CMS COLLEGE OF SCIENCE AND COMMERCE
(AUTONOMOUS)
Chinnavedampatti, Coimbatore - 641 049

An ISO 9001:2000 certified autonomous institution and
Accredited at the 'A' level by NAAC

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DEPARTMENT OF BIOTECHNOLOGY

III Year B.Sc., Biotechnology

CURRICULUM, SYLLABI & SCHEME OF EXAMINATION (CBCS)
(2011)
(FOR THE STUDENTS ADMITTED DURING THE ACADEMIC YEAR 2009)

DEPARTMENT OF BIOTECHNOLOGY
B.Sc., Biotechnology

REGULATIONS

INTRODUCTION

BIOTECHNOLOGY

Any technology application that uses biological systems, living organisms or derivatives thereof, to make or modify product and processes for specific use.

OBJECTIVES

On successful completion of the course, the students will thoroughly understand, What is Biotechnology? Techniques in Biotechnology, Biotechnological processes, Applications of Biotechnology in various fields like Nanobiotechnology, Medical Biotechnology, Pharmaceutical Biotechnology, Animal Biotechnology, Plant Biotechnology, Immuno technology, Genetic Engineering and Recombinant DNA Technology, Microbial Biotechnology, Bioprocess technology, Fermentation Technology, Genomics & Proteomics, Molecular biology, IPR, IPP, Patenting of live forms, Germplasm preservation & Cloning of animals. The students will also understand the recent advancements & developments in Biotechnological research.

ELIGIBILITY

A pass in Higher Secondary Examination with
a) Mathematics, Physics, Chemistry and biology
b) Botany, Zoology, Physics and Chemistry
c) Physics/ Chemistry/biology/ computer science
d) Physics/Chemistry / Biotechnology
e) Physics, Chemistry and biology

DURATION OF UG COURSE

The course shall extend over a period of three years comprising of six semesters, with two semesters per year. There shall not be less than ninety instructional days during each semester. Examination shall be conducted at the end of each semester for the respective subject.

DISTRIBUTION OF THE MARKS AND CREDITS UNDER CBCS

PART	SUBJECT	No of Papers	Marks @	Credits
I	**Language – I** Tamil /Malayalam/Hindi/French	4	400	12
II	**Language – II** English	4	400	12
III	**Core** Subjects	16[$]	1600	60
	Allied Subjects	6**	400	20
	Elective Subjects	3	300	15
IV	**1 - Non-Major Elective** **Elective – I** Tamil[£]/Advanced Tamil/ Communicative English **Elective – II** Tamil[£]/Advanced Tamil/ General Awareness	2	150 #	4
	2 – Skill Based Subjects	4	400	12
	3 – Foundation Course I	1	50 #	2
	4 – Foundation Course II	1	50 #	2
V	**Extension Activities**	-	50!!	1
	Total		**3800**	**140**

Note: I

@ Includes 25/40 % continuous assessment marks for theory and practical subjects respectively.

$ In core subjects both theory and practicals are included wherever applicable.

** In allied subjects both theory and practicals are included wherever applicable.

No Continuous Internal assessment for these subjects

!! The Evaluation of extension activities will be based on NSS/ NCC/ SPORTS/ Red Cross

£ Continuous Internal assessment for these subjects

The following parameters are considered throughout study period.

- **i)** Regularity of Attendance
- **ii)** Active participation in classes/Camps/Games (College/District//University)
- **iii)** Exemplary awards/certificates/prizes
- **iv)** Other Social Components (Blood Camp, Fine Arts etc)

Note: II

The Credit points, Lecture Hours, Marks are not linked.

