

## National Institute of Technology , Raipur (C.G.)

Course of Study & Scheme of Examination												B. Tech. V Semester		Branch:	Biotechnology
S.No.	Board of Studies	Sub. Code	Subject Name	Periods/week			TA	Examination Scheme				Total Marks	Credits L+(T+P)/2		
				L	T	P		FE	SE	T.C.A.	ESE				
1	Biotechnology	BT 20511 BT	Animal Biotechnology	3	1	-	20	15	15	50	70	120	4		
2	Biotechnology	BT 20512 BT	Enzyme Technology	3	1	-	20	15	15	50	70	120	4		
3	Biotechnology	BT 20513 BT	Drug Design & Pharma Technology	3	1	-	20	15	15	50	70	120	4		
4	Biotechnology	BT 20514 BT	Bioethics & Biosafety	3	1	-	20	15	15	50	70	120	4		
5	Biotechnology	BT 20515 BT	Immunology	3	1	-	20	15	15	50	70	120	4		
6	Biotechnology	BT 20516 BT	Fluid Flow Operation	4	1	-	20	15	15	50	70	120	5		
7	Biotechnology	BT 20521 BT	Fluid Flow Operation Lab	-	-	3	30	-	-	30	20	50	2		
8	Biotechnology	BT 20522 BT	Enzyme Technology Lab	-	-	3	30	-	-	30	20	50	2		
9	Biotechnology	BT 20523 BT	Immunology Lab	-	-	3	30	-	-	30	20	50	2		
10	Humanities	EN 20524 BT	Managerial Skill	-	-	2	25	-	-	25	-	25	1		
11			Technical Visit/Practical Training	-	-	-	25	-	-	25	-	25	1		
<b>Total</b>				19	6	11	260	90	90	440	480	920	33		

Note : For attendance of a student in every theory and practical class, the teachers are supposed to keep records ultimately in the following format which will be included in the semester mark-sheets.

Format for attendance			
Attendance			Category
> 85		----->	High "H"
> 70 & < 85		----->	Medium "M"
> 60 & < 70		----->	Low "L"
< 60		----->	Detained " D "

Chairman (BOS)

Member (BOS)

Member (BOS)



**DEPARTMENT OF BIOTECHNOLOGY SYLLABUS**

<b>Name of the Subject</b>	<b>Animal Biotechnology</b>	<b>Subject Code</b>	<b>BT 20511 BT</b>
<b>Semester</b>	<b>5<sup>th</sup></b>	<b>Board of Studies</b>	<b>Biotechnology</b>
<b>Maximum Marks</b>	<b>70</b>	<b>Minimum Marks</b>	<b>25</b>
<b>Lecture Periods/Week</b>	<b>Tutorial Periods/Week</b>	<b>Practical Periods/Week</b>	<b>Credits L+P</b>
<b>03</b>	<b>01</b>	<b>00</b>	<b>04</b>

**Unit I - Introduction to Animal Tissue Culture:** Historical background, Advantages, Limitations and Applications, Laboratory Design and Layout, Essential Equipments, General Safety Measures, Aseptic Techniques: Objectives and Elements, Sterile Handling, Risk Assessment.

**Unit II - Media:** Culture environment, physicochemical properties, Types of Culture Media, Balanced salts solutions, Complete Media, Serum, Disadvantages of Serum, Advantages & Disadvantages of Serum-free media, Cell Proliferation and Differentiation.

**Unit III - Primary and Secondary culture:** Isolation of Cells and Tissues, Steps involved in Primary Cell Culture, Subculture and propagation, Concept of Cell Lines and Nomenclature, Cell Line Designations, Routine maintenance, Cell Immobilization.

**Unit IV- Characterization & Quantization of Cell Lines:** Morphological studies: Chromosome analysis, DNA content, RNA and Protein, Enzyme Activity, Antigenic Markers. Transformation: Immortalization, Aberrant Growth, Tumorigenicity. Transformation Assay, Cell counting, Cell Proliferation and Viability assay.

