

SHRI GURU RAM RAI UNIVERSITY

Patel Nagar, Dehradun-248001, Uttarakhand, India

[Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017 & recognized by UGC u/s 2(f) of UGC Act 1956]

Syllabus

Pre Ph.D. Course Work (Biotechnology)



Effective from Academic Session
(2017-2018)

&

Revised in (2023-2024 & 2024-25)

Patel Nagar, Dehradun-248001, Uttarakhand.

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VISION AND MISSION- DEPARTMENT OF BIOTECHNOLOGY

Vision

1. To be producing technical manpower through excellence in research and development, teaching, learning and training, with concern for worldwide environment and human society.
2. To provide well and quality education in the field of Life Sciences and Applied Sciences with proper training and practical expertise responsive to the needs of present and future century so that students excel and enhance in their professional life.

Mission

1. Providing friendly learning ambience to develop competence in diversified areas to create excellence in industrial, educational, research and technical areas.
2. Provide an efficient educational environment where students and research scholars can realize their full potential in their chosen disciplinary subjects and attain quality education to face the challenges of the future.
3. Establish networks collaborations and linkages with industries and academic institutes to produce ethically and morally strong workforce contributing to the development of knowledge economy.
4. Harness the skills of the students and assist them to excel in their professional life by providing life long leaning skills, sound theoretical knowledge, practical experience and all-round development with the help of well qualified and experienced faculty. Inculcate moral and ethical values for character building.

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*President
Gashri*

OUTCOME BASED EDUCATION**Programme outcome (POs)****The Student will be able to:**

PO 1	Acquire knowledge and enhance their fundamentals pertaining to basic and applied fields of biotechnology, Life Sciences, Applied Sciences and allied sciences including microbiology, computer application, biostatistics etc.
PO2	Exhibit technical skills to apply modern tools, techniques (bio-analytical, IT, biostatistics, plant, animal and microbial biotechnology) and identify the utility and application in scientific studies.
PO3	Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.
PO4	Exhibit ability to design and conduct laboratory-based experiments and inculcate research aptitude and critical thinking ability to analyze and interpret data.
PO5	To identify entrepreneurship potential of biotechnological process and products, impact on environment and society, along with associated ethical issues.
PO6	Enhance their presentation, communication and writing skills through trainings, seminars, research writing, report writing.
PO7	Environment and Sustainability: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PO8	Demonstrate an ability to identify the potential of biotechnology (basic and applied) to recognize and propose/ design/derive a solution to complex problem. Attain eligibility and competency pursue career in research, various industries, entrepreneurship and inculcate lifelong learning ability.
PO9	Effective Writing: Got Skill for Write up in scientific literature and other social media platform related to life science.
PO10	Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
PO11	Social Interaction and Ethics: Elicit views of others, mediate disagreements and help reach conclusions in group. Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them settings conclusions in group settings.
PO12	Interdisciplinary approach and Practical learning: Analyse the relationships among animals, plants, microbe sand Industry. Perform proceduresas per laboratory standards in the areas of Applies Sciences, Life Sciences, Biotechnology, Biochemistry, Bioinformatics, Genomics, industrial biotechnology and fermentation technology.

Program Specific Outcome (PSOs)

PSO 1	Demonstrate proficiency in theoretical as well as practical knowledge in the field of biotechnology and allied sciences (molecular & cell biology, biochemistry, bioinformatics, RDT, plant & animal science environmental biotechnology, immunology, IPR, Genomics, microbiology, Computer application, biostatistics & others).
PSO2	Exhibit potential to design and conduct experiments, analyze and interpret data in different field of biotechnology along with inculcation of research-oriented learning.
PSO3	Identify the potential and application of biotechnology and scientific knowledge to design / derive a solution of problem pertaining to environment conservation, health, agriculture, society and industry considering associated ethical issues.
PSO4	Ability to analyze prevailing career opportunities to pursue a career in research, industries, other organizations, setup start-ups.

**Course Structure and the Assessment scheme
of
Pre Ph.D. Course Work Syllabus**

S.N.	Paper Code	Subject	Credits L:T:P	Total credit	Total marks (External + Internal)	Minimum marks to be scored for successful completion
1.	PRMC 101	Research methodology	2:1:1	4	80 (60+20)	40
2.	RPEC 102	Research & Publications Ethics	1:1:0	2	40 (30+10)	20
3.	PBTC 103	Subject Specific (core paper): Tools & Techniques	2:1:1	4	80 (60+20)	40
4.	PBTE 104 (a/b/c/d)	Subject Specific (elective paper) one out of four	2:1:1	4	80 (60+20)	40
5.	PBTF 105	Field work	0:2:2	4	80 (00+80)	40
Total				18	360	180

Paper-I: Research Methodology (Compulsory),
Code: PRMC-101

Credit: 04

Course Outcome:

1. To develop understanding of the basic framework of research process.
2. To develop an understanding of various research designs and techniques.
3. To identify various sources of information for literature review and data collection.
4. To develop an understanding of the ethical dimensions of conducting applied research
5. Appreciate the components of scholarly writing and evaluate its quality.
6. To create the research design and experimental approaches to conduct research.

