



मौलाना आज़ाद राष्ट्रीय प्रौद्योगिकी संस्थान भोपाल

Maulana Azad National Institute of Technology Bhopal

(भारत सरकार, शिक्षा मंत्रालय के अधीन राष्ट्रीय महत्व का संस्थान)
(An Institution of National Importance under MoE, Govt. of India)

Name of Program	B. Tech.
Name of Course	ENGINEERING CHEMISTRY
Course Code	CY1107/CY1207
Core / Elective / Other	CORE
Credit	3
Prerequisite:	
1.	Student should have sound knowledge of basics of chemistry, like atomic structure, bonding, chemical reactions, periodic table, their properties etc.
2.	Student should have the capability to understand how chemistry can explain various concepts of technology.
3.	Basic mathematics for doing calculations and numerical problems is desired.
Course Outcomes:	
1.	Upon successful completion of the course the student will be able to: Acquire knowledge about the municipal water and water softening.
2.	Understand fundamentals of solid, liquid and gaseous fuels.
3.	Learn various mechanism and properties of liquid, semi-solid and solid lubricants.
4.	Learn concept of corrosion, its mechanisms and methods of control and prevention.
5.	Enhance knowledge on the preparation and properties of polymers and cement.
Description of Contents in brief:	
1.	<u>LUBRICANTS</u> - Role and Effects of Friction, Functions of Lubricants, Mechanisms of Lubrication – Thick Layer, Thin layer and Extreme Pressure Lubrication. Liquid, Solid and Semi-solid Lubricants: their Physical and Chemical Properties, Importance and Testing; Examples and Their Structures; Lubricating Emulsions; Cutting Fluids; Selection of Lubricants for light and heavy machinery
2.	<u>FUELS</u> - Calorific value, Classification and Characteristic of a Good Fuel, Comparison between Solid, Liquid and Gaseous Fuels, Determination of Gross and Net Calorific Value by Bomb Calorimeter. Classification, Selection Criteria, Proximate and Ultimate Analysis of Coal, Pulverized Coal. Classification of Petroleum, Types of Cracking, Knocking, Octane and Cetane Number. Numerical problems related to caloric value and ultimate analysis.
3.	<u>WATER</u> - Sources of water, Specifications of Drinking Water, Step-wise procedure for Purification of water, Difference between Disinfection and Sterilization–Classification and Disadvantages of Hardness, Caustic Embrittlement, Boiler Corrosion, Priming and Foaming, Scale and Sludge formation: Prevention (Internal & External Treatments). Softening Methods: Lime-Soda Processes (cold and hot both), Zeolite Process, Ion-Exchange Process. Numerical problems related to purification of water.
4.	<u>MATERIALS</u> Types of Polymerization, Mechanism of Addition Polymerization and coordination polymerization, Molecular weight determination of Polymers, Thermosetting & Thermoplastic Polymers, Methods of Moulding of Plastics, Preparation, Properties and Uses of Thermoplastic Resins, Thermosetting Resins and Synthetic Rubbers. Classification and Vulcanization of Rubber, Polymer Composites, Polymers for biomedical applications.



