Government Science College, Vankal

Department of Microbiology

Short Term Course

Course Code: STCMB06 **Course Name:** Protein Purification **Duration:** 30 h

Introduction

Protein purification is a fundamental technique in molecular biology and biochemistry that isolates a specific protein of interest from a complex mixture. Protein purification is frequently practiced in biotechnology industries and research institutes. This course is designed to provide students with theoretical knowledge and hands-on experience in the principles and techniques of protein purification. The knowledge and skill obtained will enhance the employability of the students.

Objectives

- Understand the basic principles and importance of protein purification.
- Learn various methods and techniques used for protein purification.
- Gain practical skills in designing and executing protein purification protocols.
- Develop the ability to analyze and interpret protein purification results.

Modules

Module 1: Introduction to Protein Purification **4 h**

- Overview of proteins and their functions
- Importance of protein purification in research and industry
- Basic principles of protein structure and function

Module 2: Methods of Protein Purification **4h**

- Differential centrifugation
- Ultracentrifugation
- Precipitation methods (e.g., salting out, isoelectric precipitation)

Module 3: Chromatographic Techniques **4h**

- Gel filtration chromatography
- Ion exchange chromatography
- Affinity chromatography

- High-performance liquid chromatography (HPLC)

Module 4: Electrophoretic Techniques **4h**

- SDS-PAGE
- Native PAGE
- Isoelectric focusing

Module 5: Protein Quantification and Analysis **4h**

- Spectrophotometric methods
- Bradford assay
- Lowry assay
- BCA assay

Module 6: Practical Sessions **10h**

- Hands-on lab sessions for each purification technique
- Design and execution of a complete purification protocol
- Troubleshooting common issues in protein purification

Course Outcomes

By the end of the course, participants will:

- Understand the theoretical background and practical applications of various protein purification techniques.
- Be proficient in designing and executing protein purification protocols.
- Be capable of analyzing and interpreting results from protein purification experiments.
- Be prepared to apply protein purification techniques in their research or professional work.

Evaluation Norms:

Two MCQ based exams of 15 marks each will be conducted during the course duration. One exam will be conducted upon 50% course completion and the other at the end of the course. The participants must score at least 40% marks in both exams to successfully complete the certificate course and be eligible to receive the course completion certificate**.**

ISSUE OF MARKSHEET AND CERTIFICATE

The college shall publish the result after evaluation and with the recommendations of course coordinator at the end of programme. After successful completion of the course, no marks will be given to students only grades will be given as per follows

Percentage Range of Marks (Theory + Practical)	**Remarks**
90-100	O
80-90	A
60-80	B
40-60	C
<40	F

COURSE COORDINATOR:

Dr. Anil Kumar Singh,
HoD, Microbiology Department,
GSC Vankal.

Government Science College, Vankal

Department of Chemistry

Short Term Course

Course Code: STCCH06 **Course Name:** Medicinal Chemistry **Duration:** 30 h

Medicinal Chemistry

INTRODUCTION

Medicinal Chemistry is a dynamic field at the intersection of chemistry and pharmacology, focusing on the design, development, and optimization of therapeutic agents. This short-term course provides a comprehensive overview of medicinal chemistry principles, including drug discovery, design, and the molecular basis of drug action. Participants will gain foundational knowledge and practical insights into the process of developing effective pharmaceuticals.

OBJECTIVES

- Understand the basic principles and methods used in medicinal chemistry.
- Analyse the structure-activity relationship (SAR) of pharmaceutical compounds.
- Apply concepts of drug design and development in real-world scenarios.
- Evaluate the mechanisms of drug action and metabolism.
- Discuss recent advancements and future directions in medicinal chemistry.

