OBJECT ORIENTED PROGRAMMING

ENCT 151

Lecture	**: 3**	**Year : I**
Tutorial	**: 1**	**Part : II**
Practical	**: 3**	

Course Objectives:

To provide students with foundation in understanding and applying principles of object oriented programming. Emphasis will be given on developing object oriented programming skills using C ++.

1 Introduction to Object Oriented Programming (3 hours)

1.1 History of programming languages
1.2 Need of object oriented programming(OOP)
1.3 Object oriented programming versus procedure oriented programming
1.4 Concepts of object oriented programming
1.5 Popular object oriented languages
1.6 Advantages of OOP
1.7 Disadvantages of OOP

2 Basics of C++ Programming (5 hours)

2.1 C++ Program structure
2.2 Character set and tokens
2.3 Variable declaration and expression
2.4 Data types
2.5 Type conversion and casting
2.6 User defined constant const
2.7 Reference variables
2.8 Conditions and looping
2.9 Namespace scope
2.10 Functions
  2.10.1 Function overloading
  2.10.2 Inline function
  2.10.3 Default arguments
  2.10.4 Pass by reference and return by reference
2.11 Array, pointer and string
2.12 Structure and unions
2.13 Enumeration
2.14 Dynamic memory allocation

3 Objects and Classes (7 hours)

- 3.1 C++ classes
- 3.2 Objects and the member access
- 3.3 Relation of object, class and memory
- 3.4 Defining member function
- 3.5 Defining outer function inline
- 3.6 Objects as member
- 3.7 Constructors and destructors
- 3.8 Object as function arguments
- 3.9 Returning objects from functions
- 3.10 Array of objects
- 3.11 Pointer to objects
- 3.12 Dynamic memory allocation for objects
- 3.13 Dynamic constructors
- 3.14 Pointer
- 3.15 Static data member and static member function
- 3.16 Constant member functions and constant objects
- 3.17 Friend functions and friend classes

4 Operator Overloading (5 hours)

- 4.1 Overloadable and non- overloadable operators
- 4.2 Syntax of operator overloading
- 4.3 Operator overloading using member operator functions
- 4.4 Operator overloading using non member functions
- 4.5 Unary operator overloading
- 4.6 Binary operator overloading
- 4.7 Type conversion between objects
- 4.8 Explicit constructors

5 Inheritance (5 hours)

- 5.1 Base class and derived class
- 5.2 protected access specifier
- 5.3 Derived class declaration
- 5.4 Is_a relation and Has_a relation
- 5.5 Public, protected and private inheritance
- 5.6 Member overriding
- 5.7 Forms of inheritance
- 5.8 Constructors in derived class
- 5.9 Destructor in derived class
- 5.10 Need of virtual base class

6 Virtual Functions (4 hours)

- 6.1 What is virtual function
- 6.2 Need of virtual function
- 6.3 Pointer to derived class
- 6.4 Array of pointers to base class
- 6.5 Pure virtual functions and abstract class
- 6.6 Virtual destructors
- 6.7 Reinterpret cast operator
- 6.8 Run-time type information

7 Stream Computation (6 hours)

- 7.1 Input/output stream class hierarchy
- 7.2 Testing stream errors
- 7.3 Unformatted input/output and formatted input/output
- 7.4 Stream operator overloading
- 7.5 File input/output with streams
- 7.6 File stream class hierarchy
- 7.7 ASCII and binary files
- 7.8 Read/Write from file
- 7.9 Sequential access to file
- 7.10 Random access to file
- 7.11 File access pointers and their manipulators
- 7.12 Testing errors during file operations
- 7.13 File input/output with member functions

8 Templates (6 hours)

- 8.1 Function template
- 8.2 Overloading function template
- 8.3 Class template
- 8.4 Derived class template
- 8.5 Introduction to standard template library
  - 8.5.1 Components of STL
  - 8.5.2 Container
  - 8.5.3 Iterators
  - 8.5.4 Algorithms

9 Exception Handling (4 hours)

- 9.1 Basics of exception handling
- 9.2 Advantage over conventional error handling
- 9.3 Exception handling mechanism
- 9.4 Multiple handlers
- 9.5 Catching all exceptions

9.6 Rethrowing exception
9.7 Exception with arguments
9.8 Exceptions specification for function
9.9 Exceptions in constructors and destructors
9.10 Handling uncaught exceptions
9.11 Handling unexpected exception

Tutorial **(15 hours)**

After completing each chapter some problems are solved and students are asked to solve programming problems with the teacher's assistance.

