Chhattisgarh Swami Vivekananda Technical University, Newai

Name of the Program: Bachelor of Technology

Semester: B.Tech – 5th **Branch: Biotechnology**

Subject: Entrepreneurship & Startups **Course Code: C018511(018)**

Total Marks in End Semester Exam: 100 **L: 3 T: 1 P: 0 Credits: 4**

Minimum number of Class Tests: 2

Course Objective(s):

- Acquiring Entrepreneurial spirit and resourcefulness.
- Familiarization with various uses of human resource for earning dignified means of living.
- Understanding the concept and process of bioentrepreneurship - its contribution and role in the growth and development of individuals and the nation.
- Acquiring entrepreneurial quality, competency, and motivation.
- Learning the process and skills of creation and management of entrepreneurial venture.

UNIT-I Introduction to Entrepreneurship and Start – Ups

- Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation
- Types of Business Structures, Similarities/differences between entrepreneurs and managers.
- Bioentrepreneurship; Building of a Bioentrepreneur; Indicators of Bio entrepreneurship.

UNIT-II Components of a Biotech company

- History of establishment of pioneer biotechnology companies, key for success.
- Mission and Strategy; Paths for starting new Biotech ventures.
- Product selection for new Biotech venture; Successful Bioentrepreneur in India.

UNIT-III Biotech Business Models and Management

- Vertical model, Product Model, Platform Business Model, Hybrid Model, Service Business Model from Genomics based companies.
- Company's Organization Structure,
- Recruitment and management of talent.
- Financial organization and management

UNIT-IV Business Plan

- General considerations: Business plan - Do's and don'ts.
- How to write Business proposal, Checklist for Business proposal writing.
- Deficiencies in startup Business Plan.

UNIT-V Business Strategies and Technology Transfer

- Intellectual property in biotech: Licensing, Accessing University technology.
- Licensing of Biotechnological invention, funding agencies in India

Text Books:

1. Entrepreneurship and Business of Biotechnology, (2007) S. N. Jogdand, Himalaya Publishing Home.
2. Entrepreneurship and Small Business Management, (1996) C. B. Gupta and S. S. Khanka.

Reference Books:

1. The coming biotech age: The business of biomaterials (2000) R Oliver, New York: McGraw Hill.
2. Bioethics, (2008) S. Shaleesha. Wisdom educational service, Chennai

Websites:

1. https://www.fundable.com/learn/resources/guides/startup
2. https://corporatefinanceinstitute.com/resources/knowledge/finance/corporatestructure/
3. https://www.finder.com/small-business-finance-tips
4. https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-yourbusiness/

Course Outcome:

After completion of course, student should be able to

- Understand the dynamic role of bio entrepreneurship and small businesses.
- Understand the Business Plan Creation.

Chhattisgarh Swami Vivekananda Technical University, Newai

Name of the Program: Bachelor of Technology

Semester: B.Tech – 5th **Branch: Biotechnology**
Subject: Metabolic Engineering **Course Code: C018512(018)**
Total Marks in End Semester Exam: 100 **L: 3 T: 1 P: 0 Credits: 4**
Minimum number of Class Tests: 2

Course Objective(s):

- The course will provide an overview of the basic concepts and experimental techniques used in metabolic engineering and its applications.
- The students will learn that how complex regulatory mechanisms at multiple levels control the dynamics of the cellular metabolism.
- The course will also cover examples of successful engineering strategies.
- Used for the production of commercially important primary and secondary metabolites or recombinant proteins.
- They will also appreciate the vast industrial applications of metabolic engineering in the field of medicine, energy, and environment.

UNIT-I Introduction to metabolic engineering and its importance

- Introduction to metabolism, catabolism, anabolism, Key differences between metabolic controls of prokaryotes and eukaryotes.
- Stoichiometry of cellular reactions, enzyme kinetics, reaction rates, dynamic mass balance, yield coefficients and linear rate equations.
- The black box model, elementary balance, heat balance different models for cellular Reactions-Induction-Jacob Monod Model and its regulation,
- Differential regulation by isoenzymes, concerted or cumulative feedback regulation.
- Regulation in branched pathways, permeability and transport of metabolites.

