B.Sc. Biotechnology Semester - V,VI

Semester- wiseDetails

Third Year

Year / Semester	Serial Number, Code & Nomenclature of Paper				Duration of Exam	Teaching Hrs/Week &Credit			Distribution of Marks			Min. Pass Marks	
	Number	Code		Nomenclature		L	P	C	Inter-nal Assess.	Sem. Assess.	Total Marks	Interna Assess.	Sem. Assess.
III Year V Semester	5.1	BBT17 (A) BBT 17 (B)	DSE	Genetic Engineering and Recombinant DNA Technology **or** Molecular Diagnostics	3Hrs	4	--	4	30	70	100	12	28
	5.2	BBT18 (A) BBT18 (B)	DSE	Applied Plant Biotechnology **or** Agriculture Biotechnology	3Hrs	4	--	4	30	70	100	12	28
	5.3	BBT19 (A) BBT19 (B)	DSE	Applied Animal Biotechnology **or** Virology	3Hrs	4	--	4	30	70	100	12	28
	5.4	BBT 20	DCC	Practical-V	6Hrs	--	12	6	--	150	150	--	75
	5.7	VAC	VAC		1.5 Hrs	2	--	2	--	50	50	--	20
				Semester Total		**14**	**12**	**20**	**90**	**410**	**500**	--	
III Year VI Semester	6.1	BBT22 (A) BBT22 (B)	DSE	Industrial Biotechnology **or** Genomics and Proteomics	3Hrs	4	--	4	30	70	100	12	28
	6.2	BBT23 (A) BBT23 (B)	DSE	Environmental Biotechnology **or** Food and Dairy Technology	3Hrs	4	--	4	30	70	100	12	28
	6.3	BBT24 (A) BBT24 (B)	DSE	Computational Biology and IPR **or** Medical Biotechnology	3Hrs	4	--	4	30	70	100	12	28
	6.4	BBT25	DCC	Practical-VI	6Hrs	--	12	6	--	150	150	--	75
	6.7	SEC	SEC		1.5 Hrs	2	--	2	--	50	50	--	20
				Semester Total		**14**	**12**	**20**	**90**	**410**	**500**	--	
				First Year TOTAL		**28**	**24**	**40**	**180**	**820**	**1000**	--	
	Option for exit with Degree in Biotechnology (120 credits score)												

S. No.	Nature of Paper / Course	Semesters Wise Papers/Course along with Credits of Theory and Practical Components						
		I	II	III	IV	V	VI	
1.	Discipline Centric Core(DCC) Course	Subject-I (4T=4Cr) Subject-II (4T=4Cr) Subject-III (4T=4Cr) Subject IV (12P=6Cr	Subject-I (4T=4Cr) Subject-II (4T=4Cr) Subject-III (4T=4Cr) Subject IV (12P=6Cr)	Subject-I (4T=4Cr) Subject-II (4T=4Cr) Subject-III (4T=4Cr) Subject IV (12P=6Cr	Subject-I (4T=4Cr) Subject-II (4T=4Cr) Subject-III (4T=4Cr) Subject IV (12P=6Cr	--	--	**16** **16** **16** **24** **72**
2.	Discipline Specific Elective (DSE) Course	--	--	--	--	Subject-I (4T=4Cr) Subject-II (4T=4Cr) Subject-III (4T=4Cr) Subject IV (12P=6Cr	Subject-I (4T=4Cr) Subject-II (4T=4Cr) Subject-III (4T=4Cr) Subject IV (12P=6Cr	**08** **08** **08** **12** **36**
3.	Ability Enhancement Compulsory (AEC) Course	General Hindi / General English (2 Cr)	General English / General Hindi(2Cr)	--	--	--	--	**04**
4.	Generic Elective Course (GEC)	--	--	Environmental Science (2Cr)	Elementary Computer Applications (2Cr)	--	--	**04**
5.	Value Added Course (VAC)	--	--	--	--	Mulya Pravah (2 Cr)	--	**02**
6.	Skill Enhancement Course (SEC)	--	--	--	--	--	Skill Enhancement Course (2Cr)	**02**
Total Credits		**20**	**20**	**20**	**20**	**20**	**20**	**120**

Choice of elective papers have been given .Students may choose any one paper from the given elective papers.