Assignment

Appropriate assignment problems are given to students after the completion of each chapter.

Practical **(45 hours)**

There will be nine laboratory exercises encompassing the entire course content. At the end of the course, students are required to submit a programming project demonstrating the application of object-oriented programming concepts.

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as possible as indicated in the table below:

Chapter	Hours	Marks Distribution*
1	3	4
2	5	7
3	7	9
4	5	7
5	5	7
6	4	5
7	6	8
8	6	8
9	4	5
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Schildt, H. (2015). C++: The Complete Reference. McGraw-Hill Education.
2. Baral, D.S., Baral, D. (2010). Secrets of Object Oriented Programming in C++. Bhundipuran Prakasan.
3. Lafore, R. (2002). Object Oriented Programming in C++. Sams Publishing.
4. Deitel, H.M., Deitel, P.J. (2007). C++ How to Program. Prentice Hall.

DIGITAL LOGIC
ENEX 152

Lecture : 3 **Year : I**
Tutorial : 1 **Part : II**
Practical : 3

Course Objectives:
This course mainly focuses on study, analyze basic principle, design and applications of digital circuitries in various fields. It also shows an important branch of the electronics that revolutionizes the modern digital world.

1 Introduction (5 hours)

1.1 Digital versus analog signals
1.2 Logic level diagram
1.3 Digital integrated circuits (ICs)
1.4 Clock triggering systems
1.5 Digital system applications
1.6 Digital codes and conversions
  1.6.1 Decimal, binary, octal and hexadecimal codes
  1.6.2 BCD code
  1.6.3 Excess-3 code
  1.6.4 Gray code
  1.6.5 Examples of code conversions
1.7 Alphanumeric codes: ASCII code and EBCDIC code
1.8 1’s complement and 2’s complement
1.9 Signed number representation

2 Logic Gates (3 hours)

2.1 Basic gates and their equivalents
2.2 Universal gates and their equivalents
2.3 Exclusive gates and their equivalents
2.4 Positive and negative logic
2.5 De’Morgan’s laws
2.6 Applications of logic gates

3 Boolean Algebra and K-Maps (4 hours)

3.1 Boolean algebra and its laws
3.2 Simplifications of Boolean expressions
3.3 Minterms and maxterms
3.4 Sum-of-product and product-of-sum methods

3.5 Truth tables and Karnaugh map
3.6 Four variables K-maps.
3.7 Cell, pairs, quads and octets
3.8 Rolling, envelop effects and redundant groups
3.9 Don’t care conditions

4 Combinational Logic Circuits (8 hours)

4.1 Design procedures
4.2 Half-adder and full-adder
4.3 Half-subtractor and full-subtractor
4.4 Ripple carry adders and fast adders
4.5 Multiplexers design
4.6 Demultiplexers design
4.7 Basic encoders
4.8 Priority encoders
4.9 Encoder designs
4.10 Decoder designs
4.11 BCD-to-decimal decoder
4.12 Seven-segment decoder
4.13 Magnitude comparators

5 Sequential Logic Circuits (5 hours)

5.1 Latches and flip-flops: SR, D, T and JK
5.2 Excitation tables, characteristic equations
5.3 Master-slave flip-flops
5.4 Flip-flop timing diagrams
5.5 Flip-flops as the state machines
5.6 Flip-flop conversions
5.7 Flip-flop applications

6 Registers and Counters (7 hours)

6.1 Register fundamentals, register types
6.2 SISO, SIPO, PISO and PIPO registers
6.3 Data transfer timing diagrams
6.4 Asynchronous counters
6.5 Up, down and mod-n asynchronous counters
6.6 Synchronous counters
6.7 Up, down and mod-n synchronous counters
6.8 Register and counter applications

7 Sequential Machine Designs (8 hours)

7.1 Machine design procedures

- 7.2 Primitive state diagrams
- 7.3 Transition/flow tables
- 7.4 Redundant states
- 7.5 Pure binary assignment tables
- 7.6 Excitation maps
- 7.7 Realization of the models
- 7.8 Circuit diagram of synchronous machine
- 7.9 One-bit and two-bit input sequence detectors

