Code	**Laboratory Course Name**								
							ESE			
							POE	OE		
EN212	Electronic Circuit Analysis and Design	_	_	2	1	_	50*	--	25	75
EN213	Network Theory and Analysis	_	_	2	1	_	_	_	25	25
EN214	Digital Logic Design	--	--	2	1	--	25	--	25	50
EN215	Analog Communication	_	_	2	1	_	--	_	25	25
EN216	Object Oriented Programming with C++	--	1	2	2	_	50	_	50	100
Sub Total		--	1	10	6	_	125		150	275
Grand Total		**18**	**2**	**10**	**25**	**150**	**475**		**175**	**800**

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

- **Note:**

1. *- Practical and Oral Examination of Electronics Circuit Analysis and Design includes some of the practical from Network Theory and Analysis

2. Student is required to study and pass Environmental Science subject in Second Year to become eligible for award of degree.

3. Batch size for the practical /tutorial shall be of 20 students. On forming the batches, if the strength of remaining students exceeds 9, then a new batch shall be formed.

4. Vocational Training (evaluated at Final Year B.Tech Part- I) of minimum 15 days shall be completed in any vacation after S.Y. Part-II but before Final Year Part-I & the report shall be submitted and evaluated in Final Year Part-I

5. Student shall select one Self Learning Module at T.Y. Part I and T.Y. 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

6. Curriculum for Humanities and Social Sciences Self Learning Modules is common for all under graduate programmes of faculty of Engineering and Technology

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

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science & Technology (Revised from 2018-19)

Credit System structure of S.Y. B.Tech. Electronics Engineering W.E.F. 2019-20 *Semester II*

Course Code	***Theory Course Name***	***Hrs./week***			***Credits***	***Examination Scheme***			
		L	***T***	***P***		***ISE***	***ESE***	***ICA***	***Total***
EN221	Electrical Machines	3	_	_	3	30	70	-	100
EN222	Control Systems	4	_	_	4	30	70	-	100
EN223	Data Structures	3	_	_	3	30	70	-	100
EN224	Analog Integrated Circuits	4	_	_	4	30	70	-	100
EN225	Signals and Systems	4	1	_	5	30	70	25	125
Sub Total		18	1	_	19	150	350	25	525
ENV22	Environmental Studies	1	-	-	-	-	-	-	1
Course Code	***Laboratory Course Name***								
							ESE		
							POE	***OE***	
EN221	Electrical Machines	_	_	2	1	_	_	--	25	25
EN222	Control Systems	_	_	2	1	_	-	25	25	50
EN223	Data Structures	_	_	2	1	_	50	_	25	75
EN224	Analog Integrated Circuits	_	_	2	1	_	50$	_	25	75
EN226	Software Simulation Tools	_	1	2	2	_	_	_	50	50
Sub Total		--	1	10	6	_	125		150	275
Grand Total		**18**	**2**	**10**	**25**	**150**	**475**		**175**	**800**

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

- Note:

1. $ Practical and Oral Examination of Analog Integrated Circuits includes some of the simulation practical from Software Simulation Tools
2. Student is required to study and pass Environmental Science subject in Second Year to become eligible for award of degree.
3. Batch size for the practical /tutorial shall be of 20 students. On forming the batches, if the strength of remaining students exceeds 9, then a new batch shall be formed.
4. Vocational Training (evaluated at Final Year Part-I) of minimum 15 days shall be completed in any vacation after S.Y. Part-II but before Final Year Part-I & the report shall be submitted and evaluated in Final Year Part-I
5. Student shall select one Self Learning Module at T.Y. Part I and T.Y. 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
6. Curriculum for Humanities and Social Sciences Self Learning Modules is common for all under graduate programmes of faculty of Engineering and Technology
7. ICA assessment shall be a continuous process based on student's performance in – class tests, assignments, homework, subject seminars, quizzes, laboratory books and their interaction and attendance for theory and lab sessions as applicable

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

S.Y.B.Tech (Electronics Engineering) Semester-I

EN211 ENGINEERING MATHEMATICS-III

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

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

This course includes mathematical theory and concepts required by an Electronics engineer. The course consists of linear differential equations which can be used for mathematical model of electrical circuits where these variables are dynamically related. This course introduces Z-transform which provide a mathematical framework for a series of mathematical conversions that are useful for digital filters. Laplace transforms is another powerful mathematical tool for engineering problems such as circuit analyses in Electronics/electric and signal processing. This course also introduces Fourier series, which plays an important role in designing, and analyzing electrical & electronics communication system. This course also introduces fundamentals of probability distributions which are useful for digital communication and numerical solutions of linear and non linear equations and Eigen value theory.

Course Prerequisite:

Fundamentals of trigonometry, method of finding roots of algebraic equations, differentiation, integration, partial fraction, sum of sequence and methods of solving definite integrations, basics of statistics and probability theory

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Course Objectives:

1. To introduce to student method of solving higher order linear differential equations
2. To make student understand Z transform and its properties
3. To introduce to student Fourier series and integral transform
4. To introduce to student Laplace and inverse Laplace transforms and make him analyze electrical circuits using it
5. To introduce to student various probability distributions
6. To introduce to student numerical methods for finding solution of non linear equations and simultaneous linear equations

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Course Outcomes:

1. Student can solve higher order linear differential equation related to electrical circuit theory
2. Student can solve problems on Z transform and explain its properties
3. Student can express a function in terms of sine's and cosines components so as to model simple periodic functions.
4. Student can apply Laplace and inverse Laplace transforms for analysis of simple electrical circuits
5. Student can find the relation between two variables for the given data using regression and explain various probability distribution functions.
6. Student can solve simultaneous linear equations and non linear equations.

SECTION – I

Unit 1: Linear differential equations with constant coefficients: No. of lectures-07

- **Prerequisite:**
  Finding the roots of algebraic equation, basic trigonometric formulae, differentiation and integration

- **Objectives:**
  1. To make student solve linear differential equation of higher order.
  2. To introduce to student mathematical modeling of electric circuit and their solution using linear differential equations
  3. To make student realize and apply the method to solve initial value and boundary value problems.

- **Outcomes:**
  After completing this unit, student
  1. Can solve linear differential equations with constant coefficients
  2. Can solve initial value problem and boundary value problem related to electric circuits

- **Unit content:**
  Basic definition, differential operator, complimentary functions, particular integral, shortcut methods for standard functions like $e^{ax}, \sin(ax+b), \cos(ax+b)$, x^m, $e^{ax}V$ *and* xV, particular integral by general method (without method of variation of parameters) for other functions, electrical engineering applications

- **Content Delivering Methods:**
  Chalk and talk, simulation

- **Assessment Methods:**
  Problems on higher order linear differential equation, second order electric circuit

Unit 2: Z-Transform: No. of lectures-05

- **Prerequisite:**
  Fundamentals of geometric progression, series of standard functions, partial fraction method and Binomial theorem

- **Objectives:**
  1. To introduce to student concept of Z plane and Z-transform of given sequence.
  2. To make student understand different properties of Z-transform
  3. To introduce to student concept of inverse Z-transform of function F(z) with given region of convergence

- **Outcomes:**
  After completing this unit, student can
  1. Find Z- transform of given sequence
  2. Find inverse Z-transform
  3. Apply Z transform to solve difference equations

- **Unit content:**
  Introduction, Z-Transform of standard sequence, properties of Z-transform – linearity, change of scale, shifting property, multiplication by k, division by k, inverse Z-transform –power series method, partial fraction method

- **Content Delivering Methods:**
  Chalk and talk.

- **Assessment Methods:**
  Problems on Z-transform and inverse Z-transform

Unit 3: Fourier series: No. of lectures-07

- **Prerequisite:**
  Integration and rules of integration, basic trigonometric

- **Objectives:**
  1. To introduce to student basics of Fourier series of periodic functions in the given interval.
  2. To make student understand half range sine and cosine series of given function.

- **Outcomes:**
  After completing this unit, student can-
  1. Express the given periodic function as infinite series of sine and cosine functions
  2. Apply Fourier series for making the analysis of electrical signals, electromagnetic signals etc.

- **Unit content:**
  Introduction, definition, Euler's formula, Fourier series of periodic functions with period 2 π and 2L, Dirichlet's theorem (only statement), even and odd functions, half range sine and cosine series.
- **Content Delivering Methods:**
  Chalk and talk.
- **Assessment Methods:**
  Problems based on Fourier series of given function and half range series of sine's & cosines

SECTION-II

Unit 4: Laplace transform: No. of lectures-09

- **Prerequisite:**
  Basic trigonometry, differentiation, integration, solving definite integrals, making perfect square and partial fraction
- **Objectives:**
  1. To introduce student different Laplace transform and its properties
  2. To make student find Laplace transform of given function
  3. To make student find Laplace transform of special functions
  4. To make student evaluate improper integral by Laplace Transform
  5. To introduce to student various properties of inverse Laplace transform and apply them to find inverse Laplace transform
  6. To make student find inverse Laplace transform of a function
  7. To make student solve differential equations by Laplace transform
- **Outcomes:**
  After completing this unit, student can
  1. Find Laplace transform of a given function
  2. Find Laplace transform of periodic function, Heaviside function and Dirac delta Function
  3. Express given discontinuous functions in terms of unit step function
  4. Can evaluate inverse Laplace transform of given function
  5. Can solve initial value problems by Laplace transform
- **Unit content:**
  Definition, Laplace transform of standard functions, properties- first shifting, change of scale, multiplication of power t and division by t, Laplace transform of derivative and integral, Laplace transform of periodic functions, unit step functions and unit impulse functions, properties of inverse Laplace transforms- linear property, first shifting theorem, partial fraction, inverse transform of logarithmic & inverse trigonometric functions and convolution theorem, solution of differential equations by Laplace transform.

- **Content Delivering Methods:**
  Chalk and talk.

- **Assessment Methods:**
  Laplace transform of given functions based on Laplace transform formulae and its properties, expressing discontinuous functions in terms of unit step function and its Laplace transform, finding inverse Laplace transform.

Unit 5: Statistics and probability: No. of lectures-07

- **Prerequisite:**
  Mean, variance, standard deviation, basic definitions of probability, discrete and continuous functions.

- **Objectives:**
  1. To introduce to student statistical technique to obtain relation between bivariate data
  2. To introduce to student the basic concept of probability distributions and their applications.

- **Outcomes:**
  After completing this unit, student can
  1. Determine coefficient of correlation of bivariate data.
  2. Obtain functional relation between bivariate data.
  3. Describe uncertainty problems by probability distributions.

- **Unit content:**
  Coefficient of correlation and lines of regression of bivariate data, random variable, binomial, Poisson, normal distribution

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

- **Assessment Methods:**
  Problems on coefficient of correlation, fitting of lines of regressions of bivarite data, probability distributions

Unit 6: Numerical methods: No. of lectures-07

- **Prerequisite:**
  Intermediate value property, elementary transformations
- **Objectives:**
  1. To make student determine roots of equations by numerical methods.
  2. To introduce to student method to solve simultaneous linear algebraic equations.
  3. To introduce to student concept of dominant Eigen value and corresponding Eigen vector.
- **Outcomes:**
  After completing this unit, student can
  1. Evaluate roots of algebraic and transcendental equations
  2. Solve simultaneous linear algebraic equations
  3. Apply power method to determine largest Eigen value and corresponding Eigen vector of a given square matrix.
- **Unit content:**
  Numerical solution of algebraic and transcendental equations: Regula Falsi method, Newton-Raphson method, solution of simultaneous linear equations: Gauss elimination, Jacobi's method, Gauss Seidal method
- **Content Delivering Methods:**
  Chalk and talk.
- **Assessment Methods:**
  Finding the roots of non linear equations, solution of simultaneous linear equations and finding the largest Eigen value and corresponding Eigen vector of matrix.

- **Internal Continuous Assessment** (ICA):
  ICA shall consist of minimum six to eight assignments based on entire curriculum

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- **Text books:**
  1. A textbook of Applied Mathematics Vol. II and Vol. III, J.N. and P.N. Wartikar, Vidyarthi Grah Prakashan, Pune.
  2. Higher Engineering Mathematics, Dr.B.S.Grewal, Khanna Publications, Delhi.
  3. Numerical Methods, Dr.B.S.Grewal, Khanna Publications, Delhi
  4. A Textbook of Applied Mathematics, N.P. Bali, Ashok Saxena and N.Ch. S.N. Iyengar, Laxmi Publications, Delhi.
  5. Advanced Engineering Mathematics, Kreyzig-John Wiley & SMS, New York.
- **Reference Books:**
  1. Advanced Engineering Mathematics, Peter O'Neil , Cengage Learning.
  2. Engineering Mathematics, Srimanta Pal, Subodh Chandra Bhunia, Oxford University Press

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

S.Y.B.Tech. (Electronics Engineering) Semester-I

EN212 ELECTRONIC CIRCUIT ANALYSIS AND DESIGN

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

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

This course provides student detailed introduction to working of active devices such as diode, BJT, FET, MOSFET, circuits and systems like amplifier and multistage amplifiers. The course also introduces analysis and design of unregulated power supply, amplifiers and feedback amplifiers. This is one of the foundation courses which is vital for students to comprehend working of complex electronic circuits and systems

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Course Prerequisite:
Student has completed an introductory course in basic electrical and basic electronics and shall have knowledge and the ability to apply electrical theorem and laws. Student should also have very basic conceptual knowledge of active and passive devices.

