



**TULSIRAMJI GAIKWAD-PATIL College of Engineering and Technology**

Wardha Road, Nagpur - 441108

Accredited with NAAC A+ Grade

Approved by AICTE, New Delhi, Govt. of Maharashtra

**(An Autonomous Institution Affiliated to RTM Nagpur University)**



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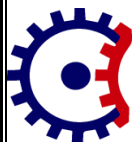
Department of Biotechnology

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## Structure and Curriculum

### B.Tech Biotechnology

(From Academic Year 2021-22)



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Department of Biotechnology

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### **Vision of Institute**

To emerge as a learning Centre of Excellence in the National Ethos in domains of Science,  
Technology and Management.

### **Mission of Institute**

1. To strive for rearing standard and stature of the students by practicing high standards of professional ethics, transparency and accountability.
2. To provide facilities and services to meet the challenges of Industry and Society.
3. To facilitate socially responsive research, innovation and entrepreneurship.
4. To ascertain holistic development of the students and staff members by inculcating knowledge and profession as work practices.



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**Department of Biotechnology**

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### **Vision of the Department**

To produce competent Entrepreneurs, Researchers and industry ready Professionals in  
Biotechnology through quality education

### **Mission of the Department**

1. To impart quality technical education and unique interdisciplinary research by merging science and technology
2. To make students aware about techniques of modern biotechnology and industrial advancements
3. To Inculcate Social and Ethical values in the students and empower them through imparting of knowledge and skills in biotechnology

### **Program Education Objectives (PEO)**

1. Develop Biotechnology graduates as human resource with technical competencies and strong foundation of science and engineering.
2. Acquire fundamental knowledge of mathematics, Biosciences and engineering to analyze, design and implement solutions to the Biotechnological problems.
3. Understand emerging concepts and trends in Biotechnology and allied fields.
4. Apply various tools to develop innovative systems for the bioprocesses.



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**Department of Biotechnology**

**Program Outcomes (PO)**

- 1. Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- 2. Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- 4. Conduct investigations of complex problems:** Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- 5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and software tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- 6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- 7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- 8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- 9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- 10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- 11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- 12. Lifelong learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

**Program Specific Outcomes (PSO)**

**PSO-1:** Ability to apply the acquired knowledge and recent techniques to come up with ideas in the domains of Bioprocess Engineering, Bioinformatics and Biopharmaceuticals.

**PSO-2:** Ability to utilize their proficiency and skills in solving real life problems in Diagnostics Genetic Engineering and Fermentation Technology using recent technologies.

**PSO-3:** Analyzing the impact of Biotechnology Engineering solutions in the societal and human context to create productive human resource for the country.



# Tulsiramji Gaikwad-Patil College of Engineering & Technology, Nagpur

(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

## Scheme of Instructions and Syllabus

Scheme of Instructions: Second Year B. Tech in Biotechnology

### Semester III

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME				
									CT-1	CT-2	CA	ESE	TOTAL
1	BS	BBT2301	Microbiology	3	-	-	3	3	15	15	10	60	100
2	PCC	BBT2302	Bioprocess Engineering	3	1	-	4	4	15	15	10	60	100
3	BS	BBT2303	Biochemistry	3	-	-	3	3	15	15	10	60	100
4	PCC	BBT2304	Analytical Techniques	3	-	-	3	3	15	15	10	60	100
5	HSMC	BBT2305	Effective Technical Communication	2	1	-	3	3	-	-	25	25	50
6	PCC	BBT2306	Bioprocess Calculations	3	-	-	3	3	15	15	10	60	100
7	BS	BBT2307	Microbiology Lab	-	-	2	2	1	-	-	25	25	50
8	BS	BBT2308	Biochemistry Lab	-	-	2	2	1			25	25	50
9	PCC	BBT2309	Analytical Techniques Lab	-	-	2	2	1			25	25	50
10	MCC	BAU2303	Environmental Science	2	-	-	2	Audit	-	-	-	-	-
			TOTAL	19	2	6	27	22	75	75	150	400	700

L- Lecture

T-Tutorial

P-Practical

CT1- Class Test 1

CT2- Class Test 2

CA- Continuous Assessment


ESE- End Semester Examination (For Laboratory: End Semester Performance)

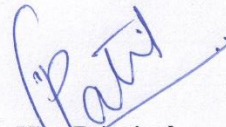
Course Category	HSMC (Hum., Soc. Sc, Mgmt.)	BSC (Basic Sc.)	ESC (Engg., Sc.)	BS (Biological Sc.)	PCC (Professional Core courses)	PEC (Professional Elective Courses)	OEC (Biological Sc.)	PROJECT (Project /Seminar/ Industrial Training)	MCC (Mandatory Courses)
Credits	3	-	-	8	11	--	--	--	Yes
Cumulative Sum	6	18	14	8	11	--	--	--	--


Progressive Total Credits: 35+22+ 57

  
BoS Chairman  
Head

Department Of Biotechnology  
Tulsiramji Gaikwad Patil Collage Of  
Engineering & Technology, Nagpur

  
Dean Academics  
Dean Academics  
Tulsiramji Gaikwad-Patil  
College Of Engineering  
and Technology, Nagpur

  
Vice-Principal  
Vice-Principal  
Tulsiramji Gaikwad-Patil  
College Of Engineering &  
Technology, Nagpur.