8 Digital Integrated Circuits (5 hours)

- 8.1 BJT and MOSFET switching circuits
- 8.2 TTL parameters
- 8.3 TTL circuits: NAND, NOT, NOR
- 8.4 CMOS parameters
- 8.5 CMOS logic circuits: NAND, NOR, NOT
- 8.6 Three-state TTL devices
- 8.7 Digital devices applications
  - 8.7.1 Multiplexing displays
  - 8.7.2 Frequency counters
  - 8.7.3 Time measurements

Tutorial (15 hours)

1. Different code conversion examples
2. Sign numbers addition and subtraction
3. Realization of positive and negative logic gates
4. Application of Boolean algebra and K-map for various logic designs
5. Multiplexer tree concepts
6. Realization of adder/subtractor using multiplexers
7. Demultiplexer tree concepts
8. Realization of adder/subtractor using demultiplexers
9. 16 - to – 4 line encoder design
10. Octal and decimal priority encoder designs
11. 4– to – 16 line decoder design
12. BCD-to-decimal decoder design
13. Any segment of 7-segment decoder design
14. Concept of designing n-bit magnitude comparator
15. Flip-flop conversion from one flip-flop to another type
16. Shift register timing diagram practice
17. Ripple counter design concept
18. Decade synchronous counter design
19. Up and down counter in a single circuit
20. 3-bit and 4-bit binary sequence detector synchronous machine design

Practical (45 hours)

1. Basic gates, universal gates and exclusive gates

2. De' Morgan’s law and its familiarization with NAND and NOR Gates
3. Encoders and decoders
4. Multiplexers and demultiplexers
5. Binary addition and subtraction
6. Latches, RS, and T flip-flops.
7. D and JK flip-flop and master-slave flip-flop
8. Shift registers
9. Circuit realizations on ripple counters
10. Circuit realizations on synchronous counters

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks distribution*
1	5	7
2	3	4
3	4	5
4	8	10
5	5	7
6	7	10
7	8	10
8	5	7
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Floyd, T. L. (2015). Digital fundamentals. Pearson Education.
2. Mano, M. M. (1995). Digital design (Latest Edition). Prentice Hall.
3. Leach, D.P., Malvino, A.P., Saha, G. (2012). Digital principles and applications. Tata McGraw-Hill Education.
4. Fletcher, W.I. (1980). An engineering approach to digital design (Latest Edition). Prentice-Hall.
5. Gothmann, W.H. (1982). Digital electronics: An introduction to theory and practice (Latest Edition). Prentice-Hall.

ENGINEERING MATHEMATICS II
ENSH 151

Lecture : 3 — **Year : I**
Tutorial : 2 — **Part : II**
Practical : 0

Course Objectives:
After completion of the course students will be able to apply knowledge of partial differentiation, multiple integrals, vector calculus, optimization, matrices and infinite series in their corresponding study area.

1 Calculus of Two and More Variables (6 hours)

1.1 Partial differentiation
  1.1.1 Partial derivatives of first and higher order
  1.1.2 Homogeneous function: Euler’s theorem for two and three variables
  1.1.3 Total derivatives and differentials, differentiation of composite and implicit functions
  1.1.4 Jacobians and their properties
1.2 Extreme values of two and three variables. Lagrange’s multiplier
1.3 Application in optimization of function of two variables in one constraint

2 Multiple Integrals (7 hours)

2.1 Double integrals in Cartesian and Polar form, change of order of integration
2.2 Triple integrals in Cartesian, cylindrical and spherical coordinates
2.3 Area, volume, moment of inertia, mass and centroid by double and triple integrals

3 Vector Calculus (12 hours)

3.1 Review of scalar and vector products, scalar and vector triple product, scalar and vector product of four vectors
3.2 Vector differentiation and integration, their geometrical meaning, velocity and acceleration
3.3 Vector differential operators: Gradient, directional derivatives, divergence and curl
3.4 Line integrals, independent of path, conservative and irrotational vector fields, scalar potential
3.5 Introduction to Green’s theorem and its application
3.6 Surface integrals, calculation of flux

3.7 Volume integrals, Gauss divergence theorem (Without proof) and its application in evaluation of surface integrals
3.8 Introduction to Stoke's theorem and its application

