GOVT.V.Y.T.PG. AUTONOMOUS COLLEGE, DURG, 491001 (C.G.)

(Former Name – Govt. Arts &ScienceCollege, Durg)
NACC Accredited Grade 'A+' College; College with Potential of Excellence (UGC)
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Website – www.govtsciencecollegedurg.ac.in Email – pprinci2010@gmail.com

DEPARTMENT OF BIOTECHNOLOGY

SUBJECT – BIOTECHNOLOGY

BACHELOR OF SCIENCE (B.Sc.)

Semester- V, VI, VII & VIII

(Based on Choice Based Credit System)

2025-26

Part A: Introduction				
Program: BSc Biotechnology		Class: **BSc VSem**	Year: **2025**	Session:**2025-2026**
1	Course Code	**BBT-DSC-05**		
2	Course Title	**Immunology**		
3	Course Type	Core Course		
4	Pre-requisite (if any)	As per Government norms.		
5	About the course	The course is designed to develop understanding about immunology and analytical tools related to it.		
6	Course Learning Outcomes (CLO)	After completing this course the students will be able to - • Understand the immunological organizations. • To explore antigens, antibodies, and cytokines. • To explore the regulation of immunological factors. • To compete with pathogenic factors related to immunology.		
6	Credit Value	Theory : 3 + Practical 1 Total credit : 4		
7	Total Marks	Max. Marks: 75+25=100	Min Passing Marks : 40%	
8		External:Internal assessment is 80:20 (in percentage)		

Part B: **Content of the Course** Total No. of Lecturer (in hours per week): Total Lecturer: 60		
Unit	Topics	No. of Lectures
I	1. Immunology – General concept, history, and development. 2. Immune system and immunity. 3. Organization of the immune system. 4. Cells involved in the immune system.	12
II	1. Types of Antigens. 2. Types and structure of antibodies. 3. Antigen-antibody interaction. 4. Cytokines	12
III	1. Major histocompatibility complex. 2. T cell receptor. 3. B cell receptors. 4. Cell-mediated immunity.	12
IV	1. Immunohematology. 2. Monoclonal antibodies. 3. Complement system. 4. Hypersensitivity.	12

V	1. Vaccine. 2. Immunodeficient disease -Cancer and AIDS. 3. Autoimmune diseases: Hemolytic anemia, Rheumatoid arthritis, insulin-dependent diabetes, Myasthenia gravis. 4. Immunology of organ transplantation.	12

• Part C - **LearningResource**
Text Books, Reference Books, Other Resources -
1. Immunology – Kuby 2. Textbook of microbiology – Anantnarayan&Panikar 3. Immunology – Roitt 4. Immunology – NandiniSethi 5. Fundamentals of Immunology – William Paul 6. Immunology – A short course 5th Edn – Eli Benjamin

The syllabus for B.Sc. Biotechnology is hereby approved for the session 2025-26.

Name and Signatures	Expert from other subject – Prof. G. S. Thakur
University Nominee - Prof. K.K. Sahu	Teacher Representation - Dr. Nikhil Mishra
Subject Expert- Dr. Pramod Mahish	Industrial Representation – Mr. Premanjan Biswas
Subject Expert- Prof. M. M. Rai	Student Representation – Mr. Somendra Kumar
Chairperson – Dr. Shweta Pandey	Faculty Member – Mr. Dinesh Kumar

B. Sc. VSem Practical
Total No. of Classes (in hours per week): Total Credit: 01 (Classes 15) **CODE-BBT-DSC-P05**

B. Sc. VSemPRACTICALS (BBT-DSC-P05)

The practical work will be based on the theory syllabus and the students will be required to perform practical knowledge of the following content as below mention -

1. Blood film preparation and identification of cells.
2. Lymphoid organs and their microscopic organization.
3. Immunization, collection of serum.
4. Blood grouping concerning antigen-antibody interaction.
5. Rh factor determination.
6. Widal test.
7. VDRL test.
8. Ouchterlony Double diffusion for antigen-antibody pattern.
9. Rocket Immunoelectrophoresis.
10. Radial Immunodiffusion.
11. DOT ELISA.

Scheme of Practical Examination

Duration : 3 Hours **Maximum marks : 25**

Pass marks: 40%

Distribution of Marks :	Marks
1. Any one practical from each section (Total 4 practicals)	(4X4 = 16)
2. Viva-Voce -	04
3. Practical record –(CCE)-	05
	Total marks 25

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Part A: Introduction				
Program: BSc Biotechnology		Class: **BSc VSem**	Year: **2025**	Session:**2025-26**
1	Course Code	**BBT- DSE-03**		
2	Course Title	**Medical Biotechnology**		
3	Course Type	Elective Course		
4	Pre-requisite (if any)	To study this course, a student must have/had the subject Biotechnology in Semester First.		
5	About the course	The course is designed to develop understanding about medical biotechnology. After successful completion of third year course, student will be able to earn a Degree in Biotechnology.		
6	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Understand about rDNA technology and its outcome. • Understand about diagnostics methods. • Understand about tissue engineering and its therapeutics. Understand about immunodeficiency and biomarkers		
6	Credit Value	Theory : 3 + Practical 1 Total credit : 4		
7	Total Marks	Max. Marks: 75+25=100 | Min Passing Marks : 40%		
8		External:Internal assessment is 80:20 (in percentage)		

Part B: **Content of the Course**		
Total No. of Lecturer (in hours per week): Total Lecturer: 60		
Unit	Topics	No. of Lectures
I	1. Immunization- Immunization, live, killed, attenuated vaccine. 2. Subunit vaccine. 3. Recombinant DNA vaccine 4. Protein-based vaccines.	12
II	1. Transfusion of immuno-competent cells. 2. Stem cell therapy. 3. Antibody-based diagnosis. 4. Monoclonal antibodies as diagnostic reagents.	12
III	1. Diagnosis of bacterial, viral, and parasitic diseases by using ELISA. 2. Diagnosis of bacterial, viral, and parasitic diseases by using western blot 3. Concept of tissue engineering. 4. Cellular therapy.	12
IV	1. Role of scaffolds and growth factors. 2. Ethical issues. 3. Primary immunodeficiency -SCID. 4. X-linked agammaglobulinemia, Defects in complement system).	12

V	1. Secondary immunodeficiency (AIDS). 2. Organ dysfunction (Kidney, heart) 3. Biomarkers for organ dysfunctions. 4. Therapeutic intervention of uncontrolled cell growth.	12

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text book- **Essentials of immunology- S K Gupta** **A textbook of immunology- Latha P Madhavee**
• Immunology – Kuby • Textbook of microbiology – Anantnarayan&Panikar • Immunology – Roitt • Immunology – NandiniSethi • Fundamentals of Immunology – William Paul • Immunology – A short course 5thEdn – Eli Benjamin , Richard Coico
Online resources- https://archive.nptel.ac.in/courses/102/105/102105083/ https://archive.nptel.ac.in/courses/102/103/102103038/

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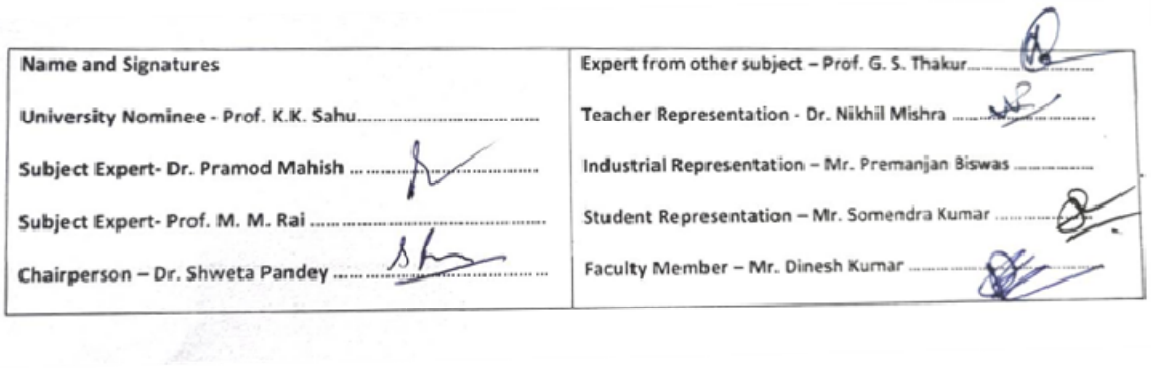

B. Sc. VSem Practical
Total No. of Classes (in hours per week): Total classes: 30

B. Sc. V SemPRACTICALS (BBT- DSE-P03)

The practical work will be based on the theory syllabus and the students will be required to perform practical knowledge of the following content as below mention -

1. Study of Ag-Ab reaction.
2. Widal test.
3. VDRL test.
4. Haemogram preparation.
5. TLC, DLC counting.
6. Hb estimation.
7. Total protein, albumin, and globulin estimation.
8. Lipid profiling.
9. Sugar testing.
10. SGPT/SGOT estimation.