**Unit V - Animal Biotechnology:** Animal Cloning, Transgenic Animal Production: Microinjection method, Retroviral vector method and Other Techniques, Applications of transgenic animals. Embryonic Stem Cell Technology, *In-vitro* Fertilization and Embryo Transfer Technology, its Significance.

**Text/ Reference Books**

1. Animal Cell Culture by John R.W. Masters, Oxford University Press.
2. Molecular Biotechnology: Primrose
3. Animal cell Biotechnology and: R.E.Spier and J.B. Griffiths(1988), Academic press.
4. Introduction to cell & tissue culture by Jennie P. Mather and Penelope E. Roberts Plenum Press, New York and London.

**DEPARTMENT OF BIOTECHNOLOGY SYLLABUS**

<b>Name of the Subject</b>	<b>Bioethics &amp; Biosafety</b>	<b>Subject Code</b>	<b>BT 20514 BT</b>
<b>Semester</b>	<b>5<sup>th</sup></b>	<b>Board of Studies</b>	<b>Biotechnology</b>
<b>Maximum Marks</b>	<b>70</b>	<b>Minimum Marks</b>	<b>25</b>
<b>Lecture Periods/Week</b>	<b>Tutorial Periods/Week</b>	<b>Practical Periods/Week</b>	<b>Credits L+P</b>
<b>03</b>	<b>01</b>	<b>00</b>	<b>04</b>

- Unit I - Introduction to Ethics & Bioethics** Ethical issues in genetic engineering, patenting human genes, cloning, genetic testing & screening; Biotechnology & social responsibility; The legal & socio-economic impact of Biotechnology; Public acceptance issue in Biotechnology-issue of access, ownership, monopoly, traditional knowledge, public verses private funding.
- Unit II - Intellectual property Rights** TRIPS; GATT; International Conventions; Patent-basic principle & requirements, Patent application, Patentable subject & patenting living organisms; Biodiversity& Farmer's rights;
- Unit III - Biosafety regulatory frame work** for GMOs in India; Biosafety regulatory frame work for GMOs at International level.
- Unit IV - Hazard assessment** Use of genetically modified organisms & their release in environment; special procedures for rDNA based product production; Biosafety in laboratory- Laboratory associated infections and other hazards; assessment of biological hazard & level of Biosafety; Prudent biosafety practices in laboratory.
- Unit V- International dimensions** in Biosafety- Cartagena Protocol on biosafety; Bioterrorism & conventions on biological weapons.

**Name of Text & Reference Books:**

1. Thomas J.A., Fush R.L., (2002), Biotechnology & safety Assessment (3<sup>rd</sup>Ed.), Academic press.
2. Fleming D.A., Hunt D.L., (2002), Biological safety Principles & practices( 3<sup>rd</sup> Ed.) ASM Press, Washington.
3. Biotechnology- A Comprehensive treatise (Vol 12), Legal economic & ethical Dimensions VCH.
4. Sasson A, Biotechnologies & Development, UNESCO Publications.
5. Singh K, Intellectual Property Rights on Biotechnology, BCIL, New Delhi.

**DEPARTMENT OF BIOTECHNOLOGY SYLLABUS**

<b>Name of the Subject</b>	<b>Drug Design and Pharma Tech.</b>	<b>Subject Code</b>	<b>BT 20513 BT</b>
<b>Semester</b>	<b>5<sup>th</sup></b>	<b>Board of Studies</b>	<b>Biotechnology</b>
<b>Maximum Marks</b>	<b>70</b>	<b>Minimum Marks</b>	<b>25</b>
<b>Lecture Periods/Week</b>	<b>Tutorial Periods/Week</b>	<b>Practical Periods/Week</b>	<b>Credits L+P</b>
<b>03</b>	<b>01</b>	<b>00</b>	<b>04</b>

**Unit 1: Introduction and historical perspective:** Biotechnology: An introduction, Pharmacist and Biotechnology, Biotechnology and Industry, GMP Compliance and Biopharmaceutical facilities.

