SEMESTER - III

ARTIFICIAL INTELLIGENCE IN DISEASE DIAGNOSIS - THEORY

1. Course Description:

Programme: M.Sc.
Course Code: P24/MIC/DSE/301
Type of course: DSE
No. of credits: 3

Max. Hours: 45
Hours per week: 3
Max. Marks: 100

2. Course Objectives:

- To study the fundamentals of Artificial Intelligence and its applications in Disease diagnosis and health Care.
- To provide insights on concepts of Artificial Intelligence in hematology and pathology.

3. Course Outcomes:

On completion of the course the student will be able to:

CO1: Understand and apply the technology of Artificial Intelligence in Disease diagnosis and health Care. (L II, III)

CO2: Analyse and apply Artificial Intelligence in Hematological techniques, Concepts of Blood banking, Transfusion and aetiology of Sickle cell anaemia & Thalassemia. (L III, IV)

CO3: Analyze the importance of Artificial intelligence in understanding the basic protocols of microscopic examination in histopathology, cytological examination; biochemical & pathological changes in Liver & kidney disorders. (L IV)

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4. Course Content:

MODULE I - APPLICATIONS OF AI IN DISEASE DIAGNOSIS & HEALTH CARE: (15 Hrs)

Introduction to Artificial Intelligence, AI fundamentals, Issues concerning AI in medical diagnosis, ethics and bias, jobs and future scope.

Applications in Healthcare, Prediction, Diagnosis, Potential in Healthcare, AI for cancer detection, Medical/surgical Robotics

Case Studies: Approaches of AI to be used in solving healthcare problems.

MODULE II – AI IN HEMATOLOGY TECHNIQUES AND BLOOD BANKING: (15 Hrs)

Techniques in hematology: Hemoglobin estimation, Hematocrit, RBC indices, Morphological changes in RBC, Serum & Hemoglobin electrophoresis. Ethics, Code of conduct of medical laboratory personnel.

Blood Banking and Transfusion: Collection of donor blood, Whole blood, blood components and blood derivatives, Transfusion of blood to recipient, Adverse effects of Transfusion, Autologous transfusion. Alternatives to blood transfusion.

Aetiology of anemia's: Approach to diagnosis of anemia's Sickle cell anemia: Symptoms and Causes, Thalassemia and types.

Applications of Artificial Intelligence in Hematological techniques and Identification of Anaemias. AI based blood analyzers.

MODULE III – AI IN HISTOLOGY AND PATHOLOGY OF ORGAN SYSTEMS: (15 Hrs)

Fixation of tissue-different fixatives and their mode of action. Processing of tissues-protocol for manual & automated tissue processors, paraffin embedding & preparation of blocks, Microtome its uses and working Staining of tissue sections, Fine Needle Aspiration cytology & exfoliative cytology (FNAC and ultrasound guided FNAC). Overview of Utilization of Artificial Intelligence in Histology

Liver: Bilirubin metabolism, types of jaundice, Acute and chronic liver diseases, liver function tests, **Kidney:** Glomerular filtration rate, renal failure and proteinuria, and renal stones, Renal function tests. Benefits of Artificial intelligence in pathology.

5. Resources:

Text books:

1.Essentials of clinical Pathology Sirish M Kawathalkar, JP Medical Ltd, 2012, ISBN: 9350901846, 9789350901847.

2.Murray et al., (1999), Manual of Clinical Microbiology, 7th edition, American Society for clinical Microbiology.

1.C. Sood, R. (2009), MLT Methods and interpretation, 5th edition, JPB Publishers.

2.D. Talib, V.H (2006), Essential Lab Medicine, 2nd edition, Mehta Publishers.

3. Dr. Parag Suresh Mahajan (2019). Artificial Intelligence in Healthcare, 2nd Edition.

4. Russell, Norvig, Artificial Intelligence: A Modern Approach, Third edition, Prentice Hall, 2010.

5. Guoguang Rong, Arnaldo Mendez, Elie Bou Assi, Bo Zhao, Mohamad Sawan, Artificial Intelligence in Healthcare: Review and Prediction Case Studies, Engineering, Volume 6, Issue 3, 2020, Pages 291-301, ISSN 2095-8099, https://doi.org/10.1016/j.eng.2019.08.015.

6.Lela Buckingham: 2012, Molecular Diagnostics: Fundamentals, Methods and Clinical Applications, 2, 978-0-8036-26.

Reference Books:

1. Pagana, K. and Pagana T.(2013), Mosby's manual of diagnostic and Lab tests, Mosby Publishers.

2. Cella, J.H. (2000). Medical Lab Technology, Jaypee Publishers.

3. Estridge, B.and Reynolds, A. (2011). Basic Clinical Laboratory Techniques, 6th Edition Delmar Cengage Learning.

4. Win, W.C. *et al.,* (2005). Koneman's Color Atlas & Text book of Diagnostic Microbiology, 6th Edition, Wolters Kluwer.

5. Mackean, S.C. *et al*., (2012), Principles and practice of hospital medicine, 1st Edition, Mc Graw Hill Publishers.

6. Arjun Panesar, Machine Learning and AI for Healthcare Big Data for Improved Health Outcomes, APress, Second Edition, 2021

7. Ankur Saxena, Shivani Chandra. Artificial Intelligence and Machine Learning in Healthcare, First edition, Springer, 2021

8. Pradeep N, Sandeep Kautish, Sheng-Lung Peng. Demystifying Big Data, Machine Learning, and Deep Learning for Health care Analytics, Elsevier Academic Press, 2021

9. Fatos Xhafa, Sudipta Roy, Lalit Mohan Goyal, Mamta Mittal, Advanced Prognostic Predictive Modelling in Healthcare Data Analytics, Springer, Lecture Notes 2021

10.Rashmi Agrawal, Jyotir Moy Chatterjee, Abhishek Kumar, Pramod Singh Rathore, Dac-Nhuong Le; Machine Learning for Healthcare: Handling and Managing Data, First Edition, CRC Press, 2021

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6. Syllabus Focus:

a) Relevance to Local, Regional, National and Global Development Needs

Local /Regional/National /Global Development Needs	Relevance
Global	The course will enable the students to learn clinical diagnosis and treatment of hematologic diseases which inevitably involve the integration of artificial intelligence (AI)-based systems into routine practice to support the hematologists' decision making, use of AI-based models to automatically differentiate cells, reliably detect malignant cell populations and interpret clinical variants, contributing to early disease detection and prognosis.

b) Components on Skill Development/Entrepreneurship Development/Employability

SD/ED/EMP	Syllabus Content	Description of Activity
SD, EMP	Module I	Models based on AI in health care, which help students to understand the role of AI in healthcare, disease diagnosis and predicting patient outcomes.

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7. Pedagogy:

S. No	Student Centric Methods Adopted	Type / Description of Activity
1.	Field trip	Experiential Learning
2.	Case studies	Problem solving
3.	Video presentations	Participative learning

8. Course Assessment Plan:

a) Weightage of Marks in Continuous Internal Assessments and End Semester Examination

CO	Continuous Internal Assessments CIA - 40%	End Semester Examination-60%
CO1	CIA1-Written Exam	End Semester Exam
CO2	CIA 2 - Presentations / Models	
CO3	CIA 2 - Case Studies	

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b) Question Paper Pattern:

ARTIFICIAL INTELLIGENCE IN DISEASE DIAGNOSIS
MODEL QUESTION PAPER – THEORY

Course Code: P24/MIC/DSE/301 **Max Marks: 60**
Credits: 3 **Time: 2½ Hrs**

SECTION – A

I. Answer the following: **3x 12 = 36 M**

1. Write notes on AI fundamentals and Issues concerning AI in medical diagnosis.

OR

2. Describe various applications of Artificial intelligence in Healthcare.

3. Explain the methods used in estimation of hemoglobin and RBC indices.

OR

4. Interpret the applications of Artificial intelligence in identification of anemias.

5. Discuss the methods used for staining of tissues. How can AI be helpful in improvising the accuracy of the techniques.