Scheme of Practical Examination

Duration : 3 Hours **Maximum marks : 25**

Pass marks: 40%

Distribution of Marks : Marks

1. Any one practical from each section (Total 4 practicals) (4X4 = 32)
2. Viva-Voce - 04
3. Practical record –(CCE)- 05

Total marks 25

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Four Year Undergraduate Program (2024-28)

Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Honors)		Semester: **VSem**	Session:**2025-2026**
1	Course Code	**BBT-DSE-04**	
2	Course Title	**Pharmaceutical Biotechnology**	
3	Course Type	Elective course	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Understand about secondary metabolite production and applications. • Understand about antibiotics and their antimicrobial applications. • Understand the mechanism of disease-based drug action. • Develop concepts of pharmacokinetics and pharmacodynamics.	
6	Credit Value	03 Credits +1practical	(Credit = 15 Hours - learning & observation)
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Unit	Topic (Course content)	No. of Period
I	**Secondary metabolites** 1. Introduction to secondary metabolites. 2. Types and Medicinal Applications of Secondary Metabolites. 3. Production of Secondary metabolites in Plants through hairy Root Culture. 4. Factors affecting Secondary metabolite production (Precursors, Growth Factors, and Nutrients.	12
II	**Microbial exploitation** 1. Types and classification of antibiotics. 2. General characteristics of an Antimicrobial Drug. 3. Mechanism of action of antimicrobial agent. 4. Microbial Resistance to antibiotics and antimicrobial agents.	12
III	**Drug action** 1. Structure, and applications of antibacterial drug. 2. Mechanism of action. 3. Mechanism of action of anticancer drugs. 4. Mechanism of action of antiviral drugs	12
IV	**Drug action and protein engineering** 1. Mechanism of action of antidiabetic drugs 2. Mechanism of action antihypertensive drugs. 3. Protein engineering principles and	12

	4. Application of protein engineering	
V	**Regulatory mechanism of drugs** 1. Molecular biology and combinatorial drug discovery. 2. Concept of pharmacokinetics, 3. Concept of pharmacodynamics. 4. Drug delivery systems.	12

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
• **Text book-** FSK Barar- Pharmaceutical- Essentials of Pharmaceuticals- S.Chand ➢ S.P. Vyas, Dixit- Pharmaceutical Biotechnology-CBS Gupta P.K. - Biotechnology and Genomics, Rastogi Publication
Reference book- • Hugo W. B. and Russell A. D. - Pharmaceutical Microbiology -Wiley India • B.Razdan-Medicinal Chemistry-CBS • Satoskar, Bhandarkar- Pharmacology and Pharmacotherapeutics- Popular • Purohit, Saluja- Pharmaceutical Biotechnology-Student Edition
Online resources-https://nptel.ac.in/courses/104102113 https://onlinecourses.nptel.ac.in/noc19_bt23/preview

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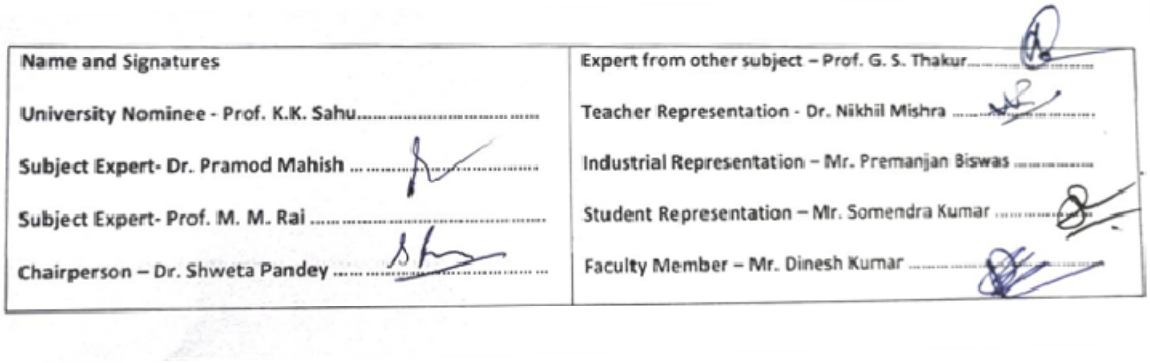

B. Sc. VSem Practical
Total No. of Classes (in hours per week): Total classes: 30

B. Sc. V SemPRACTICALS (BBT- DSE-P04)

The practical work will be based on the theory syllabus and the students will be required to perform practical knowledge of the following content as below mention -

1. Assay of antimicrobial activity of penicillin, streptomycin, and ciprofloxacin.
2. Antibiotic-resistant technique.
3. Microbial spoilage testing of pharmaceuticals.
4. Bioassay of antifungal compound.
5. Self-life determination of expired antibiotics.
6. Sterility testing for commercial pharmaceuticals.
7. Determination of minimum inhibitory concentration (mic) of antibiotics

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Scheme of Practical Examination

Duration : 3 Hours **Maximum marks : 25**

Pass marks: 40%

Distribution of Marks : Marks

1. Any one practical from each section (4X4 = 32)
   (Total 4 practicals)
2. Viva-Voce - 04
3. Practical record –(CCE)- 05

Total marks 25

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Subject Expert- Prof. M. M. Rai	Student Representation – Mr. Somendra Kumar
Chairperson – Dr. Shweta Pandey	Faculty Member – Mr. Dinesh Kumar

Part A: Introduction				
Program: BSc Biotechnology		Class: **BSc VSem**	Year: **2025**	Session:**2025-26**
1	Course Code	**BBT-SEC-05**		
2	Course Title	**Biopesticidesand Biofertilizer**		
3	Course Type	Skill Enhancement Course		
4	Pre-requisite (if any)	To study this course, a student must have/had the subject Biology in class 12th.		
5	About the course	The course is designed to develop understanding about basic knowledge of tools for diagnosis of various genetic variations.		
6	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Understand the basic concept of biofertilizers and biopesticides. • Understand the significance and applications of biofertilizers and biopesticides. • Develop skills for the production and application of biofertilizers. Develop skills for the production and application of biopesticides		
6	Credit Value	Theory 1+ Practical 1; Total credit : 2		
7	Total Marks	Max. Marks: 25+25=50	Min Passing Marks : 40%	
8		External:Internal assessment is 80:20 (in percentage)		

Part B: **Content of the Course**		
Total No. of Lecturer (in hours per week): Total Lecturer: 30		
Unit	Topics	No. of Lectures
I	1. Biofertilizers: classification and applications. 2. Symbiotic and asymbiotic process for nitrogen fixation. 3. Methods for production of biofertilizers. 4. Study of VA-mycorrhiza and its application. 5. Biopesticides: classification and applications. 6. Process of production of biopesticides. 7. Importance of *Trichoderma, Pseudomonas, and Bacillus* species as biocontrol agents. 8. Factors responsible for the effectiveness of bioagents against seed-borne and soil-borne pathogens.	30

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
• Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker • Bioinstrumentation, Webster • Advanced Instrumentation, Data Interpretation, and Control of Biotechnological

Processes, J.F. Van Impe,Kluwer Academic
- Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication

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B. Sc. VSem Practical
Total No. of Classes (in hours per week): Total classes: 30

B. Sc. V SemPRACTICALS (BBT-SEC-P05)

The practical work will be based on the theory syllabus and the students will be required to perform practical knowledge of the following content as below mention -

1. Media preparation to culture microorganisms.
2. Collection and isolation of agriculturally important microorganisms.
3. Identification and characterization of microorganisms.
4. Screening of superior strains using in vitro techniques.
5. Inoculum development.
6. Preparation of carrier.
7. Mixing of inoculum and carrier.
8. Efficiency check of developed inoculant by using pot experiments.

Scheme of Practical Examination

Duration : 3 Hours **Maximum marks : 25**

Pass marks: 40%

Distribution of Marks :	Marks
1. Any one practical from each section (Total 4 practicals)	(4X4 = 32)
2. Viva-Voce -	04
3. Field work – (CCE)-	2.5
4. Practical record –(CCE)-	2.5
	Total marks 25

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Subject Expert- Prof. M. M. Rai	Student Representation – Mr. Somendra Kumar
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Part A: Introduction				
Program: BSc Biotechnology		Class: **BSc VISem**	Year: **2026**	Session:**2025-2026**
1	Course Code	**BBT-DSC-06**		
2	Course Title	**General Biotechnology**		
3	Course Type	Core Course		
4	Pre-requisite (if any)	As per Government Norms.		
5	About the course	The course is designed to develop understanding about General Biotechnology, IPR and Plant Biotechnology.		
6	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Develop skills related to plant cell culture. • Develop competency for genetically modified plant products. • Understand the principles related to intellectual property rights. • Understand the principles related to industrial biotechnology.		
6	Credit Value	Theory : 3 + Practical 1 Total credit : 4		
7	Total Marks	Max. Marks: 75+25=100	Min Passing Marks : 40%	
8		External:Internal assessment is 80:20 (in percentage)		

Part B: **Content of the Course** Total No. of Lecturer (in hours per week): Total Lecturer: 60		
Unit	Topics	No. of Lectures
I	1. Callus &suspension cultures: Initiation and Maintenance of callus and suspension culture. 2. Single Cell Culture: Isolation and cloning of single cell & cell viability test. 3. Shoot tip culture: Rapid clonal propagation & production of virus-free plant. 4. Embryogenesis in Plant Tissue Culture: Somatic embryogenesis, Embryo culture & embryo rescue.	12
II	1. Haploid Plant Generation: Anther, Pollen, and ovary culture for production of hybrid plants. 2. Protoplast Culture: Protoplast isolation, fusion and its application in hybridization. 3. Plant transformation technology: Basis of tumor formation, Hairy root, Features of Ti &Ri plasmids, Use of Ti &Ri plasmids as vectors, Mechanism of DNA transfer. 4. Transgenic plants in crop improvement.	12

III	1. General introduction and scope of environmental biotechnology. 2. Environmental pollution and its types. 3. Control of pollution through biotechnology. 4. Waste water treatment: Physical, Chemical and Biological.	12
IV	1. Bio-fertilizer and Bio-pesticides. 2. IPR. 3. Global environmental problems: General introduction, Ozone depletion, Acid rain. 4. Greenhouse effect.	12
V	1. Bioreactors and its types. 2. Fermentation (Lactic acid, Alcohol). 3. Maintenance of industrial microorganisms. 4. Food technology: Introduction, Canning, Packing and Food preservation.	12

- Part C - **Learning Resource**

Text Books, Reference Books, Other Resources -

- Molecular Biology; Watson.
- Gene VIII; Benjamin Lewin.
- The Cell, A molecular Approach; Geoffrey M. Cooper.
- Molecular Biology of the Cell; Alberts
- Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing, 1987.
- Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition, B.R. Glick, J.J. Pasternak and C.L. Patten, 2010.
- Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989.
- Principles of Gene Manipulation 6th Edition, S.B.Primrose, R.M.Twyman and R.W. Old. Blackwell Science, 2001.