Assessment Pattern:

The assessment of the students shall be divided into two parts in which first part is continuous assessment or internal assessment or mid-term assessment (30% weightage of the maximum marks) and second part is semester assessment or external assessment or end-term assessment (70% weightage of the maximum marks). Assessment pattern and distribution of maximum marks is summarized as given below:

(i) Continuous or Internal or Mid Term Assessment:

(a) The continuous or internal or mid-term assessment (30% weightage of the maximum marks) for each theory paper shall be taken by the faculty members of the respective Departments during each semester. There will be three internal assessment tests (*i.e.*first internal assessment test or first mid-term test and second internal assessment test or second mid-term test and third internal assessment test) each of 10% weightage of maximum marks of each theory paper. Each internal assessment shall be of one hour duration for theory paper and shall be taken according to academic calendar which will be notified by the Department / University.

(b) For practical papers, there will be no continuous or internal or mid-term assessment. There will be only one external or semester or end-term assessment (100% weightage of maximum marks).

(ii) Semester or External or End Term Assessment:

(a) The semester or external or end-term assessment (70% weightage of the maximum marks) shall be three hours duration to each theory paper and twelve hours duration (spread over two days with 6 hours per day) for each practical paper and shall be taken by the University at the end of each semester.

(b) The syllabus for each theory paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

Section-A *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*

Section-B *will carry 50 marks with equally divided into five long answer type questions . Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.*

(c) The syllabus of practical paper is divided according to main streams of Biotechnology. Marks shall be awarded on the basis of major & minor experiments, spotting, viva-voce, practical record, regularity factor, lab skills, maintain cleanness of workplace, *etc*.

Question Paper Pattern:

(A) Continuous or Internal or Mid Term Assessment:

30% weightage of Maximum Marks (30 Marks out of 100 Maximum Marks).

(i) Continuous or Internal or Mid Term Assessment:

Format
Department of .....
College / University .....
Address.....

First Internal Assessment Test 20… - 20….

Class	**:**	**Max. Marks**	**: 10 Marks**
Semester	**:**	**Duration of Exam.**	**:**
Subject	**:**	**Date of Examination**	**:**

Paper : Name of Teacher :

Note: All questions are compulsory and marks are given at the end of the each question. Two or three sub-divisions may be given in the question.

Q. No. 1. ……..

or……4 Marks

Q. No. 2. ……..

or……3 Marks

Q. No. 3. ……..

or……3 Marks

(B) Semester or External or End Term Assessment:

70% weightage of Max Marks (*i.e.*70 Marks out of 100 Max Marks).

Duration of Examination: 3 Hours **Max. Marks: 70** ***Note****: The syllabus is divided into five independent units and question paper will be divided into three sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of one mark.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions . Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.*

SECTION-A

Q. 1.

Unit-I

(i) …… **2 Mark**

(ii) …… **2 Mark**

Unit-II

(iii) …… **2 Mark**

(iv) …… **2 Mark**

Unit-II

(v) …… **2 Mark**

(vi) …… **2 Mark**

Unit-IV

(vii) …… **2 Mark**

(viii) ..…… **2 Mark**

Unit-V

(ix) …… **2 Mark**

(x) …… **2 Mark**

SECTION-B

Unit-I

Q. 2. ……..…… **10 Marks**

or ……....…… **10Marks**

Unit-II

Q. 3. ……...……**10 Marks**

or ……..…..…… **10 Marks**

Unit-III

Q. 4. ……..…… **10 Marks**

or ……..…..…… **10 Marks**

Unit-IV

Q. 5. . ……..…..…… **10 Marks**

or ……..……..….. **10Marks**

Unit-V

Q. 6. ……...…… **10Marks**

or ……..……..… **10 Marks**

Practical Examinations:

Continuous or Internal or Mid Term Assessment: *Not applicable in practical.*

External or Semester or End Term Assessment:

Duration of Exam : 6 Hours
Maximum Marks : 150 Marks*
Distribution of Maximum Marks:

S. No.	Name of Exercise	Marks
1.	Exercise No. 1 : Major Experiment	12
2.	Exercise No. 2 : Major Experiment	12
3.	Exercise No. 3 : Major Experiment	12
4.	Exercise No. 4 : Minor Experiment	10
5.	Exercise No. 5 : Minor Experiment	10
6.	Exercise No. 6 : Minor Experiment	10
7.	Exercise No. 7: Preparation	8
8.	Exercise No. 8: Preparation	8
9.	Exercise No. 9: Preparation	8
10.	Exercise No. 10 : Spotting Experiment(5 x 3= 15spots)	30
11.	Record (5x3)	15
12.	Viva-voce	15
Total Marks		**150**

SEMESTER FIFTH
Paper 5.1 BBT-17 (A) GENETIC ENGINEERING AND RECOMBINANT DNA TECHNOLOGY

Course Type: DSE **Credits:4**

Duration :3 hrs	Continuous/Internal/Assessment	:30Marks
	Semester Assessment	:70 Marks

Note*: The syllabus is divided into five independent units and question paper will be divided into two sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions. Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.*

UNIT-I

Introduction of genetic engineering**:** Southern and Northern- blotting. SDS-PAGE and western blotting, *In situ* hybridization.

