

**INSTITUTIONAL ELECTIVE OFFERED BY THE DEPARTMENT OF CHEMISTRY**

<b>Course Name</b>	Nanomaterials - Synthesis, Characterization, Properties And Applications	<b>Course Code</b>	17CY7IENMA
<b>Credits</b>	03	<b>L-T-P-S</b>	3- 0 -0-0
<b>Contact hours</b>	36	<b>Faculty Handling</b>	Dr. M. S. DHARMAPRAKASH

**Course Objectives:** The basic objectives course is to make students aware of Nano scale materials and structures, their properties and size effects. To make students learn some methods of synthesis of Nano materials their characterization by XRD, SEM and TEM. Some important Industrial applications of Nano materials is also dealt with.

CO NO.	COURSE OUTCOMES: <i>AT THE END OF THE COURSE THE STUDENT WILL HAVE</i>
CO1	AN ABILITY TO UNDERSTAND AND EXPLAIN NANOSCALE MATERIALS AND PROPERTIES, VARIOUS METHODS OF SYNTHESIS, CHARACTERIZATION
CO2	AN ABILITY TO APPLY THE LEARNT KNOWLEDGE AND CHOOSE APPROPRIATE METHOD TO SYNTHESIZE AND CHARACTERIZE NANOMATERIALS.
CO3	AN ABILITY TO APPLY NANOMATERIALS FOR DEVELOPING DEVICES/PRODUCTS/PROCESSES

**UNIT-I**

**INTRODUCTION:**

**6 Hrs**

Definition, Historical Perspectives of Nanoscience and Nanotechnologies. The Nanometre Scale. Scope and interdisciplinary nature of nanoscience and nanotechnology. Scientific revolutions. Nanomaterials and Nanotechnology. Quantum Effects in Nanomaterials. Concepts of nanotechnology - size dependent properties, surface to volume ratio, atomic structure and phases, energy at the nanoscale molecular and atomic size. Classification of Nanostructures – Zero-, one-and two-dimensional nanostructure materials- Nano Particles, Nano crystalline Materials, Nanocrystalline Ceramics, Semiconductor Nanoparticles, Metal Nanoparticles, Nanotubes and Nano -Scale Architectures.

**Unit-II**

**SYNTHESIS:**

**8 Hrs**

Top down approaches and bottom up approaches.

Chemical methods: sol-gel synthesis, Co-precipitation, CVD, CVS, and combustion synthesis. Microwave Synthesis of Metallic nano Particles (Ag, Au, Pt) and Nanoparticles of Metal Oxides (ZrO<sub>2</sub>, ZnO, Al<sub>2</sub>O<sub>3</sub> and TiO<sub>2</sub>). Carbon Nanotubes -Synthesis of Multi-Walled Nanotubes Aligned Carbon Nanotube Bundles, Single-Walled Carbon Nanotubes.

Physical methods: Vapor deposition techniques- pulsed laser deposition, Magnetron sputtering - Micro lithography (photolithography).

### Unit-III

#### PROPERTIES:

6 Hrs

Effects of nanometer length scale on Physical and Chemical Properties of Nanomaterials. Size Effects – Fraction of Surface Atoms – Specific Surface Energy and Surface Stress – Effect on the Lattice Parameter – Phonon Density of States. Thermal, Magnetic and Chemical properties - Catalysis.

### Unit-IV

#### CHARACTERIZATION:

8 Hrs

**XRD**-X-ray powder diffraction – Bragg's law - Instrumentation. Determination of lattice parameters - particle size analysis using Scherer formula.

**SEM**-Working Principle of Specimen Preparation – Modes of operation– Back scattered electrons (EDAX) – secondary electrons- X-rays – typical forms of contrast– Resolution and contrast – enhancement –Analyses of SEM images.

**TEM**-Basic principles - Modes of operation – Specimen preparation – Diffraction in imperfect crystals and dislocations – Structure of Grain boundaries and interfaces- HRTEM.

### Unit-V

#### APPLICATIONS

6 Hrs

Renewable energy, solar energy, fuel cells. Materials manufacturing and automobile industry. Biomedical Science, Medicine, Diagnostics. Biotechnology. Computers, Electronics and communication. Chemical analysis, Pharmacy Environmental sciences, Sport sector, Printing, Optics. Agriculture, Food, Textile, Cosmetics. Defense, Aerospace and Marine Nanotechnology.

