K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BANGALORE - 560109

DEPARTMENT OF APPLIED SCIENCE

SESSION: 2022-2023(EVEN SEMESTER)

CO-PO MAPPING

Course:COMPLEX ANALYSIS, PROBABILITY AND STATISTICAL METHODS			
Type: Core		Course Code: 21MAT41	
No of Hours			
Theory (Lecture Class)	Practical/Field Work/Allied Activities	Total/Week	Total teaching hours
4	0	4	40
Marks			
Internal Assessment	Examination	Total	Credits
50	50	100	3

Aim/Objectives of the Course

- To provide an insight into applications of complex variables, conformal mapping and special functions arising in potential theory, quantum mechanics, heat conduction and field theory.
- Special functions familiarize the power series solution required to analyse the engineering problems.
- To develop probability distribution of discrete, continuous random variables and joint probability distribution occurring in digital signal processing, design engineering and microwave engineering.

Course Learning Outcomes

At the end of the course the studentwill be able to:

CO1	**Solve** the problems arising in electromagnetic field theory by using the concept of analytic function and complex potentials.	**Applying (K3)**
CO2	**Utilize** conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing	**Applying (K3)**
CO3	**Analysing** the probability models arising in engineering field by applying discrete and continuous probability distributions	**Applying (K3)**
CO4	**Fit** a suitable mathematical model for the statistical data by using correlation and regression analysis.	**Applying (K3)**
CO5	**Construct** joint probability distributions and demonstrate the validity of testing the hypothesis.	**Applying (K3)**

Syllabus Content

Module 1: Calculus of complex functions: Review of function of a complex variable, limits, continuity and differentiability. Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms andconsequences. **Construction of analytic functions:** Milne-Thomson method-Problems **Complex integration:** Line integral of a complex function-Cauchy's theorem and Cauchy's integral formula and problems.	**CO1** 8hrs PO1-3 PO2-2 PO3-1 PO4-1

LO: At the end of this session the student will be able to 1. Derive Cauchy-Riemann equations in Cartesian and polar forms. 2. Construct the analytic function when v is given. 3. Find the analytic function when u is given. 4. Evaluate the line integral of a complex function. 5. Derive Cauchy's theorem and Cauchy's integral formula.	PO10-1 PO12-1 PSO1-3 PSO2-1

Module 2: Special functions Series solution of Bessel's differential equation leading to Jn(x) Bessel's function of the first kind ,properties,Orthogonality of Bessel's functions. Series solution of Legendre's differential equation leading to Pn(x)-Legendre polynomials. Rodrigue's formula (without proof), problems. **LO:** At the end of this session the student will be able to 1. Derive series solution of Bessel's differential equation. 2. Discuss the properties of Bessel's function. 3. Derive orthogonality of Bessel's function. 4. Derive series solution of Legendre's differential equation. 5. Solving problems on Rodrigue's formula.	**CO2** 8 hrs. PO1-3 PO2-2 PO3-1 PO4-1 PO10-1 PO12-1 PSO1-3 PSO2-1
Module 3: **Probability Distributions:** Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean, variance. Binomial, Poisson and normal distributions-problems (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples. **LO:** At the end of this session the student will be able to 1. Describe the random variables and probability distributions using statistical methods. 2. Define Expectation, mean ,variance 3. Derive mean and standard deviation for Binomial and Poisson distributions.	**CO3** 8hrs PO1-3 PO2-2 PO3-1 PO4-1 PO10-1 PO12-1 PSO1-3 PSO2-1
Module 4: **Statistical Methods:** Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation-problems. Regression analysis- lines of regression –problems. **Curve Fitting:** Curve fitting by the method of least squares- fitting the curves of the form $y = ax + b, y = ax^2 + bx + c, y = ax^b$ **LO:** At the end of this session the student will be able to 1. Obtain the coefficients of correlation and the lines of regression for the given data. 2. Compute the coefficient of rank correlation for the given data.	**CO4** 8 hrs PO1-3 PO2-2 PO3-1 PO4-1 PO10-1 PO12-1 PSO1-3

