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

DEPARTMENT OF APPLIED SCIENCE

SESSION: 2022-2023 (ODD SEMESTER)

CO-PO MAPPING

Course: Mathematics-I for Computer Science and Engineering stream			
Type: Integrated		Course Code: BMATS101	
No of Hours			
Theory (Lecture Class)	Practical/Field Work/Allied Activities	Total/Week	Total teaching hours
Marks			
Internal Assessment	Examination	Total	Credits
50	50	100	4

Aim/Objectives of the Course

- To familiarize the important tools of calculus and differential equations that are essential in all branches of engineering.
- To develop the knowledge of matrices and linear algebra in a comprehensive manner.

Course Learning Outcomes

After completing the course, the students will be able to

CO1	**Apply** the knowledge of calculus to solve problems related to polar curves and its applications in determining the bentness of a curve.	**Applying (K3)**
CO2	**Demonstrate** the partial differentiation to calculate rates of change of multivariate functions and solve problems related to composite functions and Jacobians.	**Applying (K3)**
CO3	**Use** matrix theory for solving system of linear equations and compute eigenvalues and eigenvectors required for matrix diagonalization process	**Applying (K3)**
CO4	**Solve** first order linear/nonlinear differential equation analytically using standard methods	**Applying (K3)**
CO5	**Apply** the knowledge of modular arithmetic to computer algorithms.	**Applying (K3)**

Syllabus Content

Module 1: **Introduction to polar coordinates and curvature relating to Computer Science and Engineering.** Polar coordinates, Polar curves, angle between the radius vector and the tangent, angle between two curves. Pedal equations. Curvature and Radius of curvature - Cartesian, Parametric, Polar and Pedal forms. Problems.	**CO1** 8 hrs. PO1-3 PO2 -2

Self-study: Center and circle of curvature, evolutes and involutes. **Applications:** Computer graphics, Image processing. **(RBT Levels: L1, L2 and L3)** **LO:** At the end of this session the student will be able to 1. Find the angle between the radius vector and tangent, angle between two curves. 2. Find the Pedal equation of the curve. 3. Find the curvature and radius of curvature.	PO4-1 PO9-1 PO10-1 PO12-1 PSO1-3 PSO2-2

Module-2:Series Expansion and Multivariable Calculus (8 hours) **Introduction of series expansion and partial differentiation in Computer Science & Engineering applications.** Taylor's and Maclaurin's series expansion for one variable (Statement only) – problems. Indeterminate forms – L' Hospital's rule-Problems. Partial differentiation, total derivative - differentiation of composite functions. Jacobin and problems. Maxima and minima for a function of two variables. Problems. **Self-study:** Euler's theorem and problems. Method of Lagrange's undetermined multipliers with single constraint. **Applications:** Series expansion in computer programming, Computing errors and approximations. **(RBT Levels: L1, L2 and L3)** **LO:** At the end of this session the student will be able to 1. Obtain the series solution for the given functions.. 2. Evaluates the given limits. 3. Find the Total derivatives, maxima and minima for a function of two variables.	**CO2** 8 hrs. PO1-3 PO2 -2 PO4-1 PO9-1 PO10-1 PO12-1 PSO1-3 PSO2-2
Module-3: Linear Algebra (8 hours) **Introduction of linear algebra related to Computer Science &Engineering.** Elementary row transformation of a matrix, Rank of a matrix. Consistency and Solution of system of linear equations - Gauss-elimination method, Gauss-Jordan method and approximate solution by Gauss-Seidel method. Eigenvalues and Eigenvectors, Rayleigh's power method to find the dominant Eigenvalue and Eigenvector. **Self-Study:** Solution of system of equations by Gauss-Jacobi iterative method. Inverse of a square matrix by Cayley- Hamilton theorem. **Applications:** Boolean matrix, Network Analysis, Markov Analysis, Critical point of a network system. Optimum solution. **(RBT Levels: L1, L2 and L3).**	**CO3** 8 hrs PO1-3 PO2 -2 PO4-1 PO9-1 PO10-1 PO12-1 PSO1-3 PSO2-2

