DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO.ACAD/SU/Engg./T.E. Instru. & Biotech./63/2014

It is hereby notified for information of all concerned that, the Dean, has pointed out that, due to **typographical mistake in the Structure of T.E. Instrumentation and Control / Instrumentation and Biotechnology in Subject Code No. BSH-331 Communication Skill-II, the 50 marks shown in the Column of Term Work *should be* in the Column of Practical**.

The Hon'ble Vice-Chancellor has accepted the said typographical mistake to incorporate in above syllabi on behalf of the Academic Council under Section-14[7] of the Maharashtra Universities Act, 1994 under the Faculty of Engineering and Technology.

After above **corrections the said syllabi will be circulated as per Appendix-'A' & 'B'**.

This is implemented for the **Academic Year 2013-2014** and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF. NO. ACAD/SU/ENGG./2014/
1158-82

Date:- 07-04-2014.

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Director,
Board of College and
University Development.

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Copy forwarded with compliments to :-

1] The Principals, affiliated concerned Colleges,
Dr. Babasaheb Ambedkar Marathwada University.

2] The Director, University Network & Information Centre, UNIC, with **a request to upload this Circular on University Website.**

Copy to :-

1] The Controller of Examinations,
2] The Superintendent, [Engineering Unit] Examination Branch,
3] The Superintendent, [Eligibility Unit],
4] The Programmer [Computer Unit-1] Examinations,
5] The Programmer [Computer Unit-2] Examinations,
6] The Director, [E-Suvidha Kendra], in-front of Registrar's Quarter,
Dr. Babasaheb Ambedkar Marathwada University,
7] The Public Relation Officer,
8] The Record Keeper,
Dr. Babasaheb Ambedkar Marathwada University.

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APPENDIX - "B"

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

Revised Syllabus of

T.E.

BIOTECHNOLOGY.

[Effective from 2013-14 & onwards]

FACULTY OF ENGINEERING AND TECHNOLOGY

Proposed Revised Syllabus

Third Year of Engineering in Biotechnology

Sub no	Semester V (Part I)	Contact Hrs/Week				Examination scheme					
	Subjects	L	T	P	Total	CT	TH	TW	P	Total	Duration of theory examination
BTD 301	Fermentation Technology	4	-	-	4	20	80	-	-	100	3 Hrs
BTD 302	Advanced Molecular Biology	4	-	-	4	20	80	-	-	100	3 Hrs
BTD 303	Immunology	4	-	-	4	20	80	-	-	100	3 Hrs
BTD 304	Plant Tissue Engineering	4	-	-	4	20	80	-	-	100	3 Hrs
BTD 331	Biothermodynamics	4	-	-	4	20	80	-	-	100	3 Hrs
BTD 321	Fermentation Technology Lab	-	-	4	4	-	-	-	50	50	-
BTD 322	Advanced Molecular Biology Lab	-	-	4	4	-	-	-	50	50	-
BTD 323	Immunology lab	-	-	2	2	-	-	-	50	50	-
BTD 324	Plant Tissue Engineering Lab			4	4			-	50	50	-
BSH 331	Communication Skills II	-	-	2	2	-	-		50	50	1 Hr
	Total (Part I)	**20**	**-**	**16**	**36**	**100**	**400**	**-**	**250**	**750**	-

Sub no	SEMESTER VI (Part II)	Contact Hrs/Week				Examination scheme					
	Subjects	L	T	P	Total	CT	TH	TW	P	Total	Duration of theory examination
BTD 351	Bioseparation Techniques	4	-	-	4	20	80	-	-	100	3 Hrs
BTD 352	Recombinant DNA Technology	4	-	-	4	20	80	-	-	100	3 Hrs
BTD 353	Principles of Tissue Engineering	4	-	-	4	20	80	-	-	100	3 Hrs
BTD 354	Computational Biology	4	-	-	4	20	80	-	-	100	3 Hrs
BTD 355	Enzyme Engineering and Technology	4	-	-	4	20	80	-	-	100	3 Hrs
BTD 371	Bioseparation Techniques Lab	-	-	4	4	-	-	-	50	50	-
BTD 372	Recombinant DNA Technology Lab	-	-	4	4	-	-	-	50	50	-
BTD 373	Computational Biology Lab	-	-	2	2	-	-	-	50	50	-
BTD 374	Enzyme Engineering and Technology Lab	-	-	4	4	-	-	-	50	50	-
BTD 375	Seminar			2	2	-	-	50	-	50	-
	Total (Part II)	**20**		**16**	**36**	**100**	**400**	**50**	**200**	**750**	-

L: Lecture hours per week **P:** Practical hours per week **CT:** Class Test **TH:** University Theory Examination

TW: Term Work **P:** Practical/Oral Examination **T:** Tutorial hours per week

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
FACULTY OF ENGINEERING AND TECHNOLOGY
THIRD YEAR ENGINEERING
SEMESTER V

BTD 301: FERMENTATION TECHNOLOGY

Teaching Scheme	Examination Scheme
Theory: 04 hours/week	Class Test: 20 Marks
	Examination Duration : 03 hours
	Theory Examination: 80 Marks

➢ OBJECTIVES

1. The syllabus of Fermentation Technology deals with the basic concepts of fermentation process as well as its industrial relevance.
2. Students will study and understand all the components of the fermentation process. Completely studying the subject they should be able to set a fermentation protocol by judicious and critical selection of the varied parameters involved therein

➢ COURSE CONTENTS

SECTION A

UNIT I : INTRODUCTION TO FERMENTATION TECHNOLOGY **08**

Concept, history, classical fermentation, range of fermentation processes, components of fermentation process, modes of fermentation – submerged, solid state and solid substrate fermentation, concept of upstream processing : screening, isolation, quantification and preservation of microbes, inoculum development and strain improvement.

UNIT II : MICROBIAL GROWTH KINETICS **05**

Batch, Fed batch and Continuous culture

UNIT III : DESIGN AND OPTIMIZATION OF FERMENTATION MEDIA **05**

Design of fermentation media: Role of fermentation media, media components, fermentation media for plant and animal system, media optimization- need for media optimization, one factor at a time methodology, statistical optimization – factorial design (placket burman and response surface methodology), simplex optimization

SECTION B

UNIT IV : STERILIZATION **06**

Concept of sterilization, classification of sterilization, sterilization indicators, medium sterilization, design of batch sterilization processes, design of continuous sterilization processes, filter sterilization and its applications (media, air, fermenter exhaust air), theory and design of depth filters.

UNIT V : FERMENTER **10**

Functions of fermenter, body construction, aeration and agitation assembly, valves and steam traps, different types of fermenter vessels for submerged fermentation – waldhof, acetator-cavitator, tower, cylindroconical vessels, air lift reactor, deep jet, cyclone column, packed tower, rotating disc fermeter;

Fermenter design for solid state fermentation: tray bioreactors, packed bed reactors, hollow fiber

Advanced fermenter design: Microfermenters for Rapid screening and analysis of Biochemical processes, Animal & Plant Cell Reactor Technology, Disposable Fermenters

Instrumentation and control of fermenter- temperature, flow, pressure, agitation, foam, weight, biomass, dissolved oxygen, inlet exit gas analysis, pH, control systems, role of computer.

