CURRICULUM OF CHEMICAL ENGINEERING

RGUKT BASAR

II YEAR

I SEMESTER

S.No.	Subject Code	Subject Name	(L-T)-P	C
1	BSBE2001/3001	Environmental Science	4-0	3
2	CY2101	Organic Chemistry	4-0	4
3	CH2102	Chemical Engineering Thermodynamics	4-0	4
4	CH2101	Chemical Engineering Fluid Mechanics	4-0	4
5	MA2104	Mathematics-III	4-0	4
6	HS2101	Soft Skills - 1	2-0	1
7	CY2701	Organic Chemistry Lab	0-3	2
8	CH2701	Chemical Engineering Fluid Mechanics Lab	0-3	2
9	CH2901	Seminar - 1	0-3	1
		Total Credits		**25**

L – Lectures, T – Tutorials, P – Practicals, C – Credits

BSBE 2001/3001　　　　ENVIRONMENTAL SCIENCE

Externals: 60 Marks　　　　　　　　　　　　　　　　　　**L-T-P-C**

Internals: 40 Marks　　　　　　　　　　　　　　　　　　**4-0-0-3**

Learning Objectives:

The syllabus aims to:

- Stimulate interest in the environment and endeavors to generate awareness about environmental concerns among students.

- Develop an understanding of how natural resources and the environment affect quality of life and the quest for sustainable development.
- Develop knowledge and understanding of environmental issues and principle and apply their knowledge to mitigate the environmental problems.
- Understand and resolve some of today's most challenging scientific and policy issues—including global climate change, pollution, biodiversity conservation, sustainability, environmental pollution and toxic waste disposal, disease control, disaster management, socio-environmental issues and balancing resource use and preservation.
- Design and evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.
- Recognizes the global changes and responses for attaining a more sustainable environment.

UNIT 1: MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES
Definition, scope and importance, need for public awareness.

UNIT 2: NATURAL RESOURCES:
Renewable and non-renewable resources : Natural resources and associated problems.
a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- .Role of an individual in conservation of natural resources.
- Equitable use of resources for sustainable lifestyles.

UNIT 3: ECOSYSTEMS & BIODIVERSITY
Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids.
Introduction, types, characteristic features, structure and function of the following ecosystems:-

a. Forest ecosystem, b. Grassland ecosystem, c. Desert ecosystem, d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).
b. Biodiversity- Definition : genetic, species and ecosystem diversity. Biogeographical classification of India Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values.
c. Biodiversity at global, National and local levels. Inida as a mega-diversity nation Hot-sports of biodiversity.
d. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT 4: ENVIRONMENTAL POLLUTION
Definition, Cause, effects and control measures of :- Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards
- Solid waste Management: Causes, effect s and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution
- Pollution case studies.
- Disaster management: floods, earthquake, cyclone and landslides.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.
- Environment Protection Act., Air (Prevention and Control of Pollution) Act. Water Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act .

UNIT 5 : SOCIAL ISSUES & THE ENVIRONMENT

Human Rights. Value Education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.

Field work: Visit to a local area to document t environmental assets river/ forest/grassland/hill/mountain Visit to a local polluted site-Urban/Rural/Industrial/Agricultural . Study of common plants, insects, birds. Study of simple ecosystems-pond, river, hill slopes, etc.

REFERENCES :

a). Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.

b). Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad- 380 013, India, Email:mapin@icenet.net (R)

c). Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p

d) Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)

e). Cunningham, W.P. Cooper, T.H. Gorhan i, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 116p .

CY2101   ORGANIC CHEMISTRY

Externals: 60 Marks   **L-T-P-C**
Internals: 40 Marks   **4-0-0-4**

Objectives:

∗ The Mechanism of organic chemical reaction is essential to synthesis new organic compounds in drug and pharmaceutical industries. In order to study their kinetics of reactions to regulate the process for optimization of production of drugs and pharmaceutical, the principles of organic chemistry are essential.

∗ For chemical engineer to carry out a processes industrially for the manufacture of drgus and pharmaceuticals, Comprehension on basic reactions, reagents and their applications is needed.

∗ He/She should know the electronic behavior of organic molecules, their special and geometrical arrangement of functional groups.