3. Fitting of the curves form $y = ax + b, y = ax^2 + bx + c, y = ax^b$ 4. Fit a curve for the given data.	PSO2-1
Module 5: **Joint probability distribution:** Joint Probability distribution for two discrete random variables, expectationand covariance. **Sampling Theory:** Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test ofhypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit. **LO:** At the end of this session the student will be able to 1. Explain Type-I and Type-II errors, null hypothesis, level of significance. 2. Find the joint probability distribution for two variables. 3. Find the expectation, co-variance for the joint probability distributions.	**CO5** 8 hrs PO1-3 PO2-2 PO3-1 PO4-1 PO10-1 PO12-1 PSO1-3 PSO2-1

Text Books

1 Advanced Engineering Mathematics E. Kreyszig John Wiley & Sons 10th Edition, 2016

2 Higher Engineering Mathematics B. S. GrewalKhanna Publishers 44th Edition, 2017

3 Engineering Mathematics Srimanta Pal et al Oxford University Press 3 rd Edition, 2016

Reference Books

1. Advanced Engineering Mathematics C. Ray Wylie, Louis C. Barrett McGraw-Hill Book Co 6 th Edition, 1995

2 Introductory Methods of Numerical Analysis S.S..Sastry Prentice Hall of India 4 th Edition 2010

3 Higher Engineering Mathematics B.V. Ramana McGraw-Hill 11th Edition,2010

4 A Textbook of Engineering Mathematics N.P.Bali and Manish GoyalLaxmi Publications 6 th Edition, 2014

5 Advanced Engineering Mathematics Chandrika Prasad and ReenaGargKhanna Publishing, 2018

Useful Websites

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU EDUSAT PROGRAMME - 20

Useful Journals

- Annals of Mathematics
- ActaMathematica
- International Journal of Mathematics
- Communications on pure and applied Mathematics.

Teaching and Learning Methods

1. Lecture class: 40 hrs
2. Practical classes: 0

Assessment

Type of test/examination: Written examination
Continuous Internal Evaluation(CIE) : 40 marks (30 marks -Average of three tests + 10 marks Assignments)
Semester End Exam (SEE): 100 marks (students have to answer all main questions) which will be reduced to 60 Marks.
Test duration: 1 hour
Examination duration: 3 hour

CO to PO Mapping

PO1: Science and engineering Knowledge **PO2:** Problem Analysis **PO3:** Design & Development **PO4:**Investigations of Complex Problems **PO5:** Modern Tool Usage **PO6:** Engineer & Society	**PO7:**Environment and Society **PO8:**Ethics **PO9:**Individual & Team Work **PO10:** Communication **PO11:**Project Management& Finance **PO12:**Lifelong Learning

PSO1: Ability to apply concept of Mathematics in engineering to design a system, a component or a process/system to address a real world challenges

PSO2: Ability to develop effective communication, team work, entrepreneurial and computational skills.

CO	PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO10	PO1 1	PO12	PSO1	PSO2
18 MAT41	K-level														
CO1	K3	3	2	1	1	-	-	-	-	-	1	-	1	3	1
CO2	K3	3	2	1	1	-	-	-	-	-	1	-	1	3	1
CO3	K3	3	1	2	1	-	-	-	-	-	2	-	1	3	1
CO4	K3	3	2	2	1	-	-	-	-	-	1	-	1	3	1
CO5	K3	3	1	2	1	-	-		-	-	2	-	1	3	1

Course In charge

Head of the Department

Principal
Dr. K. RAMA NARASIMHA
Principal/Director
K S School of Engineering and Management
Bengaluru - 560 109

K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BENGALURU - 560109

DEPARTMENT OF APPLIED SCIENCE

SESSION: 2022-2023 (EVEN SEMESTER)

CO-PO MAPPING

Course Title: Applied Physics For CSE Stream			
Type: Integrated		Course Code: BPHYS202	
No of Hours			
Theory (Lecture Class)	Practical/Field Work/Allied Activities	Total hours/Week	Total teaching hours
4	3	7	76(40+36)
Marks			
Internal Assessment	Examination	Total	Credits
50	50	100	4

Aim/Objectives of the Course

1. To study the essentials of photonics and its application in computer science.
2. To study the principles of quantum mechanics and its application in quantum computing.
3. To study the electrical properties of materials
4. To study the essentials of physics for computational aspects like design and data analysis.