Course Objectives:

1. To make student analyze wave shaping circuits and voltage multipliers.
2. To make student design and analyze unregulated power supply
3. To make student comprehend working of bipolar junction transistor with basic configurations and its hybrid model
4. To make student design and analyze single stage amplifier using BJT.
5. To make student design and analyze feedback amplifiers.
6. To introduce to student working of JFET , MOSFET and its applications

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Course Outcomes:
After completing this course, student -

1. Can analyze wave shaping circuits and voltage multipliers
2. Can analyze and design unregulated power supply using different filter circuit.
3. Can elaborate working, characteristics and hybrid model of BJT
4. Can analyze and design single stage amplifier.
5. Can design and analyze feedback amplifiers.
6. Can describe construction ,working & drain characteristics of JFET and MOSFET

SECTION I

Unit 1 – Diode applications: No of lectures – 5

- **Prerequisite:**
  Working and characteristics of diode

- **Objectives:**
  1. To make student analyze wave shaping circuits
  2. To make student understand voltage multipliers

- **Outcomes:**
  After completing this unit, student –
  1. Can analyze wave shaping circuits.
  2. Can analyze voltage multipliers.

- **Unit Content:**
  Clippers: series & shunt and its analysis for positive, negative & combinational biasing clippers, transfer characteristics.
  *Clamper circuit**s*****:** analysis for positive and negative clampers
  Voltage multipliers: voltage doubler, tripler & qudraupler

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, Proteus simulation for clippers, clamper and voltage multipliers

- **Assessment Methods:**
  Questions based on analysis of clippers, clamper and voltage multipliers.

Unit 2 – Design of unregulated power supply: No of lectures – 9

- **Prerequisite:**
  Basics of rectifiers, passive components (R, L, C)

- **Objectives:**
  1. To make student realize need of filter.
  2. To make student analyze different types of filters
  3. To make student compare different types of filters.
  4. To make student design and analyze unregulated power supply

- **Outcome:**
  After completing this unit, student –
  1. Can describe need of filter
  2. Can analyze different types of filters
  3. Can select a filter as per need of the application
  4. Can design and analyze unregulated power supply for particular ripple factor.

- **Unit Content:**
  Capacitor, inductor, LC & π filter, its analysis for ripple factor; power supply design using rectifier & above filters.

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, Proteus simulation for unregulated power supply using different rectifiers and filters.

- **Assessment Methods:**
  Questions based on analysis of different filters and design of unregulated power supply using rectifiers and filters

Unit 3 – Bipolar junction transistor: No of lectures – 9

- **Prerequisite:**
  Diode and its characteristics

- **Objectives:**
  1. To make student understand types of transistor configuration, input output characteristics, mathematical & analytical concepts for each configuration.
  2. To introduce to student concept of early effect, thermal runaway and compensation techniques
  3. To make student understand different biasing circuit, mathematical derivation of stability.
  4. To introduce to student concept of hybrid model of BJT, h – parameters and its analysis

- **Outcomes:**

  After completing this unit, student –
  1. Can describe working, characteristics, mathematical & analytical concepts of each configuration of BJT.
  2. Can explain early effect, thermal runaway and compensation techniques
  3. Can analyze different biasing circuits.
  4. Can analyze hybrid model of BJT

- **Unit Content:**
  BJT characteristics –common base, common emitter & common collector configuration-input output characteristics, early effect, punch through effect
  BJT biasing & stabilization- DC load line and Q point, thermal runaway, analysis of biasing circuits – fixed, collector to base & voltage divider bias with expression for stability factor, compensation techniques for BJT using thermistor & PN diode, applications of BJT as a switch
  Analysis of BJT using hybrid model: hybrid model of BJT for CB, CE & CC configuration, generalized h-parameter analysis of BJT amplifier for A_v, A_i, R_i, R_o.

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

- **Assessment Methods:**
  Questions based on analysis for early effect, punch through effect, load line analysis and Q point, thermal runaway, analysis of different biasing circuits and compensation techniques, analysis of hybrid model of BJT, generalized h-parameter analysis

SECTION II

Unit 4 –Small signal amplifiers: No of lectures – 9

- **Prerequisite:**
  BJT load line analysis, biasing circuits

- **Objectives:**
  1. To make student understand frequency response of BJT
  2. To make student understand different coupling scheme and frequency response of multistage amplifier.
  3. To make student design a single stage amplifier.
  4. To make student analyze transistorized multistage amplifier.

- **Outcomes:**
  After completing this unit, student –
  1. Can describe frequency response of BJT
  2. Can describe different coupling scheme and frequency response of multistage amplifier
  3. Can design single stage amplifier
  4. Can analyze multistage transistor amplifier.

- **Unit Content:**
  Transistor amplifier frequency response: analysis of single stage CE amplifier, frequency response, factor affecting BW of amplifier, effect of emitter bypass capacitor CE & coupling capacitor CC on low frequency response
  Design of single stage CE amplifier
  Multistage transistor amplifiers: Need of cascading, different coupling schemes, frequency response of multistage amplifier, two stage RC coupled– its analysis for overall voltage gain.

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, Proteus simulation for single stage and multistage CE amplifier

- **Assessment Methods:**
  Questions based on analysis of single stage CE amplifier, frequency response and design of single stage CE amplifier, different coupling schemes and frequency response of multistage amplifier, mathematical expression for gain of multistage RC coupled, numerical based on multistage amplifier.

Unit 5 – Feedback in amplifiers and feedback amplifier design: No of lectures –10

- **Prerequisite:**
  Concept of amplifier, gain, bandwidth and stability factor

- **Objectives:**
  1. To make student analyze effect of negative feedback on different parameters of amplifier
  2. To make student analyze various types of negative feedback connection.
  3. To make student design two stage RC coupled voltage series feedback amplifier.
  4. To make student analyze emitter follower circuit.

- **Outcome:**
  After completing this unit, student –
  1. Can analyze effect of negative feedback on different parameters of amplifier
  2. Can analyze various types of negative feedback connection.
  3. Can design two stage RC coupled voltage series feedback amplifier.
  4. Can analyze emitter follower circuit.

- **Unit Content:**
  Principle of feedback in amplifier, effect of negative feedback on stability, bandwidth, input impedance, output impedance, noise and distortion; feedback topologies , voltage series feedback, current series feedback –their analysis, design of two stage RC coupled voltage series feedback amplifier, analysis of emitter follower

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, Proteus simulation for two stage RC coupled amplifier involving feedback.

- **Assessment Methods:**
  Questions based upon principle and feedback topologies, effect of negative feedback, analysis of voltage series feedback and current series feedback; design of two stage RC coupled voltage series feedback amplifier, emitter follower

Unit 6 – Field effect transistor: No of lectures – 4

- **Prerequisite:**
  Dominant features of PN junction, concept of unipolar and bipolar devices

- **Objectives:**
  1. To introduce to student types of JFETs- construction, working & drain characteristics of JFET (N channel).
  2. To introduce to student types of MOSFETs- construction ,working & drain characteristics of MOSFET (N channel enhancement & depletion type)
  3. To make student realize application of JFET, MOSFET and make him compare between JFET, MOSFET & BJT

- **Outcomes:**
  After completing this unit, student –
  1. Can describe construction ,working & drain characteristics of JFET
  2. Can describe construction ,working & drain characteristics of MOSFET
  3. Able to select the semiconductor devices for particular applications.

- **Unit Content:**

  N-channel JFET: construction, characteristics, application, JFET as an amplifier, JFET as VVR

  MOSFET: N channel depletion & enhancement – construction, characteristics, application as a switch.

- **Content Delivery Methods:**

  Chalk and talk, power point presentations

- **Assessment Methods:**

  Questions based on construction, characteristics of JFET & MOSFET's and its applications

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✓ *Note: - Students shall refer to the data sheets for design*

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

  ICA *shall consist of minimum eight experiments and a small project based on –*

  1. Analysis & verification of clipper & clamper circuit
  2. Analysis & verification of voltage multiplier circuit
  3. Design of unregulated power supply using bridge rectifier & capacitor filter
  4. I/O characteristics of CE configuration
  5. I/O characteristics of CB configuration
  6. Design and analysis of single stage CE amplifier.
  7. Design and analysis of two stage voltage series feedback amplifier using BJT
  8. Drain & transfer characteristics of JFET & verification of various parameters
  9. Drain & transfer characteristics of MOSFET & verification of various parameters
  10. Application of BJT / MOSFET as a switch.
  11. It is recommended that with a group of 4/5 students, few lab sessions shall be utilized for carrying out a small project. Some of the recommended (but not limited to) projects includes –
      a) Design of a LC filter using bridge rectifier circuit.
      b) Constant current source circuit
      c) Design of two stage current series feedback amplifier.

- **Text Books:**
    1. Electronic Devices and Circuits , David A. Bell ,Oxford University, Press India, Fifth edition
    2. Electronic Device & Circuits, Millman Halkias ,Tata McGraw Hill, Third edition
    3. Electronic Circuits Analysis and Design , Donald A Neamen ,Tata McGraw Hill
    4. Electronic Devices and Circuits , Allen Mottershed, PHI Publication

- **Reference Books:**
    1. Electronic Devices and Circuits , Robert Boylestad ,Prentice Hall International
    2. Electronic Design Concept, Martin Roden Shroff, Reality Publications
    3. Pulse, Digital & Switching Circuits, MillmanTaub, McGraw Hill Publications
    4. Electronic Circuit Design, S.N. Talbar, T.R. Sontakke, Sadhu Sudha Publications
    5. Electronic Devices , Floyd, Pearson Education

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

S.Y.B.Tech. (Electronics Engineering) Semester-I

EN213 NETWORK THEORY AND ANALYSIS

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

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

This course provides a thorough introduction to the electric circuit analysis and synthesis. The course also introduces basic laws, theorems and techniques which are used to develop a working knowledge of the methods of analysis, used in electrical engineering. The course also intends to cover design of filters, analysis of stability of the system and transient response of AC circuits.

Course Prerequisite:
Student has completed a course in basic electrical engineering and shall have an adept knowledge of working of various elements like resistors, inductors, capacitors, transformers, and AC and DC sources. Student shall also have knowledge about basic laws like Kirchhoff's current and voltage laws, current division rules etc. Student shall also have knowledge about differentiation and integration of different functions.

Course Objectives:

1. To introduce to student various circuit laws and network reduction techniques
2. To make student to solve for electric network by applying network theorems
3. To introduce to student concept of series and parallel resonance and its effects.
4. To make student understand concept of two port networks and various parameters
5. To make student understand the transient response of AC circuits.
6. To make student evaluate the stability and behavior of the electrical systems.
7. To make student understand and implement filter approximations

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Course Outcomes:

1. Student can apply different network theorems and network reduction techniques on DC and AC passive electrical circuits.
2. Student can analyze resonance in a series and parallel circuits.
3. Student can analyze two port networks.
4. Student can analyze transient response of AC circuits.
5. Student can apply filter approximations to design analog passive filters.
6. Student can evaluate the electrical system stability using analytical methods and pole zero diagram.

SECTION I

Unit 1 - Network analysis No of lectures – 11

- **Prerequisite:**
  Properties of electrical elements and basic electric laws used to analyze electric circuits.

- **Objectives:**
  1. To introduce the graph theory.
  2. To make student aware of different network theorems.
  3. To make student apply different network theorems for circuit analysis.

- **Outcome:**
  After completing this unit, student –
  1. Can apply graph theory for circuit analysis.
  2. Can explain different network theorems.
  3. Is able to apply different network theorems for circuit analysis.

- **Unit Content:**
  Network graphs: graph theory, tree, link currents, branch voltages, incidence matrix, fundamental cut set and tie-set matrix; network theorems: mesh and nodal analysis, superposition theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, Millman's theorem, reciprocity theorem; numerical problems on DC and AC circuits based on above with dependent & independent sources.

- **Content Delivery Methods:**
  Chalk and talk

- **Assessment Methods:**
  Numerical based upon graph theory and different network theorems, circuit analysis

Unit 2 – Resonance No of lectures – 08

- **Prerequisite:**
  Phase relation of voltage and current in resistor, inductor, capacitor, differentiation and integration of different functions

- **Objectives:**
  1. To introduce the concept of series and parallel resonance.
  2. To make student to determine variation of impedance, admittance, current, voltages in series and parallel resonance circuits.

- **Outcomes:**
  After completing this unit, student –
  1. Can describe series and parallel resonance.
  2. Can determine variation of impedance, admittance, current, voltages in series and parallel resonant circuits.

- **Unit Content:**
  Series resonance, impedance and phase angle of series resonant circuit, voltage and current in series resonant circuit, effect of resistance on frequency response curve, bandwidth, selectivity and quality factor; parallel resonant circuit (tank circuit), resonant frequency, variation of impedance with frequency, reactance curves, numerical problems based on above.

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

- **Assessment Methods:**
  Questions based upon series and parallel resonance, numerical on determining the different parameters like impedance, current, voltages and values of elements in series and parallel resonant circuits.

Unit 3 – Two port networks No of lectures – 09

- **Prerequisite:**
  Concept of network, short circuit and open circuit

- **Objectives:**

1. To make student understand two port network parameters.
2. To make student analyze two port network.
3. To make student analyze interconnected two port networks.

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

1. Can find any set of two port parameters.
2. Can evaluate the relationship between two port parameters.
3. Can analyze two ports and interconnected two port networks.

- **Unit Content:**
  Relation between two port variables, open circuit impedance parameters (Z), short circuit admittance parameters (Y), transmission parameters (ABCD), hybrid parameters (h), reciprocity and symmetry conditions, relationship between parameter sets, parallel and series connections, cascading of two-port networks, T and π representation, terminated two-port network.

