DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO. ACAD / NP / B.E. Biotechnology / 18 / 2011

It is hereby informed to all the concerned that the Hon'ble Vice-Chancellor has accepted the *Revised Syllabus of B.E. Biotechnology* under the Faculty of Engineering and Technology on behalf of the Academic Council under Section-14(7) of the Maharashtra Universities Act, 1994, as appended here with.

This is effective from the academic year 2011-2012 and onwards.

All concerned are requested to note the contents of this circular for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO. ACAD/NP/ ENGG./Biotech.
2011/17819-22

Date:- 04-08-2011.

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Director,
Board of College and
University Development.

Copy forwarded with compliments to:-

1] The Principals, affiliated concerned Colleges,
Dr. Babasaheb Ambedkar Marathwada University.

Copy to :-

1] The Controller of Examinations,
2] The Assistant Superintendent, [Engineering Unit],
3] The Record Keeper,
Dr. Babasaheb Ambedkar Marathwada University.

S*/040811/-

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S-Cover Page IIIrd Year

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

Revised Syllabus of

B.E.

BIOTECHNOLOGY

[Effective from 2011-12 & onwards]

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

Proposed Scheme of Instructions and Examination for **Fourth Year** (Biotechnology) to be effective from the academic Year 2011 – 2012.

Semester I		Teaching Scheme (h/week)			Examination Scheme (Maximum Marks)			Total Marks
Sr. No	Subject	Theory	Practical	Total	Theory	Term Work	Pract /Oral	
1	Fermentation Technology – II	4	2	6	100	25	50	175
2	Bioinformatics	4	2	6	100	25	50	175
3	Advanced Genetic Engineering	4	2	6	100	50	--	150
4	Legal And Ethical Aspects in Biotechnology And IPR	4	--	4	100	--	--	100
5	Elective I *	4	--	4	100	--	--	100
6	Project Part - I	--	2	2	--	50	--	50
	Total	20	08	28	500	150	100	750

Semester II		Teaching Scheme (h/week)			Examination Scheme (Maximum Marks)			Total Marks
Sr. No.	Subject	Theory	Practical	Total	Theory	Term Work	Pract /Oral	
7	Process Control and Separation	4	2	6	100	25	50	175
8	Protein Engineering	4	2	6	100	25	50	175
9	Pharmaceutical Biotechnology	4	--	4	100	--	--	100
10	Elective II **	4	--	4	100	--	--	100
11	Project Part - II	--	4	4	--	100	100	200
	Total	16	08	24	400	150	200	750

* Elective – I

5.1 Plant Tissue Culture and Plant Biotechnology
5.2 Biomaterials and Tissue Engineering
5.3 Nanobiotechnology

** Elective – II

10.1 Environmental Biotechnology
10.2 Animal cell Science and Technology
10.3 Food Biotechnology

1 FERMENTATION TECHNOLOGY-II

Lecture: h / week - 4; Theory paper = 100 marks; Duration: 3h
Practical: h/week - 2; Term work: 25 marks; Practical Exam: 25 marks

UNIT I: Aeration And Agitation **(10)**

Aeration and agitation with emphasis on determination of kLa, its methods-Aeration and Agitation, effect of shear, O_2 requirement of microorganisms, mass transfer theory, diffusional resistance to oxygen transfer, measurement of mass transfer coefficient and factors affecting them. Effect of Aeration and Agitation on mass transfer.

UNIT II: Instrumentation And Control **(05)**

Methods of measuring process variables, online analysis of chemical factors, control systems *viz*, manual, automatic and combination, controllers.

UNIT III: Sterilization **(05)**

Need for sterilization, different types of sterilization techniques – their mechanism of destruction, *in situ* sterilization, HTST, sterilization indicators, sterilization of fermenter, sterilization of media.

UNIT III: Fermentative Production Of Antibiotics **(05)**

Antibacterial antibiotics: penicillin, streptomycin, chloromycetin, tetracyclines, semisynthetic penicillins; Antifungal antibiotics.

UNIT IV: Fermentative Production Of Amino Acids **(04)**

asparagine, glutamine, aspartic acid

UNIT V: Fermentative Production Of Vitamins **(05)**

Microbial production of vitamins B_2 and B_{12}

UNIT VI: Fermentative Production Of Industrially Important Metabolites **(08)**

Microbial production of industrially important products like ethanol and organic acids; Alcohol Production-wine and other alcoholic beverages, glycerol, beer; organic acids like citric acid, gluconic acid and lactic acid

RECOMMENDED BOOKS

1. Fermentation Microbiology and Biotechnology – El-Mansi E.M.T. and Bryce C.F.A.

2. Principles of Fermentation Technology – Stanbury P.F. and Whitaker A Practical Work
3. Industrial microbiology and introduction by Michael J Waites, Neil L. Morgan, John S. Rockey, Gary Hington, published by Blackwell science Ltd. London.
4. Fermentation biotechnology: principles, processes and products, Owen P Wars, Open Univeristy press.
5. Practical fermentation technology, B. McNeil, L. M. Harvey, John Wiley and Sons, England.
6. Bioprocess engineering: basic concepts, by Michael L Schuler and Fikret Kargi, Pretince Hall.
7. Microbial Technology, Rajni Gupta and K. G. Mukherjee, Kulbhushan Nangia Ashish books, New Delhi.
8. Introduction to Biochemical Engineering, by D. G. Rao, 2nd edition, Tata Mac graw Hill, New Delhi.

PRACTICAL

1. Isolation and identification of microbial flora from soil or water sample
2. Submerged fermentation of amylase production
3. Solid state fermentation for amylase production
4. Determination of specific growth rate constant using Monod kinetics
5. Whole cell immobilization by entrapment method
6. Determination of capacity of resin
7. Ammonium salt precipitation of a protein
8. Aqueous two phase extraction for a protein

PRACTICAL WORK

Note: Any 4 practicals will be conducted from the above list. The practical examination shall consist of performing an experiment based on the practical work done during the course, the record of the experiments submitted by the candidate and viva-voce based on the syllabus.