  
Principal  
Principal  
Tulsiramji Gaikwad Patil College Of  
Engineering and Technology, Nagpur



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## Scheme of Instructions and Syllabus

### Scheme of Instructions: Second Year B. Tech in Biotechnology

#### Semester IV

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME				
									CT-1	CT-2	CA	ESE	TOTAL
1	BS	BBT2401	Cell & Molecular Biology	3	-	-	3	3	15	15	10	60	100
2	BS	BBT2402	Biochemistry Metabolism	3	-	-	3	3	15	15	10	60	100
3	PCC	BBT2403	Green Biotechnology and Pollution Abatement	3	-	-	3	3	15	15	10	60	100
4	PCC	BBT2404	Bioinformatics And Computational Biology	3	-	-	3	3	15	15	10	60	100
5	PCC	BBT2405	Immunology and Immunotechnology	3	-	-	3	3	15	15	10	60	100
6	HSMC	BBT2406	Engineering Economics	3	-	-	3	3	15	15	10	60	100
7	BS	BBT2407	Cell & Molecular Biology Lab	-	-	2	2	1	-	-	25	25	50
8	BS	BBT2408	Biochemistry Metabolism Lab	-	-	2	2	1	-	-	25	25	50
9	PCC	BBT2409	Bioinformatics And Computational Biology Lab	-	-	2	2	1	-	-	25	25	50
10	PROJECT	BBT2410	Micro Project	-	-	2	2	1	-	-	25	25	50
11	MCC	BAU2404	Group Reading of Classics	2	-	-	2	Audit	-	-	-	-	-
Total				20	0	8	28	22	90	90	160	460	800

L- Lecture

T-Tutorial

P-Practical

CT1- Class Test 1


CT2- Class Test 2


CA- Continuous Assessment

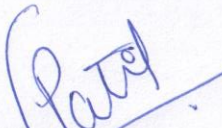
ESE- End Semester Examination (For Laboratory: End Semester Performance)

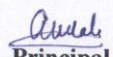
Course Category	HSMC (Hum., Soc. Sc, Mgmt.)	BSC (Basic Sc.)	ESC (Engg. Sc.)	BS (Biological Sc.)	PCC (Professional Core courses)	PEC (Professional Elective Courses)	OEC (Biological Sc.)	PROJECT (Project /Seminar/ Industrial Training)	MCC (Mandatory Courses)
Credits	3	-	-	8	10	--	--	1	Yes
Cumulative Sum	9	18	14	16	21	--	--	1	--

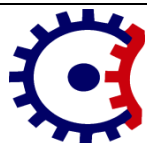
**Progressive Total Credits: 57+22= 79**

  
**BoS Chairman**  
**Head**  
Department Of Biotechnology  
Tulsiramji Gaikwad Patil Collage Of  
Engineering & Technology, Nagpur

  
**Dean Academics**  
Tulsiramji Gaikwad-Patil  
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Semester	Course Code	Name of Course	L	T	P	Credits
III	BBT2301	Microbiology	3	-	-	3

Teaching Scheme			Examination Scheme	
Theory	3 Hrs/week		CT-I	15 Marks
Tutorial	-		CT-II	15 Marks
Total Credits	3		CA	10 Marks
Duration of ESE: 3Hrs			ESE	60 Marks