Enzymes used in genetic engineering: Restriction enzymes, DNA polymerases, kinases & phosphatases, DNA ligases and other enzymes.

UNIT-II

C-DNA synthesis and cloning**:** mRNA enrichment, reverse transcription, Linkers, adapters, blunt end ligation, homopolymer tailing.

Genomic and cDNA libraries: Preparation and uses. DNA Sequencing

UNIT-III

Gene tagging and Application of transposons in gene tagging. Cloning Vectors: Plasmid vectors, Bacteriophage. Cloning and expression of foreign genes in prokaryotes (*E.coli*). Cloning and expression of foreign genes in eukaryotes(yeast).Application of molecular cloning.

UNIT-IV

Methods of Gene transfer**:** Microinjection, electroporation, microprojectile, shot gun method ultra-sonication, Liposome fusion, microlasers. Use of *Agrobacterium tumefaciens* and *A.rhizogenes*, Ti plasmids.

UNIT-V

Therapeutic use of r-DNA technology**:** Products of human therapeutic interest (insulin, HGH), recombinant vaccines. Gene therapy.

Transgenic plants**:** Bt transgenic (cotton), flavr savr tomato, golden rice. Transgenic animals.

Reference Books:

1. Sambrose and Russell. (2001), Molecular Cloning. 3 volumes. CSH Lab Pres. Hellen, K., Adrian, M. and John W. (2000). Recombinant DNA and Biotechnology.
2. Old and Primrose. (1994). Principles of Gene Manipulation, Blackwell Scientific Publications.
3. Glick B.R and Pasternak J.J. (2010), Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press.
4. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford,
5. Primrose, S. B. Twyman, P.M. and Old, R. W. (2001) Principles of gene manipulation (6th Ed.). Black well publishers.
6. Old and Primrose. (1994). Principles of Gene Manipulation, Blackwell Scientific Publications.

OR

SEMESTERFIFTH
Paper 5.1 BBT-17 (B) Molecular Diagnostics

CourseType: DSE **Credits:4**

Duration : 3 hrs
Continuous/Internal/Assessment :30Marks
Semester Assessment :70 Marks

Note*: The syllabus is divided into five independent units and question paper will be divided into two sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions. Paper setter shall be advised to set two questions from each unit and students are instructed to attemptfive questions by selecting one question from each unit.*

UNIT I

Introduction and History of diagnostics, Diseases- infectious, physiological and metabolic errors, genetic basis of diseases, inherited diseases, Comparison of molecular vs conventional diagnostics, Major types of molecular diagnostic tests, Role in disease detection and personalized medicine

UNIT II

Diagnosis of DNA and RNA viruses- Pox viruses, Adenoviruses, Rhabdo Viruses, Hepatitis Viruses and Retroviruses.

UNIT III

Cancer- different types of cancers, genetics of cancer- oncogenes, tumour suppressor genes. Methods available for the diagnosis of genetic diseases and metabolic disorders .

UNIT IV

Molecular methods: Nucleic acid extraction: principles and methods. Assessing purity and concentration of nucleic acids, PCR- basic and applied ,PCR- ELISA, RT- PCR

UNIT V

Major Metabolic disorders and its causes. Traditional methods for the diagnosis of metabolic errors. Disease due to genetic disorders - Identifying human disease genes.

Genetic disorders- Sickle cell anemia, Duchenne muscular Dystrophy, Retinoblastoma, Cystic Fibrosis and Sex – linked inherited disorders.

Reference books

1. Rao JR, Fleming CC & Moore JE. 2006. Molecular Diagnostics. Horizon Bioscience.
2. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
3. Bioinstrumentation, Webster
4. Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe,Kluwer Academic
5. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.
6. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
7. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4 th edition. Elsevier.
8. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. AppletonCentuary-Crofts publication.
9. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education. 9. Microscopic Techniques in Biotechnology, Michael Hoppert

SEMESTER FIFTH
Paper 5.2 BBT-18(A)Applied Plant Biotechnology

CourseType:DSE **Credits:4**

Duration :3 hrs
Continuous/Internal/Assessment :30Marks
Semester Assessment :70 Marks

Note*:Thesyllabusisdividedintofiveindependentunitsand questionpaperwillbedividedintotwo sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions. Paper setter shall be advised to set two questions from each unit and students are instructed to attemptfive questions by selecting one question from each unit.*

UNIT-I

Introduction and History of plant biotechnology. Applications in agriculture, industry and environment. Tissue culture laboratory organization., Aseptic techniques.

