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COURSE CURRICULUM AND SCHEME OF EXAMINATION

Under
Choice Based Credit System

For
Ph.D. (Biotechnology)
(Effective from the Academic Session 2016 – 2017)

Department of Biotechnology
Chaudhary Devi Lal University
Sirsa – 125 055

Am Jyoti Singh *Jyoti Singh* *Jyoti Singh*

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Ph.D. Biotechnology (1st Semester)

Sl. No.	Course ID	Subject	Type	Credit	Contact Hours per week	Internal Assessment (IA)*	External Exam	Maximum marks	Duration of Exam (Hours)
1	BT-601	Research Methodology and Scientific Writing	CC	4	4	30	70	100	3
2	BT-602	Recent advances in Biotechnology	CC	4	4	30	70	100	3
3	BT-603 A	Advances in Microbial Biotechnology	GEC (Any one)	4	4	30	70	100	3
4	BT-603 B	Advances in Plant Biotechnology		4	4	30	70	100	3
5	BT-603 C	Advances in Animal Biotechnology		4	4	30	70	100	3
6	BT-604	Biotechnology and Human Welfare	OEC	4	4	30	70	100	3
Total				12	24	90	210	300	

*IA = 30 Marks (20 – Midterm examination; 5 – Assignment hand written; 5 – Attendance)

Note:

1. Students are allowed to use single memory, non-programmable scientific calculator during exam sharing of calculator is not allowed.
2. The grand total of semester shall be 300 marks.

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Ph.D. (Biotechnology)
BT – 601 – Research Methodology and Scientific Writing

Credits: 4
Time: 3 Hrs.

Marks: 100
Theory: 70
IA: 30

Note for the paper setter: The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.

Unit – I

Research Methodology: Selecting and defining the research problem, formulation of research hypothesis, Good lab practices.

Scientific Writing: Scientific document organization, different steps and precautions of writing a research paper, short communications, review articles, monographs, technical and survey reports, authored books, edited books and thesis, concept of plagiarism, types and consequences.

Scientific literature: Abstracts and journals in biotechnology, online journals, major libraries subscribing journals related to biotechnology in the region and country.

Unit – II

Biochemical techniques: Preparation of buffers and reagents, Principle of centrifugation, Chromatographic techniques (TLC, Gel Filtration Chromatography, Ion exchange Chromatography, Affinity Chromatography, HPLC). Electrophoresis- agarose and PAGE (nucleic acids and proteins), immunological techniques including ELISA, immunoelectrophoresis and immunofluorescence.

Unit – III

Statistical Analysis: Measures of central tendency and dispersion: Mean mode, median, range, mean deviation and standard deviation.

Regression and Correlation Analysis: Probability and Probability Distribution, Binomial, Poisson distribution, basic idea of testing of hypothesis. Statistical data analysis using MS – Excel, ANOVA and SPSS, web based analysis tools.

Unit – IV

Research and Development Projects in Biotechnology

Funding agencies: National and international funding agencies for R & D projects.

Preparation of R & D projects for funding: Organization of research project, identification of gap areas in the subject, aim and objectives of the projects, possible outcome of the project, funds requirements and justification(s).

Biological Resource Centers (BRCs) and Bioresources: Introduction, national and international biological resource centers, responsibilities of BRC's, Bioresources (plant, animal, microbial and marine), strategic actions.

Text/Reference Books:

1. Scientific and Technical Papers, by S.F. Tribease, M.I.T. Press, Cambridge, London.
2. How to write and publish a scientific paper, by R.A. Day, IST Press, Philadelphia.
3. Sambrook & Russel 2001, Molecular Cloning: a Laboratory Manual. CSH Lab. Press.
4. Manual of Industrial Microbiology and Biotechnology by A. L. Demain and N. A. Solomon, American Society for Microbiology Press, USA.
5. Council of Biology Editors 1972, CBE Style Manual. 3rd Ed., American Institute of Biological Sciences, Washington D.C.
6. Effective writing for engineers, managers, scientists, by A.J. Tichy, Wiley, New York.
7. Ausubel FM, Brent R, Kingston RE, Moore DD, Seidman JG, Smith JA & Struhl K. 2002. Short Protocols in Molecular Biology. John Wiley.