#### Text book:

C. N. R. Rao, A. Muller, A. K. Cheetham (Eds.). The Chemistry of Nanomaterials Synthesis, Properties and Applications 2003, ISBN 3-527-30686-2

#### References:

1. G.A. Ozin and A.C. Arsenault, "Nanochemistry: A chemical approach to nanomaterials", Royal Society of Chemistry, 2005.
2. Charles P.Poole Jr. "Introduction to Nanotechnology", John Willey & Sons , 2003. T. Pradeep
3. "NANO-The Essential, understanding Nanoscience and Nanotechnology". Tata McGraw-Hill
4. Nano scale Science and Technology Robert Kelsall, Ian Hamley, and Mark Geoghegan (Editors) John-Wiley
5. Z. L. Wang (Ed.) Characterization of Nanophase Materials 1999, ISBN 3-527-29837-1

**Scheme of Evaluation:**

<b>Component</b>	<b>Type of assessment</b>	<b>Max. Marks</b>	<b>Weightage</b>	<b>Total</b>	<b>Total Marks</b>
CIE - Theory	Quiz 1	10	10	50*	50 (CIE)
	Quiz 2	10			
	Test 1	40	40		
	Test 2	40			
	Test 3	40			
SEE	End Exam	100	50		50 (SEE)
<b>Grand Total Marks</b>					<b>100</b>
<b>* minimum CIE marks (Theory) <math>\geq</math> 10.0 to gain eligibility to write the SEE</b>					



## BMS COLLEGE OF ENGINEERING, BENGALURU-19

Autonomous Institute, Affiliated to VTU

### INSTITUTIONAL ELECTIVE OFFERED BY THE DEPARTMENT OF CHEMISTRY

Course Name	Functional Materials for Engineering Applications	Course Code	21CY7IEFME
Credits	03	L-T-P-S	3-0-0-0
Contact hours	38	Faculty Handling	Dr Srinidhi Raghavan M

#### Course Objectives:

#### *The fundamental of the course is to:*

- ❖ Provide a basic knowledge of Materials sciences and Functional Materials to Engineers for their applications aspects
- ❖ Demonstrate the significance of new class of materials in Engineering applications
- ❖ Brief about the preparation of some Functional materials in various techniques
- ❖ Instruct significance of materials excellence and its applications in modern aspects

	<b>Course Outcomes: At the end of the course the student must learned by</b>
CO1	Ability to understand the significance of materials in applications aspects
CO2	To put on the erudite knowledge and select a right material for explicit to the current applications.
CO3	Progress the skill to resolve the material associated glitches in Research and Industrial aspects.

#### Course object:

The objective of this course is to provide a deeper insight and a platform for learning and development in the following thrust areas of “Functional Materials” through well designed subject to upcoming Engineers. These courses will update the knowledge of Engineering students on the recent developments in the field of materials science. This course is highly interdisciplinary by nature, encompassing aspects of basics of materials and its applications in the field of energy storage, sensors, biomedical applications, etc.



## Unit-I

**Overview of Functional Materials:** General introduction and significance of Novel materials: Carbon nanotubes and Graphene, fullerene, Oxide Superconductors, Hybrid materials (MOF), Nanocomposites, semiconductors and ceramic materials and Biomaterials.

**Carbon Nanotube:** Classifications-properties – physical and chemical properties-preparation through various methods (Plasma arcing of carbonaceous materials, laser ablation, and CVD Method) – Modifications (functionalization using gold nanoparticles)- and their potential Applications (Energy storage, Biomedical applications, etc.)

**(8 hours)**

## Unit-II

**Graphene:** Types of graphene – properties (mechanical, electrical, optical, thermal)-production of graphene (Using Hummer's Method)- potential applications. **Fullerene:** Classification – properties and applications. **Oxide superconductors:** Properties- physical and chemical properties- Types of superconductors with few examples-simple preparation and potential applications with few examples (YBCO)

**(8 hours)**

## Unit-III

**Metal organic Frame works:** Structures – properties – preparation of Metal acetylacetonate complexes for MOF architecture– characterizations and their potential applications. **Nanocomposites:** Classifications (Three types)– properties of composites materials – preparation of nanocomposites- Engineering applications.