- **Content Delivery Methods:**
  Chalk and talk

- **Assessment Methods:**
  Numerical based upon finding two port parameters, relationship between two port parameters and analysis of interconnected two port networks.

SECTION II

Unit 4 – Transient response: No of lectures – 08

- **Prerequisite:**
  Basics of Laplace transform and properties of capacitor, inductor

- **Objectives:**

1. To make student understand DC response of RL/RC circuit.
2. To make student evaluate and analyze transient and steady state response of RL/RC/RLC circuits

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

1. Can differentiate between DC response of RL and RC circuits
2. Can evaluate and analyze transient and steady response of RL/RC/RLC circuits.

- **Unit Content:**

Review of Laplace transform, initial conditions, evaluation and analysis of transient and steady state response of following:

-RL circuit- DC voltage response
-RC circuit -DC current response
-RLC circuit- DC voltage response
-RL circuit -sinusoidal response

Numerical on series and parallel combination of R, L, and C for different source function.

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

- **Assessment Methods:**
  Questions and Numerical based on DC response of RL, RC, and RLC circuits

Unit 5 – Filters and attenuators: No of lectures – 09

- **Prerequisite:**
  Characteristics of capacitor and inductor

- **Objectives:**

1. To introduce to student concept of high pass, low pass, band pass, band stop filters and attenuators.
2. To make student design passive high pass, low pass, band pass, band stop filters and attenuators.

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

1. Can describe characteristics of high pass, low pass, band pass, band stop filters and attenuators.
2. Is able to design high pass, low pass, band pass, band stop filters and attenuators.

- **Unit Content:**
  Characteristic of high pass, low pass and band pass and band stop filter; constant K type filters, m-derived filter, section m derived LPF, HPF, BPF and BSF; attenuators: Neper & Decibels, L, T, π type, and lattice attenuators.

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

- **Assessment Methods:**
  Questions based on characteristics of filters and attenuators, numerical on design of filters and attenuators.

Unit 6 – Fundamentals of network synthesis: No of lectures – 09

- **Prerequisite:**
  Basics of two port networks

- **Objectives:**

1. To make student understand network function for two port networks.
2. To make student to evaluate time domain behavior of the system using pole zero plot
3. To make student able to determine stability of the network using Routh's criterion.

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

1. Can describe network function for two port networks.
2. Can evaluate time domain behavior of the system using pole zero plot
3. Can evaluate stability of the network using Routh's criterion.

- **Unit Content:**
  Concept of complex frequency, network function for one port and two port network, poles and zeros of network function, restriction on poles and zero location of driving point function and transfer function; time domain behavior from poles and zero plot, stability of active network & Routh's criterion.

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

- **Assessment Methods:**
  Questions and numerical based on determination of time domain behavior and stability of the system

- **Internal Continuous Assessment (ICA)**

ICA *shall consist of minimum eight experiments on –*

1. Verification of superposition theorem.
2. Verification of Thevenin's theorem.
3. Frequency response of series resonance circuit.
4. Step response of RC circuit.
5. Calculation of Z and Y parameters.
6. Calculation of H-parameters.
7. To design low pass filter, to plot frequency response & to find cut off frequency.
8. To design constant high pass filter, to plot frequency response & to find cut off frequency.
9. Design of attenuators L-type and T-type.
10. Design of attenuator π-type.

Any other experiments based on above curriculum

- **Text Books:**

1. Circuit & Network Analysis and Synthesis, A Sudhakar and Shaymmohan S Palli, TMH Publication
2. Network Analysis, M.E. Van Valkenburg, PHI Publication
3. A Course in Electrical Circuit Analysis, Sony Gupta, Dhanpatroy & Son's Publication.

- **Reference Books:**

1. Theory and Problems of Electric Circuits, Joseph A Edminster, Shaum Series
2. Network & System, D. Roy Choudhary, Wiley Eastern, 2nd Edition
3. Network Analysis & Synthesis, F.F.Kuo, John Wiley & Sons, 2nd Edition

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

S.Y. B. Tech. (Electronics Engineering) Semester-I

EN214 DIGITAL LOGIC DESIGN

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

Digitization has spread to a wide range of applications, including information (computers), telecommunications, control systems and signal processing. This first course on digital electronics provides a thorough understanding of digital system design. The course intends to cover combinational and sequential circuit analysis and design. The course also introduces the finite state machine structures and state machines approach to solve problems. The course covers introduction to programmable logic device and programmable gate arrays.

Course Prerequisite:

Student shall have knowledge of binary number system and logic gates. Student shall also have knowledge about basic electronics devices – diodes, BJT and FET

Course Objectives:

1. To introduce to student concepts of digital logic circuits like number systems, Boolean algebra etc. along with their applications.
2. To introduce to student various basic gates.
3. To introduce to student different logic families along with their vital parameters.
4. To make student design combinational and sequential circuit design.
5. To introduce to student concept of synchronous state machine.
6. To make student understand programmable logic devices

Course Outcomes:

1. Student can illustrate underlying concepts of digital logic circuits and their applications.
2. Student can use logic gates knowledge to analyze and design a logic circuit.
3. Student can realize different logic families along with their vital parameters.
4. Student can design combinational and sequential circuits
5. Student can use concept of synchronous state machine for solving design problems.
6. Student can use programmable logic devices for designing logic circuits

SECTION I

Unit 1 - Number system and codes: No of lectures – 04

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

- **Objectives:**
  1. To make student recognize radix number system and their base conversions.
  2. To make student understand signed arithmetic operations in radix number system.
  3. To introduce to student different codes in binary number system.
  4. To make student understand different error detecting and correcting codes.

- **Outcomes:**
  After completing this unit, student –
  1. Can realize different radix number systems and solve base conversion examples.
  2. Can solve signed arithmetic operations in radix number systems.
  3. Can write different codes in binary number systems.
  4. Can detect errors in binary codes and correct them using various techniques.

- **Unit Content:**
  Review of number system and base conversions; representation of signed numbers, positional number system; binary codes for decimal numbers, gray code, error detecting and correcting codes - parity check codes and hamming code.

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

- **Assessment Methods:**
  Questions based upon base conversions, signed arithmetic operations, writing different binary codes and code conversions, also questions based on finding and correcting errors in codes.

Unit 2: Boolean algebra: No of lectures – 09

- **Prerequisite:** Basics of basic logic gates and universal logic gates.

- **Objectives:**
  1. To make student understand theorems of Boolean algebra.
  2. To make student understand different standard representations of logic functions.
  3. To introduce to student different simplification and implementation methods to solve logic functions.
  4. To make student understand different timing constraint in digital system design.
  5. To introduce timing hazards and design technique for hazard free systems.

- **Outcomes:**
  After completing this unit, student -
  1. Can solve different Boolean functions by applying theorems of Boolean algebra.
  2. Can realize different standard representations of logic functions.
  3. Can simplify and implement different logic functions.
  4. Can examine different timing constraint in digital system design.
  5. Can analyze different timing hazards and design hazard free systems.

- **Unit Content:**
  Theorems of Boolean algebra, DeMorgan's law; standard representation of logic functions – SOP, POS and canonical forms; simplification of logic functions - Karnaugh maps; EX-OR and equivalence operations, NAND and NOR implementations; circuit timing – timing diagram, propagation delay, timing hazards - static and dynamic, designing hazard free circuits.

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

- **Assessment Methods:**
  Questions based upon Boolean algebra, standard representation of logic functions, problems on logic functions simplifications and implementations using universal and exclusive gates, questions based on timing hazards and designing hazard free circuits.

Unit 3: Combinational circuit design: No of lectures – 09

- **Prerequisite:** Basics of binary arithmetic such as addition and subtraction. Different logic function implementations.

- **Objectives:**
  1. To make student understand combinational circuits and their design procedure.
  2. To make student analyze different combinational circuits.
  3. To introduce to student different implementation techniques in design of different combinational circuits.

- **Outcomes:**
  After completing this unit, student -
  1. Can elaborate combinational circuits and their design procedure.
  2. Can analyze different combinational circuits.
  3. Can design and implement different combinational circuits using different implementation techniques.

- **Unit Content:**
  Design and analysis procedure; design of adder, subtractor and binary parallel adder, code conversion, design of multiplexers, de-multiplexers, encoders, decoders and their applications; design of comparators and parity circuits; standard MSI circuits.

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

- **Assessment Methods:**
  Questions based upon design of different arithmetic circuits, code converters, also problems on design and implementations of different combinational circuits.

Unit 4: Logic families: No of lectures – 06

- **Prerequisite:** Basics of transistors, FET's and their different parameters.

- **Objectives:**
  1. To make student understand different parameters related to different logic families.
  2. To introduce to student implementation of different logic gates in different logic families.
  3. To introduce to student comparison between different logic families.

- **Outcomes:**
  After completing this unit, student -
  1. Can explain different parameters related to logic families.
  2. Can explain implementation of different logic gates in different logic families.
  3. Can compare different logic families with respect to their performance.

- **Unit Content:**
  Parameter definitions - noise margin, power dissipation, voltage and current parameters, propagation delay, typical values for TTL, CMOS & ECL, input/output profile for TTL & CMOS; TTL logic families-standard TTL, Totem-pole, open collector, tri-state (concept & application); significance of TTL sub families (L, H, LS, S) & MOS family-importance of (C, HC), PMOS, NMOS (inverter only), CMOS (inverter, AND & NOR); CMOS-TTL interfacing, comparison of TTL & CMOS.TTL compatible high speed CMOS series.

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

- **Assessment Methods:**
  Questions based upon explanation of different parameters of logic families, short notes of logic families, allso questions based on implementation of different logic gates in different logic families.

SECTION II

Unit 5: Sequential circuit design: No of lectures – 10

- **Prerequisite:** Basic understanding of logic gates and their circuit timings.

- **Objectives:**
  1. To make student analyze flip-flops and design of various flip-flops.
  2. To make student realize and draw the timing diagrams for various flip-flops.
  3. To make student understand the design of counters and shift registers.

- **Outcomes:**
  After completing this unit, student can-
  1. analyze flip-flops and design of various flip-flops.
  2. realize working of various flip-flops with the timing diagrams.
  3. solve design problems on counters and shift registers.

- **Unit Content:**
  Latches - S-R latch; flip-flops: S-R, J-K, D, T and master-slave, triggering of flip-flops, flip-flop characteristic equations and excitation tables; flip-flop applications – counters, registers, clock generation

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

- **Assessment Methods:**
  Questions based upon implementation of different flip-flops, derivations of characteristic equations and excitation tables, also problems based on design of counters and shift registers.

Unit 6: Synchronous state machine design: No of lectures –10

- **Prerequisite:** Basic understanding of sequential circuit design and their timing diagrams.

- **Objectives:**
  1. To introduce to student different structures of state machines.
  2. To make student understand design procedure of state machines.
  3. To introduce to student different applications of state machines and understand their design.

- **Outcomes:**
  After completing this unit, student -
  1. Can explain different structures of state machines.
  2. Can explain design procedure of state machines.
  3. Can solve different design problems on FSM's.

- **Unit Content:**
  State machine structures - Mealy and Moore machines; design of state machines - state table, state assignment, transition/excitation table, excitation maps and equations, logic realization; design of sequence generators and detectors.

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

- **Assessment Methods:**
  Questions based explanation of FSM structures, also problems on design of FSM's, sequence generators and detectors.

Unit 7: Programmable logic devices: No of lectures –04

- **Prerequisite:** Basic understanding of logic gates.
- **Objectives:**
  1. To introduce structure of programmable logic arrays and programmable array logic.
  2. To introduce their applications in combinational circuit design.
- **Outcomes:**
  After completing this unit, student -
  1. Can explain structure of programmable logic arrays and programmable array logic.
  2. Can solve problems on combinational circuit design using PLA's and PAL's.
- **Unit Content:**
  Programmable logic arrays, programmable array logic and their applications- sequential PLDs
- **Content Delivery Methods:**
  Chalk and talk, power point presentations.
- **Assessment Methods:**
  Questions based explanation architectures of PLA's and PAL's, problems based on combinational circuit design using PLD's.

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

  ICA *shall consist of minimum ten experiments based upon*-
  1. Verification of truth table of basic and universal gates.
  2. Implementation of universal gates using basic gates.
  3. Code conversion using logic gates: binary to gray, gray to binary, binary to excess-3.
  4. Implementation of any one combinational circuit using multiplexer.
  5. Implementation of any one combinational circuit using de-multiplexer.
  6. Design a n-bit comparator using logic gates.
  7. Perform 1's and 2's complement adder/subtraction using 4 bit parallel adder.
  8. Convert J-K flip-flop to T (Toggle) flip-flop and D (Data) flip-flop.
  9. Design and implement mod-n asynchronous counter.
  10. Design and implement mod-n synchronous counter.
  11. Design and implement a 4 bit bi-directional shift register.
  12. Implement a Simple/Johnson ring counter.
  13. Design and implement a sequence detector (Mealy or Moore machine).

- **Text books:**
  1. Digital Design, M. Morris Mano ,PHI, Third edition
  2. Digital Electronics, Subrata Ghoshal, Cengage Learning, First edition
  3. Modern Digital Electronics, R. P. Jain ,TMH, Third edition

- **Reference books:**
  1. Digital Design: Principles and Practices, Wakerly John F. ,Pearson Education, Forth edition
  2. Digital Principles & Applications, Leach, Malvino, Sixth edition

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

S.Y. B.Tech. (Electronics Engineering) Semester-II

EN215 ANALOG COMMUNICATION

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

This is a first course on electronic communication which intends to introduce the concepts of analog communication systems, and to equip students with various issues related to analog communication such as modulation, demodulation, transmitters and receivers and noise performance. It also covers Pulse Modulation, preliminaries of wave propagation and antenna theory.

