तार : विश्वविद्यालय
Gram : UNIVERSITY

टेलीफोन : कार्या0 : 2320496
कुलसचिव : निवास : 2321214
फैक्स : 0510 : 2321667

बुन्देलखण्ड विश्वविद्यालय, झाँसी
BUNDELKHAND UNIVERSITY, JHANSI

झाँसी (उ.प्र.) 284128

संदर्भ.....

दिनाँक 24/06/22

The Minutes of Meeting of BOS

In reference to the BOS of department of ....Biotechnology..... ....., Institute of J.C. Bose Institute ....of Life Sciences..... held on 24/06/22 regarding the revision of syllabus in tune with CBCS/NEP-2020 and subsequent approval from Academic Council. This is to certify that the syllabus is 100% revised.

Registrar
Bundelkhand University
JHANSI

24/06/22

HOD/Coordinator
Department of Biotechnology
Bundelkhand University
Jhansi-284128 (U.P.)

DEPARTMENT OF BIOTECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI
BOARD OF STUDIES (BOS)
IN ACCORDANCE WITH NATIONAL EDUCATION POLICY - 2020

Name of the course- B.Sc. (Hons) Biotechnology Subject- Biotechnology Faculty: Faculty of Science									**Date of BOS- 24/06/2022**
S. No.	Bos member	Designation	Feedback of students	Revision of syllabus (mentioned in percentage)	Credit course	Noncredit course	Multidisciplinary course	Vocational/skilled orientation course	Name of value-added course with title (semester wise)
1	Prof. Shailendra Kumar (External 1)	Professor	Yes	100% (As implemented NEP2020)	Yes	Yes	Yes	Yes	1. Food and Nutrition (Semester-I) 2. First Aid and Health (Semester-II) 3. Human Values and Environment Studies (Semester-III) 4. Physical Education and Yoga (Semester-IV) 5. Analytic Ability and Digital Awareness (Semester-V) 6. Communication Skills and Personality Development or Character Building (Semester-VI)
2	Shree Bhanu Pratap Singh (External 2)	In-charge, Parag Dairy, Jhansi							
3	Prof. R. K. Saini, (Dean Science and Converner)	Professor							
4	Dr. Jose Mathew (Internal 1)	Assistant Professor							
5	Dr. Vinay Singh Chauhan (Internal 2)	Assistant Professor							
6	Dr. Bhanumati Singh (Internal 3)	Assistant Professor							
7	Dr. Sarvendra V. Singh (Internal 4)	Assistant Professor							
8	Dr. Hemant Kumar (Internal 5)	Assistant Professor							

24/06/2022

Shailendra 24/06/2022

Internal members

Dean Science and Convener

External members

Department of Biotechnology
Bundelkhand University- Jhansi 284128 (UP)

Minutes of Board of Studies (BOS) of Department of Biotechnology on 24th June 2022

As per Bundelkhand University notification given regarding Board of studies (BOS) meeting of the department of Biotechnology, J C Bose institute of Life Sciences, session 2022 vide letter number: पत्रांक - बु०वि०/एके०/2022/7496-7506 dated 12/07/2022.

The agenda of the BOS of Biotechnology session 2022-23 on 24th June 2022

1. Implementation of NEP2020 in B.Sc. (H) Biotechnology (Undergraduate) and M.Sc. Biotechnology (Post Graduate) course/programmes from academic session 2022-23
2. Developing curriculum and syllabus of B.Sc. (Hons.) and M.Sc. Biotechnology course/programmes under NEP2020
3. Panel of experts for the Undergraduate and Post graduate programme under NEP2020
4. Panel of experts for the B.Sc. (H) Biotechnology and MSc. Biotechnology old pattern for session 2022-23.

Sr. No.	Name of BOS members	Signature
External Members: The external members have joined the BOS meeting 'ONLINE MODE'		
1	Prof. Shailendra Kumar, Department of Microbiology, Ram Manohar Lohia Avadh University, Faizabad, UP	Shailendra 24/06/2022
2	Shree Bhanu Pratap Singh, In-charge, Parag Dairy Jhansi, UP	24/06/2022
Convener of BOS		
3	Prof. R. K. Saini, Dean Science	
Internal members		
4	Dr. Jose Mathew, Assistant Professor	
5	Dr. Vinay Singh Chauhan, Assistant Professor	
6	Dr. Bhanumati Singh, Assistant Professor	
7	Dr. Sarvendra V. Singh, Assistant Professor	
8	Dr. Hemant Kumar, Assistant Professor	

Department of Biotechnology
Bundelkhand University- Jhansi 284128 (UP)

Minutes of Board of Studies (BOS) of Department of Biotechnology on 24th June 2022

As per Bundelkhand University letter no. बु०वि०/एके०/2022/7496-7506 dated 12/07/2022 regarding Board of Studies (BOS) meeting of the department of Biotechnology, J C Bose institute of Life Sciences, Meeting was held on 24th June 2022 at Bundelkhand University, Jhansi in the presence of BOS members.

The following decision have been made in the BOS meeting and approved by the BOS members.