LO: At the end of this session the student will be able to 1. Find Rank of a matrix by reducing into echelon form. 2. Solve the system of equations using Gauss-elimination method, Gauss – Jordan method and Gauss-Seidel method. 3. Find the largest eigen value and eigen vector using Rayleigh's power method.	
Module-4: Ordinary Differential Equations (ODEs) of First Order (8 hours) **Introduction to first-order ordinary differential equations pertaining to the applications for Computer Science & Engineering.** Linear and Bernoulli's differential equations. Exact and reducible to exact differential equations -Integrating factors on Orthogonal trajectories, L-R & C-R circuits. Problems. **Non-linear differential equations:** Introduction to general and singular solutions, Solvable for p only, Clairaut's equations, reducible to Clairaut's equations. Problems. **Self-Study:** Applications of ODEs, Solvable for x and y. **Applications of ordinary differential equations:** Rate of Growth or Decay, Conduction of heat. **(RBT Levels: L1, L2 and L3)** **LO:** At the end of this session the student will be able to 1. Solve first order linear/nonlinear differential equation analytically using standard methods.	**CO4** 8 hrs PO1-3 PO2 -2 PO4-1 PO9-1 PO10-1 PO12-1 PSO1-3 PSO2-2
Module-5: Modular Arithmetic (8 hours) **Introduction of modular arithmetic and its applications in Computer Science and Engineering.** Introduction to Congruences, Linear Congruences, The Remainder theorem, Solving Polynomials, Linear Diophantine Equation, System of Linear Congruences, Euler's Theorem, Wilson Theorem and Fermat's little theorem. Applications of Congruences-RSA algorithm. **Self-Study:** Divisibility, GCD, Properties of Prime Numbers, Fundamental theorem of Arithmetic. **Applications:** Cryptography, encoding and decoding, RSA applications in public key encryption. **(RBT Levels: L1, L2 and L3)** **LO:** At the end of this session the student will be able to 1.Solve the congruences by Remainder theorem, Diaphontain equations	**CO5** 8 hrs PO1-3 PO2 -2 PO4-1 PO9-1 PO10-1 PO12-1 PSO1-3 PSO2-2

Text Books

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna Publishers, 44thEd., 2021.
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10thEd., 2018.
3. **David M Burton:** "Elementary Number Theory" Mc Graw Hill, 7th Ed.,2017.

Reference Books

1. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed., 2017
2. **Srimanta Pal & Subodh C.Bhunia**: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016.
3. **N.P Bali and Manish Goyal**: "A Textbook of Engineering Mathematics Laxmi Publications, 10th Ed., 2022.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co., New York, 6th Ed., 2017.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
6. **H. K. Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S. Chand Publication, 3rd Ed., 2014.
7. **James Stewart:** "Calculus" Cengage Publications, 7thEd., 2019.
8. **David C Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4th Ed., 2018.
9. **Gareth Williams:** "Linear Algebra with Applications", Jones Bartlett Publishers Inc., 6th Ed., 2017.
10. **Gilbert Strang:** "Linear Algebra and its Applications", Cengage Publications, 4th Ed. 2022.
11. **William Stallings:** "Cryptography and Network Security" Pearson Prentice Hall, 6th Ed., 2013.
12. **Kenneth H Rosen:** "Discrete Mathematics and its Applications" McGraw-Hill, 8th Ed. 2019.
13. **Ajay Kumar Chaudhuri:** "Introduction to Number Theory" NCBA Publications, 2nd Ed., 2009.
14. **Thomas Koshy:** "Elementary Number Theory with Applications Harcourt Academic Press, 2nd Ed., 2008.

Web links and Video Lectures (e-Resources):

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

Useful Journals

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

Teaching and Learning Methods

1. Lecture class: 50 hrs
2. Practical classes: 0

Assessment

Type of test/examination: Written examination

Continuous Internal Evaluation(CIE) :

1) Three Tests each of 20 marks (duration 01 hour)

2) Two assignments each of 10 Marks

3) Practical Sessions for 10 Marks for each Experiment taken average for all Lab components to Marks. Then scaled up to 15 marks. Lab internals for 50 marks and scaled down to 5 marks.