COURSE MODULES

Module 1: Introduction to Medicinal Chemistry

- Overview and importance of medicinal chemistry
- Historical development and evolution of drug discovery
- The role of medicinal chemistry in modern pharmaceuticals

Module 2: Drug Discovery and Development Process

- Stages of drug discovery: target identification, screening, and lead optimization
- Phases of drug development: preclinical, clinical trials, and post-marketing
- Key concepts in drug development and regulatory requirements

Module 3: Structure-Activity Relationship (SAR)

- Definition and importance of SAR
- Techniques for SAR analysis
- Case studies illustrating SAR in drug optimization

Module 4: Drug Receptors and Pharmacodynamics

- Types of drug receptors and their roles
- Mechanisms of drug-receptor interaction
- Concepts of efficacy, potency, and selectivity

Module 5: Drug Metabolism and Pharmacokinetics

- Processes of drug metabolism: Phase I and Phase II reactions
- Absorption, distribution, metabolism, and excretion (ADME)
- Factors influencing pharmacokinetics and drug interactions

Module 6: Chemical Classes of Medicinal Agents

- Overview of major drug classes: antibiotics, analgesics, antihypertensives, and antivirals
- Chemical structures and mechanisms of action
- Examples of significant drugs from each class

Module 7: Natural Products in Drug Discovery

- Role of natural products in medicinal chemistry
- Techniques for isolation and synthesis of natural products
- Examples of natural product-derived drugs and their impact

Module 8: Synthesis of Medicinal Compounds

- Principles of organic synthesis in medicinal chemistry
- Key synthetic methods and strategies
- Challenges in drug synthesis and purification

Module 9: Drug Formulation and Delivery Systems

- Principles of drug formulation and stability
- Types of drug delivery systems: oral, injectable, transdermal
- Innovations in drug delivery and targeted therapies

Module 10: Toxicology and Drug Safety

- Principles of toxicology and risk assessment
- Common side effects and adverse drug reactions
- Regulatory guidelines for drug safety and efficacy

Module 11: Current Trends and Innovations

- Advances in drug discovery technologies: high-throughput screening, genomics
- Personalized medicine and precision therapeutics
- Emerging trends in medicinal chemistry and biotechnology

Module 12: Case Studies and Practical Applications

- Analysis of successful drug development case studies
- Application of medicinal chemistry principles in real-world scenarios
- Discussions on future challenges and opportunities in medicinal chemistry

LEARNING OUTCOMES

Upon completion of the course, students will be able to:

- Drug Design Fundamentals:Understand core principles of drug design and development from discovery to market
- Pharmacokinetics and Dynamics:Comprehend drug absorption, distribution, metabolism, excretion, and mechanisms of action
- Discovery Techniques:Learn modern drug discovery methods, including molecular modeling and high-throughput screening
- Regulatory and Ethical Issue:Recognize key regulatory requirements and ethical considerations in drug development

REFERENCES

1. "Foye's Principles of Medicinal Chemistry" by David A. Williams and Thomas L. Lemke (Publisher: Lippincott Williams & Wilkins).
2. "Medicinal Chemistry: A Molecular and Biochemical Approach" by Anthony W. Patrick (Publisher: Oxford University Press).
3. "Basic Principles of Drug Discovery and Development" by Benjamin E. Blass (Publisher: CRC Press).
4. "Drug Discovery and Development: Technology in Transition" by James S. Olson and Timothy J. Morris (Publisher: Springer).
5. "Natural Products in Medicinal Chemistry" by Stephen H. Cutler (Publisher: Wiley).

ISSUE OF MARKSHEET AND CERTIFICATE

The college shall publish the result after evaluation and with the recommendations of course coordinator at the end of programme.

1. After successful completion of the course, no marks will be given to students only grades will be given as per follows

Percentage Range of Marks (Theory + Practical)	**Remarks**
90-100	O
80-90	A
60-80	B
40-60	C
<40	F

COURSE COORDINATOR:

Dr. Dharmesh Mahajan,
HoD, Chemistry Department,
GSC Vankal.