Unit I-Concept & Types of Research

01

Meaning and importance of Research, Types of Research, Selection and formulation of Research Problem, Research Design, Classification of Research, Pure and Applied Research, Exploring or Formulative Research, Descriptive Research, Diagnostic Research/Study, Evaluation research/Studies, Action Research, Experimental Research, Historical Research.

Unit II –Methods Research

01

General Survey of various Methods including Survey Method, Interdisciplinary Method, Case Study Method, Sampling Method, Observation Method, Interview Method, Schedule Method, Questionnaire Method, Documentary Method, Library Method, Historical Method and Scientific Method. Characteristic Features of Scientific Method; Empirical Verifiable, Cumulative, Self - Correcting, Deterministic, Ethical & Ideological neutrality (Value Free).

Unit III - Data Collection and Data Analysis

01

Collection, Objectives and Classification of Data, Aims, Methods and Objects of Tabulation of Data, Forms and Processes of Interpretation and Presentation of Data, Primary, Secondary and Tertiary Data, Construction and adaptation of instruments, administration of questions and tests, Data organization in SPSS & Excel, Graphical representation of data, Testing of Hypothesis: Logical and Statistical Techniques.

Unit IV: Report Writing

01

Locating Information on a Topic of Interest, Acquiring Copies of Articles of Interest, The Nature of Scientific Variables, Conceptual Versus Operational Definitions of Variables, Levels of Measurement, Various Paradigms, The Basic Format for a Research Report, Identification of the Parts of a Research Report, Citation and Referencing Styles, Essentials of Report Writing, Aids for Writing Good Research Report.

References:

- 1) Bagchi, Kanak Kanti (2007) Research Methodology in Social Sciences: A Practical Guide, Delhi, Abijeet Publications.
- 2) Kothari, C.R (2004) Research Methodology: An Introduction, Delhi, New Age.
- 3) Cooper, R. Donald and Pamela S. Schindler (2003) Business Research Methods, Delhi, Tata McGraw-Hill.
- 4) Flyvbjerg, Bent (2001) Making Social Science Matter: Why Social Inquiry Fails and How it can Succeed Again, United Kingdom, Cambridge University Press.
- 5) Goodde and Hatte (1952) Methods in Social Research, New York, McGraw – Hill.

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CO	Description	Bloom's Taxonomy Level
CO1	Remember the different basic concepts of introduction to general character and concepts of biostatistics, Types of Data, Measures biostatistical analysis, Probability classical & axiomatic definition of probability, distributions, sampling, analysis of variance, Correlation and Regression. Emphasis on examples from Concept & Types of Research, Methods of Research, Data Collection and Data Analysis and Report Writing.	1 Remembering
CO2	Understand and remember the specific and basic concepts of measurement of Concept & Types of Research, Methods of Research, Data Collection and Data Analysis and Report Writing..	1,2 Remembering, Understanding
CO3	Applying , understanding and remembering the detailed processes and features of Research Methodology, Types of Data, Measures biostatistical analysis and Concept & Types of Research, Methods of Research, Data Collection and Data Analysis and Report Writing.	1,2,3 Remembering, Understanding, Demonstrating
CO4	Analyzing , applying, remembering and understanding the detailed study related to measurement of analysis of Research Methodology and Concept & Types of Research, Methods of Research, Data Collection and Data Analysis and Report Writing.	1,2,3,4 Remembering, Understanding Applying, Analyzing
CO5	Evaluating , analyzing, applying, remembering, and understanding the specific and basic concepts of measurement of Concept & Types of Research, Methods of Research, Data Collection and Data Analysis and Report Writing.	1, 2,3,4,5 Remembering, Understanding, Applying Analyzing, Evaluating
CO6	Constructing (Creating) , Evaluating, Analyzing, demonstrating, remembering, and understanding the take part in biostatistical analysis with Research methodology and detailed study of specific and basic concepts of measurement of Concept & Types of Research, Methods of Research, Data Collection and Data Analysis and Report Writing.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating, Creating

Paper-II: Research & Publication Ethics (Compulsory),
Code: RPEC-102

Credit: 02

Course Outcome:

1. To develop an understanding of research ethics, publications misconduct and plagiarism.
2. To develop Intellectual honesty and research integrity.
3. To identify various sources of information for data bases and research matrices.
4. To develop an understanding of Open access publications and initiatives.
5. Appreciate the components of scholarly writing and evaluate its quality.
6. To create the research matrices based on cite score.

Unit I-Philosophy and Ethics

0.2

Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: definition moral philosophy, nature of moral judgements and reactions.

Unit II-Scientific Conduct

0.3

Ethics with respect to science and research, Intellectual honesty and research integrity, Scientific misconducts: Falsification and Plagiarism (FFP), Redundant publication: duplicate and overlapping publication, salami slicing, Selective reporting and misrepresentation of data.

