

Chhattisgarh Swami Vivekanand Technical University Bhilai (C.G.)

SCHEME OF TEACHING & EXAMINATION

B.E. (VI Semester) BIOTECHNOLOGY

S. No.	Board of Study	Subject Code	Subject	Period per week			Scheme of Exam			Total Marks	Credit L+(T+P)/2
				L	T	P	ESE	CT	TA		
1	Biotechnology	318651 (18)	Bioprocess Technology	3	1	-	80	20	20	120	4
2	Biotechnology	318652 (18)	Basic Immunology	3	1	-	80	20	20	120	4
3	Biotechnology	318653 (18)	Environmental Biotechnology	3	1	-	80	20	20	120	4
4	Biotechnology	318654 (18)	Bioinformatics	3	1	-	80	20	20	120	4
5	Biotechnology	318655 (18)	Applied forensics in Biotechnology	3	1	-	80	20	20	120	4
6	<i>Refer Table I</i>		Professional Elective -I	4		-	80	20	20	120	4
7	Biotechnology	318661 (18)	Bioprocess Technology Lab	-	-	3	40	-	20	60	2
8	Biotechnology	318662 (18)	Basic Immunology Lab	-	-	3	40	-	20	60	2
9	Biotechnology	318663 (18)	Environmental Biotechnology Lab	-	-	3	40	-	20	60	2
10	Biotechnology	318664 (18)	Bioinformatics Lab	-	-	3	40	-	20	60	2
11	Management	300665 (76)	Managerial Skills	-	-	2	-	-	40	40	1
12	Biotechnology	-----	Library	-	-	1	-	-	-	-	-
Total				19	5	15	640	120	240	1000	33

L: Lecture

T: Tutorial

P: Practical

ESE: End Semester Examination

CT: Class Test

TA: Teachers' Assessment

Note: Industrial Training of eight weeks is mandatory for B.E. students. It is to be completed in two equal parts. The first part must have been completed in summer after IV semester. The second part to be completed during summer after VI semester after which students have to submit a training report which will be evaluated by college teachers during B.E. VII semester.

Table I: Professional Elective – I

S. No	Board of Studies	Subject Code	Subject
1	Biotechnology	318671 (18)	Biofertilizer and Biopesticide
2	Biotechnology	318672 (18)	Biomechanics
3	Biotechnology	318673 (18)	Marine Biotechnology
4	Biotechnology	318674 (18)	Bioprocess Plant Design
5	Biotechnology	318675 (18)	Catalyst Engineering
6	Biotechnology	318676 (18)	Fertilizer Technology

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Branch:	Biotechnology	Semester:	VI
Subject:	Bioprocess Technology	Code:	318651 (18)
Total Theory Periods:	36	Total Tutorial Periods:	12
No. of class Tests to be conducted:	2 (Minimum)	No. of Assignments to be submitted:	2 (Minimum)
ESE Duration:	Three Hours	Maximum Marks in ESE:	80
		Minimum Marks in ESE:	28

Course Objectives:

1. To impart knowledge of Bioprocess Technology for better understanding of its application in Fermentation Technology and Industrial processing.
2. To apply the practical aspects of industrial biotechnology using bioprocessing.

Course Outcome:

1. At the end of the course, the students would have learnt about fermentation processes, metabolic stoichiometry, Energetics, Kinetics of microbial growth etc.
2. This will serve as an effective course to understand certain specialized electives in Bioprocess related fields.

UNIT I History and development of fermentation industry: introduction to submerged and solid state Fermentation, production of primary and secondary metabolite.

UNIT II Raw material: availability, quality, processing and pretreatment of raw material.

UNIT III Induction of microbes and regulatory mechanisms; Nutritional repression, carbon catabolite repression; Feedback inhibition and feedback repression.

UNIT IV Protocols for developing mutant strains of microbes with the stable capacity of producing desired metabolites; Isolation and preservation of different types of mutants: induction resistant, feedback inhibition resistant.

UNIT V Fermentations of recombinant microbial cells for large-scale production of genetically engineered primary and secondary metabolites; Chromatographic separation of the products.

Text books:

1. Murray Moo -Young, Comprehensive Biotechnology, Vol. 1 & III-latest ed. 45.
2. Microbes & Fermentation, A. Lel and Kotlers Richard J. Mickey, Oriffin Publication.

Reference Books:

1. Industrial Fermentations- Leland, N. Y. Chemical Publishers.
2. Prescott and Dunn's- Industrial Microbiology, 4th ed.
3. Biotechnology Series, Rehm, Reed & Weinheim, Verlag-Chemie.
4. Biochemical Engineering, Aiba, Humphrey & Miller, Academic Press.
5. Fermentations & Enzyme Technology, Wang & Humphrey, Wiley & Inter Science.

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Branch:	Biotechnology	Semester:	VI
Subject:	Basic Immunology	Code:	318652 (18)
Total Theory Periods:	36	Total Tutorial Periods:	12
No. of class Tests to be conducted:	2 (Minimum)	No. of Assignments to be submitted:	2 (Minimum)
ESE Duration:	Three Hours	Maximum Marks in ESE:	80
		Minimum Marks in ESE:	28

Course Objectives:

1. To make the students understand the mechanism of diseases development and its management in the body.
2. To make them understand cancer development, its spread, genes responsible and importance of immune system in the body.