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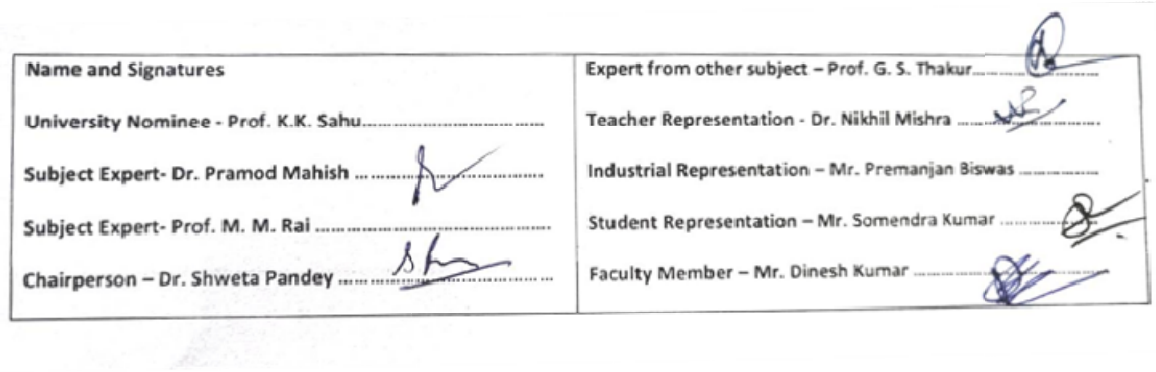

B. Sc. VI Sem Practical
Total No. of Classes (in hours per week): Total classes: 30

B. Sc. VISemPRACTICALS (BBT-DSC-P06)

The practical work will be based on the theory syllabus and the students will be required to perform practical knowledge of the following content as below mention -

1. Sterilization of plant materials.
2. Preparation of tissue culture media.
3. Plant tissue culture by plant parts.
4. Determination of total dissolved solids of water.
5. Determination of DO, BOD, COD of water.
6. MPN test.
7. Food preservation techniques.
8. Application of biopesticides on micro organisms.
9. Production of Citric acid by micro organisms.

Scheme of Practical Examination

Duration : 3 Hours **Maximum marks : 25**

Pass marks: 40%

Distribution of Marks : Marks

1. Any one practical from each section (4X4 = 32)

   (Total 4 practicals)
2. Viva-Voce - 04
3. Practical record –(CCE)- 05

Total marks 25

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Subject Expert- Dr. Pramod Mahish	Industrial Representation – Mr. Premanjan Biswas
Subject Expert- Prof. M. M. Rai	Student Representation – Mr. Somendra Kumar
Chairperson – Dr. Shweta Pandey	Faculty Member – Mr. Dinesh Kumar

Part A: Introduction				
Program: BSc Biotechnology		Class: **BSc VISem**	Year: **2026**	Session:**2025-26**
1	Course Code	**BBT- DSE-05**		
2	Course Title	**Agricultural Biotechnology**		
3	Course Type	Elective Course		
4	Pre-requisite (if any)	To study this course, a student must have/had the subject Biotechnology in Semester First.		
5	About the course	The course is designed to develop understanding about bioprocess engineering. After successful completion of second year course, student will be able to earn a Degree in Biotechnology.		
6	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Develop skills related to the use of microbes for the improvement of nitrogen fixation. • Develop skills related to the development of biofertilizers. • Understand about pathogens related to agriculture. Develop skills related to biopesticides development.		
6	Credit Value	Theory : 3 + Practical 1 Total credit : 4		
7	Total Marks	Max. Marks: 75+25=100	Min Passing Marks : 40%	
8		External:Internal assessment is 80:20 (in percentage)		

Part B: **Content of the Course**		
Total No. of Lecturer (in hours per week): Total Lecturer: 60		
Unit	Topics	No. of Lectures
I	1. Symbiotic nitrogen fixation. 2. Non symbiotic nitrogen fixation. 3. Nitrate assimilation and nitrification. 4. Phytohormones.	12
II	1. Concept and types of biofertilizers and Microbial inoculum. 2. Sulfur solubilizing biofertilizers. 3. Phosphate solubilizing biofertilizers. 4. Application of biofertilizers.	12
III	1. Concept of plant pathology. 2. Classification of plant diseases. 3. Pathogenesis mechanism related to enzymes, toxins, and nutrition. 4. Causative agent, symptoms, mechanism of action, and control majors of plant diseases caused by bacteria. Bacterial wilt, bacterial blight of rice,	12

IV	1. Causative agent, symptoms, mechanism of action, and control majors of plant diseases caused by fungus.(White rust of crucifer, Pawdery mildew of barley, Rad rot of sugarcane) 2. Causative agent, symptoms, mechanism of action, and control majors of plant diseases caused by virus. (Banchy top of banana, leaf curl of Papaya,	12
V	1. Definition and types of biopesticides 2. Advantages of biopesticides. 3. Composition, biomasses and its conversion. 4. Single-cell proteins and their nutritive values.	12

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Reference book- • Bilgrami KS and Dubey HG- Textbook of modern plant pathology, Vikas publication. • Guptal PK ad genetics and biotechnology in crop improvement- Rastogi Publication • Pathak VN Khatri, Pwathak M- Fundamentals of plant pathology- Arobotanoical publication. • Vyas S and Modi HA- Biofertisers and organic farming- AKTA Prakashan.

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Subject Expert- Prof. M. M. Rai	Student Representation – Mr. Somendra Kumar
Chairperson – Dr. Shweta Pandey	Faculty Member – Mr. Dinesh Kumar

B. Sc. VISem Practical
Total No. of Classes (in hours per week): Total classes: 30

B. Sc. VISemPRACTICALS (BBT- DSE-P05)

The practical work will be based on the theory syllabus and the students will be required to perform practical knowledge of the following content as below mention -

1. Isolation of Rhizobium sp.from root nodule of leguminous plant.
2. Isolation & Study of nonsymbiotic nitrogen-fixing organisms
3. Isolation and study of PSBs.
4. Estimation of leg hemoglobin from root nodule of leguminous plant.
5. Determination of IAA Oxidase activity.
6. Cultivation and study of Spirulina algae, Mushrooms
7. Study of community by quadrate method (Frequency, Density, and Abundance of Species)

Scheme of Practical Examination

Duration : 3 Hours **Maximum marks : 25**

Pass marks: 40%

Distribution of Marks : Marks

1. Any one practical from each section (4X4 = 32)

   (Total 4 practicals)
2. Viva-Voce - 04
3. Practical record –(CCE)- 05

Total marks 25

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Part A: Introduction				
Program: BSc Biotechnology		Class: **BSc VISem**	Year: **2026**	Session:**2025-26**
1	Course Code	**BBT- DSE-06**		
2	Course Title	Industrial and Environmental Biotechnology		
3	Course Type	Elective Course		
4	Pre-requisite (if any)	To study this course, a student must have/had the subject Biotechnology in Semester First.		
5	About the course	The course is designed to develop understanding about bioprocess engineering. After successful completion of second year course, student will be able to earn a Degree in Biotechnology.		
6	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Develop skills related to the use of microbes for the improvement of nitrogen fixation. • Develop skills related to the development of biofertilizers. • Understand about pathogens related to agriculture. Develop skills related to biopesticides development.		
6	Credit Value	Theory : 3 + Practical 1 Total credit : 4		
7	Total Marks	Max. Marks: 75+25=100	Min Passing Marks : 40%	
8		External:Internal assessment is 80:20 (in percentage)		

Part B: **Content of the Course** Total No. of Lecturer (in hours per week): Total Lecturer: 60		
Unit	Topics	No. of Lectures
I	1. Xenobiotic 2. Bioremediation 3. Phytoremediation 4. Applications of Bioremediation	12
II	1. Role of Environmental Biotechnology 2. Environmental Protection act 3. IPR 4. Patenting	12
III	1. Physical methods of waste water treatment 2. Chemical methods of waste water treatment 3. Biological methods of waste water treatment 4. Solid waste management	12
IV	1. Fundamental of fermentation technology 2. Downstream processing 3. Types of bioprocess- batch, fed-batch and continues 4. Growth kinetics	12

V	1. Media for bioprocess 2. Industrial sterilization of media and air 3. Measurement and control of bioprocess parameters 4. Microbial enhance oil recovery and bioleaching	12

- Part C - **Learning Resource**

Text Books, Reference Books, Other Resources -

Text Book-

- Murugesan A. G.andRajakumari C-Environmental Science and Biotechnology: Theory &Techniques, MJP
- Asthana D.K. and Asthana M.,-Environment: Problems and Solutions- S. Chand
- Chatterji A.K., Introduction to Environmental Biotechnology, Prentice Hall of India Pvt. Ltd