OR

6. Explain about liver diseases and liver function tests.

SECTION – B

II. Answer any FOUR: **4 x 6 = 24 M**

7. Describe the use of AI for cancer detection
8. Mention about Future scope of AI in health care
9. Describe Ethics in hematology
10. Explain Adverse effects of blood transfusion
11. Explain about Microtomes
12. Write notes on Renal failure and proteinuria

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SECTION A - INTERNAL CHOICE			3Q X 12 M = 36 M	
Question Number	**Module**	**Question**	**CO**	**BTL (Blooms Taxonomy Level)**
1	Module 1	Write notes on AI fundamentals and Issues concerning AI in medical diagnosis.	CO 1	Level II
2	Module 1	Describe various applications of Artificial intelligence in Healthcare.	CO1	Level II
3	Module 2	Explain the methods used in estimation of hemoglobin and RBC indices.	CO2	Level II
4	Module 2	Interpret the applications of Artificial intelligence in identification of anemias.	CO 2	Level III
5	Module 3	Discuss the methods used for staining of tissues. How can AI be helpful in improvising the accuracy of the techniques	CO3	Level II
6	Module 3	Explain about liver diseases and liver function tests.	CO3	Level II
SECTION B - ANSWER ANY 4 OUT OF 6 (To compulsorily have **ONE** question from **each** module)			4 Q X 6M = 24M	
7	Module 1	Describe the use of AI for cancer detection	CO 1	Level II
8	Module 1	Mention about Future scope of AI in health care	CO 1	Level II
9	Module 2	Describe Ethics in hematology	CO 2	Level II
10	Module 2	Explain Adverse effects of blood transfusion	CO 2	Level II
11	Module 3	Explain about Microtomes	CO 3	Level II
12	Module 3	Write notes on Renal failure and proteinuria	CO 3	Level II

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SEMESTER - III
ARTIFICIAL INTELLIGENCE IN DISEASE DIAGNOSIS - PRACTICAL

1. Course Description:

Course Code: P24/MIC/DSE/301/P
Type of course: DSE
No. of credits: 2

Max. Hours: 60
Hours per week: 4
Max. Marks: 50

2. Course Objectives:

- To provide knowledge in reading, understanding and interpreting basic lab reports related to hematological and pathological abnormalities
- To create awareness about safe handling of blood and its components.
- To study the application of Artificial intelligence in disease diagnosis.

3. Course Outcomes:

CO1: Hands on experience on Hb estimation, TLC, DLC and electrophoresis in blood disorders.

CO2: Analyse biochemical parameters in diseases like heart attacks and genetic disorders.

CO3: Observe, identify mammalian tissues for pathological changes in various diseases and analyze them using Artificial Intelligence.

List of Practicals

1. Collection of venous blood (technique demonstration)
2. Understand the technique of electrophoresis in diagnosis (for Multiple myeloma, Hemoglobinopathies)
3. Osmotic fragility of RBC
4. Total Leukocyte Count & Total Erythrocyte Count
5. Giemsa/Fields Staining for differential count of WBCs
6. Hb estimation by Sahli's method
7. Clotting time and bleeding time of blood
8. Permanent slides of mammalian tissue sections.
9. Section cutting of given tissue specimen using Microtome
10. Cholesterol estimation by Wybenga Pillegi method (based on module 4)
11. Detection of Phenylalanine for PKU by Paper Chromatography
12. Demonstration of AI based tools in Disease Diagnosis
13. Case studies related to Applications of Artificial Intelligence in Disease diagnosis.

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MODEL QUESTION PAPER – PRACTICAL

Course Code: P24/MIC/DSE/301/P **Max Marks: 60**
Credits: 2 **Time: 3 Hrs**

I. Write down the principles involved in major and minor experiments. **5 + 5 = 10 M**

II. MAJOR **10 M**

You are provided with the blood sample of a patient showing symptoms of Eosinophillia.

Confirm the results by performing a suitable differential staining method.

III. MINOR **5 M**

A case study related to application of Artificial intelligence in Disease diagnosis is provided to you. Interpret the case and write your inputs.

III. Identify the given spots A-E and write few significant points **5 x 3 = 15 M**

IV. Record **5 M**

V. VIVA **5 M**

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SEMESTER – III
BIOINFORMATICS AND BIG DATA MANAGEMENT –THEORY

1. Course Description

Program: M.Sc
Course Code: P24/MIC/GE/301
Course Type: GE
No. of Credits: 2

Max. Hours: 30
Hours per week: 2
Max. Marks: 50

2.Course Objectives:

- To impart concepts in bioinformatics, including information flow in biological systems
- To define sequence and structure databases in research and drug discovery.

3.Course Outcomes:

CO1: Apply databases at the NCBI and EBI resources, Evaluate BLAST results, to use algorithms for Pair wise and Multiple sequence alignment, to build protein model and understand molecular docking mechanism

CO2: Apply and compare results with those obtained through Maximum Parsimony approaches and understand phylogenetic relationships. Analyze hereditary diseases and understand drug research and development.

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4. Course Content:

MODULE I - INTRODUCTION AND BIOINFORMATICS RESOURCES : (15 Hrs)

Databases, **Nucleic acid sequence databases**: Gen Bank, EMBL, DDBJ **Genome Databases** at NCBI, EBI, TIGR, SANGER **BLAST, FASTA and MSA** (Clustal omega) algorithms and its versions Homology Modeling (Swiss model, Modeller), Molecular docking (Autodock, Chemsketch) **Running docking algorithm** Structure Analysis/ H- Bond, Evaluation of results on basis of binding energy

MODULE II - INTRODUCTION TO BIG DATA MANAGEMENT : (15 Hrs)

Introduction to Big Data: Characteristics – Evolution – Definition - Challenges with Big Data, Need and characteristics of Big Data Analysis of genomic data: Precision medicine: Early detection of hereditary disease, Better understanding of complex diseases, Drug research and development, Genetic counselling and informed decision making,

5. Resources:

Text books:

1. Aurther M lesk(2008) Introduction to Bioinformatics 3rd edition OUP Oxford
2. Philip E. Bourne, HelgeWeissig (2003)Structural Bioinformatics (Methods of Biochemical Analysis, Wiley-Blackwell
3. Essential Bioinformatics by Jin Xiong. Texas A&M University Cambridge
4. Data mining in Bioinformatics, Jason Wang ,M.J. Jaki. Hannu T.T.T., Denis. S. Springer International Edition.

Reference books:

1. CynthiaGibas Per Jambeck (2001) Developing Bioinformatics Computer Skills, First edition Shroff / O'Reilly

BIOINFORMATICS AND DRUG DESIGNING

MODEL QUESTION PAPER –THEORY

Course Code: P24/MIC/GE/301 **Max Marks: 30**

Credits: 2 **Time: 1Hr**

III.Answer any Six **6x 5 = 30 M**

1. Describe the types of databases used in bioinformatics?
2. Describe the BLAST tool at NCBI in detail.
3. Explain homology modeling and describe how it is performed (in silico)
4. Describe the steps adopted in performing molecular docking
5. Give an account on Big data analysis of genomic data
6. Explain Genetic counseling and informed decision making
7. Explain the method of phylogenetic tree construction by distance tree method
8. Give an account on Cheminformatics

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SEMESTER – III
BIOPROCESS TECHNOLOGY -THEORY

1. Course Description

Program: M.Sc **Max.Hours:45**
Course Code: P24/MIC/DSC/302 **Hours per week: 3**
Course Type: DSC **Max. Marks: 100**
No. of Credits: 3

2. Course Objectives:

- To acquaint students with technical and biological aspects of fermentation technology, designing of bioreactors and strain development strategies.
- To motivate students to set up a small scale Industry.

3. Course Outcomes:

CO1: Understand the industrial importance of microorganisms and analyze the design of bioreactors and control parameters for maximizing production (L I, II)

CO2: Understand and optimize media for maximum production of microbial metabolites and apply different methods of fermentation process (L I, III)

CO3: Apply rDNA technology in improving the strain, principles of downstream processing and attain the skills required by the Industry. (LII, III)

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4. Course Content:

MODULE I-BASIS AND DEVELOPMENT INDUSTRIAL FERMENTATION: (15Hrs)

Screening techniques-Isolation of industrially important microorganism from different sources using specific substrates; Secondary Screening-Assay methods- Physico- chemical methods, Biological methods, Fermenter design and function: STR Aeration and Agitation, Temperature and pH control, Types of fermenters- Air lift, Deep jet, Waldhof, Cylindroconical vessels, Acetators and Cavitators, cyclone column reactors, tower fermenter., Immobilized enzyme bioreactors, Reactors for animal cells.