NOTE

For paper setter(s) for setting of question paper(s) for the theory examination to be conducted by University:

1. Weightage to the question to be asked be based on number of teaching hours allotted to each topic / unit.
2. Total of 05 (five) questions maximum, be asked per section of the paper, out of which students are expected to answer / solve any three questions.

3. Questions be of a maximum 16 / 18 marks each, to add up to maximum 50 marks per section.
4. Questions of maximum 16 / 18 marks are expected for teaching of a topic. The question be a full question of 16/18 marks or have sub-questions to make a full question of 16/18 marks.
5. There be a minimum of one and a maximum of two question on each topic / unit

2 BIOINFORMATICS

Theory: h/week - 4; Paper: 100 marks; Duration: 3 h
Practical: h/week - 2; Practical Examination 50 marks; Term Work: 25 marks

UNIT I (06)

Introduction to Bioinformatics, Terminologies used in Bioinformatics, Scope and Goal of Bioinformatics, Overview of applications of Bioinformatics, Databases, Database Management system, Data structure, Database query language, Relational Model, Object Model, Object oriented and Relational databases, Network of databases for Entrez and SRS. Overview of Biological Databases.

UNIT II (05)

DNA sequencing, Nucleotide databases as Genbank, Dna Data Bank of Japan (DDBJ), European Molecular Biology Laboratory (EMBL), NCBI's Data model, Specialized genomic recourses as SGD, UniGene, TDB. Sequence retrieval systems such as Entrez and SRS.

UNIT III (08)

Protein structures, Levels of Protein sequence and Structural organization, Protein databases, Primary protein sequence Databases as PIR, MIPS, SWISS-PROT, TrEMBL. Composite Protein sequence databases as NRDB, OWL. Secondary databases as PROSITE, PRINTS, Blocks. Structure Classification databases as SCOP, CATH, PDB. Various analytical tools for protein Structure Visualization.

UNIT IV (08)

Introduction to sequence alignment, Pairwise and Multiple Sequence Alignment, Dot Plot, Needleman Wunsch Algorithm, Smith Waterman Algorithm, Local and Global Sequnce Alignment, Substitution Matrices such as PAM And BLOSUM, Calculation of alignment's statistical significance, Importance of Identity matrixes, gaps and penalties, Heuristic methods such as FASTA, Working of FASTA and Variants, BLAST, Working of BLAST and different variants of BLAST.

UNIT V (07)

Introduction to Phylogeny, Homologes, orthologs and paralogs, Construction of a phylogenetic tree, Different types of trees as rooted and unrotted trees. Phylogenetic analysis, Methods of Phylogenetic analysis as Distance method, Application of bioinformatics in vaccine designs, Drug designing – Ligand based and Structure based, scoring function for Docking, HTS, QSAR.

UNIT VI **(04)**

Introduction to biotechnology Management, General introduction to management studies, Correlation of the management and biotechnology industry, Organizational management in biotechnology companies, various disciplines in management. Technology transfer management in Biotechnology.

RECOMMENDED BOOKS

1. Introduction to Bioinformatics, by Arthur M. Lesk Oxford University Press, Oxford University Press.
2. Bioinformatics- Methods & Applications by S.C.Rastogi, N. Mandiratta, P. Rastogi.
3. Principles of management- Knoots and O.Donnell
4. Bioinformatics Sequence and Genome Analysis by David W. Mount, 2nd edition, Cold Spring Harbor Laboratory Press.
5. Bioinformatics: A practical guide to the analysis of genes and proteins A.D. Baxevanis and B.F.F. Ouellette (Eds). 2002 John Wiley and Sons.
6. Bryan Bergeron, "Bioinformatics computing", Pearson Education [BB]

PRACTICALS

1. Study of Databases and Data retrieval:
   i. Genome Databases
   ii. Sequence Database
   iii. Secondary Databases
2. Database Similarity Search BLAST AND FASTA PROGRAMS.
3. PSI/ PHI -BLAST
4. Multiple sequences Alignment using ClustalW.
5. Phylogenetic Analysis using Clustalw and Phylip software.
6. Profile Analysis, Motif searching against Motif databases.
7. Rasmol (3D structure visualisation)
8. Protein Manipulation using SPDBV
9. Introduction to modeller
10. Homology modelling using modeller, and swiss model
11. UNIX Commands
12. Different versions of Linux

PRACTICAL WORK

Note- Any 4 practicals will be conducted from the above list. The practical examination shall consist of performing an experiment based on the practical work done during the course, the record of the experiments submitted by the candidate and viva-voce based on the syllabus.

NOTE

For paper setter(s) for setting of question paper(s) for the theory examination to be conducted by University:

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5. There be a minimum of one and a maximum of two question on each topic / unit.

3 ADVANCE GENETIC ENGINEERING

Lecture: h / week - 4; Theory paper = 100 marks; Duration: 3h

UNIT I: Production Of Therapeutic Agents (12)

Engineering human interferon, human growth hormone, r-haematopoeitic growth factors, r-insulin, interleukins, interferon, r-tissue type plasminogen, r-human deoxyribonuclease, Enzymes-DNAase I and Alginate lyase against cystic fibrosis; Subunit vaccines-Peptide vaccines, Attenuated vaccines-Vector vaccines.

UNIT II: Synthesis Of Commercial Products (04)

Restriction endonucleases, Small biomolecules, Ascorbic acid, Biopolymers.