**Course Contents**

<b>Unit I</b>	<b>Historical Background of Microbiology:</b> Introduction to Microbiology, History of Microbiology (Robert Hooke, Antony van Leeuwenhoek, Francesco Redii, Louis Joblot, H. Schroder and Von Dusch, Louis Pasteur, John Tyndall, Robert Koch, Joseph Lister, Alexander Fleming, Edward Jenner). Applied Microbiology: Industrial, Medicinal, pharmaceutical
<b>Unit II</b>	<b>Microbial Taxonomy:</b> Prokaryotes and eukaryotes, bacteria types and cell components Classification of microorganisms, bacterial classification and identification methods. Fungal classification and key identification characters. Algal characteristics, groups, and classification. Viruses: types, classification, and characters. Anaerobic and aerobic bacteria
<b>Unit III</b>	<b>Microbial Nutrition and Metabolism:</b> Nutritional Requirement of Microbes, Micro-nutrients and Macro-Nutrients. Types of Media: Defined media, Differential Media, Complex Media, Growth curve and different methods to quantify bacterial growth; aerobic and anaerobic bioenergetics and utilization of energy for the biosynthesis of important molecules
<b>Unit IV</b>	<b>Control of Microorganisms:</b> Physical and chemical control of microorganisms; microbial interactions; anti-bacterial, anti-fungal, and anti-viral agents, mode of action and resistance to antibiotics, clinically important microorganisms.
<b>Unit V</b>	<b>Applied Microbiology:</b> Primary metabolites, secondary metabolites and their applications; Food Preservation Methods; Production of enzymes by microbes, production of penicillin, alcohol, and vitamin B-12.

**Text Books**

1	The textbook of Microbiology (Pawar and Daginawala)
2	Microbiology: An Introduction, 13th Edition. Authors: Gerard J. Tortora

**Reference Books**

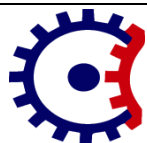
1	Overview of Microbiology, James D. Dick
2	Microbiology, Nina Parker, Mark Schneegurt

**Useful Links**

1	<a href="https://nptel.ac.in/courses/102103015">https://nptel.ac.in/courses/102103015</a>
2	<a href="https://microbiologysociety.org/">https://microbiologysociety.org/</a>
3	<a href="https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/industrial-microbiology">https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/industrial-microbiology</a>

Course Code	Course Outcomes	CL	Class Sessions	Lab Sessions
<b>BBT2301.1</b>	<b>Demonstrate</b> the microbiology regarding origin of life	3	9	-
<b>BBT2301.2</b>	<b>Analyze</b> of microbial taxonomy	4	9	-
<b>BBT2301.3</b>	<b>Choose</b> the composition for classification of different type of nutrient media	5	9	-
<b>BBT2301.4</b>	<b>Apply</b> appropriate methods for control of the growth of microorganisms	3	9	-
<b>BBT2301.5</b>	<b>Test</b> the appropriate methods for the production of microbial products	4	9	-





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**Program: B. Tech. Biotechnology**

Semester	Course Code	Name of Course	L	T	P	Credits
III	<b>BBT2302</b>	<b>Bioprocess Engineering</b>	3	1	-	4
<b>Teaching Scheme</b>			<b>Examination Scheme</b>			
<b>Theory</b>	<b>3 Hrs/week</b>			CT-I		15 Marks
<b>Tutorial</b>	<b>1</b>			CT-II		15 Marks
<b>Total Credits</b>	<b>4</b>			CA		10 Marks
<b>Duration of ESE: 3Hrs</b>				ESE		60 Marks

**Course Contents**

<b>Unit I</b>	<b>Isolation, preservation and improvement of industrial microorganism:</b> The isolation of industrially important microorganisms and Cell Banks, The preservation of industrially important microorganisms, The improvement of industrial microorganisms.
<b>Unit II</b>	<b>Media for industrial fermentations; optimization and sterilization:</b> Media design and formulation, Media sterilization, disposal of media. Optimization of parameters: physical parameters like temperature, pressure, surface tension, viscosity of the medium, etc. Chemical parameters like pH, salt concentration, dissolved oxygen. Medium optimization (Factorial Design)
<b>Unit III</b>	<b>Inocula development and fermentation kinetics:</b> The development of inocula for bacterial, streptomycete, yeast, fungal processes. The aseptic inoculation of plant fermenters, Fermentation Kinetics - Microbial Growth Kinetics (Development of growth equation, Quantifying cell concentration, Growth patterns and Kinetics), Substrate consumption kinetics, Product formation kinetics
<b>Unit IV</b>	<b>Aspects of Bioprocesses:</b> Introduction to GMP, QC and QA. Sterility, Toxicity and Product testing
<b>Unit V</b>	<b>Applications of Bioprocess Engineering:</b> Production of citric acid, amino acids, antibiotics, brewing of alcoholic products

**Text Books**

T.1	Pauline Doran, Bioprocess engineering principles
T.2	Michael Shuler, Fikret Kargi, Matthew DeLisa, Bioprocess Engineering: Basic Concepts, 3 <sup>rd</sup> Edition

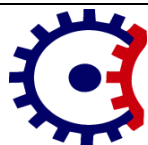
**Reference Books**

R.1	Colin Ratledge, Bjorn Kristiansen, Basic Biotechnology, 2nd Edition, Cambridge University Press, 2001
R.2	Bioreaction Engineering, Bioprocess Monitoring (Bioreaction Engineering) by Karl Schügerl