MODULE II - TYPES OF FERMENTATION: (15 Hrs)

Optimization of inoculum, Raw materials and other ingredients used in Fermentation media. Types of fermentation process- Batch, Fed batch and continuous process. Solid, submerged and surface fermentations, Direct, dual and multiple fermentations and Scale Up.

MODULE III –STRAIN IMPROVEMENT, IMMOBILIZATION AND DSP: (15 Hrs)

Strain Improvement: Selection of Natural variants, Mutations, Recombination, r DNA Gene technology.

Immobilization Methods: different matrices, whole cell and enzyme immobilization; Downstream processing: (DSP), Foam separation, Removal of solid waste, precipitation, Filtration, Centrifugation, Cell Disruption- Physical and chemical methods Solvent extraction: membrane, separation; Chromatography: Affinity and ion exchange, Crystallization and Drying

5. Resources:

Text Books:

1. L.E. Casida, (2010) Industrial microbiology, New age international publishers.
2. A.H. Patel, (2012) Industial Microbiologyby, 2nd edition, Mac Millan India pvt ltd.
3. Whittaker, Stanbury and J. Hall,(1997),Principles of fermentation technology, 2nd edition, Aditya books
4. Ed.Cruger&Cruger,(2005)Biotechnology(atextbookofindustrialmicrobiology), 2nd edition, Pancina publishers.
5. Michael J Waites,(2001), Industrial Microbiology-Blackwell Science Ltd
6. Arnold, (2004), Manual of Industrial Microbiology and Biotechnology, 2nd edition, ASM press.

Reference books:

1. S. Ram Reddy, M.A Singara Charya. A Text Book of Microbiology (Applied Microbiology), Volume IV. Himalaya publishing house
2. Gopal Reddy et al, (2008), Laboratory experiments in microbiology, 3rd edition, Himalaya publishers.
3. S.M. Reddy, S. Ram Reddy, (2000), Microbiology A Laboratory manual, BSC Publishers and Distributors.
4. James G. Cappuccino, Sherman,(2010) Microbiology Laboratory Manual, 9thedition, Pearson Education
5. Prescott, S. C., &Dunn, C. G. (1959). Industrial microbiology. New York: McGraw- Hill.
6. Peppler, H. J., & Perlman, D. (1979). Microbial technology fermentation technology. NY, NY: Academic Press.

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6. Syllabus focus

a) Relevance to Local , Regional , National and Global Development Needs

Local /Regional/National /Global Development Needs	Relevance
Global	The concept such as microbial metabolites, primary and secondary metabolites, its commercial importance, methods of fermentation, recombinant microbial products play a very important role in production of industrially important products.

b) Components on Skill Development/Entrepreneurship Development/Employability

SD/ED/EMP	Syllabus Content	Description of Activity
Skill Development	Screening, Fermenters, Fermentations, Strain improvement, DSP	Production and recovery of industrially important products

7. Pedagogy:

S. No	Student Centric Methods Adopted	Type / Description of Activity
1.	Presentation /Group discussion	Participative Learning
2.	Field trips/Quiz	Experiential Learning
3.	Case studies	Problem solving

8. Course Assessment Plan:

a. Weightage of Marks in Continuous Internal Assessments and End Semester Examination

COs	Continuous Internal Assessments - CIA (40%)	End Semester Examination - (60%)
CO1	CIA-1	End Semester examination
CO2	CIA-2 Seminar/, Poster/Model Presentation	
CO3	CIA-1	

Question Paper Pattern:

BIOPROCESS TECHNOLOGY
MODEL QUESTION PAPER-THEORY

Course Code: P24/MIC/DSC/302 **Max Marks: 60**

Credits: 3 **Time: 2 ½ Hrs**

SECTION – A

I. Answer the following **3 x 12 = 36 M**

1. Explain in detail screening techniques employed for the isolation of microorganisms producing Amylases, organic acid, growth factors and antibiotics.

OR

2. Explain in detail about the structure of a Stirred Tank Reactor

3. Discuss about the Raw materials used as a source of carbon in various fermentation processes.

OR

4. Differentiate between Batch, Fed Batch and Continuous fermentations

5. Explain and apply the different methods employed for improving the microbial strain used in industrial productions. (Eg: Primary Metabolites)

OR

6. Describe different methods employed for the immobilization of cells and enzymes.

SECTION –B

II. Answer any Four: **4x6 = 24 M**

7. Describe Biological Assay method
8. Describe Cylindroconical vessel
9. Discuss about Dual Fermentation
10. Explain Scale up
11. Explain Cell disruption methods
12. Describe Chromatography

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SECTION A - INTERNAL CHOICE			3Q X 12 M = 36 M	
Question Number	**Module**	**Question**	**CO**	**BTL (Blooms Taxonomy Level)**
1	Module 1	Explain in detail screening techniques employed for the isolation of microorganisms producing Amylases, organic acid, growth factors and antibiotics	CO 1	Level II
2	Module 1	Explain in detail about the structure of a Stirred Tank Reactor	CO 1	Level II
3	Module 2	Discuss about the Raw materials used as a source of carbon in various fermentation processes.	CO 2	Level II
4	Module 2	Differentiate between Batch, Fed Batch and Continuous fermentations	CO 2	Level II
5	Module 3	Explain and apply the different methods employed for improving the microbial strain used in industrial productions (Primary Metabolites)	CO 3	Level IV
6	Module 3	Describe different methods employed for the immobilization of cells and enzymes.	CO 3	Level II
SECTION B - ANSWER ANY 4 OUT OF 6 (To compulsorily have **ONE** question from **each** module)			**4 Q X 6M = 24M**	
7	Module 1	Describe Biological Assay method	CO 1	Level II
8	Module 1	Describe Cylindroconical vessel	CO 1	Level II
9	Module 2	Discuss about Dual Fermentation	CO 2	Level II
10	Module 2	Explain Scale up	CO 2	Level II
11	Module 3	Explain Cell disruption methods	CO 3	Level II
12	Module 3	Describe Chromatography	CO 3	Level II

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C. Question Paper Blueprint:

Modules	Hours Allotted in the Syllabus	COs Addressed	Section A (No. of Questions)	Total Marks	Section B (No. of Questions)	Total Marks
1	15	CO-1	2	12	2	6
2	15	CO-2	2	12	2	6
3	15	CO-3	2	12	2	6

9. CO-PO Mapping:

CO	PO	Cognitive Level	Classroom Sessions (Hrs)
1	1,8	Understand	15
2	1,7,8	Understand, Analyze	15
3	1,7,8	Understand, Analyze	15

SEMESTER – III
BIOPROCESS TECHNOLOGY – PRACTICAL

1. Course Description

Course Code: P24/MIC/DSC/302/P
Course Type: DSC
No. of Credits: 2

Max. Hours: 60
Hours per week: 4
Max. Marks: 50

2.Course Objectives:

- To acquaint students with technical and biological aspects of fermentation technology.
- To motivate students to set up a small-scale Industry

3.Course Outcomes:

CO1: Analyze, select media and conditions for screening of microorganisms that produce microbial metabolites of industrial importance.

CO2: Perform estimation by colorimetry and titrimetry

CO3: Equip with skills and techniques required by the Industry.

List of Practicals

1. Screening for - amylase producing organisms.
2. Screening for organic acid producing microorganisms
3. Screening for antibiotic producing microorganisms by crowded plate technique.
4. Citric acid estimation by titrimetry
5. Estimation of Glucose by DNS method
6. Estimation of Maltose by DNS method
7. Estimation of ethanol by Potassium dichromate method
8. Isolation of Yeast
9. Immobilization Techniques (entrapment method- sodium alginate method)
10. Slides - Penicillium, Aspergillus, Rhizopus, Mucor, Yeast

MODEL QUESTION PAPER-PRACTICAL

Course Code: P24/MIC/DSC/ 302/P **Max Marks: 50**
Credits: 2 **Time: 3 Hrs**

I. MAJOR: **20 M**

Estimate the amount of Glucose by DNS method, plot a standard graph. Standard concentration of Glucose is 1mg/ml

II. MINOR: **10M**

Fermentation was carried out for the production of citric acid. Estimate the amount of citric acid in the given. sample.