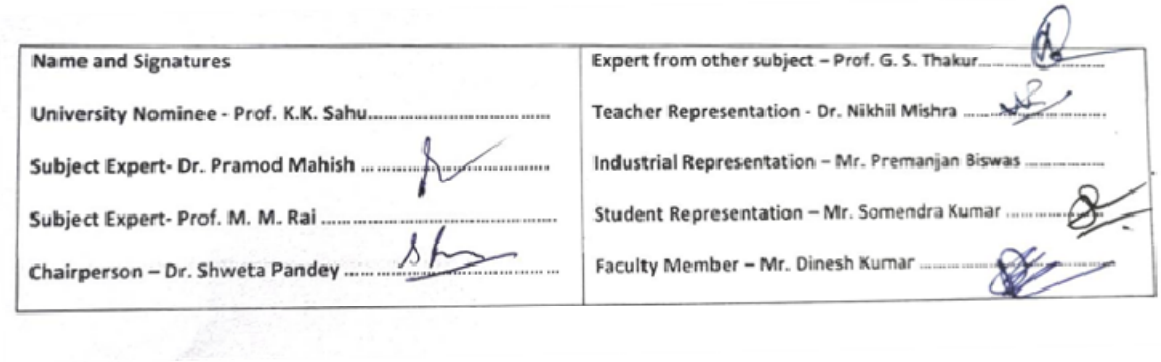
Reference Book-

- Jogdand S.N.- Environmental Biotechnology- Himalaya Publishing House
- Kalaichelvan P.T., I Arul Pandi- Bioprocess Technology, MJP Publishers
- Rajendran, Gunashekaran- Microbial Bioremediation-MJP
- Hammer & Hammer-Water & Wastewater Technology-PHI
- Metcaf& Eddy-Waste water Engineering-TMH
- Indushekhar Thakur- Environmental Biotechnology-I K Internation

Online resources- https://onlinecourses.nptel.ac.in/noc21_bt41/preview

http://acl.digimat.in/nptel/courses/video/102105088/102105088.html

The syllabus for B.Sc. Biotechnology is hereby approved for the session 2025-26.



B. Sc. VISem Practical
Total No. of Classes (in hours per week):
Total classes: 30
B. Sc. VISemPRACTICALS (BBT- DSE-P06)

The practical work will be based on the theory syllabus and the students will be required to perform practical knowledge of the following content as below mention -

1. Estimation of DO, BOD, CO.
2. MPN estimation.
3. TDS estimation.
4. Fermentation of grapes for production of wine.

Scheme of Practical Examination

Duration : 3 Hours **Maximum marks : 25**

Pass marks: 40%

Distribution of Marks :	Marks
1. Any one practical from each section (Total 4 practicals)	(4X4 = 32)
2. Viva-Voce -	04
3. Practical record –(CCE)-	05
	Total marks 25

The syllabus for B.Sc. Biotechnology is hereby approved for the session 2025-26.

Name and Signatures	Expert from other subject – Prof. G. S. Thakur
University Nominee - Prof. K.K. Sahu	Teacher Representation - Dr. Nikhil Mishra
Subject Expert- Dr. Pramod Mahish	Industrial Representation – Mr. Premanjan Biswas
Subject Expert- Prof. M. M. Rai	Student Representation – Mr. Somendra Kumar
Chairperson – Dr. Shweta Pandey	Faculty Member – Mr. Dinesh Kumar

Approved syllabus for Semester and CBCS curriculum of B.Sc. with Biotechnology, by the members of Board of Studies for

Session 2025-26

Semester VII	No. of Credits	Semester VIII For students opting B.Sc. Honours (with Biotechnology) CGPA (completion of VI Sem) < 7.5	No. of Credits	Semester VIII For students opting B.Sc. Honours (with Research) CGPA (completion of VI Sem) >=7.5	No. of Credits
BBT-DSC 07: Cell & inheritance biology	3	BBT-DSC-08 : Molecular biology	3	BBT-DSC-08 : Molecular biology	3
BBT-DSC-P-07: Cell & inheritance biology practical	1	BBT-DSC-P-08 Molecular biology practical	1	BBT-DSC-P-08 Molecular biology practical	1
Choose four DSE from the below pool		Choose four DSE from the below pool		Research Project/Dissertation Supervised by Teacher	12
BBT-DSE-07: Biomolecules and metabolism	3	BBT-DSE-11: Immunology	3	One DSE	
BBT-DSE-P-07: Biomolecules and metabolism practical	1	BBT-DSE-P-11: Immunology practical	1	BBT-DSE-11: Immunology	3
BBT-DSE-08: Microbes and Microbial genetics (3Th+1T)	4	BBT-DSE-12: Environmental biotechnology (3Th+1T)	4	BBT-DSE-P-11: Immunology practical	1
BBT-DSE-09: Biostatistics (3Th+1T)	4	BBT-DSE-13: Enzymology (3Th+1T)	4	BBT-DSE-12: Environmental biotechnology (3Th+1T)	4
BBT-DSE-10: Genomics (3Th+1T)	4	BBT-DSE-14: Proteomics (3Th+1T)	4	BBT-DSE-13: Enzymology (3Th+1T)	4
-	-	-	-	BBT-DSE-14: Proteomics (3Th+1T)	4

Part A: Introduction				
Program: BSc Biotechnology	Class: **BSc VIISem**	Year: **2025**	Session:**2025-2026**	
1	Course Code	**BBT-DSC-07**		
2	Course Title	**Cell and inheritance biology**		
3	Course Type	Core Course		
4	Pre-requisite (if any)	As per Government norms.		
5	About the course	The course is designed to develop understanding about cell and inheritance biology.		
6	Course Learning Outcomes (CLO)	➢ Understanding about cell cycle, signaling, communication and cancer. ➢ Exhaustive knowledge about cell membrane and cell organelles structure and functions. ➢ Skill development for gene mapping, pedigree analysis and phylognenetic interpretation. ➢ Concept development related to gene origin, duplication, convergence, drift and its frequency in population.		
6	Credit Value	Theory :3 + Practical 1 Total credit : 4		
7	Total Marks	Max. Marks: 75+25=100	Min Passing Marks : 40%	
8		External:Internal assessment is 80:20 (in percentage)		

Part B: **Content oftheCourse**		
Total No. of Lecturer (in hours per week): Total Lecturer: 45		
Unit	Topics	No. of Lectures
I	1. Cell cycle:Cell division and cell cycle, mitosis and meiosis, their regulation, steps in cell cycle and control of cell cycle. Cell death: Types of cell death (necrosis & apoptosis), mechanisms involved in cell apoptosis, importance and control of apoptosis. 2. Cell signaling: signaling molecules, second messengers cell surface receptors, intracellular receptors, signal transduction pathways. Cell communication: cell adhesion molecules, gap junctions, extra cellular matrix, integrins, neurotransmission & its regulation. 3. Biology of cancer cells: Properties of cancerous cells, development and causes of cancer, types of cancer cells, proto-oncogenes, oncogenes, tumour suppressor genes, metastasis, treatments of cancer. 4. Cytoskeleton: microtubules, kinesins&dyneins, cilia & flagella, centriole. actin filaments, myosin, muscle contraction, intermediate filaments.	12

II	1. Membrane structure and function: membrane composition and its structural organization, membrane transport (diffusion, osmosis, carriers &channels, active & passive transport), membrane potential. 2. Mitochondria and bioenergetics: organization and function of mitochondria, respiration, glycolysis, Kreb's cycle, Mitochondria and bioenergetics: electron transport chain, ATP synthase, anaplerotic reaction, inhibitors and uncoupling agents, fermentation, Entner-Doudoroff pathway. 3. Chloroplast: structure and function of chloroplast, photosynthetic pigments. Photosynthesis: stages of photosynthesis (light reaction-electron flow through PS I and PS II and dark reaction- C3, C4 and CAM cycle), photorespiration. 4. Endo membrane and membrane trafficking:protein targeting and translocation, transport of proteins across endoplasmic reticulum,mitochondria, nucleus, Golgi complex, vesicle fusion.	11
III	1. Basic principles of genetics: Mendelian genetics, monohybrid, dihybrid and trihybrid cross, principle of heredity. 2. Extension and modification of basic principles of genetics. 3. Pedigree analysis and application: basic rules for pedigree analysis, pedigree analysis of autosomal and sex inheritance related diseases, evolutionary pedigree. 4. Linkage and recombination: two point and three point cross.	11
IV	1. Quantitative genetics: polygenic inheritance, phenotypic variance, heritability. 2. Population genetics: genotypic and allelic frequency, Hardy-Weinberg rule, its deviation due to mutation, migration, genetic drift and natural selection. 3. Evolutionary genetics: molecular variation, biological species concept, molecular clock 4. Origin of new gene & proteins: transposable element protein domestication, lateral gene transfer, gene fusion and fission, de-novo gene origins, pseudo genes.	11

• Part C –**Learning Resource**
Text Books, Reference Books, Other Resources -
○ Molecular Biology of the Cell – Alberts ○ Molecular Cell Biology – Lodish ○ Cell and Molecular Biology – Gerald Karp ○ Cell biology – C.B.Powar ○ The Cell – Cooper

The syllabus for B.Sc. Biotechnology is hereby approved for the session 2025-26.

Name and Signatures	Expert from other subject – Prof. G. S. Thakur
University Nominee - Prof. K.K. Sahu	Teacher Representation - Dr. Nikhil Mishra
Subject Expert- Dr. Pramod Mahish	Industrial Representation – Mr. Premanjan Biswas
Subject Expert- Prof. M. M. Rai	Student Representation – Mr. Somendra Kumar
Chairperson – Dr. Shweta Pandey	Faculty Member – Mr. Dinesh Kumar

B. Sc. VIISem Practical
Total No. of Classes (in hours per week): Total Credit: 01 (Classes 15) **CODE-BBT-DSC-P**

B. Sc. VIISemPRACTICALS (BBT-DSC-P07)

The practical work will be based on the theory syllabus and the students will be required to perform practical knowledge of the following content as below mention -

1. Microscopy – Bright field, Phase contrast and fluorescence microscopy.
2. Microtomy- Histopathology.
3. Subcellular fractionation and marker enzymes.
4. Cell division by mitosis.
5. Mitotic index.
6. Effect of stress (pesticide, metels, radiation.) on cellular division.
7. Study of gaintchromosome&sex chromatin.
8. Preparation of Karyogram.
9. Plant tissue section and identification of cells.