**Useful Links**

1	<a href="https://nptel.ac.in/courses/102105064">https://nptel.ac.in/courses/102105064</a>
2	<a href="https://www.researchgate.net/publication/281716235_Industrial_fermentation">https://www.researchgate.net/publication/281716235_Industrial_fermentation</a>
3	<a href="https://www.sciencedirect.com/topics/engineering/inoculum-development">https://www.sciencedirect.com/topics/engineering/inoculum-development</a>
4	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7466055/#:~:text=During%20fermentation%2C%20yeast%20cells%20convert,influence%20beer%20flavor%20%5B9%5D.">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7466055/#:~:text=During%20fermentation%2C%20yeast%20cells%20convert,influence%20beer%20flavor%20%5B9%5D.</a>

	<b>Course Outcomes</b>	<b>CL</b>	<b>Class Sessions</b>	<b>Lab Sessions</b>
<b>BBT2302.1</b>	<b>Analyze</b> the procuring and handling industrial microorganisms	4	8	-
<b>BBT2302.2</b>	<b>Formulate</b> the media for fermentations	6	9	-
<b>BBT2302.3</b>	<b>Illustrate</b> the concepts involved in upstream processes	4	9	-
<b>BBT2302.4</b>	<b>Test</b> the aspects of Bioprocesses in industry	5	9	-
<b>BBT2302.5</b>	<b>Break Down</b> the production of fermented products	4	8	-

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Semester	Course Code	Name of Course	L	T	P	Credits
III	<b>BBT2303</b>	<b>Biochemistry</b>	3	-	-	3

Teaching Scheme			Examination Scheme	
Theory	3 Hrs/week		CT-I	15 Marks
Tutorial	-		CT-II	15 Marks
Total Credits	3		CA	10 Marks
Duration of ESE: 3Hrs			ESE	60 Marks

**Course Contents**

<b>Unit I</b>	<b>Water and buffers:</b> Properties of water- solubility, ionization property and water as a reactant, pH and buffers and their importance.
<b>Unit II</b>	<b>Carbohydrates:</b> Classification, structure and function of carbohydrates. Chemical reaction of carbohydrate, physical and chemical properties of sugars, starch, pectin.
<b>Unit III</b>	<b>Amino Acids and proteins</b> Classification, structure of amino acids, Classification and structure of protein (primary, tertiary and quaternary). Denaturation and renaturation of protein. Nucleic acid: structure and type of DNA and RNA
<b>Unit IV</b>	<b>Enzymes, kinetics and inhibition:</b> Classification and nomenclature, concept of enzyme activity, Kinetics of single substrate enzyme catalyzed reaction- Michaelis-Menten equation, significance of Km and Vmax, turnover number, catalytic efficiency, modifications of Michaelis-Menten plot, allosteric enzymes, enzyme inhibition- reversible and irreversible inhibition, kinetics of inhibition
<b>Unit V</b>	<b>Fatty acids and lipids:</b> Classification, structure, properties, function of fatty acids. Classification, structure, properties and biological function of simple lipids – triacylglycerol, phospholipids and glycolipids. Cholesterol- structure, properties

**Text Books**

1	David L. Nelson and Michael M. Cox. 2017. Lehninger Principles of Biochemistry: International Edition. 7th edition, W.H. Freeman. USA.
2	Victor W. Rodwell, David A. Bender, Kathleen M. Botham, Peter J. Kennelly and P. Anthony Weil, 2015. Harpers Illustrated Biochemistry. 30th Edition, McGraw-Hill companies, Inc. USA

**Reference Books**

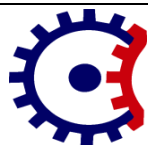
1	Enzymes, Second edition, Tavor Palmer and Philip Bonner, Horwood Publishing Series
2	Text Book of Biochemistry- Rao Rama V.S.S.; Narosa Pub. House, New Delhi

### Useful Links

1	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4576142/pdf/main.pdf">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4576142/pdf/main.pdf</a>
2	<a href="https://www.nature.com/scitable/topicpage/discovery-of-dna-structure-and-function-watson-397/">https://www.nature.com/scitable/topicpage/discovery-of-dna-structure-and-function-watson-397/</a>
3	<a href="https://wou.edu/chemistry/courses/online-chemistry-textbooks/ch450-and-ch451-biochemistry-defining-life-at-the-molecular-level/chapter-2-protein-structure/">https://wou.edu/chemistry/courses/online-chemistry-textbooks/ch450-and-ch451-biochemistry-defining-life-at-the-molecular-level/chapter-2-protein-structure/</a>