Course Outcome:

1. Students will be able to apply the knowledge in various serological methods as required.
2. Mechanism of disease progression may be useful in treatment suggestion and vaccine development.

UNIT I Overview of the immune system- Historical perspective, Innate and adaptive immunity, Hematopoiesis, Cells and organs of the immune system- Lymphoid cells: T cells & B cells, monocytes, phagocytes, mast cells and basophils; Primary and secondary lymphoid organs; Interplay between cells.

UNIT II Humoral immunity: B cell generation, activation and differentiation; Antigen-antibody interactions: Affinity & Avidity, Immunoglobulin's: Types, Molecular mechanism of generation of antibody diversity; Complement system, Cytokines, interferons, acute phase proteins.

UNIT III Cell mediated immunity: T cell subset and surface marker; T cell-dependent and -independent markers; T cell maturation, activation and differentiation; Structure and function of MHC; Structure and function of TCR; Cell mediated effector responses.

UNIT IV Antigens: Immunogenicity vs antigenicity; Factors that influence immunogenicity; Epitopes, Haptens, Pattern recognition receptors; Antigen processing and presentation.

UNIT V Immunodeficiency diseases: Primary immunodeficiency diseases, AIDS and other secondary immunodeficiency diseases, Treatment; Autoimmune diseases: Organ specific and systemic autoimmune diseases, Treatment of autoimmune diseases; Hypersensitivity: Gel and Coombs Classification, IgE-Mediated (Type I) Hypersensitivity, Type I, II, III and IV.

Text Books:

1. Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company
2. Immunology introduction text book, 2nded (2005), Nandini Shetty, new age international private Ltd publishers

Reference Books:

1. Fundamentals of Immunology, W. Paul, Lippincott Williams and Wilkins
2. Immunology, W.L. Anderson, Fence Creek Publishing (Blackwell).
3. Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc.
4. Roitt's Essential Immunology, 11thed (2006) Ivan. M. Roitt, blackwell publishing Ltd.
5. Kuby Immunology, R.A. Goldsby, T.J. Kindt, and B.A. Osborne, Free

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Branch:	Biotechnology	Semester:	VI
Subject:	Environmental Biotechnology	Code:	318653 (18)
Total Theory Periods:	36	Total Tutorial Periods:	12
No. of class Tests to be conducted:	2 (Minimum)	No. of Assignments to be submitted:	2 (Minimum)
ESE Duration:	Three Hours	Maximum Marks in ESE:	80
		Minimum Marks in ESE:	28

Course Objectives:

1. To make the students understand importance of pollution free environment and effects of global warming.
2. To get acquainted with various processes to improve environmental quality, cleaning up contaminated environment and generating valuable resources for human society.

Course Outcome:

1. The students will be able to use applications of this course in waste management, sewage treatment and bioremediation.
2. Having better knowledge of the environmental resource exhaustion the student will be able to spread awareness about effective conservation of available resources.

UNIT I Introduction to environment, Ecology and ecosystem; pollution and its control; pollution indicators; Environmental monitoring: bioreporter, biomarker and biosensor technology.

UNIT II Waste management: domestic, industrial, solid and hazardous wastes; biodiversity and its conservation; Clean technologies: biofertilizers, biopesticides, microbial polymer production and bio plastic technology.

UNIT III Biotechnology of sewage treatment: Overview of treatment principles: Primary, Secondary, and Tertiary; Theory of aeration, principles, operation and performance evaluation of sewage and wastewater treatment processes: Activated Sludge process, Extended Aeration, Trickling Filter, Mechanically aerated lagoons; Concepts of Waste stabilization ponds: Aquatic plant systems, Upflow anaerobic sludge blanket(UASB); Common effluent treatment plant: membrane based wastewater treatment processes.

UNIT IV Bioremediation: recovery of metals from waste water and sludge; Preliminary ideas of xenobiotic; Degradative capabilities of microorganisms with reference to toxicology, pesticides, herbicides, polyaromatic hydrocarbons, Persistent Organic Pollutants (POP); Anaerobic and aerobic composting; Biodegradation of plastics; Vermiculture, Concept of Biodiversity, Diversity indices: Bioremediation of inorganic (metal, radionuclie, petroleum, hydrocarbon dyes, nitrate, phosphate) and organic pollutants ; Phytoremediation; biomass for removal and biosorption of heavy metal and other inorganic ions; Removal of volatile organic compounds from waste gas; In situ and ex situ remediation strategies.

UNIT V Biofuels: biogas, biohydrogen, bioethahnol production; Biotechnology of mineral processing; Ethical issues in environmental biotechnology.

Text Books:

1. Environmental Biotechnology, PK Mohapatra.
2. Environmental Biotechnology, (2006) 3rded, S. N. Jogdan Himalaya Publishing House.