1- Ordinance and general rules, regulation and guidelines as per National Education Policy 2020 (NEP2020) for the Bachelor in Honours (Semester System) programme in Biotechnology shall be provided by Bundelkhand University Jhansi, UP and will be implemented accordingly from session 2022 onwards.
2- The Ordinance which will be provided (and implemented from session 2022 onwards) by Bundelkhand University Jhansi UP will supersedes all the previous relevant ordinance, rules and regulations.
3- The syllabus, course content and panel experts of Major III elective (Table 3a), Minor I GE (Table 4), Minor II (SEC/AEC- Table 5) and Minor III (Value-added course -Table 6) except syllabus of Biotechnology (Table 3a, Major 3 for Science (DSE) for undergraduate course science discipline and Tools and techniques in Bioinformatics (Table 4) GE or Minor 1 for science, commerce and arts discipline for undergraduate courses will be as provided by the Bundelkhand University, Jhansi (UP) and implemented accordingly.
4- The syllabus and panel of experts for syllabus of Biotechnology (Table 3a, Major 3 for Science (DSE) for undergraduate course science discipline and Tools and techniques in Bioinformatics (Table 4) GE or Minor 1 for science, commerce and arts discipline for undergraduate courses has been submitted and approved by the BOS members which will be implemented by Bundelkhand University, Jhansi for courses of science, commerce and arts discipline as required.
5- The syllabus and panel of experts for Major 1 (DSC1) and Major 2 (DSC2) and Major 3 (DSC3) as well as practicals (Lab techniques) I, II and III and training for undergraduate has been submitted and approved by the BOS members for academic session 2022-23 as per NEP2020.
6- The panel of experts for BSc. (H) Biotechnology programme as old pattern has been submitted and approved by the BOS members for academic session 2022-23.
7- The syllabus, course content and panel experts of Minor elective for post graduate programme will be as provided by the Bundelkhand University, Jhansi (UP) and implemented accordingly.
8- The syllabus and panel of experts for Major 1 (DSC1) and Major 2 (DSC2), Major 3 (DSC3), Major 4 (DSC4) and major 5(DSC5) as well as practicals (Lab techniques) I and II and Research project/training for post graduate has been submitted and approved by the BOS members for academic session 2022-23 as per NEP2020.
9- The panel of experts for M.Sc. Biotechnology programme as old pattern has been submitted and approved by the BOS members for academic session 2022-23.

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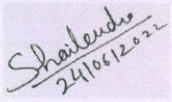
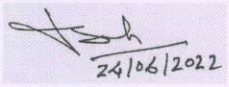
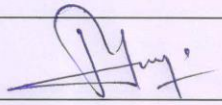
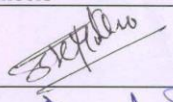
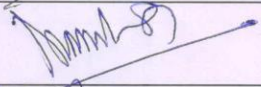
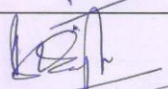
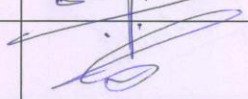
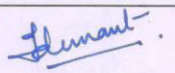
10- The duration of training and report submission for undergraduate and post graduate programme (programme under NEP 2020) shall be of three weeks as per departmental time table schedule.

11- The curriculum and syllabus of undergraduate and post graduate programme (Under NEP 2020) have been approved by the BOS members.

12- All the suggestions and directions provided by BOS members have been incorporated.

All the decision mentioned have been incorporated and approved by BOS Members.

Sr. No.	Name of BOS members	Signature
External Members: The external members have joined the BOS meeting 'ONLINE MODE'		
1	Prof. Shailendra Kumar, Department of Microbiology, Ram Manohar Lohia Avadh University, Faizabad, UP	
2	Shree Bhanu Pratap Singh, Parag Dairy Jhansi, UP	
Convener of BOS		
3	Prof. R. K. Saini, Dean Science	
Internal members		
4	Dr. Jose Mathew, Assistant Professor	
5	Dr. Vinay Singh Chauhan, Assistant Professor	
6	Dr. Bhanumati Singh, Assistant Professor	
7	Dr. Sarvendra V. Singh, Assistant Professor	
8	Dr. Hemant Kumar, Assistant Professor	

SYLLABUS
OF
M.Sc. BIOTECHNOLOGY (NEP2020)

TO BE IMPLEMENTED FROM THE ACADEMIC SESSION 2022-23 ONWARDS

DEPARTMENT OF BIOTECHNOLOGY
BUNDELKHAND UNIVERSITY– JHANSI UTTAR PRADESH – 284128
INDIA

Programme outcome (P.Os)

The MSc. Biotechnology programme of Bundelkhand University aims to train students in various theoretical and practical principles for the study and research in the field of Agriculture, Biology, pharmaceutical, industrial and clinical research. The students in this program acquire deep knowledge and critical thinking skills in conducting advanced research.

PO1: Learn and understand the necessary knowledge and concepts of biotechnology and its applications in related areas.

PO2: Understand the ability to apply biotechnological knowledge in practical or experiment design, which students can conduct independently, employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of experiment.

PO3: To solve the problems of related subject and think methodically, independently and draw a logical conclusion

PO4: Use modern tools and techniques in related fields, advanced equipment and bioinformatics software

PO5: Create an awareness of the impact of biotechnology on the environment, society, and development outside the scientific community

Program Specific Outcomes (PSO)

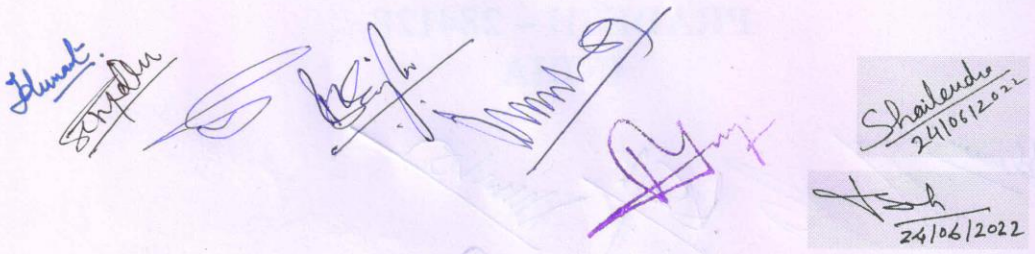
PSO1: Students will be able to demonstrate their knowledge of Immunology, Genetic engineering, Plant biotechnology, Vaccines and Agriculture Biotechnology to solve various problems in Biotechnology and related areas. Acquire knowledge of biotechnology through theory and practical.

PSO2: Students will be able to gain deep knowledge in Immunology, Genetic engineering, Plant biotechnology, Vaccines and Agriculture Biotechnology techniques used in biotechnology research laboratories.

PSO3: Students will be able to gain understanding about Industrial Bioprocess technology, Enzymology, Environmental Biotechnology and Animal Biotechnology along with related lab techniques.

PSO4: Students will be able to experience the research work ethics by working in research labs or in industries. They will learn the operation of basic laboratory instruments and will learn the principle of measurements using the various lab instruments. Make aware and handle sophisticated and advanced instrument. This will help them to begin a career in laboratories conducting fundamental research or as entrepreneurs.

PSO5: Apply their knowledge in advanced subject areas like animal and plant biotechnology, Molecular biology, food biotechnology, immune technology, environment biotechnology, drug discovery and restoration of the degraded environment to provide a sustainable competitive edge to present society, for the betterment and advancement of their professional career and develop research-oriented skills.