**Unit 2: Biopharmaceutics:** Introduction, routes of administration. Pharmacokinetics; Absorption of drugs, distribution of drugs, protein binding of drugs, drug metabolism and Excretion of drugs.

**Unit 3: Drug Delivery:** Molecular principle of drug Targeting and Liposomes. Delivery consideration of Biotechnological products: Stability profile, Barriers to peptides and protein delivery, Delivery of protein and peptide drugs, Site specific protein modification, Toxicity profile characterization.

**Unit 4: Recombinant DNA Technology:** Application of Recombinant DNA technology: Novel protein generation, Novel routes to small molecules, Cloning of hemoglobin in E-coli, Cloning of human artificial receptors for drug design and testing. Drug delivery system in Gene Therapy.

**Unit 5: Current Trends in Vaccines:** vaccine; Multivalent subunit vaccine, Purified macromolecules, Synthetic peptide vaccines, Recombinant antigen vaccine, Vector vaccines, Miscellaneous approaches, New generation vaccines, Novel vaccine delivery systems.

**Text Books:**

1. A Text book of Pharmaceutical Medicine (fourth edition) Edited by John P Griffin and John O Grady.
2. Pharmaceutical microbiology – Hugo Russel’s Black well Publication 7<sup>th</sup> Edition.

## **National Institute of Technology, Raipur (C.G.)**

### **Reference Books:**

1. Pharmaceutical Biotechnology S. P. Vyas, V.K.Dixit , CBS Publishers and Distributors.
2. Essential of Pharmacotherapeutics F.S.K. Barar, S.Chand and company Ltd.

**DEPARTMENT OF BIOTECHNOLOGY SYLLABUS**

<b>Name of the Subject</b>	<b>Enzyme Technology</b>	<b>Subject Code</b>	<b>BT 20512 BT</b>
<b>Semester</b>	<b>5<sup>th</sup></b>	<b>Board of Studies</b>	<b>Biotechnology</b>
<b>Maximum Marks</b>	<b>70</b>	<b>Minimum Marks</b>	<b>25</b>
<b>Lecture Periods/Week</b>	<b>Tutorial Periods/Week</b>	<b>Practical Periods/Week</b>	<b>Credits L+P</b>
<b>03</b>	<b>01</b>	<b>02</b>	<b>4+2</b>

**Unit 1: Introduction of Enzyme:** Brief history, nomenclature & classification, Coenzyme and Cofactors, Induced & Lock-Key hypothesis, Transition-state stabilization hypothesis, Zymogen, Ribozyme & Abzymes, Allosteric enzymes.

**Unit 2: Enzyme specificity and activity:** Types of specificity, Identification of binding site & catalytic site, 3-D structure of active site, Kinetics of single and bi-substrate enzyme catalysed reactions, Inhibition & its kinetics, factors affecting enzyme activity.

**Unit 3: Enzyme immobilization:** Methods of immobilization of enzymes-physical & chemical techniques, Kinetics of immobilized enzyme, Effect of external mass transfer & intra-particle diffusion, limitation & applications of immobilized enzymes, Bioreactors using immobilized enzyme.

**Unit 4: Production and Application:** Methods of production of enzyme, Extraction of enzyme of soluble and membrane bound enzymes, Nature of extraction medium, purification of enzyme, criteria of purity, determination of molecular weight of enzyme. Application of enzyme in leather industry, detergent industry, dairy industry; Lignocellulose degrading enzymes.

**Unit 5: Enzyme Engineering:** Introduction, aim, principle & steps of enzyme engineering; Prediction of enzyme structure, design and construction of novel enzymes, Bifunctional and polyfunctional enzyme, Enzyme in organic solvents.

**Text Books:**

1. Enzyme by Palmer (2001); Horwood publishing series.
2. Fundamental of Enzymology by Price and Stevens (2002): Oxford University Press.