III. Observe/Identify the given spots (A-E) and write few significant points **5 x 2 = 10 M**
V. Record **5 M**
VI. Viva **5 M**

Prepared by Faculty	Checked & Verified by HoD	Approved by the Principal
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SEMESTER - III

ENTREPRENEURSHIP DEVELOPMENT – THEORY

1. **Course Description:**
   Programme: M.Sc.
   Course Code: P24/MIC/DSE/304
   Course Type: DSE
   No. of credits: 3

   Max. Hours: 45
   Hours per week: 3
   Max. Marks: 100

2. **Course Objectives**
   - To learn about the entrepreneurial skills and how to mold to be successful entrepreneur.
   - To acquire knowledge on sources for business ideas, project report preparation, marketing strategies

3. **Course Outcomes**

CO1: Understand the Concept of entrepreneurship and to be successful entrepreneur. Generate, analyze and evaluate new business ideas and apply to initiate a startup. (L II, IV)

CO2: Understand and possess conceptual knowledge of process flow for registration and incorporation of a company and funding opportunities. (L II)

CO3: Apply the creativity and mold them to become women entrepreneurs using the knowledge gained to start synthesis of commercial products. (L III)

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4. Course Content

MODULE I – ENTREPRENEUR, ENTREPRENEURSHIP, BUSINESS IDEA **(15 Hrs)**

Introduction, the Concept of Entrepreneur, Characteristics of an Entrepreneur, Distinction between an Entrepreneur and a Manager, Functions of an Entrepreneur. Types of Entrepreneur, Nature and Characteristics of Entrepreneurship. Scope of Entrepreneurship. Factors affecting Entrepreneurial growth. Introduction to Motivation. Introduction, New Business ideas. Sources of Business ideas, Preliminary research, Business Idea Evaluation, Case studies.

MODULE II - IDENTIFICATION OF BUSINESS OPPORTUNITIES **(15 Hrs)**

Market Survey; Introduction, Definition of Project, Formulation of Detailed Project Report (DPR), conceptual knowledge of registration and incorporation of a company and funding opportunities.

MODULE III- SELECTION OF PRODUCT **(15 Hrs)**

Start Up ideas and scaling up.Criteria for selecting a product, Barriers to the successful development of new products. Choice of technology, plant and equipment. Importance of small-scale industries producers in setting up of small-scale units. Women entrepreneurship Case studies: Mushroom Cultivation, Vermicomposting, Biofertilizer production, Synthesis of Commercial products, Value Addition and Business analysis

5. Resources:

Text books:

1. Entrepreneurship development –RAJEEVROY
2. Natural entrepreneurship network.
3. Project Management- Vasanth Desai

Reference Books:

1. Management of small Business- Vasanth Desai
2. Entrepreneurship Development- S. Anil Kumar

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6. Syllabus Focus

a) Relevance to Local, Regional, National and Global Development Needs

Local /Regional/National /Global Development Needs	Relevance
Global	Entrepreneurs in the microbiology field can contribute significantly to the national healthcare sector by developing new drugs, vaccines, and diagnostic tools. This can lead to better disease management and healthcare outcomes.

b) Components on Skill Development/Entrepreneurship Development/Employability

SD/ED/EMP	Syllabus Content	Description of Activity
Employability	Module III	Graduates are not limited to traditional career paths in microbiology. They can venture into business roles, such as product development, sales, marketing, or even start their own company.

7. Pedagogy

S. No	Student Centric Methods Adopted	Type / Description of Activity
1	Interactive class room quiz	Experiential Learning
2	Presentation	Participative Learning

8. Course Assessment Plan

a) Weightage of Marks in Continuous Internal Assessments and End Semester Examination

CO	Continuous Internal Assessments CIA - 40%	End Semester Examination-60%
CO1	CIA-1	End semester exam
CO2	CIA-2 (Presentation of prepared food products)	
CO3	CIA-2 (Assignment)	

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Question paper pattern

ENTREPRENEURSHIP DEVELOPMENT

MODEL QUESTION PAPER – THEORY

Course Code : P24/MIC/DSE/304 **Max. Marks: 60**
Credits :3 **Time: 2 ½ Hrs**

SECTION – A

I . Answer the following: **3 x 12 = 36M**

1. Describe the common characteristics of successful entrepreneurs?

OR

2. Explain the different factors affecting entrepreneurial growth

3. Explain the preparation and evaluation of detailed project report and what does DPR detailed project report contains?

OR

4. Describe the importance of small-scale industries producers in setting up of small-scale units

5. Explain the barriers to new product development and challenges associated in creating a successful new product?

OR

6. Describe the process involved in cultivation of Mushroom.

SECTION – B

II. Answer any four **4 x 6 = 24 M**

7. Define types of Entrepreneurs
8. Define role of Manager
9. Explain Market survey
10. Describe Funding opportunities
11. Explain Women entrepreneurship
12. Explain Vermicomposting

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SECTION A - INTERNAL CHOICE				3Q X 12 M = 36 M
Question Number	**Module**	**Question**	**CO**	**BTL (Blooms Taxonomy Level)**
1	Module 1	Describe the common characteristics of successful entrepreneurs?	CO 1	Level II
2	Module 1	Explain the different factors affecting entrepreneurial growth	CO 1	Level II
3	Module 2	Explain the preparation and evaluation of detailed project report and what does DPR detailed project report contains?	CO 2	Level IV
4	Module 2	Describe the importance of small-scale industries producers in setting up of small-scale units	CO 2	Level II
5	Module 3	Explain the barriers to new product development and challenges associated with creating a successful new product?	CO 3	Level IV
6	Module 3	Describe the process involved in cultivation of Mushroom.	CO 3	Level II
SECTION B - ANSWER ANY 4 OUT OF 6 (To compulsorily have **ONE** question from **each** module)				**4 Q X 6M = 24M**
7	Module 1	Define types of Entrepreneurs	CO 1	Level I
8	Module 1	Define role of Manager	CO 1	Level I
9	Module 2	Explain Market survey	CO 2	Level II
10	Module 2	Describe Funding opportunities	CO 2	Level II
11	Module 3	Explain Women entrepreneurship	CO 3	Level II
12	Module 3	Explain Vermicomposting	CO 3	Level I

b) Question Paper Blueprint

Modules	Hours Allotted in the Syllabus	COs Addressed	Section A (No. of Questions)	Total Marks	Section B (No. of Questions)	Total Marks
1	15	CO-1	2	12	2	6
2	15	CO-2	2	12	2	6
3	15	CO-3	2	12	2	6

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9. CO-PO Mapping

CO	PO	Cognitive Level	Class room sessions (Hrs)
1	1, 2	Understand, Remember, Analyze, Apply	15
2	1, 2	Understand, Apply, Analyze,	15
3	1, 2	Understand, Apply, Evaluate	15

SEMESTER – III
ENTREPRENEURSHIP DEVELOPMENT - PRACTICAL

1. Course Description

Course Code: P24/MIC/DSE/304/P
Type of course: DSE
No. of credits: 2

Max. Hours: 60
Hours per week: 4
Max. Marks: 50

2.Course Objectives:

- To motivate and develop entrepreneurial skills to initiate startups in life sciences.

3.Course Outcomes:

CO1: Set up their own small-scale unit in Mushroom Cultivation

CO2: Carryout Vermi composting and Biofertilizer production giving rise to initiate startup.

CO3: Production of dairy, semi processed fermented food products of commercial importance

List of Practicals

1. Mushroom Cultivation
2. Vermi composting
3. Biofertilizer production
4. Synthesis of enzymes, organic acids and Commercial products
5. Production of dairy products of commercial importance – Field visit
6. Production of semi processed Fermented food of commercial importance.
7. Field visits to industrial production site

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MODEL QUESTION PAPER – PRACTIAL

Code No: P24/MIC/DSE/304/P **Max Marks: 50**

Credits: 2 **Time: 3 Hrs**

I. MAJOR **20 M**

Prepare the culture medium for isolation of spawn and make the slants.
Write the protocol for Mushroom cultivation.