Scheme of Practical Examination

Duration : 3 Hours **Maximum marks : 25**

Pass marks: 40%

Distribution of Marks :	Marks
1. Any one practical from each section (Total 4 practicals)	(4X4 = 16)
2. Viva-Voce -	04
3. Practical record –(CCE)-	05
	Total marks 25

The syllabus for B.Sc. Biotechnology is hereby approved for the session 2025-26.

Name and Signatures	Expert from other subject – Prof. G. S. Thakur
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Subject Expert- Prof. M. M. Rai	Student Representation – Mr. Somendra Kumar
Chairperson – Dr. Shweta Pandey	Faculty Member – Mr. Dinesh Kumar

Part A: Introduction				
Program: BSc Biotechnology		Class: **BSc VIISem**	Year: **2025**	Session:**2025-2026**
1	Course Code	**BBT-DSE-07**		
2	Course Title	**Bio-molecules and metabolism**		
3	Course Type	Elective Course		
4	Pre-requisite (if any)	As per Government norms.		
5	About the course	The course is designed to develop understanding about cell and inheritance biology.		
6	Course Learning Outcomes (CLO)	➢ Understanding about world of proteins. ➢ Understanding about carbohydrates, lipids and glycoconjugates. ➢ Knowledge development about nucleic acid, PPP, metabolism and integration of metabolism. ➢ Concept development related to metabolism and biosynthesis of amino acids and fatty acids.		
6	Credit Value	Theory :3 + Practical 1 Total credit : 4		
7	Total Marks	Max. Marks: 75+25=100	Min Passing Marks : 40%	
8		External:Internal assessment is 80:20 (in percentage)		

Part B: **Content of theCourse**		
Total No. of Lecturer (in hours per week): Total Lecturer: 45		
Unit	Topics	No. of Lectures
I	1. Amino acid: general structure, classification, optical properties, titration and peptides: peptide bond and types of peptide, biological role of peptides. 2. Structure of proteins: primary, secondary, tertiary and quaternary structures, Ramachandran plot, protein sequencing. 3. Protein functions: structure and function of myoglobin and haemoglobin. 4. Isolation and purification of protein: salting in and salting out, fractionation, dialysis, column chromatography, affinity chromatography, electrophoresis, isoelectric focusing, 2D electrophoresis.	12
II	1. Carbohydrates: carbohydrate as informational molecule: the sugar code, role of lectin, lectin-carbohydrate interaction, proteoglycans, glycoproteins and glycolipids. 2. Lipids structure and properties of important members of storage and membrane lipids, lipoproteins. 3. Lipid as signal, cofactors and pigments: mechanism of action of eicosanoids, steroid hormones,vitaminD and vitamin A, dolichols.	11

	4. Lipid extraction methods: Role of organic solvents and method of extraction, Determination of lipid structure:	
III	1. Nucleic acid chemistry: denaturation of nucleic acid, hybrid formation of nucleic acid from different species, non-enzymatic transformation of nucleotides and nucleic acid, DNA Sequencing (Maxam Gilbert and Sanger's Method). 2. Pentose Phosphate Pathaway: Oxidative and Non-oxidative phase, Regulation of PPP, Biological significance. 3. Metabolism of Acylglycerol: Biosynthetic pathway (Synthesis of Phosphatidic acid and Acylglycerol), Regulation of acylglycerolsynthesis. Sphingolipids: Biosynthetic pathway, Sphingolipidmetabolism in pathogenesis of human diseases, Regulation of pathway. 4. Integration of metabolism: Tissue specific metabolism, Hormonal regulation of metabolism, Obesity and regulation of body mass, Metabolic Syndrome.	11
IV	1.Phosphoryl group transfer and ATP: Free energy change, Hydrolysis of ATP, other phosphorylated compounds and thioesters, Energy production by ATP, Biological role of ATP. 2.General Aspects of Amino acid Metabolism: Amino acid pool (Sources & Utilization), Transamination (Mechanism), Deamination (Oxidative & Non-oxidative), Metabolism of Ammonia (Formation, Transport, Storage, functions, Disposal & Toxicity), Urea Cycle (Reactions & Energetics, Regulation, Disposal, Linkage with TCA cycle). 3.Biosynthesis of amino acids:Biosynthetic pathway of amino acids, Regulation of biosynthesis. 4.Biosynthesis of fatty acids: Site, Fatty acid synthetase, Biosynthetic pathway, Regulation.	11

• Part C - **LearningResource**
Text Books, Reference Books, Other Resources -
○ Lehninger Principles of Biochemistry; Nelson & Cox. ○ Biochemistry; Voet& Pratt. ○ Biochemistry; Stryer. ○ Harper's Illustrated Biochemistry; Robert Murray et al. ○ Practical Biochemistry; Wilson & Walker.

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Chairperson – Dr. Shweta Pandey	Faculty Member – Mr. Dinesh Kumar

B. Sc. VIISem Practical
Total No. of Classes (in hours per week): Total Credit: 01 (Classes 15) **CODE-BBT-DSE-P**

B. Sc. VIISemPRACTICALS (BBT-DSE-P07)

The practical work will be based on the theory syllabus and the students will be required to perform practical knowledge of the following content as below mention -

1. Titration of Amino acid
2. Colorimetric determination of pK.
3. Isolation and characterization of α Lactalbumin
4. Characterization and purification of triacyglycerol in natural oils.
5. Identification of serum glycoprotein by SDS PAGE and Western blot
6. Isolation of and characterization of plant pigments
7. Separation of protein by Native PAGE
8. Separation of amino acids by paper electrophoresis
9. Estimation of protein by Follinlowry method
10. Estimation of DNA by diphenyl amine method
11. Estimation of RNA by Orcinol Method
12. Estimation of reducing sugar by DNS method
13. Measurement of cholesterol and Vit. C in biological sample.

Scheme of Practical Examination

Duration : 3 Hours **Maximum marks : 25**

Pass marks: 40%

Distribution of Marks :	Marks
1. Any one practical from each section (Total 4 practicals)	(4X4 = 16)
2. Viva-Voce -	04
3. Practical record –(CCE)-	05
	Total marks 25

The syllabus for B.Sc. Biotechnology is hereby approved for the session 2025-26.

Name and Signatures	Expert from other subject – Prof. G. S. Thakur
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Subject Expert- Prof. M. M. Rai	Student Representation – Mr. Somendra Kumar
Chairperson – Dr. Shweta Pandey	Faculty Member – Mr. Dinesh Kumar

Part A: Introduction				
Program: BSc Biotechnology		Class: **BSc VIISem**	Year: **2025**	Session:**2025-2026**
1	Course Code	**BBT-DSE-08**		
2	Course Title	**Microbes and Microbial genetics**		
3	Course Type	Elective Course		
4	Pre-requisite (if any)	As per Government norms.		
5	About the course	The course is designed to develop understanding about cell and inheritance biology.		
6	Course Learning Outcomes (CLO)	➢ Development of understanding for microbial taxonomy and hierarchy. ➢ Knowledge of pathogenesis caused by bacteria, viruses, fungi, protistans and prions. ➢ Concept development related to microbial genomics and proteomics. ➢ Knowledge development of transposons, transduction, conjugation and quorum sensing.		
6	Credit Value	Theory :3 +Tutorial 1 Total credit : 4		
7	Total Marks	Max. Marks: =100	Min Passing Marks : 40%	
8		External:Internal assessment is 80:20 (in percentage)		

Part B: **Content of theCourse**		
Total No. of Lecturer (in hours per week): Total Lecturer: 45		
Unit	Topics	No. of Lectures
I	**1.** Eubacteria: fine structure, culture characteristics, classification of bacteria based on nutrition, economics importance. **2.** Archeobacteria: fine structure, major groups, culture characteristics, **3.** Bacterial reproduction and growth: binary fission, budding, growth curve. 4. Fungi: general character fungi, classification of fungi, nutrition and reproduction	12
II	1. Microbial regulation of gene expression: the trp and lac operon. 2. Microbial interaction with humans: beneficial and harmful microbial interaction with humans, virulence factors and toxins. 3. Quorum sensing:types and mechanism of quorum sensing in prokaryotes,molecules involved, quorum quenching, and biological importance. 4. Disease epidemiology general concept, microbial pathogenesis.	11
III	1. Human disease caused by virus: small pox, chicken pox, hepatitis, rabies, Ebola and SARS COV2, control and treatment of all diseases. 2. Human diseases caused by bacteria: diphtheria, cholera, pneumonia, tetanus, typhoid, tuberculosis, control, and treatment of all diseases.	11

	3. Human diseases caused by protista: malaria, amoebic dysentry, sleeping sickness, kalaazar. 4. Human diseases caused by fungus:aspergillosis, blastomycosis, candidiasis, control and treatment of all diseases.	
IV	1. Bacteriophage transduction: structure of bacteriophage, mechanism of infection, genomic structure, establishment of lytic and lysogeny and choice between lytic or lysogenic phases, use of biotechnological applications of bacteriophages. 2. Bacterial genetics conjugation and transformation. 3. Bacterial transposons: transposition, classes of transposable elements, mechanism of transposition. 4. Retrotransposons: importance oftransposable elements and their regulation.	11
	Tutorial	
	Discussion on : 1. Preparation of solid and liquid media for growth of microorganisms. 2. Isolation & maintenance of organism by plating, streaking & serial dilution method. 3. Isolation of pure culture from soil, air and water. 4. Bacterial growth curve, effect of temperature, pH, Carbon and Nitrogen on growth curve. 5. Microscopic examination of microbes by staining methods. 6. Study of mutation by Ames test. 7. Antibiotic sensitivity test. 8. Biochemical characterization of selected microbes.	15