The sum of three tests, two assignments will be out of 80 marks and will be scaled down to 30 marks+Practical 20 marks.

Total CIE: 50 Marks

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

Test duration: 1 hrs

Examination duration: 3 hrs Assessment.

CO	PO	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PS O1	PSO 2
18 MA T11	K-level														
CO1	K3	3	2	-	1	-	-	-	-	1	1	-	1	3	2
CO2	K3	3	2	-	1	-	-	-	-	1	1	-	1	3	2
CO3	K3	3	2	-	1	-	-	-	-	1	1	-	1	3	2
CO4	K3	3	2	-	1	-	-	-	-	1	1	-	1	3	2
CO5	K3	3	2	-	1	-	-	-	-	1	1	-	1	3	2

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:**Life long 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

Course In charge

Head of the Department
Dr. C. VASUDEV
Professor & HOD
Department of Applied Science
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DEPARTMENT OF APPLIED SCIENCE

SESSION: 2022-2023 (ODD SEMESTER)

CO-PO MAPPING

Course Title: Applied Physics for ME Stream			
Course Type: Integrated		**Course Code:BPHYM102**	
No of Hours			
Theory (Lecture Class)	Practical/Field Work/Allied Activities	Total hours/Week	Total teaching hours
4	3	7	76(40 hours Theory + 36 Lab hours)
Marks			
Internal Assessment	Examination	Total	Credits
50	50	100	4

Aim/Objectives of the Course

1. Applied Physics is one of a basic subject for all engineering course. In this course, principles of Physics are taught to build strong foundation of knowledge required for mechanical engineering courses.
2. Learning the basic concepts in Physics which are very much essential in understanding and solving engineering related challenges.
3. Gaining the knowledge of newer concepts in Low temperature phenomena and the various relevant material characterization techniques.

Course Learning Outcomes

After completing the course, the students will be able to

CO1	**Utilizing** the knowledge of simple harmonic motion, **derive** the expressions for various types of oscillations and to understand the role of shock waves in various fields.	**Applying (K3)**
CO2	**Use** the elastic properties of materials for engineering applications and practice to conduct experiments.	**Applying (K3)**
CO3	**Interpret** the application of sensitive instrumentation for Nano-scale system.	**Applying (K3)**
CO4	**Investigate** the fundamentals of Thermoelectric materials and their application.	**Applying (K3)**
CO5	**Illustrate** the low temperature phenomena and generation of low temperature.	**Applying (K3)**

Syllabus Content

Module -1: Oscillations and Shock waves Simple Harmonic motion (SHM), Differential equation for SHM (No derivation), Sprigs: Stiffness Factor and its Physical Significance, Series and Parallel combination of springs (Derivation), Types of Springs and their applications. Theory of Damped oscillations (Qualitative), Types of Damping (Graphical Approach). Engineering applications of	**CO1** 08 hrs PO1-3 PO2-3

Damped oscillations, Theory of Forced oscillations (Qualitative), Resonance, Sharpness of resonance. Numerical Problems. Shock waves: Mach number and Mach Angle, Mach Regimes, Definition and Characteristics of Shock waves, Construction and working of Reddy Shock tube, Applications of Shock Waves, Numerical problems. **LO:** At the end of this module, the students will be able to 1. Explain SHM and derive the equivalent force constant for two springs in series and parallel combination. 2. Derive the differential equation for damped and forced oscillations 3. Explain Mach number, classification based on Mach number and Reddy shock tube.	PO4-2 PO6-3 PO7-2 PO12 -2 PSO1-3 PSO2-3