Unit III-Publication Ethics

0.5

Publication ethics: definition, introduction and importance, Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest, Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types, violation of publication ethics, authorship and contributor ship, Identification of publication misconduct, complaints and appeals, Predatory publishers and journals Practice.

Unit IV-Open Access Publishing

0.25

Open access publications and initiatives, SHERPA / RoMEO online resource to check publisher copyright and self-archiving policies, Software tools to identify predatory publications developed by SPPU, Journal finder / journal suggestion tools viz. JANE, Elsevier journal Finder, Springer, Journal Suggester, etc.

Unit V-Publication Misconduct

0.25

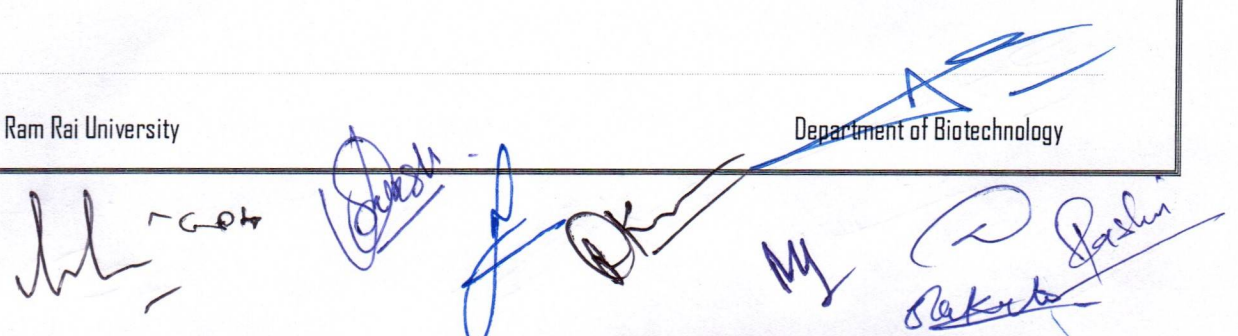
Group Discussion, Subject specific ethical issues, FFP, authorship, Conflicts of interest, Complaints and appeals: examples and fraud from India and abroad. Software tools, Use of plagiarism software like Turnitin, Urkund and other open source software tools.

Unit VI-Databases and Research Metrics

0.5

Databases, Indexing databases, Citation databases: Web of Science, scopus, etc., Research Metrics, Impact factor of journal as per journal Citation report, SNP, SJR, IPP, Cite score, Metrics: h-index, g index, i10 index, altmetrics.

1. Yogita Sharma et al.: Research & Publication Ethics (Theory & Practice), Kalyani publications.
2. Partha Pratima Ray: A Guide to Research & Publication Ethics.
3. Kishore et al.: Research & Publication Ethics.



CO	Description	Bloom's Taxonomy Level
CO1	Remember the different basic concepts of introduction to general character and concepts of Research Publication and Ethics. To develop a scientific temperament of research ethics, publications misconduct and plagiarism. To develop Intellectual honesty and research integrity. To identify various sources of information for data bases and research matrices. To develop an understanding of Open access publications and initiatives. Appreciate the components of scholarly writing and evaluate its quality.	1 Remembering
CO2	Understand and remember the specific and basic concepts of Research Publication and Ethics with brief knowledge of Philosophy and Ethics, Scientific Conduct, Publication Ethics, Open Access Publishing, Publication Misconduct and Databases and Research Metrics.	1,2 Remembering, Understanding
CO3	Applying , understanding and remembering the detailed processes and features of Research Publication and Ethics. To develop a scientific temperament of research ethics, publications misconduct and plagiarism. To develop Intellectual honesty and research integrity. To identify various sources of information for data bases and research matrices. To develop an understanding of Open access publications and initiatives. Appreciate the components of scholarly writing and evaluate its quality.	1,2,3 Remembering, Understanding, Demonstrating
CO4	Analyzing , applying, remembering and understanding the detailed study related to measurement of analysis of Research Publication and Ethics with brief knowledge of Philosophy and Ethics, Scientific Conduct, Publication Ethics, Open Access Publishing, Publication Misconduct and Databases and Research Metrics.	1,2,3,4 Remembering, Understanding Applying, Analyzing
CO5	Evaluating , analyzing, applying, remembering, and understanding the specific and basic concepts of Research Publication and Ethics with brief knowledge of Philosophy and Ethics, Scientific Conduct, Publication Ethics, Open Access Publishing, Publication Misconduct and Databases and Research Metrics.	1, 2,3,4,5 Remembering, Understanding, Applying Analyzing, Evaluating
CO6	Constructing (Creating) , Evaluating, Analyzing, demonstrating, remembering, and understanding the take part in Research Publication and Ethics with brief knowledge of Philosophy and Ethics, Scientific Conduct, Publication Ethics, Open Access Publishing, Publication Misconduct and Databases and Research Metrics.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating, Creating

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Paper III: Tools & Techniques (Core paper)

Code: PBTC-103

Credit-04

Course Outcome:

1. The objective of this course is to familiarize students with the basic concepts and applications of modern techniques used in Biochemistry, Biophysics, Cell and Molecular Biology.
2. The students will be able to understand the principle and working of different chromatography techniques.
3. The students will be able to understand the principle and working of different centrifugation techniques.
4. The students will be able to understand the principle and working of different Electrophoretic and molecular biology techniques
5. Appreciate the components of tools and techniques and its quality.
6. To create the components of tools and techniques based on cite score.

