Shiksha Mandal's

Bajaj College of Science, Wardha
(Autonomous)
B. Sc. Semester Pattern Syllabus
B. Sc. Part III
BIOTECHNOLOGY

(With effect from academic session 2023-24)

Total Theories required to complete syllabus of Semester V and Semester VI unit wise is given below:

B.Sc. Part III- Semester V

Sr. No.	Unit	Total Theories Required
1	Unit I	12
2	Unit II	10
3	Unit III	12
4	Unit IV	12
5	Unit V	12
6	Unit VI	10

B.Sc. Part III- Semester VI

Sr. No.	Unit	Total Theories Required
1	Unit I	12
2	Unit II	10
3	Unit III	10
4	Unit IV	12
5	Unit V	12
6	Unit VI	10

BIOTECHNOLOGY
B. Sc. Semester Pattern Syllabus
(With effect from academic session 2023-24)
B. Sc. Part III- Semester V

The examination will comprise of one theory paper, one in each semester and one practical in each Semester. Each theory paper will be of 3 Hrs. Duration and carry 100 marks. The internal assessment will carry 20 marks. The practical examination will be of at least 4 hours duration in one day and shall carry 30 marks. The following syllabi is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question on every unit with internal choice for each of 14 marks & one compulsory question covering all the syllabus of Semester-V (16 marks)

B. Sc. Part III – Semester V

MOLECULAR BIOLOGY & RECOMBINANT DNA TECHNOLOGY

Course Objectives:

1. To aware the students about the basic knowledge of different molecular processes like Replication, Transcription, Translation, Mutation and DNA Repair.
2. Students will aware about the concept and mechanism used in Recombinant DNA Technology.
3. Students get comprehensive knowledge about various molecular processes like PCR, DNA Fingerprinting, Restriction Enzyme, Southern Blotting used in biological research and also their implementation in the fields of advance research and forensic science.

Course Outcomes:

1. Students will be able to understand the mechanism of Replication in Prokaryotes and Eukaryotes.
2. Students will be able to understand in detail about various types of DNA Repair Mechanism in Prokaryotes and Eukaryotes, DNA Mutation and Mutagens.
3. Students will be able to understand the concept of Gene Expression by Transcription and Translation process and Operon system in Bacteria.
4. Students will be able to understand the important aspects of rDNA Technology like Cloning and other molecular tools.
5. Students will be able to understand molecular technique like Polymerase Chain Reaction (PCR), DNA Fingerprinting and Primer Designing.
6. Students will be able to perform isolate of DNA, RNA and Plasmid DNA and Chloroplast DNA.
7. Students will be able to perform DNA Amplification by PCR, Restriction Digestion of DNA, DNA Ligation, Southern Blotting, Western Blotting and GFP Cloning etc.

BSc -II Semester –V	MOLECULAR BIOLOGY & RECOMBINANT DNA TECHNOLOGY	UG-BT(09)-S5-T
Unit Number	**Topic**	**Total Theories Required**
I	**DNA Replication and Gene Mutations** A) Types of DNA Replication: Semi Conservative, Conservative and Discontinuous. Proof of Semi Conservative DNA Replication, Mechanism of DNA Replication and Enzymes involve in DNA Replication, Model of DNA Replication: Rolling Circle Model, Unidirectional Replication Model, and Bidirectional Replication Model. B) Definition of Mutation, Types of Mutation, Mutagens: Physical and Chemical Mutagens C) Repair Mechanism: Mismatch Repair, NER, BER, Recombination Repair, Light Induced and SOS Repair.	**12**
II	**Genetic Code:** A) Definition and Characteristic of Genetic Code: Start and Stop Codons, Universality, Degeneracy and Commaless Nature of Codons, Non- Overlapping, Triplet Nature of Code. B) The Decoding System: Aminoacyl Synthetases, Brief Structure of tRNA, The Adaptor Hypothesis. C) Codon-Anticodon Interaction - The Wobble Hypothesis.	**10**
III	**Transcription** A) Structure of RNA Polymerase (Core Enzyme and Holoenzyme, Role of Sigma Factor), Concept of Promoter. B) Transcription in Prokaryotes and Eukaryotes: Initiation, Elongation and Termination C) Brief Idea of Reverse Transcription. D) Regulation of Transcription in Prokaryotes: Basic Idea of Lac- and Trp-Operons.	**12**
IV	**Translation** A) Activation of Amino Acids, Shine and Dalgarno Sequence, Translation in Prokaryotes and Eukaryotes: Formation of Initiation Complex, Initiation Factors and their Regulation, Elongation and Elongation Factors, Termination of Translation.	**12**
V	**rDNA Technology** A) DNA Cloning: Basics of Genetic Engineering, Restriction Endonucleases, Other Enzymes of DNA Manipulation. B) Vectors: Plasmid Vectors (pBR322 and pUC 18/19) C) Phage Vector: Lambda Replacement and Insertion Vectors Cosmids, Phagemids and YAC. D) Cutting and Joining DNA (Cohesive End Ligation, Methods of Blunt End Ligation). Transfection and Transformation, E) Selection and Screening of Transformed Cells.	**12**
VI	A) Genomic DNA Library and cDNA Library – Concept and Methods of Creating these Libraries. Advantages and Disadvantages of cDNA Library over Genomic DNA Library. B) Principle and Application of Polymerase Chain Reaction, Designing of Primers for PCR. C) DNA Fingerprinting, Expression of Cloned Genes: General Features of an Expression Vector. Expression of a Eukaryotic Gene in Prokaryotes – Advantages and Problems, Products of rDNA Technology.	**10**

