**SCHEME OF TEACHING AND EXAMINATION**  
B.E. (V SEMESTER) CHEMICAL ENGINEERING

<table>
<thead>
<tr>
<th>S. No</th>
<th>Board of Study</th>
<th>Subject Code</th>
<th>Subject</th>
<th>Period per week</th>
<th>Scheme of Exam</th>
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<td>Theory/Practical</td>
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<td>1</td>
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<td>Fluid Flow Operations</td>
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<td>80</td>
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**Total**

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<th>P</th>
<th>ESE</th>
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**L:** Lecture  
**T:** Tutorial  
**P:** Practical  
**ESE:** End Semester Examination  
**CT:** Class Test  
**TA:** Teacher’s Assessment

*Industrial Training of eight weeks is mandatory for B.E. student. It is to be completed in two parts. The first part will be in summer after IV sem. after which students have to submit a training report which will be evaluated by the college teachers during B.E. V sem.*
Chhattisgarh Swami Vivekanand Technical University, Bhilai

<table>
<thead>
<tr>
<th>Branch:</th>
<th>Chemical Engineering</th>
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<td>Subject:</td>
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<tr>
<td>Semester:</td>
<td>V</td>
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<tr>
<td>Code:</td>
<td>319551 (19)</td>
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<td>Total Theory Periods:</td>
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<tr>
<td>No. of Tutorial Periods:</td>
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<tr>
<td>No. of class Tests to be conducted:</td>
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<td>No. of assignments to be submitted:</td>
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<tr>
<td>ESE Duration:</td>
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<tr>
<td>Maximum Marks in ESE:</td>
<td>80</td>
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<tr>
<td>Minimum Marks in ESE:</td>
<td>28</td>
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**Course Objective:**
- To introduce the basic concepts of fluid mechanics and their applications in Chemical Engineering to design the equipment for measurement and transport of fluids in chemical plants and to design the related piping and control systems.
- To develop the ability to determine pressure and velocity variations in internal and external flow of fluids to identify the basic mechanisms, formulate problems and solve the problems by analysis or by application of experimental data.

**Course Outcome:**
The course is meant for understanding the design approaches and methods of scientific and engineering principles for designing fluid flow system in any process plant and measure and monitor the flow of fluids, be it a liquid or a gas.

**UNIT I**

**UNIT II**
- Fluid Flow Phenomena: Newtonian And Non-Newtonian Fluids, Viscosity And Momentum Flux, Laminar &Turbulent Flow In Boundary Layers, Friction Factor Chart, Friction Factor &Pressure Drop, Dimensional Analysis and Pie Theorem, Dimensional less groups.

**UNIT III**

**UNIT IV**
- Pipes fitting and Valves: Pipe Sizing For Flow Of Liquids And Gasses, Joints And Fittings, Sudden Contraction And Expansion, Classification Of Valves And Pumps And Their Selection Criteria, Losses In Piping, Valves And Fittings, Performance Of Centrifugal Pumps, Characteristic Curves For Pumps, NPSH Calculation For Pumps, Fans And Blowers.

**UNIT V**

**Text Books:**

**Reference Books:**
1. B.Mersey, Fluid Mechanics, Chapman, Landon.
Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch: Chemical Engineering
Subject: Heat Transfer Operations
Semester: V
Code: 319552 (19)

Total Theory Periods: 40
Total Tutorial Periods: 10
No. of class Tests to be conducted: 2 (Minimum)
No. of assignments to be submitted: 2 (Minimum)
ESE Duration: Three Hours
Maximum Marks in ESE: 80
Minimum Marks in ESE: 28

Course Objective:
- The course is designed to provide an overview of various modes of heat transfer, its mechanism, and the industrial aspects of conduction, convection and radiation.
- Condensation and evaporation phenomena, design and construction of equipment form an integral part of this course.

Course Outcome:
- After undergoing this course the students will acquire knowledge about various modes of heat transfer, its mechanism, and the industrial aspects of conduction, convection and radiation.
- After undergoing this course the students will understand about design and construction of heat transfer equipments.

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V
Evaporation, Types of Evaporators, Performance of Tubular Evaporators, Duhring's Rule, Elevation in Boiling Point and Effect of Hydrostatic Head, Steam Economy, Enthalpy Balance, Multiple effect Evaporators, Methods of feeding, Numerical Problems based on the above.

