

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

Course of Study & Scheme of Examination												B. Tech. IV Semester		Branch:	Biotechnology
S.No.	Board of Studies	Sub. Code	Subject Name	Periods/week				Examination Scheme				Total Marks	Credits L+(T+P)/2		
				L	T	P	TA	FE	SE	T.C.A.	ESE				
1	Biotechnology	BT 20411 BT	Microbiology	3	1	-	20	15	15	50	70	120	4		
2	Biotechnology	BT 20412 BT	Plant Biotechnology	3	1	-	20	15	15	50	70	120	4		
3	Biotechnology	BT 20413 BT	Food Biotechnology	3	1	-	20	15	15	50	70	120	4		
4	Biotechnology	BT 20414 BT	Recombinant DNA Technology	3	1	-	20	15	15	50	70	120	4		
5	Mathematics	MA 20415 BT	Numerical Analysis	3	1	-	20	15	15	50	70	120	4		
6	Biotechnology	BT 20416 BT	Thermodynamics & Reaction Engineering	4	1	-	20	15	15	50	70	120	5		
7	Biotechnology	BT 20421 BT	Plant BT Lab	-	-	3	30	-	-	30	20	50	2		
8	Biotechnology	BT 20422 BT	Microbio Lab	-	-	3	30	-	-	30	20	50	2		
9	Biotechnology	BT 20423 BT	RDNA Lab	-	-	3	30	-	-	30	20	50	2		
10	Humanities	EN 20424 BT	Personality Development	-	-	2	25	-	-	25	-	25	1		
11			Discipline	-	-	-	25	-	-	25	-	25	1		
			<b>Total</b>	<b>19</b>	<b>6</b>	<b>11</b>	<b>260</b>	<b>90</b>	<b>90</b>	<b>440</b>	<b>480</b>	<b>920</b>	<b>33</b>		

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>Food Biotechnology</b>	<b>Subject Code</b>	<b>BT20413BT</b>
<b>Semester</b>	<b>4<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</b>
<b>03</b>	<b>01</b>	<b>00</b>	<b>4</b>

### **Unit I – Food Microbiology**

Role and significance of micro-organisms in food. Intrinsic and Extrinsic parameters of food that affect microorganism's growth. Micro-organisms in fresh meat, poultry, processed meat and sea food, Food spoilage, Food borne illness.

### **Unit II – Food Production Technology**

Food production Technology; Primary and Secondary fermentation, Beer, Wine and Distillation spirit, Cheese production, Vinegar and Soya sauce production, Enzymes in bakery, Fruit juice production, Utilization of food waste.

### **Unit III – Food Preservation**

Food Preservation using irradiation, characteristics radiations of interest in food preservation, Food preservation using various temperature means, Chemical preservatives used in food preservation.

### **Unit IV – Microbial Biomass & Genetically Modified Food**

Microbial biomass, Single cell protein, production (Mushroom), Genetically Engineered food- Methionine enriched oil, Transgenic “ Heart healthy” canola oil, Edible vaccines- Hepatitis B vaccine in maize, Cholera vaccine in potatoes.

### **Unit V – Food Quality & Safety Measures**

Analysis of major food ingredients; Analysis of preservative, Natural and synthetic- food colours, food flavour enhancing agents, chemical safety measurement-heavy metals, fungal toxins, bacterial toxins, herbicide and pesticide detection, Adulteration, Quality control tests.

### **Text Books:**

1. Food Microbiology- Fundamentals & Frontiers by M.P.Doyle, L.R. Beuchal &Thorna J. Montville(2001) A.S.M.Press.
2. Potten N.M.” Food Science” the AVL Publishing Co.2002.

### **Reference Books:**

1. Modern food microbiology by M.J.James, C.B.S. publishers & publishers 1987.
2. Basic food microbiology by “ J.B.Gorge C.B.S. Publishers & Distributers, 1887.

## DEPARTMENT OF BIOTECHNOLOGY SYLLABUS

<b>Name of the Subject</b>	<b>Microbiology</b>	<b>Subject Code</b>	<b>BT 20411 BT</b>
<b>Semester</b>	<b>4<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</b>
<b>03</b>	<b>01</b>	<b>03</b>	<b>4+2</b>

### **Unit I -- Introduction**

Introduction to microbiology: History and scope of Microbiology. Microscopy, Types of Micro Organisms: Bacteria, Algae, Fungi, And Protozoa, Methods in Microbial taxonomy.