UNIT III: Application Of Plant Genetic Engineering (12)

Developing insect-resistance, disease-resistance and herbicide resistance in plants and delaying fruit ripening; Developing stress and senescence-tolerance in plants, oxidative, salt and submergence stress; Genetic manipulation of flower pigmentation; Developing quality of seed storage, Provitamin A; Modification of food plant taste and appearance, yield increase in plants; Wild plant relatives as a source of novel genes; Plants as bioreactor - antibodies, polymers, foreign proteins in seeds; Genome mapping efforts in rice & maize and its potential applications.

UNIT IV: Forensic Medicine (07)

Criminal investigation (personal identification), Immigration, Paternity dispute, Identification of missing children, bodies found in plane crash, road accidents etc.; Varietal identification of plants.

UNIT V: Molecular Diagnostics (07)

Importance and advantages, Hybridization based methods, Reverse hybridization methods, Diagnostics based on DNA chips and Micro-arrays, PCR based methods, Diagnosis of Cystic fibrosis by multiplex PCR , Detection of Thalassemia mutation using ARMS-PCR, Detection of Fragile X syndrome by FMR-1 gene trinucleotide repeat analysis, To distinguish patient and donor cells as different using hypervariable tandem repeat polymorphic DNA markers, Identification of bacterial species based on the sequences of their 16S ribosomal RNA genes. Nucleic acid amplification-End-point PCR Qualitative. Real time PCR Qualitative and Quantitative. SNP based detection: Ligation assay by probe ligation and amplification (e. g. MLPA). Sequencing based detection.

RECOMMENDED BOOKS

1. Comprehensive Biotechnology by Moo-Young, Murray
2. Plant biotechnology In Agriculture: K. Lindsey and M.G.K. Jones (1990), Prentice hall, New Jersey.
3. Agricultural Biotechnology by Arie Altman. Marcel Dekker, Inc., 270 Madison Avenue, New. York, USA. 1998. 770 pp
4. Transgenic Plants Vol. 1 & 2 : S-d. Kung and R. Wu (1993), Academic Press, San Diego
5. Nano Materials by A k Bandyopadhyay, New age International Publisher
6. Plant Cell Culture, Advances in Biochemical Engineering and Biotechnology. Anderson, L.A.,
7. Human Molecular Genetics. Strachan & Read. 3rd Edition.
8. Genetic Engineering and its applications. (2004) 2/e, Joshi. P: Agrobios, India
9. Gene Cloning and DNA analysis: An introduction, (2006) T. A. Brown, Black Well Publishing Company.
10. Principles of Gene Manipulation; S. B. Primrose, R. M. Twyman & R. W. old; Blackwell Science, 6th Edition (2001).

PRACTICALS

1. DNA Amplification using PCR
2. Cloning of genomic DNA or PCR product in the host bacterium
3. Southern blotting
4. Multiporation
5. Cell fusion by chemical methods

PRACTICAL WORK

Note- Any 3 practical's will be conducted from the above list. Each practical will be conducted in a group of five students. The practical examination shall consist of performing an experiment based on the practical work done during the course, the record of the experiments submitted by the candidate and viva-voce based on the syllabus

NOTE

For paper setter(s) for setting of question paper(s) for the theory examination to be conducted by University:

1. Weightage to the question to be asked be based on number of teaching hours allotted to each topic / unit.
2. Total of 05 (five) questions maximum, be asked per section of the paper, out of which students are expected to answer / solve any three questions.

3. Questions be of a maximum 16 / 18 marks each, to add up to maximum 50 marks per section.
4. Questions of maximum 16 / 18 marks are expected for teaching of @ 04 hrs of a topic. The question be a full question of 16/18 marks or have sub-questions to make a full question of 16/18 marks.
5. There be a minimum of one and a maximum of two question on each topic / unit.

4 LEGAL & ETHICAL ASPECTES IN BIOTECHNOLOGY & INTELLECTUAL PROPERTY RIGHT

Lecture: h / week = 4; Theory paper = 100 marks; Duration: 3h

UNIT I: Basic Concepts Of Intellectual Property (04)

Introduction to intellectual property rights, Intellectual property laws, Trade Related Aspects of Intellectual Property Rights, Forms of IPR like patent design and copyright.

UNIT II: Patents (08)

Introduction to patent law and conditions for patentability, Procedure for obtaining patents, Rights of a patentee, Patent infringements, Biotechnology patents and patents on computer programs, Patents from an international perspective.

UNIT III: Copyright (08)

Registration procedure and copyright authorities, Assignment and transfer of copyright, Infringement and exceptions to infringement, Software copyright.

UNIT IV: Designs (04)

Introduction to the law on Industrial Designs, Registration and piracy, International perspective, Registration, commercial exploitation and infringement, Patent database and use of the information

UNIT V: IPR Laws (05)

Rights/protection, Indian and foreign laws, procurement infringement or violation, remedies against infringement- civil and criminal, Indian Patent Act 2005 and TRIPS.

UNIT VI: Ethics In Patenting (07)

Major changes in Indian Patent system, post TRIPS effects, Contents of patent specification and the procedure for patents- (a) Obtaining patents (b) Geographical indication (c) WTO, Detailed information on patenting biological products, Plant breeders' and farmers' rights, Biodiversity, Budapest treaty, Appropriate case studies, Case studies- PCR, oncomouse.

UNIT VII: Regulatory Aspects Pertaining Pharmaceuticals (05)

Patenting, Role and remit of regulatory authorites-FDA, investigational new drug application, European authorities, the centralized procedure, world harmonization of drug approval

RECOMMENDED BOOKS

1. Entrepreneurship: New Venture Creation, David H. Holt
2. Patterns of Entrepreneurship: Jack M. Kaplan
3. Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, S. Chand
4. F. B. Rudolph, Biotechnology: Science engineering and ethical challenges for 21st century.
5. P. Grubb, Patents for chemicals, pharmaceuticals and biotechnology.

NOTE

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1. Weightage to question to be asked be based on number of teaching hours allotted to each topic / unit.
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5. There be a minimum of one and a maximum of two question on each topic / unit.

