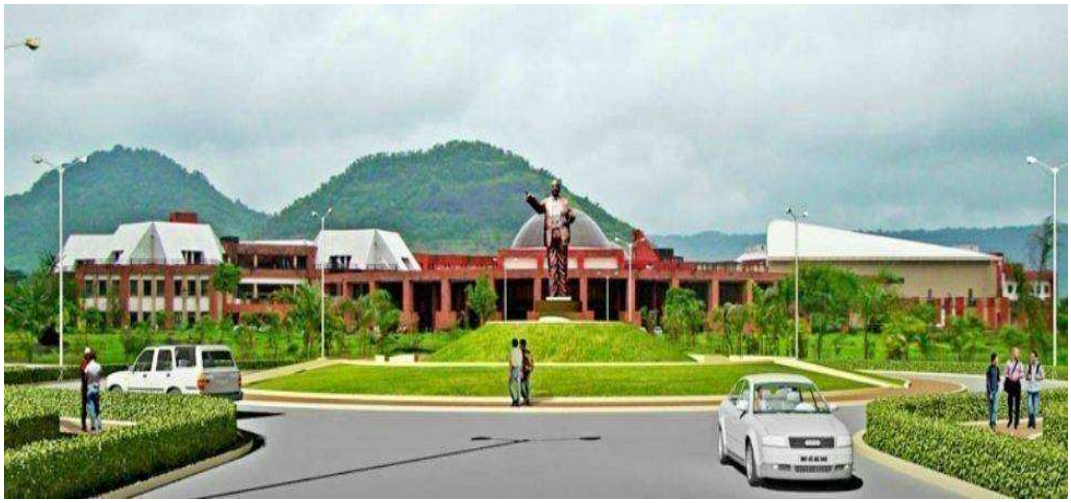
Dr. Babasaheb Ambedkar Technological University
(Under Maharashtra Act No. XXIX of 2014)
P.O. Lonere, Dist. Raigad, Pin 402 103, Maharashtra Telephone and Fax. 02140 - 275142
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POST GRADUATE CURRICULUM FOR ENVIRONMENTAL ENGINEERING AS PER NEP-2020

WITH EFFECT FROM THE ACADEMIC YEAR 2023-24



Dr. Babasaheb Ambedkar Technological University, Lonere

M. Tech. Course Structure for Environmental Engineering as per NEP-2020

With effect from academic year 2023-24

Sem	Course Code	Course Title	L	T	P	Cr	Category
Sem-I	23U2201PC101	Environmental Management	3	1	-	4	PCC
	23U2201PC102	Industrial Pollution Control - Water	3	-	-	3	PCC
	23U2201PC103	Industrial Pollution Control - Air	3	1		4	PCC
	23U2201PC104	Environmental Chemistry	3	-	-	3	PCC
	23U2201PE105	Program Elective – I A. Bioinformatics B. Process Engineering Principles	3	-	-	3	PEC
	23U2000RM106	Research Methodology	3	-	-	3	ELC
	23U2201PC107L	Environmental Monitoring Lab	-	-	2	1	PCC
	23U2201AU108	Stress Management with Yoga	2	-	-	-	Audit course
		Total	**17**	**3**	**2**	**21**	
Sem-II	23U2201PC201	Wastewater Treatment Plant Design	3	1	-	4	PCC
	23U2201PC202	Advanced Wastewater Treatment	3	1	-	4	PCC
	23U2201PC203	Energy Conversion & Environment	3	-	-	3	PEC
	23U2201PC204	Air Pollution Control Equipment Design	3	-	-	3	PEC
	23U2201PC205L	Computational Lab	-	-	2	1	PCC
	23U2201MP206	Mini Project	-	-	4	2	ELC
	23U2201HM207	Project Management / Intellectual Property Rights	2	-	-	2	-
	23U2201AE208	IKS Bucket A. History of Science and Technology in India B. Indian Art: Materials, Techniques and Artistic Practices C. Concepts and Applications in Engineering	2	-	-	2	IKS

		D. Humanities and Social Sciences					
	23U2201AU209	Disaster Management	-	-	-	-	Audit course
		Total	**18**	**2**	**6**	**21**	
Sem-III	24U2201PE301	Program Elective - II A. Enzyme Engineering B. Accident Prevention and Safety	3	-	-	3	PEC
	24U2201OE302	Open Elective A. Student Psychology B. Strategic Management – The Competitive Edge C. Business Environment D. Hospitality Industry in Tourism	3	-	-	3	OE
	24U2201AU303	Environmental studies	2	-	-	-	Audit course
	24U2201SE304	Seminar	-	-	4	2	ELC
	24U2201PR305	Project Work (Stage –I)	-	-	-	10	ELC
		Total	**9**	**-**	**-**	**18**	
Sem-IV	24U2201PR401	Project Work (Stage –II)	-	-	-	20	ELC
		Total	**-**	**-**	**-**	**20**	

SYLLABUS FOR SEMESTER-I

ENVIRONMENTAL MANAGEMENT

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the analogous environmental quality criteria and standards significant sources of water and air pollution
CO2	Students should learn to apply the Environmental Engineering concepts to control and management of various types of pollutants.
CO3	Understand the economic evaluation of environmental management programs
CO4	Students should learn to control significance of solid and hazardous wastes

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	√	-	-	-	-	-	-	-
CO2	√	√	-	-	-	-	-	-
CO3	√	√	-	-	-	-	-	-
CO4	√	√	-	√	-	-	-	-

Detailed Syllabus:

Unit 1: Methodology of Environmental management Review of National and International protocols.

Unit 2: Environmental quality criteria and standards significant sources of water and air Pollution and indices of Environmental quality – Survey and hot spot identification, preparation of management plan – Case studies of major river basin and metropolitan air quality improvement plans.

Unit 3: Noise control significance of solid and hazardous wastes, pesticide residuals and banned chemicals.

Unit 4: Economic evaluation of Environmental management programs – Economic incentives and disincentives as instruments for Environmental management – Tax, subsides, fee, tradable permits.

Unit 5: Policies on management of forests, coastal zones and land use planning.

Text / References:

1. Osencranz, S. Divan, M. L. Noble : Environmental law and policy in India Cases, Materials and Statues, Tripathi Pvt Ltd., Bombay, 1992.
2. S. Musharraf : Legal aspect of Environmental Pollution and its management. C. B. S. Publishers, Delhi 1992.
3. W. J. Banmol and W. E. Dates : The Theory of Environmental Policy – Cambridge University Press, 1988.

INDUSTRIAL POLLUTION CONTROL - WATER

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the Industrial wastewater characterization
CO2	Understand chemical oxidation, sludge dewatering and disposal methods
CO3	Understand method of Control of pollutants
CO4	Understand Control of water, Pollution from organic chemicals

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	√	-	-	-	-	-	-	-
CO2	√	√	-	-	-	-	-	-
CO3	√	√	-	-	-	-	-	-
CO4	√	√	-	√	-	-	-	-

Detailed Syllabus:

Unit 1: Industrial wastewater characterization

Unit 2: Treatability studies – Segregation, battery limit treatment – Pretreatment standards.

Unit 3: Control of pollutants – Coagulation, sedimentation, thickening, precipitation, biological oxidation biomethanation, adsorption, ion exchange, membrane separation

Unit 4: Chemical oxidation, sludge dewatering and disposal methods.

Unit 5: Control of water, Pollution from organic chemicals, refinery, petrochemical, distillery, pulp and paper, textile, fertilizer, tanneries, food and pharmaceutical industries, coke ovens and steel plants.

Text / References:

1. W. W. Eckenfelder: Industrial Pollution Control, McGraw Hill Int. Edition, 1990.
2. Metcalf and Eddy: Wastewater Engineering and treatment, Disposal and Reuse, Inc. Third Edition McGraw Hill, 1991
3. Central Pollution Control Board, India: Comprehensive Industry Document Series.

   COINDS / 3 /1980 – 81, COINDS / 8/ 1980 – 81, COINDS / 10 / 80 / 81, COINDS /24, 25 / 85. COINDS / 27/ 89, COINDS / 36/89, COINDS / 35/92, COINDS / 36/91. COINDS / 38/92.