Unit-I: Chromatography, Electrophoresis, Centrifugation & pH meter.

1.5

General principle, instrumentation and application of chromatography, electrophoresis-Basic principle and types, 2D gel electrophoresis. Centrifugation – Basic principle and types of centrifuges, types of rotors. pH meter & Digital probes.

Unit-II: Spectroscopy, Crystallography, Microscopy & Radioactivity.

1.5

Spectroscopic methods: principle and applications of UV-visible, IR, NMR. Principle and applications of X ray crystallography. Application of ELISA, RIA and blotting techniques, Types of microscopes and applications in biology, Radioactivity & radiotracer techniques.

Unit-III: Fundamentals of Computer.

0.5

Fundamentals of Computer, Concepts of Hardware and Software, Operating System, Working with Microsoft office (MS-WORD, EXCEL, POWER POINT, etc), Basic idea of Internet, search through internet and Database search, Use of internet networks in research activities.

Unit-IV: Buffer System.

0.5

General idea of buffer system, Preparation of buffers such as (phosphate buffer, Tris-HCl etc.), General idea of concentration measurement of solution viz. molarity normality, molality etc.), Management of laboratories chemicals, glassware's and working with equipments, Laboratory setting.

Recommended Books:

1. Sharma, V.K.: Techniques in Microscopy and Cell Biology Tata McGraw Hill, 1991.
2. Alberts et al.: Molecular Biology of the cell (2nd ed.), Garland, 1989.
3. Biochemical Technique: Theory & Practical J.F. Robyt & B.J. White \$ 30.95. Waveland Press, Inc.
4. Wilson & Walker: Practical Biochemistry (4th ed) University of Hertfordshire Cambridge University Press
5. Jayraman: Laboratory Manual in Biochemistry
6. Arnold L. Demain & Julian E. Davies: Manual of Industrial Microbio. & Biotech. 2nd ed.

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CO1	Remember the basic concepts of general character of Biological & Radiotracer Techniques: Analytical separation: chromatography, electrophoresis, centrifugation, principles and applications of microscopy, Spectroscopic methods and Safety rules in handling of radioisotopes and hazardous chemicals in biotechnological and advance research.	1 Remembering
CO2	Understand and remember the specific and basic concepts and applications of Biological & Radiotracer Techniques: Analytical separation: chromatography, electrophoresis, centrifugation, principles and applications of microscopy, Spectroscopic methods and Safety rules in handling of radioisotopes and hazardous chemicals.	1,2 Remembering, Understanding
CO3	Applying , understanding and remembering the detailed processes and features of Biological & Radiotracer Techniques: Analytical separation: chromatography, electrophoresis, centrifugation, principles and applications of microscopy, Spectroscopic methods and Safety rules in handling of radioisotopes and hazardous chemicals.	1,2,3 Remembering, Understanding, Demonstrating
CO4	Analyzing , applying, remembering and understanding the detailed study related to Biological & Radiotracer Techniques: Analytical separation: chromatography, electrophoresis, centrifugation, principles and applications of microscopy, Spectroscopic methods and Safety rules in handling of radioisotopes and hazardous chemicals.	1,2,3,4 Remembering, Understanding Applying, Analyzing
CO5	Evaluating , analyzing, applying, remembering, and understanding the Biological & Radiotracer Techniques: Analytical separation: chromatography, electrophoresis, centrifugation, principles and applications of microscopy, Spectroscopic methods and Safety rules in handling of radioisotopes and hazardous chemicals.	1, 2,3,4,5 Remembering, Understanding, Applying Analyzing, Evaluating
CO6	Constructing (Creating) , Evaluating, Analyzing, demonstrating, remembering, and understanding the take part in Biological & Radiotracer Techniques: Analytical separation: chromatography, electrophoresis, centrifugation, principles and applications of microscopy, Spectroscopic methods and Safety rules in handling of radioisotopes and hazardous chemicals.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating, Creating

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Paper IV: Microbial Technology (Elective)-a
Code: PBTE-104a

Credit-04

Course Outcome:

1. The objectives of this course are to educate students about fundamental concepts of bioprocess technology and its related applications, thus, preparing them to meet challenges of new and emerging areas of biotechnology industry.
2. Students will be able to understand fermentative productions of representative biomolecules like enzymes, antibodies, vitamins etc.
3. Understanding recovery and purification of biomolecules.
4. Quality control procedures like sterility, toxicity and carcinogenicity testing
5. Appreciate the components of microbial technology and its quality.
6. To create the components of microbial technology based on cite score.

Unit-I: Fermentation

01

A Historical prospective, types of fermentation, principle of microbial growth kinetics, Isolation of culture, screening and preservation.