II. MINOR **10 M**

Isolate and identify bacteria from the given semi processed Fermented food

III. Identify the given spots A-E and write few significant points **5 x 2 = 10 M**
IV. Record **5 M**
V. VIVA **5 M**

Prepared by Faculty	Checked & Verified by HoD	Approved by Principal
B. Aruna **Dr.B. Aruna**	**Dr. P.Roselin**	**Dr.Uma Joseph**

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SEMESTER - III
GENOMICS - THEORY

1. Course Description:

Programme: M.Sc.
Course Code: P24/MIC/DSC/301
Course Type: DSC
No. of credits: 3

Max.Hours: 45
Hours per week: 3
Max. Marks: 100

2. Course Objectives:

- To enable the students to understand the relevance of Genomics in the fields of biotechnology and medicine.
- To demonstrate appropriate laboratory skills and techniques related to molecular biotechnology such as PCR, AFLP, RFLP, cloning, DNA finger Printing and Non-Hybridization Nucleic acid-based techniques.

3. Course Outcomes:

CO1: Understand the basic mechanism of Cell cycle, cell signaling and signal transduction pathways and its regulation in living systems (L II)

CO2: Apply the concepts of isolation and purification of DNA and RNA, cloning, expression strategies in biological systems analyze the protein protein interaction, microarray analysis in detection of diseases. (L II, III, IV)

CO3: Analyze and Evaluate the conceptual knowledge of molecular diagnosis in medicine and its application in genetic mapping, linkage analysis, genotyping and DNA fingerprinting, Gene therapy and non-Nucleic acid-based techniques. (LII, III)

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4. Course Content:

MODULE I - CELL BIOLOGY: **(15Hrs)**

Cell cycle: Cell division, regulation and programmed cell death. Role of protein Kinases in cell cycle. Apoptosis for geno toxicity assays.

Signal transduction pathways: MAMPs, DAMPs,G- Protein linked receptors. Concept of second messenger, cAMP, cGMP. Steroid/peptide hormone regulation.

MODULE II- STANDARD METHODS IN MOLECULAR BIOLOGY: **(15 Hrs)**

Isolation and purification of DNA and RNA, Polymerase Chain Reaction (PCR) and its variants, DNA sequencing, Cloning strategies(TA Cloning, Directional Cloning, TOPO Cloning, GATEWAY Cloning, cDNA Cloning), Expression of recombinant proteins, Protein-protein and protein-DNA interactions. Microarray.

MODULE III APPLICATION OF MOLECULAR TOOLS **(15Hrs)**

Molecular diagnostics in medicine, Production of recombinant antibodies, Biochips (DNA chips, Protein chips and Sensor chips). DNA markers including RFLP, Micro/mini satellites, SNPS, RAPDs , etc. and their applications in genetic mapping, linkage analysis, genotyping and DNA fingerprinting, Gene therapy.

Principle and applications of Non- Hybridization Nucleic acid based techniques-Detection of unknown mutations by Gradient gel electrophoresis (GGE). Denaturing high performance liquid chromatography (DHPLC) Protein truncation test (PTT)

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5. Resources:

Text books:

1. Geoffrey H. Cooper (2013), The cell – A molecular approach, 4th edition.
2. Bernard R. Glick and Jack. J. Pasternak (2003), Molecular Biotechnology-Principles and Applications of recombinant DNA. 3rd edition, Washington DC, ASM press.
3. H.S. Chawla, (2002), Introduction to plant biotechnology 3rd edition, Science publishers.
4. P. K. Gupta, (2013), Biotechnology and Genomics 1st edition, Rastogi publications.
5. T.A. Brown ,(2001)Gene cloning and DNA analysis- An Introduction, Blackwell Publishing Ltd
6. James D. WatsonTaniaA. Baker,Stephen P. BellAlexander Gann,Michael Levine, Richard Losick, (2014),Molecular Biology of the Gene ,7th Edition, Pearson.
7. Upadhyay, Upadhyay, Nath, (2009), Biophysical Chemistry: Principles and Techniques HimalayaPublishingHouse.
8. J.Jayaraman(2011), Laboratory manual in biochemistry, 2nd edition,New Age International Pvt LtdPublishers
9. Bailey,W.R.& Scott, E.C (2013) Diagnostic Microbiology,13 th edition,Mosby.
10. Reddy, C. A., Beveridge, T.J., Breznak, J.A., Marzluf, G.A., Schmidt, T.M.,Snyder, L.R (2007), Methods for General and Molecular Microbiology, 3rd edition, ASM Press.
11. Collee, J.G., Frase, A.G., Marmion, B.P., Simmons, A. (2006), Mackie & McCartney Practical Medical Microbiology, 14th edition,Elsevier.

Reference books:

1. Robert F. Weaver (2011), Molecular Biology, fifth edition, Mc Graw Hill Higher Education.
2. David S Latchman Gene Regulation -A eukaryotic perspective Fifth Edition
3. David and Freifelder (2008), Molecular biology by, 2nd edition, Narosa publishers.
4. Sambrook (2001), Methods in Molecular Cloning by 3rd edition, Cold spring harbor laboratory press.

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5. Davidson JN (2010), The Biochemistry of nucleic acids, Wiley publishers.
6. Primrose (2007), Molecular biotechnology, 2nd edition, Panima publishers.
7. Keith Wilson and Bryan. L Walker, (2010), Principles and techniques of biochemistry and molecular biology, 5th edition.
8. Plummer. M and Plummer. T (1998), Introduction to practical biochemistry, Tata McGrill education.

6. Syllabus Focus

a) Relevance to Local, Regional, National and Global Development Needs

Local/Regional/National /Global Development Needs	Relevance
Global	Genomics course has potential impact for the future of human health. Human genomics knowledge and technologies provide new ways to prevent and manage many diseases, and opportunities to achieve global public health goals.

b) **Components on Skill Development/Entrepreneurship Development/Employability**

SD/ED/EMP	Syllabus Content	Description of Activity
Skill development	Module III	Research paper presentation demonstrating one technique. It would help the student to interpret the application of various Molecular tools and DNA markers.

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7.Pedagogy:

S. No	Student Centric Methods Adopted	Type/ Description of Activity
1.	Seminars & workshops	Participative learning
2.	Case studies	Problem solving
3.	Interactive class room session	Experiential learning

8. Course Assessment Plan:

a. Weightage of Marks in Continuous Internal Assessments and End Semester Examination

CO	Continuous Internal Assessments CIA- 40%	End Semester Examination- 60%
CO1	CIA1-Written Exam	End semester exam
CO2	Skill test 1 - Assignment	
CO3	Skill test II - Research paper presentation demonstrating one technique	

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b. **Question Paper Pattern:**

GENOMICS

MODEL QUESTION PAPER - THEORY

Course Code: P24/MIC/DSC/301 **MaxMarks: 60**
Credits: 3 **Time: 2 1/2 Hrs**

SECTION – A

I. **Answer the following:** **3 x 12 = 36 M**

1. Explain the cell cycle in detail.

OR

2. Discuss in detail about apoptosis.
3. Describe the various cloning vectors used in recombinant technology and their applications.

OR

4. Explain in detail the process of expression of recombinant proteins and their applications
5. Describe in detail about Biochips and their applications in molecular diagnostics

OR

6. Explain the use of Gradient gel electrophoresis and its application in detection of unknown mutations.

SECTION – B

II. **Answer any Four:** **4 x 6 = 24 M**

7. Write about Role of protein kinases
8. Describe Microarray
9. Write notes on PCR
10. Explain about Recombinant proteins
11. Write notes on AFLP and RFLP
12. Explain the technique DHPLC

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SECTION A - INTERNAL CHOICE			3Q X 12 M = 36 M	
Question Number	**Module**	**Question**	**CO**	**BTL (Blooms Taxonomy Level)**
1	Module 1	Explain the cell cycle in detail	CO 1	Level II
2	Module 1	Discuss in detail about apoptosis	CO 1	Level II
3	Module 2	Describe the various cloning vectors used in recombinant technology and their applications.	CO 2	Level III
4	Module 2	plain in detail the process of expression of recombinant proteins and their applications.	CO 2	Level III
5	Module 3	Describe in detail about Biochips and their applications in molecular diagnostics.	CO 3	Level III
6	Module 3	Explain the use of Gradient gel electrophoresis and its application in detection of unknown mutations.	CO 3	Level III
SECTION B - ANSWER ANY 4 OUT OF 6 (To compulsorily have **ONE** question from **each** module)			4 Q X 6M = 24M	
7	Module 1	Write about Role of protein kinases	CO 1	Level II
8	Module 1	Describe Microarray	CO 1	Level III
9	Module 2	Write notes on PCR	CO 2	Level III
10	Module 2	Explain about Recombinant proteins	CO 2	Level III
11	Module 3	Write notes on AFLP and RFLP	CO 3	Level III
12	Module 3	Explain the technique DHPLC	CO 3	Level III

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SEMESTER - III

GENOMICS - PRACTICAL

1. Course Description:

Course Code: P24/MIC/DSC/301/P
Course Type: DSC
No. of Credits: 2

Max. Hours: 60
Hours per week: 4
Max. Marks: 50

2.Course Objectives:

- To give practical exposure to molecular techniques involved in diagnosis of disease
- To analyze and solve problems related to molecular biology

3.Course Outcomes:

CO1: Carryout Restriction digestion and map the genes.