National Education Policy -2020

DEPARTMENT OF BIOTECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI

SYLLABUS FOR THE DEGREE OF

"MASTER OF SCIENCE IN BIOTECHNOLOGY"

(M.Sc. Second year)

(Total Credits in Second Year: 48)

IN CONTINUATION OF M.Sc. FIRST YEAR

(Total Credit For M.Sc. BIOTECHNOLOGY: First Year (52) + Second Year (48) = 100)

Shailendra 24/06/2022

24/06/2022

Second Year – 3rd Semester

1. IMMUNOLOGY (3001)

Paper Type – Theory | Total Hours – 60
Paper Type – Core | Total Credits -4

Course Objectives: To make them understand structural components of immune system and their function. In-depth knowledge and understanding of major cellular and molecular mechanisms underlying immunological processes in health and diseases. An understanding of the factors that determine the effectiveness of immune responses to microorganisms (bacteria, viruses, parasites) and how protective immunity can be elicited by vaccination.

Learning outcomes: After completion of this course successfully, the students will be able to

1. Learn the key concepts of immunological mechanisms and how this could be extrapolated towards development of novel therapeutic interventions against various diseases.
2. Able to explain the procedure for the antigen-antibody interaction based diagnostic test and their specificity and sensitivity for currently bothering disease.
3. The vaccines available for different diseases and their method of preparation and will be able to explain the problems associated with the vaccine development for the infections without vaccines at present.

Syllabus and Lecture Plan:

Unit No.	Topic/Content	Teaching Hours Lecture/Tutorial (50L+10T +0P)	
		L	T
1	History of immunology, Immune response - Innate and Adaptive Immunity and Characteristics, Anatomical organization of immune system – Primary and secondary lymphoid organs, Secondary lymphoid organs, Cells of the immune system, lymphocyte traffic. Hematopioesis, Antigens Characters, Haptens, Antigenicity and Immunogenicity, Factors affecting immunogenecity, Properties of T and B cell epitopes, Super antigens.	8	2
2	Complement System Components, activation pathways and their regulation, Complement deficiencies and role of complement system in immune response. Immunoglobulins – structure and functions, Organisation and expression of immunoglobulin genes. Mechanisms of antibody diversity, Class switching, Immunoglobulin Superfamily.	8	2
3	Organization of MHC I and II molecules, polymorphism, distribution and function, organization of MHC complex in Mouse and Humans. Role of MHC in tissue transplantation. T-Cell receptor – Structure and function, T- cell accessory membrane molecules, activation of T-cells B-Cell receptor – Structure, types and functions, activation of B-cells. Antigen presentation – Processing and presentation of exogenous and endogenous antigens.	8	1
4	Structure and functions, cytokine receptors, signal transduction mediated by cytokine receptors, cytokine related diseases and their therapeutic applications. Hypersensitivity – Definition, Type I, II, III and IV type hypersensitivity, delayed type of hypersensitivity.	8	2

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5	Autoimmunity – Organ specific and systemic diseases, mechanisms of autoimmunity and therapeutic approaches, Immunodeficiency Syndromes – Primary and secondary immunodeficiencies, their diagnosis and therapeutic approach	8	1
6	Antigen and Antibody interactions – Affinity, Avidity, Cross reactivity, forces involved in AgAb interaction, Vaccines – Active and passive immunization, whole organism vaccines, Macromolecules as vaccines, Recombinant-vector vaccines, DNA vaccines, synthetic peptide vaccines and subunit vaccines. Hybridoma technology and production of monoclonal antibodies and Its applications in diagnosis and therapy.	10	2

List of reference books:

1. Immunology. Roitt, Brostoff and Male
2. Essential Immunology. Roitt, Ivan.M.
3. Elgert Immunology
4. Lidyard, Instant notes in Immunology, 2nd Edition.
5. Darla J wise, Immunology-A comprehensive review: A Blackwell science Pub.
6. Todd & Spickett, Immunology

Teaching Methodology – Class room lectures, PowerPoint presentations, online class/E-Content, etc.

Evaluation Criteria – Written Internal Sessional examinations (MCQ / one word answer / short answer type), assignment / Presentations / Viva-Voce and main semester examinations.

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2. GENETIC ENGINEERING (3002)

Paper Type – Theory — Total Hours - 60
Paper Type – Core — Total Credits-4

Course Objectives: In this course the students will be trained in various techniques of genetic engineering, their applications in biological research. To introduce the concepts of recombinant DNA technology in a stimulating, elegant, exhaustive and explanatory manner. To understand the technique of gene manipulation and gene cloning.

Learning outcomes:

1. Explain the basic principles behind molecular cloning.
2. Apply the knowledge of molecular cloning and design cloning strategy.
3. Apply most appropriate recombinant-DNA techniques and other contemporary molecular techniques to understand the function of gene
4. Analyse published journal articles in the field of recombinant DNA technology

Syllabus and Lecture Plan:

Unit No.	Topic/Content	Teaching Hours Lecture/Tutorial (50L + 10T +0P)	
		L	T
1	Recombinant DNA Technology Enzymes used in DNA technology: DNA manipulating enzymes (Restriction Endonucleases, Polymerases, Ligase, Kinases and Phosphatases Nucleases). Linker, Adaptor, Homoploymer tailing. Cloning vectors: Plasmids, Phasmids, Cosmids, Artificial chromosomes, Shuttle vectors and Expression vectors, Viruses as vectors Application of Recombinant DNA technology in agriculture, health and industry.	10	2
2	Polymerase Chain Reaction (PCR): Principle, types and its application. Principle and techniques of hybridization: Western, Northern and Southern blotting, Microarray based detection. DNA finger printing.	10	2
3	Isolation and purification of DNA, Gel electrophoresis. Molecular Markers: Principles, types and application, Restriction Fragment Length Polymorphism (RFLP), Amplified Fragment Length Polymorphism (AFLP). Random Amplified Polymorphic DNA (RAPD), Single Nucleotide Polymorphism (SNP).	10	2
4	Gene transfer methods: Electroporation, Microinjection, calcium phosphate co-precipitation, lipofection. Analysis of protein-DNA and protein-protein interactions: Gel retardation assay, DNA footprinting, Modification interference assay, Deletion analysis, Phage display and yeast two hybrids assay.	10	2
5	DNA sequencing method: Sanger's method, Maxam and Gilbert Method, Automated method. 2. Transgenic technologies and their applications. Unit-VI DNA libraries: construction of genomic and cDNA, screening method of DNA libraries. Molecular diagnostic Methods.	10	2

List of reference books:

1. DNA Technology: The Awesome Skill by Alcamo IE. (2001). 2nd Elsevier Academic Press, USA.
2. Gene Cloning and DNA Analysis by TA Brown. Blackwell Publishing, Oxford, U.K.