∗ He/She should have insight of reaction mechanisms for different types of reactions.

∗ He/She must have knowledge to conduct the most common reactions like addition, substitution, oxidation, reduction etc., on large scale.

UNIT I
Polar effects and Aromaticity
Polar effects - Inductive effect, electromeric effect, resonance, hyper conjugation, steric hindrens, and aromaticity – examples.

UNIT II
Electrophilic and Nucleophilic Reactions
Electrophilic reactions: a) Friedel-Craft reaction b) Riemer- Teimenn Reaction c) Backmann rearrangement.
Nucleophillic reactions : a) Aldol condensation b) Perkin Reaction c) Benzoin condensation.

UNIT – III
Stereochemistry
Stereo isomerism; Optical isomerism; Symmetry and chirality; Optical isomerism in lactic acid and tartaric acid; Sequence rules; Enantiomers, diastereomers; Geometrical Isomerism; E-Z system of nomenclature, conformational analysis of ethane and Cyclohexane.

UNIT.IV
Some Reagents of Synthetic importance
Preparation and applications of Aluminum Chloride, N-Bromosuccnamide (NBS), Diazomethane, Dicyclohexylcarbodiimide (DCC), Potassiumtertiarybutoxide and Grignard reagent

UNIT.V:
Some Useful Reactions in Organic Synthesis
Protection of functional groups: Hydroxyl, Carbonyl and amino groups
Oxidation: Oxidation of alcohols and carbonyl compounds with suitable examples
Reduction: Reduction of double and triple bonds and carbonyl compounds with suitable examples.

Suggested References:

1. Text book of Organic Chemistry – Morrsion and Boyd.
2. Organic Reaction Mechanisms by VK Ahulwalia and RK Parashar
3. Reaction mechanism – Peter Skyes.
4. Text book of Organic Chemistry – P.L. Soni.
5. Organic Chemistry Vol- I-IL. Finar.
6. Reactions and Reagents – O.P. Agrawal.
7. A Text Books of Organic Chemistry- Bahl and Arun Bahl, S. Chand company, New Delhi
8. Polymer Science and Technology- Hema Singh, Acme Learning, New Delhi

Outcomes:
1. Will be able to understand the essentiality of organic chemical reaction to synthesis new organic compounds in drug and pharmaceutical industries.
2. To gain knowledge on basic reactions, reagents and their applications.
3. To gain knowledge on electronic behavior of organic molecules, their special and geometrical arrangement of functional groups.
4. To gain necessary knowledge to conduct the most common reactions like addition,

substitution, oxidation, reduction etc., on large scale.

CH2102   CHEMICAL ENGINEERING THERMODYNAMICS

Externals: 60 Marks   **L-T-P-C**

Internals: 40 Marks   **4-0-0-4**

Objectives:
- To develop property relations for homogeneous phases and to understand various Thermodynamic diagrams.
- To introduce the concepts of chemical potential, partial properties, property relations for ideal gases, fugacity excess properties.
- To develop the theoretical foundation for applications of thermodynamics to gas mixtures and liquid solutions.
- To perform the phase equilibrium calculations using simple models for VLE, Gamma/Phi approach and equation of state approach.
- To understand concept of reaction equilibrium.

Unit-1

Thermodynamic properties of pure fluids-Property relations for homogeneous phases, Gibbs free energy, Fundamental property relations, Residual properties.

Two phase systems, Thermodynamic diagrams,Tables of thermodynamic properties, Generalized property correlations for gases and gas mixtures.

Unit-2

Solution Thermodynamics: Theory, Fundamental property relation, chemical potential as a criterion for phase equilibrium, partial properties, Residual properties, ideal gas mixtures, fugacity and fugacity coefficient for pure species, fugacity and fugacity coefficient for species in solutions, generalized correlations for Fugacity coefficient, The ideal solutions, excess properties.