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	Classification, Raw Materials, Gypsum, Manufacture of Portland Cement (Both Wet and Dry Process), Chemical Composition and Constitution of Cement, Setting and Hardening of Cement, Significance of lime saturation factor and silica modulus. Special Cements: Aluminous Cement, High Early Strength Cement, White Portland Cement, Water Proof Cement. Concrete and RCC
5.	<u>CORROSION AND ITS CONTROL</u> Mechanism of Chemical and Electrochemical Corrosion, Galvanic Corrosion, Concentration Cell Corrosion, Passivity, Soil Corrosion, Pitting Corrosion, Inter-granular Corrosion, Waterline Corrosion, Stress Corrosion, Galvanic Series, Factors influencing Corrosion, Ways to protect against Corrosion. Protective Coatings, Anodic and Cathodic Coatings.
List of Text Books:	
1.	Engineering Chemistry by Jain and Jain
2.	Engineering Chemistry by S.S. Dara
3.	Engineering Chemistry by B.K. Sharma
4.	Engineering Chemistry by Shashi Chawla
List of Reference Books:	
1.	Engineering Chemistry by Shikha Agarwal; Cambridge University Press, 2015 edition.
2.	Engineering Chemistry of Wiley India Pvt. Ltd., Vairam and others, 2014 edition (second).
3.	Engineering Chemistry by PrasanthRath, Cengage Learning, 2015 edition.
4.	Applied Chemistry by H.D. Gesser, Springer Publishers
5.	B. Siva Shankar, "Engineering Chemistry", Tata Mc Graw Hill Publishing Limited, 3rd Edition, 2015.
6.	C. V. Agarwal, C. P. Murthy, A. Naidu, "Chemistry of Engineering Materials", Wiley India, 5th Edition, 2013.
7.	R. P. Mani, K. N. Mishra, "Chemistry of Engineering Materials", Cengage Learning, 3rd Edition, 2015.
Lecture Plan (about 42 Lectures):	
Lecture No.	Topic
	LUBRICANTS
Lecture 1	Introduction, Role and Effects of Friction, Functions of Lubricants.
Lecture 2	Mechanism of Lubrication – Thick Layer, Thin layer and Extreme Pressure
Lecture 3	Lubrication.
Lecture 4	Physical and Chemical Properties of oils, Their Importance and Testing.
Tutorial	Physical and Chemical Properties of oils, Their Importance and Testing.
Lecture 5	Problems based on topics covered in above four lectures and discussions. Liquid Lubricants: Detailed classification of Vegetable Oils, Animal Oils, Mineral
Lecture 6	Oils, Blended and Synthetic Oils. Semi-solid Lubricants: Examples, Physical and Chemical Properties, Their
Lecture 7	Importance and Testing.
Lecture 8	Solid Lubricants: Examples and Their Structures, Biodegradable Lubricants.
Tutorial	Lubricating Emulsions; Cutting Fluids; Selection of Lubricants. Problems based on topics covered in above three lectures and discussions



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Fuels	
Lecture 1	Introduction, Classification, Calorific value, Characteristic of a Good Fuel,
Lecture 2	Comparison between Solid, Liquid and Gaseous Fuels. Numerical Problems based on Calorific Value.
Lecture 3	Bomb Calorimeter, Numerical Problems based on calorimeter.
Lecture 4	Coal: Classification, Selection Criteria, Proximate Analysis, Numerical Problems based on Proximate Analysis.
Tutorial	Problems based on topics covered in above three lectures and discussions.
Lecture 5	Ultimate Analysis of coal, Numerical Problems based on Ultimate Analysis. Pulverized Coal. Petroleum: Classification and separation.
Lecture 6	Types of Cracking.
Lecture 7	Knocking, Octane and Cetane Number.
Lecture 8	LPG, Natural Gas, Producer Gas, Water Gas, Bio Gas.
Tutorial	Problems based on topics covered in above three lectures and discussions.
Water	
Lecture 1	Introduction, Sources of water, Specifications of Drinking Water.
Lecture 2	Steps for Purification of water, Screening Process, Sedimentation, Sedimentation with Coagulation.
Lecture 3	Filtration and Disinfection. Difference between Disinfection and Sterilization.
Lecture 4	Break Point Chlorination, Hardness: Units and Disadvantages.
Tutorial	Problems based on topics covered in above three lectures and discussions.
Lecture 5	Scale and Sludge formation: Disadvantages, Prevention (Internal & External Treatments), Caustic Embrittlement.
Lecture 6	Boiler Corrosion, Priming and Foaming.
Lecture 7	Softening Methods: Lime-Soda Processes (cold and hot both).
Lecture 8	Zeolite Process, Ion-Exchange Process.
Tutorial	Numerical problems based on Lime-Soda Processes and water analysis
Materials	
Lecture 1	Polymer: Introduction, Nomenclature, Functionality, Types of Polymerization, Mechanism of Addition Polymerization.
Lecture 2	Thermosetting & Thermoplastic Polymers, Methods of Moulding of Plastics.
Lecture 3	Thermoplastic Resins: Polyethylene, Polypropylene, Polyvinylchloride, Polyvinyl Acetate, Polystyrene, Polymethyl Methacrylate.
Lecture 4	Polytetrafluoroethylene, Nylon-6:6, Kevlar. Thermosetting Resins, Polyurethane, Epoxy Resin, Alkydes etc.
Tutorial	Problems based on topics covered in above three lectures and discussions.
Lecture 5	Bakelite, Silicone Resins, Polymer Composites. Rubber: Classification, Vulcanization, Synthetic Rubbers (Buna-S, Buna-N), PANVC, ABS etc.
Lecture 6	Cement: Introduction, Classification, Raw Materials, Gypsum, Manufacture of Portland Cement (Both Wet and Dry Process).
Lecture 7	Chemical Composition of Cement, Chemical Constitution of Cement, Setting and Hardening of Cement.
Lecture 8	Special Cements: Aluminous Cement, High Early Strength Cement, White Portland Cement, Water Proof Cement, Physical Requirements of Cement, Introduction of Concrete and RCC.
Tutorial	Problems based on topics covered in above three lectures and discussions.