5 ELECTIVE I

5.1 PLANT TISSUE CULTURE AND PLANT BIOTECHNOLOGY

Lecture: h / week- 4; Theory paper = 100 marks; Duration: 3h

UNIT I: Plant Tissue Culture **(04)**

Introduction, History and concept of cellular totipotency; Morphogenesis; Culture conditions, medium & its constituents; Method of Sterilization

UNIT II: Applications Of Plant Tissue Culture- I **(06)**

Callus culture; Cell Suspension culture; Somaclonal variation; Secondary metabolite production from plant cell cultures.

UNIT III: Applications Of Plant Tissue Culture-II **(10)**

Micropropagation-Pathways and steps; Introduction to commercial micropropagation; Embryo culture, embryo rescue, meristem culture, Anther culture & Ovary culture; Protoplast Culture and Somatic hybridization; Somatic embryogenesis and Synthetic seeds.

UNIT IV: Methods Of Genetic Engineering In Plants **(03)**

Agrobacterium tumefaciens mediated genetic transformation; Methods of gene transfer.

UNIT V: Genetic Manipulation In Plants For The Following Traits **(10)**

Herbicide resistance. Male sterility. Virus resistance, resistance towards fungal pathogens. Insect resistance. Genetic engineering of plants for improvement of crop yield and quality. Genetic engineering for introducing abiotic stress tolerance in plants. Genetic engineering of nitrogen fixing bacteria; nif genes and it control.

UNIT VI: Molecular Farming **(07)**

Production of modified carbohydrates, oil, recombinant proteins and vaccines in plants; Molecular markers in crop improvement-Detection of genetic diversity, Marker assisted selection and Breeding.

RECOMMENDED BOOKS

1. Biotechnology: Fundamentals & Applications by S.S.Purohit, Agrobios Ltd. (2001).
2. Trends in Plant Tissue Culture & Biotechnology; L K Pareek and P L Swarnkar; Published by AgroBios India (2002).
3. Plant Tissue Culture- Theories and Practices; S. S. Bhojwani and M K Rajdhan; Published by Elsevier, (1996).

4. Methods in Plant Tissue Culture; U Kumar; AgroBios India, (2003).
5. Plant Cell Tissue and Organ Culture Fundamental Methods; O L Gamborge; Published by Narosa, New Delhi (2004).
6. Plant Biotechnology: The genetic manipulation of plants; A. Slater, N. Scott, M. Fowler; Published by Oxford University press, New York (2003).
7. Transgenic Plants; V. Ranjan, Agrobios

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1. Weightage to the question to be asked be based on number of teaching hours allotted to each topic / unit.
2. Total of 05 (five) questions maximum, be asked per section of the paper, out of which students are expected to answer / solve any three questions.
3. Questions be of a maximum 16 / 18 marks each, to add up to maximum 50 marks per section.
4. Questions of maximum 16 / 18 marks are expected for teaching of @ 04 hrs of a topic. The question be a full question of 16/18 marks or have sub-questions to make a full question of 16/18 marks.
5. There are a minimum of one and a maximum of two questions on each topic / unit.

5.2 BIOMATERIALS AND TISSUE ENGINEERING

Theory: h/week – 4; Paper: 100 marks; Duration: 3 h

UNIT I: Bioactive Materials And Processing (08)

Calcium phosphate ceramics, bioactive glasses and glass-ceramic, bioactive coatings and bioactive composites.

UNIT II: Biocompatibility Of Materials (06)

Host responses to materials, biological performance of materials, biocompatibility assessment, protein adsorption and surface modificatations

UNIT III: Biocomposite Materials For Biotechnology (03)

Titanium phosphates, porous-glass ceramic: immobilized enzymes, with bacteriostatic activity, with an integrated skeleton.

UNIT IV: Biotechnology Applications Of Inorganic Glasses (05)

Nature of inorganic glasses, why inorganic glasses? Properties pertaining to biotechnology and biomedicine

UNIT V: Scope Of Tissue Engineering (08)

Scaffold, absorbable polymers, pore creation in biomaterials, special scaffolds, surface modification, cell expansion and differentiation, growth factors.

UNIT VI: Tissue Engineering (06)

Approaches and cells used for tissue engineering, biomaterials used for tissue engineering

UNIT VII: Applications Of Tissue Engineering (04)

Skin, bone, peripheral nervous system, heart valve.

RECOMMENDED BOOKS

1. Biomaterials and tissue engineering, Prof. Donglu Shi, Springer, New York.
2. Biomaterials for tissue engineering applications a review of the past and future trends, Jason A. Burdick and Roberts L. Mauck, Springer, New York.
3. Tissue engineering: Fundamentals and application, Yoshito Ikada, Elsevier, Netherlands.
4. Biomaterials Science: An Introduction to Materials in Medicine Buddy D. Ratner, Frederick J. Schoen, Allan S. Hoffman, Jack E. Lemons.
5. Hench L L Ethridgc E.C. Biomaterials, an interfacial approach, Academic press 1982 Bronzino J D, The biomedical engineering handbook CRC Press.

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5. There are a minimum of one and a maximum of two questions on each topic / unit.

5.3 NANOBIOTECHNOLOGY

Lecture 4 h / week; Theory paper = 100 marks; Duration: 3h

UNIT I: Introduction To Nanobiotechnology **(05)**

Nano: size and dimension; Nanoscience and Nanotechnology, uses and future of nanotechnology, potential hazards of nanobiotechnology and safety and public policy issues pertaining to the same

UNIT II: Methods Of Measuring Properties Of Nanomaterials **(05)**

Structure, microscopy, spectroscopy

UNIT III: Properties Of Nanomaterials **(04)**

Metal nano clusters, semiconductors, rare gas and molecular clusters, methods of synthesis

UNIT II: Nanomaterials **(06)**

Definition, Types-Nanoparticles, Nanowires, Thin Films, Multilayers and Nanocomposites. Effect of size on physico-chemical properties. Applications in various fields, Use of nanomaterials for technology development in the fields of Materials science, Life sciences with examples.