Reference Books:

1. Environmental Microbiology, W.D. Grant & P.E. Long, Blakie, Glassgow and London.
3. Microbial Gene Technology, H. Polasaed South Asian Publishers, New Delhi.
4. Biotreatment Systems, Vol.22, D. L. Wise ed CRC Press, INC.
5. Standard Comprehensive Biotechnology (Vol. 1-4) M.Y.YoungedPergamon Press, Oxford.
6. Methods for the Examination of Water and Waste Water 14thed (1985) American Public health Association.

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Branch: Biotechnology	Semester: VI
Subject: Bioinformatics	Code: 318654 (18)
Total Theory Periods: 36	Total Tutorial Periods: 12
No. of class Tests to be conducted: 2 (Minimum)	No. of Assignments to be submitted: 2 (Minimum)
ESE Duration: Three Hours	Maximum Marks in ESE: 80 Minimum Marks in ESE: 28

Course Objectives:

1. To impart knowledge on the fundamental concept of Bioinformatics.
2. To make students conversant with various analysis approaches in different prediction based methods of bioinformatics.

Course Outcome:

1. To gain systematic and comprehensive knowledge about the approaches to analyze biological data in a meaningful way.
2. To enhance their practical related skill to the different approaches of advance bioinformatics

UNIT I Phylogenetic analysis: Concept of trees, Different methods of phylogenetic predictions: Distance and character based; Maximum parsimony method; Maximum likelihood method, tree evaluation and interpretation, analysis software, Hidden markov models.

UNIT II Analysis using bioinformatics tools: Gene prediction: methods and tools, Identification of function of new genes; Genome annotation and RNA structure prediction: overview and methods.

UNIT III Visualization and protein prediction: Protein structure overview; Protein structure databases and visualization tools, various methods of protein structure prediction, protein function prediction, Homology modeling.

UNIT IV Computer aided drug designing: Drug discovery and pharminformatics; Target identification and validation; Docking of molecules; Drug design approaches: computer based tools for drug design; ADME property: absorption, distribution, metabolism and excretion.

UNIT V Application of Bioinformatics: Recent approaches in research and development in bioinformatics; Biosensing; Genome mapping: different types of maps, Human genome project, application of genome mapping.

Text books:

1. Bioinformatics: Principles and applications, Ghosh and Mallick, oxford university press.
2. Bioinformatics: Sequence and genome analysis, D. W, mount, Cold Spring HarborLaboratory Press.

Reference Books:

1. Bioinformatics: A practical guide to the analysis of genes and proteins, (2002), A.D. Baxevanis and B. F. F. ouellelteeds, John Wiley and sons.
2. Bioinformatics Computing, Bergeron and Bryan.
3. Introduction to bioinformatics, Attwood and Parry Smith, Pierson education Publication.
4. Fundamental concept of Bioinformatics, Dan e. krane
5. Introduction to Bioinformatics A Theoretical and Practical Approach, (2003), Stephen A. Krawetz, David D. Womble, Humana Press.
6. Data Mining in Bioinformatics, (2005), Jason T. L. Wang, Springer.
7. Data Mining: Multimedia, Soft Computing, and Bioinformatics, (2003), SushmitaMitra, TinkuAcharya, John Wiley and Sons.
8. Bioinformatics, Andreas D Boxevanis, Wiley Interscience.

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Branch:	Biotechnology	Semester:	VI
Subject:	Applied Forensics in Biotechnology	Code:	318655 (18)
Total Theory Periods:	36	Total Tutorial Periods:	12
No. of class Tests to be conducted:	2 (Minimum)	No. of Assignments to be submitted:	2 (Minimum)
ESE Duration:	Three Hours	Maximum Marks in ESE:	80
		Minimum Marks in ESE:	28

Course Objectives:

1. To develop critical thinking, problem solving skills and analysis in a stepwise fashion.
2. To develop knowledge about lab processes including spectroscopic and wet chemical methods of analysis and molecular methods.

Course Outcome:

1. Students will be able to develop an understanding for the scope of forensic science.
2. Students will be able to develop an understanding of the scientific methods employed in forensic science.

UNIT I Forensic Science: Definitions; History and development, scope of forensic science, basic principles of forensic science, tools and techniques of forensic science; Role of molecular biology and biotechnology in crime detection.

UNIT II Crime Scene Management and Investigation: Physical evidence: types and importance in a criminal investigation; Protecting a scene of crime: various steps involved, contamination issues; Recovery and preservation of samples from a crime scene: biological, toxicological, petroleum, explosives, trace items, projectiles and bullets: Collection, Packing and Forwarding of Physical and Trace evidences for analysis.

UNIT III Microscopy: Polarizing, Comparison Stereoscopic, Fluorescent and Electron Microscopes; Spectrophotometry: U. V, visible, IR atomic absorption, neutron activation analysis, X-rays, NMR.

UNIT IV Chromatographic techniques: TLC, GLC, GCMS, HPLC; Electrophoresis: High and Low voltage electrophoresis, Gel electrophoresis and Immuno electrophoresis.