UNIT-II Metabolic flux analysis:

- Building stoichiometric matrix; Steady state and pseudo steady state assumptions.
- Using different optimizing functions to solve linear programming problem.
- Understanding fluxcone and constraints.
- Introducing additional constraints from thermodynamics.

UNIT-III Experimental determination of metabolic fluxes

- C13 labeling, NMR and GC-MS based methods for flux determination.

UNIT-IV Computational modeling of biological networks

- Introduction to MATLAB. Synthetic circuit design, metabolic flux analysis.
- MOMA(Minimization of Metabolic Adjustment).
- iFBA (Integrated Flux Balance Analysis).
- dFBA; Enhancement of product yield and productivity.

UNIT-V Industrial applications

- Pathway engineering strategies for overproduction of some commercially important primary and secondary metabolites (e.g. amino acids, organic acids, alcohols and therapeutic compounds)
- Industrially relevant enzymes and recombinant proteins.
- Bioconversion- applications and factors affecting bioconversion, mixed or sequential bioconversions.
- Regulation of enzyme production, strain selection and improvement, the modification of existing or the introduction of entirely new metabolic pathways.

Text Books:

1. Metabolic Engineering: Principles and Methodologies by Gregory N. Stephanopoulus, Aristos A. Aristidou, and Jens Nielsen.
2. Pathway Analysis and Optimization in Metabolic Engineering by Néstor V. Torres and Eberhard O. Voit.

Reference Books:

1. The Metabolic Pathway Engineering Handbook by Christina D. Smolke.
2. Biochemical Engineering by Harvey W. Blanch and Douglas S. Clark.

Course Outcome:

After completion of course, student should be able to

- Learn and systematically analyze the complexities defining the regulation of various metabolic pathways.
- Design and learn strain-engineering strategies to alter cellular behavior, metabolic flux, and product formation.

Chhattisgarh Swami Vivekananda Technical University, Newai

Name of the Program: Bachelor of Technology

Semester: B.Tech – 5th **Branch: Biotechnology**

Subject: Analytical Techniques **Course Code: C018513(018)**

Total Marks in End Semester Exam: 100 **L: 3 T: 1 P: 0 Credits: 4**

Minimum number of Class Tests: 2

Course Objective(s):

- To learn different modern analytical techniques used in biotechnology.
- This subject is to provide a strong basis of Analytical Techniques.
- It also helps for assurance of quality, safety and efficacy of drugs, pharmaceuticals and of any compound.
- An overview of the instruments used in isolation and separation of molecules.
- To provide scientific understanding of analytical techniques and detail interpretationof results.

UNIT-I Microscopy

- Light spectroscopy and Microscopy-Absorption, IR, Scattering (Raman and Rayleigh).
- Resonance Raman, Fluorescence (steady-state and time resolved), confocal microscopy.
- Multi-photon microscopy, Atomic Force Microscopy.

UNIT-II Chromatography

- Chromatography-Ion-Exchange, Affinity.
- Hydrophobic, Size exclusion.
- FPLC, HPLC, GC.

UNIT-III Centrifugation and Electrophoresis Techniques

- Ultracentrifugation – Principle and types.
- Electrophoresis- Principles, methodology and types, 1D & 2D Gels; Pulse- Field Gel Electrophoresis(PFGE); Capillary electrophoresis; Gradient gel electrophoresis; Polyacrylamide Gel Electrophoresis (PAGE).
- Western blotting; Southern blotting; Northern blotting

UNIT-IV Colorimetry and Spectrophotometry

- Solution- and solid-state NMR spectroscopy, X-ray crystallography.
- Massspectroscopy-MALDI, LC-MS, GC-MS, MS-MS.
- Calorimetry- Basic Principle.

UNIT-V Genomics and Proteomics

- MALDI-Mass imaging, Proteomics, MS and NMR based Metabolomics.
- DNA and RNA sequencing for genomics,
- PCR for transcriptomic, Real time PCR, Droplet PCR.
- Surface Plasmon Resonance (SPR), Bio-layer interferometry (BLI), High content screening.