UNIT III: Nanobiotechnology **(10)**

Introduction, Definition. Applications of artificially synthesized nanostructures and use of biomolecules as nanostructures for applications; Synthesis of nanostructures-Physical methods- CVD, Sputtering, Pyrolysis etc.,Chemical methods- Sol-gel, Micelle, co-precipitation etc. Bio-based- Using bacteria, fungi, plant extracts, etc., Functionalization of nanostructures for biological applications, Biocompatible coatings and activation of the nanostructures for applications.

UNIT IV: Potential Risks Of Nanobiotechnology **(03)**

Potential risks, Risk to environment, societal risks, lab safety guidelines for handling nanomaterials.

UNIT IV: Recent Trends In Nanobiotechnology **(07)**

Development of new instrument for characterization, Current applications of nanostructures in life sciences, textile industry and fuel cells

RECOMMENDED BOOKS

1. Nanotechnology –S. K. Kulkarni – (Capital Publishers –Delhi)
2. A handbook on nanotechnology – A. G. Brecket (Dominant Publishers and Distributors, Delhi)
3. Nanotechnology: Research and Perspectives - Dr. Sidharth Vaidy (Pearl Books – Delhi)
4. Biofunctionalization of Nanomaterials – Ed. Challa S. S. R. Kumar (Willey-VCH Verlag GmbH and Co. KgaA, Weinheim)
5. For recent trends and protocols: see recent published research and review articles from reputed international journals.
6. Nanotechnology, by Dr. Shalini Suri, APH Publishing Corporation.
7. Nanotechnology, by M. Ratner and Daniel Ratner, Pearson Education.
8. Nanobiotechnology fundamentals and applications by Manasi Karkare, Published by I K International publishing house, New Delhi.
9. Introduction to nanobiotechnology by Charles P. Poole Jr and Frank J. Owens, Published by John Wiley and Sons, USA.

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5. There be a minimum of one and a maximum of two question on each topic / unit.

6 PROJECT PART - I

Term Work: 50 marks

The project work is to impart training in biotechnology engineering. The knowledge gained by studying various subjects separately is utilized for a single task. The project trains to co-ordinate the knowledge of biotechnology principles assimilated over the period of course study and about forty subjects. This is an exercise in literature survey, report writing and team work. The project report reflects on the devotion of students towards work and single mindedness approach. A group of 2 student or single student will have to work on a topic assigned to them or him/her. One staff member will supervise the work of the students. The project work may involve experimental/ theoretical/computational work.

A preliminary report is to be submitted containing the details of literature survey, data collected, and outlines of project.

Inline with the project topic, students will be given a research and or review paper on which he or she has to deliver a power point presentation of 5-8 min in front of the faculty of the department. 20% term work marks will be based on this presentation.

The term work will be assessed by two university approved internal examiners appointed by the Principal of the college, one of whom will be his guide & the other a staff member of the concerned branch.

7 PROCESS CONTROL AND SEPARATION

Theory: h/week - 4; Paper: 100 Marks; Duration: 3 h
Practical: h/week - 2; Practical Examination: 25 marks, Term Work: 25 marks

UNIT I: Membrane Separation (05)

Classification of separation techniques, Membrane separations, Definition of a membrane, Criteria of membrane separation processes, Types of membranes, Advantages of membrane separation processes over conventional separation techniques, Industrial Applications, Micro filtration, Ultra filtration, Reverse Osmosis, Piezodialysis, Electro dialysis, Pervaporation, Carrier mediated transport-liquid membranes, Membrane contactors, and industrial applications of all processes.

UNIT II: Control System (05)

Introduction to control system, parts of control systems, lags inherent in instruments and process. Mathematical modeling of bio-technology/chemical process, state variables and state equations for a chemical/bio-tech. process. The input out put model, Linerization of non-linear systems, solution of linear differential equation using laplas transform. Feedback and feed forward control. Block diagram and development of block diagram.

UNIT III: Dynamic Behavior Of First Order System (05)

First order system and their transfer functions. Dynamic behavior of first order system, pure capacitive process, first order system with variable time constant gains. Response of first order system in series, interacting and non-interacting systems, Derivation of transport equation.

UNIT IV: Dynamic Behavior Of Second Order System (05)

Second order system and their transfer functions. Under damped and over damped and critically damped systems, transportation lag. Dynamic behavior of higher systems. Derivation of transport equations.

UNIT V: Feed Back Control (07)

Introduction to feed back control, control elements. Dynamic behavior of feed back control processes. Closed loop transfer function control action, block diagram and application of control system for chemical reactors, distillation column adsorption column, heat exchange equipment like DPHE, S & THE and evaporator.

UNIT VI: Controllers (08)

Proportionate, proportionate Derivative, proportionate integral and proportionate Integral Derivative. Design of feed back controller: performance criteria, selection of type of controller. Tuning of feed back controller. Stability analysis by Rout criteria and Root locus analysis.

UNIT VII: Frequency Response (08)

Frequency response analysis of linear processes; Bode's diagram, Nyquist plot. Design of feed back control system using frequency response techniques, Bode's stability diagram, criteria gain and phase margin Ziegler-nichols technique Nyquest stability criteria. Advance control strategies. Cascade control, feed forward control, ratio control, selective control, split range control, adaptive and inferential control Introduction to analogue, digital computer and DCS.

RECOMMENDED BOOKS

1. Chemical process control: An Introduction to theory and practice, George Stephanopoulos, prentice Hall Of India.
2. Process System Analysis and Control, D. R Coughnour, et al McGraw Hill Publication.
3. Process control, Peter Harriot Tata McGraw Hill Publication.
4. Principle of Industrial Instrumentation, D Patranabis, McGraw Hill Publication.