UNIT VI : SCALE UP **06**

K_La and its determination, fluid rheology, factors affecting K_La – air flow rate, degree of agitation, medium and culture rheology, foam and antifoaming agent, scale up and scale down, fermentation economics and effluent treatment

SECTION A: UNIT I, II, III

SECTION B: UNIT IV, V, VI

➢ **RECOMMENDED BOOKS**

Text Books

1. Stanbury P.F., Whitaker A, and Hall S.J. (1997) Principles of Fermentation Technology 2nd ed. Aditya Books Pvt. Ltd, N.Delhi.

2. Michael L. Shuler, Fikret Kargi (2002) Bioprocess Engineering 2nd ed. Prentice Hall PTR

3. Pauline M. Doran (2012) Bioprocess engineering principles 2nd ed Academic Press.

4. R. Ananthanarayan and C. K. Jayaram Paniker (2010) Textbook of Microbiology 8th ed. Universities Press

5. Gerard J. Tortora, Berdell R. Funke and Christine L. Case (2012) Microbiology: An Introduction 11th Ed, Benjamin Cummings

Reference Books

1. Moo-Young M. ed. (1985) Comprehensive Biotechnology vol: I & II, Pergamon Press N.Y.

2. Ratledge C and Kristiansen B. eds. (2001) Basic Biotechnology 2nd ed. Cambridge Univ Press Cambridge.

➢ **PATTERN OF QUESTION PAPER**

The units in the syllabus shall be divided in two equal sections. Question paper shall be set having two sections A and B. Section A questions shall be set on first three units (I, II, III) and Section B questions on remaining three units (IV, V, VI) . Question paper should cover the entire syllabus.

➢ **FOR 80 MARKS PAPER**

1. Minimum ten questions
2. Five questions in each section
3. Question no 1 and 6 be made compulsory and should have at least ten bits of two marks out of which FIVE to be solved.
4. Two questions from remaining questions from each section be asked to solve having weightage of 15 marks

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
FACULTY OF ENGINEERING AND TECHNOLOGY
THIRD YEAR ENGINEERING
SEMESTER III

BTD 302 ADVANCED MOLECULAR BIOLOGY

Teaching Scheme	Examination Scheme
Theory: 04 hours/week	Class Test: 20 Marks
	Examination Duration : 03 hours
	Theory Examination: 80 Marks

➢ OBJECTIVES

Students should understand the advanced concepts in molecular biology and its applications in different model organisms

➢ COURSE CONTENTS

SECTION A

UNIT I **10**

Mendelian genetics part 1, hypertropic cardiomyopathy, muscular dystrophies, Mendelian genetics part 2, cystic fibrosis, thalassemia, mechanism of mutation, Haemophilia, mitochondrial disorders, chromosomes – prenatal diagnosis, William's syndrome-chromosome, newborn screening, genetic deafness, trinucelotide repeats, Huntington's syndrome, myotonic dystrophy

UNIT II **08**

Epigenetics/imprinting/X-inactivation, rett syndrome, Facioscapulohumeral Dystrophy, molecular cancer biology – colon cancer, leukaemia, Complex traitsHereditary Breast Ovarian Cancer

UNIT III 06

Genomic and epigenomic studies of human cancers, Reverse Genetics and other frontier in molecular technology

Rational Biotherapeutic Design: molecular modeling, computational approaches to predicting energetic.

SECTION B

UNIT IV **06**

Directed Evolution for Biotherapeutic Design: random mutagenesis approaches and techniques, phage display and selection techniques, combinatorial approaches and techniques

UNIT V **06**

Cellular Warfare: receptor-mediated recognition in immune system surveillance, macrophage-B-Cell collaboration, T-Cell and natural killer cell function, vaccines

UNIT VI **04**

Model organisms – bacteriophage, bacteria, Baker's yeast, nematode worm, fruit fly, house mouse

SECTION A: UNIT I, II, III

SECTION B: UNIT IV, V, VI

- **RECOMMENDED BOOKS**

Text Books

1. Sandy B. Primrose, Richard M. Twyman and Robert W. Old, (2002), Principles of Gene Manipulation, 6th ed. Wiley-Blackwell
2. D.M. Glover and D.B. Hames, (1995), DNA Cloning : A practical approach, 2nd ed, RL Press, Oxford
3. S. B. Primrose (1994), Molecular Biotechnology, 2nd Ed. Blackwell Scientific publishers, Oxford

Reference Books

1. Bruce Alberts, Alexander Johnson, Julian Lewis and Martin Raff (2007), Molecular Biology of the Cell 5th ed Garland Science;
2. Sambrook J, Fritsch E. F. an Maniatis (1989) Molecular cloning, vol. I, II, III, II nd edition, Cold spring harbor laoratory press, New York.
3. P.B. Kaufman, W. Wu , D.Kim and L.J. Cseke (1995) Molecular and cellular methods in Biology and Medicine, 3rd ed CRC Press Florida
4. S.L.Berger and A. R. Kimmel (1996) Methods in Enzymology Guide to Molecular Cloning Techniques, Vol. 152, 1st ed., Academic Press Inc, San Diego
5. John N. Abelson, Melvin I. Simon and David V. Goeddel (1990) Gene Expression Technology, Volume 185, Gene Expression Technology (Methods in Enzymology), 1 ed Academic Press
6. D. A. Mickloss and G. A Freyer (1990), DNA Science: A First Course in Recombinant Technology, 2nd ed Cold Spring Harbor Laboratory Press, New York

7. S. B. Primrose (1994), Molecular Biotechnology, 2nd Ed. Blackwell Scientific publishers, Oxford

8. J. A. Davis and W. S. Reznikoff, (1992) Milestones in Biotechnology, Classic Papers on Genetic Engineering, Butterworth-Heinemann Boston

9. M. R. Walker, and R. Rapley, (1997) Route Maps in Gene Technology, 1st ed, Blakwell Science, Oxford

10. S. M. Kingsman, (1998) Genetic Engineering : An Introduction to Gene Analysis and Exploitation in Eukaryotes, Blackwell Scientific Publications, Oxford

- **PATTERN OF QUESTION PAPER**

The units in the syllabus shall be divided in two equal sections. Question paper shall be set having two sections A and B. Section A questions shall be set on first three units (1,2,3) and Section B questions on remaining three units (4,5,6) . Question paper should cover the entire syllabus.

- **FOR 80 MARKS PAPER**

1. Minimum ten questions

2. Five questions in each section

3. Question no 1 and 6 be made compulsory and should have at least ten bits of two marks out of which FIVE to be solved.

4. Two questions from remaining questions from each section be asked to solve having weightage of 15 marks

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THIRD YEAR ENGINEERING
SEMESTER V

BTD 303: IMMUNOLOGY

Teaching Scheme	Examination Scheme
Theory: 04 hours/week	Class Test: 20 Marks
	Examination Duration : 03 hours
	Theory Examination: 80 Marks

- **OBJECTIVES**
  1. Syllabus deals with the basic concepts of immunology like immunity, immune response, infection, etc. along with its applications in the field of biotechnology like immunodiagnosis.
  2. Students after completion of the course should be versed with the basics as well the applications part of this subject and its relevance in biotechnology.

- **COURSE CONTENTS**

SECTION A

UNIT I: IMMUNOLOGY INTRODUCTION **06**

Immunology fundamentals, Immune system – Innate and acquired immunity, hematopoiesis, cells of immune system, primary and secondary lymphoid organs, antibody, antigen, haptens, adjuvants, mitogens.