Text Books:

Reference Books:
Chemical Engineering  
Semester: V
Code: 319553 (19)

Total Theory Periods: 40
Total Tutorial Periods: 10

No. of class Tests to be conducted: 2 (Minimum)
No. of assignments to be submitted: 2 (Minimum)

ESE Duration: Three Hours
Maximum Marks in ESE: 80
Minimum Marks in ESE: 28

Course Objective:
- To get exposed to finite differences and interpolation
- To be thorough with the numerical differentiation and integration
- To find numerical solutions of ordinary differential equations and unsteady state heat and mass transfer problems.
- To find numerical solutions of partial differential equations

Course outcome:
- This course helps the students to develop analytical ability in solving mathematical problems as applied to the Chemical Engineering.
- This course helps the students to understand the applications of numerical techniques in chemical engineering calculations

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

Text Books:
2. Dr. B.S. Grewal, “Numerical Methods in Engineering and Science” Khanna Publishers

Reference Books:
Course Objective:

- The purpose of the organic process technology course is to improve knowledge of the chemical processes along with emphasis on recent technological development.
- The aim of the course is to study process technologies, availability of raw materials, production trends, preparation of flow sheets, engineering and environmental problems of various chemical industries.

Course Outcome:

- After undergoing this course the students will acquire knowledge regarding various technological aspects of chemical industries.
- After undergoing this course the students will understand about manufacturing process and technical problems associated with this.

UNIT I

Dyes and Intermediates: Introduction, classification of dyes, manufacture of dyes.

UNIT II


UNIT III

Sulfonation and Sulfation: Introduction, agents, chemical & physical factors, sulfonation equipments, sulfonation of benzene.

UNIT IV

Esterification: Esterification By organic acid, study of continuous esterification column. Manufacture of ethyl acetate, cellulose acetate & nitroglycerine.
Vegetable Oil: Types of oil, extraction and processing of vegetable oil, Types of animal’s fat & oil. Types of waxes. Manufacturing of Soap & Detergent.

UNIT V


Text Books:


Reference Books:

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch: Chemical Engineering  
Subject: Chemical Engineering Thermodynamics  
Semester: V  
Code: 319555 (19)

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch: Chemical Engineering  
Subject: Chemical Engineering Thermodynamics  
Semester: V  
Code: 319555 (19)

Course Objectives:
- To familiarize with basic concepts and laws of thermodynamics
- To familiarize with volumetric properties of fluids
- To understand thermodynamic properties of fluids
- To be thorough with the numerical solution based on compression and refrigeration

Course outcomes:
1. This course helps the students to understand knowledge of thermodynamics and its application in process industries.
2. This will help to impart knowledge on the application of carnot principles in refrigeration cycle.
3. This course helps the students to understand the chemical equilibria.

UNIT I

UNIT II

UNIT III
Compression: Reciprocating Air Compressors, Single stage compression, Clearance and Clearance Volume, Volumetric Efficiency, Multistage Reciprocating Air Compressor: Arrangement for Multistage with Intercooler, Power Requirement And Efficiency.

UNIT IV
Carnot and Reversed Carnot Cycle, Air cycle for Refrigeration: Bell Coleman air cycle, Reversed Brayton cycle, Vapour compression refrigeration cycle, cascade and Multistage refrigeration, Vapour Absorption cycle, Choice of Refrigerant.

UNIT V
Solution Thermodynamics: Partial Molal Properties; Chemical Potential; Gibbs-Duhem Equation; Fugacity and Fugacity Coefficient; Activity and Activity Coefficient; Excess Properties of Mixtures. Chemical Equilibria: Chemical Equilibrium Constants; Homogeneous Reactions; Standard Gibbs Free Energy Change; Equilibrium Conversion in Single and Multiple Reactions

Text Books:
2. Dr. R. Yadav, “Fundamentals of Engineering Thermodynamics” Central Publishing House

Reference Books:
1. Y. V. C. Rao, “Chemical Engineering Thermodynamics” Universities Press
Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch: Chemical Engineering
Subject: Bio Chemical Engineering
Semester: V
Code: 319556 (19)
Total Theory Periods: 50
Total Tutorial Periods: NIL
No. of class Tests to be conducted: 2 (Minimum)
No. of assignments to be submitted: 2 (Minimum)
ESE Duration: Three Hours
Maximum Marks in ESE: 80
Minimum Marks in ESE: 28

Course Objective:
• The aim of the course is to study about basics of microbiology, cell constituents and chemicals of Life.
• The purpose of the course is to study the kinetics of enzyme and immobilization of enzymes.
• Major Metabolic Pathways: EMP pathway, TCA cycle and Respiratory chain.
• Microbial growth, study of bioreactors.
• Bio-product recovery and fermentation process.