UNIT V Methods of Investigation : History and development of finger print as science for personal identification, type of finger prints, classification of finger prints, latent finger print, causes of formation of latent finger prints, comparison of finger prints, ridge details; Narco analysis.

Text Books:

1. Forensic Science in India: A vision for the twenty first century Nanda, (2001), B.B. and Tewari, R.K, Select Publisher, New Delhi.
2. Forensic Science: An introduction to scientific and investigative techniques James, (2003), S.H and Nord. J.J, CRC Press,

Reference Books:

1. Ethics in Forensic Science, (2001), Barnett.
2. Introduction to Criminalistics, (1949), O'Hara & Osterburg, The MacMillan Co., 1964.
3. Osterburg: Crime Laboratory.
4. Saferstien: Forensic Science, Handbook, Vol. I, II & III, Prentice Hall Inc. USA.
5. Saferstein: Criminalistics, (1976), Prentice Hall Inc., USA.
6. Nickolas: Scientific Criminal Investigation.
7. Introduction to Criminalistics, Deforest, Gansellen & Lee.
8. Sharma, B.R: Forensic Science in Criminal Investigation and Trials, Central Law Agency, Allahabad, 1974.
9. Kirk: Criminal Investigation, (1953), Interscience Publisher Inc. New York.

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Branch: **Biotechnology**
Subject: **Bioprocess Technology Laboratory**
Total Lab Periods: **36**
Maximum Marks: **40**

Semester: **VI**
Code: **318661 (18)**
Batch Size: **15**
Minimum Marks: **20**

List of Experiments:

1. Demonstration of various bioreactors configuration, parts and integrated process control system .
2. Screening of process variables single dimensional search: Placket – Burmann Design practice .
3. Demonstration of inoculation and sampling in CSTR.
4. Production of wine from grapes.
5. Preparation and characterization of immobilized cell system.
6. Determination of volumetric mass transfer coefficient (KLa) by dynamic method and sulphite oxidation method.
7. Microbial cell growth kinetics : Growth of microorganisms , estimation of Monod parameters and temperature effect on growth estimation of energy activation .
8. Determination of pH , T.S.S (degree Brix) titrable acidity of wine .
9. Studies on biotransformation in continues flow reactor.
10. Determination of mixing time and power number.

Requirements:

1. Lab scale Anaerobic Bioreactor
2. Immobilized bioreactor Packed bed Reactor ,
3. Continuous stirred tank reactor

Recommended books:

1. An introduction to practical biotechnology 1sted (2006), S.Harisha, Laxmi Publications (P) Ltd.
2. Bioprocess engineering Principles, Pauline M Doran.
3. Fermentation Microbiology & Biotechnology 2nded, Mansi EMT , Mansi , ER bryle
4. Introduction to Biochemical Engineering (2012)D. G Rao , Tata Macgraw hill
5. PractcalBiochemiatry, David Plummer.
6. Industrial Microbiology, JayababuMudli.
7. “Modern Concept of Biotechnology” (1998),H. D Kumar, Vikas Publishing House.
8. “Comprehensive Biotechnology” (1985)Vol 3 and 4 M.M Young Pergamon Press Oxford.
9. “Advances in Biotechnology Process” (1986) Vol VI Page no 1.30, Alan R Liss.

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Branch: **Biotechnology**
Subject: **Basic Immunology Laboratory**
Total Lab Periods: **36**
Maximum Marks: **40**

Semester: **VI**
Code: **318662 (18)**
Batch Size: **15**
Minimum Marks: **20**

List of Experiments:

1. Determination of Blood groups.
2. R.B.C. counting.
3. W.B.C. counting.
4. Estimation of Blood Hemoglobin.
5. Differential Count of Blood leucocytes.
6. Widal Test.
7. Antigen–Antibody precipitation test.
8. Sensitivity of Microorganisms to antibiotics
9. Determination of concentration of penicillin G using agar diffusion (cup plate) method
10. Minimum inhibitory concentration (MIC) of penicillin G

Requirements:

1. Haemocytometer
2. Incubator
3. Refrigerator
4. Microscope
5. Micro-pipette

Recommended Books:

1. An introduction to practical biotechnology, 1sted (2006), S.Harisha, Laxmi Publications (P) Ltd.
2. Refer Books mentioned in theory syllabus.

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Branch: **Biotechnology**
Subject: **Environmental Biotechnology Laboratory**
Total Lab Periods: **36**
Maximum Marks: **40**

Semester: **VI**
Code: **318663 (18)**
Batch Size: **15**
Minimum Marks: **20**

List of Experiments:

1. Determination of total dissolved solids in water.
2. Determination of dissolved oxygen in water.
3. Determination of Biochemical Oxygen demand (BOD).
4. Determination of Chemical Oxygen demand of water (COD).
5. Determination of water hardness.
6. Determination of permanent Dissolved CO₂ in water.
7. Determination of total bacterial population by standard plate count technique.
8. MPN test for detection of water contamination (Coliform Test).
9. Detection of bacterial population in milk by SPC.
10. Detection of arsenic by microbiological method.