Unit-II: Experimental design for improvement of fermentation

01

Substrates for fermentation; Media development for industrial fermentation process, carbon sources, Nitrogen sources & inorganic components, industrial waste as raw material for fermentation. Types of bioreactors (CSIR, bubble column, fluidized –bed, trickling, filter etc.)

Unit-III: Down stream processing

01

Downstream process economics and cost cutting strategies, process design criteria for bio-products. General idea of product identification separation & purification techniques

Unit-IV: Products of fermentation

01

Fermentation products (raw material, microorganisms used, production and purification): Ethanol, Acetone, Citric acid, Enzymes, Glycerol Single cell protein, Antibiotics (Penicillin, Streptomycin), Meta-genomics: Approaches and applications.

Recommended Books:

1. Food Biotechnology. S.Bielecki, et al - (Ed) Elsevier Science (2000)
2. Food Biotechnology. Kalidas Shetty et al – CRC Press (2005)

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CO	Description	Bloom's Taxonomy Level
CO1	Remember the different basic concepts of introduction to production of industrial chemicals, biochemicals and chemotherapeutic products, Microbial products of pharmacological interest, Enzyme and cell immobilization techniques in industrial processing, purification of products and enzymes, enzyme kinetics.	1 Remembering
CO2	Understand and remember the specific and basic concepts of industrial chemicals, biochemicals and chemotherapeutic products, Microbial products of pharmacological interest, Enzyme and cell immobilization techniques in industrial processing, purification of products and enzymes, enzyme kinetics.	1,2 Remembering, Understanding
CO3	Applying , understanding and remembering the detailed processes, essential techniques and features of industrial chemicals, biochemicals and chemotherapeutic products, Microbial products of pharmacological interest, Enzyme and cell immobilization techniques in industrial processing, purification of products and enzymes, enzyme kinetics.	1,2,3 Remembering, Understanding, Demonstrating
CO4	Analyzing , applying, remembering and understanding the detailed study related to concepts of industrial chemicals, biochemicals and chemotherapeutic products, Microbial products of pharmacological interest, Enzyme and cell immobilization techniques in industrial processing, purification of products and enzymes, enzyme kinetics.	1,2,3,4 Remembering, Understanding Applying, Analyzing
CO5	Evaluating , analyzing, applying, remembering, and understanding the principle, methods, properties and functions of industrial chemicals, biochemicals and chemotherapeutic products, Microbial products of pharmacological interest, Enzyme and cell immobilization techniques in industrial processing, purification of products and enzymes, enzyme kinetics.	1, 2,3,4,5 Remembering, Understanding, Applying Analyzing, Evaluating
CO6	Constructing (Creating) , Evaluating, Analyzing, demonstrating, remembering, and understanding the Take part in essential techniques and features of industrial chemicals, biochemicals and chemotherapeutic products, Microbial products of pharmacological interest, Enzyme and cell immobilization techniques in industrial processing, purification of products and enzymes, enzyme kinetics. Extracellular enzymes, Biotechnologically important intracellular products.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating, Creating

Paper IV: Plant Biotechnology (Elective)-b

Code: PBTE-104b

Credit-04

Course Outcome:

1. To impart theoretical knowledge on various techniques of plant biotechnology like tissue culture, plant genetic transformation and their application in industries.
2. To develop concepts, principles and processes in plant biotechnology.
3. Students will know about different types of plant tissue culture.
4. Elucidation of different methods for the improvement of plants, including plant taste, texture, fruit ripening, sweetness etc.
5. Appreciate the components of plant biotechnology and its quality.
6. To create the components of plant biotechnology based on cite score.

Unit – I: Cell & Tissue Culture

01

Introduction to cell & tissue culture, Tissue culture media composition & preparation.

Initiation and maintenance of callus and cell suspension culture.

Unit – II: Organogenesis

01

Organogenesis, protoplast isolation, culture and fusion. Production of haploids, somaclonal variations, cryopreservation.

Unit – III: Secondary metabolite production

01

Production of secondary metabolites from plant cell cultures, Technology of plant cell culture for production of chemicals. Agro bacterium mediated gene transfer. Direct gene transfer method.

Unit – IV: Genetic Engineering

01

Plant genetic engineering for production of herbicide resistance, insect resistance, disease resistance & virus resistance. Application of plant biotechnology for the production of industrial enzymes, antigens (edible vaccines) & plant bodies.

Recommended Books:

1. P.K. Gupta: Elements of Biotechnology, Rastogi and Co. Meerut, 1996
2. R.J. Hanry: Practical Application of Plants Molecular Biology, Champan and Hall, 1997
3. H.D. Kumar: Modern Concepts of Biotechnology, Vikas Publ. Pvt. Ltd.
4. B.D. Singh: Biotechnology, Kalyani Publ.