Course Outcome:
• After undergoing this course the students will acquire knowledge regarding kinetics of Enzyme.
• After undergoing this course the students will acquire knowledge regarding major metabolic Pathways, bioreactors and bio-product recovery.

UNIT I
Introduction – Cellstructure, types; Microbiology: Bacteria, Yeasts, Molds, Algae; Chemical of Life: Carbohydrates, Lipids, Proteins; Nucleicacid: RNA and DNA; The hierarchy of cellular organization.

UNIT II
The Enzyme and Enzyme Kinetics –Introduction; Classification of enzymes; Mechanism and kinetics of enzymatic reactions; The enzyme substrate complex and enzyme action; Other influences on enzyme activity; Hydrolytic enzymes; Enzymes of industrial importance; Method of immobilization.

UNIT III
Metabolic Stoichiometry and Energetic –Energy production and coupling reactions: Glycolysis, TCA cycle, EMP pathway, Electron transport chain (Respiratory chain); Photosynthesis; Membrane transport; Fermentation: aerobic and anaerobic; Biosynthesis of carbohydrates (glycogen), Amino acids, Nucleotides.

UNIT IV
Biomass Production in Cell Cultures – Biomass and cell cultures; Cell population kinetics; Ideal reactors for measurement of kinetics: Batch and CSTR; Kinetics of balanced growth; Monod’s growth kinetics; Transient growth kinetics; Thermal –Death kinetics of cells and spores.

UNIT V
Biological Reactors – Components of Bioreactors; Components of a fermentation process; Types of bioreactors for Bio-mass production; Down stream processing: removal of particulates, Cell disruption, Primary isolation, Purification, Final product isolation, Membrane separation processes.

Text Books:

Reference Book:
List of Experiments (At least Eight experiments are to be performed by each student)

1. Determination of viscosity.
2. Experiment to determine characteristics of laminar and turbulent flow.
3. Flow through packed bed.
4. Flow through venturi meter.
5. Flow through orifice meter.
6. Flow through pipe fitting (Minor Losses).
7. Determination of friction factor (Major Losses).
8. Characteristics of centrifugal pump
9. Verification of Stokes’s law.
10. Verification of Bernoulli’s theorem.

Equipment/Machines/Instruments/Tools Required:

1. Packed bed column
2. Orifice meter
3. Venturi meter
4. Rota meter
5. Bernoulli’s apparatus
6. Viscometer

Recommended Books:

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch: Chemical Engineering  
Subject: Heat Transfer Operations Laboratory  
Semester: V  
Code: 319562 (19)

Total Lab Periods: 36  
Maximum Marks: 40  
Minimum Marks: 20  
Batch Size: 15

Experiment to be performed (Minimum Ten experiments are to be performed by each student):

2. Determination of Thermal Conductivity of insulating powder by Spherical Dome.
7. To study the temperature distribution along the length of Pin Fin in Natural Convection.
8. To study the temperature distribution along the length of Pin Fin in Forced Convection.
10. To study heat transfer characteristic of open pan evaporator.
11. To study heat transfer characteristic of horizontal tube condenser.
12. To study the steam PV cell pilot scale system

List of Equipments required:

1. Thermal Conductivity Apparatus
2. Pin Fin Apparatus
3. Double Pipe Heat Exchanger
4. Shell-Tube Heat Exchanger
5. Open pan evaporator
6. Compounded resistance set up of metal slabs
7. Horizontal Tube Condenser

Text Books:


Reference Books:


Name of the Programme: Bachelor of Engineering  
Duration of the programme: Four Years
Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch: Chemical Engineering

Subject: Organic Process Technology Laboratory

Semester: V

Code: 319563 (19)

Batch Size: 15

Minimum Marks: 20

Total Lab Periods: 36

Maximum Marks: 40

Experiment to be performed (Minimum Ten experiments are to be performed by each student):

1. To determine the acid value of given oil sample.
2. To determine the saponification value of given oil sample.
3. To determine the % of total fatty material present in given soap.
4. To determine the moisture content of the given soap sample.
5. To determine the esterification value of the given oil sample.
7. To determine the moisture content of prepared toilet soap.
8. Preparation of phenol-formaldehyde resin.
10. To determine the iodine value of the given oil sample.
11. To determine the % of oil in given oil bearing seed sample.
12. To determine free alkali content in given soap sample.
15. Manufacture of paint.