- Part C –**Learning Resource**

Text Books, Reference Books, Other Resources -

- Microbiology – Prescott
- Microbiology – Pelczar&Pelczar
- General Microbiology I and II – Powar and Daginawala
- Microbiology – Tortora
- Microbiology – Brock

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Subject Expert- Dr. Pramod Mahish	Teacher Representation - Dr. Nikhil Mishra
Subject Expert- Prof. M. M. Rai	Industrial Representation – Mr. Premanjan Biswas
Chairperson – Dr. Shweta Pandey	Student Representation – Mr. Somendra Kumar
	Faculty Member – Mr. Dinesh Kumar

Part A: Introduction				
Program: BSc Biotechnology		Class: **BSc VIISem**	Year: **2025**	Session:**2025-2026**
1	Course Code	**BBT-DSE-09**		
2	Course Title	**Biostatistics**		
3	Course Type	Elective Course		
4	Pre-requisite (if any)	As per Government norms.		
5	About the course	The course is designed to develop understanding about cell and inheritance biology.		
6	Course Learning Outcomes (CLO)	➢ Development of understanding about principle and arrangement of statistical data. ➢ Understanding about central tendencies and dispersion. ➢ Skill development related to test of significance. ➢ Skill development related to probability, correlation and regression		
6	Credit Value	Theory :3 + Practical 1 Total credit : 4		
7	Total Marks	Max. Marks: 100	Min Passing Marks : 40%	
8		External:Internal assessment is 80:20 (in percentage)		

Part B: **Content of theCourse** Total No. of Lecturer (in hours per week): Total Lecturer: 60		
Unit	Topics	No. of Lectures
I	1. Classification of data: Objective of classification, rules for classification, methods for classification. 2. Tabulation of data: Distinction between classification and tabulation, rules or main points of table, type a table, bivarate table. 3. Diagram presentation of data: General rule for constructing diagram, kinds of diagram. 4. Graphical presentation of data: Technique for construction of graphs, rule for constructing graph, histograms, false base line, gantt chart, silhouette graph, zone graph, component part graph, zec chart, histogram of two different scales, graph of frequency distribution.	12
II	1. Mean: Arithmetic mean- individual series, discrete series, continuous series, geometric mean, harmonic mean. 2. Median: Individual series, discrete series, continuous series. 3. Mode: Individual series, discrete series, continuous series. 4. Measure of dispersion: standard deviation, standard error	12
III	1. Test of Significance: Based on t distribution. - test of significance of sample-‘t’,test of significance of difference between two sample means, the difference test paired sample.	12

	2. Fisher 'Z' test: Test of significance between the observed and calculated value of r. 3. Variance: Ratio test-f test. 4. Chi- square test: Test of goodness of fit, characteristics of chi- square , special properties of chi- square	
IV	1. Analysis of Variance: One-way analysis of variance,two-way analysis of variance. 2. Probability: Calculation of probability, events, addition theorem, multiplication theorem. 3. Correlation:Types of correlation, degree of correlation, different methods to find out correlation. 4. Regression: Linear regression, regression coefficient.	12
	Tutorial	15
	Problems on: 1. Calculation of Central Tendencies. 2. Experiments related to test of significance. 3. Histogram. 4. Correlation and Regression. 5. Data analysis by ANOVA.	

• Part C –**Learning Resource**
Text Books, Reference Books, Other Resources -
○ Statistics- Dr.S.P. Singh. ○ Biostatistics- KHAN & KHAN. ○ Advance statistics Analysis ○ Statistics- D.N. Allhance.

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Chairperson – Dr. Shweta Pandey	Faculty Member – Mr. Dinesh Kumar

Course Curriculum

Part A: Introduction			
Program: Bachlor in Life Sciences (Honors)		Semester: **VIISem**	Session:**2024-2025**
1	Course Code	**BBT-DSE-10**	
2	Course Title	**Genomics**	
3	Course Type	Elective course	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Analyse and interpret genomic data. • Develop competency related to genomic and epigenomic alteration. • Understand about gene expression and regulation. • Develop an understanding of various RNA interphases.	
6	Credit Value	Theory :3 + Practical 1 Total credit : 4	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)

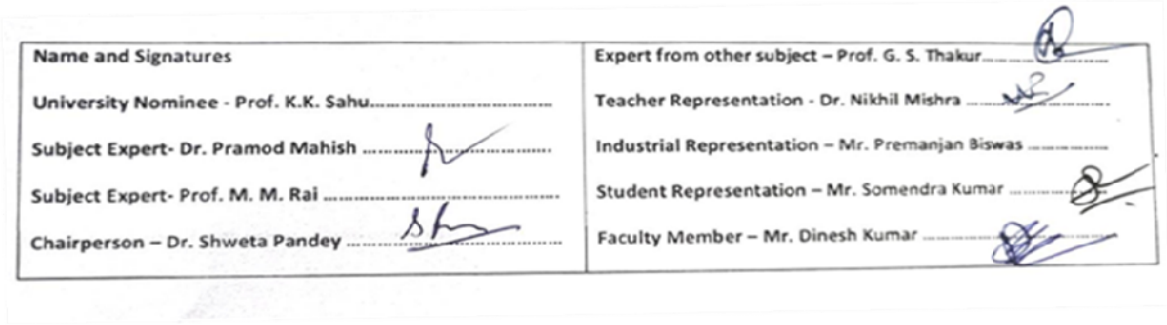
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)

Unit	Topic (Course content)	No. of Period
I	1. Genomics- Introduction, comparative genomics, Cot and Rot value, forward and reverse genetics. 2. DNA sequence analysis methods: Sanger dideoxy method and fluorescence method. 3. Gene variation and Single Nucleotide Polymorphisms (SNPs); Expressed sequenced tags (ESTs). 4. Genedisease association.	12
II	1. Epigenetic control of gene expression- DNA methylation and its role in gene expression. 2. Genome stability by DNA methylation. 3. Chromatin modifications implicated in gene silencing and activation. 4. Epitranscriptome- resetting the epigenome.	11
III	1. Transcriptional control of gene expression- Gene architecture, promoter architecture. 2. Regulation sequences, enhancers, and mechanism of their action. 3. Mediator complex and general transcription factors. 4. DNA binding and activation domains, activation of latent activators, and co-activators.	11
IV	1. Post-transcriptional control of gene expression- Introns and exons, mechanism of RNA splicing. 2. Polyadenylation. 3. Small RNA and RNA interference. 4. Catalytic RNA.	11

Tutorial		
	Discussion on problem solving : 1. Cot and Rot value. 2. Experiments associated with molecular markers. 3. In depth understanding of genome organization. 4. Understanding the post transcriptional mechanism of RNA modification.	15

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
➢ **Text books-Introduction to genomics- A M Lesk** ➢ **Genome analysis and bioinformatics- T R Sharma**
Reference book- ➢ Latchman DS (2015), Gene control, Garland Science, New York. • Krebs, JE, Goldstein ES, Kilpatrick SJ (2014) Lewins Genes XI, Jones Bartlett Publishers.
Online resources- https://onlinecourses.nptel.ac.in/noc21_bt39/preview https://nptel.ac.in/courses/102103017

The syllabus for B.Sc. Biotechnology is hereby approved for the session 2025-26.



Part A: Introduction					
Program: BSc Biotechnology		Class: **BSc VIIISem**	Year: **2026**	Session:**2025-2026**	
1	Course Code	**BBT-DSC-08**			
2	Course Title	**MOLECULAR BIOLOGY**			
3	Course Type	Core Course			
4	Pre-requisite (if any)	As per Government norms.			
5	About the course	The course is designed to develop understanding about cell and inheritance biology.			
6	Course Learning Outcomes (CLO)	➢ Development of understanding for DNA replication, mutation, transcription and translation. ➢ Knowledge development about recombination, inheritance of non-genomic DNA and cancer. ➢ Knowledge development about molecular chaperons, epigenetic mechanism, and gene regulation. ➢ Development of understanding about evolution of RNA, its catalytic role and contribution in evolution of genome and its regulation.			
6	Credit Value	Theory :3 + Practical 1 Total credit : 4			
7	Total Marks	Max. Marks: 75+25=100	Min Passing Marks : 40%		
8		External:Internal assessment is 80:20 (in percentage)			

Part B: **Content oftheCourse**		
Total No. of Lecturer (in hours per week): Total Lecturer: 45		
Unit	Topics	No. of Lectures
I	1. DNA replication: Enzymes of DNA replication, chemistry of DNA replication, replication fork, mechanism and regulation of replicationin prokaryotes and eukaryotes. 2. DNA damage, mutation and: causes and consequences of dna damage, mutagens, molecular basis of mutation, types of mutations, DNA repairs (direct repair, excision repair,mismatch repair, recombination repair, sos response). 3. Transcription: RNA polymerase and transcription unit, transcriptionin prokaryotes and eukaryotes, activators, co-activators, enhancers,motifs. post transcriptional modifications (capping, polyadenylation,splicing, RNA editing, processing of pre-tRNAand r-RNA), 4. Translation: Translational machinery components,genetic code and Wobble hypothesis, process of translation (initiation, elongation and termination in prokaryotes &eukaryotes) translation regulation(translation dependent regulation of mRNA and protein stability), post translational modification of peptides (chemical modification,proteolytic cleavage and protein splicing).	12