UNIT II: ANTIBODY: STRUCTURE, FUNCTION AND ORGANIZATION OF GENES **06**

Structure of antibodies, antibody classes and biological activities, antigenic determinants on immunoglobulins, organization of light chain and heavy chain, affinity maturation, class switching and synthesis, assembly & secretion of immunoglobulin

UNIT III: IMMUNE RESPONSE **06**

Humoral and cell mediated immune response, B cell activation, T cell activation, antigen processing and presentation, properties of cytokines & its biological function, general organization and inheritance of the MHC, complement activation

SECTION B

UNIT IV: IMMUNITY TO INFECTION **06**

Bacterial, viral, protozoal and parasitic infection with reference to (Diphtheria, Influenza virus, Malaria, helminthes) with specific representative examples of each group. Vaccines – active and passive immunization, DNA vaccines, multivalent subunit vaccines, synthetic peptide vaccines

UNIT V: CLINICAL IMMUNOLOGY **08**

Hypersensitivity: Type I, II, III & IV reactions. Autoimmunity: Organ specific and systemic autoimmune diseases., Treatment of autoimmune diseases. Transplantation and tumor immunology: Graft rejection, tissue typing, immune suppressive therapy and clinical transplantation, tumor antigens, cancer immunotherapy. Immunodeficiency diseases: phagocytic, humoral, cell mediated deficiencies and SCID. AIDS: causes, syndrome, diagnostic tools, treatment and development of vaccine.

UNIT VI: IMMUNOTECHNOLOGY **08**

Antigen antibody interaction: Strength of antigen antibody interaction, cross reactivity, precipitation, agglutination. Techniques: Immunodiffusion, immunoelectrophoresis, ELISA, ELISPOT assay, RIA, flow cytometry, microarrays. Monoclonal antibodies–Hybridoma technology, applications of monoclonal antibody in diagnostics

SECTION A: UNIT I, II, III

SECTION B: UNIT IV, V, VI

- **RECOMMENDED BOOKS**

Text Books

1. RA Goldsby, Thomas J. Kindt, Barbara A. Osborne , (2006), Kuby's Immunology; W. H. Freeman & Company, 6th edition
2. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, (2011) Roitt's Essential Immunology , Wiley-Blackwell; 12 edition medical publishing London.
3. Biotol, B C Currell, RCE Dam-Mieras, (1993) Cellular Interaction and immunobiology 1st ed. Butterworth-Heinemann;

Reference Books

1. Paul (1999), Fundamentals of immunology, 4th ed., Lippencott Raven.

- **PATTERN OF QUESTION PAPER**

The units in the syllabus shall be divided in two equal sections. Question paper shall be set having two sections A and B. Section A questions shall be set on first three units (I, II, III) and Section B questions on remaining three units (IV, V, VI) . Question paper should cover the entire syllabus.

- **FOR 80 MARKS PAPER**

1. Minimum ten questions
2. Five questions in each section
3. Question no 1 and 6 be made compulsory and should have at least ten bits of two marks out of which FIVE to be solved.
4. Two questions from remaining questions from each section be asked to solve having weightage of 15 marks

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FACULTY OF ENGINEERING AND TECHNOLOGY
THIRD YEAR ENGINEERING
SEMESTER V

BTD 304: PLANT TISSUE ENNGINEERING

Teaching Scheme	Examination Scheme
Theory: 04 hours/week	Class Test: 20 Marks
	Examination Duration : 03 hours
	Theory Examination: 80 Marks

➢ OBJECTIVES

The course work of the subjects deals with both basic as well as engineering aspects of plant tissue culture. Students should be well versed with the varied plant cell culture types and techniques as well as its large scale cultivation

➢ COURSE CONTENTS

SECTION A

UNIT I: PLANT TISSUE CULTURE **04**

Introduction, History and concept of cellular totipotency; Morphogenesis; Culture conditions, medium & its constituents; Method of Sterilization, the basic laboratory layout & equipment, safety in laboratory

UNIT II: APPLICATIONS OF PLANT TISSUE CULTURE- I **06**

Callus culture; Cell Suspension culture; Somaclonal variation; Secondary metabolite production from plant cell cultures.

UNIT III: APPLICATIONS OF PLANT TISSUE CULTURE-II **10**

Micropropagation-Pathways and steps; Introduction to commercial micropropagation; Embryo culture, embryo rescue, meristem culture, Anther culture & Ovary culture; Protoplast Culture and Somatic hybridization; Somatic embryogenesis and Synthetic seeds.

SECTION B

UNIT IV: BIOREACTOR DESIGNING **03**

Bioreactor technology in plant tissue culture: Design and development and applications of mist bioreactors for micro propagation and hairy root culture, Bioreactor engineering for recombinant protein production using plant cell suspension culture, Types and designs of bioreactors for hairy root culture

UNIT V: GENETIC MANIPULATION IN PLANTS FOR THE FOLLOWING TRAITS **10**

Agrobacterium tumefaciens mediated genetic transformation; Methods of gene transfer, Herbicide resistance, Male sterility, Virus resistance, resistance towards fungal pathogens, Insect resistance, Genetic engineering of plants for improvement of crop yield and quality, Genetic engineering for introducing abiotic stress tolerance in plants, Genetic engineering of nitrogen fixing bacteria; nif genes and its control.

UNIT VI: MOLECULAR FARMING **07**

Production of modified carbohydrates, oil, recombinant proteins and vaccines in plants, Molecular markers in crop improvement-Detection of genetic diversity, Marker assisted selection and Breeding.

SECTION A: UNIT I, II, III

SECTION B: UNIT IV, V, VI

- **RECOMMENDED BOOKS**

Text Books

1. Biotechnology: Fundamentals & Applications by S. S. Purohit, Agrobios Ltd. (2001).
2. Trends in Plant Tissue Culture & Biotechnology; L K Pareek and P L Swarnkar; Published by AgroBios India (2002).
3. Plant Tissue Culture- Theories and Practices; S. S. Bhojwani and M K Rajdhan; Published by Elsevier, (1996).

Reference Books

1. Methods in Plant Tissue Culture; U Kumar; AgroBios India, (2003).
2. Plant Cell Tissue and Organ Culture Fundamental Methods; O L Gamborge; Published by Narosa, New Delhi (2004).
3. Plant Biotechnology: The genetic manipulation of plants; A. Slater, N. Scott, M. Fowler; Published by Oxford University press, New York (2003).
4. Transgenic Plants; V. Ranjan, Agrobios

- **PATTERN OF QUESTION PAPER**

The units in the syllabus shall be divided in two equal sections. Question paper shall be set having two sections A and B. Section A questions shall be set on first three units (I, II, III) and Section B questions on remaining three units (IV, V, VI) . Question paper should cover the entire syllabus.