Equipments/Machines/Instruments/Tools Required:

1. Oven
2. Electronic balance
3. Hot plate
4. Water bath
5. Agitator
6. Distillation unit

Recommended Books:

## Chhattisgarh Swami Vivekanand Technical University, Bhilai

<table>
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<th>Semester:</th>
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<tr>
<td>Maximum Marks:</td>
<td>40</td>
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### Experiment to be performed (Minimum Ten experiments are to be performed by each student):

1. Identification of Carbohydrate in given sample.
2. Identification of Protein in given sample.
3. Identification of Fat in given sample.
4. Estimation of Carbohydrate.
5. Estimation of Protein.
6. Determination of Iodine value of fat.
7. Determination of Saponification value of given oil sample.
8. Separation of amino acid by paper chromatography.
10. Citric acid production by fermentation.
11. Study of various techniques of enzyme immobilization.
12. Study of various steps in enzyme engg.

### Equipments/Machines/Instruments/Tools Required:

1. Centrifuge.
2. Colorimeter.
3. Refractometer
4. Spectrophotometer (UV-VIS)
5. Hot Air Oven
6. Electronic Balance

### Recommended Books:

Objective: The course is introduced to develop one's outer and inner personality tremendously and enrich the abilities to enable one to meet the challenges associated with different job levels. Personality Development is essential for overall development of an individual apart from gaining technical knowledge in the subject.

Course Objectives
Upon completion of this course, the student shall be able
- To understand the concept of personality and image;
- To develop leadership, listening and interacting skills;
- To develop attitudinal changes;
- To develop decision-making qualities; and
- To communication skill.

UNIT I Personality concepts: What is Personality – its physical and psychic aspects. How to develop a positive self-image. How to aim at Excellence. How to apply the cosmic laws that govern life and personality. How to improve Memory – How to develop successful learning skills. How to develop and effectively use one’s creative power. How to apply the individual MOTIVATORS that make you a self-power personality.

UNIT II Interpersonal Skills: Leadership: Leaders who make a difference, Leadership: your idea, What do we know about leadership? If you are serious about Excellence. Concepts of leadership, Two important keys to effective leadership, Principles of leadership, Factors of leadership, Attributes. Listening: Listening skills, How to listen, Saying a lot- just by listening, The words and the music, How to talk to a disturbed person, Listening and sometimes challenging. How to win friends and influence people, How to get along with others. How to develop art of convincing others. How can one make the difference. How to deal with others particularly elders. Conflicts and cooperation.

UNIT III Attitudinal Changes: Meaning of attitude, benefits of positive attitudes, How to develop the habit of positive thinking.

Negative attitude and winning: What is FEAR and how to win it. How to win loneliness. How to win over FAILURE. How to win over PAIN. How to win over one’s ANGER and others anger. What is stress and how to cope up with it? The art of self-motivation. How to acquire mental well-being. How to acquire physical well-being.

UNIT IV Decision Making: How to make your own LUCK. How to plan goals/objectives and action plan to achieve them. How to make RIGHT DECISION and overcome problems. How to make a Decision. Decision making: A question of style. Which style, when? People decisions: The key decisions. What do we know about group decision making? General aids towards improving group decision making.

UNIT V Communication Skills: Public Speaking: Importance of Public speaking for professionals. The art of Speaking - Forget the fear of presentation, Symptoms of stage fear, Main reason for speech failure, Stop failures by acquiring Information; Preparation & designing of speech, Skills to impress in public speaking & Conversation, Use of presentation aids & media.

Study & Examination: How to tackle examination, How to develop successful study skills.

Group discussions: Purpose of GD, What factors contribute to group worthiness, Roles to be played in GD.

Course Outcomes:
- The students will be able to develop inner and outer personality exposure;
- The students will be able to develop effective leadership qualities and interacting skills;
- The students will be able to develop positive attitude, motivating skills and develop winning philosophies;
- The students will be able to develop decision-making tools; and
- The students will be able to develop group presentation, public speaking and impressive conversation.

Text Books:
1. Basic Managerial Skills for all by E. H. McGrawth, prentice Hall India Pvt. Ltd., 2006

Reference Books:
3. Personality: Classic Theories & Modern Research; Friedman ; Pearson Education, 2006