Course Code	Course Outcomes	CL	Class Sessions	Lab Sessions
<b>BBT2303.1</b>	<b>Analyze</b> the properties of water molecule	4	9	-
<b>BBT2303.2</b>	<b>Classify</b> the structure and function of carbohydrate	4	9	-
<b>BBT2303.3</b>	<b>Predict</b> the structure of amino acid and nucleic acid	3	9	-
<b>BBT2303.4</b>	<b>Asses</b> the enzyme kinetics.	4	9	-
<b>BBT2303.5</b>	<b>Formulate</b> the Fatty acids and lipid structure, properties, function	6	9	-





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**Program: B. Tech. Biotechnology**

Semester	Course Code	Name of Course	L	T	P	Credits
III	BIT2304	Analytical Techniques	3	-	-	3

Teaching Scheme			Examination Scheme	
Theory	3 Hrs/week		CT-I	15 Marks
Tutorial	-		CT-II	15 Marks
Total Credits	3		CA	10 Marks
Duration of ESE: 3Hrs			ESE	60 Marks

**Course Contents**

<b>Unit I</b>	<b>Microscopy introduction type function:</b> Principles of light microscopy Electron microscopy Multi-photon microscopy Fluorescent microscopy Confocal microscopy Atomic force microscopy absorption microscopy.
<b>Unit II</b>	<b>Centrifugation and Electrophoresis:</b> Sedimentation type of centrifugation type of rotors swing vertical fixed angle Ultracentrifugation and its application. Theory of electrophoresis technique electrophoresis of nucleic acids and protein blotting technique. Northern Blotting Western blotting pulsed field electrophoresis capillary electrophoresis.
<b>Unit III</b>	<b>Spectroscopy:</b> Introduction to principles and application of spectroscopic methods Beers Lambert Law single beam and double beam spectroscopy UV-Visible spectroscopy, Atomic absorption spectroscopy, IR, FTIR, Raman, Fluorescence spectroscopy, ESR spectroscopy.
<b>Unit IV</b>	<b>Chromatography:</b> Introduction to chromatographic techniques Theoretical basis of chromatographic separations. Column Thin layer, paper chromatography Normal phase and reversed phase chromatography, Ion-exchange, Affinity, Gas chromatography and High performance liquid chromatography, gel filtration & Hydrophobic, gas chromatography.
<b>Unit V</b>	<b>Protein Analysis:</b> solution and solid state NMR spectroscopy, X-ray crystallography, X-ray diffraction method, Mass spectroscopy –MALDI, LC-MS, GC-MS, proteomics introduction & basics..

<b>Text Books</b>	
1	Analytical Biotechnology 01 Edition: Thomas
2	Biophysical Chemistry : Upadhyay and Upadhyay Nath
<b>Reference Books</b>	
1	Biochemical Methods of analysis: Theory and Applications by Saroj Dua
2	Molecular and Biochemical analysis of Calreticulin by LezzeikFatme
<b>Useful Links</b>	
1	<a href="http://nptel.iitm.ac.in">http://nptel.iitm.ac.in</a>
2	<a href="https://www.sciencedirect.com/topics/engineering/fourier-transform-infrared-spectroscopy">https://www.sciencedirect.com/topics/engineering/fourier-transform-infrared-spectroscopy</a>

Course Code	Course Outcomes	CL	Class Sessions	Lab Sessions
<b>BBT2304.1</b>	<b>Evaluate</b> the microscopy results.	5	9	-
<b>BBT2304.2</b>	<b>Classify</b> the centrifugation and electrophoresis.	4	9	-
<b>BBT2304.3</b>	<b>Predict</b> spectroscopy results.	3	9	-
<b>BBT2304.4</b>	<b>Assess</b> chromatographic techniques.	5	9	-
<b>BBT2304.5</b>	<b>Formulate</b> Protein Analysis.	6	9	-

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Semester	Course Code	Name of Course	L	T	P	Credits
III	<b>BBT2305</b>	<b>Effective Technical Communication</b>	2	1	-	3

Teaching Scheme		Examination Scheme	
Theory	2 Hrs/week	CT-I	-
Tutorial	1	CT-II	-
Total Credits	3	CA	25 Marks
Duration of ESE: 3Hrs		ESE	25 Marks

**Course Contents**

<b>Unit I</b>	<b>Communication Skills:</b> Importance of communication, types, barriers of communication, effective communication, Listening Skills- Empathic listening, Avoid selective listening, social understanding, behaviors traits, teamwork.
<b>Unit II</b>	<b>Formal Correspondence:</b> Business Letters, e-mail etiquettes [Orders, Complaints, Enquiries, Job applications and Resume Writing, Writing Memorandum, Circulars, notices], Analytical comprehension.
<b>Unit III</b>	<b>Technical Writing:</b> Features of Technical Writing, Writing Scientific Projects, Technical Report writing, Writing Manuals, Writing Project Proposals, Writing Research papers.
<b>Unit IV</b>	<b>Presentation Skills:</b> Importance of oral presentation, planning the presentation, preparing the presentation, organizing your presentation, rehearsing presentation, checklist for making presentation. Leadership skills, decision making, negotiation skills, business etiquette, problem solving skills
<b>Unit V</b>	<b>Self-Development and Assessment:</b> Self-assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, taking notes; Complex problem solving; Creativity.

