Name of faculty: Science	**Department:**Microbiology
Program: B.Sc.	**Type:** Theory + Practical
Subject: DSC-11 Microbial Technology	**Semester:**6
Credit: 04 + 02	**Total learning hours:** 60
Course description: The major objective of this course is to acquaint students with the various aspects of industrial microbiology, different types of fermentation processes, fermenters designs and operations. Students will become familiar with mass scale culturing of microorganisms for industrial production of various biomolecules and /metabolites of industrial interest and different recovery methods in detail.	
Student learning outcome: ● Students will understand the development and importance of industrial microbiology and will be conversant with different types of fermentation processes. ● Students will learn about the design, operation and uses of different types of fermenters of laboratory, pilot and industrial scale. ● Students will gain insight into the techniques of isolation, screening, preservation and maintenance of industrially important microbial strains and different types of media used in fermentation processes. ● Students will have gained in-depth knowledge of the principles of microbial production and recovery of industrial products at large scale.	

Unit-1: History and The Development of Fermentation Process (Duration: 06 Hrs)

1.1 Historical developments in fermentation technology
1.2 Primary & Secondary metabolites
1.3 Screening
1.4 Strain Development
1.5 Fermentation Processes

Unit-2: Design of Fermenter (Duration: 08 Hrs)

2.1 Basic function of fermenter
2.2 Body construction
2.3 Fermenter system
2.4 Scale up

Unit-3: Fermentation Media (Duration: 08 Hrs)

3.1 Characteristics of ideal production medium
3.2 Media Formulation
3.3 Carbon Sources
3.4 Nitrogen Sources
3.5 Other ingredients
3.6 Animal & Plant cell culture media

Unit-4: Industrial Sterilization (Duration: 07 Hrs)

4.1 Principles of sterilization
4.2 Sterilization of equipments
4.3 Sterilization of production media
4.4 Sterilization of air

Unit-5: Product Recovery (Duration: 08 Hrs)

5.1 Stages of upstream & downstream processing
5.2 Broth conditioning
5.3 Sedimentation
5.4 Centrifugation
5.5 Filtration
5.6 Cell disruption
5.7 Product recovery
5.8 Distillation
5.9 Finishing steps

Unit-6: Microbial Fermentation of organic feed stocks (Duration: 07 Hrs)

6.1Ethanol Fermentation
6.2 Acetone- Butanol Fermentation
6.3 Glycerol

Unit-7: Microbial Fermentation of organic and amino acids (Duration: 08 Hrs)

7.1 Citric acid
7.2 Acetic acid
7.3 Commercial use of amino acids
7.4 L-Glutamic acid

Unit-8: Microbial Fermentation of enzymes, vitamins & antibiotics (Duration: 08 Hrs)

8.1 Amylases
8.2 Riboflavin
8.3 β – Lactam antibiotics

References:

Crueger W., (2005). Biotechnology: A textbook of industrial microbiology, 3rd Ed., Panima, New Delhi. ISBN: 9789385998638.

Patel, A.H., (2012). Industrial Microbiology, 2nd Ed. Macmillan, India. ISBN: 9789385750250.

Stanbury, P.F., (2006). Principles of Fermentation Technology, 2 Ed., Elsevier Science Ltd. ISBN: 9780750645010.

Syed Sajeed Ali, (2016). Fermentation and Industrial Microbiology. ISBN: 9788192756929.

Waites, M.J., et al., (2001). Industrial Microbiology, 1ST Ed., Blackwell publishing. ISBN: 0632053070.

Further Reading:

Okafor N., (2007). Modern Industrial Microbiology and Biotechnology, Science publishers. ISBN: 9781138036147.
Sivakumaar P.K., Joe M.M. and Sukesh K., (2010), An introduction to industrial microbiology, 1st Ed., S.Chand publication. ISBN: 9788121935197.