Course Learning Outcomes

After completing the course, the students will be able to

CO1	Apply the principles of lasers, and optical fibers in modern technology to perform the experiments using laser.	**Applying (K3)**
CO2	Apply the theory of modern physics to explain the principles of quantum mechanics, to set up one-dimensional Schrodinger's wave equation and its applications.	**Applying (K3)**
CO3	Determine the various electrical and thermal properties of materials like conductors and superconductors and its applications.	**Applying (K3)**
CO4	Apply the essential properties of qubits and its applications in quantum computing.	**Applying (K3)**
CO5	Acquire the knowledge of application of physics in animation to design and analyze the statistical data.	**Applying (K3)**

Syllabus Content

Module:1 **Laser and Optical Fibers:** **LASER**: Characteristic properties of a LASER beam, Interaction of Radiation with Matter, Einstein's A and B Coefficients and Expression for Energy Density (Derivation), Laser Action, Population Inversion, Metastable State, Requisites of a laser system, Semiconductor Diode Laser, Applications: Bar code scanner, Laser Printer, Laser Cooling (Qualitative), Numerical Problems.	**CO1**

Optical Fiber: Principle and Structure, Propagation of Light, Acceptance angle and Numerical Aperture (NA), Derivation of Expression for NA, Modes of Propagation, RI Profile, Classification of Optical Fibers, Attenuation and Fiber Losses, Applications: Fiber Optic networking, Fiber Optic Communication. Numerical Problems **LO:** At the end of this module, the students will be able to 1. Derive the expression for energy density in terms of Einstein's Coefficients. 2. Explain the construction and working of different types of lasers and its applications. 3. Explain the mechanism of optical fiber and attenuation. 4. Explain the different types of optical fibers and its applications.	
Module 2: **Quantum Mechanics:** de Broglie Hypothesis and Matter Waves, de Broglie wavelength and derivation of expression by analogy, Phase Velocity and Group Velocity, Heisenberg's Uncertainty Principle and its application (Non-existence of electron inside the nucleus - Non Relativistic), Principle of Complementarity, Wave Function, Time independent Schrödinger wave equation (Derivation), Physical Significance of a wave function and Born Interpretation, Expectation value, Eigen functions and Eigen Values, Particle inside one dimensional infinite potential well, Quantization of Energy States, Waveforms and Probabilities. Numerical Problems. **LO:** At the end of this module, the students will be able to 1. Explain the blackbody radiation spectrum based on Planck's law. 2. Explain the uncertainty principle and its applications. 3. Obtain the expression for time independent Schrodinger wave equation, energy Eigen values and Eigen functions.	**CO2**
Module 3: **Electrical Properties of Materials and Applications** **Electrical Conductivity in metals** Resistivity and Mobility, Concept of Phonon, Matthiessen's rule, Failures of Classical Free Electron Theory, Assumptions of Quantum Free Electron Theory, Fermi Energy, Density of States, Fermi Factor, Variation of Fermi Factor With Temperature and Energy. Numerical Problems. **Superconductivity** Introduction to Super Conductors, Temperature dependence of resistivity, Meissner's Effect, Critical Field, Temperature dependence of Critical field, Types of Super Conductors, BCS theory (Qualitative), Quantum Tunnelling, High Temperature superconductivity, Josephson Junctions (Qualitative), DC and RF SQUIDs (Qualitative), Applications in Quantum Computing: Charge, Phase and Flux qubits, Numerical Problems. **LO:** At the end of this module, the students will be able to 1. Explain CFET, QFET, Fermi energy and Fermi Dirac statistics. 2. Apply the concept of QFET to solve the problems on fermi factor. 3. Explain the concept of superconductors, Meissner's effect and BCS theory. 4. Explain the quantum tunnelling, SQUIDS, and other related applications.	**CO3**