**(6 hours)**

## Unit-IV

**Semiconductor Materials:** Types of semiconductor materials – properties of semiconductor materials-some examples with bandgap measurement-preparation and their applications (Sensors and optoelectronics applications). **Perovskite materials:** Classifications (few examples)-Properties – PV cell constructions and Energy harvesting process - Halide based perovskites for PV Cell applications and their challenges (Halide ion replacement)

**(8hours)**



## **Unit-V**

**Ceramic Materials:** Classification (Three types) – properties of ceramics (Mechanical, Electrical, Thermal and optical)- simple methods of preparation of ceramics (suitable examples” Barium titanate, Ferrites, PZT)–characterization and potential applications.

**Biomaterials:** Introduction – Bioactivity- Self-assembly - Structural hierarchy- Biocompatible Plastics-Preparation and properties and their applications.

**(8 hours)**

### **Text Books:**

1. Materials Sciences and Engineering – A First course – Sixth edition- By V. Raghavan
2. Solid state chemistry and Application – Anthony. R. West

### **Reference Books:**

1. Novel Materials – by M. R. Islam.
2. Nanomaterials and Their Applications- By Zishan Husain Khan

NPTEL Course : <https://nptel.ac.in/courses/118/102/118102003/>



### Scheme and evaluation:

Component	Type of assessment	Max. Marks	Weightage	Total	Total Marks	
CIE - Theory	AAT-1	10	2.5	25*	50 (CIE)	
	AAT-2	10	2.5			
	Test 1	40	Best of Two test			20
	Test 2	40				
	Test 3	40				
SEE	End Exam	100	50		50 (SEE)	
Grand Total Marks					100	
* Minimum CIE marks (Theory as well as Lab) $\geq$ 10.0 to gain eligibility to write the SEE						

**The choice questions have to be provided in Unit I and Unit IV**

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**BMS COLLEGE OF ENGINEERING, BENGALURU-19**  
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**INSTITUTIONAL ELECTIVE OFFERED BY THE DEPARTMENT OF CHEMISTRY**

<b>Course Name</b>	<b>Corrosion Science &amp; Engineering</b>	<b>Course Code</b>	<b>17CY8IECSE</b>
<b>Credits</b>	<b>03</b>	<b>L-T-P-S</b>	<b>3- 0 -0-0</b>
<b>Contact hours</b>	<b>40</b>	<b>Faculty Handling</b>	<b>Dr.Kalyan Raj</b>

**Course Objectives**

- Study of corrosion principles and their role in understanding different types of corrosion problems
- To gain the knowledge of types of corrosion in applying corrosive techniques to protect faster corrosion and monitoring of corrosion.
- Study of corrosion and different forms of corrosion to understand the failure of metal structures.
- Explore the different corrosion testing methods to measure the corrosion rate.
- To understand various techniques involved in design rules, coatings and other techniques in corrosion control.

<b>Course outcomes:</b> On completion of the course, the student will have the ability to:		<b>POs Mapped</b>	<b>Strength of Mapping</b>
CO1	Apply the principles of Chemistry in monitoring and controlling various forms of corrosion	PO1	1
CO2	Apply the acquired knowledge of corrosion to solve the Engineering structural problems.	PO3	2
CO3	Analyse the problems and draw meaningful inferences from corrosion testing	PO3	2

**The choice questions are to be provided in Unit II and Unit IV**

**SYLLABUS:**

**Unit – I**

**Corrosion Principles:** Introduction, definition, environment. Corrosion damage. Classification, electrochemical reactions. Polarization passivity. Faradays laws of electrolysis, application, and problems. Thermodynamics: Free energy change. Electrode potentials, e.m.f Nernst equation. Environmental effects. Effect of O<sub>2</sub>, oxidizer, velocity, temperature. Corrosion concentration, galvanic coupling. Metallurgical aspects. Numericals. **8hrs**

**Unit – II**

**Types of corrosion-1:** Uniform attack, galvanic corrosion, definition, Galvanic series, environmental effects, distance and area effect. Prevention, crevice corrosion, definition, environmental effects, mechanism. Filiform corrosion, mechanism, prevention, definition, environmental effects. Pitting corrosion, mechanism, prevention, definition, environmental effects.