Government Science College, Vankal

Department of Physics

Short Term Course

Course Code: STCPHY02
Course Name: Advancement in Green Energy Systems
Duration: 30 hours

Introduction

The short-term course on "Advancement in Green Energy Systems" is an intensive program designed to provide participants with a comprehensive understanding of the latest advancements in green energy technologies. This course is essential for students pursuing studies in physics, engineering, environmental science, and related fields. The course combines theoretical knowledge with case studies and discussions, ensuring that participants gain the skills needed to understand, design, and implement green energy solutions. The skills acquired during the course will prepare students for industry roles and enhance their research competencies, significantly boosting their career prospects and contributing to advancements in sustainable energy.

Course Objectives:

- Provide a thorough understanding of green energy systems and technologies.
- Teach the principles and applications of various renewable energy sources.
- Explore the latest advancements in green energy systems.
- Develop skills to design and evaluate green energy solutions.
- Understand the environmental impact and benefits of green energy systems.

Course Modules:

Module 1: Introduction to Green Energy Systems (4 hours)

- Overview of green energy and its importance
- History and development of green energy technologies

Module 2: Solar Energy (8 hours)

- Principles of solar energy and photovoltaic systems
- Solar panels and solar thermal systems
- Case study: Designing and evaluating a small-scale solar power system

Module 3: Wind Energy (6 hours)

- Principles of wind energy and wind turbines
- Types of wind turbines and their applications
- Case study: Analyzing wind patterns and designing a wind power system

Module 4: Bioenergy (4 hours)

- Principles of bioenergy and biomass conversion
- Biofuels and biogas production

- Case study: Evaluating biofuels from organic waste

Module 5: Energy Storage and Grid Integration (4 hours)

- Importance of energy storage in green energy systems
- Types of energy storage technologies (batteries, supercapacitors, etc.)
- Grid integration and smart grids
- Case study: Implementing an energy storage system

Module 6: Future Trends in Green Energy (4 hours)

- Emerging technologies in green energy
- Policy and economic aspects of green energy adoption
- Case studies of successful green energy projects

Course Outcomes:

By the end of this course, students will be able to:

1. **Knowledge:** Understand the principles and technologies of green energy systems.
2. **Renewable Sources:** Explain the principles and applications of various renewable energy sources.
3. **Technological Skills:** Design and evaluate green energy solutions.
4. **Environmental Impact:** Assess the environmental impact of different green energy technologies.
5. **Future Trends:** Stay informed about emerging trends and advancements in green energy.

Teaching Methodology:

- **Lectures:** Detailed lectures covering theoretical aspects of each module.
- **Case Studies:** In-depth analysis and discussions of real-world green energy projects.
- **Discussions:** Interactive discussions to enhance understanding and critical thinking.

Assessment:

- **Quizzes:** Short quizzes to test understanding of theoretical concepts. Two quizzes during the course (100% of final marks).

Recommended Books:

- Renewable Energy: Power for a Sustainable Future by Godfrey Boyle
- Solar Energy: The Physics and Engineering of Photovoltaic Conversion Technologies and Systems by Olindo Isabella, Klaus Jäger, Arno Smets, René van Swaaij, and Miro Zeman
- Wind Energy Explained: Theory, Design and Application by James F. Manwell, Jon G. McGowan, and Anthony L. Rogers, 2nd Edition.
- Bioenergy: Principles and Applications by Yebo Li and Samir Kumar Khanal

Issue of Marksheet and Certificate

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80-90	A
60-80	B
40-60	C
<40	F

Course Cordinator:

Dr. Hemal Vankar,
HoD, Physics Department,
GSC Vankal.

Government Science College, Vankal

Department of Mathematics

Short Term Course

Course Code: STCMT02 **Course Name:** Introduction to Excel-Based Mathematical Modelling and Simulation **Duration:** 30 h

Introduction to Excel-Based Mathematical Modelling and Simulation (30 hours)

INTRODUCTION

This course introduces undergraduate mathematics students with limited Excel experience to basic Excel functions and how to apply them to mathematical modelling and simulations. It covers fundamental skills in Excel and demonstrates how to use these skills to solve simple mathematical problems and perform basic simulations.