### **Unit II -- Microbial Growth & Nutrition**

Microbial Nutrition, Nutritional types of microorganism. Culture Media. Isolation of pure culture and its techniques. Microbial growth. Growth curve and derivation and mathematical expression. Measurement of microbial Growth. Factors affecting Microbial Growth.

### **Unit III -- Microbial Metabolism**

Microorganisms Control; Physical and Chemical agents. Microbial metabolism: Glycolytic pathways, PPP pathway, Entner Duodroff pathway, Fermentation, TCA Cycle, ETC and Oxidative phosphorylation; Microbial photosynthesis, Nitrogen fixation by microorganism.

### **Unit IV -- Microbes & Diseases**

Viruses: Introduction, Characteristics, Bacteriophages and Eukaryotic viruses; structure and infection cycle. Diseases caused by Bacteria and Viruses: AIDS, T.B, STD, Hepatitis.

### **Unit V -- Applied Microbiology**

Pathogenicity of microorganisms: Host parasite relationships, Mode of action of Antimicrobial drugs, Chemotherapy. Introduction to microorganism used in food, Industries and environment.

### **Text Books**

1. Microbiology by Pelzar, Chan & Kreig [1986] Mc Graw Hill.
2. Microbiology by Presscott, Harley & Klein [1986] William C. Brown press.

### **References Books**

1. Foundation of Microbiology by K.P. Talaro & A. Talaro , III edition, W.C.B. McGraw Hill [1999].
2. An introduction to Microbiology by P. Tauro, K.K. Kapoor and K.S. Yadav
3. Microbiology and Biotechnology by D.P.Singh and S.K. Dwvedi.
4. Industrial Microbiology by L.E.Casida.

## DEPARTMENT OF BIOTECHNOLOGY SYLLABUS

<b>Name of the Subject</b>	<b>Numerical Analysis</b>	<b>Subject Code</b>	<b>MA20415BT</b>
<b>Semester</b>	<b>4<sup>th</sup></b>	<b>Board of Studies</b>	<b>Mathematics</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</b>
<b>03</b>	<b>01</b>	<b>00</b>	<b>4</b>

### Unit I - Numerical Solution of Algebraic & Transcendental Equations

Bisection Method, Regula Falsi Method, Newton- Raphson Method, Secant Method, Birge-Vieta Method, Errors in numerical computation, Error type, Analysis and Estimation, Error Propagation.

### Unit II - System of Linear Algebraic Equations

Solution of simultaneous algebraic equations by Gauss elimination method, Gauss-Jordan method, Crout's triangularization method, iterative methods of solutions, Jacobi method, Gauss-Siedel method, relaxation method.

### Unit III - Interpolation with Equal and Unequal Intervals

Finite difference, difference of polynomial in Factorial notation, Other difference operator, Newton's Forward and Backward interpolation formula, Central interpolation formula, Stirling's formula, Bessel's formula, Lagrange's formula and Newton's Divided difference interpolation formula.

### Unit IV - Numerical Differentiation, Integration & Curve fitting

Numerical differentiation, Numerical integration – Newton-Cote's Quadrature Formula, Trapezoidal Rule, Simpson's Rules, Weddle's Rule, Principle of least square, Curve Fitting Linear & non linear, exponential, logarithmic curve.

### Unit V- Numerical Solution of Ordinary Differential Equation

Picard's method, Taylor's series method, Euler's methods, Euler's modified method, Runge-kutta fourth order method, **Predictor**-corrector method, Adams- Bashforth Method, Milne's method.

#### Text Books:

1. Jain M. K. & Iyenger R.K. "Numerical Methods for Scientific & Engg. Computation," New-Age, International Pub. 4<sup>th</sup> Edition.
2. Grewal B.S. "Numerical Methods", Khanna Pub.

#### Reference Books:

1. Burden, Richard L., Fairs, J. Douglas Fairs, "Numerical Analysis", Thomson Asia. PTE, 7<sup>th</sup> Edition.

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

2. Gourdin A., Boumahrat M. “Applied Numerical Method”, PHI.
3. Rajasekaran , S. “ Numerical Method in Science & Engineering, A Practical Approach”  
S.Chand & Co Ltd., II Edition.

## DEPARTMENT OF BIOTECHNOLOGY SYLLABUS

<b>Name of the Subject</b>	<b>Plant Biotechnology</b>	<b>Subject Code</b>	<b>BT20412BT</b>
<b>Semester</b>	<b>4<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</b>
<b>03</b>	<b>01</b>	<b>03</b>	<b>4+2</b>

### **Unit I -- Introduction of Plant tissue culture**

History and scope of plant tissue culture, Terms used in tissue cultures, Types of culture, Basic techniques of plant tissue culture. Single cell culture and single cell clones, Measurement of growth and Plant growth Regulators.