Solution composition, velocity, evaluation of damage, prevention. Inter granular corrosion, definition, austenite SS. Weld decay. Control for austenite SS, knife line attack. Selective leaching. Dezincification. Type's mechanism, prevention. **8hrs**

### Unit – III

**Types of corrosion-2:** Erosion corrosion: definition, effect of surface film Velocity of environment, impingement, galvanic effect control of erosion corrosion. Cavitation damage. Fretting corrosion. Wear-oxidation and oxidation – wear mechanisms. Corrosion fatigue, definition, environmental factors, mechanism. Hydrogen damage, prevention, classification. Bio and soil corrosion. **8hrs**

### Unit – IV

**Corrosion testing and monitoring:** Introduction, classification. Purpose of corrosion testing, materials, specimen. Surface preparation, measuring and weighing. Types of testing, lab, pilot plant and field tests. Measurement of corrosion rate, weight loss method. Electrochemical methods, Tafel extrapolation. Linear polarization method, cleaning specimen after exposure. Effect of temperature, std. expression for corrosion rate. Application, numericals. **8hrs**

### Unit – V

**Corrosion control:** Selection of materials, alteration of environment, temperature. Medium, velocity, removal of oxygen. Design, wall thickness, design rules. Cathodic protection, principles, procedure. Anodic protection, principle procedure, comparison. Metallic and other inorganic coatings, Cladding, vapour phase deposition, diffusion, chemical conversion coating. Surface modification, organic coating. Corrosion inhibitors. **8hrs**

#### Text Books:

1. M.G. Fontana, Corrosion Engineering, Tata McGraw-Hill Edition 2005

#### Reference Books:

1. Engineering Chemistry by B.K.Sharma. Edition: 6th Edition, 2011. Publisher: Krishna Prakashana Media (p) Ltd.
2. Electrochemistry and corrosion science, Nestor Perez, Springer (India) pvt.Ltd. 2004
3. Principles and prevention of corrosion, D.A.Jones, Macmillan Publ.Co. (1996)
4. Corrosion Handbook, Electrochemical society series. John Wiley and sons. (2000)

#### MOOCs:

<https://www.mooc-list.com/tags/engineering>  
[www.mooc-list.com/.../materials-and-materials-processing-saylororg](http://www.mooc-list.com/.../materials-and-materials-processing-saylororg)

#### Scheme and evaluation:

Component	Type of assessment	Max. Marks	Weightage	Total	Total Marks
CIE - Theory	Quiz 1	10	10	50*	50 (CIE)
	Quiz 2	10			
	Test 1	40	40		
	Test 2	40			
	Test 3	40			
SEE	End Exam	100	50		50 (SEE)
<b>Grand Total Marks</b>					<b>100</b>
<b>* minimum CIE marks (Theory) ≥ 10.0 to gain eligibility to write the SEE</b>					



# BMS COLLEGE OF ENGINEERING, BENGALURU-19

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## INSTITUTIONAL ELECTIVE OFFERED BY THE DEPARTMENT OF CHEMISTRY

Course Name	Industrial Engineering Materials	Course Code	19CY8IEIEM
Credits	03	L-T-P-S	3- 0 -0-0
Contact hours	40	Faculty handling	Dr. Srinidhi Raghavan.M

### Course Objectives:

The fundamental of the course is to:

- ❖ Deliver basic knowledge of Engineering Materials
- ❖ Demonstrate the importance of materials in Industrial Engineering prospective
- ❖ Brief about the techniques and analysis to make new type of materials
- ❖ Instruct significance of materials quality and its applications in Industrial aspects

A	Course Outcomes: At the end of the course the student will have
CO1	An ability to understand the importance of materials in Industrial prospective
CO2	To apply the learnt knowledge and select suitable materials for specific applications
CO3	Develop the skill to solve the material related glitches in Industrial aspects

### Unit – I

**Engineering materials:** Introduction, classification and properties and applications of Engineering materials: Glass, Refractories, Abrasives, Insulating materials, and nanocomposites, Lubricants and Biomaterials. **Glass:** Properties of Glass- Physical and Chemical properties – Devitrification- Causes and preventions – Manufacture of glass- - Types of glasses - Preparation of Silica glass and its properties. Application of Glass in Industrial prospective. **(8 hours)**

### Unit-II

**Refractories:** Introduction, Classification and characteristics – Manufacturing of refractories –Silica bricks (Acidic refractories) and Fireclay refractories- Seger cone test –refractoriness under load- Thermal expansion and contraction- Chemical inertness- Thermal conductivity- Abrasion and erosion. Failure of a refractory materials and it is applications. **Abrasives:** Introduction–Properties–Classifications and applications. **(8 hours)**

### Unit-III

**Insulating Materials:** Introduction – Properties- Factor affecting insulation Resistance-Electrical Insulators – Importance of electrical insulators and its applications. **Semiconductor materials:** Introduction-types and Classifications-Applications. **(8 hours)**

## Unit- IV

**Sensors:** Introduction – Classifications-Solid state sensors – Electrochemical sensors- Biosensors– Monitoring Sensors-with examples and applications- Types of Sensors (Temperature, IR, UV, Touch and proximity sensors) – Principle and working and applications.