Text Books:

1. Biophysical Chemistry, Vol II by Charles R. Canter and Paul R. Shimmel.
2. Protein Purification: Principles and Practice by Robert K. Scopes (Narosa).
3. Principles of Fluorescence Spectroscopy by Joseph R. Lakowicz.

Reference Books:

1. Raman Spectroscopy for Chemical Analysis by RICHARD L. McCREERY
2. Mass Spectrometry Basics by Christopher G. Herbert and Robert W. Johnstone.
3. Chromatographic methods by A Braithwaite and F. J. Smith (Kluwer Academic Publishers).

Course Outcome:

After completion of course, student should be able to

- Understand and apply modern analytical techniques used in biotechnology.
- Understand the working of instruments as well as for the development of new technologies.

Chhattisgarh Swami Vivekananda Technical University, Newai

Name of the Program: Bachelor of Technology

Semester: B.Tech – 5th **Branch: Biotechnology**

Subject: Biosafety and Bioethics **Course Code: C018514(018)**

Total Marks in End Semester Exam: 100 **L: 2 T: 1 P: 0 Credits: 3**

Minimum number of Class Tests: 2

Course Objective(s):

- To make the students understand the regulations in biosafety in different committees.
- To make them learn about the biosafety procedures and protocols and to learn about the ethics and its socioeconomic impacts of biotechnology.
- To understand the laws governing biotechnology and related field at national and international level.
- To gain knowledge about safety precautions necessary during biotechnological work.
- To understand the ethical perspective of handling biomaterials

UNIT-I Biotechnology and Society

- Biotechnology and society Introduction to science, technology and society, issues of access-Case studies/experiences from developing and developed countries.
- Ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs. private funding, biotechnology in international relations, globalization and development divide.
- Public acceptance issues for biotechnology: Biotechnology and hunger: Challenges for the Indian Biotechnological research and industries

UNIT-II Definition and concept of property rights

- History and evaluation of IPR: duties and their correlations like: patent design and copy right.
- Distinction among the various forms of IPR, requirements of a patentable invention like novelty, inventive step and prior art and state of art.
- Special procedures for r-DNA based product production, TRIPS, international convention, patents and methods for patent application.

UNIT-III Rules and regulations

- Regulations on ethical principles in biotechnological practice: The Nuremberg code, the Belmont report, co-operational guidelines.
- WHO, guidelines of DBT (India), Guidelines of an informed consent.
- Public acceptance issues in biotechnology: issue of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability and public verses private funding.

UNIT-IV Biosafety in laboratory

- **L**aboratory associated infections and other hazards, assessment of biological hazards and level of biosafety practices in the laboratory.
- Biosafety regulations and national and inter-national guideline regarding r-DNA.
- Experimental protocol approval, environmental aspects of biotechnological application; Biosafety: classification and description of biosafety levels; Design of clean rooms and biosafety labs.
- Biosafety regulations to protect nature; Growers and consumers interest and nation interest; Potential risk from genetically modified organisms; Ethical issues in research and case studies.

UNIT-V National and International Regulation

- International dimensions in biosafety, Catagena Protocol in biosafety, bioterrorism and inventions of biological weapons.
- Good manufacturing practice and Good lab practices (GMP and GLP). National and international regulations for food and pharma products.

Text Books:

1. Biotechnology & Safety Assessment, 3rded (2002), Thomas, J. A, fuch, R. L, Academic Press.
2. Biological safety Principles & practices, 3rded (2000) Fleming, D. A. Hunt, D.L. ASM ton.

Reference Books:

1. Biotechnology –A comprehensive treatise (Vol 12) Legal economic &dinonsions VCH.
2. Encylopedia of Bioethics.
3. Intellectual property rights on Biotechnology, K.Singh, BCIL, New Delhi.

Course Outcome:

After completion of course, student should be able to

- Students would have had acquired knowledge and skills on biopolicy, ethics and safety issues.
- Students will have the knowledge of overviews of intellectual property and ethical considerations for research and developments of products.