Solution Thermodynamics Applications: The liquid phase properties from VLE data, models for the excess Gibbs energy, property changes of mixing

Unit-3

VLE at low to moderate pressures-The nature of equilibrium, the phase rule, Duhems theorem, VLE: Qualitative behavior, the gamma /Phi formulation of VLE, Dew point and bubble point calculations, flash calculations, solute (1)/solvent (2) systems

Unit-4

Thermodynamic Properties and VLE from Equations of State- properties of fluids from the virial equations of state, properties of fluids from cubic equations of state, fluid properties from correlations of the Pitzer type, VLE from cubic equations of state.

Topics in Phase Equilibria- Equilibrium and stability, Liquid-Liquid Equilibrium (LLE), Vapor-Liquid–Liquid Equilibrium (VLLE), Solid-Liquid Equilibrium (SLE), Solid Vapor Equilibrium (SVE).

Unit-5
Chemical Reaction Equilibria: the reaction coordinate, application of equilibrium criteria to Chemical reactions, standard Gibbs free energy change, equilibrium constant, Effect of temperature on equilibrium constant, evaluation of equilibrium constants, relation of equilibrium constants to composition, equilibrium conversions for single reaction, phase rule and Duhem's theorem for reacting systems.

Text Books:
1. Introduction to Chemical Engineering Thermodynamics, J M Smith, H C Van Ness and M M Abbott, 6th Edition, TMH.

Reference Books:
1. Chemical Engineering Thermodynamics, Pradeep Ahuja, PHI Learning Pvt. Ltd., New Delhi, 2009
2. A Text Book of Chemical Engineering Thermodynamics, K.V. Narayanan, PHI Learning Pvt. Ltd., New Delhi, 2001.

CH2101   CHEMICAL ENGINEERING FLUID MECHANICS

Externals: 60 Marks   **L-T-P-C**

Internals: 40 Marks   **4-0-0-4**

Objectives:

Understand concepts on nature of fluids, pressure concepts and measurement of pressure by various experimental methods and by mathematical relations and enhancement of problem solving skills.

- Learn detailed explanation on types of fluids, stress and velocity relations, type of fluid flow and boundary layer relations.
- Understand relationship between kinetic energy, potential energy, internal energy and work complex flow systems using Bernoulli's equation with application to industrial problems.
- Understand clear concepts on Flow of incompressible fluids in conduits and thin layers and friction factor variations with velocity and friction losses using Bernoulli Equations and they will be demonstrated experimentally.
- Study Flow of compressible fluids, Dimensional analysis, Dimensional homogeneity and various dimensionless numbers and their applications.
- Understand principles and working of various types of pumps, transportation and metering of fluids using various experimental techniques and applications to industry.

Unit-1

Unit systems, basic concepts, nature of fluids, Hydrostatic equilibrium, Applications of fluid statics, Fluid flow phenomena-Laminar flow, Shear rate, Shear stress, Rheological properties of fluids, Turbulence, Boundary layers.

Unit-2

Basic equations of fluid flow -Mass balance in a flowing fluid; continuity, differential momentum balance; Equations of motion, Macroscopic momentum balances, Mechanical energy equations

Unit-3

Incompressible Flow in pipes and channels shear stress and skin friction in pipes, laminar flow in pipes and channels.
Turbulent flow in pipes and channels, friction from changes in velocity or direction, Dimensional analysis including Buckingham π Theorem and Rayleigh's method

Unit-4

Flow of compressible fluids -Definitions and basic equations, Processes of compressible flow, Isentropic flow through nozzles, adiabatic frictional flow, and isothermal frictional flow.

Flow past immersed bodies-Drag and Drag coefficient, flow through beds of solids, motion of particles through fluids. Fluidization, Minimum fluidization velocity, Types of fluidization, applications of fluidization. Continuous fluidization; slurry and pneumatic transport

Unit-5

Transportation of fluids-Pipes, tubes, fittings and valves, Seals, classification and selection of pumps,fans, blowers, and compressors. Pumps- developed head, suction lift and cavitation, NPSH, Characteristics curves of centrifugal pumps.

Metering of fluids: Constructional features and working principles of Venturimeter,Orifice meter, rotameter, pitot tude,target meter, magnetic meter etc.

Text Books:
1. Unit Operations of Chemical Engineering, W.L.McCabe, J.C.Smith & Peter Harriot, McGraw- Hill, 6th Edition, 2001.
2. Fluid Mechanics for Chemical Engineers, Noel de Nevers, 2nd edition, McGraw Hill International editions, 1991.