**Biomaterials:** Introduction- Bioactivity- Structural Hierarchy-Self-assembly – Biocompatibility- Biopolymers- Applications.  
(8 hours)

## Unit-V

**Lubricants:** Introduction- Functions of lubricants- Types of lubricants- Classification of lubricants (Liquid – Semisolid – solid)- Synthetic lubricant. Properties of lubricants (viscosity – Flash and fire point)- Applications of lubricant in industrial prospective.  
(8 hours)

### Text Books:

1. Materials Science and Engineering (A first course by Raghavan V.)
2. Material Science and Metallurgy (U.C. Jindal, Indian Edition)

### Reference Books:

1. Engineering Chemistry by Shikha Agarwal. Edition: 6th Edition, 2018. Publisher: Cambridge.
2. Materials Science and Engineering by R. Balasubramaniam: 2<sup>nd</sup> Edition. Publisher: Wiley.

MOOCS : <https://nptel.ac.in/courses/112/108/112108150/>

### Scheme and evaluation:

Component	Type of assessment	Max. Marks	Weightage	Total	Total Marks
CIE - Theory	Quiz 1	10	10	50*	50 (CIE)
	Quiz 2	10			
	Test 1	40	40		
	Test 2	40			
	Test 3	40			
SEE	End Exam	100	50		50 (SEE)
<b>Grand Total Marks</b>					<b>100</b>
<b>* minimum CIE marks (Theory) <math>\geq</math> 10.0 to gain eligibility to write the SEE</b>					

BMS COLLEGE OF ENGINEERING, BANGALORE

Autonomous Institute, Affiliated to VTU

DEPARTMENT OF CHEMISTRY

<b>Course Title</b>	<b>Battery Materials and Technology</b>				
<b>Course Code</b>	<b>23CY8IEBMT</b>	<b>Credits</b>	<b>03</b>	<b>L – T – P</b>	<b>3 – 0 – 0</b>
<b>CIE</b>	<b>100 marks (50% weightage)</b>	<b>SEE</b>	<b>100 marks (50% weightage)</b>		
<b>Faculty Handling</b>	<b>Dr. Manjunatha S</b>				

**Course Objectives:**

To impart fundamental knowledge of the principle, methodology and applications of various energy storage devices and recycling.

**Unit-I**

**Basic concepts**

**8Hrs**

Introduction, Origin of Energy Storage, Fossil Fuels and the Carbon Cycle, Necessity of Energy Storage, Classification of Energy Storage.

Supercapacitors and batteries: definition, basic components, working, classification with examples, characteristics and applications.

Supercapacitors vs. Batteries

**Unit-II**

**Materials for Energy storage Devices**

**8Hrs**

Materials for battery: Anode materials, Cathode Materials, Electrolytes, Separators, current collectors

Materials for supercapacitors: Electrode material, Electrolyte material, Current collector, Binder and Separators

Characterization of the materials

Safety Standards and testing,

**Unit-III**

**Common Batteries**

**8Hrs**

Primary Batteries: Zn-air battery, Zn-Ag<sub>2</sub>O, Zn-MnO<sub>2</sub> battery Construction, working, features and applications.

Secondary batteries: Lead-acid battery, Ni-Cd, Ni-Metal hydride battery, Construction, working, features and applications.

## Unit-IV

### Modern batteries and Applications

8Hrs

Li-ion and Na-ion battery: Construction, working

Li-S battery: Construction, working

Opportunities and Challenges of Li and Na ion batteries

Applications of Batteries: Storage of Solar-generated Electricity, Batteries in space, Storage in electricity supply network, Electric vehicles.

## Unit-V

### Battery Recycling

7 Hrs

Battery types for recycling, Current state-of-the-art of battery recycling, Battery cell disassembling, Pyrometallurgical processes, Hydrometallurgical processes, Challenges related to sustainability of battery recycling, Key industrial activities on battery recycling, Ecological aspects.