Requirements:

1. Evaporating Dish
2. Water Bath
3. Desiccators
4. Balance
5. Thermometer
6. Heating Mantle

Recommended Books:

1. Experiments in Microbiology, Plant Pathology and Biotechnology by K R Aneja
2. An introduction to practical biotechnology 1sted (2006), S.Harisha, Laxmi Publications (P) Ltd.
3. Refer Books mentioned in theory syllabus.

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Branch: **Biotechnology**
Subject: **Bioinformatics Laboratory**
Total Lab Periods: **36**
Maximum Marks: **40**

Semester: **VI**
Code: **318664 (18)**
Batch Size: **15**
Minimum Marks: **20**

List of Experiments:

1. Phylogenetic Analysis.
2. Gene Prediction.
3. Motif and pattern searching.
4. Secondary Structure prediction of protein.
5. Tertiary Structure Prediction of protein.
6. Homology Modeling.
7. Protein- Ligand docking.
8. Analysis Using Scoring Matrices.
9. Dynamic Programming – Smith Watermann Algorithm.
10. Dynamic programming-Needleman Wunsch Algorithm.
11. Primer design for PCR.

Requirements:

Updated software will be used as per the requirement.

Reference Books:

Refer theory books mentioned in the syllabus.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Name of Program:	Bachelor of Engineering	Semester:	VI
Branch:	Common to All Branches	Code:	300665 (76)
Subject:	Managerial Skills	Tutorial Period:	NIL
No. of Lectures:	2/Week	Marks in TA:	40
Total Marks in ESE:	NIL	Minimum number of Class Tests to be conducted:	Two

Objective:

The course is introduced to develop managerial skills tremendously and enrich the abilities to enable one to meet the challenges associated with different job levels. Managerial skills are essential for overall professional development of an individual apart from gaining technical knowledge in the subject.

Course Objectives

Upon completion of this course, the student shall be able

- To define and explain the concept of managerial, written and oral communication skill;
- To understand the leadership skill;
- To develop self-appraisal and understand distinction between leader and manager;
- To develop positive attitude and thinking; and
- To understand managerial functions and develop creativity.

UNIT I Managerial Communication Skills: Importance of Business Writing: writing business letters, memorandum, minutes, and reports- informal and formal, legal aspects of business communication, oral communication- presentation, conversation skills, negotiations, and listening skills, how to structure speech and presentation, body language.

UNIT II Managerial skills - Leadership: Characteristics of leader, how to develop leadership; ethics and values of leadership, leaders who make difference, conduct of meetings, small group communications and Brain storming, Decision making, How to make right decision, Conflicts and cooperation, Dissatisfaction: Making them productive.

UNIT III Proactive Manager: How to become the real you: The journey of self-discovery, the path of self-discovery, Assertiveness: A skill to develop, Hero or developer, Difference between manager and leader, Managerial skill check list, team development, How to teach and train, time management, Stress management, Self-assessment.

UNIT IV Attitudinal Change: Concept of attitude through example, benefits of right attitude, how to develop habit of positive thinking, what is fear? How to win it? How to win over failure? How to overcome criticism? How to become real you? How to Motivate? How to build up self confidence?

UNIT V Creativity: Creativity as a managerial skill, Trying to get a grip on creativity. Overview of Management Concepts: Function of Management: Planning, organizing, staffing, controlling.

Course Outcome

- The students will be able to develop formal and informal, negotiation, written and oral communication skill;
- The students will be able to develop manage groups, resolve conflicts and leadership skill and decision making qualities;
- The students will be able to develop self-appraisal, teaching, training and managing stress and time;
- The students will be able develop positive thinking, motivating team members and winning race; and
- The students will be able to develop creativity and fundamental management functions.

Text Books:

1. Basic Managerial Skills for all by E.H. Mc Grawth, Prentice Hall India Pvt Ltd,2006
2. Basic Employability Skills by P. B. Deshmukh, BSP Books Pvt. Ltd., Hyderabad, 2014

Reference Books:

1. How to develop a pleasing personality by Atul John Rego, Better yourself books, Mumbai,2006
2. The powerful Personality by Dr. Ujjawal Patni & Dr. Pratap Deshmukh, Fusion Books, 2006
3. How to Success by Brian Adams, Better Yourself books, Mumbai, 1969

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Branch:	Biotechnology	Semester:	VI
Subject:	Biofertilizer and Biopesticide (Professional Elective – I)	Code:	318671 (18)
Total Theory Periods:	48	Total Tutorial Periods:	NIL
No. of class Tests to be conducted:	2 (Minimum)	No. of Assignments to be submitted:	2 (Minimum)
ESE Duration:	Three Hours	Maximum Marks in ESE:	80
		Minimum Marks in ESE:	28

Course Objectives:

1. To impart the knowledge about microbes useful in agriculture.
2. To make them understand their advantages.

Course Outcome:

1. The course will help the students to apply the knowledge in a better way in agriculture.
2. The course will enable the students to spread awareness amongst the farmers regarding biofertilizers and biopesticides.