OBJECTIVES

By the end of this course, students will:

1. Acquire basic proficiency in using Excel for mathematical tasks.

2. Construct and manage simple mathematical models using Excel.

3. Perform basic simulations and analyse the results.

4. Visualize and interpret data to support mathematical conclusions.

COURSE MODULE

Week 1: Getting Started with Excel and Basic Operations (6 hours)

Excel Basics: Introduction to Excel interface: ribbons, menus, and toolbars, Understanding cells, rows, columns, and worksheets, Basic data entry and editing: typing, deleting, and moving data

Basic Formulas and Functions: Creating and using basic formulas (e.g., addition, subtraction), Introduction to basic functions: `SUM`, `AVERAGE`, `MIN`, `MAX`, Cell references: relative and absolute references

Week 2: Basic Mathematical Modelling in Excel (6 hours)

Setting Up Simple Models: Creating and solving basic equations (e.g., linear equations), Using Excel to calculate areas, volumes, and other basic mathematical quantities, Implementing basic mathematical operations (e.g., percent change, averages)

Data Organization and Management: Formatting cells and ranges: number formats, text alignment, Sorting and filtering data: ascending/descending, custom filters, using tables to manage data effectively

Week 3: Introduction to Data Visualization (6 hours)

Creating Basic Charts: Types of charts: column charts, line charts, bar charts, customizing chart elements: titles, axis labels, and legends, Adjusting chart styles for clarity

Visualizing Mathematical Data: Using charts to represent mathematical data and trends, applying conditional formatting to highlight key data points, Creating simple sparklines to show trends in data

Week 4: Basic Simulation Techniques (6 hours)

Introduction to Simulations: Basics of simulations: purpose and applications, Setting up basic simulations in Excel using random number generation (`RAND`, `RANDBETWEEN`), Running simple simulations (e.g., coin tosses, dice rolls)

Analysing Simulation Results: Interpreting simulation outputs and results, Basic statistical analysis: mean, median, mode, range, visualizing simulation results using histograms and charts

Week 5: Practical Applications and Review (6 hours)

Applying Excel to Mathematical Problems: Practical examples: budgeting, basic financial calculations, simple mathematical models, Group projects: developing and presenting simple models and simulations

Course Review and Final Assessment: Review of key concepts and skills learned throughout the course, Final project: creating and analyzing a mathematical model and simulation, Course wrap-up and feedback

LEARNING OUTCOMES

By the end of this course, students will be able to:

1. Perform basic mathematical operations and create simple models using Excel.

2. Organize and manage data effectively within Excel.

3. Create and customize basic charts to visualize mathematical data.

4. Conduct simple simulations and analyze the results to draw conclusions.

REFERENCES

1. "Excel 2021 for Dummies" by Greg Harvey

2. "Excel Basics In 30 Minutes" by Ian Lamont

3. "Microsoft Excel Step by Step" by Curtis Frye

4. "Excel Data Analysis: Your visual blueprint for analysing data, charts, and PivotTables" by Jinjer Simon

EVALUATION METHODS

1. **Homework Assignments (30%)**: Weekly tasks focused on basic Excel operations, simple modelling, and data visualization.

2. **Midterm Quiz (20%)**: Assessment of understanding basic Excel functions and mathematical modelling concepts.

3. **Final Project (30%)**: A practical project involving the creation and analysis of a basic mathematical model and simulation.

4. **Participation and Engagement (20%)**: Active involvement in lectures, hands-on sessions, and group discussions.

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40-60	C
<40	F

COURSE COORDINATOR:

Mr. Vanaraj D. Kagada,
HoD, Mathematics Department,
GSC Vankal.