**Text Books**

1	Effective technical Communication by Barun K.Mitra,Oxford University Press
2	Technical Communication-Principles and Practice by Meenakshi Raman & Sharma, Oxford University Press,2011, ISBN-13-978-0-19-806529-

**Reference Books**

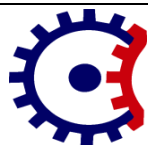
1	Organizational Behavior by Don Hellriegel, Jhon W. Slocum,Richard W. Woodman Meenakshi Raman "Technical Communication: Principles and practice"Oxford University press, India
2	Meenakshi Raman "Technical Communication: Principles and practice"Oxford University press, India

**Useful Links**

1	<a href="https://nptel.ac.in/courses/109104031">https://nptel.ac.in/courses/109104031</a>
2	<a href="https://www.coursera.org/learn/business-english-skills-how-to-navigate-tone-formality-directness-in-emails">https://www.coursera.org/learn/business-english-skills-how-to-navigate-tone-formality-directness-in-emails</a>
3	<a href="https://www.skillsyouneed.com/presentation-skills.html">https://www.skillsyouneed.com/presentation-skills.html</a>
4	<a href="https://in.indeed.com/career-advice/career-development/how-to-write-official-letter">https://in.indeed.com/career-advice/career-development/how-to-write-official-letter</a>

Course Code	Course Outcomes	CL	Class Sessions	Lab Sessions
<b>BBT2305.1</b>	<b>Determine</b> the barriers of communication and overcome those	3	9	-
<b>BBT2305.2</b>	<b>Justify</b> their messages through formal correspondence	5	8	-
<b>BBT2305.3</b>	<b>Categorize</b> their technical work	4	9	-
<b>BBT2305.4</b>	<b>Choose</b> the skills required for effective presentation	5	8	-
<b>BBT2305.5</b>	<b>Assess</b> themselves and <b>solve</b> the problems	5	9	-



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Semester	Course Code	Name of Course	L	T	P	Credits
III	<b>BBT2306</b>	<b>Bioprocess Calculations</b>	3	-	-	3

Teaching Scheme			Examination Scheme	
Theory	3 Hrs/week		CT-I	15 Marks
Tutorial	-		CT-II	15 Marks
Total Credits	3		CA	10 Marks
Duration of ESE: 3Hrs			ESE	60 Marks

**Course Contents**

<b>Unit I</b>	<b>Introduction to Engineering Calculations:</b> Units and Conversions, Density, Specific Gravity; specific volume, Mole Concept, chemical composition, Pressure, Temperature, standard Conditions, physical and chemical data, stoichiometry, atomic mass, molar mass, Equivalent mass, Normality, Molarity and Molality of micro and macromolecules.
<b>Unit II</b>	Ideal gases, partial pressure, vapour pressures, application of ideal gas laws, volume changes with changes of composition, dissociating gases, humidity and saturation, solubility and crystallization.
<b>Unit III</b>	Material balance without chemical reaction, separation, mixing, drying, crystallization. Basic concepts of recycle, bypass and purge streams. Recycle, purge and bypass calculations.
<b>Unit IV</b>	Material balance with chemical reaction, conversion and yield, Biochemical stoichiometry: Limiting and excess reactants conversion, degree of completion, selectivity, yields problems
<b>Unit V</b>	Fundamentals of energy balances, Law of conservation of energy, Heat capacity, sensible heat, latent heat, calculation of enthalpy changes. General energy balance equation and Energy balance calculations with and without reactions.

**Text Books**

1	Bioprocess Engineering Principles: Pauline M. Doran
2	Unit Operations of Chemical Engineering: Warren L. McCabe, Julian C. Smith, 5 <sup>th</sup> Edition

**Reference Books**

1	Chemical Process Principles: Hougen and Watson, Vols I & II
2	Stoichiometry: B I Vora and Bhatt
3	Stoichiometry: Williams and Johnson

**Useful Links**

1	<a href="https://nptel.ac.in/courses/102103015">https://nptel.ac.in/courses/102103015</a>
2	<a href="https://www.engr.colostate.edu/CBE101/topics/energy_balances.html">https://www.engr.colostate.edu/CBE101/topics/energy_balances.html</a>
3	<a href="https://www.sciencedirect.com/topics/engineering/ideal-gas">https://www.sciencedirect.com/topics/engineering/ideal-gas</a>