Module -2: Elasticity Stress-Strain Curve, Stress hardening and softening. Elastic Moduli, Poisson's ratio, Relation between Y, n and σ (with derivation), mention relation between K, Y and σ, limiting values of Poisson's ratio. Beams, Bending moment and derivation of expression, Cantilever and I section girder and their Engineering Applications, Elastic materials (qualitative). Failures of engineering materials - Ductile fracture, Brittle fracture, Stress concentration, Fatigue and factors affecting fatigue (only qualitative explanation), Numerical problems. **LO:** At the end of this module, the students will be able to 1. Explain the different types of elastic moduli. Derive the relation between elastic modulus. 2. Derive the bending moment in terms of Moment inertia. 3. Explain the failures of Engineering applications.	**CO2** 08 hrs PO1-3 PO2-3 PO4-2 PO6-3 PO7-3 PO12-2 PSO1-3 PSO2-3
Module 3: Material Characterization and Instrumentation Techniques Introduction to nano materials: Nanomaterial and nanocomposites. Principle, construction and working of X-ray Diffractometer, Crystallite size determination by Scherrer equation, Atomic Force Microscopy (AFM): Principle, construction, working and applications, X-ray photoelectron spectroscopy(XPS), Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Numerical Problems. **LO**: At the end of this module, the students will be able to 1. Explain nanomaterials and nanocomposites. 2. Determine crystal size using Scherrer equation. 3. Explain the construction and working of various nanomaterial characterization instruments.	**CO3** 08hrs PO1-3 PO2-2 PO4-1 PO6-3 PO7-2 PO12-2 PSO1-3 PSO2-3
Module 4: Thermoelectric materials and devices Thermo emf and thermo current, Seeback effect, Peltier effect, Seeback and Peltier coefficients, figure of merit (Mention Expression), laws of thermoelectricity. Expression for thermo emf in terms of T1 and T2, Thermo couples, thermopile, Construction and Working of Thermoelectric generators (TEG) and Thermoelectric coolers (TEC), low, mid and high temperature thermoelectric materials, Applications: Exhaust of Automobiles, Refrigerator, Space Program (RTG), Numerical Problems.	**CO4** 08hrs PO1-3 PO2-3 PO4-2 PO6-3

LO: At the end of this module, the students will be able to 1. Explain the Seebeck effect, Peltier effect, Seeback and Peltier coefficients. 2. Explain the laws of thermoelectricity and hence derive the expression for thermo emf interms of T_1 and T_2. 3. Explain the construction and working of various thermoelectric devices.	PO7-3 PO12-2 PSO1-3 PSO2-3
Module 5: Cryogenics Production of low temperature - Joule Thomson effect (Derivation with 3 cases), Porous plug experiment with theory, Thermodynamical analysis of Joule Thomson effect, Liquefaction of Oxygen by cascade process, Lindey's air liquefier, Liquefaction of Helium and its properties, Platinum Resistance Thermometer, Applications of Cryogenics, in Aerospace, Tribology and Food processing(qualitative), Numerical Problems. **LO**: At the end of this module, the students will be able to 1. Obtain the theory of Joule Thomson effect and explain the three cases. 2. Explain the construction and working of various Cryogenics devices. 3. Explain the applications of cryogenics.	**CO5** 08hrs PO1-3 PO2-2 PO4-1 PO6-3 PO7-2 PO12-2 PSO1-3 PSO2-3

Text Books

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

1. Vibrations and Waves (MIT introductory Physics Series), A P French, CBS, 2003 Edition
2. Timoshenko, S. and Goodier J.N. "Theory of Elasticity", 2nd Edition, McGraw Hill Book Co, 2001.
3. Sadhu Singh, "Theory of Elasticity", Khanna Publishers, 1997
4. Mechanical Properties of Engineered Materials by Wole Soboyejo, CRC Press; 1st edition, 2002
5. Heat & Thermodynamics and Statistical Physics(XVIII-Edition) – Singhal, Agarwal &Satyaprakash – Pragati Prakashan, Meerut, 2006. 4
6. Heat and Thermodynamics (I-Edition) – D.S.Mathur - S. Chand & Company Ltd., New-Delhi, 1991
7. Heat and Thermodynamics, Brijlal & Subramanyam,S. Chand & Company Ltd., New-Delhi.
8. Physics of Cryogenics by Bahman Zohuri, Elsevier, 2018
9. Materials Characterization Techniques-Sam Zhang, Lin Li, Ashok Kumar, CRC Press, First Edition, 2008.
10. Characterization of Materials- Mitra P.K . Prentice Hall India Learning Private Limited.
11. Nanoscience and Nanotechnology: Fundamentals to Frontiers – M.S.Ramachandra Rao & Shubra Singh, Wiley India Pvt Ltd.
12. Nano Composite Materials-Synthesis, Properties and Applications, J. Parameswaranpillai, N.Hameed, T.Kurian, Y. Yu, CRC Press.
13. Shock waves made simple by Chintoo S Kumar, K Takayama and K P J Reddy: Willey India Pvt. Ltd, Delhi,2014