Plant growth regulators (PGRs) and their role *in vitro* cultures. Explants Selection, sterilization and callus formation.

UNIT-II

Protoplast Culture: Isolation of protoplast .Protoplast culture and regeneration, protoplast fusion , methods of fusion. Selection and regeneration of fused protoplast

UNIT-III

Basic genetic engineering techniques in r-DNA Technology for Plant transformation. pBR322, phage , cosmids, phagmids. Direct DNA transfer. Screening and identification of hybrid and cybrid. Somatic hybridization.

UNIT-IV

Application of transgenic plants**:** Herbicide resistance, insect resistance, disease resistance, nutritional enhancement, edible vaccines.

UNIT-V

Bioreactors Plant secondary metabolites and their production, biotransformation, elicitors. Regulatory framework for genetically modified(GM) crops.

Reference Books:

1. Introduction to Plant Tissue Culture: M.K. Razdan
2. Plant Tissue Culture Theory & Practical: S.S. Bhojwani & M.R. Razdan
3. Slan A.C. (1996), Plant Tissue Culture- Oxford & (BH Publishing co. pvt.ltd.)
4. Lydiane kyle John Kleyin plant test tubes: An Introduction to micro propagation.
5. Introduction to plant biotechnology by H.S. Chawla
6. Plant Tissue Culture: Application and Limitations. Bhowjwani, S.S. 1990.
7. Plant Cell Culture, Advances in Biochemical Engineering and Biotechnology. Anderson, L.A.,Recombinant DNA. Watson, 1992.
8. Gene transfer to Plants. Portykns, 1995.
9. Plant Biotechnology, Ashwani Kumar, Shikha Rohy, I.K. International Pvt. Ltd, 2006.
10. Biotechnology by B.D.Singh (Kalyani Publishers)

OR

SEMESTER FIFTH
Paper 5.2 BBT-18 (B) Agriculture Biotechnology

Course Type: DSE **Credits: 4**

Duration : 3 hrs Continuous/Internal/Assessment :30Marks
Semester Assessment :70 Marks

Note *: The syllabus is divided into five independent units and question paper will be divided into two sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions. Paper setter shall be advised to set two questions from each unit and students are instructed to attemptfive questions by selecting one question from each unit.*

Unit I

Concept, scope, and evolution of agricultural biotechnology , Role of molecular biology, and tissue culture, Gene transfer techniques: Agrobacterium-mediated, biolistics, electroporation ,Genetically modified organisms (GMOs) in agriculture

Unit II

Marker-assisted selection (MAS), quantitative trait loci (QTLs) and molecular markers , Promoters and vectors used in plant transformation Transgenic plants: traits for pest resistance, drought tolerance, enhanced nutrition

Unit III

Genetically modified crops and food security: case studies and regulatory aspects. Biotechnology in abiotic and biotic stress management. Biotechnology for post-harvest technology and food processing

Unit IV

Genetic engineering of microbes for stress tolerance and plant growth promotion,Industrial and Emerging Trends in Agri-Biotech,- Agricultural nanobiotechnology: nano-fertilizers, nano-pesticides , Synthetic biology in crop design , Bioinformatics tools in agricultural genomics

Unit V

Molecular breeding, Application of bioinformatics tools in crop genome analysis , Bio-entrepreneurship, seed technology : seed production , quality control and storage.

Reference Books:

1. **"Agriculture Biotechnology"** by SVS Chauhan and Seeema Chauhan
2. **"Plant Biotechnology"** by Slater, Scott & Fowler
3. **"Agricultural Biotechnology"** by Arie Altman
4. Research papers and government policy documents on GM crops and biosafety

SEMESTER FIFTH

Paper 5.3 BBT-19 (A) Applied Animal Biotechnology

Course Type: DSE **Credits: 4**

Duration :3 hrs	Continuous/Internal/Assessment	:30Marks
	Semester Assessment	:70 Marks

Note *: The syllabus is divided into five independent units and question paper will be divided into two sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions. Paper setter shall be advised to set two questions from each unit and students are instructed to attemptfive questions by selecting one question from each unit.*

UNIT-I

Introduction and scope of animal tissue culture**:** Culture medium -Natural media and artificially defined media. Growth kinetics of animal cells in cultures. Primary culture, Secondary culture (Transformed cell and continuous cell lines).

UNIT-II

Bioreactors for animal cell culture. Transgenic animals: Technique and application. Sheep and Mice. Bioethical issues in animal cell culture.