INDUSTRIAL POLLUTION CONTROL - AIR

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the Air Quality and emission standards
CO2	Understand the Sources and classification of air Pollutants
CO3	Understand the Source and control of air Pollution from selected industries
CO4	Understand the Air Pollution control system

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	√	-	-	-	-	-	-	-
CO2	√	√	√	-	-	-	-	-
CO3	√	√	-	-	-	-	-	-
CO4	√	√	-	√	-	-	-	-

Detailed Syllabus:

Unit 1: Air Quality and emission standards Sources and classification of air Pollutants.

Unit 2: Nature and characteristics of gaseous and particulate pollutants.

Unit 3: Control of Gaseous emission by absorption, adsorption, condensation, chemical transformation and

combustion methods.

Unit 4: Control of particulate emission by mechanical connectors, bag filter, electrostatic precipitators and wet scrubbers.

Unit 5: Source and control of air Pollution from selected industries – fertilizer, cement, paper, refinery, mineral and metallurgical processes etc. Air Pollution control system.

Text / References:

1. H. E. Hesketh: Air Pollution control Second Ed., Ann Arbor Science, 1992.
2. S. Calvert and H. M. Englund: Handbook of Air Pollution Engineering, John Wiley, 1984.
3. A. J. Buonicore and W. T. Davis: Air Pollution Engineering manual, Van Nostrand, 1993.
4. M. N. Rao and H. V. N. Rao: Air Pollution, Tata McGraw Hill, 1989.

ENVIRONMENTAL CHEMISTRY

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the environmental chemistry of water, water pollution, water treatment
CO2	Understand the soil chemistry
CO3	Understand the toxicological chemistry
CO4	Understand the basic concept of instrumental methods of pollutants analysis

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	√	-	-	-	-	-	-	-
CO2	√	√	-	-	-	-	-	-
CO3	√	√	√	-	-	-	-	-
CO4	√	√	-	√	-	-	-	-

Detailed Syllabus:

Unit 1: General Chemistry

Unit 2: Environmental Chemistry of water, water pollution, water treatment.

Unit 3: Geochemistry, Soil Chemistry, Atmospheric Chemistry, Inorganic and Organic air Pollutants,

Unit 4: Chemistry of hazardous substances, Toxicological Chemistry,

Unit 5: Basic concept of instrumental methods of pollutants analysis such as Ion Selective Electrode, Atomic Absorption Spectrometry, Flame Photometry, Chromatography, Mercury Analyzer, Total Organic Carbon Analyzer.

Text / References:

1. S. E. Mnahan: Fundamentals of Environmental Chemistry, Lewis Publisher, 1993. C. N. Sawyer and P. L. McGraw Hill Book Co. 1978.
2. W. S. Stumm and J. J. Morgan: Aquatic Chemistry, Wiley- Interscience, 1971.
3. J. H. Seinfeld: Air Pollution McGraw Hill Book Co. 1986.
4. H. H. Willard, L. L. Merrit and J. A. Dean: Instrumental Methods of Analysis, Van Nostrand Reinhold, 1976.

PROGRAM ELECTIVE – I

A. BIOINFORMATICS

Course Outcomes: At the end of the course, the student will be able to:

CO1	They should be able to understand basic knowledge about enzyme technology
CO2	They should understand role of biotechnology in medical field and industrial genetics.
CO3	They should know importance of biotechnology in agricultural, food and beverage industries, environment, energy and chemical industries
CO4	They should understand to how to recover biological products.

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	√	-	-	-	-	-	-	-
CO2	√	√	-	-	-	-	-	-
CO3	√	√	√	-	-	-	-	-
CO4	√	√	√	√	-	-	-	-

Detailed Syllabus:

Unit 1: Overview of bioinformatics, introduction to molecular biology, DNA, RNA, proteins, their structural profiles and properties

Unit 2: Use of Linux operating system and Perl, understanding and using biological databases, alignment of pairs of sequences

Unit 3: Tools of sequence alignment, alignment of multiple sequences, phylogenetic analysis

Unit 4: Gene prediction methods, visualization and prediction of protein structure, gene mapping, gene expression

Unit 5: DNA micro arrays, proteomics, metabolic pathways, metabolic flux analysis, genetic networks, problem solving in bioinformatics.

Reference Books:

1. Krawetz and Womble, “Introduction to Bioinformatics : A Theoretical and practical approach”
2. Rastogi and Mendivatta, “Bioinformatics : Concepts, skills and applications”

B. PROCESS ENGINEERING PRINCIPLES

Course Outcomes: At the end of the course, the student will be able to:

CO1	Students will demonstrate ability to design process equipments as heat exchanger, distillation column, high pressure vessels.
CO2	Students will learn engineering calculations
CO3	To provide experience in the process of original chemical engineering design in the areas of equipment design, process design and plant design through the process of formulating a design solution to a perceived need and then executing the design
CO4	Students will learn analogous mechanism of momentum Transport for steady and unsteady flow.

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	√	-	-	-	-	-	-	-
CO2	√	√	-	-	-	-	-	-
CO3	√	√	√	-	-	-	-	-
CO4	√	√	√	√	-	-	-	-

Detailed Syllabus:

Unit 1: Brief overview of fundamentals of chemical engineering - concepts of unit operation & unit processes

Unit 2: Introduction to engineering calculations; variables, their dimensions and units

Unit 3: Dimensionally homogenous and Non-homogenous equations; standard conditions and ideal gases; Physical and chemical property data;

Unit 4: Basics of Material and energy balances in a macroscopic view point.

Unit 5: Fluid mechanics: Fluids vs solids, Fluid statics and applications including manometer; Mass and energy balances in fluid flow, Bernoullis equation, its applications including pump work. Newton's law of viscosity, flow curves for Non-Newtonian fluids, Pressure drop due to skin friction, significance of friction factor and Reynold's number. Flow machinery, overview of valves and pumps.

Text Books:

1. "Unit operations of Chemical Engineering" 5th ed. by W L McCabe, J C Smith and P. Harriot Mc Graw-Hill (1993).

2. D.M. Himmelblau, "Basic Principles and Calculations in Chemical Engineering", 6th Edition Prentice Hall of India, 1997.

3. B. I. Bhat and S. M. Vora, “Stoichiometry” Tata McGraw-Hill, New Delhi

RESEARCH METHODOLOGY

Course Outcomes: At the end of the course, the student will be able to:

CO1	To develop a research orientation among the scholars and to acquaint them with fundamentals of research methods
CO2	To develop understanding of the basic framework of research process
CO3	To identify various sources of information for literature review and data collection
CO4	To understand the components of scholarly writing and evaluate its quality

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1		√	√	√	-	-	-	-
CO2	-	-	√	-	-	-	-	-
CO3	-	-	√	-	-	-	-	-
CO4	-	-	√	√	-	-	-	-

Detailed Syllabus:

Unit 1: Introduction to Research, Defining research, Meaning of research, Objectives of research, Motivation in research, Types of research

Unit 2: Problem Formulation and Literature Review, Formulating the research problem, Literature review, Development of working hypothesis

Unit 3: Research Design and Planning, Important concepts in research design, Research life cycle, Developing a research plan

Unit 4: Modeling, Simulation, and Data Collection, Overview of modeling and simulation, Classification of models, Development of models, Experimentation and simulation, Methods of data collection

Unit 5: Statistical Analysis and Research Reporting, Sampling methods, Statistical analysis, Hypothesis testing, Research ethics, Plagiarism, Writing research proposals and papers

References:

1. J.P. Holman, Experimental Methods for Engineers.

2. C.R. Kothari, Research Methodology, Methods & Techniques.

3. R. A. Fisher, Statistical Methods for Research Workers, Cosmo Publications, New Delhi ISBN:81-307-0128-6

ENVIRONMENTAL MONITORING LABORATORY

The experiments based on following topics will be covered.

1. Air Quality Monitoring: Ambient Monitoring Gases, Suspended particulate matter and its characterization, source Monitoring, stack Monitoring, and exhaust measurement. Noise Pollution Monitoring, Metrological data collection and analysis.

2. Water quality Monitoring: Mineral analysis, Demand analysis, Nutrient analysis, Metal analysis, Organic analysis.

3. Microbiological examination: Rapid detection method, Heterotrophic plate counts. Multiple tube fermentation technique, Membrane filters technique.