Practicals:

1) Screening of antimicrobial metabolite producing microorganisms:
   (i) Crowded plate method (ii) Wilkin's method
2) Sterility testing by direct inoculation method.
3) Bioassay of penicillin
4) Fermentative production of amylase by submerged fermentation and its estimation
5) Separation of amino acids by paper chromatography

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Name of Faculty: Science	**Department:** Biotechnology
Program: B.Sc. Biotechnology	**Type:** Theory + Practical
Subject: DSC-12 Plant and Animal Biotechnology	**Semester:** 6
Credit: 04 + 02	**Total Learning Hours:** 60

Course Description:
The main objective of the course will be to build the basic concepts of Plant & Animal Biotechnology and look at its applications. Also to inculcate strong fundamentals on modern aspects of basic botany and tissue culture technique.

Student Learning Outcome: After completion of this course the students will be able to:

- Understand the concept of in vitro micropropagation, in-vitro embryogenesis and its applications, various mechanisms of transfer of desired DNA into plant cells
- Acquainted with protoplast isolation and fusion techniques
- Learn vital steps involved for successful transfer of plantlets from labs to fields
- Appreciate applications & concepts of Animal Biotechnology
- Acquire basic skills & protocols for performing in Animal Cell Culture lab
- Understand the reproductive strategies & their role in breed improvement

Unit 1: Introduction to Plant Tissue Culture (07 Hours)
1.1 Principles of plant tissue culture, cell totipotency and cyto-differentiation
1.2 Laboratory requirement of plant tissue culture, sterilization techniques and instruments used, culture condition and explants selection
1.3 Media preparation and role of various components used in media, Macro and micronutrients and their roles
1.4 Role of phyto-hormone in plants and their application in tissue culture

Unit 2: Techniques used in Plant Tissue Culture (08 Hours)
2.1 Callus culture, Single cell culture, Protoplast isolation, culture and fusion
2.2 Haploid culture: Anther culture, pollen culture, ovule culture, Triploid plant production: endosperm culture
2.3 Somatic embryogenesis, Somaclonal variation, Synthetic seeds, Generating Virus free plants
2.4 Cryopreservation and Germplasm conservation

Unit 3: Genetic Engineering of Plants (08 Hours)
3.1 Transformation of gene, vector mediated and non-vector mediated methods of transformation in plants
3.2 Hairy root culture, selection of desired variety
3.3 Recombinant products produced in plant tissue culture
3.4 Introduction to Genome Editing techniques

Unit 4: Plant Secondary Metabolites (07 Hours)
4.1 Introduction to secondary metabolites, Function and use of secondary metabolites
4.2 Classification and types role of secondary metabolites in plants

4.3 Role of elicitors in production of secondary metabolites
4.4 Strategies of large scale production of secondary metabolites; Use of bioreactors and their types

Unit 5 Introduction to Animal Biotechnology (07 Hours)
5.1 Definitions & Historic Overview
5.2 Laboratory Design & Layout
5.3 Equipment
5.4 Culture Vessels & Substrates
5.5 Culture Media

Unit 6 Basic Lab Requirements of Animal Tissue Culture (08 Hours)
6.1 Applications of Animal Biotechnology & Tissue Culture
6.2 Advantages of Animal Tissue Culture
6.3 Limitations of Animal Tissue Culture
6.4 Types of Tissue Culture

Unit 7 Basic Cell Culture Techniques (08 Hours)
7.1 Preparation of Reagents & Media
7.2 Sterilization of Media
7.3 Isolation of Animal Material
7.4 Establishment of Cell Culture

Unit 8 Artificial Animal Breeding & Transgenic Animals (07 Hours)
8.1 Artificial Insemination & Embryo transfer (superovulation, MOET, Demi-embryo)
8.2 Animal Cloning
8.3 Transgenic Animals
8.4 Animals as Bioreactors

References and Textbooks:

- S. S. Bhojwani & M.K. Razdan ,Plant Tissue Culture, Theory and Practice, a Revised Edition., Elsevier, ISBN: 9780080539096
- B.D. Singh, Biotechnology, Kalyani Publishers, ISSN: 9789327220650
- H. S. Chawla, Introduction to Plant Biotechnology, 3rd Ed., Oxford & IBH Publishing Co Pvt.Ltd, ISBN: 9788120417328
- C Veeresham & CK Kokate, Medicinal plant biotechnology. CBS Publishers and Distributers; 2006. ISBN: 9788123910970
- MK Razdan. Introduction To Plant Tissue Culture, 2/E. Oxford and IBH publishing; 2002. ISBN: 9788120417939
- R.N Trigiano and D.J Gray, Plant Tissue Culture, Development and Biotechnology, 1st Edition, CRC Press, ISBN: 9781420083262
- Ian Freshney, , Culture of Animal Cells: A Manual of Basic techniques, 7th Edition, Wiley Blackwell, ISBN: 9781118873656
- M.M Ranga, Animal Biotechnology, 3rd Revised Edition, Agrobios India, ISBN: 978-8177543094

Practicals

1. Preparation of Stocks and Media (Murashiage and Skoog, Gamborg B5)
2. Explant selection, treatment and inoculation for callus induction
3. Protoplast isolation using mechanical and enzymatic methods
4. Animal Media Preparation & sterilization (RPMI 1640)
5. Isolation of Hepatocytes/splenocytes/ fibroblast from liver/spleen/chick embryo
6. Peripheral Blood Lymphocyte culture (PBLC)

References and Textbook for Practicals

- Culture of Animal Cells: A Manual of Basic techniques by Ian Freshney, Wiley Blackwell
- T. Pullaiah, MV Subba Rao, E Sreedevi, Plant Tissue Culture: Theory and Practicals, 2nd Edition, Scientific Publishers, ISBN: 9788172335946

Name of Faculty: Science	**Department:** Biotechnology
Program: B.Sc.	**Type:** Theory
Subject: SEC-4 Essential Skills in Computing	**Semester:** 6
Credit: 04	**Total Learning Hours:** 60

Course Description:
This course enhances the fundamentals of computer, office automation , database management and internet facility. Introduce the fundamentals of computing devices and reinforce computer vocabulary, particularly with respect to personal use of computer hardware and software, the Internet. Provide hands-on use of Office applications Word, Excel and PowerPoint. Introduce the database concept with SQL in Access.

Student Learning Outcome: After completion of this course the students will be able to:

- Understand concepts of computer component
- Manage the documents, presentation and gain practical exposure on spreadsheet using office tool.
- Create and manage database using database tool.
- Use SQL statements to store, modify and retrieve data from tables
- gain skills & knowledge to browse and get updated worldwide information

UNIT 1:INTRODUCTION OF COMPUTERS (06 h)

1.1 Evolution of computers ,Classification of Computers and components of computer
1.2 Fundamentals of Computers
1.2.1. Hardware
1.2.2.Software
1.2.3 Data and User
1.3Essential Computer Hardware
1.3.1 Processing device
1.3.2 Memory device-RAM & ROM
1.3.3 Input and Output devices
1.3.4 Storage device-Optical & Magnetic
1.4. Operating System

UNIT 2: OPERATE THE COMPUTER SYSTEM(04 h)

2.1. Start Menu
2.1.1. Programs Documents Setting
2.1.2. Taskbar toolbar
2.1.3. Find and replace utility
2.1.4. Help menu
2.1.5. Shut Down, Restart
2.2. Manage Computer
2.2.1. Files & Folders

2.2.2. Configuring Printers
2.2.3. Installing Programs
2.2.4. Display setting

UNIT 3: DOCUMENT WRITER (10 h)

3.1. Components of Word Writer
3.1.1. Creating Document Typing Text
3.1.2. Saving and Closing Opening an Existing
3.1.3. Password Protection
3.1.4. Printing & Previewing Documents
3.1.5. Switch between Multiple Documents
3.1.6. Save to PDF
3.2. Familiar Formatting Tools
3.2.1. Working with Text boxes & frame
3.2.2. Working with Pictures &Objects
3.2.3. Inserting Place Comments
3.2.4. Working with Tables
3.2.5. Spell Check utility
3.2.6. Use of hyperlink
3.3. Other features
3.3.1. document templates
3.3.2. Insert and edit images
3.3.3. Add custom charts and manage charts
3.3.4. Add and manage table
3.3.5. View multiple documents
3.3.6. Mail merge