SUGGESTED LIST OF EXPERIMENTS

1. Thermocouple/Thermometer
2. Manometer
3. Liquid level system
4. Thermal system
5. Pneumatic system
6. Pneumatic controller

PRACTICAL WORK

Note-Minimum five experiments, based on the syllabus, should be conducted during the course and record (journal) for the same shall be submitted. The practical examination shall consist of performing an experiment based on the practical work done during the course, the record of experiments submitted by the candidate and viva-voce based on the syllabus.

NOTE

For paper setter(s) for setting of question paper(s) for the theory examination to be conducted by University:

1. Weightage to the question to be asked be based on number of teaching hours allotted to each topic / unit.
2. Total of 05 (five) questions maximum, be asked per section of the paper, out of which students are expected to answer / solve any three questions.
3. Questions be of a maximum 16 / 18 marks each, to add up to maximum 50 marks per section.
4. Questions of maximum 16 / 18 marks are expected for teaching of @ 04 hrs of a topic. The question be a full question of 16/18 marks or have sub-questions to make a full question of 16/18 marks.
5. There be a minimum of one and a maximum of two question on each topic / unit.

8 PROTEIN ENGINEERING

Lectures: h/week - 4; Theory: 100 marks; Duration: 3 h

UNIT I: Basics Of Proteins **(10)**

Overview regarding biosynthetic and degradative pathways of proteins, Conformation studies of different proteins, Specific conformation of enzymes considering position of active sites. Effect of amino acids on structure of proteins, Energy status of a protein molecule, structure and function relation of enzymes.

UNIT II: Structural Elucidation Of Proteins **(06)**

Physical methods such as X-ray, Site directed mutagenesis for specific protein function.2D and 3D gel electrophoresis, isoelectric focusing

UNIT III: Designing Of Peptide And Enzyme Engineering **(06)**

Basic concepts for designing a new protein / enzyme molecule. Specific examples of enzyme engineering, Tryesyl T RNA Synthatase. Dihydrofolate reductase, Subtilisin. Chemical synthesis of specific amino acid sequence, Carboxylic acid specific immobilization, amino group protection by acetylation.

UNIT IV: Protein Modification **(10)**

Chemical modification in the homologous and heterologous proteins produced from prokaryotes: Phosphorylation glycosylation, methylation, formylation methioniation and demethionation.

UNIT V: Applications Of Protein Engineering **(04)**

Production of antibiotics, antibody molecules

UNIT VI: Advancement In Protein Engineering **(04)**

Peptide mass finger priniting: MS-ESI-TOF and MALDI-TOF, crystallography for determination of protein structure

RECOMMENDED BOOKS

1. Klaus Demobowsky, Novel Therapeutic Proteins: Wiley Publications.
2. Messer- schmidt, Hndbook of Metaloproteins – Wiley Publications.
3. Ronald Kellner et al., Microcharacterisation of proteins, 2nd ed. Wiley, Publications
4. Susane Brakmann, Directed Molecular Evolution of Proteins- Wiley Publications
5. Walsh, Protein Biotechnology and biochemistry, 2nd ed., Wiley Publications
6. Westermeier – Proteomics in Practice- Wiley Publications.

7. Buchanan B.B. Grussem. W. and Jones. R.L. 2000. Biochemistry and Molecular
8. Biology of Plants. American Society of Plant Physiologists, Maryland, USA.
9. Protein engineering: applications in science, medicine, and industry by Masayori Inouye, Raghupathy Sarma
10. Protein engineering by Jeffrey L. Cleland, Charles S. Craik - 1996 - 518 pages
11. Protein engineering by Morio Ikehara - 1990 - 355 pages
12. Proteins by Thomas E. Creighton - 1993 - 507 pages
13. Protein engineering by Peter C. E. Moody, Anthony J. Wilkinson, Tony Wilkinson - 1990 - 85 pages
14. Protein Engineering Handbook, Volume 1 Stefan Lutz, Stefan Lutz (Prof.), Uwe Théo Bornscheuer - 2009 - 973 pages

PRACTICALS

1. Tube gel electrophoresis
2. Paper electrophoresis
3. Determination of isoelectric point
4. SDS PAGE
5. NATIVE PAGE
6. 2D gel electrophoresis

PRACTICAL WORK

Note-Minimum four experiments, based on the syllabus, should be conducted during the course and record (journal) for the same shall be submitted. The practical examination shall consist of performing an experiment based on the practical work done during the course, the record of experiments submitted by the candidate and viva-voce based on the syllabus.

NOTE

For paper setter(s) for setting of question paper(s) for the theory examination to be conducted by University

1. Weightage to the question to be asked be based on number of teaching hours allotted to each topic / unit.
2. Total of 05 (five) questions maximum, be asked per section of the paper, out of which students are expected to answer / solve any three questions.
3. Questions be of a maximum 16 / 18 marks each, to add up to maximum 50 marks per section.

4. Questions of maximum 16 / 18 marks are expected for teaching of a topic. The question be a full question of 16/18 marks or have sub-questions to make a full question of 16/18 marks.
5. There be a minimum of one and a maximum of two question on each topic / unit.

9 PHARMACEUTICAL BIOTECHNOLOGY

Lecture: h / week - 4; Theory paper = 100 marks; Duration: 3h

UNIT I: Introduction To Pharmaceutical Biotechnology **(03)**

Pharmaceutical biotechnology and its industrial applications, prokaryotic and eukaryotic cell in biotech production, biopharmaceuticals expresses in plants

UNIT II: Therapeutic Proteins **(05)**

Pharmacokinetics and pharmacodynamics of biotech drugs, formulation of biotech products, Toxicity studies, Clinical trials peptide and protein drugs and recent advances-gene therapy, antisense.

UNIT III: Vaccine Production **(05)**

Scientific, technical and economical aspects, production of DNA vaccines, characterization and bio analytical aspects of recombinant proteins.