4 Laplace Transform (7 hours)

4.1 Definition of Laplace transform, condition for existence, Laplace transforms of some elementary functions, properties of Laplace transform, shifting and change of scale properties
4.2 Inverse Laplace transform, uniqueness of inverse Laplace transform, properties of inverse Laplace transform
4.3 Laplace transform of derivatives and integral, multiplication and division by t^n the convolution theorem
4.4 Laplace transform of Heaviside's unit function, Dirac-delta function and periodic functions
4.5 Application of Laplace transform to ordinary differential equations

5 Matrices (8 hours)

5.1 Review of algebra of real and complex matrices
5.2 Rank of matrices and its application in system of linear equations
5.3 Vector space, linear dependence and independence
5.4 Eigen values: Cayley Hamilton theorem and its applications
5.5 Eigen vectors, diagonalization of matrices
5.6 Reduction of quadratic forms into canonical forms (Three variables only)

6 Solution of Differential Equation in Series and Special Functions (5 hours)

6.1 Power series method
6.2 Bessel's functions: Introduction, properties and application
6.3 Legendre's function: Introduction, properties and application

Tutorial (30 hours)

1. Techniques of partial differentiation, differentiation of composite and implicit functions, total derivatives, and related exercises
2. Exercises related to Euler's theorem
3. Exercises related to extreme values of two and three variables
4. Change of order of integration in multiple integrals
5. Exercises related to application of double and triple integrals in finding area, volume, moment of inertia, mass and centroid
6. Examples related to revision of scalar and vector product of two and three vectors
7. Problems on gradient, directional derivatives, divergence and curl
8. Exercises on line integrals, independent of path
9. Exercises on surface integrals
10. Exercises on Green's theorem, verification and application in calculating line integrals
11. Verification of Stoke's theorem, application

12. Verification of Gauss' Divergence theorem, and application in calculating surface integrals
13. Exercises related to Laplace transforms
14. Exercises on inverse Laplace transforms
15. Problems related to application of Laplace transform to ordinary differential equations
16. Examples related to Laplace transform of Heaviside's unit function, Dirac-delta function and periodic functions
17. Rank and solution of simultaneous equations
18. Eigen values and Eigen vectors, diagonalization problems
19. Problems related to reduction of quadratic forms into canonical forms
20. Exercises related to Bessel's function and Legendre's polynomial

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Mark distribution*
1	6	8
2	7	8
3	12	18
4	7	8
5	8	12
6	5	6
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Kreyszig, E. (2011). Advanced engineering mathematics. John Wiley & Sons.
2. Jeffrey, A. (2002). Advanced engineering mathematics. Academic Press.
3. O'Neil, P.V. (2011). Advanced engineering mathematics. Cengage Learning.
4. Sastry, S.S. (2008). Engineering mathematics (Vols. I–II). PHI Learning.
5. Wylie, C.R, Barrett, L.C. (1995). Advanced engineering mathematics (Latest Edition). McGraw-Hill.
6. Dutta, D. (2006). Textbook of engineering mathematics (Vols. I–II). New Age International.

ELECTRICAL CIRCUITS AND MACHINES
ENEE 154

Lecture : 4 | **Year : I**
Tutorial : 1 | **Part : II**
Practical : 3/2

Course Objectives:
To develop a comprehensive understanding of electric circuit theory and analysis techniques, alongside the principles and operation of electric machines including transformers, DC and AC machines.

1 Transients in Electric Circuit (7 hours)

1.1 Characteristics of various network elements
1.2 Nodal analysis with dependent and independent sources
1.3 Mesh analysis with dependent and independent sources
1.4 Application of matrix method in network analysis
1.5 Procedure of evaluating initial conditions
1.6 Initial values of derivatives
1.7 Initial condition in the case of R-L-C network

2 Transient Analysis R-L-C Circuit by Classical Method (10 hours)

2.1 Introduction
2.2 First order differential equation with constant coefficient
2.3 Higher order homogenous and non-homogenous differential equation with constant coefficient
2.4 Particular integral by method of undetermined coefficient
2.5 Response of R-L and R-C circuits with DC excitation
  2.5.1 DC excitation
  2.5.2 Exponential excitation
  2.5.3 Sinusoidal excitation
2.6 Response of Series R-L-C circuits with
  2.6.1 DC excitation
  2.6.2 Exponential excitation
  2.6.3 Sinusoidal excitation
2.7 Response of Parallel R-L-C circuits with
  2.7.1 DC excitation
  2.7.2 Exponential excitation