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CO	Description	Bloom's Taxonomy Level
CO1	Remember the different basic concepts of introduction to general character of plant biotechnology, cryo and organogenic differentiation, types of culture, In vitro haploid production, protoplast Isolation and fusion and Plant Growth Promoting bacteria.	1 Remembering
CO2	Understand and remember the specific and basic concepts of plant biotechnology, cryo and organogenic differentiation, types of culture, Somatic embryogenesis and production of synthetic seeds , In vitro haploid production, protoplast Isolation and fusion and Plant Growth Promoting bacteria. Somaclonal variation nomenclature, methods, applications basis and disadvantages.	1,2 Remembering, Understanding
CO3	Applying , understanding and remembering the detailed processes and features of plant biotechnology, cryo and organogenic differentiation, types of culture, In vitro haploid production, protoplast Isolation and fusion and Plant Growth Promoting bacteria. Somaclonal variation nomenclature, methods, applications basis and disadvantages.	1,2,3 Remembering, Understanding, Demonstrating
CO4	Analyzing , applying, remembering and understanding the detailed study related to plant biotechnology, cryo and organogenic differentiation, types of culture, In vitro haploid production, protoplast Isolation and fusion and Plant Growth Promoting bacteria. Somaclonal variation nomenclature, methods, applications basis and disadvantages.	1,2,3,4 Remembering, Understanding Applying, Analyzing
CO5	Evaluating , analyzing, applying, remembering, and understanding the plant biotechnology, cryo and organogenic differentiation, types of culture, In vitro haploid production, protoplast Isolation and fusion and Plant Growth Promoting bacteria. Control mechanisms and manipulation, Somaclonal variation nomenclature, methods, applications basis and	1, 2,3,4,5 Remembering, Understanding, Applying Analyzing, Evaluating
CO6	Constructing (Creating) , Evaluating, Analyzing, demonstrating, remembering, and understanding the take part in plant biotechnology, cryo and organogenic differentiation, types of culture, In vitro haploid production, protoplast Isolation and fusion and Plant Growth Promoting bacteria. Biofertilisers, Ecological risks of transgenic crop and global market, Biodiversity and its conservation Somaclonal variation nomenclature, methods, applications basis and disadvantages.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating, Creating

Paper IV: Recombinant DNA Technology (Elective)-c
Code: PBTE-104c

Credit-04

Course Outcome:

1. The objectives of this course are to teach students with various approaches to conducting genetic engineering and their applications in biological research as well as in biotechnology industries.
2. Genetic engineering is a technology that has been developed based on our fundamental understanding of the principles of molecular biology and this is reflected in the contents of this course.
3. To know the basics and concepts of various genetic engineering terms.
4. Elucidate different techniques involved in genetic engineering.
5. Appreciate the components of RDT and its quality.
6. To create the components of RDT based on cite score.

Unit-I: Cloning vectors & Enzymes in RDT

01

Introduction to Recombinant DNA technology and applications, Cloning vector: Plasmids, Phages, cosmids, Yeast cloning vectors, plant viruses as vectors, BAC, PAC & YAC, Nucleic acid modifying enzymes & restriction endonuclease.

Unit-II: Cloning strategies

01

Basic steps of gene cloning, Synthesis of cDNA, Construction of cDNA and genomic libraries, Selection of rDNA clones, Probe labeling and hybridization, Blotting techniques: Southern, Northern and Western blotting.

Unit-III: DNA Sequencing & identification

01

DNA sequencing: chemical, enzymatic methods & pyrosequencing, PCR types & applications, Site directed mutagenesis, Ribonuclease protection assay, Gel retardation assay, DNA foot printing, DNA finger printing.

Unit-IV: Genome analysis & transgenic

01

Genomic analysis: Exon-intron trapping, S-1 mapping, RFLP, RAPD, AFLP, Transgenic Technology, Types approaches & application of Plant & Animals transgenics, Gene therapy: Principles, strategies and ethics of gene therapy, Expressed Tag sequence.

Recommended Books:

1. Gene cloning T.A Brown:
2. Molecular Biotechnology, Glick & Pasternak: Panima Publ. Corporation, 1994
3. Molecular biology & Biotechnology (3rded), Walker & Gingold: Panima Publ. Corporation, 1999
4. Lewin: Genes, Vol. VII Oxford, 1998, Inded.
5. Straehan & Read: Human Molecular Genetics 1999, John Wiley & Sons Pte. Ltd.
6. Gene cloning, Glover: 1984
7. Recombinant DNA, Watson et al: 1983
8. Genetic Engineering Vol. 1-4, Villiamson (ed)
9. Genetic Engineering Vol. 1-7 Setton and Bolanden (ed)