References Books:
1. Introduction to Fluid Mechanics, Fox and Mc Donald , 8th Edition
2. Transport processes and unit operations, Christie J. Geankoplis, PHI.

MA2104   MATHEMATICS-III
(For Chemical Engineering Department)

External Marks: 60Marks   **L-T-P-C**

Internal Marks: 40Marks   **4-0-0-4**

Objectives:

- To introduce Laplace Transforms and its applications in solving Differential equations.
- To learn various numerical methods for solving Differential equations.
- To introduce the concept of partial differentials and various methods of solving PDEs.
- To learn Various methods to solve second order Partial differential equations.
- To introduce Fourier series and it's properties.

UNIT-I

Laplace Transform:

Definition of Laplace Transform, linearity property, conditions for existence of Laplace Transform. First and second shifting properties, Laplace Transform of derivatives and integrals, unit step functions, Dirac delta-function, error function. Differentiation and integration of transforms, convolution theorem.

UNIT-II

Inverse Laplace Transform & Fourier Transform:

Inverse Laplace Transform, periodic functions. Evaluation of integrals by Laplace Transform. Solution of initial and boundary value problems and solving Differential Equations & Integral Equations.

Fourier Transform, Fourier sine and cosine transforms. Linearity, scaling, frequency shifting and time shifting properties, convolution theorem.

UNIT-III

Numerical Solution of Ordinary Differential Equations:

Numerical solutions of IVP - Difference equations, stability, error and convergence analysis. Single step methods -Taylor series method, Euler method, Picard's method of successive approximation, Runge-Kutta Method (second order & fourth order) . Multi step methods. Newton's method for system of equations, stability, error and convergence analysis.

UNIT-IV

First order Partial Differential Equations:

Definition of PDEs, Classification of PDEs(linear, non-linear), Solving first order Linear equation, Pfaffian Differential Equations, Compatible system of PDEs, Charpit's Method.

UNIT-V

Second order Partial Differential Equations:

Classification of Second order PDE, Boundary Value Problems, Finite difference approximations to partial derivatives, convergence and stability analysis. Explicit and Implicit schemes - Crank-Nicolson scheme. Solution of wave equation.

Text Books:

1. Jain. R.K. Iyengar. S.R.K., Advanced Engineering Mathematics, 3rd Edition, Narosa.
2. Churchill. R.V. Brown. J.W., Fourier series and boundary value problems, Mc Graw. Hill.
3. M.K. Jain., Numerical solutions of differential equations 2nd Edition. Wiley Eastern, 1984
4. S.D. Conte & C. de Boor, Elementary Numerical analysis - an algorithmic approach, Mc Graw Hill, 1980 3rd Edition Newyork.
5. M.K Jain, S.R.K Iyengar, R.K Jain, computational methods for PDE, wiley eastern 1994
6. An Elementary course in Partial Differential equations –T.Amarnath, Narosa Publishing House

Reference Books:

1. E. Kreyszig Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons (1999)
2. E. Ward Cheney, David R. Kindcaid, Numerical methods and applications, Brooks / core (2008)
3. Butcher, J.C 1987, the Numerical analysis of ordinary differential equations, Runge - Kutta and general linear methods. Wiley, Newyork.

HS2101   **Soft Skills - I**

Externals: 60 Marks   **L-T-P-C**
Internals: 40 Marks   **2-0-0-1**

Objectives:
- ➢ To implement practically the skills needed for employment.
- ➢ To deal with the society in an acceptable way.
- ➢ To make them competent to attempt and qualify in various tests.
- ➢ To make them proficient in using vocabulary in various situations.

UNIT-I
Vocabulary Building – Teaching Root words – Word association - How to talk about Personality Type - How to talk about Doctors - How to talk about Various Practitioners - How to talk about Science and Scientists - How to talk about various Speech Habits - How to insult your enemies - How to flatter your friends - How to talk about a variety of personal characteristics - How to talk about actions

UNIT-II
Common Errors in English

UNIT-III
Twenty -four seven - L for gist - NDTV debates - L for specific information - Ted Talks - L for detail - Devils' Advocate - **Picture perception** – Describing people, paintings, cartoons etc.