II	1. DNA recombination**:** Types of recombination (homologous and site specific recombination), models of homologous recombination, protein machinery involved in homologous recombination, biological importance of recombination. 2. Maintenance of DNA sequence**:** nucleosome model, Barr bodies,role of methylation, telomerization, phosphorylation, acetylation and deacetylation in the maintenance of DNA sequences. 3. Genetic system of mitochondria and plasmids: introduction, mt and cpDNA, chloroplast inheritance: Corren's experiment, maternal inheritance of mitochondria in humans, mitochondrial mutation and human diseases. 4. Molecular chaperons: location and function, human chaperone proteins, bacterial chaperone, nomenclature, clinical significance.	11
III	**1.** Proteasomes: ubiquitination, structure and organization, assembly, protein degradation process, inhibitors, biological role, clinical significance. **2.** Epigenetic mechanism: heterochromatin and histones, cpgiland, chromosome condensation. **3.** Overview of gene control: operon and its types, gene control in establishment of lytic and lysogeny, restricting multiple replication in prokaryotes and eukaryotes. **4.** DNA binding and motif in gene regulatory protein: types, function, structure, DNA binding protein in genomes.	11
IV	1. RNA world and origin of life 2. Genome sequences and evolution. 3. Catalytic RNAs 4. Non-coding and regulatory RNAs.	11

- Part C –**LearningResource**

Text Books, Reference Books, Other Resources -

- Molecular Biology; Watson.
- Gene VIII; Benjamin Lewin.
- The Cell, A molecular Approach; Geoffrey M. Cooper.
- Molecular Biology of the Cell; Alberts
- Cell and Molecular Biology; Lodish.
- Cell and Molecular biology; Gerrald& Karp

The syllabus for B.Sc. Biotechnology is hereby approved for the session 2025-26.

Name and Signatures	Expert from other subject – Prof. G. S. Thakur
University Nominee - Prof. K.K. Sahu	Teacher Representation - Dr. Nikhil Mishra
Subject Expert- Dr. Pramod Mahish	Industrial Representation – Mr. Premanjan Biswas
Subject Expert- Prof. M. M. Rai	Student Representation – Mr. Somendra Kumar
Chairperson – Dr. Shweta Pandey	Faculty Member – Mr. Dinesh Kumar

Total No. of Classes (in hours per week):
Total Credit: 01 (Classes 15)
CODE-BBT-DSE-P

The practical work will be based on the theory syllabus and the students will be required to perform practical knowledge of the following content as below mention -

1. Isolation of genomic DNA.(Plant , Bacteria, Fungus)
2. Isolation of RNA.
3. Isolation of plasmid DNA
4. DNA Purification.
5. RNA purification
6. DNA molecular size determination
7. Southern blotting.
8. Whole blood DNA extraction
9. Action of T4 DNA ligase
10. Taq DNA polymerase action

Scheme of Practical Examination

Duration : 3 Hours **Maximum marks : 25**

Pass marks: 40%

Distribution of Marks :	Marks
1. Any one practical from each section (Total 4 practicals)	(4X4 = 16)
2. Viva-Voce -	04
3. Practical record –(CCE)-	05
	Total marks 25

The syllabus for B.Sc. Biotechnology is hereby approved for the session 2024-25-26-27.

Name and Signatures	Expert from other subject – Prof. G. S. Thakur
University Nominee - Prof. K.K. Sahu	Teacher Representation - Dr. Nikhil Mishra
Subject Expert- Dr. Pramod Mahish	Industrial Representation – Mr. Premanjan Biswas
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Chairperson – Dr. Shweta Pandey	Faculty Member – Mr. Dinesh Kumar

Part A: Introduction					
Program: BSc Biotechnology		Class: **BSc VIIISem**	Year: **2026**	Session:**2025-2026**	
1	Course Code	**BBT-DSE-11**			
2	Course Title	**Immunology**			
3	Course Type	Elective Course			
4	Pre-requisite (if any)	As per Government norms.			
5	About the course	The course is designed to develop understanding about cell and inheritance biology.			
6	Course Learning Outcomes (CLO)	➢ Understanding about cellular organization, Ag-Ab& Leucocyte migration of immune components. ➢ Understanding about B & T Cell expression and about complement system. ➢ Attainment of knowledge related to cytokines, MHC, and cytotoxic responses. ➢ Attainment of immune based medically significant knowledge related to hypersensitivity, transplantation and vaccines. • .			
6	Credit Value	Theory :3 + Practical 1 Total credit : 4			
7	Total Marks	Max. Marks: 75+25=100	Min Passing Marks : 40%		
8		External:Internal assessment is 80:20 (in percentage)			

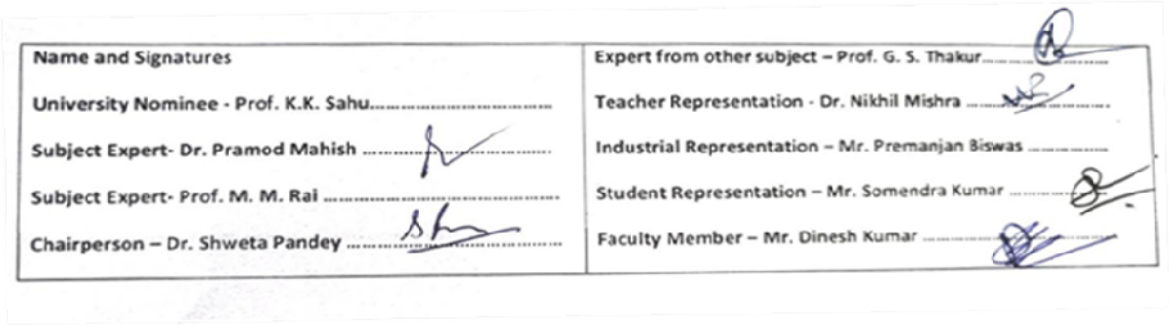
Part B: **Content of theCourse**		
Total No. of Lecturer (in hours per week): Total Lecturer: 60		
Unit	Topics	No. of Lectures
I	1. Cells and organs of the immune system: hematopoiesis, cells of the immune system, organs of the immune system, systemic function of the immune system, lymphoid cells and organs—evolutionary comparisons 2. Antigen: immunogenicity versus antigenicity, factors that influence immunogenicity, epitopes, haptens and the study of antigenicity, antibody: basic structure of antibodies, antibody-mediated effector functions, antibody classes and biological activities, antigenic determinants on immunoglobulins, the b-cell receptor, monoclonal antibodies 3. Antigen – antibody interaction: strength of antigen-antibody interactions, cross-reactivity, precipitation reactions, agglutination reactions, radioimmunoassay,enzyme-linked immunosorbent assay, western blotting, immuno-precipitation, immunofluorescence, flow cytometry and fluorescence, alternatives to antigen-antibody reactions, immunoelectron microscopy	12

	4. Leukocyte activation and migration: lymphocyte recirculation, cell- adhesion molecules, neutrophil extravasation, lymphocyte extravasation	
II	1. B-cell generation, selection, rearrangement in gene, B-cell maturation, B-cell activation and proliferation, the humoral response, germinal centers and antigen-induced B-cell differentiation, regulation of B-cell development 2. B cell maturation, activation and differentiation: T-cell maturation and the thymus, thymic selection of the T-cell repertoire, Th-cell activation, T-cell differentiation, cell death and T-cell populations 3. T cell receptors: T-cell receptors: structure and roles, organization and rearrangement of TCR genes, T-cell receptor complex: TCR-CD3, T-cell accessory membrane molecules, alloreactivity of T cells	12
III	1. Complement system:the functions of complement, the complement components, complement activation, regulation of the complement system, biological consequences of complement activation, complement deficiencies 2. Cytokines:properties of cytokines, cytokine receptors, cytokine antagonists, cytokine secretion by Th1 and Th2 subsets, cytokine-related diseases, therapeutic uses of cytokines and their receptors, cytokines in hematopoiesis 3. Major histo-compatibility agent: organization and inheritance, regulation of MHC expression, MHC and disease susceptibility. 4. Cell mediated cytotoxic response:effector responses, general properties of effector T cells & cytotoxic Tcells, natural killer cells, antibody-dependent cell-mediated cytotoxicity	12
IV	1. Hypersensitivity, antibody-mediated cytotoxic, hypersensitivity, immune complex–mediated, hypersensitivity, type IV or delayed-type hypersensitivity. 2. Tolerance and autoimmuntiy:organ-specific autoimmune diseases, systemic autoimmune disease, treatment of autoimmune diseases; herd immunity. 3. Transplantation immunology:immunologic basis of graft rejection, clinical manifestations of graft rejection, general immunosuppressive therapy, specific immunosuppressive therapy, immune tolerance to allografts, clinical transplantation 4. Vaccines: attenuated vaccines/mRNA vaccines/DNA vaccines, designing vaccines for active immunization.	12

• Part C –**LearningResource**
Text Books, Reference Books, Other Resources -
○ Immunology – Kuby

- Text book of microbiology – Anantnarayan&Panikar
- Immunology – Roitt
- Immunology – NandiniSethi
- Fundamentals of Immunology – William Paul
- Immunology – A short course 5th Edn – Eli Benjamin , Richard Coico.

The syllabus for B.Sc. Biotechnology is hereby approved for the session 2025-26..