### **Unit II -- Culture Media preparation and Culture Techniques**

Plant tissue culture Media and its composition, Preparation. Protoplast culture, fusion and regeneration of Hybrid plants. Micropropagation and Haploid production, Somaclonal variations. Embryo culture and Reuse.

### **Unit III -- Gene Transfer**

Methods of Gene Transfer; Physical, Chemical and Agrobacterium mediated gene transfer, Ti plasmid, Derived vectors, Marker genes transfer for transformation. Transgene stability, expression and gene silencing.

### **Unit IV-- Application of Plant Tissue culture**

Application to Resistance to Biotic stress; Insect resistance, virus resistance, fungal and bacterial diseases. Resistance to abiotic stress, Herbicide resistance, modification of seed protein quality, suppression of endogenous genes and plant derived vaccines.

### **Unit V -- Molecular markers and Screening Techniques**

Molecular Marker Aided Plant Breeding. Molecular markers based on DNA molecular breeding and PCR amplification. Molecular marker assisted selection and Quantitative trait loci.

### **Text books**

1. Introduction to plant tissue culture by M.K. Razdan
2. Theory and Practice: Plant tissue Culture by S.S. Bhojwani
3. Plant Biotechnology by H.S. Chawla.

## DEPARTMENT OF BIOTECHNOLOGY SYLLABUS

<b>Name of the Subject</b>	<b>Recombinant DNA Technology</b>	<b>Subject Code</b>	<b>BT20414BT</b>
<b>Semester</b>	<b>4<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</b>
<b>03</b>	<b>01</b>	<b>03</b>	<b>4+2</b>

### **Unit I: Basic concept of rDNA**

Introduction and basic concept of recombinant DNA Technology. Tools in Genetic Engineering: Restriction Enzymes, Modification Enzymes, Cloning Vector.

### **Unit II: Vectors**

Vectors- Plasmids, Bacteriophages- M13,  $\lambda$  and P1, Phasmid, Phagmid, Cosmid. Artificial Chromosomes: BAC, YAC and Expression vectors.

### **Unit III: Gene cloning and Molecular markers**

Gene Cloning- Isolation of desired gene, preparation of Recombinant DNA, Integration into host cell and screening of transformants, PCR and Blotting Techniques, Molecular markers: RFLP, RAPD, AFLP, SSCP.

### **Unit IV: Gene library**

Gene Libraries: c-DNA preparation, Genomic DNA library preparation, Amplification of gene library, Difference between c-DNA library and Genomic DNA library

### **Unit V: Probes and Gene transfer methods**

Preparation and application of molecular probes, DNA probes, RNA probes, radioactive and non-radioactive labeling of DNA, Methods of gene transfer- natural and artificial.

### **Text Books:**

1. Principle of gene cloning by Old and Primrose.
2. Molecular cloning by Sambrook et al.
3. A textbook of Biotechnology by R.C. Dubey, S.Chand & company Ltd.

### **References Books:**

1. Gene cloning & DNA analysis “ An Introduction “ by T. A. Brown.
2. From gene to Genomes “Concept & Application of DNA Technology” by J.W.Dale & M.V. Schartz..

**DEPARTMENT OF BIOTECHNOLOGY SYLLABUS**

<b>Name of the Subject</b>	<b>Thermodynamics &amp; Reaction Engineering</b>	<b>Subject Code</b>	<b>BT20416BT</b>
<b>Semester</b>	<b>4<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</b>
<b>04</b>	<b>01</b>	<b>00</b>	<b>5</b>

**Unit I - Introduction to Thermodynamic**

Thermodynamic functions, Laws of thermodynamics, Heat effects-standard heat of reaction, free energy of formation, choice Raouilts Law and Henry's Law, Fluid phase equilibrium.

**Unit II - Thermodynamics Theories:** Chemical potential, fugacity, activity, activity coefficient, chemical reaction equilibria, standard free energy change, equilibrium conversion, Vant Hoff's Eq. Clausius Clayperon Eq: Gibbs Duhem Eq. Application of thermodynamics on Bimolecular.

**Unit III - Introduction to Chemical Reaction Engineering**

Kinetics of homogenous reactions, reaction mechanism, temperature dependency, rate constant, interpretation of batch kinetic data.