UNIT-III

Transfection of animal cell lines**:** Cryopreservation of cell line, ovum, sperm and embryo. *In vitro* fertilization and embryo transfer..

UNIT-IV

Expression of cloned proteins in animal cells: Expression vector, over production and downstream processing of the expressed proteins. Production and application of monoclonal antibodies. Hybridoma technology.

UNIT-V

Application of animal cells cultures for studies of gene expression. Stem cells – types and application.

Reference Books:

1. Animal Tissue Culture- Mathur
2. Animal Tissue Culture - R. IanFreshney
3. Animal biotechnology- M.M.Ranga
4. Cell & Tissue Culture in animals- Masters
5. Biotechnology-expanding horizons B.D. Singh

OR

SEMESTER FIFTH
Paper 5.3 BBT-19 (B) Virology

Course Type: DSE **Credits: 4**

Duration: 3 hrs

Continuous/Internal/Assessment : 30Marks
Semester Assessment : 70 Marks

Note: *The syllabus is divided into five independent units and question paper will be divided into two sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions. Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.*

UNIT – I

History-Properties of viruses -classification of viruses based on the nature of genome-Methods of study, Cultivation of viruses Assay techniques- -physical counts, Hemagglutination, plaque assay, pock method, end point method

UNIT – II

Multiplication of bacterial viruses--lytic cycle -one step growth curve and molecular mechanism, lysogeny - establishment of lysogenic state, immunity regulation of lytic state and lysogenic state, significance of lysogeny

UNIT – III

Immune responses to viruses, Interferon and other cytokines, Antiviral therapy

UNIT – IV

Structure and multiplication of Adenovirus, Hepatitis B, C & E viruses, Vaccinia virus, Reovirus and HIV. Introduction to Prions.

UNIT-V

Structure of TMV, multiplication and movement, symptoms, transmission and control measures of viral diseases. Introduction to Viroids.

Reference books

Basic Virology – Edward K Wanger

Matthew's Plant virology

Fundamentals of molecular virology – Acheson and Nicholas H

Genetics of viruses and bacteria - Hayes; Microbiology - Davis

An introduction to viruses - Biswas & Biswas Plant viruses - A D Singh

Paper 5.4 BBT -20 DCC PRACTICAL V

PRACTICALS -Genetic Engineering and Recombinant DNA technology

1. Isolation of plasmid DNA.
2. Isolation of phage DNA.
3. Restriction mapping of Plasmid DNA.
4. Cloning in Vectors.

PRACTICALS -Molecular diagnostics

1. PCR analysis
2. ELISA
3. DNA Extraction from blood
4. RNA Isolation from blood

PRACTICALS -Plant Biotechnology

1. To study the production of transgenic.
2. Isolation & identification of secondary metabolites from plant cell
3. Preparation of synthetic seeds: Encapsulation Techniques.
4. Demonstration of protoplast fusion employing PEG.

PRACTICALS -Agriculture Biotechnology

1. Isolation of Plant DNA & quantification by spectrophotometric method.
2. RFLP and RAPD analysis
3. RNA extraction, Agarose gel electrophoresis of RNA, RT-PCR analysis of a plant gene.
4. Polymerase chain reaction to amplify a plant gene.
5. Rapid screening tests for abiotic stress tolerance (drought, salinity - PEG, Mannitol & NaCl)
6. Surface-sterilization of seeds, establishment of axenic plants, acclimatization of tissue culture plants and establishment in greenhouse.
7. Seed germination test and purity analysis

PRACTICALS- Animal Biotechnology

1. To study of transplantations -tumors, organs, cells.
2. Western- blotting.
3. Isolation of Genomic DNA from blood
4. Agarose gel electrophoresis of DNA
5. Cell viability and cytotoxicity assay

PRACTICALS – Virology

1. Study of safety rules and precautions in a virology lab

2. Familiarization with instruments used in virology (laminar air flow, incubator, microscope, etc.)

3. Observation of cytopathic effects (CPE) of viruses in cell cultures (demo/slides)

4. Preparation of bacterial lawn (for bacteriophage work)

5. Demonstration of plaque formation by bacteriophage on *E. coli*

SEMESTER SIXTH
Paper 6.1 BBT-22 (A) Industrial Biotechnology

Course Type: DSE **Credits: 4**

Duration : 3 hrs
Continuous/Internal/Assessment :30Marks
Semester Assessment :70 Marks

Note *: The syllabus is divided into five independent units and question paper will be divided into two sections.*

Section-A *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*

- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions. Paper setter shall be advised to set two questions from each unit and students are instructed to attemptfive questions by selecting one question from each unit.*

UNIT- I

Fermentation**:** Types of Bacteria and Fungi involved in fermentation process.