3 Transient Analysis Using Laplace Transform (7 hours)

- 3.1 Introduction
- 3.2 Response of R-L and R-C circuits with
  - 3.2.1 DC excitation
  - 3.2.2 Exponential excitation
  - 3.2.3 Sinusoidal excitation
- 3.3 Response of series R-L-C circuits with
  - 3.3.1 DC excitation
  - 3.3.2 Exponential excitation
  - 3.3.3 Sinusoidal excitation
- 3.4 Response of parallel R-L-C circuits with
  - 3.4.1 DC excitation
  - 3.4.2 Exponential excitation

4 Network Transfer Function and Frequency Response (8 hours)

- 4.1 Concept of complex frequency
- 4.2 Transfer functions of two port networks
- 4.3 Poles and zeros of networks
- 4.4 Magnitude and phase response
- 4.5 Bode diagrams
- 4.6 Band width, high-q and low-q circuits
- 4.7 Basic concept of filters: High-pass, low-pass, band-stop and band-pass filters

5 Two-Port Parameters of Network (8 hours)

- 5.1 Definitions of two-port networks
- 5.2 Parameters of two-port networks
  - 5.2.1 Open circuit impedance parameters
  - 5.2.2 Short circuit admittance parameters
  - 5.2.3 Transmission line parameters
  - 5.2.4 Inverse transmission line parameters
  - 5.2.5 Hybrid parameters
  - 5.2.6 Inverse hybrid parameters
- 5.3 Relationship and transformation between sets of parameters
- 5.4 Interconnection of two port networks
- 5.5 Condition for reciprocity and symmetry

6 Magnetic Circuit and Induction (3 hours)

- 6.1 Magnetic circuit and its types
- 6.2 B-H relationship and hysteresis with DC excitation
- 6.3 Hysteresis with AC excitation
- 6.4 Hysteresis loss and Eddy current loss

6.5 Faraday's law of electromagnetic induction, statically and dynamically induced EMF
6.6 Force on current carrying conductor

7 Transformers (6 hours)

7.1 Construction, operating principle and EMF equation of single-phase transformer
7.2 No load and load operation of transformer
7.3 Equivalent circuit diagram of transformer
7.4 Transformer testing (Open circuit and short circuit)
7.5 Voltage regulation, losses, efficiency and condition for maximum efficiency
7.6 Auto transformer, Isolation transformer

8 DC Machine (5 hours)

8.1 Constructional details of DC machine
8.2 Operating principle and EMF equation of DC generator
8.3 Operating principle and torque equation of DC motor
8.4 Types of DC machine
8.5 Back EMF and its role in DC motor
8.6 Performance characteristics of DC motor
8.7 Starting of DC motor using 3-point starter
8.8 Speed control of DC motor (Armature control, field control)
8.9 Losses and efficiency

9 AC Motor (6 hours)

9.1 Construction, production of rotating magnetic field and operating principle of three-phase induction motor
9.2 Torque equation of three-phase induction motor at standstill and running condition
9.3 Torque slip characteristics, condition for maximum torque and effect of rotor resistance on torque slip characteristics
9.4 Single-phase induction motor
9.5 Double field revolving theory
9.6 Starting of single-phase induction motor (Capacitor start and run, shaded pole)
9.7 Introduction to permanent magnet brushless DC motor, hysteresis motor, stepper motor, servo motor, universal motor

Tutorial (15 hours)

The tutorial sessions will focus on chapter-specific exercises aimed at enhancing understanding and application in electrical circuits and machines.

Practical (22.5 hours)

1. Transient response in first order system passive circuit

- Measure step and impulse response RL and RC circuit using oscilloscope
- Relate time response to analytical transfer function calculation

2. Transient response in second order system passive circuit
    - Measure step and impulse response RLC series and parallel circuit using oscilloscope
    - Relate time response to analytical transfer function and pole-zero configuration
3. Two port network
    - To calculate and verify 'ABCD' parameters of two-port network
    - To determine equivalent parameters of parallel connection of two-port network
4. Two winding transformers
    - Measure amplitude and phase response and plot Bode diagram for RLC circuits
    - To perform open circuit (OC) and short circuit (SC) test to determine
5. DC motor
    - speed control of DC Shunt motor by (a) armature control method (b) field control method
    - To observe the effect of increasing load on DC shunt motor's speed, armature current and field current
6. Single phase AC motors
    - To study the effect of a capacitor on the starting and running of a single-phase induction motor
    - Reversing the direction of rotation of a single-phase capacitor start induction motor

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Mark distribution*
1	7	7
2	10	10
3	7	7
4	8	8
5	8	8
6	3	3
7	6	6
8	5	5
9	6	6
Total	**60**	**60**

* There may be minor deviation in marks distribution.