➢ **FOR 80 MARKS PAPER**

1. Minimum ten questions
2. Five questions in each section
3. Question no 1 and 6 be made compulsory and should have at least ten bits of two marks out of which FIVE to be solved.
4. Two questions from remaining questions from each section be asked to solve having weightage of 15 marks

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FACULTY OF ENGINEERING AND TECHNOLOGY
THIRD YEAR ENGINEERING
SEMESTER V

BTD 331: BIOTHERMODYNAMICS

Teaching Scheme	Examination Scheme
Theory: 04 hours/week	Class Test: 20 Marks
	Examination Duration : 03 hours
	Theory Examination: 80 Marks

- **OBJECTIVES**

1. Syllabus is framed from the perspective of fundamentals of thermodynamics and its correlation with biotechnological systems.
2. Students should be able to understand the basic laws pertaining to thermodynamics and should be able to apply them in biotechnolological systems

- **COURSE CONTENTS**

SECTION A

UNIT I : SECOND LAW OF THERMODYNAMICS **08**

Statement of second law, heat engine, thermodynamic temperature scales, Carnot cycle for an ideal gas, the Kelvin scale as a thermodynamic temperature scale, entropy, entropy changes for an ideal gas, principle of increase of entropy, mathematical statement of second law, statement of third law

UNIT II : THERMODYNAMIC PROPERTIES OF FLUIDS AND PHASE EQUILIBRIA **08**

Relationships among thermodynamic properties for a homogeneous phase of constant composition, residual properties, two-phase systems, thermodynamic diagrams, table of thermodynamic properties, generalized correlations of thermodynamic properties of gases

UNIT III : THERMODYNAMIC PROPERTIES AND VLE FROM EUQTIONS OF STATE **06**

Properties of fluids from the virial equations of state, properties of fluids from cubic equations of state, vapor/liquid equilibrium from cubic equations of state

SECTION B

UNIT IV : GIBBS FREE ENERGY – THEORY **10**

Introduction, Equilibrium, Reversible processes, Phase transitions, Chemical potential, Effect of solutes on boiling points and freezing points, Ionic solutions, Equilibrium constant, Standard state in biochemistry, Effect of temperature on Keq Acids and bases, Chemical coupling, Redox reactions

UNIT V : APPLICATIONS OF THERMODYNAMICS TO BIOTECHNOLOGICAL SYSTEMS **05**

Osmosis, Dialysis, Donnan equilibrium, Membrane transport, Molecular pharmacology, Hemoglobin, Enzyme-linked immunosorbent assay (ELISA), DNA Polymerase chain reaction (PCR), Free energy of transfer of amino acids Protein solubility, Protein stability, Protein dynamics, Non-equilibrium thermodynamics and life

UNIT VI : THERMODYNAMICS OF BIOCHEMICAL CHANGES **03**

Bioenergetics, Types of biochemical reactions, Gibb's free energy concept for biochanges, energy concept and generation of high energy molecules and their transformations, biochemical pathways and feasibility of individual steps and overall reactions, enviro modifications such as redox, electron transfer etc, enzyme participation.

SECTION A: UNIT I, II, III

SECTION B: UNIT IV, V, VI

- **RECOMMENDED BOOKS**

Text Books

1. Introduction to Chemical Engineering Thermodynamics: J. M. Smith & H. C. Vanness, Graw Hill book company, Fifth Edition, 1999.
2. Chemical Engineering Thermodynamics:Narayanan
3. Chemical engineering thermodynamics: Arora
4. Bioenergetics

Reference Books

1. Principles of Chemical Equilibrium : Kenneth Denbigh
2. Chemical Engineering thermodynamics: Y.V.C. Rao
3. Chemical Engineering Thermodynamics : T. E. Daubert
4. Applications to Advanced thermodynamics: Goats
5. Chemical and Process Thermodynamics: B.G. Kyle
6. Biological Thermodynamics," D. T. Haynie.

➢ **PATTERN OF QUESTION PAPER**

The units in the syllabus shall be divided in two equal sections. Question paper shall be set having two sections A and B. Section A questions shall be set on first three units (I, II, III) and Section B questions on remaining three units (IV, V, VI) . Question paper should cover the entire syllabus.

➢ **FOR 80 MARKS PAPER**

1. Minimum ten questions
2. Five questions in each section
3. Question no 1 and 6 be made compulsory and should have at least ten bits of two marks out of which FIVE to be solved.
4. Two questions from remaining questions from each section be asked to solve having weightage of 15 marks

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FACULTY OF ENGINEERING AND TECHNOLOGY
THIRD YEAR ENGINEERING
SEMESTER V

BTD 321 FERMENTATION TECHNOLOGY LAB

Teaching Scheme	Examination Scheme
Practical: 04 hours/week	Practical Examination: 04 hours
	Practical marks : 50 Marks

➢ LIST OF PRACTICALS

1. Preservation of microbial cultures on slants, stabs and glycerol stocks
2. Quantification of microbial cells by haemocytometer, stage micrometer
3. Microbial growth curve
4. Inoculum development of microbial cultures
5. Plate assay for antibiotics by well diffusion and disk diffusion method
6. Screening plate assay for amylase/protease/ asparaginase/glutaminase producers
7. Production of Baker's yeast.
8. Demonstration of laboratory scale fermenter
9. Production of metabolite by submerged fermentation
10. Metabolite production by solid state fermentation
11. Media optimization for amylase production (carbon, nitrogen, pH , temperature)

➢ PATTERN OF PRACTICAL EXAMAMINATION

Any 8 practical's should be conducted from the above list. The practical examination shall consist of performing an experiment based on the practical work done during the course i.e. one major and one minor experiment during examination, the record of the experiments submitted by the candidate and viva-voce based on the syllabus.

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THIRD YEAR ENGINEERING
SEMESTER V

BTD 322 ADVANCES IN MOLECULAR BIOLOGY

Teaching Scheme	Examination Scheme
Practical: 04 hours/week	Practical Examination: 04 hours
	Practical marks : 50 Marks

➢ LIST OF PRACTICALS

1. Cloning using restriction enzymes
2. Cloning of PCR products
3. Cloning in expression vector
4. Induction of expression of recombinant protein
5. Purification of recombinant proteins using His Tag
6. Analysis of genetic markers in bacteria
7. Measurement of growth rate; One step growth curve using a even phage
8. Enrichment for antibiotic resistant and auxotrophic mutants
9. Genetic mapping by conjugation
10. Isolation of specialized transducing phage
11. Assay for gene induction
12. Assay for gene repression
13. RNA isolation
14. Northern analysis
15. RT PCR

➢ PATTERN OF PRACTICAL EXAMAMINATION

Any 8 practical's should be conducted from the above list. The practical examination shall consist of performing an experiment based on the practical work done during the course i.e. one major and one minor experiment during examination, the record of the experiments submitted by the candidate and viva-voce based on the syllabus.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
FACULTY OF ENGINEERING AND TECHNOLOGY
THIRD YEAR ENGINEERING
SEMESTER V

BTD 323: IMMUNOLOGY LAB

Teaching Scheme	Examination Scheme
Practical: 02 hours/week	Practical Examination: 04 Hours
	Practical marks : 50 Marks

➢ LIST OF PRACTICALS

1. ABO blood group testing
2. Separation of plasma and serum from blood
3. RBC AND WBC count
4. Single radial immunodiffusion
5. Ouchterlony double immunodiffusion
6. Counter current Immunoelectrophoresis
7. Rocket Immunoelectrophoresis
8. Enzyme Linked Immunosorbent assay
9. Characterization of immunoglobulins by SDS-PAGE
10. Western Blot
11. Antibody production

➢ PATTERN OF PRACTICAL EXAMAMINATION

Any 8 practical's should be conducted from the above list. The practical examination shall consist of performing an experiment based on the practical work done during the course i.e. one major and one minor experiment during examination, the record of the experiments submitted by the candidate and viva-voce based on the syllabus.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
FACULTY OF ENGINEERING AND TECHNOLOGY
THIRD YEAR ENGINEERING
SEMESTER V

BTD 324: PLANT TISSUE ENGINEERING LAB

Teaching Scheme	Examination Scheme
Practical: 04 hours/week	Practical Examination: 04 Hours
	Practical marks : 50 Marks