Bioreactors / Fermenter – Application , types ,design and operation of Bioreactors.

UNIT- II

Basic concepts of Upstream and Downstream processing in Bioprocess.
Primary Metabolites- Production of commercially important primary metabolites like organic acids, amino acids and Industrial alcohols.

UNIT- III

Secondary Metabolites- Production processes for various classes of secondary metabolites: Antibiotics, Vitamins and Steroids.

UNIT- IV

Production of Industrial Enzymes. Cheese, Beer, SCP & Mushroom culture, Production of recombinant proteins having therapeutic and diagnostic applications. Vaccines.

UNIT - V

Biocontrol agents: Bioinsecticides, Production of Biopesticides, Bioherbicides ,Biofertilizers, Biopolymers, Biodiesel.

Reference Books:

1. Casida, L.E. "Industrial Microbiology", New Age International (P) Ltd, 1968.
2. Presscott, S.C. and Cecil G. Dunn, "Industrial Microbiology", Agrobios (India), 2005.
3. Cruger,Wulf and Anneliese Crueger, "Biotechnology: A Textbook of Industrial Microbiology", 2nd Edition, Panima Publishing, 2000.
4. Stanbury, P.F., A. Whitaker and S.J. Hall "Principles of Fermentation Technology", 2 nd Edition, Butterworth – Heinemann (an imprint of Elsevier), 1995.
5. C.F.A Bryce and EL.Mansi, Fermentation microbiology & Biotechnology, 1999.
6. K.G.Ramawat & Shaily Goyal, Comprehensive Biotechnology, 2009, S.Chand.

OR

SEMESTER SIXTH

Paper 6.1 BBT-22 (B) GENOMICS and PROTEOMICS

Course Type: DSE **Credits: 4**

Duration :3 hrs Continuous/Internal/Assessment : 30 Marks
Semester Assessment : 70 Marks

Note*: The syllabus is divided into five independent units and question paper will be divided into two sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions. Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.*

UNIT-I

Introduction and scope of Genomics, Genome size, structural genomics, Functional genomics and comparative genomics, DNA sequencing methods.

UNIT-II

Genome Projects: Human Genome Project, Plant Genome Project: Arabidopsis thaliana, Fungal Genome Project: Neurospora crasa

UNIT-III

Introduction to Proteomics, Analysis of proteomes. SDS PAGE, 2D-PAGE.Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE

UNIT-IV

Functional proteomics, structural proteomics and comparative proteomics, Applications of proteomics in health and agriculture.

UNIT-V

Pharmacogenomics and drug development , Gene expression analysis: microarrays, RT-PCR.

References:

1. Voet D, Voet JG & Pratt CW, Fundamentals of Biochemistry, 2nd Edition. Wiley 2006
2. Brown TA, Genomes, 3rd Edition. Garland Science 2006
3. Campbell AM & Heyer LJ, Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Benjamin Cummings 2007
4. Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell, 2006.
5. Glick BR & Pasternak JJ, Molecular Biotechnology, 3rd Edition, ASM Press, 1998..

SEMESTER SIXTH

Paper 6.2 BBT-23 (A)Environmental Biotechnology

CourseType: DSE **Credits: 4**

Duration :3 hrs	Continuous/Internal/Assessment	:30Marks
	Semester Assessment	:70 Marks

Note *:The syllabus is divided Into five independent units and question paper will be divided into two sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions. Paper setter shall be advised to set two questions from each unit and students are instructed to attemptfive questions by selecting one question from each unit*

UNIT-I

Types of pollution and pollutants**:** Air, water and land**:** Causes, nature of pollutions, impact and control strategies. Effect of chemical dyes on plants, animals, and human (DDT, PCB, HM, Endocrine disrupting chemicals). Heavy Metals. Role of biotechnology in sustainable development.

UNIT-II

Solid and Liquid waste treatment**:** Biotechnological approaches for solid and liquid waste management.

Phytoremediation -Terrestrial and aquatic photosystems.

UNIT-III

Biodegradation of macromolecules; Biodegradation of xenobiotics; Vermicomposting.

Heavy metal pollution; Bioremediation –Role of microbes in bioremediation.

UNIT-IV

Biosensors to detect environmental pollutants. Natural pesticides – Neem and *Thuringiensis*.
Biotechnology strategies in forestry and wetland management.

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UNIT-V

Bio-fertilizers, Bio-pesticides. Genetically modified organisms - Biosafety and risk assessment.