### Reference books:

1. Battery Reference Book, third Edition, T R Crompton, 2000
2. The handbook of lithium – ion battery pack design: Chemistry, components, types and terminology, John Warner (Elsevier)
3. Electrochemical energy: Advanced materials and technologies, Edited by J Zhang (CRC press)

### Text Books:

1. UNDERSTANDING BATTERIES, Ronald M Dell and David A J Rand

### MOOCs:

[https://onlinecourses.nptel.ac.in/noc21\\_mm34/preview](https://onlinecourses.nptel.ac.in/noc21_mm34/preview)

### Scheme of Evaluation:

Component	Type of assessment	Max. Marks	Weightage	Total	Total Marks
CIE - Theory	AAT	10	10	50*	50 (CIE)
	Test 1	40	40		
	Test 2	40			
	Test 3	40			
SEE	End Exam	100	50		50 (SEE)
<b>Grand Total Marks</b>					<b>100</b>
<b>* Minimum CIE marks (Theory) <math>\geq</math> 20.0 to gain eligibility to write the SEE</b>					

<b>Course outcomes:</b> On completion of the course, the student will have the ability to:	
<b>CO1</b>	Understand and apply the principles of energy storage devices
<b>CO2</b>	Apply the Engineering knowledge to fabricate materials for energy storage devices.
<b>CO3</b>	Use sustainable material to fabricate the reusable batteries
<b>CO4</b>	Engage in lifelong learning and application of advanced technologies in secondary battery.



# B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute, Affiliated to VTU

## Department of chemistry

BATCH 2022-23 Onwards

<b>COURSE TITLE:</b> ENVIRONMENTAL DISASTER MANAGEMENT AND MITIGATION	<b>Course Code:</b> 23CY8IEEDM	<b>Credits:</b> 03
<b>L:T:P:</b> 3:0:0	<b>Contact Hours:</b> 40	<b>Hours/Week:</b> 03

### Course Objectives:

- Understand the various types of natural resources and problems due to over exploitation of natural resources
- Assess various aspects of waste management practiced in industries.
- Analyze various factors which cause environmental pollution and their control measures

### Course Content

#### Unit-1

##### Fundamentals of Environmental Pollution

08 hours

Ecology – Ecosystem (Definition, components, types) Ecological Succession (Definition, types), producers, consumers and decomposers, Ecological Pyramid, Ecological bioremediation

##### Global effects of pollution –

Ozone - Importance, formation, depletion, remedial measures.

Greenhouse effect - Definition, sources, consequences and remedial measures

Acid rain - Definition, formation, consequences and remedial measures

Photochemical Smog - Definition, formation, consequences and remedial measures

Radioactive waste - Definition, classification, Disposal methods, Radioactive sensors (Geiger-Muller counter and scintillation counter)

##### **Practical topic:**

Students should conduct the case study of any local pollution issue and suggest remedial measure as an assignment

#### Unit-2

##### Water & Wastewater Treatment and Management

08 hours

Water Resources contamination – Sources of water, Classification of impurities in water, Total Hardness of water, Disadvantages of hardness of water.



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## Department of chemistry

Water analysis – Hazardous elements, Determination of Nitrates in water (Colorimetric method), DO Oxygen sag curve, BOD and COD, Experimental determination of COD of waste water, numerical problems on COD.

Water treatment – Potable water, softening of water by ion exchange process, Construction and working of water treatment plant (primary, secondary and tertiary), Desalination (Reverse osmosis and Electrodialysis), Application of Nanotechnology in Water treatment

Water conservation – Artificial groundwater recharge, Remote Sensing for watershed management, Rain water harvesting in rural and urban areas.

<b>Practical topic:</b>	Students should conduct the case study of any local Rain water harvesting system and storage area
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### Unit-3

#### Atmospheric pollution and management

08 hours

Atmosphere — Structure of the atmosphere, Composition of urban atmosphere, Criteria pollutants, air quality indices.

Atmospheric pollutants — Classification, oxides of Sulphur, Nitrogen and Carbon, effects of air pollution, Control methods for gaseous pollutants (SO<sub>2</sub> and automobile emission)

Gas sensors — Construction and working of sensor, Electrochemical sensors for NO<sub>x</sub>

Control methods for particulate pollutants — Gravitational settling chambers, cyclone separators, wet collectors, fabric filters (Bag-house filter), electrostatic precipitators (ESP).