➢ LIST OF PRACTICALS

1. Preparation and sterilization of plant tissue culture media
2. Development of callus culture
3. Development of suspension culture
4. Embryogenesis
5. Organogenesis
6. Anther culture
7. Protoplast isolation, culture and fusion
8. *Agrobacterium* mediated transfer
9. Embryo encapsulation
10. Micropropogation
11. Production of secondary metabolite using plant cells

➢ PATTERN OF PRACTICAL EXAMAMINATION

Any 8 practical's should be conducted from the above list. The practical examination shall consist of performing an experiment based on the practical work done during the course i.e. one major and one minor experiment during examination, the record of the experiments submitted by the candidate and viva-voce based on the syllabus.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
FACULTY OF ENGINEERING AND TECHNOLOGY
THIRD YEAR ENGINEERING (ALL BRANCHES)
SEMESTER – V

BSH 331: COMMUNICATION SKILLS-II

Teaching Scheme	Examination Scheme
Practicals:2 Hrs/Week	Online Exam.: 50 Marks
	Duration of paper: 01 Hr

UNIT-I

- Fast calculation techniques, Number system, ratio ,proportion, variations averages,
- Simple interest ,compound interest, profit, loss
- Work and time speed and distance
- Set theory and vann diagram, permutation and combination
- Probability, alphanumeric series, logical deduction, reasoning, coding and decoding and blood relation
- Data interpretation

UNIT-II

- The key components of non verbal communication i.e. eye contacts, body language, vocal tone and volume.
- Team work and team building, The basics of team intelligence, Diversity awareness, Gender issues
- Group discussion, unstructured group discussions and actual group discussions
- Presentation skills ,self confidence and decision making

UNIT-III

- Adapting to corporate life
- Phone etiquettes, Email etiquettes, clothing etiquettes, Dinning table etiquettes
- Getting ready for an interviews, corporate dressing, writing reports and proposals, minutes writing,

RECOMMENDED BOOKS

➢ **Reference books**

1. Gopal Swamy Ramesh,Mahadevan Ramesh ,"The Ace of soft skills"Pearson publication
2. Bansal Harison,"Spoken English"
3. Orientblackswan, "English for Engineers and Technologist"
4. Jerry Wiessman , "Presenting to Win" Pretince Hall publications
5. Willium sanborn Pfeiffer,T.V.S,Padamaja, "Technical Communication"
6. M. Tyra, "Magical book on Quikermaths" BSC publishing co.pvt.ltd.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
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THIRD YEAR ENGINEERING
SEMESTER VI

BTD 351: BIOSEPARATION TECHNIQUES

Teaching Scheme	Examination Scheme
Theory: 04 hours/week	Class Test: 20 Marks
	Examination Duration : 03 hours
	Theory Examination: 80 Marks

➢ OBJECTIVES

1. The syllabus deals with different separations techniques used commonly in purification and or separation of biotechnological products.
2. At the end of the course work students are expected to design a separation protocol for the biotechnological metabolites taking into consideration its properties and industrial applicability.

➢ COURSE CONTENT

SECTION A

UNIT I: BIOSEPARATION TECHNIQUES AND CELL DISRUPTION 06

Bioseparation, its economic importance, nature and basis of Bioseparation processes, various Bioseparation techniques, RIPP scheme and current trends in Bioseparation.
Cell disruption: Overview of bacterial, fungal, yeast, plant and mammalian cell, classification of methods of cell lysis, mechanical methods: homogenizer, bead mill, ultrasonication, non mechanical methods of cell lysis – enzyme, solvents, chelating agent, chaotropic agents, antibiotics, osmotic shock, freeze thaw, and its advantages and disadvantages.

UNIT II: CHROMATOGRAPHY I 08

Basics of chromatography, adsorption chromatography, partition chromatography, theories of chroamtography, classification of chromatographic techniques, batch adsorption, column chromatography, column dynamics, chromatographic terms and parameters.
Practice of chromatography- HPLC and GC

UNIT III: CHROMATOGRAPHY II 08

Principle/theory, stationary and mobile phase, sample loading, elution and applications of Ion exchange chromatography, hydrophobic chromatography, gel permeation chromatography, affinity chromatography, reverse phase chromatography.

SECTION B

UNIT IV: CONCENTRATION I **08**

Centrifuges: Basic separation techniques: sedimentation, centrifugation, ultracentrifugation, gradient Centrifugation, various modules of centrifuges and scale up of centrifuges

Filtration and Membrane techniques: theory of filtration, filter medium, driving force, constant pressure cake filtration, constant rate cake filtration, improvement in filtration efficiency, mode of operation and equipment (filter press and rotary drum vacuum filtration); Membrane techniques : Definition of a membrane, theory of filtration, Criteria of membrane separation processes, Types of membranes, Advantages of membrane separation processes over conventional separation techniques, Industrial Applications, Membrane separations - Micro filtration, Ultra filtration, Reverse Osmosis, Piezodialysis, Electro dialysis, Membrane electrolysis, Pervaporation, Carrier mediated transport-liquid membranes, Membrane contactors, Polarization phenomenon, Membrane fouling, Membrane modules

UNIT V: CONCENTRATION II **06**

Precipitation: salts, solvents and polymers

Extraction: Theory of extraction, types of extraction, aqueous two phase extraction and super critical fluid extraction

Lypphilization

UNIT VI: INDUSTRIAL APPLICATIONS OF SEPARATION TECHNIQUES **04**

Synthesis of Bioseparation Processes, Process analysis, Process Economics, Illustrative Examples, Industrial applications with examples, Separation of bioconversion products/ secondary metabolites e.g. Steroids and antibiotics

SECTION A: UNIT I, II, III

SECTION B: UNIT IV, V, VI

- **RECOMMENDED BOOKS**

Textbooks

1. Product recovery in Bioprocess Technology, Butterworth-Heinemann Ltd. 1992
2. Principles of Bioseparation engineering, Raja Ghosh, world scientific Publishing CO. Ltd.
3. Protein purification, Robert Scopes, 2nd edition, Springer Verlag

Reference Books

1. Separation Processes n Biotechnology, J. A. Asenjo Marcel Dekker Inc.

2. Unit Operation of Chemical Engineering, McCabe, W.L., Smith, J.C. and Harritt, P., McGraw Hill

3. Separation Process Principles. Seader, J.D, and Henley, E.J. Wiley.

➢ PATTERN OF QUESTION PAPER

The units in the syllabus shall be divided in two equal sections. Question paper shall be set having two sections A and B. Section A questions shall be set on first three units (I, II, III) and Section B questions on remaining three units (IV, V, VI) . Question paper should cover the entire syllabus.