Module 4: **Quantum Computing:** **Principles of Quantum Information & Quantum Computing:** Introduction to Quantum Computing, Moore's law & its end, Differences between Classical & Quantum computing. Concept of qubit and its properties. Representation of qubit by Bloch sphere. Single and Two qubits. Extension to N qubits. **Dirac representation and matrix operations:** Matrix representation of 0 and 1 States, Identity Operator I, Applying I to $\|0\rangle$ and $\|1\rangle$ states, Pauli Matrices and its operations on $\|0\rangle$ and $\|1\rangle$ states, Explanation of i) Conjugate of a matrix and ii) Transpose of a matrix. Unitary matrix U, Examples: Row and Column Matrices and their multiplication (Inner Product), Probability, and Quantum Superposition, normalization rule. Orthogonality, Orthonormality. Numerical Problems **Quantum Gates:** **Single Qubit Gates:** Quantum Not Gate, Pauli – X, Y and Z Gates, Hadamard Gate, Phase Gate (or S Gate), T Gate **Multiple Qubit Gates:** Controlled gate, CNOT Gate, (Discussion for 4 different input states). Representation of Swap gate, Controlled -Z gate, Toffoli gate. **LO:** At the end of this module, the students will be able to 1. Explain the difference between classical and quantum computing. 2. Explain the concept of single Qubit, two Qubit and N-Qubits. 3. Apply the concept of 'ket' 0 and 1 and solve the problems using matrices. 4. Construct single qubit, two qubit and three qubit quantum gates.	**CO4**
Module 5: **Applications of Physics in computing:** **Physics of Animation:** Taxonomy of physics-based animation methods, Frames, Frames per Second, Size and Scale, Weight and Strength, Motion and Timing in Animations, Constant Force and Acceleration, The Odd rule, Odd-rule Scenarios, Motion Graphs, Examples of Character Animation: Jumping, Parts of Jump, Jump Magnification, Stop Time, Walking: Strides and Steps, Walk Timing. Numerical Problems **Statistical Physics for Computing**: Descriptive statistics and inferential statistics, Poisson distribution and modelling the probability of proton decay, Normal Distributions (Bell Curves), Monte Carlo Method: Determination of Value of π. Numerical Problems. **LO:** At the end of this module, the students will be able to 1. Explain the physics-based animation methods, frames, FPS and basics of animation. 2. Acquire the concept of odd rule and solve the problems on base distance and frame numbers. 3. Explain examples of animation related to jumping and walking of a animated character. 4. Explain and apply the concept of various theoretical models to solve the problems on statistical probability.	**CO5**

Text Books

1. A Text book of Engineering Physics- M.N. Avadhanulu and P.G. Kshirsagar, 10th revised Ed, S.Chand & Company Ltd, New Delhi
2. An Introduction to Lasers theory and applications by M.N.Avadhanulu and P.S.Hemne revised edition 2012 . S. Chand and company Ltd -New Delhi.
3. Engineering Physics-Gaur and Gupta-Dhanpat Rai Publications-2017
4. Concepts of Modern Physics-Arthur Beiser: 6th Ed;Tata McGraw Hill Edu Pvt Ltd- New Delhi 2006

Reference Books (specify minimum two foreign authors text books)

1. Solid State Physics, S O Pillai, New Age International Private Limited, 8th Edition, 2018.
2. Lasers and Non-Linear Optics, B B Loud, New age international, 2011 edition.
3. Quantum Computation and Quantum Information, Michael A. Nielsen & Isaac L. Chuang, Cambridge Universities Press, 2010 Edition.
4. Quantum Computing, Vishal Sahani, McGraw Hill Education, 2007 Edition.
5. Quantum Computing – A Beginner's Introduction, Parag K Lala, Indian Edition, Mc GrawHill, Reprint 2020.
6. Engineering Physics, S P Basavaraj, 2005 Edition, Subhash Stores.
7. Physics for Animators, Michele Bousquet with Alejandro Garcia, CRC Press, Taylor & Francis, 2016.
8. Quantum Computation and Logic: How Quantum Computers Have Inspired Logical Investigations, Maria Luisa Dalla Chiara, Roberto Giuntini, Roberto Leporini, Giuseppe Sergioli, Trendsin Logic, Volume 48, Springer.
9. Statistical Physics: Berkely Physics Course, Volume 5, F. Reif, McGraw Hill.
10. Introduction to Superconductivity, Michael Tinkham, McGraw Hill, INC, II Edition.

Web links and Video Lectures (e-Resources):

- LASER: https://www.youtube.com/watch?v=WgzynezPiyc
- Superconductivity : https://www.youtube.com/watch?v=MT5Xl5ppn48
- Optical Fiber : https://www.youtube.com/watch?v=N_kA8EpCUQo
- Quantum Mechanics : https://www.youtube.com/watch?v=p7bzE1E5PMY&t=136s
- Quantum Computing : https://www.youtube.com/watch?v=jHoEjvuPoB8
- Quantum Computing :https://www.youtube.com/watch?v=ZuvCUU2jD30
- Physics of Animation : https://www.youtube.com/watch?v=kj1kaA_8Fu4
- Statistical Physics Simulation : https://phet.colorado.edu/sims/html/plinko-probability/latest/plinko-probability_en.html
- NPTEL Supercoductivity:https://archive.nptel.ac.in/courses/115/103/115103108/
- https://www.britannica.com/technology/laser,k
- https://nptel.ac.in/courses/115/102/115102124/
- http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
- https://onlinecourses.nptel.ac.in/noc20_mm14/preview
- W1 Nptel.ac.in
- W2 www.physics.org
- W3 www.physicsclassroom.com
- W4 www.coursera.org