Sr. No.	Practicals (UG-BT(09)-S3-P)	Minor/Major
1	Estimation of DNA & RNA concentration by UV spectrophotometry.	**Minor**
2	Estimation of proteins by Bradford method.	**Major**
3	Isolation of genomic DNA from Bacterial/ Animal/ Plant cell.	**Major**
4	Isolation of Plasmid DNA.	**Major**
5	Isolation of RNA from bacteria /plant cells.	**Minor**
6	Isolation of chloroplast DNA.	**Minor**
7	Restriction digestion of DNA.	**Major**
8	Demonstration of Replica plating technique.	**Major**
9	Identification of Lac+ bacteria by blue white screening using IPTG.	**Major**
10	Ligation of DNA.	**Minor**
11	Demonstration of Southern blotting.	**Major**
12	Demonstration of western blotting.	**Major**
13	Amplification of DNA Fragment by PCR	**Major**
14	Demonstration of Basic Bioinformatics Tool (DNA sequence retrieval, identification of Open Reading Frame and Nucleotide Blast)	**Major**
15	Demonstration of gene specific primer designing using software	**Major**

Recommended readings:

1. Watson JD, Baker JA, Bell SP, Gann A, Lewin M, and Losick R (2004) Molecular Biology of the Gene, Benjamin Cummings- CSHL Press, USA.
2. Brown, TA (1995) Essential Molecular Biology, Vol. I, A Practical Approach, IRL Press, Oxford, UK.
3. Lewin B. (2013) Gene XI, Pearson Prentice Hall, Pearson Education, Inc., NT, USA
4. Malacinski GM (2003) Essentials of Molecular Biology, 4th edn., Jones and Batiett, London.
5. Verma P.S. and, Agarwal V.K. (2010) Molecular biology, S. Chand and company PVT.
6. Gerald Karp (2007) Cell and Molecular Biology: Concepts and Experiments, 5th edition Wiley
7. Nelson DL and Cox MM (2005) Lehninger's Principles of Biochemistry, 4th edn., McMillan Worth Publ. Inc. NY.
8. Russell, PJ (1998) Genetics, 5th edn, Benjamin-Cummings Publ. Co. Inc., NY
9. Weaver R (2011), Molecular Biology, 5th Edition McGrew Hill Science. USA
10. Pal J.K. and Saroj, (2009), Ghaskadbi Fundamentals of Molecular Biology, Oxford University Press, India
11. Burton E Tropp, Jones and Bartlett Learning (2011)Molecular Biology: Genes to proteins, 4th edition , USA
12. J.D. Watson, N.H. Hopkins, J.W Roberts, J. A. Seitz & A.M. Weiner; Molecular Biology of the Gene, 6th Edition, Benjamin Cummings Publishing Company Inc, 2007.
13. Alberts et al; Molecular Biology of the Cell, 4th edition, Garland, 2002

14. Sambrook, J and Russell, D.W. (2001) Molecular Cloning: A Laboratory Manual, Cold Spring Harbor, N.Y.: Cold Spring Harbor Laboratory.
15. C.B.Powar (2012) Genetics Vol-I. Himalaya Publishing House.
16. C.B.Powar (2012) Genetics Vol-II. Himalaya Publishing House.