Reference Books (specify minimum two foreign authors text books)

1. Introduction to Mechanics — M.K. Verma: 2nd Ed, University Press(India) Pvt Ltd, Hyderabad 2009
2. Lasers and Non Linear Optics – B.B. Laud, 3rd Ed, New Age International Publishers 2011
3. LASERS Principles, Types and Applications by K.R,Nambiar-New Age International Publishers.
4. Solid State Physics-S O Pillai, 8th Ed- New Age International Publishers-2018
5. Shock waves made simple- Chintoo S Kumar, K Takayama and KPJ Reddy: Willey India Pvt. Ltd.New Delhi2014
6. Materials Characterization Techniques-Sam Zhang, Lin Li, Ashok Kumar, CRC Press, First Edition, 2008

7. Characterization of Materials- Mitra P.K . Prentice Hall India Learning Private Limited

Web links and Video Lectures (e-Resources):

Simple Harmonic motion:https://www.youtube.com/watch?v=k2FvSzWeVxQ
Shock waves:https://physics.info/shock/
Shock waves and its applications:https://www.youtube.com/watch?v=tz_3M3v3kxk
Stress- strain curves:https://web.mit.edu/course/3/3.11/www/modules/ss.pdf
Stress curves:https://www.youtube.com/watch?v=f08Y39UiC-o
Fracture in materials:https://www.youtube.com/watch?v=x47nky4MbK8
Thermoelecticity:https://www.youtube.com/watch?v=2w7NBuu5w9c&list=PLtkeUZItwHK5y6qy1GFxa4Z4Rc
mzUaaz6
Thermoelectric generator and coolers:https://www.youtube.com/watch?v=NruYdb31xk8
Cryogenics:https://cevgroup.org/cryogenics-basics-applications/
Liquefaction of gases:https://www.youtube.com/watch?v=aMelwOsGpIs
Virtual lab:https://www.vlab.co.in/participating-institute-amrita-vishwa-vidyapeetham
Material characterization :https://onlinecourses.nptel.ac.in/noc20_mm14/preview
https://www.encyclopedia.com/science-and-technology/physics/physics/cryogenics
https://www.usna.edu/NAOE/_files/documents/Courses/EN380/Course_Notes/Ch10_Deformation.pdf

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

http://nptel.ac.in
https://swayam.gov.in
https://virtuallabs.merlot.org/vl_physics.html
https://phet.colorado.edu
https://www.myphysicslab.com

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

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 Young's modulus of the material of the given bar Uniform Bending.
2. Determination of Rigidity modulus of the Material of the wire using Torsional Pendulum.
3. Study of Forced Mechanical Oscillations and Resonance.
4. Study of the frequency response of Series & Parallel LCR circuits.
5. Determination of Fermi Energy of the given Conductor.
6. Determination of Resistivity by Four Probe Method.
7. Determination of effective spring constant of the given springs in series and parallel combinations.
8. Determination of Young's modulus of the material of the given bar Single Cantilever.
9. Determination of the Moment of Inertia of the given irregular body using torsional pendulum.
10. Determination of Wavelength of Laser using Diffraction Grating.
11. Determination of Acceptance angle and Numerical Aperture of the given Optical Fiber.
12. Determination of the Radius of Curvature of the given Plano Convex Lens by setting Newton's Rings.
13. Step Interactive Physical Simulations.
14. Study of motion using spread Sheets
15. Application of Statistics using Spread Sheets.
16. PHET Interactive Simulations

:(https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype)

Teaching and Learning Methods

1. Lecture class: 40 hours
2. Practical classes: 3 hours

Assessment

Type of test/examination: Written examination

Continuous Internal Evaluation(CIE) : 50 marks (20 marks i.e., Sum of three tests + 20 marks i.e., Sum of two Assignments + 20 marks Lab I.A(15 marks daily based performance+5 marks lab test))