Reference Books:

1. Environmental Biotechnology: Concepts and Applications Hans-Joachim Jördening, Josef Winter John Wiley & Sons,
2. Advanced Environmental Biotechnology By S.K.Agarwal APH Publishing,
3. Environmental Biotechnology By S.N Jogdand Himalaya Publishing
4. Textbook of Environmental Biotechnology By Mohapatra I. K. International Pvt Ltd
5. Environmental Biotechnology: Basic Concepts and Applications By Indu Shekhar Thakur
6. Environmental Biotechnology: Theory and Application By Gareth G. Evans , Judy Furlong.
7. Manahan, S.E. 1997. Environmental Science and Technology. Lewis, New York.
8. Evans, G.M. and Furlong J.C. 2003. Environmental Biotechnology: Theory and Application. John Wiley and Sons.
9. Thomas, J.A. and Fuchs, R. 2002. Biotechnology and Safety Assessment. Academic Press.

OR

SEMESTER SIXTH

Paper 6.2 BBT-23 (B)Food and Dairy technology

CourseType: DSE **Credits:4**

Duration :3 hrs	Continuous/Internal/Assessment	:30Marks
	Semester Assessment	:70 Marks

Note*: The syllabus is divided into five independent units and question paper will be divided into two sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions. Paper setter shall be advised to set two questions from each unit and students are instructed to attemptfive questions by selecting one question from each unit*

UNIT-I

Introduction to food science, scope and importance, composition and nutritive value of foods, food groups and functions, principles of food preservation.

UNIT – II

Food microbiology, microorganisms in food, sources of contamination, food spoilage, food poisoning and infections, microbial standards of foods.

UNIT – III

Food processing and preservation, thermal processing, refrigeration, freezing, dehydration, canning, fermented foods, food packaging.

UNIT – IV

Dairy technology, composition and properties of milk, collection and testing, milk processing methods, dairy products, quality control and adulteration tests.

UNIT – V

Food quality and safety, sensory evaluation, food laws and regulations (FSSAI, HACCP, ISO), genetically modified foods, probiotics and prebiotics, advances in food and dairy biotechnology

Reference books

1 Ftizer, Food Microbiology, THM Publications.

2.eller. Genettic Engineering of food: Detection of Genetic Modifications, Wiley Publications.

3. Lel A. et. al. Microorganism & Fermentations - N.Y. Chemical. Rehm, Biotechnology set Wiley Publication

4. KeshavTrehan Biotechnology, New Age International Pvt Ltd.,2002

SEMESTER SIXTH
Paper 6.3 BBT-24(A)Computational Biology and IPR

CourseType: DSE **Credits:4**

Duration :3 hrs	Continuous/Internal/Assessment	:30Marks
	Semester Assessment	:70 Marks

Note*: The syllabus is divided into five independent units and question paper will be divided into two sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions. Paper setter shall be advised to set two questions from each unit and students are instructed to attemptfive questions by selecting one question from each unit.*

UNIT- I

Introduction to Bioinformatics and Biological Databases**:** Principles of DNA and Protein sequencing, File Formats for storage of Sequence and Structural Data, Primary Sequence Databases of Nucleic Acids and Proteins, Organism Specific Genome Databases, Structural Databases.

UNIT- II

Specialized Sequence Databases of Expressed Sequence Tags, Gene Expression, Single Nucleotide Polymorphism,

OMIM, Unigene etc., Data Retrival with ENTERZ, SRS and DBGET, Secondary Databases (Pfam, PROSITE, PRINT, Block, etc.)

UNIT- III

Algorithms and Tools: Sequence Alignment (Pair wise and Multiple). Alignment Algorithms, Database, Similarity Searches (BLAST, FASTA AND psi-BLAST). Matrices (PAM, BLOSUM), Profiles and Motifs.

UNIT- IV

Intellectual Property right : Introduction , trade secret , Copy right, Industrial Design and Rights, Traditional Knowledge, Geographical Indication, Plant variety protection (PVP) Importance and benefit from IPR – patentable and non patentables – patenting life – legal protection of biotechnological inventions –World Intellectual Property Rights Organization (WIPO).

UNIT- V

Patent : Patent requirement, procedure of Patent Filing.Grant of Patent and Patenting Authorities: Types of patent applications, Limits of patent, patent laws Ordinary, PCT, Conventional, Divisional and Patent of Addition;; Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patent owner.

Reference Books:

1. Bioinformatics: Concepts, Skills and Application by Rastogi, S.C
2. B N Mishra, Bioinformatics: Concept and application, Pearson Education (in Press)
3. Anthony JF Griffths: An intro to Genetic analysis. 1st Ed.
4. Michael Starkey and Ramnath Elaswarapu; Genomics Protocols, Humana Pres
5. Stephen Misner & Stephen Krawetz Bioinformatics Methods and Protocol
6. Lawrence Hunter – Artificial Intelligence & Mol. Biology.
7. Westhead P: Instant notes on Bioinformatics; Viva Publication
8. Hooman H Rasidi Bioinformatics Basic Application in Biological Science and medicine; CRC Press.
9. Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.
10. Singh K K (2015). Biotechnology and Intellectual Property Rights: Legal and Social Implications.