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Ph.D. (Biotechnology)
BT – 602 – Recent Advances in Biotechnology

Credits: 4
Time: 3 Hrs.

Marks: 100
Theory: 70
IA: 30

Note for the paper setter: The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.

Unit – I

Experimental Design for improvement of fermentation: Plackett-Burman design, Fractional factorial design, Curvature in fractional factorial design, response surface methodology, Bioprocess simulation - commercially available tools, contract fermentations, Bioremediation and its applications to various contaminants and sites.

Unit – II

Human Genome: Sequencing of Human Genome, Brief account of repetitive sequences present in human genome, Human Genome project - latest developments.
Bioinformatics tools: miRNA finder, Single Nucleotide Polymorphism, Ensembl Genome browser, Transcription Factor search, CPG islands, Gene Promoter Miner, *CDART - NCBI - NIH*, Simple Modular Architecture Research Tool, Phylogenetic analysis tools.

Unit – III

Systems Biology: Introduction, flux balance analysis - Law of mass action, representation of metabolic networks by stoichiometric matrix and system equation; Metabolic control analysis - reductionists versus system theory, flux control coefficient, summation theorem, metabolites effects and elasticities; Genome based reconstruction of metabolic networks – useful databases, graphic representation of metabolic networks.

Unit – IV

Nanobiotechnology: Nanomedicine- therapeutic nanodevices; nanoparticles for disease diagnosis, drug solubilization and delivery; nanoparticles as biosensors, biochips; use of nanoparticles as molecular imaging probes, non-viral transfection agents; nanoparticles for cleaning environment particularly heavy metal bioremediation; enhanced oil- recovery.

Text/Reference Books:

1. Manual of Industrial Microbiology and Biotechnology – second edition. Demain, A. L. and Davies, J.E. (2004) American Society for Microbiology Press, USA.
2. Brown TA. 2007. Genome III. Garland Science Pub.
3. Campbell & Heyer 2004. Discovery genomics, Proteomics and Bioinformatics. Pearson Education.
4. Gibson G & Muse SV. 2004. A Primer of Genome Science. Sinauer Associates.
5. Kun LY. 2006. Microbial Biotechnology. World Scientific.
6. Twyman RM. 2003. Advanced Molecular Biology. Bios Scientific. Fuller R. 1997.
7. Sambrook & Russel 2001 Molecular Cloning: a Laboratory Manual. CSH Lab. Press
8. Systems Biology (2009) by Edda Klipp, Wolfram Liebermeister, Christoph Wierling, Axel Kowald, Hans Lehrach, Ralf Herwig, John Wiley.

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Ph.D. (Biotechnology)
BT – 603 A – Advances in Microbial Biotechnology

Credits: 4
Time: 3 Hrs.

Marks: 100
Theory: 70
IA: 30

Note for the paper setter: The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.

Unit – I

Advances in Microbial Physiology and Molecular Biology: Oxidative stress, regulation of cell cycle, molecular evolution, general organization of genomes, gene specific transcription factors, activation of gene expression, structural organization and regulation of nuclear gene, gene transcription and post transcriptional modification, molecular mapping of genome.

Unit – II

Advances in molecular ecology and biodiversity of microorganisms: Conventional and molecular taxonomy, species concept, microbial Diversity, origin and evolution & microbes. Nucleic acid techniques in diagnostic microbiology.

Unit – III

Advances in industrial microbial technology: Recombinant DNA Technology for genetic improvement. Recent advances in production of antibiotics, & pharmaceutical products, enzymes, Biofuels, Biopesticides, Biofertilizers, Biodegradable plastics SCP. Production of non-microbial origin products by genetically engineered microorganisms.

Unit – IV

Advances in Food Microbiology: Concept of probiotics and applications of new tools of biotechnology for quality feed/food production; Microorganisms and proteins used in probiotics; Lactic acid bacteria as live vaccines; Factors affecting delignification; Bioconversion of substrates, anti-nutritional factors present in feeds; Microbial detoxification of aflatoxins.