Annexure No.UEC5
BOS.DT:05-08-2011

CMS COLLEGE OF SCIENCE AND COMMERCE
COIMBATORE – 641 049
(AUTONOMOUS)
B.Sc., BIOTECHNOLOGY DEGREE COURSE

SCHEME OF EXAMINATION - CBCS PATTERN
(FOR THE STUDENTS ADMITTED DURING THE ACADEMIC YEAR 2009)

Semester	Part	Sub. Code	Subject Title	Inst. Hrs per week	Examination Details				Credits
					Duration in Hours.	CIA	End Semester Exam	Total Marks	
SEMESTER I									
	I		Language – Paper I	6	3	25	75	100	3
	II		English – Paper I	6	3	25	75	100	3
	III		Core paper I - Cell Biology	4	3	25	75	100	4
	III		Core Paper II- Biochemistry	4	3	25	75	100	4
	III		Core Practical-I: Cell biology & Biochemistry	2	**	**	**	**	**
	III		Allied: Chemistry 1	4	3	20	55	75	4
	III		Allied Practical : Chemistry	2	**	**	**	**	**
	IV		Foundation Course I – Environmental Studies	2	3	-	50	50	2
Total				***30***				***525***	***20***
SEMESTER II									
	I		Language – Paper II	6	3	25	75	100	3
	II		English – Paper II	6	3	25	75	100	3
	III		Core paper III – Microbiology	5	3	25	75	100	4
	III		Core Practical I: Cell biology & Biochemistry	4	3	40	60	100	3
	III		Allied: Chemistry II	4	3	20	55	75	4
	III		Allied Practical : Chemistry	3	3	20	30	50	2
	IV		Foundation Course II – Cultural Heritage of India	2	3	-	50	50	2
Total				***30***				***575***	***21***
SEMESTER III									
	I		Language- Paper III	6	3	25	75	100	3
	II		English - Paper III	6	3	25	75	100	3
	III		Core paper IV- Genetics	4	3	25	75	100	4
	III		Core paper V-Molecular Biology	4	3	25	75	100	4
	III		Core Practical II**:** Microbiology and Immunology	2	**	**	**	**	**
	III		Allied: Basic Mathematics	3	3	20	55	75	4
	IV		Skill based Subject I Microscopy & Spectroscopy	3	3	25	75	100	3
	IV		Tamil I / Advanced Tamil (OR) Non major elective-I (Communicative English)	2	3	-	75	75	2
Total				***30***				***650***	***23***

SEMESTER IV									
	III		Language – Paper IV	6	3	25	75	100	3
	III		English - Paper IV	6	3	25	75	100	3
	III		Core Paper VI- Immunology	4	3	25	75	100	4
	III		Core Practical-II – Microbiology & Immunology	3	3	40	60	100	3
	III		Allied: Fundamentals of Computers & C Programming	4	3	20	55	75	4
	III		Allied Practical: Fundamentals of Computers & C Programming	2	3	20	30	50	2
	IV		Skill based Subject 2 Separation Techniques	3	3	25	75	100	3
	IV		Tamil /Advanced Tamil (OR) N on- Major Elective – II (General awareness)	2	3	-	75	75	2
Total				***30***				***700***	***24***
SEMESTER V *****[μ]									
	III		Core Paper VII – Recombinant DNA Technology I	4	3	25	75	100	4
	III		Core Paper VIII - Microbial Biotechnology	4	3	25	75	100	4
	III		Core Paper IX - Plant Biotechnology	4	3	25	75	100	4
	III		Core paper X – Animal Biotechnology	4	3	25	75	100	4
	III		Core Practical –III[μ]: Molecular Biology, Plant tissue culture and Animal cell culture.	4	**	**	**	**	**
	III		Core Practical –IV *****: Recombinant DNA Technology, Microbial Biotechnology and Bioprocess Technology.	3	**	**	**	**	**
	III		Elective Paper I – Fermentation Technology	4	3	25	75	100	5
	IV		Skill Based Subject 3 Advanced Biotechniques	3	3	25	75	100	3
Total				***30***				***600***	***24***
SEMESTER VI									
	III		Core paper XI– Recombinant DNA Technology - II	4	3	25	75	100	4
	III		Core paper XII - Bioinformatics	4	3	25	75	100	4
	III		Core Practical -III[μ]: Molecular Biology, Plant tissue culture and Animal cell culture.	4	6	40	60	100	3
	III		Core Practical –IV *****: Recombinant DNA Technology, Microbial Biotechnology and Bioprocess Technology.	4	6	40	60	100	3
	III		Elective Paper II- Nanobiotechnology	4	3	25	75	100	5
	III		Elective paper III – Pharmaceutical Biotechnology	4	3	25	75	100	5
	IV		Skill Based Subject 4 Bioinstrumentation Practical	3	3	25	75	100	3
	V		Extension Activities	-	-	-	-	50	1
	VI		Mini Project[μ]	3					
Total				***30***				***750***	***28***
GRAND TOTAL								***3800***	***140***