➢ FOR 80 MARKS PAPER

1. Minimum ten questions

2. Five questions in each section

3. Question no 1 and 6 be made compulsory and should have at least ten bits of two marks out of which FIVE to be solved.

4. Two questions from remaining questions from each section be asked to solve having weightage of 15 marks

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
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THIRD YEAR ENGINEERING
SEMESTER VI

BTD 352: RECOMBINANT DNA TECHNOLOGY

Teaching Scheme	Examination Scheme
Theory: 04 hours/week	Class Test: 20 Marks
	Examination Duration : 03 hours
	Theory Examination: 80 Marks

➢ OBJECTIVES

Syllabus deals with the basics and applications of recombinant technology and its industrial applicability in biotechnology sector. With the completions of this course work students should be able to design the recombinant protocol in both prokaryotic and eukaryotic systems

➢ COURSE CONTENTS

SECTION A

UNIT I : OVERVIEW OF RECOMBINANT DNA TECHNOLOGY **06**

Basics Of Recombinant DNA Technology: safety guidelines of recombinant DNA research. Genetic elements that control gene expression in prokaryotes and eukaryotes, Role of genes within cells, overview of cloning, bioethics and biohazards of genetic engineering

UNIT II : TOOLS FOR RECOMBINANT DNA TECHNOLOGY **08**

Enzymes: restriction endonucleases, reverse transcriptase, DNA polymerase and ligases. Vectors: Plasmids, Multiple cloning sites, selection markers, lambda phage, phagemids, cosmids, M13 vectors, vectors for cloning in eukaryotic cells, Expression Vectors, super vectors (BACs, YACs)

UNIT III : LIBRARIES **06**

Gene libraries, EST, Cloning strategies: DNA cloning, cDNA synthesis, genomic DNA libraries, cDNA library, amplification of gene libraries, identifying the products of cDNA clones, isolation, selection of recombinants, screening of libraries with DNA probes and antisera

SECTION B

UNIT IV: METHODS OF GENE TRANSFER **06**

Gene transfer technologies, Transformation, Transfection, Translocation, Conjugation. Modification of bacteria and viruses: live vaccines, transgenesis and cloning, Animal transgenesis, Application of transgenic animals, plant transgenesis: *Agrobacterium* mediated gene transfer and gene gun, transgenic plants and their applications

UNIT IV : TECHNIQUES USED IN GENETIC ENGINEERING 08

PCR reaction, optimization of PCR reaction, primer design, analysis of PCR products, PCR technique, Inverse PCR, Nested PCR, RACE PCR, Real Time PCR, Biomarkers : dominant and codominant biomarkers, RAPD, SSR, ISSR, RFLP and AFLP, applications of PCR, Site directed mutagenesis, Methods In Genetic Engineering: Restriction and modifying enzymes, Restriction mapping, Southern blot, Northern blot, Western blot; micro array technology, gene silencing techniques: antisense technology, RNAi.

UNIT VI : APPLICATIONS OF RECOMBINANT DNA TECHNOLOGY 06

Gene therapy, DNA vaccine, Subunit vaccines-Peptide vaccines, Attenuated vaccines-Vector vaccines, Production of Therapeutic Agents such as Engineering human interferon, human growth hormone, r-haematopoeitic growth factors, r-insulin, interleukins, interferon, r-tissue type plasminogen, r-human deoxyribonuclease,

SECTION A: UNIT I, II, III

SECTION B: UNIT IV, V, VI

- **RECOMMENDED BOOKS**

Textbooks

1. Plant biotechnology In Agriculture: K. Lindsey and M.G.K. Jones (1990), Prentice hall, New Jersey
2. Transgenic Plants Vol. 1 & 2 : S-d. Kung and R. Wu (1993), Academic Press, San Diego
3. Gene Cloning and DNA analysis: An introduction, (2006) T. A. Brown, Black Well Publishing Company.
4. Principles of Gene Manipulation; S. B. Primrose, R. M. Twyman & R. W. old; Blackwell Science, 6th Edition (2001).

Reference Books

1. Comprehensive Biotechnology by Moo-Young, Murray
2. Agricultural Biotechnology by Arie Altman. Marcel Dekker, Inc., 270 Madison Avenue, New. York, USA. 1998. 770 pp
3. Plant Cell Culture, Advances in Biochemical Engineering and Biotechnology. Anderson, L.A.,
4. Human Molecular Genetics. Strachan & Read. 3rd Edition.
5. Genetic Engineering and its applications. (2004) 2/e, Joshi. P: Agrobios, India

- **PATTERN OF QUESTION PAPER**

The units in the syllabus shall be divided in two equal sections. Question paper shall be set having two sections A and B. Section A questions shall be set on first three units (I, II, III) and Section B questions on remaining three units (IV, V, VI) . Question paper should cover the entire syllabus.

- **FOR 80 MARKS PAPER**

1. Minimum ten questions
2. Five questions in each section
3. Question no 1 and 6 be made compulsory and should have at least ten bits of two marks out of which FIVE to be solved.
4. Two questions from remaining questions from each section be asked to solve having weightage of 15 marks

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THIRD YEAR ENGINEERING
SEMESTER VI

BTD 353: PRINCIPLES OF TISSUE ENGINEERING

Teaching Scheme	Examination Scheme
Theory: 04 hours/week	Class Test: 20 Marks
	Examination Duration : 03 hours
	Theory Examination: 80 Marks

- **OBJECTIVES**
  Students should understand and apply the concepts of tissue engineering in the biotechnology field

- **COURSE CONTENT**

SECTION A

UNIT I: INTRODUCTION TO TISSUE ENGINEERING **04**

The history and scope of tissue engineering Introduction, Scientific Challenges, General Scientific Issues, Social Challenges

The challenge of imitating nature Cell Technology, Construct Technology Integration into the Living System

Organization of cells into higher ordered structures Cellular Changes Involved in the EMT, Stimuli of the Transformation

UNIT II: DYNAMICS OF CELL-ECM INTERACTIONS **08**

Composition and Diversity of the ECM, Receptors for Extracellular Matrix Molecules, Cell—ECM Interactions, Signal Transduction Events during Cell—ECM Interactions, Relevance for Tissue Engineering

Matrix molecules & their ligands Fibrillar Collagens: Major Scaffold Proteins in the ECM, Elastic Fibers and Microfibrils, Fibronectin: A Multidomain, Multifunctional Adhesive ECM Glycoprotein, Laminins: Large, Adhesive Basement Membrane Molecules, Modulators of Cell-Matrix Interactions, Proteoglycans: Multifunctional ECM and Cell Surface Molecules

Inductive phenomena Epithelial to Mesenchymal Signaling in Endoderm Development, Lung Development and Instructive Signaling, Permissive Signaling during Pancreas Development

UNIT III : MORPHOGENESIS & TISSUE ENGINEERING **08**

Bone Morphogenetic Proteins, Cartilage-Derived Morphogenetic Proteins, Pleitropy and Thresholds, BMPs Bind to Extracellular Matrix, BMPs: Actions Beyond Bone, BMP Receptors, Responding Stem Cells, Morphogens and Gene Therapy, Biomimetic Biomaterials, Tissue Engineering of Bones and Joints

Cell determination & differentiation -Roles of MRFs during Embryogenesis, Initiation of Skeletal Muscle Development

Mechanical & chemical determinants of tissue development- Extracellular Matrix Structure and Function, Pattern Formation through ECM Remodeling, Mechanochemical Switching between Growth and Differentiation

UNIT IV: ANIMAL CELL CULTURE **04**

Regulation of cell behavior by matricellular proteins

Growth factors Wound Healing, Role of Basic Fibroblast Growth Factor and Angiogenesis, Other Roles of Growth Factors and Cytokines

UNIT V: TISSUE ENGINEERING BIOREACTORS **10**

Cell—Polymer Constructs, Bioreactor Technologies, Bioreactor Modulation of Tissue Formation, Bioreactor Cultivation of Functional Tissues, Tissue Engineering Bioreactors: State of the Art

Tissue assembly in microgravity Microgravity as a Novel Tissue Culture Venue, Vascularization: Overcoming Size Limitations of Tissue Assemblies, From Single Cells to Tissues in Space, *In Vitro* Embryology, Gravitational Sensing, Caveats

In vivo synthesis of tissue & organs Scale of Functional Deficit: Macromolecule versus Organ, Basic Parameters of the Living Environment during *in Vivo* Organ Synthesis, Fundamental Design Principles for Tissue and Organ Regeneration Templates, Examples of *in Vivo* Organ Synthesis