Text / Reference Books:

1. Molecular methods for microbial identification and typing, ed. Towner J. and Cockayne A, (2000), Chapman & Hall London.
2. Environmental Molecular Microbiology: Protocols and Applications, ed. Paul A. Rochelle, 2002, Horizon Scientific Press England.
3. Modern Microbial genetics, ed. Uldis N. Streips & Ronald E. Yasbin, Wiley – Liss New York.
4. Review of current – topics in microbiology, Microbial Biotechnology and molecular biology. Critical reading and evaluation of current literature.

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Ph.D. (Biotechnology)
BT – 603 B – Advances in Plant Biotechnology

Credits: 4
Time: 3 Hrs.

Marks: 100
Theory: 70
IA: 30

Note for the paper setter: The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.

Unit – I

Micropropagation – Techniques, Factors affecting morphogenesis and proliferation rate, Technical problem in micropropagation, Meristem culture for the production of pathogen free plants, Applications of micropropagation.

Plant Transformation technology: Agrobacterium mediated transformation, binary vectors and co-integrate vector, direct DNA transfer, Transgene stability and gene silencing. Chloroplast transformation its success with tobacco and potato.

Unit – II

Plant genetic engineering: Genetically modified plants for crop improvement towards designer crops, present status of GMP's worldwide, process for commercial release of GM a crop in India-committees and conditions involved, Environmental impact of GM crops-a critical analysis, various metabolic products of genetic engineering and their industrial applications.

Unit – III

Genome and genomics: Whole genome sequencing of plant species, deciphering the function of genes in crop plant, comparative genomics, functional genomics, microarray (Basic & applied research).

Unit – IV

Molecular breeding: DNA-based markers (RFLPs, RAPD, AFLP, SSR, STS, dart etc.), mapping populations (F2s, back crosses, RILs, NILs and DH). Molecular mapping and tagging of agronomically important traits, QTLs analysis in crop plants, gene pyramiding. Some popular software for data analysis, data feeding and dendrogram construction, understanding linkage maps.

Text / Reference Books:

1. Plant Biotechnology and Molecular Markers, ed. Shrivastava P. S., Narula A. and Shrivastava S. S., 2004, Anamaya Publisher, New Delhi
2. Agricultural Biotechnology, ed. Altman A., 1998, Marcel Dekker.
3. Plant Biotechnology and Transgenic Plants, ed. Kirsi-Marja Oksman-Caldentey, Wolfgang Barz, 2002, Marcel Dekker.
4. Plant Biotechnology: The Genetic Manipulation of Plants, ed. Adrain Slater, Nigel W Scott, and Mark R Fowler, 2004, Oxford University Press.
5. The GMO Hand Book: Genetically Modified Animals, Microbes and Plants, ed. Sarad R.P. Humana Press, New Jersey, USA.
6. Plant Biotechnology 2002, Kluwer Academic Publishers.

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Ph.D. (Biotechnology)
BT – 603 C – Advances in Animal Biotechnology

Credits: 4
Time: 3 Hrs.

Marks: 100
Theory: 70
IA: 30

Note for the paper setter: The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.

Unit – I

Probiotics: Introduction, history of probiotics, normal microflora of GI tract, methods for analysis of intestinal microflora, microorganisms and proteins used in probiotics, recombinant probiotics. Mechanism of action of probiotics, Applications of probiotics for humans and animals.

Unit – II

Molecular diagnostics: Introduction, importance and historical perspective of development of molecular diagnostic technology, concept of development of group specific and strain specific nucleic acid based diagnostics (PCR, Real Time PCR, DNA array technology and LAMP). basis for selection of gene/nucleotide sequence of pathogenic organism to target for detection. OIE guidelines in development of diagnostics.

Unit – III

Vaccines: Introduction to immune system, cellular and humoral immune response, history of development of vaccines, introduction to the concept of vaccines, conventional methods of animal vaccine production and recombinant approaches to vaccine production.
RNA interference: Introduction, miRNA, siRNA, RISC activation and catalysis, applications.

Unit – IV

Cloning: Types, case study of Garima and Dolly, applications, ethical and policy issues
Stem cells: Characteristics, Kinds, types and applications.
Intellectual Property Rights: Introduction, History, Objectives, limitations and ethics.