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	CORROSION AND ITS CONTROL
Lecture 1	Introduction and Mechanism of Chemical and Electrochemical Corrosion. Galvanic
Lecture 2	Corrosion, Concentration Cell Corrosion, Passivity, Soil Corrosion.
Lecture 3	Pitting Corrosion, Intergranular Corrosion, Waterline Corrosion, Stress Corrosion.
Lecture 4	Galvanic Series, Factors influencing Corrosion, Ways to protect against Corrosion.
Tutorial	Problems based on topics covered in above three lectures and discussions.
Lecture 5	Introduction of Protective Coatings, Metallic Coatings.
Lecture 6	Introduction of Anodic and Cathodic Coatings, Methods of application of Metal coatings.
Lecture 7	Objectives and theory of Electroplating.
Lecture 8	Chemical Conversion Coatings, Paints, Varnishes and Enamels.
Tutorial	Problems based on topics covered in above three lectures and discussions.



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Name of Program	B.Tech.
Name of Course	ENVIRONMENTAL SCIENCE
Course Code	CY1110/CY1210
Core / Elective / Other	CORE
Credit	2
Course Learning Objectives: The course will enable the students to	
- To identify the major challenges in environmental issues and evaluate possible solutions. - Develop analytical skills, critical thinking and demonstrate socio-economic skills for sustainable development. - To analyze an overall impact of specific issues and develop environmental management plan.	
UNIT-1 <u>NATURAL RESOURCES AND ASSOCIATED PROBLEMS</u>	
Renewable and Non-renewable Resources and problems associated with them. Forest: Deforestation, mining, dams, and their effects. Water: Use and overutilization, floods, drought, conflicts over water, and dams. Mineral: Use and exploitation, environmental effects of extracting, and using mineral resources. Food: World food problems, Effects of modern agriculture, Fertilizer and pesticide problems, Water logging and salinity, and Genetic diversity loss. Energy: Solar, wind, and Hydropower, Tidal, Geothermal, and Biomass energy, Bio-gas and Hydrogen as fuel; Coal, petroleum, natural gas, and nuclear energy.	
UNIT-2 <u>AIR POLLUTION</u>	
Concept of spheres of Atmosphere, Photochemical Smog, Sources and effects of Air Pollutants, Oxides of Carbon, Nitrogen and Sulphur, Ozone and Hydrocarbons. Effect of Air Pollutants on living and non-living beings and on the climate. Brief discussion on the control of Gaseous and Particulates Pollutants: Absorption, Adsorption, Combustion, and Emission.	
UNIT-3 <u>WATER POLLUTION</u>	
Introduction, Hydrosphere and its importance, Point and Nonpoint sources of Water Pollution, Classification and effects of Water Pollutants: Sewage, pathogens, plant nutrients, Organic and Inorganic chemicals, Radioactive elements, <i>etc.</i> , Effect of Water Pollution: Prevention and Control, Preliminary, Primary, and Secondary Steps of Wastewater Treatment.	
UNIT-4 <u>OTHER POLLUTIONS</u>	
Sources, effects and control of Soil Pollution, Noise Pollution, Thermal and Radioactive Pollution, Solid Waste Management: Classification and origin, methods of waste disposal.	



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UNIT-5

ENVIRONMENTAL MANAGEMENT

Carbon Footprint: Analysis and ways of minimization; Life Cycle Assessment: Procedure and importance; Methodology, Role and Limitations of Environmental Impact Assessment; Important Environmental Laws: The Forest Conservation Act-1980, Water (PCP) Act-1974 and 1977, Air (PCP) Act-1981 and EPA-1986; Basic principles, importance of Sustainability and ten commandments of Green Chemistry.