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CO	Description	Bloom's Taxonomy Level
CO1	Remember the different basic concepts of introduction to molecular tools used in RDT and applications, Restriction and modification system, hybridization techniques, Genetic engineering in animals, Random and site-directed mutagenesis and Genetic engineering in plants.	1 Remembering
CO2	Understand and remember the specific and basic concepts of basic principle components of molecular tools used in RDT and applications, Restriction and modification system, hybridization techniques, Genetic engineering in animals, Random and site-directed mutagenesis and Genetic engineering in plants. Develop understanding of various modern tools, instruments and RDT techniques and their utilization to solve the society and industry-related problems.	1,2 Remembering, Understanding
CO3	Applying , understanding and remembering the detailed processes, essential techniques and features of molecular tools used in RDT and applications, Restriction and modification system, hybridization techniques, Genetic engineering in animals, Random and site-directed mutagenesis and Genetic engineering in plants. Apply the basic and advanced recombinant DNA techniques for higher studies, employment and advanced research in industrial and academic scale.	1,2,3 Remembering, Understanding, Demonstrating
CO4	Analyzing , applying, remembering and understanding the detailed study related to concepts of molecular tools used in RDT and applications, Restriction and modification system, hybridization techniques, Genetic engineering in animals, Random and site-directed mutagenesis and Genetic engineering in plants. Comprehend the range of molecular biology techniques for DNA or genome profiling, DNA sequencing/synthesis. Knowledge of the biological systems information and the explanation of the key concepts Omics technologies-genomics.	1,2,3,4 Remembering, Understanding Applying, Analyzing
CO5	Evaluating , analyzing, applying, remembering, and understanding the principle, methods, properties and functions of molecular tools used in RDT and applications, Restriction and modification system, hybridization techniques, Genetic engineering in animals, Random and site-directed mutagenesis and Genetic engineering in plants. Demonstrate an understanding of transgenic technology and applications in health, agriculture and environment, alongwith associated social and environmental issues.	1, 2,3,4,5 Remembering, Understanding, Applying Analyzing, Evaluating
CO6	Constructing (Creating) , Evaluating, Analyzing, demonstrating, remembering, and understanding the take part in molecular tools used in RDT and applications, Restriction and modification system, hybridization techniques, Genetic engineering in animals, Random and site-directed mutagenesis and Genetic engineering in plants. Acquire domain-specific knowledge and develop globally-relevant skills for academic and professional enhancement.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating, Creating

Paper IV: Bioinformatics (Elective)-d
Code: PBTE-104d

Credit-04

Course Outcome:

1. The objective of this course is to introduce to provide students with theory and practical experience of use of common computational tools and databases, which facilitate investigation of molecular biology and evolution-related concepts.
2. Research and business belong together and both are needed. In a rapidly developing life science industry, there is an urgent need for people who combine business knowledge with the understanding of science & technology.
3. Bio-entrepreneurship, an interdisciplinary course, revolves around the central theme of how to manage and develop life science companies and projects.
4. The objectives of this course are to teach students about concepts of entrepreneurship including identifying a winning business opportunity, gathering funding and launching a business, growing and nurturing the organization and harvesting the rewards.
5. Appreciate the components of bioinformatics and its quality.
6. To create the components of bioinformatics based on cite score.

Unit-I: Introduction

01

Introduction to bioinformatics. Objectives, Application and Scopes, Web Browsers, Biological databases- Primary, secondary database, Bibliographics, Gene Bank, EMBL, DDBJ, SWISSPROT. Search engine- Entrez, SRS Web Server- NCBI, EBI.

Unit-II: Sequence alignment and applications

01

Local and Global alignment; Scoring Matrices; Homology and related concepts; Dot matrix; general, gap, gap penalty, Dynamic Programming methods for global and local alignments; sequence similarity, searching tools – FASTA, BLAST; Statistical and biological significance, Multiple Sequence alignment and applications.

Unit-III: IPR

01

Legal and IPR issues in Biotechnology, Intellectual Property Protection (IPP), Trade secret protection, licensing of bio-product, procedure for obtaining, patent, characteristics of the disclosure for a biotechnology invention, marketing a biotechnology invention, trade regulations.

Unit-IV: Bio-business

01

Worldwide market scenario of biotechnology based business, Bio-business prospective in India. Management Process & organization, General analysis of Indian Bio-business, Project formulation and selection, technological assessment, technical report, feasibility and commercial viability of project.

Recommended Books:

1. Lesk: Introduction to Bioinformatics, Wiley Publication.
2. Primrose and Twyman: Principles of genomes and genomics.
3. ROM and Holmas EC: Molecular Evolution: a phylogenetic approach, Blackwell science.
4. Des Higgins and Willie Taylor: Bioinformatics: Sequences, structure and databanks, Oxford University Press
5. P. Narayan: Patent Law.
6. S. L Rao: Economic reforms and Indian markets.
7. Sharma, Munjal, Shankar: A Text Book of Bioinformatics, Rastogi Publication
8. Bioinformatics: Methods and Applications Genimics Proteomics and Drug Discovery, S C Rastogi, N Mendiratta, P. Rastogi: Prentice Hall of India Private Ltd
9. Manual of Industrial Microbiology and Biotechnology by A. L. Demain and N.A. Solomon.