UNIT I Introduction and scope, biofertilizers: classification, characteristics, role and mode of action; Crop specificity, advantages and limitations, types of biofertilizer formulation.

UNIT II Biofertilizer production technology: carrier based bacterial biofertilizers, liquid biofertilizers, BGA, Azolla and Trichoderma, Mycorrhiza.

UNIT III Quality measurement standards and analysis: quality specification; Tolerance limits; Method analysis under FCO.

UNIT IV Biopesticides: Introduction; Diseases; Isolation, identification, purification and pure culturing of recognized biopesticide organisms with commercial potential for crop disease management and growth promotion; Different types of biopesticide formulation and their efficacy under field level, Processing, formulation and quality testing of biocontrol agents.

UNIT V Application, practical recommendations, economics Different methods of application of various biopesticide agents in different cropping systems and soil condition: Pseudomonas spp., Bacillus spp., Trichoderma spp. and Actinomycetes.

Text books:

1. Biofertilizer handbook- research- production- application, (2012) Dr. P Bhattacharyya and Dr. HLS Tandon, FDCO.
2. Formulation of Microbial Biopesticides, (1998), Burges H.D, Kluwer Academic Publishers, Dordrecht

Reference books:

1. Biofertilizers marketing system in India (1992) Dr. HLS Tandon, FDCO.
2. Methods of analysis of soils, plants, waters, fertilizers and organic manures (2009) Dr. HLS Tandon, 2nd revised & enlarged edition, FDCO.
3. Biofertilizers and organic fertilizers- a sourcebook-cum-directory, (2011) Dr. HLS Tandon, FDCO.
4. Biological Control of Plant Pathogens (1974), Baker, K.F and Cook. R. J, Freeman.W.H. Francisco.
5. Insect Pathology (1993), Tanada, Y and Kayes, H.K., Academic Press Inc. New York.
6. Developments in the Biological Control of Soil Borne Plant pathogens, (1977), Whilips, S.M.

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Branch:	Biotechnology	Semester:	VI
Subject:	Biomechanics	Code:	318672 (18)
	(Professional Elective – I)		
Total Theory Periods:	48	Total Tutorial Periods:	NIL
No. of class Tests to be conducted:	2 (Minimum)	No. of Assignments to be submitted:	2 (Minimum)
ESE Duration:	Three Hours	Maximum Marks in ESE:	80
		Minimum Marks in ESE:	28

Course Objectives:

1. To make the students understand about biomechanics that provides background in musculoskeletal anatomy and principles of biomechanics.
2. To make them learn the applications of biomechanics for the welfare of human s.

Course Outcome:

1. The students will be able to apply the principles of biomechanics in therapeutic way.
2. Knowledge of the subject will enable the students to design improved prosthetics.

UNIT I Definition; Introduction, Mechanics, force, momentum, friction, gravity, equilibrium, levers, elasticity (stress, strain, Hooke's law), springs, Newton's laws, work energy.

UNIT II Structure, function and adaptations of major tissues and organs: bones, cartilage, ligaments, tendons, muscles, skin, heart, blood vessels, lung, liver, kidney and intestine.

UNIT III Static and dynamic cell processes, mechanics of biomembranes, mechano-transduction, fluid mechanics (Bernoulli's theorem: blood flow in blood vessels, gas flow in lungs), Stoke's law, Mass of conservation and continuity equation, incompressible Flow, Newtonian and Non-Newtonian fluids, transport of fluids.

UNIT IV Biomechanics of implants: design of orthopedic implants, specifications for prosthetic joints, biocompatibility, requirement of a biomaterial, characteristics of different types of biomaterials, manufacturing process of implants, fixation of implants.

UNIT V Applications: sports and exercise therapy (crutch walking, hydrostatics, hydrodynamics), physiotherapy, biomedical area, therapeutic interaction with different physiological systems.

Text Books:

1. Biomechanics- Principles and Applications, 2nded (2005), D. J. Schneck and J. D. Bronzino, CRC Press.
2. Biomechanics: Mechanical Properties of Living Tissues, 2nd ed, (1993), Fung.

Reference Books:

1. Fundamentals of Orthopedic Biomechanics, Burstein and Wright.
2. Basic Biomechanics of the Musculoskeletal System, Nordin & Frankel.
3. Cardiovascular Biomechanics, Chandran.
4. Clinical Kinesiology for Physical Therapy, (1996) Lippert, Lynn, Jaypee New Delhi.
5. Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation, 2nd ed (1999) Ozkaya and Nordin, Springer-Verlag.
6. Medical instrumentation –Application & design, 3rd ed. (2003). J. G Webster, John Wiley and sons Inc.
7. Aquatic Exercise Therapy (1996) Bates, Andrea and Hanson, Norm, W.B.Saunders, Philadelphia.

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Branch:	Biotechnology	Semester:	VI
Subject:	Marine Biotechnology (Professional Elective – I)	Code:	318673 (18)
Total Theory Periods:	48	Total Tutorial Periods:	NIL
No. of class Tests to be conducted:	2 (Minimum)	No. of Assignments to be submitted:	2 (Minimum)
ESE Duration:	Three Hours	Maximum Marks in ESE:	80
		Minimum Marks in ESE:	28

Course Objectives:

1. To familiarize the students about marine environment and the habitants.
2. To enable them to optimize appropriate exploitation in favour of human welfare.