Chhattisgarh Swami Vivekananda Technical University, Newai

Name of the Program: Bachelor of Technology

Semester: B.Tech – 5th **Branch: Biotechnology**

Subject: Genome Editing **Course Code: C018532(018)**

Total Marks in End Semester Exam: 100 **L: 2 T: 0 P:0 Credits: 2**

Minimum number of Class Tests: 2

Course Objective(s):

- The course will provide the technical details and applications ofmodern tools for precision gene targeting and editing.
- The courses will provide information about targeted gene silencing.
- They will learn the risk, safety, and ethics of gene editing tools.

UNIT-I Overview of traditional method

- Overview of traditional methods: homologues recombination for gene knockout.
- RNAi system, Cre-LoxP and Flp-FRT systems.

UNIT-II Engineered enzyme systems

- Engineered enzyme systems: Zinc finger nucleases (ZFNs), transcription-activator like effector nucleases (TALEN).
- Meganucleases and the clustered regularly interspaced short palindromic repeats (CRISPR/Cas9) system.
- Design of sgRNA. Multiplex Automated Genomic Engineering(MAGE).

UNIT-III Gene Editing

- Applications in Targeted gene mutation.
- Gene therapy, creating chromosome rearrangement.
- Study gene function with stem cells, transgenic animals.

UNIT-IV Gene Labeling

- Endogenous gene labeling
- Targeted transgene addition, GM plants.

UNIT-V Biofuel and Bioremediation

- Application is biofuel productionand in bioremediation.
- Ethics, safety and risk of targeted gene editing.

Text Books:

1. CRISPR Gene Editing, Methods and Protocols, Editors: Luo, Yonglun (Ed.)
2. Genome Editing and Engineering, From TALENs, ZFNs and CRISPRs to Molecular Surgery. Edited by Krishnarao Appasani.

Reference Books:

1. Progress in Molecular Biology and Translational Science Vol. 149-Genome Editing in Plants. Edited by Donald P. Weeks and Bing Yang. Academic Press.
2. Precision Medicine, CRISPR, and Genome Engineering, Moving from Association to Biology and Therapeutics, Editors: Tsang, Stephen H. (Ed.).

Course Outcome:

After completion of course, student should be able to

- Learn and systematically analyze technical details of precise gene-editing tools.
- The vast applications of gene editing in the field of medicine, agriculture, and the environment.

Chhattisgarh Swami Vivekananda Technical University, Newai

Name of the Program: Bachelor of Technology

Semester: B.Tech – 5th **Branch: Biotechnology**

Subject: Biosimilars Technology **Course Code: C018533(018)**

Total Marks in End Semester Exam: 100 **L: 2 T:0 P:0 Credits: 2**

Minimum number of Class Tests: 2

Course Objective(s):

- To introduce students about the design and development of different kinds of biologics, biomimetics, and biosimilars.
- Students will learn different biotechnological applications.
- The course will introduce the regulatory framework about the Biosimilars.

UNIT-I Introduction to Biopharma

- Generics in Biopharma, definition of biologics, biosimilars, super biologics.
- Differences between chemical genetics and biosimilars, the developmental and regulatory challenges in biosimilar development.
- Prerequisites for Biosimilar development, Biosimilar market potential.

UNIT-II Types of Biosimilar Drugs

- Peptides, proteins, antibodies, Enzymes, Vaccines.
- Nucleic acid based therapies (DNA, RNA, etc).
- Cell based therapies (including stem cells).

UNIT-III Characterization methods

- Aggregation- precipitation, floccule strength, precipitate ageing & kinetics, adsorption of proteins & peptides on surfaces.
- Effect of temperature on protein structure, hydration & thermal stability of proteins - solid powders, suspension on non-aqueous solvents, reversed micelles, aqueous solution of polyols.
- Analytical and spectrophotometric characterization of proteins.
- Protein sequencing and structure determination.

UNIT-IV Bioequivalence studies

- Immunogenicity & allergenicity of biosimilars; factors affecting immunogenicity - structural, post-translational modifications, formulations, impurities, manufacturing and formulation methods for biosimilars.
- Types of bioequivalence (average, population, individual), experimental designs & statistical considerations for bioequivalence studies (Non-replicated designs – General Linear Model, Replicated crossover designs).
- Introduction to “ORANGE BOOK” & “PURPLE BOOK”.