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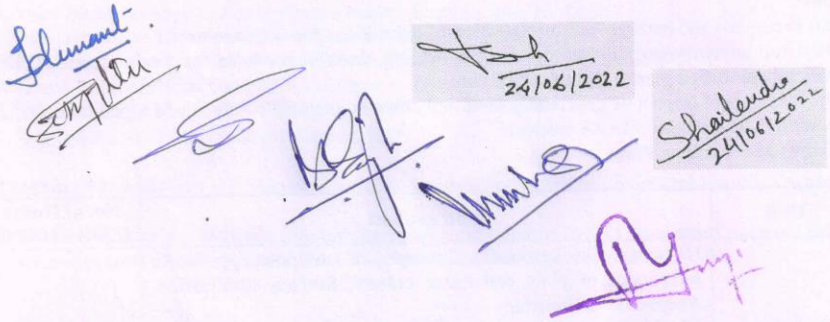
3. Molecular Biotechnology by Glick BR and Pasternak JJ. ASM Press Washington D.C.
4. Principle of gene cloning by Old and primrose VthEds.
5. S B Primrose and R M Twyman Principles of Gene Manipulation and Genomics Seventh edition 2006 Blackwell Publisher, Australia.
6. Watson JD, Candy AA, Myers RM and Witkowski JA, Recombinant DNA (Gene and Genome – A short course) WH Freeman and Company, New York, IInd Edition 1992.
7. Biotechnology. Singh,B. D.

Teaching Methodology – Class room lectures, PowerPoint presentations, online class/E-Content, etc.

Evaluation Criteria – Written Internal Sessional examinations (MCQ / one word answer / short answer type), assignment / Presentations / Viva-Voce and main semester examinations.



3. PLANT BIOTECHNOLOGY – 3003

Paper Type – Theory Total Hours – 60
Paper Type – Elective Total Credits -4

Course Objectives

This course will introduce students to principles, practices and applications of plant biotechnology, plant genomics, genetic transformation and molecular breeding of plants. Plant Biotechnology aims to impart understanding of the basic principles of the plant tissue culture techniques used in biotechnology. Applications of plant biotechnology, significance of plant biotechnology in agriculture, medicine and the production of high-value products for food and pharmaceutical.

Course outcomes

CO1: understand Plant tissue culture basic, techniques used in plant tissue culture, sterilization of explants, nutritional requirement, organ culture, Micropropagation methods

CO2: Haploid plant production and their application in plant breeding for producing true homozygous plants

CO3: Protoplast and embryo culture, selection of hybrids in crop improvement.

CO4: Crop improvement through genetic engineering, describe methods for obtaining and application of genetically modified plants, plant derived vaccines

CO5: Understand Impact of genetically modified crops in genomic research and agriculture. Efficacy and Environmental concerns of GM products.

Syllabus and Lecture Plan:

Unit	Unit content	No. of Hours (L50+T10+P0)
UNIT I Plant Tissue Culture	Historical background, Concept of totipotency, Basic techniques of plant cell tissue culture, Surface sterilization, Aseptic tissue transfer, Nutritional requirements of cell In vitro- Various type of nutrient media, Development of explants. Methods of plant micro propagation. Plant tissue culture techniques. Ovary and ovule culture. Invitro pollination and fertilization. Embryo culture. Embryogenesis and organogenesis and their practical applications. Micropropagation of elite species. Auxillary bud, shoot tip and meristem culture.	10 + 2
UNIT II Haploid production	Haploids and their application. Anther and pollen culture. Monoploid production. Production of triploids through endosperm culture. Somaclonal variation and applications. Single cell cultures and their application in selection of variants/mutants with or without mutagen treatment.	10 + 2
UNIT III Protoplast and Embryo culture	Protoplast isolation and regeneration and its applications. Various methods of fusing protoplasts-Chemical, electrical.Somatic hybridization. Selection system for hybrids. Role of protoplast culture and somatic hybridization in the improvement of crop plants.	10 + 2
UNIT IV Crop Improvement through genetic engineering	Vectors for the constrcuction of transgenic plants. Plasmid and plant virus vectors. Methods of gene transfer in to plant cells. Agrobacterium mediated. Direct gene transfers. Cointegration and binary vectors. Microinjection. Improved Crop productivity. Biotic stress resistant plants. Engineering Herbicide resistant plants. Direct strategy. Indirect strategy.	10 + 2

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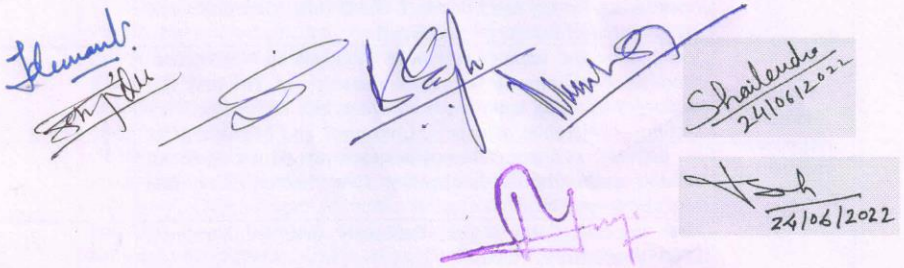
	Engineering viral diseases resistant plants. Insect resistant plants. Plants resistant to drought, salt, heat, water freezing etc. Improvement of nutritional quality. Seed storage proteins. Engineering for vitamins and iron deficiency. Terminator and traitor technology. Plant derived vaccines.	
UNIT V Practical Concerns	Impact of genetically modified crops in genomic research and agriculture. Efficacy and Environmental concerns. Legislation for transgenic plants.	**10 + 2**

References:

1. Molecular Biology and genetic engineering. Gupta, P.K. (2008)
2. Biotechnology and Genomics. Gupta, P.K. (2008)
3. Molecular Biology in crop protection. Marshall, G and Walters, D.
4. Plant Biotechnology in Agriculture. Lindsey, K. and Jones, M .G.
5. Biosynthesis and Manipulation of Plant Products. Grierson, D.
6. Plants, genes, and Agriculture. Maarten J. Chrispeels and David E. Sadava
7. A text Book of Biotechnology R.C.Dubay
8. Biotechnology. Singh, B.D. (2008)
9. A text Book of Biotechnology. Kumar, H.D.