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. **NPTEL Quantum Computing :** https://archive.nptel.ac.in/courses/115/101/115101092
2. **Virtual LAB :**https://www.vlab.co.in/participating-institute-amrita-vishwa-vidyapeetham
3. **Virtual LAB :** https://vlab.amrita.edu/index.php?sub=1&brch=189&sim=343&cnt=1

Useful Journals

- Journal of Nature Physics
- Journal of Foundation of Physics
- Journal of Physical Review
- Journal of Applied Physics
- Journal of Classical and Quantum Gravity

Teaching and Learning Methods

1. Lecture class: 40 hours
2. Practical classes: 36 hours

Laboratory Component:

Any Ten Experiments have to be completed from the list of experiments

Note: The experiments have to be classified into

a) Exercise
b) Demonstration
c) Structured Inquiry
d) Open Ended

Based on the convenience classify the following experiments into above categories. Select at least one simulation/spreadsheet activity.

List of Experiments

1. Determination of wavelength of LASER using Diffraction Grating.
2. Determination of acceptance angle and numerical aperture of the given Optical Fiber.
3. Determination of Magnetic Flux Density at any point along the axis of a circular coil.
4. Determination of resistivity of a semiconductor by Four Probe Method
5. Study the I-V Characteristics of the Given Bipolar Junction Transistor.
6. Determination of dielectric constant of the material of capacitor by Charging and Discharging method.
7. Study the Characteristics of a Photo-Diode and to determine the power responsivity / Verification of Inverse Square Law of Intensity of Light.
8. Study the frequency response of Series & Parallel LCR circuits.
9. Determination of Planck's Constant using LEDs.
10. Determination of Fermi Energy of Copper.
11. Identification of circuit elements in a Black Box and determination of values of the components.
12. Determination of Energy gap of the given Semiconductor.
13. Step Interactive Physical Simulations.
14. Study of motion using spread Sheets
15. Study of Application of Statistics using spread sheets
16. PHET Interactive Simulations(https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype)

CO	PO	PO1	PO2	PO3	PO 4	PO5	PO6	PO 7	PO8	PO9	PO10	PO 11	PO 12	PS O1	PS O2
BPHYS102	K-level														
CO1	K3	K3	K3	-	K2	-	K2	K3	-	-	-	-	K3	K3	K3
CO2	K3	K3	K3	-	K3	-	K3	K3	-	-	-	-	K3	K3	K3
CO3	K3	K3	K3	K3	K2	K3	K3	K3	-	-	-	-	K3	K3	K3
CO4	K3	K3	K3	K3	K3	K3	K3	K3	-	K3	K3	K3	K3	K3	K3
CO5	K3	K3	K2	K3	K2	-	K3	-	-	-	-	-	K3	K3	K3

Assessment

Type of test/examination: Written examination

Continuous Internal Evaluation (CIE): 50 marks (Sum of three tests + 20 marks Assignments + 20 marks(15 for daily performance based+5 for lab test) laboratory component.

Semester End Exam (SEE): 100 marks (students have to answer all main questions) which will be reduced to 50 Marks.

Test duration: 1 :00 hours

Examination duration: 3 hours

CO to PO mapping

PO1: Science and engineering Knowledge **PO2:** Problem Analysis **PO3:** Design & Development **PO4:** Investigations of Complex Problems **PO5:** Modern Tool Usage **PO6:** Engineer & Society	**PO7:** Environment and Society **PO8:** Ethics **PO9:** Individual & Team Work **PO10:** Communication **PO11:** Project Mngmt & Finance **PO12:** Life long Learning

PSO1: Ability to understand the basic principles, laws, theories and problem solving skills of Engineering Physics and their application in engineering and technology.

PSO2: Ability to apply the concepts of physics to design a process to address the real-world challenges.