µ Mini Project:
Each group of students has to undergo a mini project during the 6th semester. This should be of a minimum duration of 3 hours per week at our laboratory under the guidance of the teaching staff. Maximum of 3 students per group has to perform mini project and submit a project report. The valuation of the same is to be incorporated into the internal assessment of Core Practical III (to a maximum of 5 marks).

***** Summer Training/ Internship
Each student has to undergo a Summer Training/ Internship during the summer prior to Semester V. This should be of a minimum duration of 15 days at any off-campus site approved by the Head of the Department. Students are required to submit a written report upon completion. The valuation of the same is to be incorporated into the internal assessment of Core Practical IV (to a maximum of 5 marks).

****** Examinations will be conducted in the Even Semester

Total Credits: 140 [Part I -12, Part II -12, Part III-95, Part IV -20, Part V-1]
Each paper carries an internal component; there is a pass minimum for External component and overall

Distribution of marks between Internal* and External assessment
Theory: Internal assessment* (25): External assessment (75)
Practical: Internal assessment* (40): External assessment (60)

COMPONENTS OF INTERNAL ASSESSMENT*

Theory: One Internal test and One Model test in each semester

Internal Test	- 10 marks
End semester Model test	- 10 marks
One Assignment	- 5 marks

Core Practicals I, II:

Minimum 10 experiments to be conducted/ semester	– 20 marks
Average of two tests	- 15 marks
Record work	- 5 marks

Core Practical III:

Minimum 10 experiments to be conducted/ semester	– 20 marks
Average of two tests	- 10 marks
µReport of Mini project	- 5 marks
Record work	- 5 marks

Core Practical IV:

Minimum 10 experiments to be conducted / semester	– 20 marks
Average of two tests	- 10 marks
Report of Summer Training/ Internship	- 5 marks
Record work	- 5 marks

***** Retest for internal examination to be conducted for genuine cases as per the recommendations of class in charge, subject in charge. The final decision to be made by the HOD.

Semester V

COURSE: B.Sc., Biotechnology

SUBJECT TITLE: CORE PAPER VII: RECOMBINANT DNA TECHNOLOGY- I

NUMBER OF HOURS/WEEK: 4 Hrs

SUBJECT DESCRIPTION
This course presents the principles and applications of recombinant DNA Technology for the production of useful biological products.

GOALS
To make the student to understand the concept of vector preparation, gene manipulation and gene transfer technologies

OBJECTIVES
On successful completion of the subject, student should have understood: Biology of plasmid, usability of plasmid and viral particles as vectors and cloning strategies.

CONTENTS:

UNIT I
Introduction to gene manipulation. Tools for rDNA Technology: Cutting- DNase, Restriction endonucleases. Modification: Nucleases, Polymerases, methylases, end modifying enzymes. Ligation: Categories of reaction, ligases.

UNIT II
Plasmid and chromosomal DNA isolation from *E. coli*, Vectors: Plasmids: Basic and desirable properties of plasmids, Natural plasmid vectors, plasmid pBR322, improved pBR322 derived vectors-pUC series vectors, Low copy number and runaway vectors.

UNIT III
Yeast vectors – YEP, YIP, YRP and YAC. Phage lambda vectors, Cosmids, Uses of Bacteriophage M13 and P1.