Course Code	Course Outcomes	CL	Class Sessions	Lab Sessions
<b>BBT2306.1</b>	<b>Apply</b> different units and conversions in bioprocess	3	8	-
<b>BBT2306.2</b>	<b>Illustrate</b> ideal gases and analyze their properties	4	9	-
<b>BBT2306.3</b>	<b>Assess</b> the methods of separation, mixing and crystallization	5	10	-
<b>BBT2306.4</b>	<b>Categories</b> material balance and biochemical stichometry	4	10	-
<b>BBT2306.5</b>	<b>Use</b> the energy balance calculations for the process with and without reactions	3	9	-



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**Program: B.TechBiotechnology**

Semester	Course Code	Name of Course	L	T	P	Credits
III	BBT2307	Microbiology Lab	-	-	2	1
<b>Teaching Scheme</b>					<b>Examination Scheme</b>	
Practical	2 Hrs/week				CT-I	-
Tutorial	-				CT-II	-
Total Credits	1				CA	25 Marks
					ESE	25 Marks

Sr. No.	List of Experiment
1	Media preparation, sterilization and disinfection
2	Microscopic examination of different groups of microorganisms
3	Total count and viable count determination
4	Microbial simple and differential staining methods
5	Isolation of pure culture and its preservation
6	Microbial Growth Curve Determination
7	Effect of physical and chemical environment on growth
8	Biochemical tests for microbial identification
9	Antibiotic Sensitivity of Microorganisms

**Text Books/Reference Books**

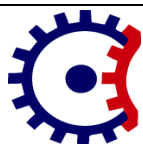
1	Prescott's Microbiology by Willey, Sherwood and Woolverton
2	Brock Biology of Microorganisms by Madigan, Martinko, Stahl and Clark
3	General Microbiology by Stanier, Ingraham, Wheelis and Painter.
4	Microbiology, M. Pelczar, E. Chan, N. Kreig, 5th ed, MGH.

**Useful Links**

1.	<a href="https://nptel.ac.in/courses/102/103/102103015/">https://nptel.ac.in/courses/102/103/102103015/</a>
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Course Code	Course Outcomes	CL	Class Sessions	Lab Sessions
<b>BBT2307.1</b>	<b>Classify</b> preparation of media and sterilization, disinfection techniques	4	-	4
<b>BBT2307.2</b>	<b>Illustrate</b> Isolation of pure culture and its preservation microbial growth curve Determination.	4	-	4
<b>BBT2307.3</b>	<b>Evaluate</b> the Antibiotic Sensitivity of Microorganisms	5	-	4
<b>BBT2307.4</b>	<b>Analyze</b> of Microbial Identification	4	-	4
<b>BBT2307.5</b>	<b>Asses</b> the isolation and its determination techniques	5	-	4





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### Program: B. Tech Biotechnology

Semester	Course Code	Name of Course	L	T	P	Credits
III	BBT2308	Biochemistry Lab	-	-	2	1
Teaching Scheme					Examination Scheme	
Practical	2 Hrs/week				CT-I	-
Tutorial	-				CT-II	-
Total Credits	1				CA	25 Marks
					ESE	25 Marks

Sr. No.	List of Experiments
1	Laboratory practices in biochemistry and reagent preparation (calculations)
2	Preparation of buffers
3	Quantitative estimation of amino acids
4	Quantitative and qualitative estimation of lipids
5	Quantitative estimation of proteins.
6	Estimation of RNA by orcinol reagent
7	Estimation of DNA by diphenylamine reagent method
8	Analyze the presence of carbohydrate both qualitatively and quantitatively.
9	To perform the enzyme immobilization by entrapment in alginate beads or by any other methods.

#### Text Books/

1	David L. Nelson and Michael M. Cox. 2017. Lehninger Principles of Biochemistry: International Edition. 7th edition, W.H. Freeman. USA.
2	Victor W. Rodwell, David A. Bender, Kathleen M. Botham, Peter J. Kennelly and P. Anthony Weil, 2015. Harpers Illustrated Biochemistry. 30th Edition, McGraw-Hill companies, Inc. USA.