UNIT-V Case Studies

- Indian companies working in this space & their product pipeline (Biocon, Intas, DrReddy’s, Reliance, Bharat Biotech, Lupin, Cipla, Shanta, etc).
- Products - Erythropoietin, growth hormone, granulocyte stimulating factors, interferons, streptokinase, monoclonal antibodies.

Text Books:

1. Laszlo Endrenyi, Paul Declerck and Shein-Chung Chow, Biosimilar Drug Development, Drugs and Pharmaceutical Sciences, Vol 216, CRC Press.
2. Cheng Liu and K. John Morrow Jr., Biosimilars of Monoclonal Antibodies: A Practical Guide to Manufacturing, Preclinical and Clinical Development, Wiley, Dec 2016.

Reference Books:

1. https://www.drugs.com/medical-answers/many-biosimilars-approved-unitedstates-3463281/.

Course Outcome:

After completion of course, student should be able to

- Perspective of the complexity to establish biosimilarity of therapeutic proteins and biologics.
- Understand and evaluate biosimilars from a health economics and outcomes research lens.

Chhattisgarh Swami Vivekananda Technical University, Newai

Name of the Program: Bachelor of Technology

Semester: B.Tech – 5th **Branch: Biotechnology**

Subject: Marine Biotechnology **Course Code: C018531(018)**

Total Marks in End Semester Exam: 100 **L: 2 T:0 P:0 Credits: 2**

Minimum number of Class Tests: 2

Course Objective(s):

- To familiarize the students about marine environment and the habitants.
- To enable them to optimize appropriate exploitation in favour of human welfare.
- The subject deals with the scope and application of marine biota in biotechnology.

UNIT-I Introduction to Marine Environment

- 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

- 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 biodeteroriation of natural and synthetic materials.

UNIT-III Medicinal Compounds

- 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).
- GFP, RFP characteristics and their applications; Green mussel adhesive protein, Chitosan and its applications.

UNIT-IV Indicators

- 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 Application of Marine Biotechnology

- Remote sensing, culture of live plant feed and animal feed.
- Commercial importance of marine flora and fauna (cosmetics, pharmacology, food etc).
- Probiotic bacteria and their importance in aquaculture.
- Vaccines in aquaculture: Fish, shrimps & prawns.
- Quality control; Techniques for identification of bacterial & viral pathogens in aquaculture and Remedies.

Text Books:

1. Marine Biotechnology (1993) Volume 1, 2, 3, David H.Attway& Oskar R.Zabosky, Plenum Press.
2. Recent advances in Marine Biotechnology (2000) Fingerman M., Science Publishers.
3. Text book of Marine Ecology (1989). Nair N.B. &Thampy, D.M.

Reference Books:

1. Marine Biology: Function, biodiversity, ecology (2001), Jeffrey S. Levinton, CD (515pp) with cd-rom".
2. Recent Advances in Marine Biotechnology (1999) Volume 3, Milton fingerman et al.
3. Marine. Natural Products, (1978) Volume 1 & 2 P.J.Scheuer, Volume (1980-81) Academic Press.

Course Outcome:

After completion of course, student should be able to

- 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.
- 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.

Chhattisgarh Swami Vivekanand Technical University, Newai

Name of the Program: Bachelor of Technology
Semester: B.Tech – 5th **Branch: Biotechnology**
Subject: Bioentrepreneurship and Startups (Lab) **Course Code: C018521(018)**
Total Marks in End Semester Exam: 40 **L: 0 T: 0 P: 2 Credits: 1**

List of Experiments:

1. Cultivation of medicinal mushroom (coriolus) and its commercial use.
2. Production of bioethanol from local available raw materials.
3. Preparation of bio fertilizer using *rhizobium* and *mycorrhiza*.
4. To perform the technique of hydroponics for commercial purpose.
5. Farming of rare and endanger medicinal plant using tissue culture technique.
6. Extraction of volatile oil.
7. Preparation of different product from moringa of high nutritional value.
8. Prepare frozen fruits for long time preservation.
9. To perform floriculture.
10. Extraction of secondary metabolites and enzymes from plants and bacteria.