<b>Practical topic:</b>	Students should conduct a survey on regulations on automotive emission controls, fuel quality, and catalytic convertors
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### Unit-4

#### Solid and Hazardous Waste Management

08 hours

Land disposal of hazardous waste – Introduction, Classification of methods, Land filling (site selection & design) and Underground injection.

E-Waste management – Introduction, sources of e-waste, Composition, Characteristics, and Need of e-waste management. Toxic materials used in manufacturing electronic and electrical products; Recycling and Recovery: Different approaches of recycling (separation, hydrometallurgical extraction, pyrometallurgical methods). Recycling of Li-Ion batteries. Extraction of copper from E-waste.

Bio-waste processing – Definition, advantages, limitations and applications of Composting, Biomethanation, Biohydrogen,



# B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute, Affiliated to VTU

## Department of chemistry

Emerging Technologies in Waste Management – Smart Waste Collection and SCADA systems,

**Practical  
topic:**

Students should conduct a survey on Rules and regulations for solid waste management in India.

### Unit-5

#### Sustainable Development

08 hours

Introduction, goals of sustainable development, challenges of sustainability

Solar cells – Construction and working of Si based PV cell, advantages and disadvantages.

Quantum Dot Sensitized Solar Cells (QDSSC's) - Principle, Properties and Applications.

Hydrogen as a fuel – Importance, Advantages and disadvantages, Production by electrolysis of water and storage using metal hydrides

Biodiesel – Definition of Biodiesel, Production and advantages of Biodiesel.

Green Chemistry - Introduction, principles of green chemistry, Numerical on atom economy.

**Practical  
topic:**

Students should conduct a survey on status of alternative fuels for different purposes worldwide and implementation of IoT.

#### Text Books

1. Arcivala S J, and S R Asolekar, Wastewater Treatment for Pollution Control and Reuse, 3<sup>rd</sup> Edition, ISBN-13-978-0-07-062099-5, Tata McGraw Hill Pvt Ltd., New Delhi, 2009.
2. George Tchobanoglous et al, Integrated Solid Waste Management, 2<sup>nd</sup> Edition, ISBN 10.0070632375 McGraw Hill Book Company, New York, 1993.
3. C S Rao Environmental Pollution Control and Engineering, ISBN 0470217634 New age international Pvt Ltd, New Delhi, 2009

#### Reference Books

1. Jagbir Singh and A L Ramanathan (Eds), Solid Waste Management- Present and Future Challenges, ISBN 9380026420, I K International House Pvt Ltd., New Delhi, 2010.
2. Metcalf and Eddy, Wastewater Engineering-Treatment, Disposal & Reuse, ISBN 0070418780, Tata McGraw Hill, Book Company, New Delhi, 1991.
3. H E Babbilt and R Baumann, Sewage and Sewage Treatment, ISBN 0-07-112250-81986.
4. Martell, Solid Wastes, John Wiley & sons, New York, 1975.
5. Frank Krieth, Handbook of Solid Waste, ISBN 0071500340 McGraw Hill Inc., New York, 1996
6. White, F. R., Franke P. R., & Hindle M., Integrated solid waste management: a life cycle inventory. McDougall, P. John Wiley & Sons. 2001.
7. Nicholas, P., & Cheremisinoff, P. D., Handbook of solid waste management and waste minimization technologies, Imprint of Elsevier Science. 2005



# B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute, Affiliated to VTU

## Department of chemistry

Online resources: NPTEL/SWAYAM/MOOCs

<b>Course outcomes:</b> On completion of the course, the student will have the ability to:	
<b>CO1</b>	Understand the problems due to over exploitation of natural resources.
<b>CO2</b>	Analyze the problems and draw meaningful inferences through surveying various factors which cause environmental pollution.
<b>CO3</b>	Implement sustainable physical and chemical treatment methods to control pollution
<b>CO4</b>	Apply the knowledge of technologies to process waste and dispose waste and deliver effective oral presentation on environmental issues.
<b>CO5</b>	Apply the knowledge of environmental studies, interpret the data to assess and address the issues of Environmental Pollution

### Scheme of Evaluation

Component	Type of assessment	Max. Marks	Weightage	Total	Total Marks
Theory	AAT <sup>#</sup> (Alternative Assessment Tool)	20	5	25	25
	Test 1	40	Best of Two tests		
	Test 2	40			
	Test 3	40			
	CIE	50	15		
SEE	Sem End Exam	100	50		50 (SEE)
<b>Grand Total Marks</b>					<b>100</b>
#AAT includes assignment from self-study components					
*minimum CIE marks $\geq 20$ to gain eligibility to write the SEE					