Teaching Methodology – Class room lectures, PowerPoint presentations, online class/E-Content, etc.

Evaluation Criteria – Written Internal Sessional examinations (MCQ / one word answer / short answer type), assignment / Presentations / Viva-Voce and main semester examinations.



4. Vaccines – (3004)

Paper Type – Theory — Total Hours –60
Paper Type – Elective — Total Credits -4

Course Objectives

This course will provide students with an overview of current developments in different areas of vaccines.

Course Outcomes

By the end of this course, students should be able to:

- Differentiate and understand immune responses in relation to infection and vaccination;
- Understand requirement and designing of different types of vaccines;
- Understand importance of conventional and new emerging vaccine technologies.

Syllabus and Lecture Plan:

Unit	Unit content	No. of Hours (L48+T12+P0)
Unit I Vaccine types & design	History of vaccines, Conventional vaccines; Bacterial vaccines; Viral Vaccines; Vaccines based on routes of administration: parenteral, oral, mucosal; Live attenuated and inactivated vaccine; Subunit Vaccines and Toxoids; Peptide Vaccine.	12 + 3
Unit II Immune response to infection	Protective immune response in bacterial; viral and parasitic infections; Primary and Secondary immune responses during infection; Antigen presentation and Role of Antigen presenting cells: Dendritic cells in immune response; Innate immune response; Humoral (antibody mediated) responses; Cell mediated responses: role of CD4+ and CD8+ T cells; Memory responses: Memory and effector T and B cells, Generation and Maintenance of memory T and B cells	12 + 3
Unit III Immune response to vaccination	Vaccination and immune response; Adjuvants in Vaccination; Modulation of immune responses: Induction of Th1 and Th2 responses by using appropriate adjuvants and antigen delivery systems - Microbial adjuvants, Liposomal and Microparticles as delivery systems; Chemokines and cytokines; Role of soluble mediators in vaccination; Oral Immunization and Mucosal Immunity.	12 + 3
Unit IV Vaccine technologies	New Vaccine Technologies; Rationally designed Vaccines; DNA Vaccination; Mucosal vaccination; New approaches for vaccine delivery; Engineering virus vectors for vaccination; Vaccines for targeted delivery (Vaccine Delivery systems); Disease specific vaccine design: Tuberculosis Vaccine; Malaria Vaccine; HIV/AIDS vaccine; New emerging diseases and vaccine needs (Ebola, Zika)	12 + 3

Reference Books

1. Janeway, C. A., Travers, P., Walport, M., & Shlomchik, M. J. (2005). Immuno Biology: the Immune System in Health and Disease. USA: Garland Science Pub.
2. Kindt, T. J., Osborne, B. A., Goldsby, R. A., & Kuby, J. (2013). Kuby Immunology. New York: W.H. Freeman.
3. Kaufmann, S. H. (2004). Novel Vaccination Strategies. Weinheim: Wiley-VCH.
4. Journal Articles (relevant issues) from: Annual Review of Immunology, Annual
5. Review of Microbiology, Current Opinion in Immunology, Nature Immunology, Expert review of vaccines.

Teaching Methodology – Class room lectures, PowerPoint presentations, online class/E-Content, etc.

Evaluation Criteria – Written Internal Sessional examinations (MCQ / one word answer / short answer type), assignment / Presentations / Viva-Voce and main semester examinations.

24/06/2022

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5. Agriculture Biotechnology (3005)

Paper Type – Theory — Total Hours – 60
Paper Type – Elective — Total Credits -4

Course objective

The course aims to expose students to the basic scientific and technical aspects of the different disciplines of agricultural biotechnologies. It exposes the students about plant cell micopropagation, plant tissue culture techniques.

Production of haploid plants, use of plant cells, gene transfer techniques, crop improvement methods.

Single cell protein use and its economic implications

Course Outcomes:

CO1: To understand plant tissue culture techniques and micropropagation

CO2: To understand Haploids plants and their applications, protoplast regeneration and applications

CO3: To understand gene transfer techniques and methods of crop improvement

CO4: Understand the concept of utilizing plants for production of vaccines and production of biofertilizers and single cell protein

Syllabus and Lecture Plan:

Unit	Unit content	No. of Hours (L48+T12+P0)
UNIT I	Historical account Scope of Agriculture Biotechnology	3 + 1
UNIT II	Plant Tissue culture Totipotency, micro propagation and its stages, sterilization methods for equipment, media and explants, media preparation, meristmatic tissue culture, embryogenesis and embryo culture, haploid culture, single cell and protoplast culture, Artificial seed	11 + 2
UNIT III	Biotechnology for Crop Improvement, Techniques of gene transfer, Vectors used for gene transfer, Ti Plasmid, Co-Integrate and Binary vector, Microinjection, macro injection, gene gun, electroporation and polyethylene mediated gene transfer, chemical method of gene transfer, Molecular tagging of genes/traits. Marker-assisted selection of qualitative and quantitative traits.	14 + 2
UNIT IV	Genetic engineering for increasing crop productivity by manipulation of Photosynthesis, Nitrogen fixation, Nutrient uptake efficiency. Development of biotic stress tolerance (Insects, fungi, bacteria, viruses, weeds) and abiotic stress (drought, salt and temperature) in plants, GMO crops, Bt Cotton, Golden rice, Flavr savr tomato, development of resistance in crop against insecticide and herbicide, edible vaccine	14 + 3
Unit V	Plant Metabolic Engineering. The concept of secondary metabolites, Historical and current views, Importance of secondary metabolites in medicine and agriculture, Plants as bioreactor	6+2

Reference Books

1. Biotechnology and genomics. Gupta, P.K.
2. Plant Biotechnology. Doods
3. A text Book of Biotechnology. Kumar, H.D.
4. Molecular Biology and Genetic engineering. Gupta, P.K.
5. Biotechnology. Singh, B.D.
6. Gene Biotechnology. Jogdand, S.N.
7. Fundamentals of Genetics. Singh B. D. 2004. Kayani Publishers. New Delhi

Teaching Methodology – Class room lectures, PowerPoint presentations, online class/E-Content, etc.