Course Outcome:

1. Knowledge of the aquatic flora and fauna will enable the students to develop innovative products beneficial for the society and also analyze the pollution hazards and effective prevention as well as control.
2. Better knowledge of the climate and environmental conditions of different regions will enable the students to plan appropriate data for maximum utilization of the resources with minimum loss.

UNIT I Introduction to marine environment: physical and chemical properties of ocean, composition of sea water, law of sea; Marine Flora-Phytoplankton, seaweeds, sea grasses and mangroves, Marine fauna–Zooplankton; Major marine invertebrates (crustaceans & molluscs); Vertebrates (Pisces) and marine mammals (dolphin and whales): characteristics and identification.

UNIT II Marine microbes: Bacteria, fungi, algae, protozoa and viruses; Biology of micro-organisms, their biotechnological importance, Microbial nitrogen fixation; Carbon, nitrogen and phosphorus cycle; Decomposition of organic matter; Bioleaching and biodeterioration of natural and synthetic materials.

UNIT III Medicinal compounds from marine flora and fauna: marine toxins, antiviral and antimicrobial agents, primary and secondary metabolites produced by microbes (enzymes, antibiotics, organic acid, toxins etc).

UNIT IV Biological indicators, pollution indicators: Prevention and control: Application in protein biomarkers, biosensors and biochips; Bioremediation, BOD, COD, bioaugmentation: estimation of microbial load, removal of pollutants, inorganic and organic wastes; Biofouling; Biofilm formation and corrosion (causes and prevention).

UNIT V Remote sensing, culture of live plant feed and animal feed Commercial importance of marine flora and fauna (cosmetics, pharmacology, food etc).

Text Books:

1. Marine Biotechnology (1993) Volume 1, 2, 3, David H. Attway & Oskar R. Zabolosky, Plenum Press.
2. Recent advances in Marine Biotechnology (2000) Fingerman M., Science Publishers.

Reference: Books:

1. Marine Biology: Function, biodiversity, ecology (2001), Jeffrey S. Levinton, CD (515pp) with cd-rom".
2. Microbiology 5thed (1993), Pelczar MJ Jr., Chan ECS and Kreig NR, Tata McGraw Hill.
3. Aquaculture, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Recent Advances in Marine Biotechnology (1999) Volume 3, Milton Fingerman *et al.*,
5. Biotechnology, Recombinant DNA Technology, Environmental Biotechnology (2003) S. Mahesh *et al.*,
6. Marine. Natural Products, (1978) Volume 1 & 2 P.J. Scheuer, Volume (1980-81) Academic Press.
7. Biodegradation and detoxification of Environmental pollutants (1928) A.M. Chakravarthy CRC Press.
8. Marine Pollution (1976) Johnston R. ed Academic Press.
9. Pollution and Biological resources of the Oceans (1982) Patin S.A, Butterworth & Co. Ltd.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch:	Biotechnology	Semester:	VI
Subject:	Bioprocess Plant Design (Professional Elective – I)	Code:	318674 (18)
Total Theory Periods:	48	Total Tutorial Periods:	NIL
No. of class Tests to be conducted:	2 (Minimum)	No. of Assignments to be submitted:	2 (Minimum)
ESE Duration:	Three Hours	Maximum Marks in ESE:	80
		Minimum Marks in ESE:	28

Course Objective:

1. The purpose of this course is to study about the plant designing.
2. The aim of the course is to improve knowledge about the design of double pipe heat exchanger, shell and tube heat exchanger, cylindrical and spherical vessels and tall vertical vessels.

Course Outcome:

1. After undergoing this course the students will understand about the design of double pipe heat exchanger, shell and tube heat exchanger, cylindrical and spherical vessels and tall vertical vessels.
2. The students will be able to apply the knowledge in bioprocess industry.

UNIT I Review of mass and energy balance concepts: Development of the flow sheet and its description, Piping and instrumentation diagrams.

UNIT II Conceptual design of: Double pipe heat exchanger, shell and tube heat exchanger.

UNIT III Conceptual design of distillation columns: sieve tray type, bubble cap type.

UNIT IV Conceptual design of cylindrical and spherical vessels: For internal and external pressures, Heads and closures, Storage tanks.

UNIT V Conceptual design of tall vertical vessels: Selection of fluid moving machinery, Design aspects aimed at maintaining aseptic conditions, Bioprocess validation.