UNIT IV
Ti Plasmids, Plant viruses as vectors, SV40 based vectors and Baculoviral vectors, Retroviral vectors. Prokaryotic and eukaryotic expression vectors.

UNIT V
Gene Transfer Methods: Electroporation, Microprojectile bombardment, liposome mediated gene delivery, calcium chloride method. Gene transfer to plants: *Agrobacterium* mediated transfer, protoplast transformation, Gene transfer to animal cells, cloning a gene with bacteriophage lambda and with plasmids.

TEXT BOOKS:

1. **Introduction to gene cloning**- 3rd Ed, (1998), Brown T.A, Stanley Thomas Pub ltd, Germany.

2. **Principles of gene manipulation** -6th Ed, (2003), Old, R.W. and Primrose S.B, Black well Sci ltd, Germany.
3. **Gene Biotechnology**- Jogdand, (1997), Himalaya Publishing House, Mumbai.

REFERENCES:

1. **From Genes To Clones**- 2nd Ed (2003), Ernst.L.Winnacker, Panima publishing Corporation, New Delhi.
2. **Genes VIII,** Benjamin Lewin (2004), Pearson Education Corporation, New Jersy.
3. **Molecular Biology** -II Ed, (1987) Friefielder. D, Narosa publishing house, New Delhi.
4. **Recombinant DNA Technology**-2nd Ed, (2001), J.D.Watson, WH Freeman and Company, New York
5. **Molecular Biotechnology** (1996), Glick and Pasternak, Panima Publishing Corporation, New Delhi.
6. **Molecular Cloning: A Laboratory Manual** (2000), Sambrook, J., Fritsch, E.F., and Maniatis, T., Cold Spring Harbor Laboratory Press, New York.

Semester V

COURSE: B.Sc. Biotechnology

SUBJECT TITLE: CORE PAPER VIII: PLANT BIOTECHNOLOGY

NUMBER OF HOURS/WEEK: 4 Hrs

SUBJECT DESCRIPTION
The course deals with the study of various culturing techniques of plant cells and its applications. It also gives emphasis on Gene transferring methods.

GOALS
To enable the students to learn various culturing techniques of plant cells, Gene transferring mechanisms and production of transgenic plants.

OBJECTIVES
On successful completion of the course, the students will be aware of

1. Various *in vitro* culture techniques
2. Gene transferring mechanisms
3. Transgenics

CONTENTS:

UNIT I
Plant genome organization-chloroplast, mitochondria and nuclear. Organization of chloroplast genome-nucleus encoded and chloroplast-encoded genes for chloroplast proteins, targeting of proteins to chloroplast, cytoplasmic male sterility.

UNIT II
An overview of Conventional methods of crop improvement. Plant tissue culture- Media preparation, Plant Growth Regulators, Sterilization methods. In vitro culture: physical and chemical factors. Culture systems: organ, callus, cell, hairy root and protoplast cultures. Incubation systems: static and suspension culture systems.

UNIT III
Somatic embryogenesis and synthetic seeds, haploid production, embryo culture and their applications. Somaclonal variations.

UNIT IV
Plant transformation techniques – Mechanism of DNA transfer – Agrobacterium mediated gene transfer, general features of TI and RI plasmids and their use as vectors. Molecular marker aided breeding, RFLP maps, RAPD markers and SCAR (Sequence Characterized applied regions).

UNIT V
Genetic engineering in plants- selectable markers, reporter genes and promoters used in plant vectors. Genetic engineering of plants for virus resistance and pest resistance. DNA markers in marker-assisted selection and plant breeding. Tagging, mapping and cloning of plant genes.

REFERENCES:

TEXT BOOKS:

1. **Plant Biotechnology** - Ramawat, K.G. 2000. Second Edition, S. Chand & Co., New Delhi.
2. **An introduction to Plant Tissue culture** - Razdan. M.K. 1993. Oxford & IBH Publishing Co, New Delhi.
3. **Introduction to Plant Biotechnology** – Chawla, H.S. 2002. Second edition, Science Publishers, Inc, Enfield, NH,USA
4. **Plant molecular Biology** -Grierson and S.V. 1988. Covey, Blackie & Son Ltd.