Course In charge

Head of the Department
24/08/2023
Dr. C. VASUDEV
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Dr. K. RAMA NARASIMHA
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K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BENGALURU - 560109

DEPARTMENT OF APPLIED SCIENCE

SESSION: 2022-2023 (EVEN SEMESTER)

CO-PO MAPPING

Course: Applied Chemistry for Mechanical Engineering stream

Type: Core (Theory/Practical/Integrated) | **Course Code: BCHEM202**

No of Hours

Theory (Lecture Class)	Practical/Field Work/Allied Activities	Total/Week	Total teaching hours
4	3	7 (4 + 3)	76 (40 + 36)

Marks

Internal Assessment	Examination	Total	Credits
50	50	100	4

Aim/Objectives of the Course

1. To enable students to acquire knowledge on principles of chemistry for engineering applications.
2. To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
3. To provide students with a solid foundation in analytical reasoning required to solve societal problems.

Course Learning Outcomes

After completing the course, the students will be able to

CO1	**Apply** redox reaction concept to enhance the efficiency of energy storage systems and also able to determine the calorific value of a fuel.	**Applying (K3)**
CO2	**Utilize** the concept of different corrosion control techniques to protect the engineering metals.	**Applying (K3)**
CO3	**Make use** and explore macromolecules for engineering applications.	**Applying (K3)**
CO4	**Utilize** the principle of phase rule, electrochemical and optical sensors for the estimation of different components in the analyte.	**Applying (K3)**
CO5	**Make use** of alloys, ceramics and nanomaterials for the engineering applications.	**Applying (K3)**

Syllabus Content

MODULE 1: Energy; Source, Conversion and Storage **Fuels:** Introduction, calorific value, determination of calorific value using bomb calorimeter, numerical problems on GCV and NCV. **Green fuels:** Introduction, power alcohol, synthesis and applications of biodiesel. **High energy fuels:** Production of hydrogen by electrolysis of water and its advantages. **Energy devices:** Introduction, construction, working, and applications of Photovoltaic cells, Li-ion battery and methanol-oxygen fuel cell. **Self- learning:** Plastic recycling to fuels and its monomers or other useful products. **Practical Component:**	**CO1** 8 hrs PO1-3 PO2-3 PO3-1 PO5-1 PO6-1

1. Determination of acid value of biofuel (Demonstrative experiment) 2. Synthesis of biodiesel (Open ended experiment) **LO:** At the end of this session the student will be able to 1. Calculate the GCV and NCV of a solid fuel. 2. Apply redox reaction concept to illustrate the working of batteries. 3. Utilize the concepts of chemistry in the production of green fuels.	PO7-1 PO9-3 PO12-1 PSO1-2 PSO2-1
MODULE 2: Corrosion Science and Engineering **Corrosion:** Introduction, electrochemical theory of corrosion, types of corrosion-differential metal, differential aeration (waterline and pitting), stress corrosion (caustic embrittlement). **Corrosion control:** Metal coating-galvanization, surface conversion coating-anodization and cathodic protection-sacrificial anode method. Corrosion testing by weight loss method. Corrosion penetration rate (CPR)-numerical problems. **Metal finishing:** Introduction, technological importance. Electroplating: Introduction, Electroplating of chromium (hard and decorative). Electroless plating: Introduction, electroless plating of nickel. Self-learning: Factors affecting the rate of corrosion, factors influencing the nature and quality of electrodeposit (Current density, concentration of metal ion, Ph and temperature). **Practical Component:** Determination of strength of an acid in Pb-acid battery. **LO:** At the end of this session the student will be able to 1. Utilize the concept of electrochemical theory of corrosion to illustrate various types of corrosion and its control. Also able estimate the iron in TMT bar. 2. Determine corrosion penetration rate of metals at different corrosive medium.	**CO2** 8 hrs PO1-3 PO2-3 PO3-1 PO5-1 PO6-1 PO7-1 PO9-1 PO12-1 PSO1-2 PSO2-1
MODULE 3: Macromolecules for Engineering Applications Polymers: Introduction, methods of polymerization (Condensation and Free radical), molecular weight; number average and weight average, numerical problems. Synthesis, properties and industrial applications of polyvinylchloride (PVC) and polystyrene. Fibers: Introduction, synthesis, properties and industrial applications of Kevlar and Polyester. Plastics: Introduction, synthesis, properties and industrial applications of poly (methyl methacrylate) (PMMA) and Teflon. Composites: Introduction, properties and industrial applications of carbon-based reinforced composites (graphene/carbon nano-tubes as fillers) and metal matrix polymer composites. Lubricants: Introduction, classification, properties and applications of lubricants. Self-learning: Biodegradable polymer: Introduction, synthesis, properties and applications of polylactic acid (PLA). **Practical Component:** 1. Estimation of iron in TMT bar by external indicator method. 2. Determination of Chemical Oxygen Demand (COD) of industrial waste water sample. 3. Determination of Viscosity coefficient of lubricant (Ostwald's viscometer). **LO:** At the end of this session the student will be able to 1. Find Number average and Weight average Molecular weight of polymers to know the nature of polymer. Illustrate the methods of e-waste disposal and extraction of precious metals from e-waste. 2. Explain the synthesis, properties and applications of commercial polymers.	**CO3** 8 hrs PO1-3 PO2-3 PO3-1 PO5-1 PO6-1 PO7-3 PO9-3 PO12-1 PSO1-2 PSO2-1