UNIT IV: Product Analysis **(06)**

PROTEIN based contaminants, detection of protein based impurities, immunological approaches, endotoxin and pyrogenic contaminants, miscellaneous contaminants, Validation studies.

UNIT V: Case Study Of Industrially Important Metabolites **(14)**

Study of following metabolites from biotechnology perspective- cytokines, growth factors, therapeutic hormones, recombinant blood products and therapeutic enzymes.

UNIT VII: Drug Development Process **(08)**

History of biopharmaceuticals, Drug development process, preclinical studies, pharmacokinetics and pharmacodynamics, toxicity studies, delivery of pharmaceuticals and role and remit of regulatory authorities.

RECOMMENDED BOOKS

1. Proteins: Biochemistry and Biotechnology - Gary Walsh
2. Pharmaceutical biotechnology concepts and applications – Gary Walsh, Wiley
3. Pharmaceutical biotechnology: Drug discovery and clinical applications, Oliver Kayser and Rainer H Muller, Wiley.
4. Foye's Principles of Medicinal Chemistry –William David A. and Lemke Thomas L.

5. Pharmaceutical Biotechnology, 2nd ed. by Crommelin D.J.A. & Sindelar R. D.

NOTE

For paper setter(s) for setting of question paper(s) for the theory examination to be conducted by University:

1. Weightage to the question to be asked be based on number of teaching hours allotted to each topic / unit.
2. Total of 05 (five) questions maximum, be asked per section of the paper, out of which students are expected to answer / solve any three questions.
3. Questions be of a maximum 16 / 18 marks each, to add up to maximum 50 marks per section.
4. Questions of maximum 16 / 18 marks are expected for teaching of a topic. The question be a full question of 16/18 marks or have sub-questions to make a full question of 16/18 marks.
5. There be a minimum of one and a maximum of two question on each topic / unit

10 ELECTIVE II

10.1 ENVIRONMENTAL ENGINEERING

Lecture: h / week – 04; Theory paper = 100 marks; Duration: 3h
Practical: h / week 02; Term work = 25 marks

UNIT I: Environmental Biotechnology: Vision And Development (02)
Biodiversity, Ecology, Pollution control, Agriculture, Bio-energy

UNIT II: Biodiversity And Ecology (05)
Biosphere, Ecosystem, Natural cycles (Nitrogen, Carbon, Phosphorus, Sulfur), Energy flow.

UNIT III: Environmental Pollution And Control (16)
Water pollution, Sources of pollutants, Waste water processing, Advanced waste water treatment in different industries (Brewery, Petroleum, paper and pulp); Soil pollution, Sources of pollutants, Bioremediation-In-situ (intrinsic, genetically engineered), Ex-situ (solid phase treatment slurry phase treatment, vermi composting); Air pollution-Sources of pollutants, Removal and control; Hazardous waste management - Physical treatment, Chemical treatment, Biological treatment, Xenobiotic compounds and their degradation. Characteristics of xenobiotic compounds, Examples of xenobiotic compounds, Mechanism of degradation.

UNIT IV: Environmental Impact Assessment (EIA) (03)
Need and objectives of EIA, Factors involved in EIA, Environmental attributes, Methods of EIA - Ad-hoc, Overlay, Network, Matrix, Checklist, Cost benefit, limitations and problems of EIA

UNIT V: Global Warming And Green House Effect (02)
Reasons for global warming, Technique of Green house effect, Applications of Green house effect.

UNIT VI: Agricultural Biotechnology (08)
Pesticides and Insecticides-types, mode of action and applications; Herbicides-types, mode of action and applications; Fungicides- types, mode of action and applications; Biopesticides-*B. thuringensis*- mode of action and applications; Viral pesticides-example, mode of action and applications, Neem pesticides mode of action and applications; Biofertilizers - Nitrogen fixing organisms their examples, mode of action and applications; Phosphorus solublizing organisms their example, mode of action and applications; Genetically modified organisms-need, application, stress tolerant plants.

UNIT VII: Bio-Energy **(03)**

Renewable sources of energy; Biomass as a source of energy; Energy crops-Production and applications.

UNIT VIII: Integrated Environmental Management (Overview) **(01)**

RECOMMENDED BOOKS

1. Environmental Biotechnology; M. H. Fulekar; Oxford & IBH Publishing Company pvt. Ltd; 1st edition
2. Environmental Biotechnology; Dilipkumar Markandey; APH Publishing Corporation 1st Edition
3. Environmental Biotechnology: theory and applications; G. Evans & J. Furlong; Wiley & Sons Pvt. Ltd; 1st edition
4. Textbook of Environmental Engineering; P. Venugopal Rao; PHI Pvt Ltd; 1st edition
5. Environmental Biotechnology; Alan Sragg; Oxford University Press; 2nd edition
6. Biotechnology; B. D. Singh; Kalyani Publications; 1st edition
7. Water and Waste Water Technology; Hammer & Hammer Jr.; PHI Pvt Ltd, 4th edition
8. Green House Technology for controlled Environment; G N Tiwary; Narosa Publishing House, 1st edition

NOTE

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3. Questions be of a maximum 16 / 18 marks each, to add up to maximum 50 marks per section.
4. Questions of maximum 16 / 18 marks are expected for teaching of 04 hrs of a topic. The question be a full question of 16/18 marks or have sub-questions to make a full question of 16 / 18 marks.
5. There be a minimum of one and a maximum of two question on each topic / unit.