REFERENCE BOOKS:

1. **Molecular Biotechnology** - Glick, B.R. and J.J. Pasternak, 1998. Second Edition, ASM Press, Washington.
2. **Plant tissue culture** - Bhojwani. S.S and Razdan. M.K 2004. Elsevier science.
3. **Genetic Engineering of crop plants** edited by G.W.Lycett and D.Grierson.
4. **Plants, genes and agriculture** -M.J. Chrispeels and D.F. Sadava.
5. **Plant cell culture, A Practical approach**, 2nd Edition, Edited by R.A. Dixon and R.A. Gonzales.

Semester V

COURSE: B.Sc. Biotechnology

SUBJECT TITLE: CORE PAPER IX: MICROBIAL BIOTECHNOLOGY

NUMBER OF HOURS/WEEK: 4 Hrs

SUBJECT DESCRIPTION
This course presents the principles and applications of microorganisms for the production of useful biological materials.

GOALS
To enable the students to learn the various Microbial Biotechnology applications.

OBJECTIVES
On successful completion of the course the students will be aware of Screening and optimization and production of useful biomaterials from microorganisms.

CONTENTS:

UNIT I
Industrially important microorganisms – Isolation, identification, Strain improvement and preservation of culture, media for industrial fermentation, handling and development of inoculum for fermentation processes and methods of sterilization.

UNIT II
Production of ethanol, acetone and butanol, Production of organic acids- citric acid, acetic acid and lactic acid, Production of amino acids- Lysine and Glutamine, Production of antibiotics- Penicillin and Streptomycin

UNIT III
Enzyme production from microbes – Amylase and Protease, enzyme immobilization techniques. Nitrogen fixation. Biofertilizers, Biopesticides and Biopolymers.

UNIT IV
Food microbiology: Fermented foods- Bread and Soysauce, Dairy products- Cheese, Alcoholic beverages - Wine and Beer, SCP- mushroom, baker's yeast and spirulina.

UNIT V
Bioremediation- Role of microbes in wastewater treatment, Biodegradation of xenobiotics, Solid waste management, Biomining.

REFERENCES:

TEXT BOOKS:

1. **Microbial Biotechnology** - Glazer *et al.,* (1995.) W.H. Freeman & Co. New York.
2. **Industrial microbiology** - A. H. Patel, (1985) Macmillan Publication, New Delhi.
3. **Principles of Fermentation Technology** - Stanbury, P.F. and H.Whitaker, (1997), Aditya Books (P) Ltd, New Delhi.

4. **Biotechnology** - W. Crueger and A. Crueger.(2004.) Panima Publication, New Delhi.
5. **Industrial Microbiology** - Casida, L.E., (2005), New Age International (P) Ltd.

REFERENCE BOOKS:

1. **Industrial Microbiology** - Prescott, Dunn, (2005), Agrobios (India), 6th Edition.
2. **Molecular Biotechnology**- Glick, B.R. and J.J. Pasternak, (1998). Second Edition, ASM Press, Washington, DC.
3. **Industrial Microbiology: An Introduction**- Michael J. Waites, (2001), Blackwell Publishing Ltd.

Semester V

COURSE: B.Sc. Biotechnology

SUBJECT TITLE: CORE PAPER X: ANIMAL BIOTECHNOLOGY

NUMBER OF HOURS/WEEK: 4 Hrs

SUBJECT DESCRIPTION
The course deals with the study of embryology, various culturing techniques of animals cells and its applications. It also gives emphasis on Gene transferring methods.

GOALS
To enable the students to learn various culturing techniques of animal cells, Gene transferring mechanisms and production of transgenic animals.

OBJECTIVES
On successful completion of the course the students will be aware of

i) Various *in vitro* culture techniques
ii) Preservation of animal cells
iii) Gene transferring mechanisms
iv) Transgenics & cloning

CONTENTS:

UNIT I
Animal cells organization, Equipments and materials for animal cell culture technology, Culture media: Balanced salt solution and simple growth medium, physical, chemical and metabolic functions of different constituents of culture medium, role of carbon dioxide, serum, growth factors, Serum free media and their applications.