BMS COLLEGE OF ENGINEERING, BANGALORE

Autonomous Institute, Affiliated to VTU

DEPARTMENT OF CHEMISTRY

<b>Course Title</b>	<b>Surface Finishing and Engineering</b>				
<b>Course Code</b>	<b>23CY8IESFE</b>	<b>Credits</b>	<b>03</b>	<b>L – T – P</b>	<b>3 – 0 – 0</b>
<b>CIE</b>	<b>100 marks (50% weightage)</b>	<b>SEE</b>	<b>100 marks (50% weightage)</b>		
<b>Faculty Handling</b>	<b>Dr. K L Nagashree</b>				

**Course Objectives:**

To impart knowledge of the principle, methodology and applications of various surface finishing and engineering technologies used in industries.

**Unit-I**

Surface Finishing: Meaning, Technological importance of surface finishing; Units; Measurement of surface roughness; Surface finishing industrial standards; Symbols of surface finishing; Common surface finishing process; Criteria for choosing a method of surface finishing; disadvantages.

Pre-treatment methods: Purpose.

Chemical pre-treatment-water rinsing, vapour degreasing, ultrasonics, pickling.

Mechanical pre-treatment- polishing and buffing, abrasives, belt polishing, blast finishing.

Electrochemical pre-treatment-Anodic and cathodic electrocleaning.

**8Hrs**

**Unit-II**

Conventional surface modification methods: flame hardening, induction hardening, high energy beam hardening, diffusion assisted surface alloying.

Advanced surface modification methods: Laser, Plasma and electron beam assisted surface modification.

**8Hrs**

**Unit-III**

Surface Conversion Coatings: Chromating, phosphating, anodizing. Oxidation treatments, Carburizing, Nitriding, Carbonitriding and Ferritic Nitrocarburizing, pack cementation, ion implantation and laser alloying.

Organic Coatings-Paints. Ceramic coatings and Linings.

**8Hrs**

#### Unit-IV

Surface Coating by Physical Routes: Physical vapor deposition (Thermal evaporation, sputtering and Ion Plating), pulsed laser deposition, cathodic arc evaporation.

Surface Coating by chemical Routes: Chemical vapor deposition, laser assisted chemical vapor deposition.

Thermal Spraying (flame spraying, HVOF spraying, wire arc spraying, kinetic spraying)

Laser surface cladding.

**8Hrs**

#### Unit-V

Hot dipping Coatings-Galvanization, Tinning, Aluminium Coatings.

Electroplating: Definition, Principle, bath parameters, electroplating of hard and decorative chromium, nickel, gold, tin-lead alloy.

Electroless plating: Definition, Principle, bath parameters, electroless plating of nickel.

Electroless composite plating.

**7 Hrs**

#### Text Books:

1. **Metal Finishing-** Editor: Michael Murphy, 2000, Volume 98.
2. **Metal Finishing-** Editor: Reginald E. Tucker, 2012, Volume 110

#### MOOCs:

[https://onlinecourses.nptel.ac.in/noc23\\_mm21/preview](https://onlinecourses.nptel.ac.in/noc23_mm21/preview)

#### Scheme of Evaluation:

Component	Type of assessment	Max. Marks	Weightage	Total	Total Marks
CIE - Theory	AAT	10	10	50*	50 (CIE)
	Test 1	40	Best of Two test		
	Test 2	40			
	Test 3	40			
SEE	End Exam	100	50		50 (SEE)
<b>Grand Total Marks</b>					<b>100</b>
<b>* minimum CIE marks (Theory) <math>\geq</math> 10.0 to gain eligibility to write the SEE</b>					

	<b>Course outcomes:</b> On completion of the course, the student will have the ability to:	<b>POs Mapped</b>	<b>Strength of mapping</b>
CO1	<b>Apply</b> the acquired knowledge of surface finishing techniques to solve Engineering problems related to material maintenance.	PO1	3
CO2	<b>Analyze</b> the various surface engineering techniques and arrive at suitable technique for surface protection.	PO2	2
CO3	Implement <b>sustainable solutions</b> through surface finishing techniques to improve the life of materials used in industries.	PO7	2
CO4	Engage in <b>lifelong learning</b> and application of advanced technologies in surface finishing and engineering.	PO1, PO12	1 each