References

1. Van Valkenburg, M. E. (2019). Network analysis. Pearson Education.
2. Hayt, W.H., Kemmerly, J.E., Phillips, J.D., Durbin, S.M. (2019). Engineering circuit analysis. McGraw-Hill Education.
3. Ciletti, M.D. (1995). Introduction to circuit analysis and design (Latest Edition). Oxford University Press.
4. Soni, K.M. (2013). Circuits and systems. S. K. Kataria & Sons.
5. Nagrath, F.I.J., Kothari, D.P. (2017). Electric machines. McGraw Hill Education.
6. Fitzgerald, A.E., Kingsley, C. (2017). Electric machinery. McGraw Hill Education.
7. Sahdev, S.K. (2018). Electrical machines. Cambridge University Press.
8. Hussain, A. (2016). Electrical machines. Dhanpat Rai & Co.

ELECTRONIC DEVICE AND CIRCUITS
ENEX 151

Lecture : 3 | **Year : I**
Tutorial : 1 | **Part : II**
Practical : 3

Course Objectives:
To introduce the fundamentals of analysis of electronic circuits and to provide basic understanding of semiconductor devices and analog integrated circuits.

1 The Bipolar Junction Transistor (BJT) (9 hours)

1.1 Review of operation of the npn transistor in the active mode
1.2 Review of graphical representation of transistor characteristics
1.3 Analysis of transistor circuits at DC
1.4 Graphical DC load line analysis
1.5 Transistor as an amplifier (r_π, r_e, g_m)
1.6 Biasing BJT for discrete-circuit design
1.7 Small signal equivalent circuit models (π and T)
1.8 Basic single-stage BJT amplifier configuration (C-B, C-E, C-C)
1.9 Small signal analysis of amplifier
1.10 Transistor as a switch – cutoff and saturation
1.11 A general large-signal model of the BJT: The Ebers-Moll model

2 Field-Effect Transistor (10 hours)

2.1 Structure and physical operation of the junction field-effect transistor
2.2 Structure and physical operation of enhancement-type MOSFET
2.3 Current-voltage characteristic of enhancement-type MOSFET
2.4 The depletion-type MOSFET
2.5 Biasing in MOS amplifier circuits
2.6 MOSFET circuits at DC
2.7 MOSFET as an amplifier (Common source)
2.8 MOSFET and CMOS as logic circuits

3 Operational Amplifier Circuits and Oscillator (10 hours)

3.1 Review of basic principles of sinusoidal oscillator
3.2 Review of Op-Amp square and triangular, RC oscillator circuits
3.3 LC and crystal oscillators
3.4 Integrated circuit timers
3.5 Precision rectifier circuits
3.6 Bias circuits suitable for IC design
3.7 The Widlar current source

3.8 The differential amplifier
3.9 Active loads
3.10 Output stages

4 Output Stages and Power Amplifiers (10 hours)

4.1 Classification of output stages
4.2 Class A output stage
4.3 Class B output stage
4.4 Class AB output stage
4.5 Biasing of class AB output stage
4.6 Power BJT's
4.7 Transformer-coupled push-pull stage
4.8 Tuned amplifiers

5 Power Supplies, Breakdown Diodes, and Voltage Reference (6 hours)

5.1 Unregulated power supply
5.2 Zener regulated power supply
5.3 Zener diodes, bandgap voltage reference, constant current diodes
5.4 Transistor shunt/series voltage regulator
5.5 Improving voltage regulator performance with feedback
5.6 IC voltage regulator

Tutorial (15 hours)

The tutorial sessions will focus on chapter-specific exercises aimed at enhancing understanding and application in electronic device and circuits.