UNIT 4: WPS PRESENTATION (10 h)

4.1. Introduction of presentation , toolbar and files
4.2. Familiar Formatting Tools
4.2.1. WordArt text effects,
4.2.2. built-in slide styles
4.2.3. Use of templates.
4.3. Advanced Animation
4.3.1. Multimedia: using audio and video -Audio and video formats -Inserting audio and video objects
4.3.2. Animations -Set and customize animation effects -Set text animations -Animate the elements of a chart
4.4. Extended Desktop
4.4.1. Organizing and publishing a presentation
4.4.2. Custom slide shows ‑Managing transitions
4.4.3. Graphic objects formatting ‑Editing of graphic objects , Visual communication: using graphics and images .
4.4.4. Insert Shapes, SmartArts, Charts and Diagrams
4.4.5. Other tools: equations
4.5. Use of Hypertext links

4.5.1. Action buttons
4.5.2. Import slides from other presentations
4.5.3. Export slides as graphics object

UNIT 5: WPS SPREADSHEET.(10 h)

5.1. Introduction to workbook ,worksheet and manage worksheet
5.2. Introduction to toolbars, add and view toolbar
5.3. Formulas toolbar
5.4. Built in functions, types of functions
5.5. Table Formatting , Pivot Tables
5.6. Insert Built-in Charts & customize charts
5.7. View Multiple Documents

UNIT 6:DATABASE MANAGEMENT SYSTEM(04 h)

6.1. Database system applications.
6.2. Purpose of Database system.
6.3. View of Data-Data abstraction, Instance and schema, Data model.
6.4. Database language-DDL, DML
6.5. Database Architecture-Two tier Architecture, Three tier Architecture.

UNIT 7: PRACTICAL APPROACH FOR DATABASE(10 h)

7.1. Introduction to tables ,data types and field properties
7.2. Create a table and add fields ,Guidelines for naming fields, controls, and objects
7.3. Set the field size , Combine fields using the Calculated data type
7.4. Add or change a table's primary key
7.5. Create and use an index to improve performance
7.6. SQL Queries: CREATE, INSERT, UPDATE, DELETE and SELECT with WHERE clause, ORDER BY etc.

UNIT 8: AWARENESS OF INTERNET (06 h)

8.1. Introduction of Internet and browser
8.2. Surfing Internet
8.3. Using of Search engine browser
8.4. Mail Utility

References:

- Fundamentals of Computers" by Rajaraman V and Adabala N.
- "FUNDAMENTALS OF COMPUTERS" by E Balagurusamy
- WPS Office - Free Office Suite for Word,PDF,Excel ,WPS SOFTWARE PTE. LTD.[Available on google play store]
- MS Office in a Nutshell -Publisher: VikasPublishing House
- Wps office 2016 writer eBook , by Lalit Mali, Kindle Edition
- The Internet Book by Douglas E. Comer
- Advanced Microsoft Access: Learn Techniques of Ms Access for Database Management Systems by Blerton Abazi

Practicals:

1. Type a document related to "Basic of computer" and do formatting of it
2. Create a biodata of your own with academic and job experience
3. Create a word document which makes an invitation card and send it to at least 5 different people using mail-merge.
4. Create a different subject page and use an index with hyperlink and references on that page.
5. Use of spreadsheet which use of utility of fill, format and use of built-in functions
6. Use of spreadsheet which manage the employee attendance and make calculation based on using user-defined formula
7. Make a various charts with any specified table.
8. Create presentation with given topic and use WPS presentation
9. Create presentation with image and video link
10. Create a database which creates a table of personal details. Use insert and update query of SQL: CREATE, INSERT, UPDATE, DELETE
11. Write a queries use of SELECT with WHERE clause, ORDER BY
12. Write a create index of any table data with using of SELECT query