Text / Reference Books:

1. Brown TA. 2007. Genome III. Garland Science Pub.
2. Campbell AM & Heyer L. 2004. Discovery genomics, Proteomics and Bioinformatics. Pearson Education.
3. Gibson G & Muse SV. 2004. A Primer of Genome Science. Sinauer Associates.
4. Kindt TJ, Goldsby RA & Osbrne BA. 2007. Kuby Immunology. WH Freeman.
5. Kun LY. 2006. Microbial Biotechnology. World Scientific.
6. Levine MM, Kaper JB, Rappuoli R, Liu MA, Good MF. 2004. New Generation Vaccines. 3rd Ed. Informa Healthcare.
7. Twyman RM. 2003. Advanced Molecular Biology. Bios Scientific. Fuller R. 1997.
8. Probiotics 2: Applications and Practical Aspects. Springer.
10. Huffnagle GB & Wernick S. 2007. The Probiotics Revolution: The Definitive Guide to Safe, Natural Health. Bantam Books.
11. Sambrook & Russel DW. 2001. Molecular Cloning: a Laboratory Manual. CSH Lab. Press.

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Ph.D. (Biotechnology)
BT – 604 – Biotechnology and Human Welfare

Credits: 4
Time: 3 Hrs.

Marks: 100
Theory: 70
IA: 30

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Unit – I

Biotechnology: Introduction, scope, application, social and ethical issues in biotechnology.
Microbial Biotechnology: Introduction to microorganisms (bacteria, fungi and virus), isolation and screening of industrially important microorganisms, fermented food, SCP, ethanol, enzymes, vitamins, role of probiotics and prebiotics in human health.

Unit – II

Bioinformatics: (A brief account) Importance, Scope of Bioinformatics, world wide web as a tool, Bioinformatics institutes and databases, Bioinformatics training & limitations.
Nanobiotechnology: An Overview, Insights and intervention into the Nano world, Important Developments, Societal implications & Ethical issues in Nanotechnology, Applications of Nanobiotechnology in different areas.

Unit – III

Medical Biotechnology: (A brief account) Biotechnology in medicine, Vaccines, Diagnostic, Forensic, Gene therapy, Nano Medicine & Drug Delivery, Cell & Tissue Engineering, Stem Cell therapy.

Animal Biotechnology: *In-vitro* fertilization and embryo transfer in humans and livestock, transgenic animals, animal cloning, application of animal cloning, policy issues of animal cloning.

Unit – IV

Agricultural Biotechnology: Introduction to plant tissue culture and its applications, Gene transfer methods in plants, transgenic plants - Bt-cotton and Golden rice (A brief introduction).

Intellectual Property Rights (IPR): intellectual properties, copyrights, trademarks, trade secrets, patents, geographical indications etc., protection of plant variety and farmers right act, Indian patent act and amendments, patent filing, implications of intellectual property rights on the commercialization of biotechnology products.

Text/Reference Books:

1. Das H.K. (2004) Textbook of Biotechnology, Willey Dreamtech. Pvt. Ltd, New Delhi.
2. Natesh et al. (1987) Biotechnology in Agriculture Oxford & IBH, New Delhi.
3. Kumar H.D. (2004) A Text Book of Biotechnology, Eastern Willey Press, New Delhi.
4. Tizard I.R. (2013) Immunology- An introduction, 5th Edition, P Saunders College press.
5. Bhushan, Bharat (Ed.) 2010 Handbook of Nanotechnology. Springer.
6. Gupta P.K. (2010) Biotechnology & Genomics, 5th Reprint, Rastogi Publications Meerut.
7. Singh B.D. (2010) Biotechnology, 4th edition, Kalyani Publication.
8. Black J.G (2008) Microbiology- Principles and Explorations, 7th ed, John Wiley & Sons.
9. <http://patentoffice.nic.in>
10. Principles of fermentation technology- 2nd edition, Stanbury et al. (2005). Elsevier
11. Biotechnology – A text book of industrial microbiology (2nd Edition) Crueger, W and Crueger, A. (2004) Panima Publishing Corporation, New Delhi.
12. Animal Biotechnology: Muray Moo Young (1989) Pergamon Press, Oxford.
13. Yadav, P.R. and Tyagi, R. (2006) Environmental Biotechnology. Discovery Publishing House, New Delhi.

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