Equipments/Machines/Instruments/Tools/Software Required:

- Microscope
- Balance (500 g – 0.1 g)
- Balance (200g - 0.1 mg)
- Table top Centrifuge
- Laminar air Flow
- Autoclave
- Column
- Microfuge
- Micropipettes (200 µl – 1000 µl), (20 µl - 200 µl), (1 µl – 20 µl).
- Hot air Oven
- Vortex shaker
- Magnetic Stirrer
- Fume hood
- Bunsen Burner
- Soxhlet Apparatus
- Deep freezer

Recommended Books:

1. The Startup Owner's Manual: The Step by- Step Guide for Building a Great Company, Steve Blank and Bob Dorf, K & S Ranch ISBN – 978- 0984999392.
2. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Eric Ries, Penguin UK ISBN – 978-0670921607.

Chhattisgarh Swami Vivekanand Technical University, Newai

Name of the Program: Bachelor of Technology
Semester: B.Tech – 5th **Branch: Biotechnology**
Subject: Metabolic Engineering (Lab) **Course Code: C018522(018)**
Total Marks in End Semester Exam: 40 **L: 0 T: 0 P: 2 Credits: 1**

List of Experiments:

1. To determine the Acidic value and Saponification value of given oil sample.
2. To determine the free alkali content and moisture content of given soap sample.
3. To determine the total solid content in sample.
4. To determine the percentage of total fatty material present in given soap.
5. Preparation of phenol-formaldehyde resin.
6. Solvent extraction of oil from oilseed in solvent apparatus.
7. Develop engineering strategies to boost production of industrially relevantcompound in E. coli.
8. Strain engineering (deletion or overexpression of genes) to boost production oftarget compound followed by metabolite extraction and quantification.
9. Demonstration of feed-back regulation and product inhibition.
10. Development of a flux model and correlation of the model with experimental data.

Equipments/Machines/Instruments/Tools/Software Required:

1. Solvent apparatus
2. Separating funnel
3. Stirrer
4. Burette
5. Pipette
6. Round bottom flask
7. Condenser
8. Air Oven

Recommended Books:

1. S. S. Dara, Practical Chemistry
2. Parasuram, Soaps and Detergents
3. G. N. Pandey, Chemical Technology, Volume II

Chhattisgarh Swami Vivekanand Technical University, Newai

Name of the Program: Bachelor of Technology
Semester: B.Tech – 5th **Branch: Biotechnology**
Subject: Analytical Techniques (Lab) **Course Code: C018523(018)**
Total Marks in End Semester Exam: 40 **L: 0 T: 0 P: 2 Credits: 1**

List of Experiments:

1. To find out concentration of unknown solution using Colorimeter and Spectrophotometer.
2. Spectro-photometric analysis of carbohydrates and proteins.
3. Measurement of IR and Raman spectra of small molecules.
4. Measurement of excitation and emission spectra of a fluorophore and theirwavelengths for maximum excitation and emission.
5. Purification of a compound from a mixture using HPLC.
6. Protein purification using affinity, ion-exchange and gel filtration chromatography.
7. Analysis of NMR spectra and structure determination of a bio-active compound like cyclosporine.
8. Analysis of SPR and ITC data and calculation of binding affinities.
9. Demonstration of analysis of genomics.
10. Electrophoretic separation of biomolecules.

Equipments/Machines/Instruments/Tools/Software Required:

- Microscope
- Balance (200g - 0.1 mg)
- Table top Centrifuge
- Electrophoresis Chamber
- PCR
- Micropipettes (200 µl – 1000 µl), (20 µl - 200 µl), (1 µl – 20 µl).
- Hot air Oven
- UV -Vis spectrometer
- Vortex shaker
- UV Transilluminator
- HPLC
- Colorimeter

Recommended Books:

1. 1. Practical Biochemistry by Wilson and Walker.
2. Instrumental Methods of Chemical Analysis, E. W. Ewing, McGraw Hill, NewYork. 4th Ed, 1975
3. Instrumental Methods of Analysis, B. K. Sharma, Goel Publishing house.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Name of the Program: BTech **Semester: V**
Subject: Environmental Studies **Code: C000506(020)**
Period per week (L-T-P): (0-0-2) / Week **Non-Credit**
Total Contact Hours: 40 **No. of assignments to be submitted: 05**

PREREQUISITE: Knowledge of basic Chemistry, Physics and Mathematics.