**Unit IV- Enzyme Reactions**

Kinetics of enzyme catalyzed reactions in free and immobilized states, choice Michaelis-Menten equation and its various modifications. Effects of external mass transfer immobilized enzyme systems, analysis if intra-particle diffusion and reactions.

**Unit V- Enzyme Kinetics**

Kinetics of substrate utilization, product formation and biomass production, Monod growth model and its various modifications, structured and unstructured kinetic rate models, thermal death rate kinetics of cells and spores.

**Name of Text Books:**

1. Chemical Reaction Engineering : Octave Levenspiel
2. Chemical Reaction Engineering : Foggler
3. Bailey & Ollis, "Biochemical Engineering Fundamentals", Mcgraw Hill (2<sup>nd</sup> Ed.), 1986.

**Name of Reference Books:**



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

1. Chemical Engg. Thermodynamics : J.M. Smith
2. Thermodynamics : Glass Stone
3. Bio-chemical Reaction Engg: J.M. Coulson & Richarder vol-3

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

**Subject: Microbiology Lab**

**Subject Code: BT20411BT**

**End Semester Exam Marks : 20**

**List of Experiments :**

1. General precautions and safety measures in Microbiology Lab.
2. Study of working principle of Microscope / Laminar flow/ Autoclave.
3. Preparation of Culture Media.
4. Isolation of microorganisms from soil.
5. Isolation of microorganisms from air.
6. Isolation of microorganisms from water.
7. Pure culture isolation techniques.
8. Gram staining of bacteria.
9. Simple staining using acidic/basic stains
10. Staining of fungal cell and Identification.
11. Antibiotic sensitivity test.
12. Standard analysis of drinking water.
13. Determination of optimum temperature for growth
14. Determination of thermal death temperature and thermal death time
15. Effect of pH on growth of bacteria

**List of Equipments/Machine Required:**

1. Autoclave
2. Hot Air Oven
3. Laminar Air Flow
4. Microscope
5. Water Bath
6. Colony Counter
7. Digital Balance
8. Rotating Incubator
9. BOD Incubator
10. Distillation Unit

**Recommended Books:**

1. Practical Microbiology- Principles and Techniques by Vinita Kale and Kishore Bhusari
2. Refer Books mentioned in theory syllabus.



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

**Subject: Plant Biotechnology Lab**

**Subject Code: BT20421BT**

**End Semester Exam Marks : 20**

**List of Experiments:**

1. Introduction to plant Tissue culture.
2. Sterilization of plant materials
3. Media preparation.
4. Transformation Techniques.
5. Protoplast Isolation techniques.
6. Protoplast fusion and Regeneration.
7. Micro propagation.
8. Shoot, root and anther culture.
9. Isolation of plant pathogens (Fungi)
10. Isolation of plant pathogens (Bacteria)
11. Extraction of cellulose from diseased plants(in vivo)
12. Extraction of pectolytic enzymes from disc

**List of Equipments/Machine Required:**

1. As mentioned in microbiology, Cellular and Molecular Biology and Genetic Engineering.

**Recommended Books:**

1. Experiments in Microbiology, Plant Pathology and Biotechnology by K R Aneja.
2. Refer books mentioned in theory syllabus.

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

**Subject : Recombinant DNA Technology Lab**

**Subject Code : BT20423BT**

**End Semester Exam Marks: 20**

**List of Practicals:**

1. Isolation of DNA from plant cell by CTAB method.
2. Isolation of DNA from onion cell.
3. Electrophoresis of DNA from plant/onion cell.
4. Isolation of RNA from yeast cell.
5. Estimation of DNA by Diphenyl method.
6. Estimation of RNA by orcinol method.
7. Total Genomic DNA extraction ( Kit).
8. Plasmid Conjugation ( Kit).
9. Isolation of DNA from Blood ( Kit ).
10. Silver Staining of DNA isolated from plant/Animal ( Kit).
11. DNA Ligation ( Kit).
12. Restriction Digestion (Kit).
13. Experiments to perform amplification of DNA
14. Transfer of DNA/Protein from Gel to nitrocellulose membrane by western blotting.

**Equipments required**

1. Refrigerated Micro-Ultracentrifuge
2. Gel Electrophoresis Apparatus
3. Oven
4. Incubator
5. UV Trans-illuminator
6. Micropipette
7. PCR Machine
8. Western Blotting Apparatus
9. Gel Rocker
10. Ultra-low Refrigerator