Evaluation Criteria – Written Internal Sessional examinations (MCQ / one word answer / short answer type), assignment / Presentations / Viva-Voce and main semester examinations.

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6. **Lab Techniques 1 (30001)**

Paper Type – Practical — Total Hours – 60
Paper Type – Core — Total Credits -2

Course Objectives: To train students with the techniques that can fulfil their job opportunities in drug, pharma, vaccine, pathology and diagnostic kit making company.

Learning outcomes:

1. Learn important immunological techniques such as immunodiffusion, precipitation, agglutination and ELISA.
2. These techniques are routinely used by the diagnostic, vaccine and sera manufacturing companies hence this will open avenues for students in Biotech industries.
3. Hand on practical exposure to these techniques would enhance entrepreneurship Skills of the students.

S. No.	Practical	No. of Hours (L0+T0+P60)
1	To determine the blood group and Rh factor of an individual. (APPLICATION OF AGGLUTINATION TEST).	60
2	To study the double immunodiffusion technique with given set of antigen and antibody.	
3	To study the reaction pattern of antigens with given antibody by Ouchterlony method	
4	To study the immunodiffusion technique by single radial immunodiffusion and determine the concentration of unknown antigen	
5	To find out the titre of antibody by double immunodiffusion against given antigen	
6	To perform widal test for typhoid (APPLICATION OF AGGLUTINATION TEST)	
7	To perform ELISA and find out the concentration of given unknown antibody	

Teaching methodology: Hands on training/ demonstrations, interactive discussions
Evaluation Criteria: Semester end Practical Examination with viva voce

7. **Lab Techniques 2 (30002)**

Paper Type – Practical — Total Hours – 60
Paper Type –Core — Total Credits -2

S. No.	Practical	No. of Hours (L0+T0+P60)
1	Preparation of MS Media	60
2	Preparation of working solution	
3	Demonstration of various sterilization techniques	
4	Isolation and sterilization of explants	
5	Preparation of callus culture from explants	

Teaching methodology: Hands on training/ demonstrations, interactive discussions
Evaluation Criteria: Semester end Practical Examination with viva voce

8. **Research project/industrial training/survey/field training**

Paper Type – Core — Total Credits -4

Students have to complete Research project/industrial training/survey/field training according to Departmental time table.

Second Year -4th Semester

1. Industrial Bioprocess technology – 4001

Paper Type – Theory
Paper Type –Core
Total Hours – 60
Total Credits -4

Course Objectives:

CO1: The purpose of this course is to teach students about applying biotechnology to industrial process
CO2: To teach the basic principles of processing of bioproducts
CO3: To expose students to relevant advancement in industrial Bioprocess technology.

Learning outcomes:

LO1: Student can appreciate the relevance of microorganisms and have a better understanding to industrial context
LO2: Students will learn the design and operations of various bioreactors and downstream processing
LO3: Student will be able to apply gene manipulation technique to industrially important microorganisms

Syllabus and Lecture Plan:

Unit No.	Topic/Content	Teaching Hours Lecture/Tutorial (50L + 10T +0P)	
		L	T
1	Scope and history of industrial microbiology. Isolation, Maintenance and Preservation of industrial strains. Screening and Methods of strain improvement (mutagenesis, strain protoplast fusion etc) of industrial important strains.	10	2
2	Composition of typical Fermentation media. Inoculum Preparation. Medium sterilization, design of a batch and continuous sterilization processes, holding time, Scale up of sterilization.	8	1
3	Fermenter design body construction Basic concepts of fermenter-batch, continuous, fed batch, packed bed, bubble column, trickle, plug flow reactors. Fermentations-Submerged and solid state, fluidized bed.	8	2
4	Downstream Processing: Cell disintegration: Physical, chemical and Enzymatic Methods. Removal of microbial cells and other solid matter, foam separation, precipitation, filtration, centrifugation, Liquid- liquid extraction, drying and crystallization.	10	1
5	Industrial production of Penicillin and Streptomycin. Production of Amylase and Protease enzyme. Industrial production of Lysine, Glutamic acid and Single Cell Protein (SCP).	7	2
6	Industrial production of Vitamin B12 and Riboflavin. Industrial production of organic acids: Lactic acid and Citric acid. Industrial production of Vinegar, alcohol and alcoholic beverages (Beer and Wine)	7	2

List of reference books:

1. Principles of fermentation Technology by Stanbury PF, Whitaker A and Hall SJ. (2006).
2. Industrial Microbiology by Casida LE. (1991). 1st edition. Wiley Eastern Limited.
3. Biotechnology - A text book of Industrial Microbiology Wulf Crueger & Anneliese Crueger.
4. Prescott and Dunn's Industrial Microbiology by Reed, G, CBS Publishers & Distributors.
5. Industrial Microbiology: An introduction by Waites, MJ, Morgan, NL, Rockey, JS,Higton, G, Edition .1st, Wiley-Blackwell.

Teaching Methodology – Class room lectures, PowerPoint presentations, online class/E-Content, etc.
Evaluation Criteria – Written Internal Sessional examinations (MCQ / one word answer / short answer type), assignment / Presentations / Viva-Voce and main semester examinations.

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2. Enzymology – (4002)

Paper Type – Theory — Total Hours – 60
Paper Type –Core — Total Credits -4

Course objectives: The course will cover a wide range of subjects such as vitamins and co- enzyme, classification of enzyme, mechanism and kinetics of enzyme catalyzed reaction. The final part will deal with the production, extraction, purification, characterization and application of enzymes.