List of Text Books:

Environmental Pollution by S. M. Shafi, Atlantic publishers and distributors, 2005, First Edition.

Environmental Engineering and Management by Suresh K. Dhameja, S. K. Kataria and sons, 2014, Second Edition.

Perspectives in Environmental Studies by Anubha Kaushik and C. P. Kaushik, New Age International Publishers, 2021, Seventh Edition

The Science of Environmental Pollution by Frank R. Spellman, CRC Press, 2021, Fourth Edition.

A textbook of Environmental Chemistry and Pollution Control by S. S. Dara, S. Chand and company Ltd., 2007, First Edition

List of Reference Books:

Environmental Chemistry by Anil Kumar De and Arnab Kumar De, New Age International Publishers, 2021, Tenth Edition.

Introduction to Environmental Engineering and Science by Gilbert M. Masters and Wendall P. Ella, Pearson Education India, 2015, Third Edition.

Textbook of Environmental Studies by Erach Bharucha, Universities Press (India) Private Limited, 2005, First Edition.

Environmental Pollution Control Engineering by C. S. Rao, New Age International Publishers, 2018, Third Edition.

URLs:

<https://nptel.ac.in/courses/123105001/>

<https://nptel.ac.in/courses/119106008/>

https://www.youtube.com/watch?v=4AuwG2G_ERU

https://nptel.ac.in/content/storage2/courses/122106030/Pdfs/1_1.pdf

<https://nptel.ac.in/courses/103/107/103107084/>

<https://www.asdlib.org/onlineArticles/ecourseware/Manahan/GreenChem-2.pdf>



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DETAILED LECTURE PLAN (about 26 Lectures)	
Lecture	Topics
NATURAL RESOURCES AND ASSOCIATED PROBLEMS	
Lecture 1	Forest Resources: Deforestation, Mining, Dams and their effectson forests, and Tribal people.
Lecture 2	Water Resources: Use and overutilization of surface and ground water, Floods, Drought, Conflicts over water.
Lecture 3	Mineral Resources: Use and exploitation, Environmental effects of extracting andusing mineral resources, Case Study: Sariska Tiger Reserve, Rajasthan.
Lecture 4	Food Resources: World food problems, Changes in land-use by agriculture andgrazing, Effects of modern agriculture, Fertilizer/pesticide problems, Water logging and salinity, and Loss of genetic diversity.
Lecture 5	Energy Resources: a) Renewable Sources: Solar energy, Wind energy, and Hydropower; b) Tidal energy, Geothermal energy, Biomass energy, Bio-gas and Hydrogen as fuel
Lecture 6	Non-renewable sources: Coal, Petroleum, Natural Gas, and Nuclear Energy. Causesof increasing energy needs.
AIR POLLUTION	
Lecture 1	Concept of spheres of atmosphere and lapse rate; Photochemical smog.
Lecture 2	Natural and Man-made Sources of Air Pollution: a) Origin, Functioning, and Effects of Particulate or particulate matters (PMs), Carbon monoxide and Oxides of Sulphur.
Lecture 3	b) Origin, Functioning, and Effects of oxides of Nitrogen, Ozone (Ozone depletion) and Hydrocarbons, Effect of air pollutants on humans, animals, plants, materials, and climate. Cases study of Bhopal Gas Tragedy and Ozone Hole Over Antarctica.
Lecture 4	Outline and schematic of control of Gaseous pollutants: a) Absorption (Equipment like Gas scrubber, Venturi scrubber, and Cyclone Scrubber); b) Adsorption (Equipment like Fixed-bed adsorber);
Lecture 5	c) Combustion (Equipment like Direct/Thermal/Catalytic incinerator); d) Emission (Equipment like Wet scrubber and Electrostatic precipitator)
WATER POLLUTION	
Lecture 1	Introduction of Hydrosphere and its importance. Point and nonpoint sources of water pollution: Domestic, Municipal, Industrial, and Agricultural.