COURSE OBJECTIVES:

1. Basic knowledge of environment, ecology, ecosystems, biodiversity and conservation.
2. Fundamentals of natural resources, control, uses and its impact on environment.
3. Human population, growth, growing needs and its impact on society and environment.
4. Types of environmental pollution, legislations, enactment and management.

COURSE DETAILS:

UNIT I: Introduction to environmental studies, ecology and ecosystems (06 hours)

Introduction to environment; Concept and structure of ecology and ecosystem, energy flow; Community ecology; Food chains and webs; Ecological succession; Characteristic features of forest, grassland, desert and aquatic ecosystem; Multidisciplinary nature of environmental studies, scope and importance; Concept of sustainability and sustainable development.

UNIT II: Biodiversity and conservation (06 hours)

Introduction to biological diversity and levels of genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots; Threats to biodiversity, habitat loss, conflicts and biological invasions; In-situ and Ex-situ conservation of biodiversity: Ecosystem and biodiversity services.

UNIT III: Natural resources and environment (08 hours)

Concept of Renewable and non-renewable resources; Land resources, land use change, land degradation, soil erosion; Desertification; Deforestation: causes, consequences and remedial measures; Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state); Energy resources: environmental impacts of energy generation, use of alternative and nonconventional energy sources, growing energy needs.

UNIT IV: Human communities, social issues and environment (08 hours)

Basic concept of human population, growth and communities; Impacts on environment, human health, welfare and human rights; Resettlement and rehabilitation; Environmental natural disaster: floods, earthquake, cyclones, tsunami and landslides; Manmade disaster; Environmental movements; Environmental ethics: role of gender and cultures in environmental conservation; Environmental education and public awareness; Human health risks and preventive measurements.

UNIT V: Environmental pollution, policies, legislations, assessment and practices (12 hours)

Environmental pollution: Causes, effects and controls of air, water, soil, noise and marine pollution; Concept of hazardous and non-hazardous wastes, biomedical and e-wastes; Solid waste management and control measures; Climate change, global warming, ozone layer depletion, acid rain and their societal impacts; Environment laws: Wildlife Protection Act, Forest Conservation Act, Water (Prevention and control of Pollution) Act, Air (Prevention & Control of Pollution) Act, Environment Protection Act, Biodiversity Act, International agreements negotiations, protocols and practices; EIA, EMP.

On completion of each unit, students have to submit one assignment from each unit.

COURSE OUTCOMES (CO):

On completion of the course, students will able to:

1. Interpret and demonstrate the concept of ecology and ecosystem for environmental sustainability.
2. Define and establish the diversified knowledge of biodiversity and its conservation.
3. Explain the uses of natural resources efficiently and its impact on environment.
4. Illustrate and solve the simple and complex social issues relating to human communities.
5. Exemplify and make useful solution to combat the environmental degradation with the aid of national and international legislations and protocols there under.
6. Demonstrate and elucidate the complicated issues and anthropological problems for societal development.

TEXT BOOKS:

1. De, A.K., (2006).*Environmental Chemistry*, 6th Edition, New Age International, New Delhi.
2. Bharucha, E. (2013). *Textbook of Environmental Studies for Undergraduate Courses*. Universities Press.
3. Asthana, D. K. (2006).*Text Book of Environmental Studies*. S. Chand Publishing.

REFERENCE BOOKS:

1. Odum, E. P., Odum, H. T., & Andrews, J. (1971).*Fundamentals of ecology*. Philadelphia: Saunders.
2. Basu, M., Xavier, S. (2016). Fundamentals of Environmental Studies, Cambridge University Press, India.
3. Sharma, P. D., & Sharma, P. D. (2005).*Ecology and Environment*. Rastogi Publications.

OPEN SOURSE LEARNING:

http://nptel.ac.in/