Text / References:

L. S. Clesceeri, A. E. Greenberg and R. R. Trussell: standard methods for the examination of water and wastewater, APHA Publishing, 17th Ed. 1989.

H. H. Ramp and H. Krist: Laboratory Manual for the Examination of water, Wastewater and soil, VCH Publishers, 1989.

IS Codes: IS 5182, IS 11255, IS 8829, IS 3028.

STRESS MANAGEMENT WITH YOGA (AUDIT COURSE)

Course Objectives:

1. Understand the physiological and psychological aspects of stress and its impact on overall well-being.

2. Learn and practice specific yoga postures, breathing exercises, and relaxation techniques to alleviate stress.

3. Explore the connection between mindfulness, meditation, and stress reduction, fostering mental clarity.

4. Discover holistic practices that promote better sleep, nutrition, and overall lifestyle habits for stress management.

5. Develop practical skills to manage stress in daily life, enhancing resilience and promoting emotional balance.

Course Outcomes:

CO 1. Recognize the signs and sources of stress, understanding its effects on mental and physical well-being.

CO 2. Master a variety of yoga techniques, including postures, breathing, and meditation, to effectively manage stress.

CO 3. Acquire relaxation strategies that promote calmness, reduce anxiety, and enhance overall mental clarity.

CO 4. Incorporate healthy habits inspired by yoga principles to foster better sleep, nutrition, and self-care routines.

CO 5. Develop practical skills to navigate and cope with stress, enhancing emotional balance and promoting a more harmonious life.

Detailed Syllabus:

Unit-1: Introduction to Yoga for Stress Management, Stress according to Western perspective, Stress-Eastern Perspective, Developmental process: Western and Eastern Perspective, Stress Hazards and Yoga

Unit-2: Meeting the challenges of Stress, Introduction to Stress Physiology, Stress, Appetite and Dietary, management- Modern and Yogic perspective, Sleep and Stress: understanding the relationship for effective management of stress

Unit-3: Stress Assessment methods- a valuable tool toward stress management, Role of Yoga in prevention and management of stress related disorders – a summary of research evidence, Concept of stress and its management - perspectives from Patanjali Yoga Sutra

Unit-4: Concept of stress and its management - perspectives from Bhagavad Gita, Bio-Psycho-Socio-Spiritual model of stress management, Yoga practices for Stress Management; Breathing practices: Hands in and out breathing, Hands stretch breathing, Ankle stretch breathing, Dog Breathing, Rabbit breathing, Tiger breathing, Sashankasana breathing, Bhujangasana breathing, Ardha Shalabhasana breathing (alternate legs), Straight leg raising (alternate legs), Straight leg raising (both legs), Sethubandhasana lumbar stretch, Instant Relaxation Technique (IRT)

Unit-5: Loosening Practices: Shoulder Rotation, Side bending, standing twist, Hip rotation, Thigh strengthening, Chakki chalan, Bhunamasana Chalana, Alternative toe touching, Side leg raising, Pavana muktasana kriya: Wind releasing pose movements, Quick Relaxation Technique (QRT), Asana practices: Tadasana, Ardhakati Chakrasana, Ardha Chakrasana, Trikonasana, Vrikshasana, Vakarasana, Janu Sirshasana, Ushtrasana, Sashankasana, Ardhamatseyndrasana, Paschimottanasana, Poorvottanasana, Gomukhasana, Makarasana, Bhujangasana, Salambha Shalabahasana, Dhanurasana, Setubandhasana, Sarvangasana, Mastyasana; Deep Relaxation Technique (DRT) Soorya Namaskar; Pranayama: Kapalbhati kriya and Sectional Breathing, Nadishuddhi Pranayama, Bhramari, Sheetali, Sitkari and Ujjayi, Om Meditation Cyclic Meditation, Integrated Yoga Module

Textbooks / References:

1. H R Nagendra and R Nagarathna. Yoga for Promotion of Positive Health. Swami Vivekananda Yoga Prakashana. 2011.

2. Contrada, R., & Baum, A. (Eds.). The handbook of stress science: Biology, psychology, and health. Springer Publishing Company. 2010

3. Al'Absi, M. (Ed.). Stress and addiction: Biological and psychological mechanisms. Elsevier. 2011.

4. Van den Bergh, O. Principles, and practice of stress management. Guilford Publications. 2021.
5. Swami Muktibodhananda, Hatha Yoga Pradipika, Bihar Scool of Yoga, 1998
6. Swami Satyananda Saraswati, Four Chapters on Freedom, Bihar Scool of Yoga, 1975
7. Swami Tapasyananda, Srimad Bhagavat Gita, Sri Ramakrishna Math, 2012

SYLLABUS FOR SEMESTER-II

WASTEWATER TREATMENT PLANT DESIGN

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand principles of various processes applicable to industrial wastewater treatment
CO2	Identify the best applicable technologies for wastewater treatment from the perspective of yield production
CO3	To impart knowledge on the concept and application of Industrial pollution prevention, cleaner technologies, industrial wastewater treatment and residue management
CO4	Understand principles of Unit Operation and design

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	√	-	-	-	-	-	-	-
CO2	√	√	-	-	-	-	-	-
CO3	√	√	-	-	-	-	-	-
CO4	√	√	√	√	-	-	-	-

Detailed Syllabus:

Unit 1: Introduction to Wastewater Treatment Plant Design: Impact of Flow rate and Mass Loading Factors on Design, Evaluation and Selection of Design Flow rates, Evaluation and Selection of Design Mass Loading, Process Selection, Elements of Conceptual Process Design.

Unit 2: Physical Unit Operation: Flow Measurement, Screening, Flow Equalization, Mixing, Sedimentation, Accelerated Gravity Separation, Flotation, Granular Medium Filtration, Gas Transfer, Volatilization and gas stripping of Volatile Organic Compounds (VOCs) from Wastewater Management Facilities.

Unit 3: Chemical Unit Processes: Chemical Precipitation, Adsorption, Disinfection, Disinfection with Chlorine, Dechlorination, Disinfection with Chlorine Dioxide, Disinfection with Bromine Chloride, Disinfection with Ozone, Disinfection with Ultraviolet Light, Other Chemical Applications.

Unit 4: Biological Unit Operation: Overview of Biological Wastewater Treatment, Introduction to Microbial Metabolism, Important Microorganisms in Biological Treatment, Bacterial Growth, Kinetics of Biological Growth,

Unit 5: Biological Treatment Process, Aerobic Attached Growth Treatment Process, Anaerobic Attached Growth Treatment Process, Biological Nutrient Removal, Pond Treatment Processes. Physical and Chemical Treatment of Wastewater: Bar Racks and Screen, Combination, Grit Removal, Flow Equalization, Other Preliminary Treatment Operations, Primary Sedimentation Tanks, Other Solids – Removal Operation, Chemical Precipitation, Disinfection with Chlorine Compounds, Other means of Disinfection, Post Aeration, Odor Control, Control of VOCs Released from Wastewater Management Facilities.

Text / References:

1. W. W. Eckenfelder: Industrial Pollution Control, McGraw Hill Int. Edition, 1990.
2. Metcalf and Eddy: Wastewater Engineering and treatment, Disposal and Reuse, Inc. Third Edition McGraw Hill, 1991

ADVANCED WASTEWATER TREATMENT

Course Outcomes: At the end of the course, the student will be able to:

CO1	To educate the students in detailed design concepts related to water transmission
CO2	To impart knowledge on the transformation of chemicals in the environment
CO3	Perform advanced wastewater treatment, treatment technologies used for advanced wastewater treatment
CO4	Understand the need for advanced wastewater treatment

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	√	-	-	-	-	-	-	-
CO2	√	√	-	-	-	-	-	-
CO3	√	√	-	-	-	-	-	-
CO4	√	√	√	√	-	-	-	-

Detailed Syllabus:

Unit 1-2: Biological Treatment of Wastewater: The Activated-Sludge Process, Selection and Design of physical Facilities for Activated Sludge Process, Activated-Sludge Process Design, Aerated Lagoons, Trickling Filters, Rotating Biological Contactors, Combined Aerobic Treatment Process, Stabilization Ponds.