Practical (45 hours)

1. Diode characteristics, rectifiers, Zener diodes
2. Bipolar junction transistor characteristics and single stage amplifier
3. BJT single stage amplifier (Rin, Rout, Gain)
4. Power amplifiers
5. Field effect transistor characteristics
6. FET single stage amplifier
7. BJT differential amplifier
8. Relaxation oscillator and sinusoidal oscillator (Phase shift, Wien bridge)
9. Series, shunt and IC voltage regulators
10. Multivibrator using 555 timer IC
11. Project presentation

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Mark distribution*
1	9	12
2	10	13
3	10	13
4	10	13
5	6	9
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Sedra, A.S., Smith, K.C. (2010). Microelectronic circuits. Oxford University Press.
2. Boylestad, R.L., Nashelsky, L. (2013). Electronic devices and circuit theory. Pearson.
3. Floyd, T. L. (2013). Electronic devices. Pearson Education Limited.
4. Millman, J., Halkias, C., Parikh, C.D. (2010). Integrated electronics: Analog and digital circuits and systems. Tata McGraw-Hill Education.
5. Bell, D.A. (2009). Electronic devices and circuits. Oxford University Press.

ENGINEERING CHEMISTRY

ENSH 153

Lecture : 3 **Year : I**
Tutorial : 1 **Part : II**
Practical : 3

Course Objectives:
To develop the basic concepts of physical chemistry, inorganic chemistry, analytical chemistry, environmental chemistry, green and sustainable chemistry, nano chemistry, polymer chemistry and organic chemistry relevant to the different disciplines of engineering.

1 Electrochemistry and Buffer (8 hours)

1.1 Electrochemistry
 1.1.1 Introduction
 1.1.2 EMF of galvanic cell, Nernst equation
 1.1.3 Polarization and overpotential
 1.1.4 Butler-Volmer equation and Tafel plots
1.2 Electrode processes and mechanisms (Qualitative only)
 1.2.1 Charge transfer processes at electrodes
 1.2.2 Mass transfer and diffusion in electrochemical systems
1.3 Industrial and applied electrochemistry
 1.3.1 Batteries: Lead acid and lithium ion
 1.3.2 Solar-photovoltaic cell (With typical examples), fuel cell
 1.3.3 Corrosion
1.4 Buffer, buffer range, buffer capacity and buffer solution (Henderson-Hasselbalch equation) and its applications

2 Catalyst and Catalysis (4 hours)

2.1 Definition and types
2.2 Design and criteria
 2.2.1 Structure-activity relationships
 2.2.2 Selection criteria of catalyst
2.3 Photocatalysis and electrocatalysis
2.4 Catalysis for energy and environmental applications
 2.4.1 Catalytic conversion of fossil fuels
 2.4.2 Renewable energy catalysts
 2.4.3 Catalyst for pollution control

3 Analytical Techniques and their Applications (6 hours)

3.1 Chromatography
3.2 Mass spectroscopy
3.3 X-ray diffraction (XRD)
3.4 UV-visible spectroscopy
3.5 Infrared-spectroscopy (IR)
3.6 Nuclear magnetic resonance spectroscopy (NMR)

4 Metal Complexes, Rare Earth Elements and Metal alloys (6 hours)

4.1 Complexes
  4.1.1 Introduction and Werner's theory
  4.1.2 Geometry of complex by VBT and its applications
  4.1.3 Crystal field theory: Principle and applications
4.2 Rare earth elements: Introduction and applications
4.3 Metallic alloys and applications

5 Sustainable Chemistry (7 hours)

5.1 Green chemistry: Introduction and principles
5.2 Water chemistry
  5.2.1 Importance of water quality standards
  5.2.2 Degree of hardness, scale formation in boiler and softening of hard water
  5.2.3 Water pollution with reference to turbidity, COD, BOD, heavy metals, radioactive substances, and plastic
  5.2.4 Industrial wastewater and its treatment
5.3 Air pollution: Particulate matter, SOx, NOx, GHGs, VOCs, their impacts and remedies
5.4 Waste management
  5.4.1 Segregation and management of solid waste
  5.4.2 Management of biodegradable waste into energy
  5.4.3 E-waste and its management

6 Nanoscience and Nanotechnology (3 hours)

6.1 Introduction and types of nano materials (0-, 1-, 2-, and 3- dimensional)
6.2 Nanoparticles, nanofibers, nanowires, carbon nanotubes, graphene, mxene, quantum dots, and their uses
6.3 Preparation of nanomaterials