UNIT VI: ORGANOTYPIC & HISTIOTYPIC MODELS OF ENGINEERED TISSUES **06**

The Collagen Gel Model, Models of Cell Interactions in Collagen Lattices, Other Types of Epithelial—Mesenchymal Models Vascular Models, Selection of Scaffolds Other Than Gels for Model Systems, Cell Signaling and the Enrichment of Scaffolds, Goals and Uses of Model Tissue and Organ Building

Quantitative aspects of tissue engineering: Basic issues in kinetics, transport & mechanics Molecular Interactions with Cells Molecular and Cell Transport through Tissue, Cell and Tissue Mechanics

SECTION A: UNIT I, II, III

SECTION B: UNIT IV, V, VI

RECOMMENDED BOOKS

1. Principles of tissue engineering, 2nd edition by Robert Lanza & Robert Langer

- **PATTERN OF QUESTION PAPER**

The units in the syllabus shall be divided in two equal sections. Question paper shall be set having two sections A and B. Section A questions shall be set on first three units (I, II, III) and Section B questions on remaining three units (IV, V, VI) . Question paper should cover the entire syllabus.

➢ **FOR 80 MARKS PAPER**

1. Minimum ten questions

2. Five questions in each section

3. Question no 1 and 6 be made compulsory and should have at least ten bits of two marks out of which FIVE to be solved.

4. Two questions from remaining questions from each section be asked to solve having weightage of 15 marks

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THIRD YEAR ENGINEERING
SEMESTER VI

BTD 354: COMPUTATIONAL BIOLOGY

Teaching Scheme	Examination Scheme
Theory: 04 hours/week	Class Test: 20 Marks
	Examination Duration : 03 hours
	Theory Examination: 80 Marks

- **OBJECTIVES**

  Study should be able to understand the role of various computational techniques, how to use and apply them in understanding the structural and functional aspects of biomolecules.

- **COURSE CONTENTS**

SECTION A

UNIT I **06**

Introduction to Bioinformatics, Terminologies used in Bioinformatics, Scope and Goal of Bioinformatics, Overview of applications of Bioinformatics, Databases, Database Management system, Data structure, Database query language, Relational Model, Object Model, Object oriented and Relational databases, Network of databases for Entrez and SRS. Overview of Biological Databases.

UNIT II **05**

DNA sequencing, Nucleotide databases as Genbank, Dna Data Bank of Japan (DDBJ), European Molecular Biology Laboratory (EMBL), NCBI's Data model, Specialized genomic recourses as SGD, UniGene, TDB. Sequence retrieval systems such as Entrez and SRS.

UNIT III **08**

Protein structures, Levels of Protein sequence and Structural organization, Protein databases, Primary protein sequence Databases as PIR, MIPS, SWISS-PROT, TrEMBL. Composite Protein sequence databases as NRDB, OWL. Secondary databases as PROSITE, PRINTS, Blocks. Structure Classification databases as SCOP, CATH, PDB. Various analytical tools for protein Structure Visualization.

SECTION B

UNIT IV **08**

Introduction to sequence alignment, Pairwise and Multiple Sequence Alignment, Dot Plot, Needleman Wunsch Algorithm, Smith Waterman Algorithm, Local and Global Sequnce Alignment, Substitution Matrices such as PAM And BLOSUM, Calculation of alignment's

statistical significance, Importance of Identity matrixes, gaps and penalties, Heuristic methods such as FASTA, Working of FASTA and Variants, BLAST, Working of BLAST and different variants of BLAST.

UNIT V **07**

Introduction to Phylogeny, Homologes, orthologs and paralogs, Construction of a phylogenetic tree, Different types of trees as rooted and unrotted trees. Phylogenetic analysis, Methods of Phylogenetic analysis as Distance method, Application of bioinformatics in vaccine designs, Drug designing – Ligand based and Structure based, scoring function for Docking, HTS, QSAR.

UNIT VI **06**

Introduction to biotechnology Management, General introduction to management studies, Correlation of the management and biotechnology industry, Organizational management in biotechnology companies, various disciplines in management. Technology transfer management in Biotechnology.

SECTION A: UNIT I, II, III

SECTION B: UNIT IV, V, VI

- **RECOMMENDED BOOKS**

1. Introduction to Bioinformatics, by Arthur M. Lesk Oxford University Press, Oxford University Press.
2. Bioinformatics- Methods & Applications by S. C. Rastogi, N. Mandiratta, P. Rastogi.
3. Principles of management- Knoots and O. Donnell
4. Bioinformatics Sequence and Genome Analysis by David W. Mount, 2nd edition, Cold Spring Harbor Laboratory Press.
5. Bioinformatics: A practical guide to the analysis of genes and proteins A.D. Baxevanis and B.F.F. Ouellette (Eds). 2002 John Wiley and Sons.
6. Bryan Bergeron, "Bioinformatics computing", Pearson Education [BB]

- **PATTERN OF QUESTION PAPER**

The units in the syllabus shall be divided in two equal sections. Question paper shall be set having two sections A and B. Section A questions shall be set on first three units (I, II, III) and Section B questions on remaining three units (IV, V, VI) . Question paper should cover the entire syllabus.

- **FOR 80 MARKS PAPER**

1. Minimum ten questions
2. Five questions in each section

3. Question no 1 and 6 be made compulsory and should have at least ten bits of two marks out of which FIVE to be solved.

4. Two questions from remaining questions from each section be asked to solve having weightage of 15 marks

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FACULTY OF ENGINEERING AND TECHNOLOGY
THIRD YEAR ENGINEERING
SEMESTER VI

BTD 355: ENZYME ENGINEERING AND TECHNOLOGY

Teaching Scheme	Examination Scheme
Theory: 04 hours/week	Class Test: 20 Marks
	Examination Duration : 03 hours
	Theory Examination: 80 Marks

➢ OBJECTIVES

Syllabus deals with the basic concepts in enzymology including its industrial applications. They should become versed in extraction, purification, immobilization and application aspects of enzymes.

➢ COURSE CONTENTS

SECTION A

UNIT I: BASICS OF ENZYMES **06**

Enzymes : Introduction, history, classification, enzyme units, mechanism of enzyme action, mechanism of enzyme catalysis, effect of pH and ionic strength on enzyme catalysis, effect of temperature, pressure, reversible and irreversible reactions, enzyme inhibition, enzyme stability: kinetic treatment (model, half life, decimal reduction time, energy of activation and Z value) and thermodynamic treatment.

UNIT II: EXTRACTION, ISOLATION AND PURIFICATION OF ENZYMES **06**

Choice of enzyme sources, extraction of enzymes by physical and chemical methods, microbial fermentation of enzymes, screening of novel enzymes, isolation and preparation of enzymes, purification of enzymes including case studies for enzyme purification of any four industrially significant enzymes (amylase, lipase, alcohol dehyrogenase, protease).

UNIT III: APPLICATIONS OF ENZYMES **08**

Detergents, food industry, leather and wool industry, starch hydrolysis, glucose and maltose syrup, glucose from cellulose, lactase in dairy industry, enzymes in fruit juice, wine, brewing and distilleries, Glucose oxidase and catalase in food industry, medical, diagnostic and therapeutic applications of enzymes, enzymes used in animal feed, enzymes used in textile, paper and pulp industry, enzyme biosensors: calorimetric, potentiometric, amperometric, optical and piezo-electric.