Unit 3-4: Need for Advanced Wastewater Treatment, Treatment Technologies Used for Advanced Wastewater Treatment, Removal of Residual Suspended Solids by Granular- Medium Filtration, Removal of Residual Suspended Solids by Micro screening, Control of Nutrients, Conversion of Ammonia by Biological Nitrification

Unit 5: Removal of Phosphorous by Biological Nitrification / Denitrification, Removal of Phosphorous Biological Methods, Combined Removal of Nitrogen and Phosphorous by Biological Methods, Removal of Nitrogen by Physical and Chemical Process, Removal of Phosphorous by Chemical Addition, Removal of Toxic Compounds and Refractory Organics, Removal of Dissolved Inorganic Substances.

Text / References:

1. W. W. Eckenfelder: Industrial Pollution Control, McGraw Hill Int. Edition, 1990.
2. Metcalf and Eddy: Wastewater Engineering and treatment, Disposal and Reuse, Inc. Third Edition McGraw Hill, 1991

ENERGY CONVERSION & ENVIRONMENT

Course Outcomes: At the end of the course, the student will be able to:

CO1	To provide training to solve problems relevant to the energy conservation.
CO2	To provide students the knowledge in planning conducting energy audit, energy survey, and evaluate energy conservation opportunities.
CO3	To provide knowledge to design and evaluate energy efficient technologies such as heat exchanger networks, multiple effect evaporators, co-generation, etc.
CO4	Students should learn to principles and source of energy conservation

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	√	-	-	-	-	-	-	-
CO2	√	√	-	-	-	-	-	-
CO3	√	√	√	-	-	-	-	-
CO4	√	√	√	√	-	-	-	-

Detailed Syllabus:

Unit 1-2: Principles and source of energy conservation methods: Thermal, nuclear, hydro, solar. An introduction to fuels, combustion fundamentals, Thermodynamics of combustion rates and properties of combustion products; Formation of Pollutants, Measurement and controls,

Unit 3-4: Fundamentals of engine processes, source of emissions from automobiles, effect of operating and design parameters on emission, recent trends in design of non-polluting power units, control methods

Unit 5: Exhaust reactor problem and prospects, Exhaust emission test, procedures, standards and legislation, Combustion in stationary sources, Power Production, Cogeneration. Alternative energy sources utilization, economics, Environmental impacts and Management.

Text / References:

A. M. Kanury : Introduction to Combustion Phenomena, Gordon and Beach Science Publishers, 1975.

E. Starkman : Combustion Generated Air Pollution, Plenum Press, 1971.

G. S. Springer and D. J. Patterson : Engine Emmision, Pollution Formation and Measurement, Plenum Press, 1973.

J. M. Fowler, Energy and the Environment, McGraw Hill, 1975.

AIR POLLUTION CONTROL EQUIPMENT DESIGN

Course Outcomes: At the end of the course, the student will be able to:

CO1	To learn design a energy system to meet the desired needs within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability and sustainability.
CO2	To learn catalyst conversion
CO3	To understand the basics for design as per the codes & standards for the mechanical design of equipments used in the process industry.
CO4	To learn Pollution control by absorption, adsorption, condensation

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	√	-	-	-	-	-	-	-
CO2	√	√	-	-	-	-	-	-
CO3	√	√	-	-	-	-	-	-
CO4	√	√	√	√	-	-	-	-

Detailed Syllabus:

Unit 1-2: Air Pollution in the chemical process industries: Pollution control by absorption, adsorption, condensation, oxidation and catalyst Conversion

Unit 3-4: Particulate emission, control by internal impaction, interception, stack height criteria,

Unit 5: Exhaust systems, Dispersion heights and plume characteristics.

Text / References:

Noel De Nevers: Air Pollution Control Engineering, McGraw Hill International Ed. 1993.

H. E. Hesekh: Air Pollution Control Second Edition, Ann Arbor Science, 1992.

S. Calvert and H. M. Englund: Handbook of Air Pollution Engineering, John Wiley, 1984.

A. J. Buonicore and W. T. Davis: Air Pollution Engineering manual, Van Nostrand, 1993.

M. N. Rao and H. V. N. Rao : Air Pollution, Tata McGraw Hill, 1989.

COMPUTATIONAL LAB

Objective: To train students on computation and design methods by practical approach

Syllabus: Computation and design experiments will be conducted with the help of in-house code and available software out of: ASPEN, MATLAB, C/C++ LANGUAGE, POLYMATH, MINITAB, DWSIM, MS-EXCEL, DESIGN EXPERT, etc. for environmental engineering processes such as reaction rate kinetics, pipe simulator, heat exchanger, reactor design, optimization of process parameters and many more applications. Online NPTEL courses can also be included along with above hands-on practicals.

Sr. No.	NPTEL Course	Cr	Name of Instructor	Host Institute	Link
1.	MATLAB based programming	3	Prof. Parag A. Deshpande	IIT Kharagpur	https://nptel.ac.in/courses/103105220
2.	ASPEN Plus Simulation software – a basic course for beginners	3	Prof. Prabirkumar Saha	IIT Guwahati	https://nptel.ac.in/courses/103103209

References:

1. Santosh K. Gupta, Numerical Methods for Engineers, 2nd Edition, New Age International (P) Ltd., New Delhi.

2. Steven C. Chapra &Raymond P Canale, Numerical Methods for Engineers, 4th Edition, Tata McGraw Hill, New Delhi.

3. Bruce A. Finlayson, Lorenz T. Biegler, Ignacio E. Grossmann, Mathematics in Chemical Engineering , 2006 Wiley.

4. Gilbert Strang, Linear Algebra and its applications, Harcouth Brace Jovanovich, 1988.

MINI PROJECT

Course Outcomes: At the end of the course, the student will be able to:

CO1	Communicate with group of people on different research topics
CO2	Prepare a project report that includes consolidated information on a project topic

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	√	-	-	-
CO2	-	-	-	-	-	√	√	√

Detailed Syllabus:

Any topic of relevance to chemical and allied engineering and science.

PROJECT MANAGEMENT / INTELLECTUAL PROPERTY RIGHTS

COURSE OUTCOMES: At the end of the course the student will be able to:

1) Enumerate and demonstrate fundamental terms such as copy-rights, Patents, Trademarks etc.

2) Interpret and follow Laws of copy-rights, Patents, Trademarks and various IP registration Processes to register own project research.

3) Exhibit the enhance capability to do economic analysis of IP rights, technology and innovation related policy issues and firms' commercial strategies.

4) Develop awareness at all levels (research and innovation) of society to develop patentable technologies.

5) Apply trade mark law, copy right law, patent law and also carry out intellectual property audits.

6) Manage and safeguard the intellectual property and protect it against unauthorized use.

COURSE CONTENTS:

A. PROJECT MANAGEMENT:

Unit-1: Introduction to Project management: Characteristics of projects, Definition and objectives of Project Management, Stages of Project Management, Project Planning Process, Establishing Project organization. Work definition: Defining work content, Time Estimation Method, Project Cost Estimation and budgeting, Project Risk Management, Project scheduling and Planning Tools: Work Breakdown structure, LRC, Gantt charts, CPM/PERT Networks.

Unit-2: Developing Project Plan (Baseline), Project cash flow analysis, Project scheduling with resource constraints: Resource Leveling and Resource Allocation. Time Cost Trade off: Crashing Heuristic.

Unit-3: Project Implementation: Project Monitoring and Control with PERT/Cost, Computers applications in Project Management, Contract Management, Project Procurement Management. Post-Project Analysis.

B. IPR:

Unit-4: Introduction to IPR; Overview & Importance; IPR in India and IPR abroad; Patents ;their definition; granting; infringement; searching & filing; Utility Models an introduction. Copyrights; their definition; granting; infringement; searching & filing, distinction between related and copy rights; Trademarks, role in commerce, importance, protection, registration; domain names.

Unit-5: Industrial Designs; Design Patents; scope; protection; filing infringement; difference between

Designs & Patents' Geographical indications, international protection; Plant varieties; breeder's rights, protection; biotechnology& research and rights managements; licensing, commercialization; legal issues, enforcement; Case studies in IPR.

REFERENCES:

1) Shtub, Bard and Globerson, Project Management: Engineering, Technology, and Implementation, Prentice Hall, India.

2) Lock, Gower, Project Management Handbook.

3) Prabuddha Ganguli, IPR published by Tata McGraw Hill 2001.