Course Prerequisite:

A very basic knowledge of signals and systems is desirable. Student shall have mathematical background of trigonometry; student shall also have background of analog electronic circuit design and digital technique.

Course Objectives:

1. To introduce to student essential components of communication system and emphasize need of modulation
2. To make student recognize concept of noise and its effects in communication systems
3. To make student understand amplitude modulation and demodulation with its mathematical background.
4. To make student understand frequency modulation and demodulation with its mathematical background
5. To make student understand pulse modulation and its types.
6. To make student comprehend nature and behavior of wave propagation and basic principle of different antenna systems
7. To make student simulate some of above systems using suitable simulation tool

Course Outcomes:

1. Student can describe basic components of communication system and examine the needs of modulation.
2. Student can describe concept of noise and also recognizes its effects.
3. Student can describe amplitude modulation and demodulation and analyze the signals in time and frequency domain.
4. Student can describe frequency modulation and demodulation and analyze the signals in time and frequency domain.
5. Student can describe the process of pulse modulation & classify its types.
6. Student can examine behavior of wave propagation and basic principle of different antenna.
7. Student can simulate components of communication system using simulation software and can interpret results.

SECTION I

Unit 1 – Introduction to electronic communication No of lectures – 06

- **Prerequisite:**
  Preliminaries of signals and their propagation

- **Objectives:**
  1. To make student familiar with transmitter and receiver blocks for communication.
  2. To make student understand need of modulation.
  3. To make student understand different types of communication, media and modulation techniques.
  4. To make student understand different types of propagation.
  5. To introduce to student antenna characteristics and types.

- **Outcome:**
  After completing this unit, student can –
  1. Draw and explain communication system block diagram
  2. Describe need of modulation
  3. Describe various communication applications on basis of frequency spectrum.
  4. Compare different types of wave propagation.
  5. Compare different types of antennas & its parameters

- **Unit Content:**
  Introduction of communication, elements of a communication systems, modulation and demodulation, need of modulation, types of modulation, type of communication channels (transmission line, parallel wires, coaxial cables, waveguides and optical fibers), electromagnetic spectrum, bandwidth, concept of multiplexing (TDM and FDM), application of communication.

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

- **Assessment Methods:**
  Descriptive questions based on communication system, modulation, questions based on bandwidth calculation.

Unit 2 – Noise No of lectures – 06

- **Prerequisite:**
  Communication system, analog and digital signals, analog electronic circuit design

- **Objectives:**
  1. To make student understand effect of noise and different types of noise.
  2. To make student calculate parameters of noise

- **Outcomes:**
  After completing this unit, student can–
  1.Explain effect of noise and analyze different types of noise.
  2.Compute signal to noise ratio, noise figure, noise temperature

- **Unit Content:**
  Noise & communication – sources of noise, external noise, internal noise, types of noise, white noise, thermal noise, shot noise, partition noise, low frequency or flicker noise, burst noise, avalanche noise, addition of noise, signal to noise ratio, noise figure, noise temperature.

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

- **Assessment Methods:**
  Objective questions based on noise & communication – external noise, internal noise, addition of noise, numerical questions based on signal to noise ratio, noise figure, noise temperature

Unit 3 – Amplitude modulation & demodulation No of lectures – 10

- **Prerequisite:**
  Communication system, modulation, trigonometry, electronic devices and circuit design.

- **Objectives:**
  1. To make student understand concept, representation and mathematical derivation of amplitude modulation.
  2. To make student learn effects of over and under modulation.
  3. To explain student concept of AM signal in the form of – DSB, SSB, ISB, VSB signals.
  4. To make student understand different suppression techniques, their limitations and applications.
  5. To make student simulate AM modulator using suitable simulation tool

- **Outcomes:**
  At the end of this unit, student can –
  1. Derive AM equation.
  2. Compute power, current and modulation index of AM signal
  3. Design balanced modulator for DSB and SSB.
  4. Compare between different suppression techniques.
  5. Simulate AM modulator using suitable simulation tool

- **Unit Content:**
  Mathematical treatment and expression for AM, frequency spectrum, modulation index, representation of AM wave, power relation as applied to sinusoidal signals, AM generation techniques, DSB, SSB generation techniques, ISB and VSB. AM demodulation, AM radio receiver types, TRF, super heterodyne, AM receiver characteristics, intermediate frequencies and its choice, AGC

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, animations, demonstration of MATLAB program.

- **Assessment Methods:**
  Descriptive questions based on AM block diagrams for high & low level modulation, analytical questions based on AM transmitters, numerical questions based on power, current and modulation index of AM signal.

SECTION II

Unit 4 – Frequency modulation & demodulation No of lectures – 08

- **Prerequisite:**
  Basics of AM receivers

- **Objectives:**
  1. To make student understand elements of FM Transmitter.
  2. To make student understand different types of FM receiver
  3. To make student understand working of various circuits used in receiver system
  4. To make student design FM receiver
  5. To make student simulate FM receiver using suitable simulation tool.

- **Outcomes:**
  After completing this unit, student can –
  1. Compare different types of FM receivers
  2. Design FM receiver
  3. Describe the applications of FM receiver
  4. Simulate FM receiver using suitable simulation tool.

- **Unit Content:**
  Mathematical analysis of FM and PM, frequency spectrum analysis of FM, modulation index and bandwidth requirements, narrow band and wide band FM, comparison of AM,FM and PM, direct and indirect methods of FM generation, need for pre-emphasis, de-emphasis. FM detection techniques - slope detector, dual slope detector, Foster Seeley discriminator, ratio detector

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, demonstration of MATLAB program.

- **Assessment Methods:**
  Descriptive questions based on AM receiver block diagram and circuits

Unit 5 – Pulse modulation: No of lectures – 08

- **Prerequisite:**
  Basics of analog communication systems

- **Objectives:**
  1.To make student explain the term sampling.
  2.To make student understand Nyquist rate.
  3.To make student classify types of sampling.
  4.To make student understand pulse modulation and its types.

- **Outcomes:**
  After completing this unit, student can –
  1.Illustrate sampling process.
  2.Make use of Nyquist criteria for different signals.
  3.Illustrate different types of sampling.
  4.Describe the process pulse modulation & its types.

- **Unit Content:**
  Sampling theorem, Nyquist rate, sampling types and effects.- natural sampling, flat top sampling and flat top sampling , analog pulse modulation/demodulation methods- pulse amplitude modulation and pulse time modulation (direct and indirect method)

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

- **Assessment Methods:**
  Descriptive questions based on sampling theorem, Nyquist criteria and types of pulse modulation.

Unit 6 – Antenna & wave propagation No of lectures – 06

- **Prerequisite:**
  Communication system, modulation, analog electronic circuit

- **Objectives:**
  1. To make student understand concept , characteristics and types of antenna
  2. To make student understand wave propagation and its types.

- **Outcomes:**
  After completing this unit, student can –
  1. Define and calculate different characteristics of antenna
  2. Describe types of wave propagation

- **Unit Content:**
  Introduction - characteristics of antennas, half wave dipole antenna, folded antenna, Yagi antenna, horn antenna, lens antenna, wave propagation – introduction, ground wave, sky waves, space waves.

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

- **Assessment Methods:**
  Descriptive questions based on types of antenna and wave propagation

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

  ICA *shall consist of minimum eight experiments and a small project based on –*

  1. AM modulation & demodulation techniques
  2. Noise measurement
  3. Single sideband techniques
  4. Spectrum analysis of modulation using spectrum analyzer
  5. Radio receivers
  6. Angle modulation & demodulation techniques
  7. Pulse Modulation (PAM, PWM, PPM)
  8. Antenna characteristics
  9. Minimum 4 experiments using suitable software simulation tool
  10. It is recommended that with a group of 4/5 students, few lab sessions shall be utilized for carrying out a small project. Some of the recommended (but not limited to) Projects includes –
      a. Design of FM transmitter.
      b. Design of FM receiver

- **Text Books:**

1. Communication Electronics –Principles and Applications, Lois E. Frenzel, Tata McGraw Hill Education Pvt. Ltd; Third edition.
2. Electronic Communication Systems, George Kennedy, Bernard Davis, Tata McGraw Hill Publishing Company Ltd; Forth edition.
3. Advanced Electronics Communication System –Wayne Tomasi, 6/e, Pearson Education

- **Reference Books:**

1. Electronic Communications – Modulation and Transmission, Robert J. Schoenbeck, Prentice Hall of India Pvt. Ltd.
2. Digital and Analog Communication Systems, K Sam Shanmugam, Wiley Student Edition
3. Telecommunication Switching Systems and Networks, Thiagarajan Viswanathan, Prentice Hall of India Pvt. Ltd.
4. Electronic Communications, 4th edition, Dennis Roddy, John Coolen, Prentice Hall of India Pvt. Ltd.
5. Electronic Communications Systems, Roy Blake, Cengage Learning, Second edition.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

S.Y. B.Tech. (Electronics Engineering) Semester-I

EN216 OBJECT ORIENTED PROGRAMMING WITH C++

Teaching Scheme
Tutorial – 1 Hour/week, 1 Credit
Practical– 2 Hours/week, 1 Credit

Examination Scheme
ICA- 50 Marks
POE- 50 Marks

This course provides an introduction to object-oriented software development through C++. It's an extension to C with number of features added. The course introduces concept of class and object. 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.

Course Prerequisite:
Student has completed a course in 'C programming' and shall have an adept knowledge of programming with C.

Course Objectives:
1. To introduce to student features of object oriented language.
2. To make student understand 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 use function overloading and operator overloading to implement compile time polymorphism
6. To make student use virtual functions to implement run time polymorphism

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Course Outcomes:
1. Student can differentiate between C and C++ in terms of data hiding and class. He can also implement programs using class.
2. Student can describe significance and implement different types of constructors and destructors
3. Student can implement structure, types of inheritance and explain importance of inheritance.
4. Student can use function overloading and operator overloading to implement compile time polymorphism
5. Student can use virtual functions to implement run time polymorphism
6. Student can use different features of object oriented programming efficiently

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SECTION I

Unit 1-Brief review of C No. of Lectures – 02

- **Prerequisite**:
  Fundamentals of C programming

- **Objectives:**
  1. To strengthen student's concepts of basic data types and derived data types.
  2. To strengthen student's concepts of different operators in C and its precedence.
  3. To strengthen student's concepts of various decision control statements and loops.
  4. To strengthen student's concepts of arrays
  5. To make student write simple C programs using various operators, control structures and loop structures.

- **Outcomes**:
  After completing this unit, student will be able to
  1. Use basic data types, user defined data types, and derived data types efficiently
  2. Use different operators in C and its precedence efficiently
  3. Use various decision control statements and loops efficiently
  4. Use 1D & 2D arrays efficiently
  5. Write C programs by applying knowledge of various C features
  6. Apply features like structures and unions efficiently in small C applications.

- **Unit Content:**
  Review of concepts of C programming- C character set, tokens, constants, keywords, primitive data types, variables, operators and operator precedence, formatted and unformatted input- output functions, different control structures -if-else, loops- for, do -while loop and switch –case statement, declaration and initialization of 1-D and 2-D arrays, array operations.

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

- **Assessment Method** :
  C programs based on decision control statements, loops.

Unit 2- Review of structures, functions and pointers No of lectures -02

- **Prerequisite:**
  Fundamentals of C programming

- **Objectives:**
  1. To strengthen student's concepts of structures, unions, functions and pointers.
  2. To make students write programs using structures , functions and pointers

- **Outcomes :**
  After completing this unit, student will be able to
  1. Write programs using structures and unions efficiently
  2. Write programs using functions
  3. Use pointers efficiently in programs

- **Unit Content –**
  Review of structures and unions – definition and declaration of structures and unions, accessing elements of structure and union; function: declaration and definition of functions, functions using pass by value; pointer to basic data types, pointer arithmetic, pointers and array.

- **Content Delivery Methods:**

Chalk and talk, power point presentations, programming

- **Assessment Method :**

C programs based on structures, functions and pointers

Unit 3: Introduction to C++ No. of Lectures – 02

- **Prerequisite:**
  Fundamentals of C programming

- **Objectives:**
  1. To make student understand 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 definition and declaration of a function in C++
  4. To introduce to student concept and declaration of different types of functions like inline functions and friend functions.
  5. To make student understand function overloading and virtual functions.
  6. To make student write C++ programs using object oriented approach.

- **Outcomes:**
  After completing this unit, student will be able to
  1. Describe difference between subject oriented programming and object oriented programming.
  2. Explain various features of OOP's.
  3. Write programs using object oriented approach.
  4. Write programs using inline functions and friend functions
  5. Can implement concept of function overloading and virtual functions.
  6. Can write program using functions with different calling methods.

- **Unit Content:**
  Introduction to object oriented programming, features: class, object, encapsulation, data abstraction, inheritance, polymorphism, data hiding; difference between C and C++, structure of C++ program, tokens, keywords, identifiers & constants, operators in C++, scope resolution operator; declaration of functions, stream input output functions in C++, inline functions, concept of function overloading, friend functions, and virtual functions.