CO2: Carryout gene cloning, RFLP, southern transfer and analyze PCR products

CO3: Apply and solve problems related to molecular biology

List of Practicals

1. Restriction Digestion and mapping.
2. PCR technique.
3. Preparation of competent cells and Transformation.
4. Gene cloning in bacteria (Demonstration).
5. Demonstration of RFLP/AFLP.
6. Plasmid DNA isolation
7. Problems related to Molecular biology

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MODEL QUESTION PAPER - PRACTICAL

Course Code: P24/MIC/DSC/301/P **Max Marks: 50**

Credits: 2 **Time: 3 Hrs**

I. Write down the principles involved in major and minor experiments. **7+3=10 M**

II. Isolate the Plasmid DNA and demonstrate it by carrying out agarose gel electrophoresis. **10 M**

III. Calculate and determine the transformation efficiency form the culture plate provided. **5 M**

IV. Identify the given spots (A-E) and write few significant points **5 x 3 = 15 M**

V. Record **5 M**

VI. Viva **5 M**

Prepared by Faculty	Checked &Verified by HoD	Approved by the Principal
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SEMESTER -III

NANOBIOTECHNOLOGY- THEORY

1.Course Description:

Programme: M.Sc.
Course Code: P24/MIC/DSE/302
Course Type: DSE
No. of credits: 3

Max. Hours: 45
Hours per week: 3
Max. Marks: 100

2.Course objectives:

- To provide an intensive and in-depth learning to the students in the field of Nanobiotechnology.
- To understand the rapid development and growing societal role of nanobioscience and DNA secondary structures at the nanometer scale.

3. Course Outcomes:

CO1: Understand the structure of nanocomponents, factors influencing their size and correlate the application of nanobiotechnology in medicine .(LII)

CO 2: Understand the synthesis of nano bio assemblies and their application in life sciences and interaction of biomolecules with surfaces of different chemical and physical structures (. LII, IV)

CO 3: Understand the production and the applications of various types of nanostructured materials and apply concepts of Nanobiology and nanotribolgy in the current day. (L II , IV)

4.Course Content:

MODULE I - INTRODUCTION TO NANOBIOTECHNOLOGY **(15 Hrs)**

Scientific revolution, Nucleation : Influence of nucleation rate on the size of the crystals-macroscopic to microscopic crystals and nanocrystals - large surface to volume ratio, top-down and bottom-up approaches-self assembly process-grain boundary volume in nanocrystals-defects in nanocrystals-surface effects on the properties. Theragnostics, challenges in translation of nanomedicine.

MODULE II - NANOBIOLOGY **(15 Hrs)**

Interaction between biomolecules and nano particle surface, Different types of organic and inorganic materials used for the synthesis of hybrid nano-bio assemblies. C-dots fluorescent nanoparticles for life sciences applications ;Nucleic Acid Engineering using DNA as Nanomaterials DNA based particles used as building blocks, micelles.

MODULE III –APPLICATIONS OF NANOBIOTECHNOLOGY (15 Hrs)

Lipid Bilayers – Liposomes – Neosomes-Phytosomes, Polysacharides – Peptides –Nucleic acids – DNA scaffolds –Enzymes- Biomolecular motors– limitations of natural biomolecules, Application of Nanomaterials in Medicine (Homeopathy , Ayurvada etc.,) and in Veterinary Sciences. Nanotherapeutics

5. Resources:

Text Books:

1. K. Kannangara, G Smith, M. Simmons, B. Raguse, Nanotechnology: Basic science M. Wilson and Emerging technologies, Overseas Press India Pvt Ltd, New Delhi, First Edition, 2005.
2. Masoud Rahman, Sophie Laurent, Nancy Tawil,L'Hocine Yahia,Morteza Mahmoudi (2013) , Protein-Nanoparticle Interactions, Springer-Verlag Berlin Heidelberg.
3. T.Pradeep (2007) , Nano-The Essentials /TMH
4. Murthy, B.S., Shankar, P., Raj, B., Rath, B.B., Murday, J (2013), Textbook of Nanoscience and Nanotechnology, Springer-Verlag Berlin Heidelberg publishers.

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Reference Books:

1. Claudio Nicolini(2009) , Nanobiotechnology & Nanobiosciences Pan Stanford Publishing Pte. Ltd,
2. C.M. Niemeyer and C.A. Mirkin (2004), Nanobiotechnology, Concepts, Applications and perspectives, WILEY-VCH, Verlag Gmb H&Co,.
3. S. David Goodsell,(2004), Bionanotechnology, Lessons from Nature, Wiley-Liss, Inc. 4.Melgardt M.deVilliers, Pornanong Aramwit, Glen S.Kwon(2009), Nanotechnology in Drug Delivery, Springer-American Association of Pharmaceutical Scientists Press .
4. Robert A. Freitas Jr.(1999), Nanomedicine, Volume I:Basic Capabilities, Landes Bioscience,
5. Sulabha K. Kulkarni (2015),Nanotechnology: Principles and Practices 3rd edition. Springer.
6. M.H. Fulekar (2010) ,Nanotechnology: Importance and Applications, I K International Publishing House.
7. DNA Nanotechnology – From Structure to Function, Edited by Chunhai Fan, SpringerVerlag Berlin Heidelberg, 2013, ISBN 978-3-642-36076-3.
8. DNA Nanotechnology: Methods and Protocols, Edited by Giampaolo Zuccheri and Bruno Samorì, , LLC, 2011, ISBN 978- 1-61779-142-0.

Web Sites

1. www.nanotechnologyfordummies.com
2. www.nanobotblogspot.com
3. www.azonano.com
4. www.nano.gov
5. www.forbesnanotech.com
6. www.foresight.org
7. www.nanotech-now.com
8. www.classcentral.com/course/youtube-dna-nanotechnology-a-foundation-for-programmable-nanoscale-materials-158912

6.Syllabus Focus

a. Relevance to Local, Regional, National, and Global Development Needs

Local /Regional/National /Global Development Needs	Relevance
Global	Explore global nanobiotechnology: applications, ethical considerations, sustainability, regulatory frameworks, and future prospects for development

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b. Components on Skill Development/Entrepreneurship Development/Employability

SD/ED/EMP	Syllabus Content	Description of Activity
Employability	Module II	_Synthesis of nano particles

7. Pedagogy:

S. No	Student Centric Methods Adopted	Type/Description of Activity
1.	Video Presentations	Participative Learning
2.	Field trip	Experiential Learning
3.	Group Discussion	Participative Learning

8.Course Assessment Plan:

a. Weightage of Marks in Continuous Internal Assessments and End Semester Examination

COs	Continuous Internal Assessments – CIA (40%)	End Semester Examination - (60%)
CO1	CIA-1	End Semester examination
CO2	CIA-1 Synthesis of nanoparticles	
C03	CIA-2 Presentations on DNA scaffolds, Biomolecular motors	

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b. Question Paper Pattern:

NANOBIOTECHNOLOGY
MODEL QUESTION PAPER – THEORY

Course Code: P24/MIC/DSE/302 **Max Marks: 60**
Credits: 3 **Time: 2 ½ Hrs**

SECTION – A

I. Answer the following: **3 x 12 = 36 M**

1. Explain about Nucleation process in nanoparticles

OR

2. Give an account on importance of nanobiotechnology in medicine.

3. Explain synthesis of hybrid nano-bio assemblies

OR

4. List out the applications of C-dots fluorescent nanoparticles

5. Explain DNA scaffolds

OR

6. Describe the Applications of Nanomaterials in Homeopathy and Ayurveda

SECTION – B

II.Answer any FOUR: **4 x 6 = 24 M**

7. What is Theragnostics
8. Describe Targeted drug delivery
9. Explain micelles
10. Explain Interaction between biomolecules and nano particle surface
11. Explain Phytosomes
12. Describe Biomolecular motors

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SECTION A - INTERNAL CHOICE				3Q X 12 M = 36 M
Question Number	**Module**	**Question**	**CO**	**BTL (Blooms Taxonomy Level)**
1	Module 1	Explain about Nucleation process in nanoparticles	CO 1	Level II
2	Module 1	Give an account on importance of nanobiotechnology in medicine.	CO 1	Level II
3	Module 2	Explain synthesis of hybrid nano-bio assemblies	CO 2	Level II
4	Module 2	st out the applications of C-dots fluorescent nanoparticles	CO 2	Level I
5	Module 3	Explain DNA scaffolds	CO 3	Level II
6	Module 3	Describe the Applications of Nanomaterials in Homeopathy and Ayurveda	CO 3	Level I
SECTION B - ANSWER ANY 4 OUT OF 6 (To compulsorily have **ONE** question from **each** module)				**4 Q X 6M = 24M**
7	Module 1	What is Theragnostics	CO 1	Level I
8	Module 1	Describe Targeted drug delivery	CO 1	Level I
9	Module 2	Explain micelles	CO 2	Level II
10	Module 2	Explain Interaction between biomolecules and nano particle surface	CO 2	Level II
11	Module 3	Explain Phytosomes	CO 3	Level II
12	Module 3	Describe Biomolecular motors	CO 3	Level I

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SEMESTER -III
NANOBIOTECHNOLOGY - PRACTICAL

1. Course Description

Course Code: P24/MIC/DSE/302/P
Course Type: DSE
No. of credits: 2

Max. Hours : 60
Hours per week: 4
Max. Marks: 50

2. Course objectives:

- To familiarize students with the various nanoparticles synthesis methods like chemical methods and green synthesis methods and characterize them.
- To evaluate the antibacterial activity of the synthesized nanoparticles.

3.Course Outcomes:

CO1: Learn the different methods of synthesis of nanoparticles like ZnO, TiO2, Fe3O4 and AgO and understand the techniques used in the characterization of nanoparticles.
CO2: Understand the biological properties of the nanoparticles.
CO3: Evaluate the better method for the synthesis of nanoparticles..

List of Practicals

1. Chemical synthesis of ZnO nanoparticles using different capping agents.
2. Green synthesis of TiO2 nanoparticles using microorganisms.
3. Antibacterial activity of ZnO /AgO/TiO2 nanoparticles.
4. Chemical synthesis of Fe3O4/AgO/TiO2 nanoparticles.
5. Characterization of nanoparticles by UV-Vis spectroscopy.
6. Isolation of DNA from Bacteria.
7. To study antibacterial activity of nanomaterial.
8. Field visit to Research institutes for demonstration of various techniques used in characterization of nanoparticles-X Ray Diffraction/SEM/TEM/FTIR.

CBCS 2024 Sem III **NANOBIOTECHNOLOGY**

MODEL QUESTION PAPER - PRACTICAL

Course Code: P24/MIC/DSE/302/P
Credits: 2

Max Marks: 50
Time: 3Hrs

I. MAJOR 20 M

1. Demonstrate the chemical synthesis of ZnO nanoparticles using different capping agents.

2. Demonstrate the chemical synthesis of Fe3O4 nanoparticles.

II. MINOR **10M**

2. Write the principle, synthesis method, characterization of TiO2 nanoparticles and interpret the antibacterial activity against the given bacterial culture.

OR

2. Characterize the ZnO nanoparticle sample provided to you by UV-Vis spectroscopy

III. Identify the given spots (A-E) and write few significant points **5x2=10 M**

IV. Record **5M**

V. Viva **5M**

Prepared by Faculty	Checked & Verified by HoD	Approved by the Principal
K. Swathi	Ros	
Ms.K.Swathi	**Dr.P.Roselin**	**Dr.Uma Joseph**

SEMESTER -III
PHARMACEUTICAL MICROBIOLOGY -THEORY

1. Course Description
Programme: M.Sc
Hours per week: 3
Course code: P24/MIC/DSE/303
No. of credits: 3

Max.marks: 100
Max. hours : 45
Course Type: DSE

2. Course Objectives:

- To emphasize principles involved in dosage, routes of administration and mode of action of antimicrobial agents.
- To impart knowledge about Drug Resistance
- To understand spoilage, sterilization of pharmaceutical products and pharmacokinetics

3. Course Outcomes:

CO 1: Understand the principles of chemotherapy, non -medicinal antimicrobials and the development of antibiotics based on their target sites of action. (L II)

CO 2: Understand & gain knowledge about different routes of administration and dosage forms and understand the categorization of different antibiotics based on their mode of action. (L II)

CO 3: Understand the Drug Resistance in Bacteria, apply assay methods for analyzing antimicrobial agents, evaluate factors influencing spoilage, preservation of pharmaceutical products. (L II, IV)

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4. Course Content:

MODULE I - PRINCIPLES OF DRUGS **(15 Hrs)**

History of Chemotherapy- Paul Ehrlich contributions, Non -medicinal chemical antimicrobials - sanitizers, disinfectants, antiseptics, antimicrobial action of phenols and phenolic compounds, alcohols, halogens, heavy metals, dyes, aldehydes, detergents.
Antibiotics - The origin, development of antibiotics, types of antibiotics and their classification, Target sites of drug action on bacteria.

MODULE II - ROUTE OF ADMINISTRATION & MODE OF ACTION OF DRUGS **(15 Hrs)**
Choice of drug, dosage, route of administration, combined/mixed multi drug therapy, control of antibiotic/drug usage
Mode of action of important drugs : Cell wall inhibitors (Beta lactam – eg. Penicillin), membrane inhibitors (polymyxins), macromolecular synthesis inhibitors (protein and nucleic acid), antifungal antibiotics (nystatin)

MODULE III- DRUG RESISTANCE & ASSAY METHODS **(15Hrs)**

Clinical basis of drug resistance, biochemistry of drug resistance, genetics of drug resistance in bacteria.
Assay for growth inhibiting substances – Assay for non- medicinal antimicrobials (Phenol coefficient/RWC). Drug sensitivity testing methods and their importance. Assay for antibiotics – Determination of MIC, the liquid tube assay, agar plate assay (disc diffusion, agar well , E -test, and cylinders cup method).
Microbiological spoilage, preservation of pharmaceutical products: Microbial spoilage, preservation of pharmaceutical products; antimicrobial agents used as preservatives.
Introduction to pharmacokinetics and drug design

5. Resources:

Textbooks:

1. T J Franklin & G A Snow (2005), Biochemistry & Molecular Biology of Antimicrobial Drug Action, 6th edition, Springer Science &BussinessMedia.
2. Stephen P Denyer, Norman Hodges, Sean P Gorman, Brendan F Gilmore (2011) Hugo & Russell's, Pharmaceutical Microbiology 8th edition, Blackwellpublishers.
3. Joanne M. willey, Linda M sherwood, Christopher J wooolverton (2011). Prescott's Microbiology. 8th edition .McGraw HillPublishers
4. Harold P. Lambert , Antibiotic and Chemotherapy, 9th edition.
5. Michael J. pelczar,E.C.SChan,Noel R. Krieg,(2013),Microbiology,5thedition,McGraw Hilleducation.