IKS (BUCKET)

HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA

Course Outcomes: At the end of the course, the student will be able to:

CO1	Appreciate Indian contribution to science and technology Appreciate the development of different branches of science in ancient India
CO2	Learn the development of Mathematics and Astronomy in India
CO3	Learn the development of Ayurveda in India
CO4	Understand development in Agriculture and Metallurgy.

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1								
CO2								
CO3								
CO4								

Detailed Syllabus:

Unit-1: Introduction: Logic and methodology of Indian sciences, An overview of Indian contributions to sciences, An overview of Indian contributions to technology.

Unit-2: Astronomy: Development of astronomy in India, Pancanga: Indian calendrical computations, The distinct features of Indian planetary models, Computation of eclipses: Its simplicity, elegance and efficiency, Observational astronomy in India.

Unit-3: Mathematics: An overview of the development of mathematics in India, Mathematics contained in Sulbasutras, Combinatorial aspects of the Chandassastra, Solutions to the first and second order indeterminate equations, Weaving mathematics into beautiful poetry: Bhaskaracarya, The evolution of sine function in India, The discovery of calculus by Kerala astronomers.

Unit-4: Ayurveda: History of Ayurveda, Rational foundations of Ayurveda, Textual sources in Ayurveda, Ayurveda and allied disciplines, Approach to health and disease in Ayurveda, Approach to diet and nutrition in Ayurveda, Ayurveda and modern medicine, Ayurveda and Yoga.

Unit-5: Technological development in India: Agriculture: Origin and development, Ancient crops,·Traditional practices, Water management: Overview, Harappan water management, Other case studies, Medieval Water structures, Pottery: Overview, Technical aspects, Silpasastra: Architecture and Construction, An introduction to Silpasastra, Construction Technology, Metallurgy, Copper/Bronze/Zinc, Iron and Steel Technology in India

REFERENCES:

1) Dr. Binod Bihari Satpathy, "History of Science and Technology in India".

INDIAN ART: MATERIALS, TECHNIQUES AND ARTISTIC PRACTICES

Course Objectives:

1. To introduce the diversity of art practices and material culture from the Indian subcontinent.
2. To situate these practices against their socio-cultural, political and temporal settings.
3. To support an immersive approach to understanding Indian art.
4. To bring together the recent findings in Indian art

Course Outcomes: At the end of the course, the student will be able to:

CO1	Draw connections between the historical artifacts and contemporary objects from the immediate surroundings
CO2	Encourage themselves as an art practitioner, aspiring art historians, educators, and those preparing for competitive examinations in India
CO3	Direct the possible ways of exploring these thematic

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1								
CO2								
CO3								
CO4								

Detailed Syllabus:

Unit-1: Clay and Architecture I: Clay: Terracotta and Terracruda, How is clay processed into objects?, Brick structures and urns from the Indus Valley and Megalithic sites in south India, Sculptures of terracotta and bronze from Harappa, Terracruda or unbaked clay-made objects and rituals.

Architecture I: Basics of Buddhist and Jain architecture- Wood, stone and living rock, Stupa, vihara, caves and temples from Shunga, Kushana, Maurya and Gupta periods.

Unit-2: Pigment and Architecture II: Pigment: Mineral and vegetal colours- How pigment-based paints are processed and applied to walls Bhimbetka drawings, Murals of Sittanavasal and Ajanta.
Architecture II: Hinduism and temple building- Architectural treatise and utilisation of Vastupurusha mandala for making temples, Temples of Badami Chalukyas, Rashtrakuta, Chola, Chandela and Eastern Ganga dynasties.
Unit-3: Stone and Garden Stone: Memorials, Architectural Remnants and Objects- Types of stone in India: Mathura Sandstone, Deccani Basalt, Rajasthani Marble, Stone carving for architecture, Hero stones and their social significance, Household items and objects in royal court.
Garden: Islam, the garden of paradise and afterlife, Tombs, palace, garden and waterways from the Mughal and Deccani context, Regional and foreign flora and fauna in Mughal and Deccani gardens.
Unit-4: Paper and Printing: How does paper affect the character of painting and calligraphy? How are ink and pigments prepared? Jain manuscripts and Islamic treatise, Mughal, Deccani, Rajput and Pahari miniature paintings, Mysore and Tanjore paintings.
Printing: European Interventions -Printmaking techniques and their application in books and images, Bazar paintings of Kalighat and Battala woodcuts, Lithograph and Oleograph from Calcutta, Pune and Lucknow.

Unit-5: Multimedia Approaches: Introduction to the key developments in Indian Art after 1947, Post-independence artistic and design practices, Canvas painting, textile, furniture making between the 1950s and 1990s, Neoliberalism, transnational connections and "new media" approaches, Curatorial and collaborative projects between artists, educators and communities, Biennale, entrepreneurship and expansive notion of "art" after 2010.

Text Books/References:

1. Ali, Daud and Emma Flatt eds. 2020. Garden and landscape practices in pre-colonial India: histories from the Deccan. New Delhi: Routledge.
2. Dehejia, Vidya. 2006. Chola: Sacred Bronzes of Southern India. London: Royal Academy of Arts.
3. Goswamy, B. N., and Eberhard Fischer. 2017. Pahari Paintnings: The Horst Metzger collection in the Museum Rietberg. New Delhi: Niyogi Books.
4. Hardy, Adam. 2007. The Temple Architecture of India. Chichester (GB): J. Wiley and Sons.
5. Huntington, Susan. 1993. The Art of Ancient India: Buddhist, Hindu, Jain. New York: Weatherhill.
6. Koch, Ebba. 2001. Mughal Art and Imperial Ideology: Collected Essays. New Delhi: Oxford University Press.
7. Meister, Michael and M. A. Dhaky. 1999. Encyclopedia of Indian Temple Architecture. New Delhi: Manohar Publishers.
8. Mitter, Partha. 2001. Indian Art. Oxford and New York: Oxford University Press.
9. Sengupta, Paula. 2012. The Printed Picture: Four Centuries of Indian Printmaking. New Delhi: Delhi Art Gallery.
10. Singh, Kavita, ed. 2018. Scent upon a Southern Breeze: the synaesthetic arts of the Deccan. Mumbai: Marg.
11. Subramanyan, K. G. 2007. The Magic of Making: Essays on Art and Culture. Calcutta: Seagull.

CONCEPTS AND APPLICATIONS IN ENGINEERING

Course Outcomes: At the end of the course, the student will be able to:

CO1	Learn various aspects related to vedas and ancient literature
CO2	Appreciate the development of Mathematics and Astronomy in India
CO3	Understand the development of Metallurgy in India
CO4	Appreciate the knowledge of architecture and language system in India

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1								
CO2								
CO3								
CO4								

Detailed Syllabus:

Unit-1: The Vedic Corpus: Introduction to Vedas, A synopsis of the four Vedas, Sub-classification of Vedas, Messages in Vedas, Introduction to Vedāṅgas, Prologue on Śikṣā and Vyākaraṇa, Basics of Nirukta and Chandas, Introduction to Kalpa and Jyotiṣa, Vedic Life: A Distinctive Features. Number systems in India - Historical evidence, Salient aspects of Indian Mathematics, Bhūta-Saṃkhyā system, Kaṭapayādi system, Measurements for time, distance, and weight. Piṅgala and the Binary system

Unit-2: Mathematics: Introduction to Indian Mathematics, Unique aspects of Indian Mathematics, Indian

Mathematicians and their Contributions, Algebra, Geometry, Trigonometry, Binary mathematics and combinatorial problems in Chandaḥ Śāstra, Magic squares in India. Astronomy: Introduction to Indian astronomy, Indian contributions in astronomy, The celestial coordinate system, Elements of the Indian calendar, Notion of years and months. Pañcāṅga – The Indian calendar system. Astronomical Instruments (Yantras), Jantar Mantar of Rājā Jai Singh Sawai

Unit-3: Engineering and Technology: Metals and Metalworking: Wootz Steel: The rise and fall of a great Indian technology, The Indian S & T heritage, Mining and ore extraction, Metals and metalworking technology, Iron and steel in India, Lost wax casting of idols and artefacts, Apparatuses used for extraction of metallic components. Irrigation systems and practices in South India, Literary sources for science and technology, Physical structures in India, Irrigation and water management, Dyes and painting technology, The art of making perfumes, Surgical techniques, Shipbuilding, Sixty-four art forms (64 Kalās), Status of Indigenous S & T

Unit-4: Town Planning and Architecture: Perspective of Arthaśāstra on town planning, Vāstu-śāstra – The science of architecture, Eight limbs of Vāstu, Town planning, Temples in India: marvelous stone architecture for eternity, Temple architecture in India, Iconography. Knowledge Framework and classifications: Indian scheme of knowledge, The knowledge triangle, Prameya – A vaiśeṣikan approach to physical reality, Dravyas – the constituents of the physical reality, Attributes – the properties of substances and Action –the driver of conjunction and disjunction, Sāmānya, viśēṣa, samavāya,

Unit-5: Pramāṇa – the means of valid knowledge, Saṃśaya – ambiguities in existing knowledge, Framework for establishing valid knowledge, Deductive or inductive logic framework, Potential fallacies in the reasoning process, Siddhānta: established tenets in a field of study, Introduction to Linguistics, Aṣṭādhyāyī, Phonetics, Word generation, Computational aspects, Mnemonics, Recursive operations, Rule based operations, Sentence formation, Verbs and prefixes, Role of Sanskrit in natural language processing

REFERENCES:

1) Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. (2022), "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Private Ltd. Delhi.