BIOTECHNOLOGY
B. Sc. Semester Pattern Syllabus
(With effect from academic session 2023-24)
B. Sc. Part II- Semester VI

The examination will comprise of one theory paper, one in each semester and one practical in each Semester. Each theory paper will be of 3 Hrs. Duration and carry 100 marks. The internal assessment will carry 20 marks. The practical examination will be of at least 4 hours duration in one day and shall carry 30 marks. The following syllabus is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question on every unit with internal choice for each of 14 marks & one compulsory question covering all the syllabus of Semester-VI (16 marks)

B. Sc. Part II – Semester VI
APPLICATIONS OF BIOTECHNOLOGY

Course Objectives:

1. The objective of this course is to aware students with the Environmental Biotechnology, Community Drinking Water Purification Processes, Assessment of Water Qualities and Xenobiotic and its impact on Environment.
2. Students will gain knowledge regarding screening, fermentation, application of GMO in Biotechnology Industries, Quality Assurances and Quality Control.
3. Student will gain knowledge regarding Plant and Animal Tissue Culture Techniques (PTC and ATC).
4. Students get comprehensive knowledge about various Recombinant DNA Products i.e. Bt-Cotton, gene therapy, rDNA Vaccines, Transgenic Animal and Plants.

Course Outcomes:

1. Students will be able to understand analysis of water quality by MPN, BOD, COB, IMViC test, Biodegradation, Biodeterioration, and Biotransformation,
2. Students will be able to understand applications of GMOs, Quality Control and Quality Assurances.
3. Student will be able to learn Good Manufacturing Practices and Production of Cheese, .Mushroom and Spirulina.
4. Students will be able to learn about Animal and Plant Tissue Culture Techniques.
5. Students will be able to understand Structure of Biotechnology Industries, Quality Control and Quality Assurance in Food and Pharmaceutical Industry.
6. Students will be able to learn about the Plant and Animal Tissue Culture Technology (ATC and PTC).
7. Students will be able to understand recombinant DNA Products i.e. Bt-Cotton, Gene Therapy, rDNA Vaccines, Transgenic Animal and Plants.

BSc –II Semester – VI	APPLICATIONS OF BIOTECHNOLOGY	UG-BT(09)-S6-T
Unit Number	**Topic**	**Total Theories Required**
I	**Environmental Biotechnology** A) Water and Waste Water Treatment Process: Current Community Drinking Water Treatment Process, Disinfection of Water (Chlorination and Ozonation), Sewage: Definition and Composition, Primary, Secondary and Advanced Treatment of Sewage (Domestic Waste Water). B) Assessment of Water and Wastewater Quality: Concept of COD, DO and BOD. Define Coliform, Indicators of Faecal Pollution and MPN and MF Technique for Coliforms. IMViC Test. C) Definition and Concept: Biodegradation, Biodeterioration, Biotransformation, Xenobiotic and Recalcitrant Compounds. Bio Accumulation and Process of Biomagnifications.	**12**
II	**Industrial Biotechnology** A) Introduction of Industrial Biotechnology: Important Commercial Products Produced by Microorganisms. GMOs and their Applications, B) Isolation and Screening of Industrially Important Microorganisms – Primary and Secondary Screening. C) Design of Typical Fermentor, Basic concept of Upstream, Downstream processing and Scale-Up of fermentation process.	**10**
III	**Food Biotechnology** A) Industrial Awareness: Quality Control and Quality Assurance in Food and Pharmaceutical Industry, Concept of Current Good Manufacturing Practices in Pharmaceutical Industry. B) Types of Cheese and its Production, Microorganisms as Food Supplements – Production of Mushroom and Spirulina, Assessment of Microbiological Quality of Packaged Foods.	**10**
IV	**Plant Tissue culture** A) Introduction and History, Design of Typical Plant Tissue Culture Laboratory. Laboratory Facilities, Tissue Culture as a Technique to Produce Novel Plants And Hybrids, Tissue Culture Media (Composition and Preparation). Plant Growth Substances: Concept and Role: Hormone Auxin, Gibberllins, Cytokins, Ethylene, Abscisic Acid. B) Callus and Suspension Cultures: Initiation and Maintenance of Callus and Suspension Cultures; Single Cell Clones. Tissue and Micro- Propagation, Suspension Culture, Callus Formation, Regeneration, Production of Haploids, Protoplast Culture and Somatic Hybridization.	**12**
V	**Animal Tissue Culture** A) History and Development of Cell Culture-Contribution of Ross Harrison, Alex Carrel, Charles Lindbergh, Lanwilmut. B) Design of Typical Animal Tissue Culture Laboratory and its Management, Laboratory Facilities, Culture Media, Growth Factors, Characteristics of Cells in Culture: Contact Inhibition, Anchorage Dependence, Cell-Cell Communication etc.; Cell Senescence; Cell and Tissue Response to Trophic Factors. C) Various Techniques of Animal Cell and Tissue Culture, Primary Culture, Immortal Cells, Cell Lines. Maintenance of Cell Lines in the Laboratory.	**12**
VI	**Recombinant DNA Technology Product** A) Brief Idea about Recombinant DNA Products in Medicine (Insulin, Somatostatin, Vaccines), Concept of Gene Therapy, Production of	**10**