**Reference Books:**

1. Enzyme technology by Helmut uhlings (1998): John Wiley
2. A. L. Lehninger, d.L. Nelson, M.M Cox- "Principle of Biochemistry " by Werth publishers, 2000.
3. L. Stryer, J.M. Berge, J.L. Tymoczko-"Biochemistry" W.H. freeman & Co. 2002
4. Introduction to protein structure by B randen and Tooze(1998): Garland publishing group.

**National Institute of Technology, Raipur (C.G.)**



**DEPARTMENT OF BIOTECHNOLOGY SYLLABUS**

<b>Name of the Subject</b>	<b>Fluid Flow Operations</b>	<b>Subject Code</b>	<b>BT 20516 BT</b>
<b>Semester</b>	<b>5<sup>th</sup></b>	<b>Board of Studies</b>	<b>Biotechnology</b>
<b>Maximum Marks</b>	<b>70</b>	<b>Minimum Marks</b>	<b>25</b>
<b>Lecture Periods/Week</b>	<b>Tutorial Periods/Week</b>	<b>Practical Periods/Week</b>	<b>Credits L+P</b>
<b>04</b>	<b>01</b>	<b>00</b>	<b>05</b>

**Unit 1: Introduction :** Properties and nature of fluids - ideal fluid - real fluid - density - specific weight - specific volume, surface tension, compressibility, capillarity - absolute and gauge pressures. Fluid statics - forces on fluids, hydrostatic equilibrium - measurement of pressure using manometer - U-tube manometer, differential manometer, inverted manometer, micromanometer, manometers connected in series. Continuous gravity decanter - Centrifugal decanter. Forces on submerged bodies - Buoyancy - stability of floating and submerged bodies.

**Unit 2: Introduction to fluid flow:** Flow of incompressible fluid - classification of flow - steady and unsteady state flow, uniform and non-uniform flow - Three, two and one-directional flow - streamline, streak line, path line, stream tube, velocity potential, laminar flow.

**Unit 3: Equations of change for isothermal systems**

- equation of continuity, equation of motion - Navier-Stoke's equation, Euler equation - Newtonian and non-Newtonian fluids, viscosity, momentum flux, Reynold's experiment, turbulent flow, turbulence, nature of turbulence, flow in boundary layers - boundary layer separation, wake formation- flow through pipe line system - Bernouilli equation' kinetic energy correction factors - correction in Bernouilli equation for fluid friction - Shear stress and velocity distribution in circular channel. The friction factor - Hagen-Poiseuille equation, laminar flow of non-Newtonian fluids - Velocity distribution for turbulent flow. The friction factor chart - commercial pipes and pipe fittings. Friction head loss for changes in velocity, direction and due to pipe fittings.

**Unit 4: Transportation and metering of fluids** - pipes and pipe standards, tubings. Pipe joints - flange - expansion joints, valves, automatic control valves - material of construction. Water hammer - Pumps, reciprocating pumps, centrifugal pumps, centrifugal pump theory - selection of centrifugal pumps - various types, head Vs. flow rate - characteristics of centrifugal pumps. The displacement and current meters - variable area meter, orifice meter, venturimeter, flow nozzles, rotameter, wiers and notches - Pitot tubes - velocity meters - anemometers, turbine flow meter, current meters, hot wire anemometer, laser dopper anemometry, flow visualization, Microfluidics.