OR

SEMESTER SIXTH
Paper 6.3 BBT-24 (B)Medical Biotechnology

Course Type: DSE **Credits:4**

Duration : 3 hrs
Continuous/Internal/Assessment :30Marks
Semester Assessment :70 Marks

Note*: The syllabus is divided into five independent units and question paper will be divided into two sections*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions. Paper setter shall be advised to set two questions from each unit and students are instructed to attemptfive questions by selecting one question from each unit.*

UNIT – I

Introduction – Significance of Medical Biotechnology. Revolution in clinical diagnosis, Antigen-Antibody interaction, Vaccines-Live, killed, Subunit, Attenuated and Imaging techniques.

UNIT – II

Genetic & Metabolic Disorders – Introduction, Classification, Impact of genetic diseases on human health - Chromosome errors - Down syndrome, Klinefelter's . Metabolic disorders –Phenylketonuria, Diabetes, Hemophilia and sickle cell anemia.

UNIT – III

Recombinant DNA technology for human insulin, Hepatitis B vaccine. Therapeutic proteins and peptides – Erythropoietin, Tissue plasminogen activator, clott. Antibody Engineering and Therapeutic Antibodies.

UNIT – IV

Cancer - Molecular, cellular and genetic basis of cancer, tumor virus and oncogenes, tumor suppressor genes and mechanism of action of p53 proteins. Stem Cells - Sources and types of stem cells, Stem cell transplant and its types.

UNIT – V

Nanobiotechnology - Introduction, types and structures of nanoparticles, biosynthesis of nanoparticles, application of nanoparticles in treatment.

Text Books:

1. Glick B.R. and Pasurank..Molecular biotechnology – Principle and Applications of
2. Recombinant DNA- J.I.(4th edition), ASM Press. 2010.

3. Anthony D. Ho, Hoffman. R, and Esmail D. Zanjani, Stem Cell Transplantation (4th edition), Wiley – liss publishers, 2006.
4. Hornyak. G.L , Moore. J.J. Tibbals H.F., Dutta. J. Fundamentals of Nanotechnology (1st edition), CRC press, 2008.

Paper 6.4 BBT -25 DCC PRACTICAL VI

Practicals- Industrial Biotechnology

1. Batch fermentation in conical flask.
2. Solid state fermentation.
3. Screening of microbes for production of industrially important enzymes.
4. Optimization of conditions for optimal production of enzyme: - Media composition, Incubation temperature, Aeration, Incubation time.
5. Instrumentation of fermentor. Design of various types of fementers & bioreactors.
6. Study different parts of fermenter.
7. A visit to any educational institute/industry to see an industrial fermenter, and downstream processing operation.

Practicals- Genomics and Proteomics

1. Agarose gel electrophoresis
2. Proteomics 2D PAGE database
3. Genome databases
4. Use of SNP databases at NCBI
5. SDS PAGE

Practicals- Environmental Biotechnology

1. To estimate total hardness of water
2. To estimate Calcium hardness of water
3. To estimate the total solids (TS), total dissolved solids (TDS) and suspended solids (SS) in the given water sample
4. To estimate dissolved oxygen content of wastewater.
5. To estimate chemical oxygen demand of the given sample.
6. To estimate Biological Oxygen Demand (BOD)
7. To measure the concentration of chloride in it the given sample

Practicals: Food and Dairy technology

1. Detection of adulterant in milk
2. Detection of cellulose in milk
3. Detection of added urea in milk
4. Detection of starch in the milk
5. Microbiological analysis of milk

Practicals- Computational Biology and IPR

1. Working on Biological databases, NCBI, DDBJ, EMBL.
2. Visualizing and Retrieving protein and nucleic acid sequences, structures, EST sequences, SNP data using database browsers and genome browsers.
3. Converting sequences between different formats. Nucleic acid sequence analysis by using
4. Phylogeny approaches BLAST and FASTA
5. Protein Sequence analysis and structure predication working on docking and visualizing.

Practicals-Medical Biotechnology

1. Biochemical test for identification of bacteria
2. Estimation of blood glucose.
3. Detection of blood group and RH Factor
4. Estimation of iron in blood.
5. Detection of bar bodies in human cells.
6. Total leukocyte count in blood sample.