Text Books:

1. Process Equipment Design “D.Q. Kern”.
2. Introduction to chemical equipment design “B.C Bhattacharya”.

Reference Books:

1. Process Plant Design “Richardson and Coulson Vol 6”.
2. Conceptual Design of Chemical Process “J. M. Douglas”.
3. Process Plant Design “Backhurst and Harker”.
4. Mass Transfer Equipment Design data Book.
5. Chemical Equipment Design “Earnest E. Ludwig”.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch:	Biotechnology	Semester:	VI
Subject:	Catalyst Engineering (Professional Elective – I)	Code:	318675 (18)
Total Theory Periods:	48	Total Tutorial Periods:	NIL
No. of class Tests to be conducted:	2 (Minimum)	No. of Assignments to be submitted:	2 (Minimum)
ESE Duration:	Three Hours	Maximum Marks in ESE:	80
		Minimum Marks in ESE:	28

Course Objective:

1. The purpose of this course is to improve knowledge about the catalysts.
2. The aim of the course is to study the properties of catalysts, kinetics of enzyme catalyzed reactions and factors affecting the efficiency of enzyme as catalyst.

Course Outcome:

1. The students will be able to apply the knowledge of enzymes and catalysts in biochemical processes.
2. At the end of the course the students will have clear understanding of enzyme kinetics, catalyst effectiveness and application of enzymes.

UNIT I Fundamental Aspects of Catalysis: Homogeneous and heterogeneous catalysis, Adsorption, Biocatalysis, Definition and properties of catalysts, Kinetics of catalyzed reactions, Steps in catalysis, Rate law, Mechanism, Limiting steps, Classification of catalysts, Catalyst preparation, Promoters, Inhibitors, Deactivation of catalysts, Mechanism of Rate Equation, Rate Equation from experiments.

UNIT II Catalyst Effectiveness: Thiele Modulus, Impact of reactor type and Catalyst performance on yield and selectivity, Systematic strategies for reactor and catalyst selection, Structured systems, Design of reactors for gas-solid reactions, Solid Catalysts-Determination of surface area, Void volume, Solid density, Pore volume and pore distribution, Solid Catalyzed Reactions: Rate Equation, Controlling resistance Phenomenon, Experimental methods for finding rates.

UNIT III Enzyme as Biological Catalyst: Classification, Nomenclature, Enzyme assay, Specific activity, Enzyme activity units, Kinetics of Enzyme catalyzed reactions, Enzyme-substrate complex and enzyme action, Single enzyme kinetics, Step rate constants, Modulation and regulation of enzymatic activity, Enzyme deactivation.

UNIT IV Factors affecting the efficiency of enzyme as catalyst: Proximity and Orientation Covalent analysis, Acid base catalysis, Specificity, Broad Specificity, Intermediate specificity, Stereo specificity.

UNIT V Applied enzyme catalysts: Application of hydrolytic enzymes, Immobilized enzyme technology, Immobilized enzyme kinetics.

Text Books:

1. Chemical Reaction Engg. "H.ScottFogler".
2. Chemical Reaction Kinetics "J.M. Smith".

Reference Books:

1. Chemical Reaction Engg. "Octave Levenspiel".
2. Bio Chemical Engg. "BalleyOllise"
3. Biochemistry "Lehninger A.L".

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Branch:	Biotechnology	Semester:	VI
Subject:	Fertilizer Technology (Professional Elective – I)	Code:	318676 (18)
Total Theory Periods:	48	Total Tutorial Periods:	NIL
No. of class Tests to be conducted:	2 (Minimum)	No. of Assignments to be submitted:	2 (Minimum)
ESE Duration:	Three Hours	Maximum Marks in ESE:	80
		Minimum Marks in ESE:	28

Course Objective:

1. To impart the knowledge of the chemical fertilizer production processes and recent technological development.
2. To make the students learn about various raw materials, products and their environmental effects.

Course Outcome:

1. The students will become aware of related environmental hazards and control.
2. The course will enable students to execute usage of organic fertilizers.

- UNIT I** Nitrogenous Fertilizers: Manufacture of Ammonia; Nitric acid; Ammonium sulphate; Ammonium nitrate; Urea, Case study of selected fertilizer plants with environmental aspects.
- UNIT II** Phosphatic Fertilizers: Manufacture of Phosphoric acid; Single superphosphate; Triple superphosphate; Ammonium phosphate; Nitro phosphate, Case study of selected fertilizer plants with environmental aspects.
- UNIT III** Miscellaneous Fertilizers: Bio-fertilizers, Liquid fertilizers, Complex fertilizers, NPK fertilizer, Mixed fertilizer, Case study of selected fertilizer plants with environmental aspects.
- UNIT IV** Agrochemical Industries: Pesticides, Insecticides, Rodenticides, Fungicides, Herbicides, Manufacture of DDT, Manufacture of BHC, Plant nutrients.
- UNIT V** Manure: Classification of manure (Vermicompost, Farmyard manure, Sheep and Goat manure, Poultry manure, Green manure), Role of organic manure, Advantages and disadvantages of organic manure.

Text Books:

1. "Outlines of Chemical Technology" Gopala Rao M. and Marshall S, East-West Press Pvt. Ltd.
2. "Shreve's Chemical Process Industries" Austin, G.T, McGraw-Hill Book Co.

Reference Book:

1. "A Text Book of Chemical Technology", Pandey G. N, Volume – I, Vikas Publishing House Pvt. Ltd.