Name and Signatures	Expert from other subject – Prof. G. S. Thakur
University Nominee - Prof. K.K. Sahu	Teacher Representation - Dr. Nikhil Mishra
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Subject Expert- Prof. M. M. Rai	Student Representation – Mr. Somendra Kumar
Chairperson – Dr. Shweta Pandey	Faculty Member – Mr. Dinesh Kumar

Total No. of Classes (in hours per week):
Total Credit: 01 (Classes 15)
CODE-BBT-DSE-P

The practical work will be based on the theory syllabus and the students will be required to perform practical knowledge of the following content as below mention -

1. Blood film preparation and identification of cells.
2. Lymphoid organs and their microscopic organization.
3. Immunization, collection of serum.
4. Ouchterlony Double diffusion for antigen – antibody pattern
5. Ouchterlony Double diffusion for antibody titration
6. RocketImmuno electrophoresis.
5. Radial Immunodiffusion.
6. Purification of IgG from serum.
7. DOT ELISA.
8. Immunodiagnostics (using commercial kits)

Scheme of Practical Examination

Duration : 3 Hours **Maximum marks : 25**

Pass marks: 40%

Distribution of Marks :	Marks
1. Any one practical from each section (Total 4 practicals)	(4X4 = 16)
2. Viva-Voce -	04
3. Practical record –(CCE)-	05
	Total marks 25

The syllabus for B.Sc. Biotechnology is hereby approved for the session 2025-26.

Name and Signatures	
University Nominee - Prof. K.K. Sahu	Expert from other subject – Prof. G. S. Thakur
Subject Expert- Dr. Pramod Mahish	Teacher Representation - Dr. Nikhil Mishra
Subject Expert- Prof. M. M. Rai	Industrial Representation – Mr. Premanjan Biswas
Chairperson – Dr. Shweta Pandey	Student Representation – Mr. Somendra Kumar
	Faculty Member – Mr. Dinesh Kumar

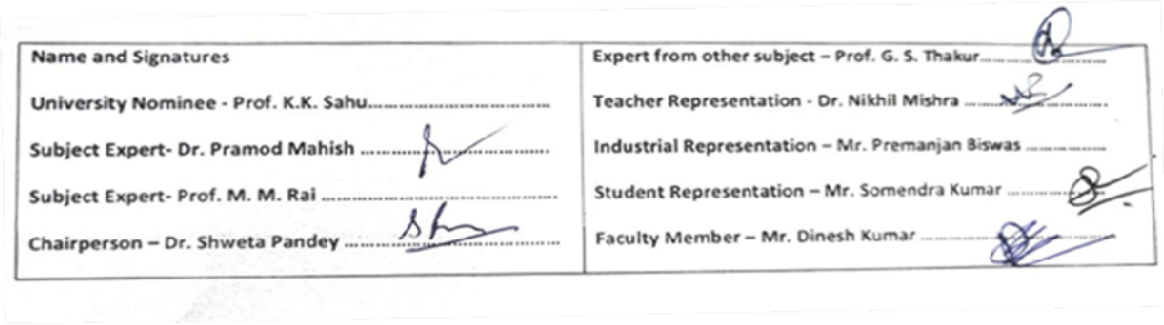
Part A: Introduction				
Program: BSc Biotechnology		Class: **BSc VIIISem**	Year: **2026**	Session:**2025-2026**
1	Course Code	**BBT-DSE-12**		
2	Course Title	**ENVIRONMENTAL BIOTECHNOLOGY**		
3	Course Type	Elective Course		
4	Pre-requisite (if any)	As per Government norms.		
5	About the course	The course is designed to develop understanding about cell and inheritance biology.		
6	Course Learning Outcomes (CLO)	➢ Skill development for Biotechnological approach of environmental protection. ➢ Skill development for management and treatment for industrial waste water. ➢ Skill development for xenobiotics and solid waste treatment. ➢ Development of knowledge about legal aspects of environmental protection and patenting.		
6	Credit Value	Theory :3 +Tutorial 1 Total credit : 4		
7	Total Marks	Max. Marks: 100	Min Passing Marks : 40%	
8		External:Internal assessment is 80:20 (in percentage)		

Part B: **Content ofthe Course**		
Total No. of Lecturer (in hours per week): Total Lecturer: 45		
Unit	Topics	No. of Lectures
I	1. Role of biotechnology in environment protection. 2. Air pollution and its control through biotechnology. 3. Water pollution and its control: water is a scarce natural resource. Need for water management , measurement of water pollution, source of water pollution 4. Methods for measurement of water & air pollution.	12
II	1. Waste water treatment:waste water collection, waste water treatment physical, chemical and biological treatment process. 2. Microbiology of waste water treatment: aerobic process: activated sludge, oxidation ditches, trickling filter tower, rotating biological contactors (rbc), rotating drums, oxidation ponds. 3. Anaerobic process: anaerobic digestion, anaerobic filters, up flow anaerobic sludge blanket reactors. 4. Industrial waste water treatment: treatment schemes for waste water of dairy, distillery, tannery, sugar, antibiotics industries	11
III	1. Xenobiotics: microbiology of degradation of xenobiotics in environment, ecological consideration hydrocarbons, substituted hydrocarbons, oil surfactant, pesticides.	11

	2. Bioremediation: bioremediation of contaminated soil and wasteland. 3. Biopesticides: biopesticide in integrated pest management. 4. Solid waste: source and management (co production)	
IV	1. Global environmental problems: climate change. 2. Biotechnology and environment: biotechnological approach for management of global environmental problem, regulation / legislation for hazardous products. 3. Regulations for environmental protection: the environment protection act, the air (prevention and control of pollution)act, the water (prevention and control of pollution) act, Indian forest act, wildlife protection act. 4. Patenting: patenting/ copyright/geographical indication (geo-tagging).	12
	Tutorial	15
	1. Determination of BOD, COD. 2. Determination of TDS. 3. Evaluation of methods to measure the pollution in air and water. 4. Application of biopesticides on microorganisms. 5. Determination of MPN of *E coli* bacteria.	

• Part C –**LearningResource**
Text Books, Reference Books, Other Resources -
○ Text book of Environmental Chemistry and Pollution Control: S.S Dara, S. Chand & Company Ltd. ○ Environmental biology And Toxicology: P.D. Sharma, Rastogi Publications, Merut. ○ Environmental Biotechnology, PrathamVashishith. Dominant Publishers and Distributors, N.Delhi. ○ Environmental Chemistry: A.K.De, Wiley Eastern ltd, N.Delhi. ○ Wastewater Engineering- Treatment, Disposal & Reuse. Metall and Eddy, Inc, Tata Mcgraw Hill, N.Delhi.

The syllabus for B.Sc. Biotechnology is hereby approved for the session 2025-26.



Part A: Introduction				
Program: BSc Biotechnology		Class: **BSc VIIISem**	Year: **2026**	Session:**2025-2026**
1	Course Code	**BBT-DSE-13**		
2	Course Title	**Enzymology**		
3	Course Type	Elective Course		
4	Pre-requisite (if any)	As per Government norms.		
5	About the course	The course is designed to develop understanding about cell and inheritance biology.		
6	Course Learning Outcomes (CLO)	➢ Development of knowledge about Enzyme nomenclature, enzyme assays, coenzymes, cofactors and factors affecting enzyme activities. ➢ Development of knowledge about enzyme catalytic mechanisms and kinetics. ➢ Skill development for industrial production of enzymes, biocatalysis. ➢ To develop research aptitude related to enzyme production through case studies		
6	Credit Value	Theory :3 +Tutorial 1 Total credit : 4		
7	Total Marks	Max. Marks: 100	Min Passing Marks : 40%	
8		External:Internal assessment is 80:20 (in percentage)		

Part B: **Content ofthe Course**		
Total No. of Lecturer (in hours per week): Total Lecturer: 45		
Unit	Topics	No. of Lectures
I	1. Enzyme classification and nomenclature: trivial and systematic name, ECnumber. 2. Classes of enzyme with example and working mechanism. 3. Methods of enzyme assay: enzyme units, types of assay, factors to control in assay. 4. Coenzyme: general information and examples, non-enzymatic cofactors and cofactors	12
II	1. Active site of enzyme and factor affecting enzyme activity (ph, temperature, inhibitors and substrate concentration) 2. Isoenzyme and allosteric enzymes 3. Enzyme catalysis mechanism: acid base catalysis, covalent catalysis, metal ion catalysis, electrostatic catalysis, 4. Catalysis through proximity and orientation effect catalysis by preferential transition state binding.	11
III	1. Transformation of Michelis – Menton equation: the double reciprocal plot. 2. Enzyme kinetics: kinetic tests for determining inhibition mechanism. 3. Evidence of enzyme: transition state complementarities.	11

	4. Enzyme production: synthesis, recovery, purification and formulation.	
IV	1. Enzyme processes: the evolution from degradation to synthesis enzyme biocatalysis: catalysis in aqueous and non conventional media. 2. Enzyme immobilization: techniques, effect of immobilization on kinetic parameters, 3. Enzyme isolation, disruption, fractionation, purification and concentration methods, methods of purity 4. Basic concept of industrial scale and optimization, amylase, glucose oxidase, lipase, protease, production and their uses	11
	Tutorial	15
	1. Protein electrophoresis – native and denaturing conditions. 2. N &C terminal analysis of proteins. 3. Enzyme purification and kinetic analysis. 4. Method for immobilization of enzyme. 5. Chemical modification of proteins.	

• Part C –**LearningResource**
Text Books, Reference Books, Other Resources -
○ Lehninger Principles of Biochemistry; Nelson & Cox. ○ Biochemistry; Voet& Pratt. ○ Principles of Enzymology; Price & Stevens. ○ Enzyme Biocatalysis, Principle & Applications; Andres Illanes. ○ Enzyme Kinetics**;** Hans Bisswanger

The syllabus for B.Sc. Biotechnology is hereby approved for the session 2025-26.