SECTION B

UNIT IV: IMMOBILIZATION OF ENZYME **08**

The economic argument for immobilization, Methods of immobilization, properties of immobilized enzymes, Kinetics of immobilised enzymes, Effect of solute partition on the kinetics of immobilised enzymes, Effects of solute diffusion on the kinetics of immobilised enzymes, Analysis of diffusional effects in porous supports.

UNIT V : IMMOBILIZED ENZYME REACTORS AND APPLICATIONS OF IMMOBILIZED ENZYMES **06**

Enzyme reactors: Membrane reactors, Continuous flow reactors, Packed bed reactors, Continuous flow, stirred tank reactors, Fluidised bed reactors, Applications of immobilized enzymes

UNIT VI : RECENT ADVANCES AND FUTURE PROSPECTS IN ENZYME TECHNOLOGY **06**

Enzymic reactionsin biphasic liquid systems, stabilization of enzymes in biphasic aqueous-organic systems, equilibria in biphasic aqueous-organic systems, use of aqueous two phase systems, use of enzymes in reverse, interesterification of lipids. Whither enzyme technology, unnatural substrates, enzyme engineering, artificial enzymes, coenzyme regenerating systems, thermozymes, ribozymes, inteins: enzymes generating protein splicing

SECTION A: UNIT I, II, III

SECTION B: UNIT IV, V, VI

- **RECOMMENDED BOOKS**

1. Enzyme technology by dr. S. Shanmugam and t satishkumar i k international publishing house, new delhi, 2009,
2. Enzyme technology by m f chaplin and c. Bucke, 1990. Cambridge university press USA.

- **PATTERN OF QUESTION PAPER**

The units in the syllabus shall be divided in two equal sections. Question paper shall be set having two sections A and B. Section A questions shall be set on first three units (I, II, III) and Section B questions on remaining three units (IV, V, VI) . Question paper should cover the entire syllabus.

- **FOR 80 MARKS PAPER**

1. Minimum ten questions
2. Five questions in each section

3. Question no 1 and 6 be made compulsory and should have at least ten bits of two marks out of which FIVE to be solved.

4. Two questions from remaining questions from each section be asked to solve having weightage of 15 marks

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THIRD YEAR ENGINEERING
SEMESTER VI

BTD 371: BIOSEPARATION TECHNIQUES LAB

Teaching Scheme	Examination Scheme
Practical: 04 hours/week	Practical Examination: 04 Hours
	Practical Marks : 50 Marks

➢ LIST OF PRACTICALS

1. Adsorption on charcoal: Application in removal of unwanted dye.
2. Precipitation of proteins using Ammonium Sulphate
3. Precipitation of proteins using solvents
4. Use of blender for disruption of plant tissues
5. Use of enzyme/EDTA/Guanidine for studying cell lysis
6. Dialysis of proteins followed by concentration of proteins with dialysis bag.
7. Chromatography for separation of biomolecules
8. Use of sonicator/homogenizer for cell disruption
9. Aqueous two phase extraction.

➢ PATTERN OF PRACTICAL EXAMAMINATION

Any 8 practical's should be conducted from the above list. The practical examination shall consist of performing an experiment based on the practical work done during the course i.e. one major and one minor experiment during examination, the record of the experiments submitted by the candidate and viva-voce based on the syllabus.

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SEMESTER VI

BTD 372: RECOMBINANT DNA TECHNOLOGY LAB

Teaching Scheme	**Examination Scheme**
Practical: 04 hours/week	**Practical Examination: 04 Hours**
	Practical Marks : 50 Marks

➢ LIST OF PRACTICALS

1. DNA Amplification using PCR
2. Cloning of genomic DNA or PCR product in the host bacterium
3. Southern blotting
4. Multiporation
5. Cell fusion by chemical methods
6. Real Time PCR

➢ PATTERN OF PRACTICAL EXAMAMINATION

Any 4 practical's should be conducted from the above list. The practical examination shall consist of performing an experiment based on the practical work done during the course i.e. one major and one minor experiment during examination, the record of the experiments submitted by the candidate and viva-voce based on the syllabus.

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SEMESTER VI

BTD 373: COMPUTATIONAL BIOLOGY LAB

Teaching Scheme	Examination Scheme
Practical: 02 hours/week	Practical Examination: 04 Hours
	Practical Marks : 50 Marks

➢ LIST OF PRACTICALS

1. Study of Databases and Data retrieval:
   i. Genome Databases
   ii. Sequence Database
   iii. Secondary Databases
2. Database Similarity Search BLAST AND FASTA PROGRAMS.
3. PSI/ PHI -BLAST
4. Multiple sequences Alignment using ClustalW.
5. Phylogenetic Analysis using Clustalw and Phylip software.
6. Profile Analysis, Motif searching against Motif databases.
7. Rasmol (3D structure visualisation)
8. Protein Manipulation using SPDBV
9. Introduction to modeller
10. Homology modelling using modeller, and swiss model
11. UNIX Commands
12. Different versions of Linux

➢ PATTERN OF PRACTICAL EXAMAMINATION

Any 8 practical's should be conducted from the above list. The practical examination shall consist of performing an experiment based on the practical work done during the course i.e. one major and one minor experiment during examination, the record of the experiments submitted by the candidate and viva-voce based on the syllabus.

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THIRD YEAR ENGINEERING
SEMESTER VI

BTD 374: ENZYME ENGINEERING AND TECHNOLOGY LAB

Teaching Scheme	Examination Scheme
Practical: 04 hours/week	Practical Examination: 04 Hours
	Practical Marks : 50 Marks

➢ LIST OF PRACTICALS

1. Standard curve for proteins by Folin Lowry method using BSA as standard
2. Standard curve of reducing sugars by dinitrosalicylic acid method using glucose as a standard.
3. Standard curve for proteins by Biuret method
4. Determination of proteins concentration of given sample
5. Determination of enzyme activity of amylase/protease/alkaline phosphatase
6. Determination of specific activity of amylase/protease/alkaline phosphatase
7. Effect of pH on enzyme activity amylase/protease/alkaline phosphatase
8. Effect of temperature on enzyme activity amylase/protease/alkaline phosphatase
9. Effect of inhibitors of enzyme activity amylase/protease/alkaline phosphatase
10. Determination of Km and Vmax for an enzyme amylase/protease/alkaline phosphatase
11. Effect of substrate concentration en enzyme activity
12. Enzyme immobilization
13. Determination of temperature stability of immobilized enzyme
14. Determination of pH stability of immobilized enzyme

➢ PATTERN OF PRACTICAL EXAMAMINATION

Any 8 practical's should be conducted from the above list. The practical examination shall consist of performing an experiment based on the practical work done during the course i.e. one major and one minor experiment during examination, the record of the experiments submitted by the candidate and viva-voce based on the syllabus.

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THIRD YEAR ENGINEERING
SEMESTER VI

BTD 375 SEMINAR

Teaching scheme	**Examination pattern**
2 hrs/week	**Term Work: 50 marks**

The student will be assigned a topic in the field of Biotech Engineering or allied fields. The students are expected to search, collect and compile information (literature) on the topic assigned to them. One staff member will supervise the work of the student. Term work shall consist of a typed record, to be submitted by the student, of the work done during the term. The student will have to present a seminar on the topic in the presence of staff members and students of the concerned department. The term work will be assessed by two internal examiners appointed by the Principal of the college one of whom will be his/her supervisor & the other a staff member of the concerned branch.