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	PO	PO1	PO2	PO3	PO 4	PO5	PO6	PO 7	PO8	PO9	PO10	PO1 1	PO12	PSO 1	PSO 2
BPHYS102	K-level														
CO1	K3	3	3	-	2	-	3	2	-	-	-	-	2	3	3
CO2	K3	3	3	-	2	-	3	3	-	-	-	-	2	3	3
CO3	K3	3	2	-	1	-	3	2	-	-	-	-	2	3	3
CO4	K3	3	3	-	2	-	3	3	-	-	-	-	2	3	3
CO5	K3	3	2	-	1	-	3	2	-	-	-	-	2	3	3

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
Dr. C. VASUDEV
Professor & HOD
Department of Applied Science
K.S. School of Engineering & Management
Bangalore - 560 109

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DEPARTMENT OF APPLIED SCIENCE

SESSION: 2022-2023 (ODD SEMESTER)

CO-PO MAPPING

Course: Applied Chemistry for Computer Science & Engineering stream-AI&DS			
Type: Core (Theory/Practical/Integrated)		Course Code: BCHES202	
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	**Utilize** various concepts of chemistry for corrosion control and to analyze engineering materials.	**Applying (K3)**
CO2	**Make use** of different techniques for the production of green fuels and also able to determine molecular weight of a polymer.	**Applying (K3)**
CO3	**Utilize** the principle of electrochemical and optical sensors for the estimation of different components in the analyte.	**Applying (K3)**
CO4	**Utilize** the properties of Liquid Crystal, Organic Light Emitting Diodes and Quantum Light emitting diodes to Illustrate the working mechanism of display systems.	**Applying (K3)**
CO5	**Apply** various recycling and extraction techniques in the e-waste management	**Applying (K3)**

Syllabus Content

MODULE 1: Corrosion and Electrode System **Corrosion Chemistry:** Introduction, electrochemical theory of corrosion, types of corrosion- differential metal and differential aeration. Corrosion control - galvanization, anodization and sacrificial anode method. Corrosion Penetration Rate (CPR) - Introduction and numerical problem. **Electrode System:** Introduction, types of electrodes. Ion selective electrode – definition, construction, working and applications of glass electrode. Determination of pH using glass electrode. Reference electrode- Introduction, calomel electrode– construction, working and applications of calomel electrode. Concentration cell– Definition, construction and Numerical problems.	**CO1** 8 hrs PO1-3 PO2-3 PO3-1 PO5-1 PO6-1

Analytical Techniques: Introduction, principle and instrumentation of Conductometry: its application in the estimation of weak acid. Potentiometry: its application in the estimation of iron. **Self-learning:** IR and UV-Visible spectroscopy. **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. Utilize the concept of electrochemical theory of corrosion to illustrate various types of corrosion and its control. Also, able to determine corrosion penetration rate of metals at different corrosive medium. 2. Derive an expression for P^H using glass electrode and determine E_{cell} of concentration cell. 3. Make use of principle and instruments of electrochemical and optical sensors for sample analysis.	PO7-2 PO9-3 PO12-1 PSO1-2 PSO2-1
MODULE 2: Polymers and Green Fuels **Polymers**: Introduction, Molecular weight: Number average, weight average and numerical problems. Preparation, properties, and commercial applications of Kevlar fiber. Conducting polymers– synthesis and conducting mechanism of polyacetylene and commercial applications. **Green Fuels:** Introduction, construction and working of solar photovoltaic cell, advantages, and disadvantages. Generation of energy (green hydrogen) by electrolysis of water and its advantages. **Self-learning:** Regenerative fuel cells. **LO:** At the end of this session the student will be able to 1. Apply electrolysis concept in the production of hydrogen 2. Find Number average and Weight average Molecular weight of polymers to know the nature of polymer. 3. Explain working and applications of P.V. cell	**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: Sensors and Energy Systems **Sensors:** Introduction, working, principle and applications of Conductometric sensors, Electrochemical sensors, Thermometric sensors (Flame photometry) and Optical sensors (colorimetry). Sensors for the measurement of dissolved oxygen (DO). Electrochemical sensors for the pharmaceuticals. Electrochemical gas sensors for Sox and NOx . Disposable sensors in the detection of biomolecules and pesticides. **Energy Systems:** Introduction to batteries, construction, working and applications of Lithium ion and Sodium ion batteries. Quantum Dot Sensitized Solar Cells (QDSSC's)-Principle, Properties and Applications. **Self-learning**: Types of electrochemical sensor, Gas sensor - O_2 sensor, Biosensor – Glucose sensors. **Practical Component:** 1. Estimation of iron in TMT bar by external indicator method. 2. Estimation of metal in e-waste by optical sensors. 3. Determination of Chemical Oxygen Demand (COD) of industrial waste water sample. 4. Determination of Viscosity coefficient of lubricant (Ostwald's viscometer). 5. Determination of strength of an acid in Pb-acid battery. **LO:** At the end of this session the student will be able to 1. Apply redox reaction concept to illustrate the working of batteries.	**CO3** 8 hrs PO1-3 PO2-3 PO3-1 PO5-1 PO6-1 PO7-1 PO8-1 PO9-3 PO12-1 PSO1-2 PSO2-1