10.2 ANIMAL CELL SCIENCE AND TECHNOLOGY

Lecture: h / week - 4; Theory paper = 100 marks; Duration: 3h
Practical: h / week - 4; Term work = 25 marks; Practical Exam: 25 marks

UNIT I: Introduction To Animal Cell Culture (05)
Historical Background. In-vitro and in-vivo cell metabolism. In-vitro growth promoting factors: Physiological and nutritional factors, Growth factors [EGF, FGF, PDGF, NGF, IGF, CSF, Erythropoietin], Hormones

UNIT II: Prerequisites Of Cell Culture (05)
Balanced salt solution. Media for culturing cells and tissues – Natural, Artificial. Sterilization procedures. Bioethical issues related to animal biotechnology

UNIT III: Establishment Of Cultures And Their Maintenance (08)
Initiation of primary cultures from anchorage dependant and non- anchorage dependant cells. outine maintenance of cultured cells. Detection and prevention of contamination. Established cell lines- origin and properties and cell-transformation. Commonly used cell lines- origin and characteristics. Organ Cultures

UNIT IV: Analysis Of Cell Growth (03)
Growth kinetics of primary and established cultures. Characterization of cell lines. Measurement of cell death *in-vitro*

UNIT V: Specialized Culture Techniques (05)
In-vitro generation of lymphocytes from embryonic stem cells. Isolation and culture of skeletal muscle myofibres as means to analyze satellite cells. Artificial Skin. Culture of human and rat Schwann cells. Long-term preservation of animal cells/ cell lines.

UNIT VI: Scaling Up Of Animal Cells (02)
Bioreactors for monolayer cultures. Bioreactors for suspension cultures. Immobilized cultures-Immurement cultures, Entrapment cultures

UNIT VII: Applications Of Animal Biotechnology (06)
Use of cell culture for production of a regulatory protein. Use of cell culture for production of a hormone (e.g. Insulin). Use of cell culture for production of vaccines. Cell hybridization and human hybridization. Use of cell culture in drug targeting and drug toxicity analysis. Transplantation of cultured cells.

UNIT VIII: Stem Cell Biotechnology **(03)**

Types and characteristics of stem cells. Culture conditions/equipments essential for embryonic stem cell cultures. Use of stem cell cultures for treatment of genetic disorders

UNIT IX: Transgenic Animals **(03)**

Methods of transgenesis. Vectors involved. Biopharmaceutical applications of transgenic animals.

RECOMMENDED BOOKS

1. C. Helgasson; Basic cell culture protocols, 3rd edition, Human press
2. E. D. Rang, H.P. Dale, M.M. Ritter; Pharmacology, 5th edition
3. J. Mather and d. Barnes; Animal cell culture methods, Elsevier, vol 57
4. J.R.W. Masters; Animal Cell Culture- A practical approach, Oxford university press
5. J. Paul Basic Protocols in cell and tissue culture
6. M. Butler; Animal cell technology-Principles and products, Open University press
7. M. Butler and M. Dawson, Cell culture lab fax, Bios scientific Pvt. Ltd.
8. M. Cylnes; Animal cell culture techniques, Springer Verlag
9. M.M. Young; Animal Biotechnology, Pergamon press, Oxford
10. N. Jenkins; Animal cell biotechnology-Methods and protocols, Human Press
11. R.I. Freshney; Culture of animal cells: A manual of basic techniques, John Wiley and sons, 4th edition.

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4. Questions of maximum 16 / 18 marks are expected for teaching of @ 04 hrs of a topic. The question be a full question of 16/18 marks or have sub-questions to make a full question of 16/18 marks.
5. There be a minimum of one and a maximum of two question on each topic / unit.

10.3 FOOD BIOTECHNOLOGY

Theory: h/week - 4; Paper: 100 marks; Duration: 3 h

SECTION A: FOOD BIOTECHNOLOGY

UNIT I: Overview Of Food Biotechnology **(06)**

Biotechnology in relation to the food industry, Food processing, general engineering aspects and processing methods. Preliminary processing methods, conversion and preservation operations. Nutritional value of food, spoilage of food, Microorganisms in water, milk, vegetables, fresh meats and poultry, processed meats, seafood's, fermented dairy products and miscellaneous food products.

UNIT II: Food Preservation **(10)**

Introduction to Physical and chemicals methods of food preservation: Principles and methods of food preservation- Refrigeration, Freezing, heating, dehydration, drying, canning, extrusion Cooking, hydrostatic pressure cooking, dielectric heating, microwave processing, aseptic Processing juices and concentrates, membrane technology, additives, irradiation. Storage of food, modified atmosphere packaging.

UNIT III: Microbial Technology In Production Of Different Food Products **(06)**

Technologies used for microbial production of food ingredients, biotechnology of microbial polysaccharides in food, microbial biotechnology of food flavor production, microbial production of oils and fats, food applications of algae, butanol production from agricultural biomass

SECTION B: FUNCTIONAL FOODS (NUTRACEUTICALS)

UNIT IV: Functional Foods **(06)**

Food or medicine? Concept of per and probiotics, use of nutraceutical supplements, safety, major Nutraceuticals and their applications.

UNIT V: Metabolism, Bioavailability, And Pharmacokinetics Of Nutraceuticals **(04)**

UNIT VI: Nutraceutical And Cardio Vascular Health **(04)**

Black and green tea, soy, essential fatty acids, coenzyme Q10, Lycopene, octacosanol, melatonin, Resveratrol, luetin.

UNIT VII: Nutraceutical And Cancer Prevention **(04)**

Tea, lycopene, flax seed, PUFA, coenzyme Q10

11 PROJECT PART - II

Term Work: 100 marks
Practical Examination: 100 marks

A group of 2 students or a single student who have (has) been assigned a topic in Project-I is expected to complete the details of the project. A group of 2 students or a single student will have to submit a detailed typed & bound report of the work done, in Project-I and Project-II combined together. The practical examination shall consist of a *viva-voce* based on the project work completed in Part-I and Part-II by the candidate.

It will be mandatory for the students to present their project work in any national or international conference or even they can submit their manuscript based on their project work to any national or international journal or conference proceeding. The students must attach a Xerox copy of the certificate of merit or participation in their project report.