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Lecture 2	Classification of water pollutants: a) Sewage, Pathogens, Plant nutrients, Effect of water pollution on humans, animals, and plants.
Lecture 3	b) Organic chemicals, Inorganic minerals, Sediments, Heat, and Radioactivity.
Lecture 4	Prevention and control of water pollution, Water conservation and Rainwater harvesting.
Lecture 5	Preliminary, Primary, and Secondary steps of wastewater treatment. Case study of Minamata Tragedy.
OTHER POLLUTIONS	
Lecture 1	Soil Pollution: Concept of Lithosphere, Causes, Effects, and Control measures.
Lecture 2	Noise Pollution: Sources, Effects, and Control of noise pollution.
Lecture 3	Thermal Pollution: Sources of surplus heat, Hazardous effect on aquatic system and ways of control. Case study of Chernobyl Nuclear Disaster.
Lecture 4	Solid waste management: Classification and origin, Methods of waste disposal.
ENVIRONMENTAL MANAGEMENT	
Lecture 1	Carbon Footprint: Analysis and ways of minimization.
Lecture 2	Life Cycle Assessment (LCA): Procedure and importance.
Lecture 3	Environmental Impact Assessment (EIA): a) Methodology and b) Role of EIA in Sustainable Development
Lecture 4 & 5	Important Environmental Laws: Salient features of The Forest Conservation Act, 1980; The Water (Prevention and Control of Pollution) Act, 1974 and 1977; The Air (Prevention and Control of Pollution) Act, 1981 and The Environment (Protection) Act, 1986. Case study of Silent Valley Hydroelectric Project.
Lecture 6	Basic principles, Importance of Sustainability, and Ten Commandments of Green Chemistry.



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Name of Program	B. Tech.
Name of Course	ENGINEERING CHEMISTRY LAB
Course Code	CY1126/CY1226
Core / Elective / Other	CORE
Credit	1
Prerequisite:	
1.	Student should be capable of handling glass-wares like burette, pipette etc., and minor equipment's like pH meter, weighing balance etc.
2.	Student should understand the sensitivity of working in the chemistry lab with utmost care so that no harm should come to him or others.
3.	Knowledge of basic mathematics is required.
Course Outcomes:	
1.	Upon successful completion of the course the student will be able to: Acquire basic analytical and technical skills to work effectively in the various fields of chemistry.
2.	Gain the ability to perform accurate quantitative measurements with an understanding of the theory.
3.	Able to present scientific and technical information resulting from laboratory experimentation in both written and oral formats.
4.	Acquire knowledge and understanding of the issues of safety regulations.
Description of Contents in brief:	
1.	Oxidation - Reduction Titrations Determination of strength of ferrous ammonium sulphate by using potassium ferricyanide as an external indicator. Determination of strength of ferrous ammonium sulphate by using diphenyl amine as an internal indicator.
2.	Iodometric Titrations Determination of strength of copper sulphate by using potassium iodide as a source of iodine. Determination of strength of potassium dichromate by using potassium iodide as a source of iodine.
3.	Water Analysis Determination of total alkalinity of water sample by standard acid method using methyl orange as an indicator. Determination of total hardness of water sample by EDTA solution using Eriochrome Black-T as an indicator. Determination of pH of tap water sample (Demonstration)
4.	Viscosity Testing Determination of viscosity of water and water-based solutions by Ostwald Viscometer. Determination of viscosity-index of lubricating oil by a. Red Wood Viscometer Number 1 b. Red Wood Viscometer number 2 Determination of drop point of semi solid lubricant. (Demonstration) Determination of consistency of semi solid lubricant. (Demonstration)



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5.	Determination of Flash and Fire point of liquid fuel and lubricants by a. Cleaveland's Open Cup Apparatus b. Abel's Flash Point Apparatus c. Pensky Martin's Flash Point Apparatus
6.	Determination of calorific value of a solid fuel using Bomb Calorimeter. (Demonstration)
List of Text Books:	
1.	A Textbook of Experiments and Calculations in Engineering Chemistry by S.S. Dara, S Chand & Company, 2015, ninth edition.
2.	A book of Practical Engineering Chemistry by A. Mittal, H. L. Kapoor and J. Mittal, Kedarnath Ramnath Publications, 2001, First edition.
3.	Experiments in Engineering Chemistry by Payal B. Joshi, Dreamtech Press, 2020, First Edition.
List of Reference Books:	
1.	Laboratory manual on Engineering Chemistry by S. K. Bhasin and Sudha Rani, Dhanpat Rai Publishing Company Private Limited, 2012, Third edition.
2.	Theory and Practical of Engineering Chemistry by Shashi Chawla, Dhanpat Rai Publishing Company Private Limited, 2009, First edition.