Course outcomes:

Upon successful completion of this course, the student will learn:

- The major classes of enzyme and their functions in the cell;
- Role of co-enzyme cofactor in enzyme catalyzed reaction;
- Differentiate between equilibrium and steady state kinetics and analyzed simple kinetic
- data and estimate important parameter (Km. Vmax, Kcat etc);
- Enzyme purification and enzyme engineering
- To define the molecular biology of enzymes

Unit	Unit content	No. of Hours (L50+T10+P0)
I- Enzyme Classification	Introduction of enzyme, enzyme classification and nomenclature, concept of enzyme substrate complex, active site, specificity, factors affecting rate of enzyme catalyzed reactions, mechanism of enzyme action, enzyme units.	5+1
II- enzyme kinetics and their inhibition	Microbial sources of enzymes, kinetics of enzyme activity, Michaelis-Menten equationand its derivation, different plots for the determination of Km and Vmax and their physiological significance , two substrate reactions, enzyme inhibition, types of inhibition	10 +2
III- Regulatory enzymes	Microbial enzyme production, submerged and solid state fermentation, Important parameter in enzyme production. Enzyme purification techniques-Precipitation, Chromatographic separation, gel filtration, anion and cation exchange, zymography	15+3
IV- Enzyme Technology and its applications	Methods for large scale production of enzymes, immobilized enzymes and their comparison with soluble enzymes, methods for immobilization of enzymes, applications of immobilized and soluble enzymes in health and industry, applications of fundamental studies of Biotechnology	12+3
V- Molecular Biology Enzymes	Thermal stability and catalytic efficiency of enzyme, site directed mutagenesis and enzyme engineering, modification of active site of an enzyme.	8+1

References:

1. Understanding Enzymes. Palmer,T.
3. Fundamentals of Biochemistry. Jain, J.L.
4. General Enzymology. Kulkarni and Deshpande
5. Lehninger Principles of Biochemistry. Nelson and Cox
6. Enzyme Kinetics. A modern approach. Marangoni, A.G.
7 .Fundamentals of Enzymology. Price, N.C. and Stevens, L.
8. Enzyme Assays: A practical approach. Eisenthal and Danson
9. Enzymology . T. Devasena.
10.Enzyme. Dixon, M. and Webb, E.C.

Teaching Methodology – Class room lectures, PowerPoint presentations, online class/E-Content, etc.

Evaluation Criteria – Written Internal Sessional examinations (MCQ / one word answer / short answer type), assignment / Presentations / Viva-Voce and main semester examinations.

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3. ENVIRONMENTAL BIOTECHNOLOGY (4003)

Paper Type – Theory — Total Hours –60
Paper Type –Core — Total Credits- 4

Course Objectives: This course aims to introduce fundamentals of environmental biotechnology, most applicable tools in environmental biotechnology and will be supported by relevant examples from the national and international literature.

Learning outcomes: The major outcome of the course is to understand the applications of biotechnology to assess environmental quality and its monitoring. Also, student will understand the remediation of contaminated environment.

Syllabus and Lecture Plan:

Unit No.	Topic/Content	Teaching Hours Lecture/Tutorial (50L + 10T +0P)	
		L	T
1	Introduction to Environment, Concept of ecosystems and ecosystem management, biogeochemical cycling in ecological systems; Environmental problems- ozone depletion, greenhouse effect, water, air and soil pollution, land degradation.	12	2
2	Genetically engineered microorganisms in environment; Role of environmental biotechnology in management of environmental problems, Bioremediation, advantages and disadvantages; In situ and ex-situ bioremediation; slurry bioremediation; Bioremediation of contaminated ground water and phytoremediation of soil metals; microbiology of degradation of xenobiotics	12	3
3	Sewage and waste water treatment and solid waste management, chemical measure of water pollution, conventional biological treatment, role of microphyte and macrophytes in water treatment; Recent approaches to biological waste water treatment, composting process and techniques, use of composted materials.	13	3
4	Biofertilizers and factors affecting its efficancy, their storage, self-life and quality control; Biopesticides and methods of application	13	2

List of reference books:

1. Wastewater Engineering – Treatment, Disposal and Reuse, Metcalf and Eddy. Inc. Tata McGrawHill, New Delhi. 1991
2. Environmental Science (5th Edition) by WP Cunninghum & BW Saigo., Mc Graw Hill. 28 1999.
3. Introduction to Biodeterioration, D Allsopp and K J Seal, ELBS/Edward Arnold. Cambridge Univ Press. 2004.
4. Biotechnology for Wastewater Treatment. P Nicholas Cheremisinoff. Prentice Hall Of India. 2001
5. Biotechnological Methods of Pollution Control. SA Abbasi and E Ramaswami. Universities Press 1999
6. Environmental Biotechnology, Concepts and Applications. Hans-Joachin Jordening and Josef Winter. Winter-VCH. 2005
7. Biology of wastewater Treatment. N F Gray. Mc Graw Hill. 2004.
8. Fundamentals of ecology (5th Edition) by EP Odum and GW Barrett, Thomson Books/Cole, 2005.

Teaching Methodology – Class room lectures, PowerPoint presentations, online class/E-Content, etc.

Evaluation Criteria – Written Internal Sessional examinations (MCQ / one word answer / short answer type), assignment / Presentations / Viva-Voce and main semester examinations.

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4. ANIMAL BIOTECHNOLOGY (4004)

Paper Type – Theory — Total Hours – 60
Paper Type – Core — Total Credits-4

Course Objectives:

Students will be introduced to principles and practices of animal biotechnology and their application in vaccines, tissue engineering and biopharmaceuticals. To study culturing techniques, types of cultures, media formulation and sterilization methods used in animal cell cultures. To create awareness in the students about the economic, social and cultural benefits of IPRs in the field of biology. To study values of IPRs and generating wealth for IPRs through commercialization.

Course Outcomes: After successful completion student will be able to

CO1: Understand animal cell culturing methods, and the techniques to get improvised cell lines of the eukaryotes and their maintenance.