- **Content Delivery Methods:**

Chalk and talk, power point presentation, programming

- **Assessment Method :**
  Programming using structure, programming on functions with different calling approach, programming on inline functions

Unit 4- Classes and object No. of Lectures – 03

- **Prerequisite:**
  Fundamentals of C programming and object oriented programming

- **Objectives:**
  1. To make student understand 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 importance of friend functions.
  5. To make student understand static data members and member functions.
  6. To make student write program using class using member functions, static data members and member functions, friend functions.

- **Outcomes:**
  After completing this unit, student will be able to
  1. Explain difference between structure and class.
  2. Describe significance of a class with different visibility labels.
  3. Write program using class and inline functions.
  4. Write program using friend functions.
  5. Can implement static data members and member functions

- **Unit Content:**
  Declaration of a class, defining member functions, creating 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, power point presentation, programming

- **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

SECTION II

Unit 5-Constructors and destructors No. of Lectures – 02

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

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

- **Outcomes:**
  After completing this unit, student will be able to
  1. Explain importance and properties of a constructor.
  2. Implement different types of constructors.
  3. Describe importance and properties of a destructor.
  4. 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, power point presentation, programming

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

Unit 6–Inheritance No. of Lectures – 02

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

- **Objectives:**
  1. To make student realize necessity of inheritance.
  2. To make student understand different types of inheritance.
  3. To make student understand ambiguity in hybrid inheritance and how to overcome it
  4. To make student understand virtual base class
  5. To make student write program using different types of inheritance and virtual base classes

- **Outcomes:**
  After completing this unit, student will be able to
  1. Explain importance of inheritance and write its structures.
  2. Implement different types of inheritance.
  3. Explain and implement ambiguity in hybrid inheritance
  4. 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, power point presentation, programming

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

Unit 7-Function overloading and operator overloading
(Compile Time Polymorphism) No. of Lectures – 02

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

- **Objectives:**
  1. To introduce to student 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 will be able to-
  1. Explain concept of compile time polymorphism.
  2. Implement structure of function overloading and can explain advantages of function overloading.
  3. Explain advantages of operator overloading and can implement structure of operator overloading.
  4. 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, power point presentation, programming

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

Unit 8–Polymorphism No. of Lectures – 02

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

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

- **Outcomes:**
  After completing this unit, student will be able to-
  1. Explain difference between compile time and run time polymorphism.
  2. Write program using this pointer.
  3. 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, power point presentation, programming

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

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

ICA shall consist of minimum ten experiments based upon above curriculum containing-

1. Program using member function in a class using concept of private, public, and protected data members
2. Program using inline function
3. Program using function overloading.
4. Program using constructor.
5. Program using destructors.
6. Program to access private data of class using friend function.
7. Program on operator overloading
8. Program on single inheritance.
9. Program on multilevel inheritance.
10. Program using virtual base class with keyword virtual.
11. Program using virtual function to represent polymorphic features.

- **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, 2nd Edition, 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

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Punyashlok Ahilyadevi Holkar Solapur University, Solapur

S.Y. B.Tech. (Electronics Engineering) Semester-II

EN221 ELECTRICAL MACHINES

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

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

This is a course aiming at the fundamental concepts and applications of electrical machines. This course introduces basic working principles and construction details of dc generators, motors, three phase induction motors, spatial motors & three phase transformers. It also introduces importance of power factor improvement & three phase power measurement. Due attention is given to speed control, torque measurement of different motors, concept of drive and selection criteria of motor.

Course Prerequisite:
Student shall have knowledge of magnetic, electromagnetic fundamentals, circuit theory and types of electrical supply. He shall also have basic knowledge of power and power factor.

Course Objectives:

1. To emphasize on working, types, and characteristics of dc generator.
2. To make student understand speed control, starting and braking of DC motors.
3. To introduce to student three phase power measurement and need of power factor improvement.
4. To make student introduce working, torque equation, types of starters and speed control of three phase induction motor.
5. To make student comprehend working of different single phase special motors.
6. To make student understand construction and three phase transformer connections.

Course Outcomes:

1. Students can describe working principle, types and characteristics of dc generator.
2. Students can explain working, speed control, starting and braking of dc motors and three - phase induction motors.
3. Students can elaborate three phase power measurement and power factor improvement methods.
4. Students can explain working, types of starters and speed control of three - phase induction motor and can derive the torque equation.
5. Students can describe working and application of different single phase special motors.
6. Students can elaborate three phase transformer connections.

SECTION I

Unit 1– DC generators No of lectures – 06

- **Prerequisite:**
  Basics of magnetic circuit, Faraday's laws of electromagnetic induction

- **Objectives:**
  1. To introduce to student construction of dc machine
  2. To introduce to student working principle of generator.
  3. To make student derive EMF equations for different types of generators.
  4. To introduce to the student characteristics of dc generators.

- **Outcomes:**
  After completing this unit, student -
  1. Can explain construction of dc machine.
  2. Can describe working of generator.
  3. Can derive EMF equation for generator.
  4. Can draw characteristics of dc generators.

- **Unit Content:**
  Construction and components of dc machine, principle of operation of generator, EMF equation characteristics of dc generators.

- **Content Delivery Methods:**

Chalk and talk, power point presentation

- **Assessment Methods:**
  Questions based on explanation of dc machine construction, and characteristics of different generators, derivation of generated EMF equation, numerical on calculation of EMF and performance parameters of generator.

Unit 2– D.C. motors No of lectures – 10

- **Prerequisite:**
  Basics of magnetic circuit, Faraday's laws of electromagnetic induction

- **Objectives:**
  1. To make student understand construction, working principle & types of dc motors.
  2. To make student understand the significance of back emf.
  3. To make student understand different methods of speed control, characteristics & applications of dc motors.
  4. To make student realize the necessity of starters and types of starters.
  5. To make student understand different tests on dc motors and types of electric braking.

- **Outcomes:**

  After completing this unit, student –

1. Can explain construction and working principle of different dc motors.
2. Can describe significance of back emf.
3. Can explain different characteristics, methods of speed control and application.
4. Can describe necessity and types of starters.

5.Can explain different test of DC motor and types of electric braking

- **Unit Content:**

  Working principle, concept of back emf, types, characteristics- speed Vs torque, armature current Vs speed & armature current Vs torque, speed control methods-voltage control method, armature rheostat control method and flux control method, study of starters- 3-point and 4-point starter & electronic starters, testing of dc motors-no load test and brake load test, electrical braking -plugging, dynamic & regenerative braking.

- **Content Delivery Methods:**

Chalk and talk, power point presentation

- **Assessment Methods:**

  Questions based on explanation of working, characteristics, application, speed control methods, starters, testing methods and applications of different dc motors, numerical on speed control , torque and efficiency of different motors

Unit 3– Three phase power measurement and power factor improvement

No of lectures – 05

- **Prerequisite:**

Basics of poly phase ac system and power factor

- **Objectives:**

1. To introduce to student of three phase power measurement by two wattmeter method.
2. To make student realize importance of improvement of power factor.

- **Outcomes:**

  After completing this unit, student –

1. Can explain two wattmeter method
2. Can derive relation for power factor angle & three phase complex power
3. Can explain various causes of low power factor & methods of improvement of power factor

- **Unit Content:**
  Introduction to three phase power measurement, three phase power measurement in balanced load by three, two & one wattmeter method, causes of low power factor, effect of low power factor & its disadvantages, different methods for power factor improvement
- **Content Delivery Methods:**
  Chalk and talk, power point presentation
- **Assessment Methods:**
  Questions based on explanation of two wattmeter method, effect of low power factor, causes of low power factor and different methods for power factor improvement, derivation of power factor angle, and complex power, numerical on two wattmeter method

SECTION II

Unit 4- Three phase induction motors: No of lectures – 09

- **Prerequisite:**
  Fundamentals of three phase ac supply & motors
- **Objectives:**
  1. To introduce to student construction and working principle of three phase induction motor.
  2. To make student understand torque of three phase induction motor under different conditions.
  3. To make student understand different methods of speed control, slip torque characteristics & applications of three phase induction motor.
  4. To make student realize power flow in three phase induction motor.
  5. To introduce to student types of starters for three phase induction motor.
- **Outcomes:**
  After completing this unit, student –
  1. Can explain the construction and working principle of three phase induction motor.
  2. Can analyze torque of three phase induction motor under different conditions and find condition for maximum torque.
  3. Can explain different methods of speed control, slip torque characteristics & applications of three phase induction motor.
  4. Can analyze power flow in three phase induction motor and find efficiency.
  5. Can describe necessity and types of starters.
- **Unit Content:**
  Working principle, types, starting torque ,full load torque, running torque and condition for the maximum torque, torque-slip characteristics, power flow diagram , speed control methods, stator side control, rotor side control and electronic methods, electrical braking, starters-DOL, star-delta, auto transformer & electronic starters.

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

- **Assessment Methods:**
  Explanation of working, types of motor, torque-slip characteristics, power flow diagram speed control methods , speed control methods, application & starters, derivation of motor toque & condition for maximum torque under various conditions. Numerical on speed control, torque and efficiency of three phase induction motors

Unit 5-Special motors No of lectures – 05

- **Prerequisite:**
  Fundamentals of motors

- **Objectives:**
  1. To make student understand constriction and working principle of various special motors
  2. To introduce to student concept of drive and selection criteria of motor for different applications

- **Outcomes:**
  After completing this unit, student –
  1. Can explain construction and working principle of different motors.
  2. Student can explain the concept of drive and selection criteria of motor.

- **Unit Content:**
  Working principle, construction, types & applications of single phase induction motors, universal motor, shaded pole motor, brushless dc motor , stepper motor and servo motor, introduction, concepts of drives, types & selection criteria of motor for different applications

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

- **Assessment Methods:**
  Questions based on explanation of construction, working, application of special motors & concept of electrical drive, selection of proper motor for given application with reason.

Unit 6- Three phase transformers No of lectures – 07

- **Prerequisite:**
  Fundamentals of ac circuits and magnetism

- **Objectives:**
  1. To make student understand the construction and working principle of three phase transformer.
  2. To make student realize the various types of connections and types of transformers

- **Outcomes:**
  After completing this unit, student –
  1. Can explain construction and working principle of three phase transformer.
  2. Can describe various types of connections and types of transformer connection

- **Unit Content:**
  Introduction, working principle of three-phase transformer, construction details, connection diagrams - star-star, delta-delta, delta-star, star-delta, V-V and T-T connections, special transformers - single phase auto transformer, current transformer & potential transformer

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

- **Assessment Methods:**
  Questions based on explanation of working, types of transformer connection, numerical on transformation ratio & voltage, current relation for different connections

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- **Internal Continuous Assessment (ICA):**
  ICA *shall consist of minimum ten experiments*

1. Speed control of dc shunt motors by flux control method.
2. Speed control of dc shunt motors by armature voltage control method.
3. Armature current Vs torque characteristics of dc shunt motor.
4. Armature current Vs speed characteristics of dc shunt motor.
5. No load test on dc shunt motor.
6. Break load test on dc motor.
7. Verification of high starting current and necessity of starter for stating dc shunt motor.
8. Torque Vs slip characteristics of three-phase induction motor.
9. Verification of three phase transformer connection
10. Load test on three phase induction motor.
11. Verification of high starting current and necessity of starter for stating three phase induction motor.
12. Three phase power measurement by two wattmeter method.
13. Three phase power measurement by one wattmeter method.
14. Break load test on single phase induction motor.
15. Magnetization characteristics of dc shunt generator. Determining critical field resistance and critical speed
16. Load test on dc shunt generator.

Text Books:

1. Text book of Electrical technology Volume I & II, , B.L. Theraja, S. Chand publications, edition- 21st revised
2. Basic Electrical Engineering, R.Ananda Natarajan,P.Ramesh Babu , SCITECH Publications
3. Fractional and sub-fractional horse power electric motors, Veinott and Martin McGraw-Hill Publications, Electrical and Mechanical Engineering Series, Fourth edition

- **Reference Books:**

1. Electrical technology, H. Cotton, CBS Publishers and Distributors, Seventh edition
2. Electrical Power, S.L. Uppal, Khanna Publishers, Delhi, Thirteenth edition
3. A course in Electrical & Electronics Measurement & Instrumentation, A.K.Sawhney, Bernard Davis, Dhanpatrai & Co Pvt Ltd, Fourth edition

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

S.Y.B.Tech. (Electronics Engineering) Semester-II

EN222 CONTROL SYSTEMS

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

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

Course Prerequisite:

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

Course Objectives:

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

Course Outcomes:

After completion of this course

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

SECTION I

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

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

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

- **Outcomes:**
  After completing this unit, student is–
1. Able to classify the system and represent it mathematically.
2. Able to represent electrical system mathematically.
3. Able to determine system transfer function using block diagram reduction method, signal flow graph method.

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

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, MATLAB simulation for pole zero plot and transfer function representation.

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

Unit 2-Control system components No of lectures-05

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

- **Objectives:**

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

- **Outcomes:**

After completing this unit, student –

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

- **Unit Content:**

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

- **Content Delivery Methods:**

Chalk and talk, power point presentation

- **Assessment Methods:**

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

Unit 3-Time response analysis No of lectures – 09

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

- **Objectives:**

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

- **Outcomes:**

After completing this unit, student –

1. Can analyze step response of first order system.
2. Can analyze step and impulse response of second order system.
3. Can find time domain specifications of second order system.
4. Can calculate steady state error, error coefficients of type 0 to type 2 systems
5. Is able to compensate error of of type 0 to type 2 systems

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

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

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

SECTION II

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

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

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

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

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

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

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

Unit 5-Frequency domain analysis No of lectures – 07

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

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

- **Outcomes:**
  After completing this unit, student –
  1. Can describe specifications of frequency domain.
  2. Can analyze the system by drawing frequency response.
  3. Can analyze system by drawing Bode plot.
  4. Is able to draw polar plot & Nyquist plot.