2. Make use of principle and instruments of electrochemical and optical sensors for sample analysis. 3. Determine strength of an acid in Pb-acid battery.	
MODULE 4: Materials for Memory and Display Systems **Memory Devices:** Introduction, Basic concepts of electronic memory, History of organic/polymer electronic memory devices, Classification of electronic memory devices, types of organic memory devices(organic molecules, polymeric materials, organic, inorganic hybrid materials). **Display Systems**: Photoactive and electroactive materials, Nanomaterials and organic materials used in optoelectronic devices. **Liquid crystals (LC's)** - Introduction, classification, properties and application in Liquid Crystal Displays (LCD's). Properties and application of Organic Light Emitting Diodes (OLED's) and Quantum Light Emitting Diodes (QLED's), Light emitting electrochemical cells. **Self-learning:** Properties and functions of Silicon (Si), Germanium (Ge), Copper (Cu), Aluminium (Al),and Brominated flame retardants in computers. **Practical Component:** **1.** Synthesis of iron oxide nanoparticles **LO:** At the end of this session the student will be able to 1. Classify different type of memory devices. 2. Utilize the properties of Liquid Crystal, Organic Light Emitting Diodes and Quantum Light emitting diodes to Illustrate the working mechanism of display systems. 3. Synthesize iron oxide nano particles by precipitation method.	**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: E-Waste Management E-Waste: Introduction, sources of e-waste, Composition, Characteristics, and Need of e-waste management. Toxic materials used in manufacturing electronic and electrical products, health hazards due to exposure to e-waste. Recycling and Recovery: Different approaches of recycling (separation, thermal treatments, hydrometallurgical extraction, pyro metallurgical methods, direct recycling). Extraction of gold from E-waste. Role of stakeholders in environmental management of e-waste (producers, consumers, recyclers, and statutory bodies). Self-learning: Impact of heavy metals on environment and human health. **Practical Component:** 1. Synthesis of iron oxide nanoparticles. **LO:** At the end of this session the student will be able to 1. Explain various sources of e-waste 2. Apply various recycling and extraction techniques in the e-waste management.	**CO5** 8 hrs PO1-3 PO2-3 PO3-1 PO5-1 PO6-1 PO7-3 PO9-1 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 timetable, 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 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
BCHES202	K-level														
CO1	K3	3	3	1	-	1	1	2	-	3	-	-	1	2	1
CO2	K3	3	3	1	-	1	1	1	-	1	-	-	1	2	1
CO3	K3	3	3	1	-	1	1	1	-	3	-	-	1	2	1
CO4	K3	3	3	1	-	1	1	1	-	3	-	-	1	2	1
CO5	K3	3	3	1	-	1	1	3	1	1	-	-	1	2	1

Course In charge

Head of the Department

Dr. C. VASUDEV
Professor & HOD
Department of Applied Science
K.S. School of Engineering & Management
Bangalore - 560 109

Principal

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