CO	Description	Bloom's Taxonomy Level
CO1	Remember the different basic concepts of introduction to general character of Bioinformatics, history of Bioinformatics, Sequence Information Sources, Protein Information Sources, techniques for data identifications, Sequence and Phylogeny analysis, Searching Databases and genome annotation.	1 Remembering
CO2	Understand and remember the specific and basic concepts of Bioinformatics, history of Bioinformatics, Sequence Information Sources, Protein Information Sources, techniques for data identifications, Sequence and Phylogeny analysis, Searching Databases and genome annotation.	1,2 Remembering, Understanding
CO3	Applying , understanding and remembering the detailed processes and features of Bioinformatics, history of Bioinformatics, Sequence Information Sources, Protein Information Sources, techniques for data identifications, Sequence and Phylogeny analysis, Searching Databases and genome annotation.	1,2,3 Remembering, Understanding, Demonstrating
CO4	Analyzing , applying, remembering and understanding the detailed study related to Bioinformatics, history of Bioinformatics, Sequence Information Sources, Protein Information Sources, techniques for data identifications, Sequence and Phylogeny analysis, Searching Databases and genome annotation.	1,2,3,4 Remembering, Understanding Applying, Analyzing
CO5	Evaluating , analyzing, applying, remembering, and understanding the Bioinformatics, history of Bioinformatics, Sequence Information Sources, Protein Information Sources, techniques for data identifications, Sequence and Phylogeny analysis, Searching Databases and genome annotation.	1, 2,3,4,5 Remembering, Understanding, Applying Analyzing, Evaluating
CO6	Constructing (Creating) , Evaluating, Analyzing, demonstrating, remembering, and understanding the take part in Bioinformatics, history of Bioinformatics, Sequence Information Sources, Protein Information Sources, techniques for data identifications, Sequence and Phylogeny analysis, Searching Databases and genome annotation.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating Creating

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Paper V: Field work**Code: PBTF-105****Credit-04**

Assessment will be based on work assigned by head of the department like to attend or present research paper/s in Seminar/ conference, write up on review literature and field visits for sample collection/tour report submission etc.

CO	Description	Bloom's Taxonomy Level
CO1	Remember the different basic concepts and introduction to field work: Acquire ability to analyze scientific advancements to identify a research area, design objectives and utilize modern tools, e-resources for literature survey. Demonstrate technical skills to conduct experiments operate various analytical techniques and instruments, and ability to interpret data to derive a solution / conclusion to complex problem.	1 Remembering
CO2	Understand and remember the specific and basic concepts of field work: Acquire ability to analyze scientific advancements to identify a research area, design objectives and utilize modern tools, e-resources for literature survey. Demonstrate technical skills to conduct experiments operate various analytical techniques and instruments, and ability to interpret data to derive a solution/conclusion to complex problem. Exhibit competent scientific writing (with critical analysis) and enhance presentation skills.	1,2 Remembering, Understanding
CO3	Applying , understanding and remembering the detailed processes, essential techniques and features of apply modern concepts in field work: Acquire ability to analyze scientific advancements to identify a research area, design objectives and utilize modern tools, e-resources for literature survey. Demonstrate technical skills to conduct experiments operate various analytical techniques and instruments, and ability to interpret data to derive a solution/ conclusion to complex problem and decision making for higher studies, employment and advanced research in industrial and academic scale.	1,2,3 Remembering, Understanding, Demonstrating
CO4	Analyzing , applying, remembering and understanding the detailed study related to demonstrate the scientific knowledge of field work: Acquire ability to analyze scientific advancements to identify a research area, design objectives and utilize modern tools, e-resources for literature survey. Demonstrate technical skills to conduct experiments operate various analytical techniques and instruments, and ability to interpret data to derive a solution / conclusion to complex problem. Knowledge of	1,2,3,4 Remembering, Understanding Applying, Analyzing

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	the field work in research of biological systems information and the explanation of the key concepts.	
CO5	Evaluating , analyzing, applying, remembering, and understanding the principle, methods, properties and functions of field work: Acquire ability to analyze scientific advancements to identify a research area, design objectives and utilize modern tools, e-resources for literature survey. Demonstrate technical skills to conduct experiments operate various analytical techniques and instruments, and ability to interpret data to derive a solution / conclusion to complex problem. Exhibit competent scientific writing (with critical analysis) and enhance presentation skills.	1, 2,3,4,5 Remembering, Understanding, Applying Analyzing, Evaluating
CO6	Constructing (Creating) , Evaluating, Analyzing, demonstrating, remembering, and understanding the take part the scientific knowledge regarding field work: Acquire ability to analyze scientific advancements to identify a research area, design objectives and utilize modern tools, e-resources for literature survey. Demonstrate technical skills to conduct experiments operate various analytical techniques and instruments, and ability to interpret data to derive a solution / conclusion to complex problem. Exhibit competent scientific writing (with critical analysis) and enhance presentation skills.and their utilization to solve the society and industry-related problems.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating, Creating

The bottom of the page contains several handwritten signatures and initials in blue ink. From left to right, there is a signature that appears to be 'M...', a large circular signature, the text 'C.P.H.', a signature that looks like 'Rajesh', a signature that looks like 'Rajesh M', and a signature that looks like 'Rajesh'.