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

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

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

Unit 6- Compensators & Controllers No of lectures – 06

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

- **Objectives:**
  1. To make student understand different types of compensators.
  2. To introduce to student concept of P,PI &PID controllers.
  3.

- **Outcomes:**
  After completing this unit, student –
  1. Can analyze lag compensators, lead compensators and lag-lead compensator.
  2. Can describe P,PI &PID controllers

- **Unit Content:**
  Need of compensator, lag compensators, lead compensators and lag-lead compensators, proportional controllers, PI controllers and PID controllers
- **Content Delivery Methods:**
  Chalk and talk, power point presentation, MATLAB/Simulink simulations for P, PI and PID controllers.
- **Assessment Methods:**
  Descriptive questions to ensure understanding of compensation techniques, lag compensators, lead compensators and lag-lead compensator and P,PI & PID controllers.

- **Internal Continuous Assessment (ICA)**
  ICA consists of minimum eight experiments out of below list. Minimum two experiments shall be on MATLAB platform.

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

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

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

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

S.Y. B.Tech. (Electronics Engineering) Semester-II

EN223 DATA STRUCTURES

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

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

Data Structure is a way of collecting and organizing data in such a way that operations on these data can be performed in an effective way. Data Structures is about rendering data elements in terms of some relationship, for better organization and storage. This course introduces linear and non linear data structures including stack, queues, linked list, trees and graphs

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Course Prerequisite:
Student has completed a course in 'C programming' and shall have an adept knowledge of programming with C. Student has also completed a course in 'Object Oriented Programming using C++' and has knowledge about programming using class in depth.

Course Objectives:

1. To introduce to student data structure and its real life applications.
2. To make student understand, design and implement stack and queues.
3. To make student implement different types of linked lists
4. To make student realize need of recursion and its applications.
5. To make student use searching methods and different sorting techniques efficiently
6. To make student understand different types of binary trees and different tree traversal methods
7. To make student use different graph traversal methods and graph representation methods.

Course Outcomes:

1. Student can implement stack and queues.
2. Student can describe the significance and implement different types of linked lists
3. Student can describe the significance of recursion and can use recursion efficiently
4. Student can implement different searching and sorting technique and can compare different techniques in terms of time complexity
5. Student can describe different types of binary trees and can implement different tree traversal methods
6. Student can illustrate different graph representation and traversal methods

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SECTION I

Unit 1–Stack and queues No of lectures – 08

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

- **Objectives:**
  1. To introduce to student different linear and non linear data structures.
  2. To make student understand structure of stack
  3. To make student write program on stack using array
  4. To make student understand different applications of stack.
  5. To make student understand structure and types of queue.
  6. To make student write program on queue using array
  7. To make student realize different applications of queue.

- **Outcomes:**
  After completing this unit, student -
  1. Can explain difference between a stack and a queue
  2. Can explain applications of stack and queue.
  3. Can write program using stack for static implementation.
  4. Can write program using different types of queues.

- **Unit Content:**
  Introduction to data structure, examples and real life applications, stack definition, static implementation using arrays, operations on stack, applications of stack; queue definition, operations on simple queue using arrays, operations on circular queue using arrays & concept of dequeue and priority queue, concept of applications of queue

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

- **Assessment Methods:**
  Programming on static implementation of stack, static implementation of queue, static implementation of circular queue, numerical on applications of stack (infix to postfix conversion and postfix expression evaluation)

Unit 2–Linked lists: No of lectures – 08

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

- **Objectives:**
  1. To introduce to student structure of linked list.
  2. To make student realize advantages of linked list over stack and queue.
  3. To make student write algorithms on different operations on linked list.
  4. To make student understand different types of linked list and its related programming concept
  5. To make student write programs for dynamic implementation of stack and queue.
  6. To make student recognize applications of linked list.

- **Outcomes:**
  After completing this unit, student –
  1. Can explain advantages of linked list over stack and queue.
  2. Can write algorithms on different operations on linked list.
  3. Can write programs using different types of linked list.
  4. Can write program using dynamic implementation of stack and queue.
  5. Can describe applications of linked list.

- **Unit Content:**

Definition, representation and operations on linked list, types of linked lists: singly linked list, circular linked list, concept of doubly linked list; stack using linked list, queue using linked list, concept of applications of linked list.

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

- **Assessment Methods:**

Algorithm for different operations on linked list, programming on dynamic implementation of singly linked list and circular linked list, programming on dynamic implementation of stack and queue using linked list, illustration of applications of linked list (Polynomial addition using linked list).

Unit 3–Recursion: No of lectures – 04

- **Prerequisite:** Concepts of C programming, concepts of stack and linked list.
- **Objectives:**
  1. To make student understand general algorithm of recursion.
  2. To make student understand the static storage allocation and dynamic storage allocation for recursion.
  3. To make student write programs using recursion for different applications

- **Outcomes:**
  After completing this unit, student –
  1. Can explain general algorithm of recursion.
  2. Can differentiate between static & dynamic storage allocation for recursion
  3. Can write programs using recursion for different applications

- **Unit Content:**
  Recursion in C, how recursion works: static storage allocation and dynamic storage allocation; writing recursive algorithm, examples of recursion

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

- **Assessment Methods:**
  Algorithm for recursion, programming on different examples of recursion

SECTION II

Unit 4-Trees: No of lectures – 06

- **Prerequisite:**
  Concepts of C programming, concepts of linked list and recursion

- **Objectives:**
  1. To introduce to student concept of trees.
  2. To make student understand different operations on binary search tree
  3. To make student understand different tree traversal methods.
  4. To introduce to student structure of threaded binary trees and B tree

- **Outcomes:**
  After completing this unit, student –
  1. Can explain concept of trees.
  2. Can write algorithms on different operations on binary search tree.
  3. Can write programs using recursion for tree traversal methods.
  4. Can explain structure of threaded binary trees and B tree.
  5. Can construct B tree from given preorder, inorder and postorder traversal sequence.

- **Unit Content:**
  Definition of trees, terminologies of trees, binary trees, types of binary trees, operations on the binary search tree, tree traversals, concepts of threaded binary trees, concepts of B-tree

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

- **Assessment Methods:**
  Algorithm for different operations on a binary search tree, recursive programs on tree traversal methods, construction of B Tree from the given preorder, inorder and postorder traversal sequence.

Unit 5-Graph: No of lectures – 06

- **Prerequisite:**
  Concepts of C programming, concepts of stack, queue, linked list and recursion, concept of trees

- **Objectives:**
  1. To introduce to student types of graph.
  2. To make student comprehend different representation methods of graph.
  3. To make student derive representation for a given graph using different representation methods
  4. To make student comprehend graph traversal methods. (depth first traversal and breadth first traversal)

- **Outcomes:**
  After completing this unit, student –
  1. Can describe different types of graphs.
  2. Can explain different representation methods for a graph.
  3. Can derive representation for a given graph using different representation methods
  4. Can write algorithm on different graph traversal methods (depth first traversal and breadth first traversal)

- **Unit Content:**
  Definition and examples of graphs, types of graph, representation methods of graphs: adjacency matrix representation, adjacency linked representation and multi-list representation; graphs traversal methods: depth first search, breadth first search

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

- **Assessment Methods:**
  Representation for a given graph using different graph representation methods, algorithm for depth first traversal and breadth first traversal methods

Unit 6- Searching and sorting techniques: No of lectures – 08

- **Prerequisite:**
  Concepts of C programming and linked list

- **Objectives:**
  1. To introduce to student linear and binary search methods.
  2. To make student write algorithm and program using linear and binary search methods
  3. To make student realize advantages of hashing over linear and binary search methods.
  4. To introduce to student different hashing functions.
  5. To make student understand the open hashing and close hashing collision resolution techniques.
  6. To introduce to student different sorting techniques with related programming.

- **Outcomes:**

  After completing this unit, student –

  1. Can describe linear and binary search methods.
  2. Can write algorithm and program using linear and binary search methods.
  3. Can compare hashing and linear and binary search methods.
  4. Can describe different hashing functions.
  5. Can explain open hashing and close hashing collision resolution techniques.
  6. Can write programs using different sorting techniques.

- **Unit Content:**

  Linear search, binary search, definition of hashing, hashing functions, collision resolution techniques: open hashing, close hashing; bubble sort, selection sort, insertion sort, merge sort, quick sort, heap sort,

- **Content Delivery Methods:**

  Chalk and talk, programming through demo

- **Assessment Methods:**

  Algorithm and programming on linear and binary search methods, programming on different types of sorting techniques.

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

  ICA shall consist of minimum ten experiments based upon above curriculum containing-

  1. Static implementation of stack
  2. Static implementation of queue
  3. Static implementation of circular queue
  4. Implementation of singly linked list
  5. Implementation of circular linked list
  6. Dynamic implementation of stack using linked list
  7. Dynamic implementation of queue using linked list
  8. Reverse printing a linked list using recursion
  9. Linear search and binary search
  10. Bubble sort, selection sort and insertion sort.

- **Text Books:**

  1. Data Structures -A Pseudicode Approach with C, Richard F.Gilberg, Behrouz A. Forouzan, Cengage Learning, Second edition
  2. Data structure using C, ISRD Group, The McGraw-Hill Companies Ltd.
  3. Data Structure using C & C++, Rajesh K. Shukla, WILEY India.
  4. Data Structure through C in Depth, S.K. Srivastava, Deepali Srivastava, BPB Publications

- **Reference Books:**

  1. Fundamentals of Data Structures, Ellis Horowitz, Sartaj Sahani, Galgotic Books
  2. Data Structures and program design, Robert L. Kruse, Easter Economy Edition, PHI Private Limited, Edition-III
  3. Data Structure using C & C++, Y.Langsam, M.J. Augenstein, A.M Tanenbaum, PHI Second edition.
  4. Introduction to Data Structures in C, Ashok N.Kamthane, Pearson Education
  5. Understand Pointers in C, Yashwant Kanetkar, BPB Publication, Third edition

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

S.Y. B. Tech. (Electronics Engineering) Semester-II

EN224 ANALOG INTEGRATED CIRCUITS

Teaching Scheme	**Examination Scheme**
Lectures – 4 Hours/week, 4 Credits	**ESE –** 70 Marks
Practical– 2 Hours/week, 1 Credit	**ISE –** 30 Marks
	ICA- 25 Marks
	POE- 50 Marks

This is a course on the fundamental concepts and applications of operational amplifiers and few other analog integrated circuits. This course introduces basic op-amp principles and show how the op-amp can be used to solve a variety of application problems. Much attention is given to basic op-amp configurations, linear and non-linear applications of op-amp including active filters, oscillators and waveform generators. It also introduces PLL and data converter principles and circuits

Course Prerequisite:

Student shall have knowledge of circuit theory and BJT & FET devices. He shall also have basic knowledge of digital logic design.

.

Course Objectives:

1. To make student understand principles, configurations and specifications of ideal and practical op amp
2. To make student understand frequency response of op amp
3. To make student understand general and non linear applications of op amp
4. To enable student design active filters using op amp and analyze oscillator applications
5. To introduce to student working of PLL and data converters

Course Outcomes:

1. Student can explain working of op amp and characteristics of ideal and practical op amp
2. Student can describe frequency response of op amp
3. Student can analyze different linear and non linear applications of op amp
4. Student can design first and second order filter and can analyze oscillators
5. Student can describe monolithic VCO and its application in PLL
6. Student can explain data converter techniques and can use monolithic data converters for practical applications.

SECTION I

Unit 1–Op amp fundamentals No of lectures – 10

- **Prerequisite:** BJT and FET amplifiers

- **Objectives:**
  1. To introduce to the student equivalent circuit of BJT op amp
  2. To introduce to student different parameters for ideal and practical op amp
  3. To make student realize limitations of open loop applications of op amp leading to necessity of negative feedback
  4. To make student derive for gain, input resistance and output resistance for – non inverting, inverting and differential amplifier configurations.

- **Outcomes:**
  After completing this unit, student -
  1. Can analyze BJT op amp equivalent circuits
  2. Can explain different parameters for ideal and practical op amps
  3. Can explain various applications of open loop op amp and its limitations
  4. Can extract from data sheet some of the basic op parameters
  5. Can derive for gain, input resistance and output resistance for – non inverting, inverting and differential amplifier configurations

- **Unit Content:**
  Op amp block diagram, analysis of equivalent circuit, op amp parameters- ideal & practical, equivalent circuit of op amp, ideal voltage curve, open loop applications, necessity of feedback, voltage series feedback amplifier – voltage gain, input resistance, output resistance, bandwidth, total output offset voltage, voltage follower, voltage shunt feedback amplifier- voltage gain, input resistance, output resistance, bandwidth, total output offset voltage ,current to voltage converter, inverter, differential amplifier with one op amp- voltage gain, input resistance, bandwidth, differential amplifier with two op amps- voltage gain, input resistance, bandwidth, 741 op amp, FET op amp

- **Content Delivery Methods:**

Chalk and talk, power point presentations

- **Assessment Methods:**

Definition of various op amp parameters, open loop applications waveforms, derivation of gain, input resistance and output resistance for – non inverting, inverting and differential amplifier configurations and numerical based on it

Unit 2– Practical op amp No of lectures – 06

- **Prerequisite:** Op amp basics.