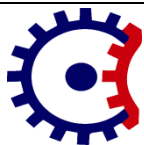
#### Reference Books

1	Enzymes, Second edition, Trevor Palmer and Philip Bonner, Horwood Publishing Series
2	Text Book of Biochemistry- Rao Rama V.S.S.; Narosa Pub. House, New Delhi

#### Useful Links

1.	<a href="https://nptel.ac.in/courses/102/103/102103015/">https://nptel.ac.in/courses/102/103/102103015/</a>
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<b>Course Code</b>	<b>Course Outcomes</b>	<b>CL</b>	<b>Class Sessions</b>	<b>Lab Sessions</b>
<b>BBT2308.1</b>	<b>Illustrate</b> the light microscopy	4	-	4
<b>BBT2308.2</b>	<b>Classify</b> Centrifugation and Electrophoresis	4	-	4
<b>BBT2308.3</b>	<b>Analyse</b> the protein characterization	4	-	4
<b>BBT2308.4</b>	<b>Asses</b> chromatographic techniques	5	-	4
<b>BBT2308.5</b>	<b>Formulate</b> Protein Analysis	6	-	4



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**Program: B. Tech Biotechnology**

Semester	Course Code	Name of Course	L	T	P	Credits
III	BBT2309	Analytical Techniques Lab	-	-	2	1
Teaching Scheme					Examination Scheme	
Practical	2 Hrs/week				CT-I	-
Tutorial	-				CT-II	-
Total Credits	1				CA	25 Marks
					ESE	25 Marks
Sr. No.	List of Experiment					
1	Understanding components of different kinds of microscopes.					
2	Analysis of proteins by western blotting techniques.					
3	Determination of adsorption spectrum and extinction coefficient.					
4	Purifications of proteins by salting out method.					
5	Size determination of yeast cell by centrifugal method.					
6	Demonstration of Electrophoresis (Proteins and Nucleic acid).					
7	Separation of amino acids by paper chromatography					
8	Separation of amino acids by thin layer chromatography					
Text Books/Reference Books						
1	Analytical Biotechnology 01 Edition: Thomas					
2	Biophysical Chemistry: Upadhyay and Upadhyay Nath					
Useful Links						
1.	<a href="https://nptel.ac.in/courses/102/103/102103015/">https://nptel.ac.in/courses/102/103/102103015/</a>					

Course Code	Course Outcomes	CL	Class Sessions	Lab Sessions
BBT2309.1	Evaluate the microscopy results.	5	-	4
BBT2309.2	Classify Centrifugation and Electrophoresis	4	-	4
BBT2309.3	Predict Spectroscopy:	3	-	4
BBT2309.4	Asses. chromatographic techniques	5	-	4
BBT2309.5	Formulate Protein Analysis	6	-	4



**BoS Chairman**

**Head**

Department Of Biotechnology  
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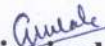
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**Vice Principal**

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**Program: B. Tech. (Audit Course)**

Semester	Course Code	Name of Course	L	T	P	Credits
III	BAU2303	Environmental Science	2	-	-	Audit
Teaching Scheme			Examination Scheme			
Theory	2Hrs/week		CT-I	-		
Tutorial	-		CT-II	-		
Total Credits	Audit		CA	-		
Duration of ESE: 2 Hrs			ESE	50 Marks (MCQ)		

**Course Contents**

<b>Unit I</b>	<b>Natural Resources:</b> Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Energy resources: Growing energy needs, use of alternate energy sources. Forest resources: Use and over-exploitation, deforestation, mining, dams and their effects on forest. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.
<b>Unit II</b>	<b>Ecosystems:</b> Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers. Energy flow in the ecosystem, Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems.
<b>Unit III</b>	<b>Environmental Pollution:</b> Definition, Cause, effects and control measures of: - a. Air pollution, b. Water pollution, c. Noise pollution, d. nuclear hazards. E-Solid waste Management: Causes, effects and control measures of urban and industrial wastes.

**Text Books**

1	Ecology and Environmental Science, Rana S.V.S, PHI Learning Private Ltd.
2	Environmental Science and Engineering, Anjali Bagad, PHI Learning Private Ltd.
3	Environmental Science, Fundamentals, Ethics & Laws, Shulka, Ashish & Others, I. K. International P. Ltd.

**Reference Books**


1	Environmental Science and Demystified, William Linda, Tata McGraw Hill
2	Essential of Ecology and Environmental Science, Rana SVS, Prentice Hall Of India.





3	Environmental Pollution Control Engineering, C S Rap, New Age International Publishers.
<b>Useful Links</b>	
1	<a href="https://youtu.be/NRoFvz8Ugeo">https://youtu.be/NRoFvz8Ugeo</a>
2	<a href="https://youtu.be/iMSwvJh1IA8">https://youtu.be/iMSwvJh1IA8</a>
3	<a href="https://youtu.be/els4M2QG0">https://youtu.be/els4M2QG0</a>

	Course Outcomes	CL	Class Sessions
BAU2303.1	<b>Examine</b> natural resources and their importance	3	8
BAU2303.2	<b>Illustrate</b> the energy flow in the ecosystem	3	8
BAU2303.3	<b>Predict</b> the causes of environmental pollution and preventive measures.	3	8

  
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