**Text Book**

1. McCabe and Smith, "Unit Operations in Chemical Engineering", McGraw-Hill

**National Institute of Technology, Raipur (C.G.)**

2. Streeter, "Fluid Mechanics"

**Reference Books:**

1. Christie J. Geankoplis, "Transport Processes and Unit Operations", Prentice Hall of India.

**DEPARTMENT OF BIOTECHNOLOGY SYLLABUS**

<b>Name of the Subject</b>	<b>Immunology</b>	<b>Subject Code</b>	<b>BT 20515 BT</b>
<b>Semester</b>	<b>5<sup>th</sup></b>	<b>Board of Studies</b>	<b>Biotechnology</b>
<b>Maximum Marks</b>	<b>70</b>	<b>Minimum Marks</b>	<b>25</b>
<b>Lecture Periods/Week</b>	<b>Tutorial Periods/Week</b>	<b>Practical Periods/Week</b>	<b>Credits L+P</b>
<b>03</b>	<b>01</b>	<b>02</b>	<b>4+2</b>

**Unit 1: Overview of Immune System:** Innate and Adaptive Immunity, Cells and Organs of the Immune System, Hematopoiesis, MHC.

**Unit 2: Immunoglobulins and Antigens:** Structure, Function and Classification of Immunoglobulins. Structure and function of Antigens, epitopes. Isotype, Allotype and Idiotype. Cytokines and its regulation.

**Unit 3: Genetics of Immunoglobulins:** Two gene model and verification, DNA rearrangements, VDJ joining and its different mechanisms, Class Switching, Expression of Ig genes and its Regulation Antibody genes and Antibody Engineering.

**Unit 4: Immune Response and Defects:** Introduction of complement system, Basic concepts of Ag-Ab interactions, Immunodeficiency disorders, AIDS and SCID. Autoimmunity Diseases.

**Unit 5: Transplantation and Vaccines :** Graft Acceptance and Rejection and its Mechanism, Tumor Immunology, Vaccines, Hypersensitivity.

**Name of Text books:**

1. Kubey's Immunology
2. Immunology by Ivan Roitts

**National Institute of Technology, Raipur (C.G.)**

**Subject : Enzyme Technology Lab**

**Subject Code : BT20522BT**

**End Semester Exam Marks : 20**

**List of Experiments :**

1. Production of Amylase by *A. Niger*.
2. Effect of temperature/pH/concentration on salivary amylase activity.
3. Production of catalase enzyme by microorganisms.
4. Production of lactase by yeast cell.
5. Various Techniques of enzyme immobilization.
6. Study of various enzyme reactors.
7. Various techniques for enzyme engineering.
8. Preparation of poly/bifunctional enzymes.
9. Test for urease activity.
10. Test for oxidase activity.
11. Test for coagulase activity.
12. Test for Gelatin Hydrolysis. (proteolytic Activity )
13. Indole production test
14. Methyl Red test
15. Citrate utilization test

**National Institute of Technology, Raipur (C.G.)**

**Subject: Fluid Flow Operation Lab**

**Subject Code: BT 20521BT**

**End Semester Exam Marks: 20**

**List of Experiments:**

1. To determine coefficient of discharge of Venturimeter and Orificemeter.
2. To determine the velocity coefficient of closed circuit Pitot tube apparatus.
3. To calibrate given Rotameter.
4. Verification of Bernoulli's theorem.
5. To determine over all heat transfer coefficient of double pipe heat exchangers.
6. To determine over all heat transfer coefficient of shell and tube heat exchanger.
7. Determination of coefficient of friction for different pipes.
8. To determine Reynolds number of flowing fluid and draw friction factor curve.
9. To study the flow over a Triangular or Rectangular notch or weir and to find the value of coefficient of discharge ( $C_d$ )
10. To determine fluidization coefficient of fluidized bed.
11. Study of humidifier.
12. Study of spray dryer
13. Determine the heat transfer coefficient for heat flow through composite wall.

**List of Equipments/Machine Required:**

1. Shell and tube heat exchanger
2. Sudden expansion and sudden contraction arrangement
3. Fluidized bed.
4. Spray dryer.
5. Pitot tube
6. Humidifier
7. Venturimeter and Orificemeter
8. Rotameter

**Recommended Books:**

1. McCabe and Smith, Unit Operation of Chemical Engg
2. Coulson and Richardson, Chemical Engineering, vol 1.
3. Treyball, Mass Transfer Operation