- **Objectives:**
  1. To make student design offset voltage compensation network due to input offset voltage for open loop and closed loop configuration
  2. To make student design offset voltage compensation network due to input bias current
  3. To make student understand effect of input offset current on output offset voltage
  4. To introduce to student total output offset voltage and its significance
  5. To make student design completely compensated inverting and non inverting amplifier circuits
  6. To make student understand temperature and supply voltage sensitive op amp parameters

- **Outcomes:**
  After completing this unit, student –
  1. Can design completely compensated inverting and non inverting amplifier circuits
  2. Can calculate total output offset voltage and state its significance
  3. Can explain temperature and supply voltage sensitive op amp parameters

- **Unit Content:**
  Input offset voltage, offset voltage compensation network for different configuration, input bias current, total output offset voltage, effect of change in temperature and supply voltage

- **Content Delivery Methods:**

Chalk and talk, power point presentations

- **Assessment Methods:**
  Design process for compensating networks and numerical based on it, explanation of temperature and supply voltage sensitive op amp parameters

Unit 3– Frequency response of op amp: No of lectures – 05

- **Prerequisite:** Op amp basics

- **Objectives:**
  1. To make student understand high frequency model and frequency response of a single stage and multi stage op amp
  2. To make student understand open loop and closed loop gains as a function of frequency
  3. To make student evaluate circuit stability
  4. To make student understand effect of slew rate on open loop and closed loop applications

- **Outcomes:**
  After completing this unit, student –
  1. Can explain high frequency model and frequency response for op amps with single and multiple break frequencies
  2. Student can explain open loop and closed loop gains as a function of frequency
  3. Student can evaluate circuit stability
  4. Student can evaluate effect of slew rate on various open loop and closed loop applications

- **Unit Content:**
  Frequency response, compensating networks, high frequency op amp equivalent circuit, open loop and closed loop gains as a function of frequency, multistage roll off, circuit stability, slew rate and its effect
  .
- **Content Delivery Methods:**
  Chalk and talk, power point presentation, videos

- **Assessment Methods:**
  Explanation of high frequency model, frequency response and gain as a function of frequency, numerical based on circuit stability and effect of slew rate

Unit 4– General applications of op amp: No of lectures – 05

- **Prerequisite:** Op amp basics

- **Objectives:**
  1. To make student understand scaling amplifier with summing & averaging as a special case
  2. To introduce to student need of instrumentation amplifier and make him analyze differential amplifier and instrumentation amplifier
  3. To make student analyze practical integrator and differentiator
  4. To make student appraise need of V to I and I to V converter and analyze op amp based V to I and I to V converter

- **Outcomes:**
  After completing this unit, student –
  1. Can analyze scaling, summing and averaging amplifier
  2. Can evaluate need of differential amplifier for real life applications and analyze a differential amplifier using one & two op amp, can explain their limitations leading to analysis of an instrumentation amplifier for real life application
  3. Student can analyze practical integrator and differentiator and can interpret its significance
  4. Student can appraise need of V to I and I to V converter and can analyze op amp based V to I and I to V converter

- **Unit Content:**
  Summing, scaling and averaging amplifier, instrumentation amplifier, V to I converter with floating and grounded load, I to V converter, integrator, differentiator

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

- **Assessment Methods:**
  Questions based on analysis of op amp applications, numerical on applications

SECTION II

Unit 5- Non linear applications of op amp: No of lectures – 08

- **Prerequisite:** Basics of op amp, electronic devices and circuits

- **Objectives:**
  1. To introduce to student closed loop comparator applications
  2. To introduce to student precision rectifier applications
  3. To introduce to student log and antilog amplifiers

- **Outcomes:**
  After completing this unit, student –
  1. Can analyze closed loop comparator applications and can compare them with similar open loop applications
  2. Can analyze rectifier applications and can compare them with conventional (high signal) rectifiers
  3. Can analyze sample and hold, log and antilog amplifiers.

- **Unit Content:**
  Basic comparator, zero crossing detector, Schmitt trigger, window detector, half wave and full wave rectifiers, peak detector, peak to peak detector, phase detector, precision rectifiers, clipper, clamper, sample and hold, log and antilog amplifier, current source, voltage source

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

- **Assessment Methods:**
  Analysis of non linear applications and numerical based on it, input –output waveforms

Unit 6- Active filters and oscillators: No of lectures – 08

- **Prerequisite:** Op amp basics, frequency response, electronic devices and circuits, passive filters

- **Objectives:**
  1. To make student design first and second order active filters
  2. To make student design high order (upto four) active filters
  3. To make student design oscillators
  4. To make student design other waveform generator

- **Outcomes:**
  After completing this unit, student –
  1. Can design first and second order active filters and compare it with passive filters
  2. Can design third and fourth order filters
  3. Can design oscillators
  4. Can design other waveform generators

- **Unit Content:**
  Active filters introduction, first order low pass Butterworth filter, second order low pass Butterworth filter, first order high pass Butterworth filter, second order high pass Butterworth filter, higher order filters, wide and narrow band pass filters, band reject filters, all pass filters, oscillator principle, types, phase shift oscillator, Wien bridge oscillator, triangular, square and saw tooth wave generator

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

- **Assessment Methods:**
  Design of first, second, third & fourth order filters, design of oscillators and waveform generators

Unit 7- Phase locked loop (PLL) No of lectures – 04

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

- **Objectives:**
  1. To introduce to student operating principle of VCO and PLL
  2. To introduce to student VCO and PLL ICs
  3. To make student understand various applications of PLL IC

- **Outcomes:**
  After completing this unit, student –
  1. Can explain working principle of VCO and PLL
  2. Can use VCO and PLL ICs
  3. Can explain various applications of PLL IC.

- **Unit Content:**
  PLL Operating principle, block diagram, monolithic VCO and PLL, PLL applications – frequency multiplier, FSK demodulator

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

- **Assessment Methods:**
  Questions based on operating principles of VCO and PLL, applications of VCO and PLL ICs

Unit 8- Signal converters No of lectures – 06

- **Prerequisite:** Basics of op amp, digital logic design

- **Objectives:**
  1. To make student recognize need of ADC and DAC
  2. To introduce to student various DAC techniques and to make compare them
  3. To make student use DAC IC
  4. To introduce to student various ADC techniques and to make him to compare them
  5. To make student use ADC IC

- **Outcomes:**
  After completing this unit, student –
  1. Can explain various DAC techniques and can compare them
  2. Can explain various ADC techniques and compare them
  3. Can use DAC IC
  4. Can use ADC IC
  5. Can explain various ADC and DAC specifications and extract them from data sheet
  6. Can recognize need of sample & hold and current to voltage converter

- **Unit Content:**
  Basic DAC techniques- weighted resistor, R-2R ladder, monolithic DAC- 1408, ADC techniques- Flash, successive approximation, single & dual slope, monolithic ADC- 0816, DAC and ADC specifications

- **Content Delivery Methods:**
  Chalk and talk, power point presentations, animation on different types of antennas

- **Assessment Methods:**
  Questions based on DAC and ADC techniques and their comparison, numerical on DAC, use of DAC and ADC ICs, DAC and ADC specifications

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

  ICA *shall consist of minimum ten experiments and a small project based upon-*

  1. Parameter measurement
  2. Inverting and non inverting amplifier configuration
  3. Frequency response and gain bandwidth product
  4. Linear applications
  5. Non linear applications
  6. Active filter design
  7. Waveform generator
  8. Design of DAC
  9. Minimum 2 experiments using suitable software simulation tool

  10. It is recommended that with a group of 4/5 students, few lab sessions shall be utilized for carrying out a small project. Some of the recommended (but not limited to) projects includes –
      a. Two op amp differential amplifier
      b. Instrumentation amplifier
      c. Variable frequency audio oscillator
      d. Bass booster
      e. Audio mixer
      f. Projects based on transducers – light, temperature
      g. Regulated voltage source

- **Text Books:**
  1. Op-Amps and Linear Integrated Circuits, Ramakant A. Gayakwad, PHI Learning Pvt.Ltd., Fourth edition
  2. Design with Operational Amplifiers and Analog Integrated Circuits, Sergio Franco,Tata McGraw-Hill Publishing Company Ltd., Third edition
  3. Linear Integrated Circuits, D. Roy Choudhary, Shail B. Jain, New age International Publishers, Third edition

- **Reference Books:**
  1. An introduction to Operational Amplifiers, Lucas M. Faulkenberry, John Wiley & Sons, Second edition
  2. Operational Amplifiers, G.B. Clayton, English Language Book Society, Second edition
  3. Operational Amplifiers and Linear Integrated Circuits, Robert F. Coughlin, Frederick F. Driscoll, Prentice Hall of India Pvt. Ltd., Fourth edition

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

S.Y. B.Tech. (Electronics Engineering) Semester-II

EN225 SIGNALS AND SYSTEMS

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

This course covers the fundamentals of signal and system analysis, with focus on representations of discrete-time and continuous-time signals (singularity functions, complex exponentials, Fourier representations, Laplace and Z transforms, sampling) and representations of linear, time-invariant systems (difference and differential equations, block diagrams, system functions, poles and zeros, convolution, impulse and step responses, frequency responses). It also introduces concepts of correlation and spectral density.

Course Prerequisite:

Student shall have mathematical background of differential equations, differentiation and integration. He shall also have basic knowledge of Laplace transform & Z transform.

Course Objectives:

1. To make student understand mathematical descriptions and representations of continuous and discrete signals & systems.
2. To make student understand the representation of a signal in terms of impulse, impulse response of a system and the convolution operation.
3. To make student understand the Fourier representation of periodic signals & Fourier transform of aperiodic signals.
4. To make student understand the sampling theorem & concept of aliasing.
5. To enable student use transforms techniques for the analysis of LTI systems.
6. To make student understand the concept of correlation & spectral density.

Course Outcomes:

At the end of the course

1. Student is able to sketch & label signals, perform arithmetic operations, transformations on a given continuous time (CT) and discrete Time (DT) signals.
2. Student can develop input output relationship for linear time invariant system and compute the convolution between given CT & DT signals.
3. Student is able to understand and resolve the signals in frequency domain using Fourier series and Fourier transform.
4. Student is able to understand the process of sampling and the effects of under sampling.
5. Student is able to apply the Laplace transform and Z- transform for analysis of continuous-time signals and systems.
6. Student is able to define correlation, spectral density & state their properties.

SECTION I

Unit 1–Introduction to signals and systems No of lectures – 10

- **Prerequisite:** Basic mathematics

- **Objectives:**
  1. To introduce to student different class of signals.
  2. To make student perform signal transformations and arithmetic operations on continuous time & discrete time signals.
  3. To introduce to student different types of systems based on system properties.

- **Outcomes:**
  After completing this unit, student -
  1. Is able to sketch and label different basic signals.
  2. Can classify the given continuous time or discrete time signal into different classes such as even/odd, energy / power signals, periodic / a periodic signals etc.
  3. Can perform different transformations such as shifting, scaling & reversal on a given signal.
  4. Can perform different arithmetic operations on given signals.
  5. Can classify the given system represented by input / output relation into different types such as static/dynamic, linear/nonlinear, causal/non causal, stable/unstable, time invariant/ time variant etc.

- **Unit Content:**
  Introduction and Classification of signals: definition of signal and systems, continuous time and discrete time signal, classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power.
  Elementary signals used for testing: reasons for using standard test signals, exponential, sine, impulse, step and its properties, ramp, rectangular, triangular, signum, sinc.
  Operations on signals: amplitude scaling, addition, multiplication, differentiation, integration (accumulator for DT), time scaling, time shifting and time folding.
  Systems: definition, classification: linear and non-linear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable, invertible.

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

- **Assessment Methods:**
  Different types of signals, signal transformations, classification of signals, system properties. (Numerical approach)

Unit 2– System analysis No of lectures – 08

- **Prerequisite:** Basic signals, properties of signals & systems

- **Objectives:**
  1. To make student understand representation of continuous time signals & discrete time signals in terms of unit impulse signal.
  2. To make student understand the block diagram representation of LTI systems represented by differential / difference equations. (up to second order systems)
  3. To make student understand the convolution operation.
  4. To compute the convolution sum / integral of given signals.
  5. To make student identify properties of the system from impulse response of the system.
  6. To make student understand step response of the LTI system.

- **Outcomes:**
  After completing this unit, student –
  1. Can compute the convolution sum/ integral of given signals.
  2. Is able to represent the given system (up to second order systems) using block diagram.
  3. Is able to identify the system properties given the impulse response of the system.
  4. Given the impulse response of the system can obtain its step response.

- **Unit Content:**
  System modeling: input output relation, impulse response, definition of impulse response, convolution integral, convolution sum, computation of convolution integral & convolution sum properties of convolution, system interconnection, system properties in terms of impulse response, step response in terms of impulse response

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

  Assessment Methods:

  Convolution sum / integral computation, properties of convolution, system interconnections, and block diagram representation, step response of the system.

Unit 3– Fourier series representation of periodic signals: No of lectures – 06

- **Prerequisite:** Mathematical representation of signals, trigonometric identities, integration

- **Objectives:**
  1. To make student understand the response of LTI systems to complex exponentials.
  2. To make student understand trigonometric & exponential Fourier series representation of periodic CT signal.
  3. To make student understand relation between trigonometric & exponential Fourier series coefficients.
  4. To make student understand the Gibbs phenomenon.