CO2: Characterization of cultured cell, study growth parameters, molecular diagnostics based on cell culture, Applications of cell culture

CO3: Students will have the knowledge regarding the recombinant products produced by the genetically manipulated eukaryotic organisms to benefit the human health

CO4: Application of animal biotechnology in improvement of livestock, detection of transgenic

CO5: Biosafety issues in biotechnology - risk assessment and risk management, biosafety guidelines

CO6: Social concern about the use of GMOs and awareness towards the biosafety laws.

Syllabus and Lecture Plan:

Unit	Unit content	No. of Hours (L48+T12+P)
UNIT I Animal Cell Culture (Equipments, Consumables & Media)	Equipments and materials used in animal cell culture. Sterilization and safety measures. Natural media, Synthetic media. Role of serum in cell culture. Advantages and disadvantages of serum in culture medium. Growth factors. Growth curve. Procedures for coating of culture surface. Cytotoxicity and viability assays. Measuring parameters of growth. Organ and histotypic cultures. Three-dimensional culture and tissue engineering. Primary Culture and Tissue disaggregation. Subculture and Establishing Cell lines. Maintenance of cell culture and cell separation.	12 + 3
Unit-II Cell Culture Technology	Biology and characterization of the cultured cells, measuring parameters of growth. Basic techniques of mammalian cell culture in vitro; Scaling-up of animal cell culture at commercial level. Cell synchronization. Cell cloning and micromanipulation. Cell transformation. Basics, embryonic & adult stem cells, Trans differentiation, Applications Application of animal cell culture. Cultivation of Viruses. Molecular Diagnostics development based on cell culture for Virus.	12 + 3
Unit- III Transgenic Animals	In vitro fertilization, ET and cloning. Transgenic Animals and Transfection Methods Introduction, Transfection Methods, Gene transfer through microinjection, Retroviral infection, Targeted gene transfer. Gene disruption, gene replacement. Transgene integration. Gene therapy Transgenic animal and their applications. Transgenic mice, sheep, goat, Rabbits, Cattle, Pigs and fish. Animal Bioreactors and molecular pharming. Animal cloning.	12 + 3
UNIT IV	Applications of Animal Biotechnology, Valuable products from cell culture. Application of molecular markers for improvement of livestock	12 + 3

Reference Books

Culture of Animal cells. Freshney, R.T. (2000) Alan R. Lirs Inc. New York.

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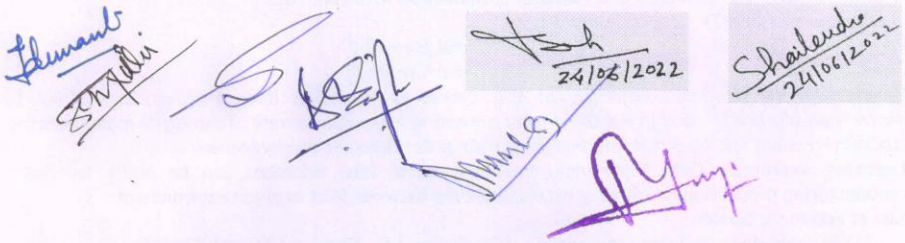
Biotechnology and genomics. (2008) Gupta, P.K. Rastogi Publications Meerut.
Molecular Biology and Genetic engineering. (2008) Gupta, P.K.
Text book of Biotechnology. Das, H.K.
Biotechnology. Singh, B. D. (2008) Kalyani Publishers, New Delhi.
Fundamentals of Genetics. 2004. Singh. B. D. Kalyani Publishers. New Delhi.
Bioethics and Biosafety in Biotechnology. Sreeramulu, V. (2007) New Age International Publishers. New Delhi.

Teaching Methodology – Class room lectures, PowerPoint presentations, online class/E-Content, etc.

Evaluation Criteria – Written Internal Sessional examinations (MCQ / one word answer / short answer type), assignment / Presentations / Viva-Voce and main semester examinations.



5. Lab Techniques 1 (40001)

Paper Type – Practical — Total Hours – 60
Paper Type –Core — Total Credits -2

S. No.	Practical	No. of Hours (L0+T0+P60)
1	Isolation and purification of enzymes.	60
2	Enzyme assays.	
3	Fractionation of enzyme proteins by Ammonium sulphate and Desalting.	
4	Enzyme Immobilization	
5	Determination of optimum reaction conditions for enzyme activity	

Teaching methodology: Hands on training/ demonstrations, interactive discussions
Evaluation Criteria: Semester end Practical Examination with viva voce

6. Lab Techniques 2 (40002)

Paper Type – Practical — Total Hours-60
Paper Type –Core — Total Credits -2

Course Objectives: Main objective of this course is to create interest in students about how microorganisms can be used in our day-to-day life and to make them aware of industrial manufacturing of products by using microbes that will enlighten their path to become a entrepreneur.

Learning outcomes: Gain knowledge practically as to how microbes can be easily handled for manufacturing products and how they can examine the bacterial load in given environment.

List of reference books:

1. Microbiology. A Laboratory manual. Cappucino, J.G., Sherman, N. and Weseele
2. Experiments in Microbiology, Plant Pathology and Biotechnology. Aneja, A.R
3. Microbes in Action by Harry W. Seeley, Paul J. van Demark; Freemen

S. No.	Practical	No. of Hours (L0+T0+P60)
1	To prepare ginger beer and estimate the total acidity.	60
2	To prepare sauerkraut, an eastern European fermented cuisine and find out the percentage lactic acid produced	
3	To prepare Korean fermented cuisine Kimchi and observe how it is different from Sauerkraut	
4	To isolate amylase producing species of Aspergillus species and test for its presence	
5	To produce Wine from grapes and estimate total acidity and volatile acidity in it	
6	To isolate citric acid producing Aspergillus species and process its purification	
7	To perform bacteriological examination of water by MPN method	
8	Determination of total bacterial population by Standard Plate Count method	
9	To determine total dissolved solids of water	
10	To determine the Chemical oxygen demand of water	

Teaching methodology: Hands on training/ demonstrations, interactive discussions
Evaluation Criteria: Semester end Practical Examination with viva voce

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7. Research project/industrial training/survey/field training

Paper Type –Core Total Credits -4

*Students have to complete Research project/industrial training/survey/field training according to departmental time table.

After completing 2nd year (3rd and 4th semester) of MSc. Biotechnology programme awarded for the degree of - Master of science in Biotechnology