HUMANITIES AND SOCIAL SCIENCES

Course Outcomes: At the end of the course, the student will be able to:

CO1	Learn various aspects related to vedas and ancient literature
CO2	Appreciate the development of language system and philosophy in India
CO3	Understand the development of Ayurveda and health wellness in India
CO4	Appreciate the knowledge of architecture and administration system in India

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1								
CO2								
CO3								
CO4								

Detailed Syllabus:

Unit-1: The Vedic Corpus: Introduction to Vedas, A synopsis of the four Vedas, Sub-classification of Vedas, Messages in Vedas, Introduction to Vedāṅgas, Prologue on Śikṣā and Vyākaraṇa, Basics of Nirukta and Chandas, Introduction to Kalpa and Jyotiṣa, Vedic Life: A Distinctive Features, Philosophical Systems: An introduction to philosophical systems, Development of philosophy, Unique features of

philosophy, Sāṅkhya approach of philosophy, Introduction to Yoga, Tenet of Nyāya philosophy, Principles of Vaiśeṣika, Doctrine of Pūrva-Mīmāṃsā Darśana, Thesis of Vedānta and synopsis of Advaita, Philosophy of Viśiṣṭādvaita, Ideology of Dvaita, Tenets of Jaina, Doctrine of Buddhism, Notions of Cārvāka

Unit-2: Wisdom through the Ages: Gateways of ancestral wisdoms, Introduction to Purāṇa, The Purāṇic repository, Issues of interest in Purāṇas, Introduction to Itihāsas, Key messages in Itihāsas, Wisdom through Nīti-śāstras, Wisdom through Subhāṣita, Knowledge Framework and classifications: Indian scheme of knowledge, The knowledge triangle, Prameya – A vaiśeṣikan approach to physical reality, Dravyas – the constituents of the physical reality, Attributes – the properties of substances and Action – the driver of conjunction and disjunction, Sāmānya, viśēṣa, samavāya, Pramāṇa – the means of valid knowledge, Saṃśaya – ambiguities in existing knowledge, Framework for establishing valid knowledge, Deductive or inductive logic framework, Potential fallacies in the reasoning process, Siddhānta: established tenets in a field of study

Unit-3: Linguistics: Introduction to Linguistics, Aṣṭādhyāyī, Phonetics, Word generation, Computational aspects, Mnemonics, Recursive operations, Rule based operations, Sentence formation, Verbs and prefixes, Role of Sanskrit in natural language processing; Number Systems and Units of Measurement: Number systems in India – Historical evidence, Salient aspects of Indian Mathematics, Bhūta-Saṃkhyā system, Kaṭapayādi system, Measurements for time, distance, and weight, Piṅgala and the Binary system

Unit-4: Health Wellness and Psychology: Introduction to health, Āyurveda: approach to health, Sapta-dhātavaḥ: seven-tissues, Role of agni in health, Tri-doṣas, Āyurveda: definition of health, Psychological aspects of health, Disease management elements, Dinacaryā: daily regimen for health & wellness, Importance of sleep, Food intake methods and drugs, Approach to lead a healthy life, Indian approach to psychology, The tri guṇa system & holistic picture of the individual, The Nature of Consciousness, Consciousness studies and issues,

Unit-5: Town Planning and Architecture: Perspective of Arthaśāstra on town planning, Vāstu-śāstra – The science of architecture, Eight limbs of Vāstu, Town planning, Temples in India: marvelous stone architecture for eternity, Temple architecture in India, Iconography, Governance and Public Administration: Introduction to raja dharma, Arthaśāstra: a historical perspective, Elements of a kauṭilyan state, The king & the amātya, Janapada & durga, Treasury and the State Economy (Kośa), Danda, Mitra, The Administrative Setup, Relevance of Arthaśāstra, Public Administration in Epics.

REFERENCES:

1) Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. (2022), "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Private Ltd. Delhi.

Sr. No.	NPTEL Course	Cr	Name of Instructor	Host Institute	Link
1.	History of Science and Technology in India	4	Prof. Madhav Govind	UGC-HRDC, Jawaharlal Nehru University New Delhi	https://onlinecourses.swayam2.ac.in/arp19_ap87/preview
2.	Indian Art: Materials, Techniques and Artistic Practices	4	Prof. Rajarshi Sengupta	Indian Institute of Technology Kanpur	https://onlinecourses.nptel.ac.in/noc22_hs133/preview
3.	Indian Knowledge System (IKS): Concepts and Applications in Engineering	4	Prof. B. Mahadevan, Dr. Vinayak Rajat Bhat, Dr. R Venkata Raghavan	Indian Institute of Management Bangalore (IIMB), Chanakya University, Bangalore	https://onlinecourses.swayam2.ac.in/imb23_mg53/preview
4.	Indian Knowledge System (IKS): Humanities and Social Sciences	4	Prof. B. Mahadevan, Dr. Vinayak Rajat Bhat, Dr. R Venkata Raghavan	Indian Institute of Management Bangalore (IIMB), Chanakya University, Bangalore	https://onlinecourses.swayam2.ac.in/imb23_mg55/preview
5.	Ancient Indian Management	2	Dr. Alka Jain	Taxila Business School	https://onlinecourses.swayam2.ac.in/aic22_ge19/preview

DISASTER MANAGEMENT

Course Outcomes: At the end of the course, the student will be able to:

CO1	Identify types of disaster
CO2	Understand issues originating from disaster like migration and rehabilitation
CO3	Understand disaster management policies and strategies in India
CO4	Learn from various case studies

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1								
CO2								
CO3								
CO4								

Detailed Syllabus:

Unit-1: Disaster Management: Disaster and Disaster Management – Concepts, Issues Concerned with Disaster Management, Phases of Disaster Management, Bhopal Disaster: A Case Study; Types of Disasters: Natural Disaster, Man-made Disaster

Unit-2: Types of Disasters: Slow onset Disasters & Rapid onset Disasters, Simple and Complex Disasters, Tsunami: A Case Study, Cyclone Phallin 2013: A Case Study; Disaster and Disaster Management in India, National institute of Disaster Management, National Disaster Management Act 2005, The National Policy on Disaster Management, 2009

Unit-3: National Plan on Disaster Management 2016, Refugee Problems, Impact of Disaster on the lives of Refugees, Problems of Women and Children during disasters, Principles of Psychosocial Care, Issues and Recovery During Emergency, Relationship between Disasters, Development and Vulnerabilities, Relationship between Disasters, Development and Vulnerabilities

Unit-4: Equity Issues in Disasters, Issues of Rehabilitation and Resettlement among the Disaster Survivors, Stakeholders in Disaster Relief Management: Central Government, State Government. District Administration, Armed Forces, Para-Military Forces, Fire Services

Unit-5: Disaster Risk Reduction Strategies, Risk Reduction Preparedness Plans, Action Plans and Procedures, Early Warning Systems, Components of Disaster Relief, Factors contributing to Vulnerability, Disaster Risk Reduction - Master Planning for the Future, Capacity Building Rehabilitation measures and long term reconstruction, Understanding Kerala Disaster 2018

References:

1. Disaster Management in India by Ministry of Home Affairs, Government of India

SYLLABUS FOR SEMESTER-III

PROGRAM ELECTIVE – V

A. ENZYME ENGINEERING

Course Outcomes: At the end of the course, the student will be able to:

CO1	
CO2	
CO3	
CO4	

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1								
CO2								
CO3								
CO4								

Detailed Syllabus:

Unit 1: Introduction to Enzymes, Classification and Nomenclature of enzymes, Structure of enzyme; Enzyme Production, Cloning of Enzyme, Over-expression in Host, Extraction of enzyme, Purification Strategies, Enzyme Characterization Approaches

Unit-2: Enzyme catalyzed Biochemical reactions, Carbohydrate Metabolism, Lipid and Protein Metabolism, Detoxification

Unit-3: Enzyme-Substrate interaction, Spectroscopic approaches, Isothermal Calorimetry, Surface plasma resonance, Enzyme assay system, Enzyme Kinetics

Unit-4: Enzyme Inhibitor Designing, Traditional approach, Modern approach, Computational approaches, Enzyme Inhibition kinetics

Unit-5: Enzyme Applications, Enzymes in Industrial setup, Enzymes in catalyzing chemical reactions, Enzymes in medical field, Enzymes in environment field, Enzymes in drug discovery

References:

1. Young Je Yoo , Yan Feng , Yong-Hwan Kim , Camila Flor J. Yagonia, Fundamentals of Enzyme Engineering, Springer Dordrecht, 2017. DOI: https://doi.org/10.1007/978-94-024-1026-6

B. ACCIDENT PREVENTION AND SAFETY

Course Outcomes: At the end of the course, the student will be able to:

CO1	
CO2	
CO3	
CO4	

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1								
CO2								
CO3								
CO4								

Detailed Syllabus:

Unit 1: Introduction to Process safety, Accidents and Loss statistics, Toxicological Studies
Unit-2: Fire and Explosion, Prevention of Fire and Explosion
Unit-3: Source model and dispersion, Relief and relief sizing
Unit-4: Hazard Identification, HAZOP analysis, Risk Assessment
Unit-5: QRA and LOPA, Process of Accident Investigation; Reliability Engineering, Economics of loss prevention

References:

1. Daniel A. Crowl, Joseph F. Louvar, "Chemical Process Safety: Fundaments with Applications", Prentice Hall International Series, 2019

Online NPTEL courses for Program Elective – V:

Sr. No.	Name of Elective	NPTEL Course	Cr	Name of Instructor	Host Institute	Link
1.	Enzyme Engineering	Enzyme Sciences and Technology	3	Prof. Vishal Trivedi	IIT Guwahati	https://archive.nptel.ac.in/courses/102/103/102103097/
2.	Accident Prevention and Safety	Chemical Process Safety	3	Prof. Shishir Sinha	IIT Roorkee	https://nptel.ac.in/courses/103107156

OPEN ELECTIVE (Bucket)

Sr. No.	NPTEL Course	Cr	Name of Instructor	Host Institute	Link
1.	Student Psychology	3	Dr. S. Renukadevi	National Institute of Technical Teachers Training and Research, Chennai	https://onlinecourses.swayam2.ac.in/ntr19_ed23/preview
2.	Strategic Management – The Competitive Edge	2	Prof. R Srinivasan	IISc Bangalore	https://onlinecourses.nptel.ac.in/noc23_mg85/preview
3.	Business Environment	4	By Dr. Chhavi Jain	IIS (Deemed to be University), Jaipur	https://onlinecourses.swayam2.ac.in/imb23_mg49/preview

4.	Hospitality Industry In Tourism	4	Prof. H. Rajashekar	University of Mysore, Manasagangothri	https://onlinecourses.swayam2.ac.in/cec19_mg30/preview

A. STUDENT PSYCHOLOGY

Course Outcomes: At the end of the course, the student will be able to:

CO1	
CO2	
CO3	
CO4	

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1								
CO2								
CO3								
CO4								

Detailed Syllabus:

Unit 1: Teaching Learning Process, Student Characteristics, Types and Problems
Unit-2: Psychological Tests and Inventories, Student Motivation
Unit-3: Physical and Cognitive Development, Emotional and Social Development
Unit-4: Neuro-Linguistic Programming
Unit-5: Counselling Skills and Summary

References:

1. Sharma, R.A. (2007). Training Technology. Meerut : Surya Publications.
2. Sharma, R.A. (2007). Psychology of Teaching-Learning Process. Meerut : Surya Publications
3. B. Mukhopadhyay (1997). Motivation in Educational Management. New Delhi : Sterling Publishers

B. STRATEGIC MANAGEMENT – THE COMPETITIVE EDGE

Course Outcomes: At the end of the course, the student will be able to:

CO1	
CO2	
CO3	
CO4	

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1								
CO2								

CO3								
CO4								

Detailed Syllabus:

Unit 1: Introduction to Strategic Management; Concept of Corporate Strategy; Strategic Management Process; Board of Directors - Role and Functions; Top Management - Role and Skills; Board Functioning - Indian Context

Unit-2: Environmental Scanning; Industry Analysis; Synthesis of External Factors; External Factors Analysis Summary (EFAS) Internal Scanning; Value Chain Analysis; Synthesis of Internal Factors; Internal Factors Analysis Summary (IFAS)

Unit-3: Strategy Formulation; Strategic Factors Analysis Summary (SFAS) Business Strategy; Corporate Strategy Functional Strategy Strategic Choice

Unit-4: Strategy Implementation Organization Structure; Corporate Culture; Diversification; Mergers and Acquisitions; Evaluation and Control; Strategic Information Systems

Unit-5: Other Strategic Issues; R&D, IT, KM, Technology; Strategic Risk and other issues

References:

4. R Srinivasan Strategic Management- The Indian Context, Prentice Hall Learning, Sixth Edition, 2020
5. R Srinivasan Case Studies in Marketing- The Indian Context, Prentice Hall Learning, Seventh Edition, 2018

C. BUSINESS ENVIRONMENT

Course Outcomes: At the end of the course, the student will be able to:

CO1	
CO2	
CO3	
CO4	

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1								
CO2								
CO3								
CO4								

Detailed Syllabus:

Unit 1: Business: Concept of Business, Scope and Characteristics of Business, Types of Business Organisations, Liberalisation, Privatisation and Globalisation; Business Environment: Levels of Business Environment- External- Macro, Micro, Internal. Competitive Structure of Industries, PESTLE, SWOT, Porter's Five Forces Model Environment Analysis, Changing dimensions of Business Environment, Socio Cultural Environment, Demographic Environment.

Unit-2: Culture: Nature and Impact of Culture on Business, Cultural Elements- Language, Religion, Family, Aesthetics, Education, etc. Economic Environment, Nature of Economy, Elements of Economic Environment, Economic Systems and Business Environment; Economic planning in India, Economic Policies and Conditions

Unit-3: Polito-Legal Environment; Political Environment: Political Environment and Economic System Types of Political Systems, Risks posed by Political Systems; Political Institutions- Legislature, Executive, Judiciary, Role of Government in business; Legal Environment: Major regulations pertaining to Business, Intellectual Property Rights. Financial Environment: Financial System and its components; Financial Institutions in India and their role, Foreign Investments, Foreign Direct Investments; Need for FDI in developing countries, Factors influencing FDI

Unit-4: Natural and Technological Environment; Natural resources and sustainability, Renewable and Non-renewable resources; Environmental issues related to Business Global Warming, Carbon credits, Industries and Pollution; Technology and Competitive Advantage, Innovation, Technological Leadership, sources of technological dynamics, impact of technology on globalization, Technology transfer, technology adaption, Digitalization of Business;

Unit-5: Corporate Social Responsibility: CSR concept, Need for social responsibility of business, Social Responsibility of Business towards different groups; Barriers to social responsibility, Business Ethics, Corporate Governance; Social Audit; Economic Integration: Levels of Economic Integration, Effects of Economic Integration, Major Regional Trading Blocs; WTO- Objective and Evolution of GATT, Uruguay Round, GATT vs WTO, Organisation of WTO, Functions of WTO, TRIPS, TRIMS, GATS, Dispute Settlement Mechanism, Dumping and anti-dumping measures

References:

1. Business and Sustainability, Michael Blowfield
2. Green to Gold: How Smart Companies Use Environmental Strategy to Innovate, Create Value, and Build Competitive Advantage, Daniel C. Esty, Andrew S. Winston
3. The Triple Bottom Line: How Today's Best-Run Companies Are Achieving Economic, Social and Environmental Success - and How You Can Too, by Andrew Savitz
4. The New Sustainability Advantage: Seven Business Case Benefits of a Triple Bottom Line, Bob Willard

D. HOSPITALITY INDUSTRY IN TOURISM

Course Outcomes: At the end of the course, the student will be able to:

CO1	
CO2	
CO3	
CO4	

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1								
CO2								
CO3								
CO4								

Detailed Syllabus:

Unit 1: Structure of Hospitality Industry, Customer care in Hospitality Industry; Departmentalization in Hotels, Classifications of Hotels & Hotel Rooms, Basis for Classification of Hotels, Distribution Channel in Hospitality; Role of Management Information System (MIS) in Hospitality Industry; Communication in Hotels; Basics of Food production

Unit-2: Food Commodities, Food Additives in Food Production, Indian Cuisine, International Cuisine; Food Purchasing Control; Receiving Control, Storing Control and issuing Control; Production Control, Sales Control

Unit-3: Beverage Cost Control; Introduction to the Hotel Food Service Industry; Attributes of the Food & Beverage Service Staff; Food & Beverage Service Department Equipment; Menu, Beverages - Alcoholic (Wines & Spirits), Beverages - Non Alcoholic (Tea & Coffee), Various Personnel in Hotels

Unit-4: Introduction to House Keeping, Role of House Keeping Department, Bed Making Procedure in Hotels Room Cleaning Procedure in Hotels; Cleaning Public Areas & Pest Control, Organization & Functions of front Office, Quality of Front office in Hotels, Reservation Procedure in Hotels

Unit-5: Guest Registration, Front Office Accounting System, front office functions, Hygiene & sanitation, Hygiene & sanitation in Food Sector; Food Borne Illnesses, Environmental Hygiene pertaining to hotel kitchen and service area, Food laws, regulations, quality and food standards

References:

1. Sampad Kumar Swain, Jitendra Mohan Mishra, "Tourism principles and practices", 2012
2. Denney G. Rutherford, "Hotel Management and Operations", 1994.

ENVIRONMENTAL STUDIES

Course Outcomes: At the end of the course, the student will be able to:

CO1	
CO2	
CO3	
CO4	

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1								
CO2								
CO3								
CO4								

Detailed Syllabus:

Unit-1: Sustainability Concepts – Innovations and Challenges, Environmental Measurements from Different Disciplines

Unit-2: Ecology, Population & Environmental Chemistry, Physical Process in Environment

Unit-3: Environmental Biological Concepts, Environmental Risk Assessments with Concepts of EIA and LCA

Unit-4: Water – Quantity and Quality, Water Treatment Basics, Basics of Wastewater Collection, Treatment & Resource Recovery

Unit-5: Basics of Solid Waste, Soil and Noise Pollution, Basics of Air Pollution Issues – Global and Local, Case Studies

REFERENCES:

6. Gilbert M Masters and Wendell P Ela, "Introduction to Environmental Engineering and Science", Publisher: Pearson Education India; 3rd edition, ISBN-10:9332549761, ISBN-13: 978-9332549760
7. Howard Peavy, Donald Rowe, and George Tchobanoglous, "Environmental Engineering", Publisher: McGraw Hill Education; ISBN-10: 9351340260, ISBN-13: 978-9351340263

SEMINAR

Course Outcomes: At the end of the course, the student will be able to:

CO1	Communicate with group of people on different research topics
CO2	Prepare a seminar report that includes consolidated information on a research topic

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	-	-	-	-	√	-	-	-
CO2	-	-	-	-	-	√	√	√

Detailed Syllabus:

Any topic of relevance to chemical and allied engineering and science.

PROJECT WORK (STAGE - I)

Course Outcomes: At the end of the course, the student will be able to:

CO1	Identify the problem based on literature survey	
CO2	Formulate the problem	
CO3	Identify the methods or techniques required for the solution	
CO4	Develop the solution methodology	

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1								
CO2								
CO3								
CO4								

Guidelines:

When undertaking an M.Tech. project in Chemical Engineering, the process involves various stages, from selecting a topic to completing the final thesis. Here are the typical guidelines that can help navigate the project:

- Project Topic Selection

  Relevance: Choose a project related to current trends and challenges in chemical engineering (e.g., renewable energy, water treatment, industrial waste management, sustainability, etc.).

  Interest: Pick a topic that interests you, as it will keep you motivated throughout the project.

  Feasibility: Ensure that the project is feasible in terms of time, resources, and facilities available in your institution or at an industrial partner.

  Literature Review: Start with a thorough literature review to identify gaps in current research and technologies.

- Research Proposal

  Objective: Clearly define the project's goal (e.g., designing a new process, optimizing an existing system, simulating processes).

  Scope: Specify the boundaries of your project (what will be studied and what will not).

  Methodology: Describe the methods, techniques, and tools you will use, such as experimental work, process simulation, or theoretical analysis.

  Expected Outcomes: Highlight the expected results and their potential applications.

  Timeline: Provide a detailed schedule for completing different stages of the project (e.g., literature review, data collection, analysis, report writing).

- Resources Required: List any special equipment, software, or materials you will need.

SYLLABUS FOR SEMESTER-IV

PROJECT WORK (STAGE - II)

Course Outcomes: At the end of the course, the student will be able to:

CO1	Implement the methods/techniques identified in dissertation part-A
CO2	Analyze and interpret the results obtained
CO3	Compare the results obtained with literature
CO4	Demonstrate the original contribution to knowledge

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1								
CO2								
CO3								
CO4								

Guidelines:

The extended guidelines are:

- Project Execution
  Literature Survey: Conduct a comprehensive literature survey to understand the existing work and identify gaps.
  Data Collection/Simulation: Depending on your project, collect experimental data or carry out simulations. For experimental projects, ensure the experimental setup is well-planned.
  Process Design/Optimization: If your project involves process design or optimization, ensure that you apply the appropriate principles of thermodynamics, kinetics, fluid mechanics, and mass/energy balance.
  Modeling & Simulation: If modeling or simulation is involved, tools such as Aspen Plus, MATLAB, HYSYS, COMSOL, or others can be used depending on the nature of the project.
  Analysis & Interpretation: Analyze the results critically, comparing them with theoretical predictions or industry standards.

- Documentation & Report Writing
  Structure of the Thesis:
  Title Page: Include your project title, name, department, institution, and year.
  Abstract: Provide a concise summary of the problem, methodology, findings, and implications.
  Introduction: Explain the background, objectives, scope, and significance of the project.
  Literature Review: Summarize previous work related to your topic.
  Methodology: Describe the techniques and processes used in your project.
  Results and Discussion: Present your findings and interpret them.
  Conclusion: Summarize the key results and suggest future research or applications.
  References: List all the papers, books, and other sources you referred to during the project.
  Appendices: Include any additional material, such as charts, raw data, or code used for simulations.
  Figures and Tables: Make sure figures and tables are properly labeled and referenced in the text. They should be clear and relevant.
  Language & Clarity: Write in clear, professional language. Avoid jargon and ensure that your explanations are understandable to someone familiar with chemical engineering concepts.

- Supervision and Feedback

Advisor/Guide: Regularly meet with your project advisor to discuss progress, challenges, and feedback.
Peer Review: Seek feedback from peers or other experts to get different perspectives on your work.

- Presentation
  Prepare a Presentation: Summarize the key aspects of your project for the final defense. Focus on objectives, methodology, results, and conclusions.
  Time Management: Practice your presentation to stay within the time limit and be ready for questions from the faculty or committee members.

- Ethical Considerations
  Integrity: Ensure your work is original, and properly cite all sources of information. Avoid plagiarism.
  Environmental and Social Impact: Consider the ethical and environmental impact of your project, especially if it involves industrial applications.

- Final Submission
  Formatting: Follow the formatting guidelines provided by your institution (e.g., font size, spacing, margin size).
  Submission Deadline: Make sure to submit the project within the stipulated deadline.
  Soft and Hard Copies: Submit both soft (digital) and hard copies of your report, depending on your institution's requirements.