- **Outcomes:**
  After completing this unit, student –
  1. Is able to compute Fourier series coefficients of a given signal.
  2. Is able to derive relation between trigonometric & exponential FS coefficients.
  3. Is able to explain Gibbs phenomenon.

- **Unit Content:**
  Introduction, Fourier series representation of continuous time periodic signals using trigonometric and exponential Fourier series, amplitude and phase response , convergence of Fourier series, Gibbs phenomenon ,properties of Fourier series.

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

- **Assessment Methods:**
  Trigonometric & exponential Fourier series coefficient computation, Gibbs phenomenon

SECTION II

Unit 4– The continuous time Fourier Transform No of lectures – 08

- **Prerequisite:** Mathematical representation of signals, trigonometric identities, integration

- **Objectives:**
  1. To make student understand representation of periodic signal as a Fourier transform.
  2. To make student understand properties of continuous time Fourier transform.
  3. To make student understand Fourier transform representation of periodic signals

- **Outcomes:**
  After completing this unit, student –
  1. Can compute the Fourier transform of a given signal.
  2. Is able to state the properties of Fourier transform and make use of them for finding Fourier transform of given complex aperiodic signal.
  3. Can draw the amplitude & phase spectrum of a given signal.

- **Unit Content:**
  Introduction, Fourier transform (FT) representation of aperiodic continuous time signal, Dirichlet conditions for existence of Fourier transform, evaluation of magnitude and phase response, Fourier transform of standard continuous time signals, Fourier transform for periodic signals, properties of Fourier transforms, interplay between time and frequency domain using rectangular and sinc signals.

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

- **Assessment Methods:**
  Computing Fourier transform & inverse Fourier transform, Fourier transform properties, amplitude & phase spectrum

Unit 5– Sampling: No of lectures – 06

- **Prerequisite:** Convolution, Fourier transform & its properties
- **Objectives:**
  1. To make student understand mathematical representation of signal in terms of its samples.
  2. To make student understand the requirements of sampling and sampling theorem.
  3. To make student understand the interpolation techniques for reconstruction of a signal from its samples.
  4. To introduce to student the effect of aliasing during sampling.
- **Outcomes:**
  After completing this unit, student –
  1. Can define sampling theorem.
  2. Can sample a given CT signal & represent it in terms of samples.
  3. Can explain the effect of aliasing.
- **Unit Content:**
  Representation of CT signal by samples, sampling theorem, reconstruction using interpolation, under sampling/aliasing
- **Content Delivery Methods:**
  Chalk and talk, power point presentation, videos
- **Assessment Methods:**
  Sampling theorem, numerical on sampling, questions based on concept of aliasing

Unit 6- System analysis using Laplace and Z transform: No of lectures – 04

- **Prerequisite:** Laplace and Z transform
- **Objectives:**
  1. To introduce to student use of Laplace & Z transform for analysis of LTI system.
  2. To introduce to student to characterize LTI system based on its impulse response / transfer function
- **Outcomes:**
  After completing this unit, student –
  1. Can make use of LT & ZT for analysis of LTI system.
  2. Can identify the system stability, causality given its transfer function.
- **Unit Content:**
  Overview of Laplace transform and Z Transform and their properties, analysis and characteristics of LTI system using Z and Laplace transform
- **Content Delivery Methods:**
  Chalk and talk, power point presentation

- **Assessment Methods:**
  LTI system characterization using Laplace & Z transform

Unit 7- Correlation and spectral density: No of lectures – 06

- **Prerequisite:** Basic mathematics, convolution operation , concept of random variable

- **Objectives:**
  1. To make student understand the concepts of correlation & spectral density.
  2. To make student understand the relation between correlation & convolution sum.
  3. To make student understand the properties of correlation & spectral density.
  4. To make student understand the relation between correlation & spectral density

- **Outcomes:**
  After completing this unit, student –
  1. Is able to define correlation & spectral density.
  2. Is able to compute autocorrelation & cross correlation between given discrete time signals.
  3. Is able to describe the properties of correlation & spectral density.
  4. Is able to explain the interrelation between correlation and spectral density.

- **Unit Content:**
  Definition of correlation and spectral density, auto-correlation, cross correlation, energy / power spectral density, properties of correlation and spectral density, inter relation between correlation and spectral density

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

- **Assessment Methods:**
  Correlation and spectral density definition, properties of correlation and spectral density, computation of autocorrelation & cross correlation

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- **Internal Continuous Assessment (ICA):**
  ICA *shall consist of minimum eight tutorials based upon-*
  1. Operations on signals.
  2. Convolution sum, convolution integral & correlation
  3. Even & odd parts of signals
  4. Step response of system
  5. Fourier series representations
  6. Fourier transform & Properties of FT
  7. Sampling continuous time signals
  8. Analysis of LTI systems
  9. Correlation & spectral density

- **Text Books:**
  1. Signals and Systems, A.V. Oppenheim, A. S. Wilsky, PHI Publication**.**
  2. Signals and Systems, Simon Haykin, Barry Van Veen , John Wiley & Sons
  3. Introduction to Analog and Digital Communications, Simon Haykins, Wiley India

- **Reference Books:**
  1. Signals and Systems, M. J. Roberts, TMH
  2. Signals and Systems, Ghosh, Pearson Education.
  3. Signals, Systems and Transforms, Charles Phillips, Pearson Education, Third Edition,

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

S.Y. B. Tech. (Electronics Engineering) Semester-II

EN226 SOFTWARE SIMULATION TOOLS

Teaching Scheme
Practical – 2 Hours/week, 1 Credit
Tutorial – 1 Hour/week, 1 Credit

Examination Scheme
ICA- 50 Marks

MATLAB is widely used as numeric computation software for engineering and scientific calculations. It is an interactive programming language that can be used for many applications including data analysis and visualization, simulation and engineering problem solving. This course introduces MATLAB and other simulation software tools like OrCAD / PROTEUS to simulate electronic circuits for solving engineering problems.

Course Prerequisite:
Student should have basic knowledge of structured programming language such as C.

Course Objectives:

1. To make student understand the MATLAB environment along with basic programming constructs.
2. To make student use MATLAB and SIMULINK as a tool to simulate electronic circuits
3. To make student understand system behavior using different analysis tools and functions available in MATLAB and SIMULINK
4. To make student use OrCAD/PROTEUS as a tool to simulate electronic circuits

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Course Outcomes:

1. Student is able to solve simple matrix manipulation problems by writing functions in MATLAB
2. Student is able to solve problems of DC circuit analysis using MATLAB
3. Student is able to create simple models for rectifiers and resonance circuits using SIMULINK blocks.
4. Student is able to demonstrate visualized behavior of various amplifiers and OP-AMP circuits using functionalities of MATLAB and SIMULINK
5. Student is able to simulate simple electronic circuits involving diodes, transistors etc. using OrCAD/PROTEUS
6. Student is able to create a small project-based simulation consisting of simple electronic circuits involving diodes, transistors etc.

SECTION - I

Unit 1: MATLAB fundamentals:

- **Prerequisite**: Basics of structured programming language (such as C)
- **Objective**:
  1. To introduce to students basics of scientific programming
  2. To make student understand the fundamental abstractions in procedural programming (variable/values/types/assignment, control flow(conditional/loops/error handling))
  3. To make student understand MATLAB specific compound data types
  4. To make student understand in-built functions and expression to write a program
- **Outcomes:**
  After completing this unit, student is able to –
  1. Write simple MATLAB programs using variables and expressions
  2. Write simple MATLAB programs using various im-built math functions
  3. Write simple MATLAB programs using loops and branching statements
- **Unit Content:**

  MATLAB Environment, constants, variables and expressions, operators, matrix operations, vectors, complex numbers, math functions, input–output, control structures-loops and branching
- **Content Delivery Methods:** Chalk and talk, programming
- **Assessment Methods:**
  MATLAB programs

Unit 2: MATLAB Functions:

- **Prerequisite**: Syntax and semantics of MATLAB including data types, control structures, variables, operators.
- **Objective**:
  1. To make student understand how to define and execute a function file.
  2. To make student learn different ways to define a function file and function handling.
  3. To make student understand the difference between function file and script file.
- **Outcomes**:
  After completing this unit, student is able to –
  1. Write and execute a function file.
  2. Design and implement a function file and write appropriate function calls in a script file.
  3. Differentiate between functions file and script file.

- **Unit Content**:

  M files and script files, function sub programs, types of functions, functions handling, errors and warnings.

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

- **Assessment Methods:**
  MATLAB programs

Unit 3: MATLAB graphics:

- **Prerequisite**:
  Preliminary 2D geometry

- **Objective**:

  1. To make student learn how MATLAB can be used to create and format many types of two dimensional and three dimensional plots

- **Outcomes**:

  After completing this unit, student is able to –
  1. Plot two and three dimensional graphs to represent result / output.
  2. Compare results using different format and types of plots

- **Unit content**:

  Two dimensional plots, multiple plots, sub plots, specialized two dimensional plots, three dimensional plots

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

- **Assessment Methods:**
  MATLAB programs

SECTION – II

Unit 4: Problem solving using MATLAB:

- **Prerequisite**: Concepts of DC circuit analysis, RL, RC and RLC circuits, MATLAB basics

- **Objectives**:
  1. To make student develop MATLAB functions to solve electronic circuit problems
  2. To make student analyze circuit behavior by plotting graphs of important circuit entities

- **Outcome**:
  After completing this unit, student is able to –
  1. Solve DC circuit analysis problems using MATLAB.
  2. Analyze transient response of RC circuit using MATLAB
  3. Analyze transient response of RLC circuit using MATLAB

- **Unit Content:**

DC circuit analysis using MATLAB: solving nodal analysis, loop analysis problems using MATLAB, verification of maximum power transfer theorem using MATLAB; solving transient analysis problems of RC and RLC circuits using MATLAB

- **Content Delivery Methods:**

Chalk and talk, programming

- **Assessment Methods:**

MATLAB programs

Unit 5: Simulation using MATLAB/SIMULINK:

- **Prerequisite:** Concept of active, passive devices, analog and digital circuits, MATLAB basics

- **Objectives:**
  1. To make student use MATLAB and SIMULINK as a tool to simulate electronic circuits
  2. To make student analyze circuit behavior using different analysis tools and functions available in SIMULINK

- **Outcome:**
  After completing this unit, student is able to –
  1. Create simple models for rectifiers and resonance circuits using SIMULINK blocks.
  2. Analyze behavior of series and parallel circuits using MATLAB and SIMULINK
  3. Validate network theorems using SIMULINK visualization functionalities

- **Unit Content:**

  Introduction to SIMULINK, modeling, commonly used blocks, simulation using MATLAB / SIMULINK - rectifiers, filters, series and parallel circuits, validation of network theorems, resonance circuits, any other circuits / concepts covered in course -Electronic Circuit Analysis and Design and Network Theory and Analysis

- **Content Delivery Methods:**
  Chalk and talk, circuit simulation & programming

- **Assessment Methods:**
  Simulation of circuits / concepts covered in Electronic Circuit Analysis and Design and Network Theory and Analysis Course using MATLAB/ SIMULINK

Unit 6: Simulation using other software simulation tools:

- **Prerequisite**: Knowledge of analog and digital circuits

- **Objectives:**
  1. To make student correlate theoretical concepts with practical design and simulations.
  2. To make student viable to check the performance and feasibility of design through simulation before hardware realization
  3. To make student skilled at circuit testing using simulation
  4. To make student innovate circuit design through small problems

- **Outcome:**
  After completing this unit, student is able to–
  1. Correlate theoretical concepts with practical design using simulations.
  2. Check the performance and feasibility of design through simulation before hardware realization
  3. Test / debug circuit using simulation
  4. Innovate circuit design through small problems

- **Unit Content:**
  Simulation of circuits using software simulation tool like OrCAD / PROTEUS – multistage transistor amplifiers, feedback amplifiers, power amplifiers, oscillators, multivibrators, op amp configurations, op amp applications, active filters, any other circuits / concepts covered in courses -Electronic Circuit Analysis and Design and Linear Integrated Circuits courses

- **Content Delivery Methods:**
  Chalk and talk, circuit simulation

- **Assessment Methods:**
  Simulation of circuits / concepts covered in Electronic Circuit Analysis and Design and Linear Integrated Circuits courses

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- **Internal Continuous Assessment (ICA):**
  ICA *shall consist of minimum ten experiments and a small project based upon-*

  1. MATLAB Programming – Students shall solve/simulate simple electronic circuit related problems to learn various MATLAB features / concepts
  2. Simulation of circuits / concepts covered in Electronic Circuit Analysis and Design I and Network Theory and Analysis Course using MATLAB/ SIMULINK
  3. Simulation of circuits / concepts covered in Electronic Circuit Analysis and Design and Linear Integrated Circuits courses using OrCAD/PROTEUS
  4. It is recommended that with a group of 4/5 students, few lab sessions shall be utilized for carrying out a small project.

- **Text Books:**
  1. MATLAB and its application in Engineering, R.K.Bansal, A.K.Goel and M.K.Sharma,Pearson Education
  2. MATLAB & Simulink, Agam Kumar Tyagi, Oxford University Press
  3. Getting starting with MATLAB-7, Rudra Pratap, Oxford University Press
  4. Electronics and Circuit Analysis using MATLAB, John O. Attia, CRC Press
  5. PSPICE and MATLAB for Electronics: An Integrated Approach, John O. Attia, CRC Press

- **Reference Books:**

  1. MATLAB and SIMULINK manuals
  2. OrCAD/ PROTEUS manual