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Reference books:

1. Roger G Finch,DavidGreenwood,S Ragnar Norrby,Richard J Whitley(2003),Antibiotic and Chemotherapy,8th edition,Churchill LivingstonePublishers
2. William Hewitt(2004), Microbiological Assay for Pharmaceutical Analysis -A Rational Approach, CRCPress
3. Principles of Pharmacology by H.L.Sharma and K.K.Sharma, RS medical publishers.
4. Principles and methods of sterilization in health sciences. Perkins, JK. Pub: Charles C. Thomos,Springfield.
5. Compendium of methods for the microbiological examination of foods. Vanderzant, C. and Splittstoesser, D. Pub: American Public Health Association, Washington,D.C.
6. Disinfectants: Their use and evaluation of effectiveness. Collins, CH., Allwood, MC., Bloomfield, SF. And Fox, A. (eds). Pub: Academic Press, NewYork
7. Inhibition and destruction of microbial cell by Hugo, WB. (ed). Pub: Academic Press,NY Manual of Clinical Microbiology. Lennette, EH. (ed).Pub: American Society for Microbiology,Washington.
8. Principles and Practice of disinfection. Russell, AP.,Hugo,WB., and Ayliffe,
9. GAJ.(eds). Publ. BlackwellSci.
10. Antibiotics. Lancini, G. and Parenti, F. publ:Springer-Verlag.
11. The Molecular Basis of antibiotic action. Ga.e, EF. Et al. Publ: Wiley, NewYork.
12. Antimicrobial Drug action. Williams, RAD., Lambart, PA. & Singleton, P. Pub:BiosSci.
13. Antiviral Drugs. Kargor,S.
14. Burger's Medicinal chemistry Vol. I – III. Ed. Nanfield E.World.
15. The control of antibiotic resistant bacteria. Stuart, Harris andHarris.
16. Indian Pharmacopea; United States Pharmacopea; BritishPharmacopea.
17. P.K.Gupta, Molecular Biology and GeneticEngineering

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6. Syllabus Focus:

a). Relevance to Local, Regional, National, and Global Development Needs

Local /Regional/National /Global Development Needs	Relevance
Global	Awareness on mode of action of drugs and understanding phenomenon of drug resistance in order to reduce the drug usage

b) Components on Skill Development/Entrepreneurship Development/Employability

SD/ED/EMP	Syllabus Content	Description of Activity
Employability	Module 3	Knowledge on assays and Good Manufacturing practices in industry enable quality sustenance of pharmaceutical products _Activity: Testing and determining the efficacy of different antimicrobial agents.

7. Pedagogy :

S. No	Student Centric Methods Adopted	Type/Description of Activity
1.	Seminar Presentation	Participative Learning
3.	Antimicrobial activity analysis	Experiential Learning

8. Course Assessment Plan

a) Weightage of Marks in Continuous Internal Assessments and End Semester Examination

COs	Continuous Internal Assessments - CIA (40%)	End Semester Examination - (60%)
CO1	CIA-1	End Semester examination
C0 2	CIA-2 Seminar Presentation	
C0 3	CIA-2 Antimicrobial activity analysis	

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a) Question Paper Pattern

PHARMACEUTICAL MICROBIOLOGY
MODEL QUESTION PAPER- THEORY

Course Code: P24/MIC/DSE/303 **Max Marks: 60**
Credits: 3 **Time: 2 ½ Hrs**

SECTION – A

I. Answer the following **3 x 12 = 36 M**

1. Explain Non-medicinal antimicrobials.

OR

2. Define and classify the antibiotics based on structure and mode of action.

3. Describe sensitivity testing for drugs.

OR

4. Analyze the importance of cell wall crosslinking step in determining mode of action of drugs
5. Describe Drug resistance.

OR

6. Explain about microbial spoilage of pharmaceutical products.

SECTION – B

III. Answer any FOUR **4 x 6 = 24 M**

7.Illustrate Paul Ehrlich contributions
8.Describe Target sites of drug action
9. What is Combined drug therapy
10. Explain Cylinder cup method
11. Explain Antimicrobials as drug preservatives
12. Outline Pharmacokinetics

SECTION A - INTERNAL CHOICE				3 Q X 12 M = 36 M
Question Number	**Module**	**Question**	**CO**	**BTL(Blooms Taxonomy Level)**
1	**Module 1**	Explain Non-medicinal antimicrobials	**CO 1**	**Level II**
2	**Module 1**	Define and classify the antibiotics based on structure and mode of action.	**CO 1**	**Level II**
3	**Module 2**	Describe sensitivity testing for drugs.	**CO 2**	**Level II**
4	**Module 2**	Analyze the importance of cell wall crosslinking step in determining mode of action of drugs	**CO 2**	**Level IV**
5	**Module 3**	Describe Drug resistance.	**CO 3**	**Level II**
6	**Module 3**	Explain about microbial spoilage of pharmaceutical products.	**CO 3**	**Level II**
SECTION B - ANSWER ANY 4 OUT OF 6 (To compulsorily have **ONE** question from **each** module)				**4 Q X 6 M = 24 M**
7	**Module 1**	Illustrate Paul Ehrlich contributions	**CO 1**	**Level II**
8	**Module 1**	Describe Target sites of drug action	**CO 1**	**Level I**
9	**Module 2**	What is Combined drug therapy	**CO 2**	**Level I**
10	**Module 2**	Explain Cylinder cup method	**CO 2**	**Level II**
11	**Module 3**	Explain Antimicrobials as drug preservatives	**CO 3**	**Level II**
12	**Module 4**	Outline Pharmacokinetics	**CO 3**	**Level II**

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b) Question Paper Blueprint:

Modules	Hours Allotted in the Syllabus	COs Addressed	Section A (No. of Questions)	Total Marks	Section B (No. of Questions)	Total Marks
1	15	CO-1	2	12	2	6
2	15	CO-2	2	12	2	6
3	15	CO-3	2	12	2	6

9.Mapping of CO with PO and PSO

CO	PO	PSO	Cognitive Level	Classroom Session
1	1	3,7	Understand	15
2	1	6,8	Analyze, Understand	15
3	1,3,5	3,6,8	Understand, Apply	15

Semester -III
PHARMACEUTICAL MICROBIOLOGY - PRACTICAL

1. Course Description
Course code: P24/MIC/DSE/303/P
Course Type: DSE
No. of credits: 2

Max. Hours : 60
Hours per week : 4
Max. Marks : 50

2. Course Objectives:

- To demonstrate and analyze basic laboratory skills and techniques related. to the sterilization of pharmaceutical products and equipments used.
- To give practical exposure and Hands on training for assay methods to carry out toxicity and sterility testing methods.

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3. Course Outcomes:

CO1: Perform and interpret sterility testing methods for pharmaceutical products and equipment.

CO 2: Evaluate the antimicrobial activity of antibiotics by chemical assays

CO 3: Evaluate the potency of antimicrobial agents and understand the concept of toxicity testing.

List of Practicals

1. Sterility testing methods for pharmaceutical products
2. Testing for sterilization equipment
3. Tests for disinfectants (Phenol coefficient/RWC)
4. Determination of antibacterial spectrum ofdrugs/antibiotics
5. Chemical assays for antimicrobial drugs- Streptomycin, Tetracycline
6. Testing for antibiotic/drug sensitivity/resistance
7. Determination of MIC valued for antimicrobial chemicals
8. Microbiological assays for antibiotics
   (Liquid tube assay, agar tube assay, agar plate assays)

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MODEL QUESTION PAPER - PRACTICAL

Course Code: P24/MIC/DSE/303/P **Max Marks: 50**
Credits: 2 **Time: 3 Hrs**

SECTION – A

Time: 3hours **Max marks: 50**

I. MAJOR **20 M**

1. Determine the concentration of Streptomycin in the given sample using Nitroprusside reagent. Write the principle involved in this method.
NOTE: Concentration of Standard Streptomycin is 1mg/ml
2. A patient suffering from acne is on long term treatment with tetracycline. A sample collected from the above patient is provided to you. Estimate the amount of Tetracycline in the given sample by colorimetry. Write the principle involved in the estimation.
NOTE: Concentration of Standard tetracycline is 0.25mg/ml

II MINOR **10 M**

1. Determine the disinfectant capacity of Dettol in comparision with phenol.
2. Determine the potency of antibiotics by turbidimetric method.

III. Observe/ Identify the given spots A-E and write few significant points **10 M**
IV. Record **5M**
V.VIVA **5M**

Prepared by Faculty	Checked &Verified by HoD	Approved by the Principal
Dr. Anitha	Dr.P.Roselin	Dr.Uma Joseph

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