	Recombinant Vaccines – Hepatitis Vaccine. B) Concept of Transgenic Animals, In Vitro Fertilization and Embryo Transfer in Humans and Farm Animals. C) Concept of Transgenic Plants (BT Cotton). Cloning in Plants- Ti Plasmid, Applications of Transgenic Plants.	

Sr. No.	Practicals (UG-BT(09)-S6-P)	Minor/Major
1	Determination of chlorine demand of water.	**Minor**
2	Determination of faecal coliforms by MPN technique/MF technique.	**Major**
3	Determination of COD/BOD.	**Major**
4	IMViC test.	**Minor**
5	Microbiological quality assurance of any of the commercially available foods.	**Major**
6	Sterility testing of injectibles	**Minor**
7	GFP Cloning in *E.coli*	**Major**
8	Isolation of protoplast from different tissues using mechanical method / commercially available enzymes.	**Major**
9	Callus Induction and Regeneration using different explants.	**Major**
10	Anther culture, embryo culture, suspension culture.	**Major**
11	Preparation of Balance Salt solution.	**Major**
12	Separation of serum.	**Minor**
13	Establishing primary cell culture of chicken embryo fibroblasts.	**Major**
14	Preparation, sterilisation and quality control of Animal Tissue Culture Media	**Minor**
15	Cell count by hemocytometer.	**Major**
16	Bioassay of Antibiotics/Vitamins	**Major**

Recommended readings:

1. Casida LE Jr. (2016)Industrial Microbiology, 2 edition, New Age International publication
2. Satyanarayana U (2011)Biotechnology, Books and Allied (P) Ltd., Kolkata
3. Singh BD (2007) Biotechnology Expanding horizons, Kalyani publication.
4. Razdan. M.K. (2003) An introduction to Plant Tissue culture,.
5. Bhojwani. S.S and Razdan (2004), Plant tissue culture, Oxford & IBH Publishing Co, New Delhi.
6. Adrian Slater, Nigel W. Scott, Mark R. Fowler (2008) Plant Biotechnology: An Introduction to Genetic Engineering, Oxford University Press.
7. George EF (1999), Plant Propagation by Tissue Culture: Volume 1 & 2. Exegetics Limited, 1999.
8. Dixon R.A. and R.A. Gonzales()Plant cell culture, A Practical approach, 2nd Edition, Exegetics Limited.
9. Reinert J.and Bajaj Y.P.S. (1977). Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture, By Springer - Verlag, Berlin.
10. Glick, B.R. and Pasternak J.J. (1998) Molecular Biotechnology, 2nd Edition, ASM Press, Washington.
11. Aneja K.R (2010) Experiments in Microbiology Plant Pathology and Biotechnology, New age International .Limited Publishers.

12. Masters RW (2009) Animal Cell Culture – Practical Approach. 2 Edited, Oxford.
13. Gupta P.K. (1995) Elements of Biotechnology, Rastogi and Company**.**
14. Kung S.D. and. Wu R (1993) Transgenic Plant Vol.1 & 2, Academic press, San Diego.
15. Reddy SM, Reddy SR and Narendra Babu G, (2012) Basic Industrial Biotechnology, 1st edition, New Age International publication