MODULE 4: Phase Rule and Analytical Techniques Phase rule: Introduction, Definition of terms: phase, components, degree of freedom, phase rule equation. Phase diagram: Two component-lead-silver system. Analytical techniques: Introduction, principle, instrumentation of potentiometric sensors; its application in the estimation of iron, Optical sensors (colorimetry); its application in the estimation of the copper, pHsensor (Glass electrode); its application in the determination of pH of beverages. Self-learning: Determinationofviscosityofbiofuelanditscorrelationwithtemperature **Practical Component:** 1. Conductometric estimation of acid mixture 2. Potentiometric estimation of FAS using $K_2Cr_2O_7$ 3. Determination of pKa of vinegar using pH sensor (Glass electrode) 4. Estimation of Copper present in electroplating effluent (PCB) by optical sensor (colorimetry) 5. Estimation of total hardness of water by EDTA method **LO:** At the end of this session the student will be able to 1. Apply phase rule to illustrate two component system. 2. Make use of principle and instruments of electrochemical and optical sensors for sample analysis.	**CO4** 8 hrs PO1-3 PO2-3 PO3-1 PO5-1 PO6-1 PO7-1 PO9-3 PO12-1 PSO1-2 PSO2-1
MODULE 5: Materials for Engineering Applications Alloys: Introduction, classification, composition, properties and applications of Stainless Steel, Brass and Alnico. Ceramics: Introduction, classification based on chemical composition, properties and applications of perovskites (CaTiO3). Nano chemistry: Introduction, size dependent properties of nanomaterial (surface area, catalytical and thermal), synthesis of nanoparticles by sol-gel, and co-precipitation method. Nano materials: Introduction, properties and engineering applications of carbon nanotubes and graphene. Self-learning: Abrasives: Introduction, classification, properties and applications of silicon carbide(carborundum). **Practical Component:** 1. Synthesis of iron oxide nanoparticles. 2. Estimation of percentage of iron in steel. **LO:** At the end of this session the student will be able to 1. Draw the properties and application of nano materials and Perovskite Materials. 2. Classify different alloys on the basis of its composition and properties. 3. Synthesize iron oxide nano particles by precipitation method.	**CO5** 8 hrs PO1-3 PO2-3 PO3-1 PO5-1 PO6-1 PO7-1 PO9-3 PO12-1 PSO1-2 PSO2-1

Text Books

1. Basuchandra's Applied Chemistry for Electrical and Electronic Engineering Stream Fourth edition-2022
2. A Text Book of Engg. Chemistry, Shashi Chawla, & Co.(P)Ltd.
3. SS Dara & Dr. SS Umare. -A Text book of Engineering Chemistry, S Chand & Company Ltd., 12th Edition, 2011.
4. R.V. Gadag and Nithyananda Shetty-A Text Book of Engineering Chemistry, I.K. International Publishing house. 2nd Edition, 2019.
5. B.S. Jai Prakash, R. Venugopal, Sivakumaraiah& Pushpa Iyengar.,- Chemistry for Engineering Students", Subash Publications, Bangalore.5th Edition, 2014
6. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma & M.S. Pathania, S. Nagin Chand & Co., 41 Edition, 2004.

Reference Books (specify minimum two foreign authors text books)

1. Wiley Engineering Chemistry, Wiley India Pvt .Ltd. New Delhi,2013-2ndEdition.
2. Engineering Chemistry, Satyaprakash & Manisha Agrawal, Khanna Book Publishing, Delhi
3. G.A.Ozin, A.C. Arsenault &Lud ovicoCademartiri "*Nanochemistry A Chemical Approach to Nanomaterials*", Royal Society of Chemistry, First Edition, 2005.