Name of Faculty: Science	**Department**: Biotechnology
Program: B.Sc. Biotechnology	**Type:** Theory
Subject: DSE-6 Recombinant DNA Technology	**Semester:** 06
Credit: 02	**Total learning hours:** 30
Course description: The objectives of this course are to provide students with the theory and practical experience of the use of Recombinant DNA technology which facilitate investigation of molecular biology and evolution-related concepts.	
Student learning outcome: ● Students will develop an understanding on basic idea of gene cloning, its importance, types of enzymes used as tools in gene cloning as being prime players. ● As being carriers of genes of interest, students will understand about different types of vectors and comparative advantages offered by each of them so that proper choice of vector can be done. ● Students will gain knowledge about techniques to insert prepared clones into different organisms and identification of recombinants. ● The unit focuses on and thus provides knowledge of different techniques to, first, identify and then further validation of recombinants. ● At the end of the course, the students will have sufficient scientific understanding of the subject and have good knowledge of application of Recombinant DNA techniques in Life Sciences Research.	

UNIT-1: Introduction & scope **(4 hrs)**

1.1 Introduction to Recombinant DNA Technology and its Scope
1.2 Milestones in Genetic Engineering: Isolation of Gene
1.3 Concept and Basic Steps of Gene Cloning
1.4 Application of Recombinant DNA Technology

UNIT-2: Enzymes in Recombinant DNA Technology **(4 hrs)**

2.1Nucleases and Restriction Endonucleases
2.2 DNA Polymerases and Terminal Transferase
2.3 Reverse Transcriptase, Kinase and Phosphatase
2.4 DNA Ligases (T4 DNA ligase & *E.coli* DNA ligase)

UNIT-3 Cloning vector **(6 hrs)**

3.1 Plasmids
3.2 Cosmids
3.3 Phages- Lambda and M13
3.4 Artificial Chromosomes (BAC &YAC)
3.5 Shuttle Vectors and Expression Vectors
3.6 Plant Vectors (Agrobacterium and virus based)

UNIT-4 Gene Cloning and Screening **(4 hrs)**

4.1 Cutting and Joining Vector and Insert DNA
4.2 Transformation of Recombinant DNA in Host

4.3 Insertion of Phage DNA
4 .4 Introduction of DNA to Non-Bacterial Cells
4.5 Methods for Screening of Transformants

UNIT-5 Gene Cloning and Expression (3 hrs)

5.1 Factors Affecting Expression of Cloned DNA
5.2 Synthesis of cDNA,
5.3 Construction of cDNA Library and Genomic DNA Library (including applications.

UNIT-6 Techniques in RDT (3 hrs)

6.1 Southern, Northern and Western blotting
6.2 Polymerase Chain Reaction: Working Mechanism and Application, Variants of PCR
6.3 Site Directed Mutagenesis.

Unit-7 Application of RDT (3 hrs)

7.1 Transgenic Technology: Types Approaches & Application (Plant & Animals).
7.2 Gene therapy: Principles, Strategies and Ethics of Human Gene Therapy.
7.3 Application of DNA Technology in Forensics and Parental Disputes.

Unit-8 DNA Sequencing Methodologies (3 hrs)

8.1 Sanger's Di-deoxy Chain Termination Method
8.2 Capillary Based Gel Electrophoresis (Automated Sequencing)
8.3 Overview: Next Generation Sequencing

References and Textbooks: (With Author, Edition, Publishers, ISBN)

- Brown TA. Gene cloning and DNA analysis: an introduction. John Wiley & Sons; 2016 Jan 19. ISBN 978-1-4051-8173-0
- Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, New York. SBN 10: 0716722828
- Molecular Biotechnology: Principles Application of Recombinant DNA 2nd Edition. Glick, B.R. and Pasternak, J. J. (1998) ASM press Washington DC. 978-1-55581-498-4
- Principles of Gene Manipulation by S.B. Primrose, RM Twyman and RW Old (6thEdition) 1-4051-3544-1