UNIT-IV
 Read between the lines – R for Pleasure - Reading Newspaper - Movie Reviews **- R for Specific information –** Essays - Textbooks

UNIT-V
 Now you are talking - Giving Opinions - Stating Facts - Agree and disagree - Decisions and Intentions - Raising Questions - Giving and receiving effective feedback

UNIT –VI
Writing Dialogue

Suggested References:
1. Word Power Made Easy
2. Ted Talks
3. NDTV Talks
4. Newspapers (The Hindu, Times of India)

CY2701   **ORGANIC CHEMISTRY LAB**

Externals: 60 Marks   **L-T-P-C**

Internals: 40 Marks   **0-0-3-2**

Objectives:
To confirm the formation and nature of the product in a chemical processes, the knowledge of some physical, chemical and instrumental methods is essential for a chemical engineer.

ORGANIC CHEMISTRY LAB:

1. Criteria of Purity of Solid and Liquid, Determination of Melting Point & Boiling Point. Detecting Nitrogen, Sulphur, and Halogens in Organic Compounds.
2. Identification of an Unknown Substance from the following classes of Organic Compounds, Alcohols, Phenols, Aldehydes, Ketones, Carbohydrates and Carboxylic acids.
3. Preparation of Aspririn
4. Preparation of Paracetamol
5. Preparation of Acetanilide
6. Preparation of Sulphonic acid
7. Preparation of derivatives for Aldehydes and Amines.
8. Beckman Rearrangement (Preparation of Benzanilide from Benzophenone oxime).
9. Determination of strength of a Glycine Solution.
10. Estimation of an Aldehyde.

Outcomes:

* Students will get the knowledge of methods to confirm the formation and the nature of the product.
* Students will get the knowledge of some physical, chemical and instrumental methods that are essential for a chemical engineer.

Suggested References:

1. Vogels Text Book of Qualitative Organic Analysis
2. Comprehensive Practical Organic Chemistry – Preparation and Quantitative analysis byV K Ahluwalia, Renu Aggarwal.

CH2701   CHEMICAL ENGINEERING FLUID MECHANICS LAB

Externals: 60Marks   **L-T-P-C**

Internals: 40Marks   **0-0-3-2**

 Note: Any 8 Experiments out of given set of experiments.

Objectives:
- Know the different types of flow using Reynolds apparatus.
- Verify the Bernoulli's equation by using Bernoulli's apparatus.
- Calibrate the Rotameter.
- Find out the variation of orifice coefficients with Reynolds Number.
- Determine the venturi coefficient by using venturimeter.
- Find out the frictional losses in flow through pipes.
- Study the coefficient of contraction in an open orifice.
- Study the coefficient of discharge in V- Notches.
- Study the characteristic of a centrifugal pump.
- Find out the pressure drop in packed bed for different velocities.

List of experiments
1. Identification of laminar and turbulent flows
2. Measurement of point velocities
3. Verification of Bernoulli's equation
4. Calibration of Rotameter
5. Variation of Orifice coefficient with Reynolds Number
6. Determination of Venturi coefficient
7. Friction losses in Fluid flow in pipes
8. Pressure drop in a packed bed for different fluid velocities
9. Pressure drop and void fraction in a fluidized bed
10. Studying the coefficient of contraction for a given open orifice
11. Studying the coefficient of discharge in a V-notch
12. Studying the Characteristics of a centrifugal pump

List of Equipment
Reynolds apparatus, Pitot tube setup, Bernoulli's Apparatus, Rotameter Assembly, Orifice meter Assembly, Venturi meter Assembly, Pipe Assembly with provision for Pressure measurement, Packed bed with Pressure drop measurement, Fluidized bed with Pressure drop measurement, Open Orifice Assembly, V-notch Assembly, Centrifugal Pump

CH2901   Seminar-I

Externals: 100 Marks   **L-T-P-C**

                                                                   0-0-3-1

Objectives:

- To improve the presentation skills
- To prepare PPT more effectively

Student has to choose a general topic to give a power point presentation