4. Wiley."*Engineering Chemistry*", India Pvt. Ltd. New Delhi. Second Edition. 2013.
5. V.R.Gowariker, N.V.Viswanathan&J.Sreedhar., "*Polymer Science*", Wiley-Eastern Ltd. New Delhi, First Edition, 1986.
6. M.G.Fontana., "*Corrosion Engineering*", Tata McGraw Hill Publishing Pvt. Ltd. New Delhi, Third Edition, 1986.

Weblinks and Video Lectures(e-Resources):

- http://libgen.rs/
- https://nptel.ac.in/downloads/122101001/
- https://nptel.ac.in/courses/104/103/104103019/
- https://ndl.iitkgp.ac.in/
- https://www.youtube.com/watch?v=faESCxAWR9k
- https://www.youtube.com/watch?v=TBqXMWaxZYM&list=PLyhmwFtznRhuz8L1bb3X9IbHrDMjHWWh
- https://www.youtube.com/watch?v=j5Hml6KN4TI
- https://www.youtube.com/watch?v=X9GHBdyYcyo
- https://www.youtube.com/watch?v=1xWBPZnEJk8
- https://www.youtube.com/watch?v=wRAo-M8xBHM

Activity Based Learning (Suggested Activities in Class)/Practical Based learning

- https://www.vlab.co.in/broad-area-chemical-sciences
- https://demonstrations.wolfram.com/topics.php
- https://interestingengineering.com/science

Useful Journals

1. Journal of Power Sources.(*www.**journals**.elsevier.com/**journal-of-power-sources**)*
2. Journal of Alloys and Compounds.(*www.journals.elsevier.com/journal-of-alloys-and-compounds)*
3. Fuel Cells Bulletin.(*www.journals.elsevier.com/**fuel-cells-bulletin***)
4. Electrochemical Acta. (*www.journals.elsevier.com/**electrochimica-acta)***
5. European Polymer Journal. (*www.**journals**.elsevier.com/**european-polymer-journal***)

Teaching and Learning Methods

1. **Lecture class**: 40 hrs
2. **Practical classes:** 36

Assignment: 2 assignments

Type of test/examination: Written examination/Assignment

Continuous Internal Evaluation (CIE):

1. Three Unit Tests each of 25 Marks (**Test duration:** 1hour)
2. Two assignments each of 25 Marks
3. **CIE for the practical component:** On completion of every experiment in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The 15 marks are for conducting the experiment, Brief procedure writeup and preparation of the laboratory record, the other 10 marks shall be for the test conducted at the end of the semester (The laboratory test duration of 03 hours is conducted for 50 marks and scale down to 10 marks)

The sum of two /three tests, two assignments will be out of 100 marks and scale down to 25 marks. Lab component 25 marks added to theory component to access total CIE of 50 marks.

Semester End Exam (SEE):

Theory SEE will be conducted by University as per the scheduled time table, with common question papers for the subject (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.

2. There will be 2 main questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module. The students have to answer 5 full questions, selecting one full question from each module.
SEE will be conducted for 100 marks (students have to answer all main questions) which will be reduced to 50 Marks.
Examination duration: 3 hrs.

CO to PO Mapping

PO1: Science and engineering Knowledge **PO2:** Problem Analysis **PO3:** Design & Development **PO4:** Investigations of Complex Problems **PO5:** Modern Tool Usage **PO6:** Engineer & Society	**PO7:** Environment and Society **PO8:** Ethics **PO9:** Individual & Team Work **PO10:** Communication **PO11:** Project Mngmt & Finance **PO12:**Lifelong Learning

PSO1: Ability to apply concept of Chemistry to design a system, to address a real-world challenge.
PSO2: Ability to develop effective communication, team work and computational skills.

CO	PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
BCHEM202	K-level														
CO1	K3	3	3	1	-	1	1	1	-	3	-	-	1	2	1
CO2	K3	3	3	1	-	1	1	1	-	1	-	-	1	2	1
CO3	K3	3	3	1	-	1	1	3	-	3	-	-	1	2	1
CO4	K3	3	3	1	-	1	1	1	-	3	-	-	1	2	1
CO5	K3	3	3	1	-	1	1	1	-	3	-	-	1	2	1

Course In charge

Head of the Department

Principal

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