7 Engineering Materials (7 hours)

7.1 Polymers
  7.1.1 Natural and synthetic, organic and inorganic, conducting and non-conducting

- 7.1.2 Types of polymerizations: Addition and condensation polymerization
- 7.1.3 Preparation and applications of epoxy resin, polyurethane, Kevlar, polycarbonate, polymethyl methacrylate, polyacrylonitrile, silicones; Phosphorus based polymer, Sulphur based polymer
- 7.1.4 Conducting polymers: Synthesis and application
- 7.1.5 Composite: Fiber reinforced polymer
- 7.1.6 Natural polymers: Cellulose, chitin, chitosan, collagen

7.2 Cement: Hydration and setting chemistry of cement

8 Explosives, Lubricants and Paints (4 hours)

8.1 Explosives
- 8.1.1 Types of explosives: Primary, low and high explosives
- 8.1.2 Preparation and applications of TNT, TNG, Nitrocellulose and plastic explosives

8.2 Lubricants: Introduction, function and classification

8.3 Paints
- 8.3.1 Introduction, requisites, types and applications
- 8.3.2 Environmental and health impact

Tutorial (15 hours)

1. Introduction to cells, electroplating, EMF, electric double layer, problems related to buffer and Nernst equations
2. Types of catalyst and types of catalysis
3. Electromagnetic radiation, electromagnetic spectrum, electromagnetic wave, principles of spectroscopy, types of molecular spectra
4. Complexes, ligands, postulates, compounds with coordination number 4 and 6, splitting of octahedral and tetrahedral complexes and rare earth elements
5. Application of green chemistry and industrial waste management
6. Application of nanomaterials in pollution minimization
7. Introduction and stabilization of free radicle, carbocation and carbanion.
8. Exothermic reaction of cement and its applications
9. Introduction of and applications of explosives, lubricants and paints

Practical (45 hours)

10. Determination of total, temporary and permanent hardness of water sample using complexometric titration
11. Determination of the alkalinity of water sample A and B by double indicator titration
12. Estimation of the amount of residual chlorine in water by iodometric titration
13. Preparation of the standard buffer solution (Acidic or basic) and measure the approximate pH of given unknown solution by using Universal Indicator

14. Comparison of the cleansing power of two sample of detergents by determining the reduction they cause in surface tension of water
15. Construction of Daniell cell and study of the variation of cell potential with concentration
16. Separation of the pigments through the process of paper / thin layer chromatography
17. Determination of total iron in ground water using spectrophotometer technique
18. Determination of amount of copper and iron in a given mixture solution by $K_2Cr_2O_7$ titration
19. Preparation of cross – linked polymer by condensation polymerization method
20. Standardize potassium permanganate solution and use it to estimate the amount of Iron and determine the percentage purity in the sample of ferrous salt solution
21. Preparation of Ni-DMG complex and estimation of the amount of nickel

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	**Hours**	**Marks Distribution***
1	8	10
2	4	5
3	6	5
4	6	10
5	7	10
6	3	5
7	7	10
8	4	5
Total	45	60

*There may be minor deviation in mark distribution

References

1. Maron, S. H., Prutton, C. F. (1965). Principles of Physical Chemistry (Latest Edition). Macmillan.
2. Lee, J.D. (2007). Concise Inorganic Chemistry. John Wiley & Sons.
3. Madan, R.D., Prakash, S. (1994). Inorganic Chemistry (Latest Edition). S. Chand & Company Ltd.
4. Bahl, S., Tuli, G.D., Bahl, A. (2009). Essentials of Physical Chemistry. S. Chand & Co. Ltd.
5. Bhagi, A. K., Morrison, G. R. T., Boyd, R. N. (2008). Organic Chemistry. Prentice-Hall of India.
6. Morrison, R. T., Boyd, R. N. (2008). Organic Chemistry. Prentice-Hall of India.

7. Vogel. (2008). Vogel's Textbook of Quantitative Chemical Analysis. Pearson Education.
8. Murthy, B. S., Shankar, P., Baldev, R., Rath, B. B., Murday, J. (2012). Textbook of nanoscience and nanotechnology. Universities Press.
9. Chatwal, G.R. (2023). Textbook of Environmental Chemistry. Himalaya Publishing House.