UNIT II
Biology and characterization of cultured cells, measurement of cell death, Types of cell culture: primary and established culture, tissue culture & organ culture, Three dimensional cultures, Feeder layers, Disaggregation of tissues and cell separation, Cell synchronization, Cryopreservation, Apoptosis and necrosis.

UNIT III
Embryology- culturing and preservation of embryos, Gametogenesis and fertilization in animals, Genetic regulation of embryonic development in Drosophila, Homeotic genes in development.

UNIT IV
Molecular techniques in cell culture: Manipulation of genes- cell cloning and micro manipulation, gene silencing and targeting, Cell transformation- physical, chemical and biological methods, Hybridoma technology and applications.

UNIT V
Transgenics: Transgenic Animals- Production and Applications, Transgenic animals in livestock improvement, transgenics in industries, chimera production, ethical issues in animal biotechnology.

REFERENCES:

TEXT BOOKS:

1. **Animal Biotechnology: Recent concepts & Developments**, P. Ramadass (2008), MJP Publishers, Chennai.
2. **Culture of Animal cells: A Manual of basic Techniques**, R. Ian Freshney, (2003) A John Wiley & Sons Inc publications, NY.
3. **Animal Cell Culture** - 3rd Edition- John R.W. Masters (2000) Oxford University Press, Oxford.

REFERENCE BOOKS:

1. **Animal Cell Biotechnology- Methods and Protocols**, Ed. Nigel Jenkins, (1999), Humana Press, New Jersey.
2. **Developmental Biology**- 7th Edition, Scott F. Gilbert (2003) Sinaver Associates Inc Publishers, Sunderland, Massachusetts, USA.
3. **Molecular Biotechnology: Principles and applications of Recombinant DNA**- Bernard. R. Glick & Jack. J.Pasternak, (2002) Panima Publishing Corporation, New Delhi.
4. **Animal Cell Culture**, BIOTOL Series
5. **Developmental Biology**, R.M.Twyman (2003), Viva Books Pvt Ltd, New Delhi.
6. **Molecular Biotechnology**-Second Edition, S.B. Primrose (2001) Panima Publishing Corporation, New Delhi.

Semester V

COURSE: B.Sc. Biotechnology

SUBJECT TITLE: CORE PRACTICAL III- MOLECULAR BIOLOGY, PLANT TISSUE CULTURE AND ANIMAL CELL CULTURE

NUMBER OF HOURS/WEEK: 4 Hrs

SUBJECT DESCRIPTION:
This course presents Plant Tissue Culture, Animal Cell Culture and Immunological techniques.

GOALS
To enable the students to learn the various techniques involved in culturing of plants and animals, and also learn basic immunological techniques.

OBJECTIVES
On successful completion of the course students will be aware of culturing of plants and animal cells, and detecting the antigen - antibody interactions by different methods.

CONTENTS:

Molecular Biology:

1. Bacterial DNA Isolation
2. Plasmid DNA Isolation
3. Plant DNA Isolation
4. Animal DNA Isolation
5. Isolation of total RNA
6. Agarose gel Electrophoresis
7. SDS-PAGE

Plant Tissue culture:

8. PTC laboratory organization
9. Sterilization procedures
10. Preparation of PTC medium
11. Micropropagation
12. *In vitro* germination of seeds
13. Callus induction and differentiation
14. Embryo culture
15. Protoplast isolation and protoplast fusion
16. Artificial seed production.

Animal cell culture:

17. Preparation of cell culture media and membrane filtration
18. Establishment of primary culture from chick embryo
19. Cell counting and Cell viability
20. Trypsinization of Monolayer and Sub-culturing
21. Cryopreservation and Thawing
22. Measurement of doubling time

REFERENCES:

1. **Practical Immunology**- 4th Edition, Frank C. Hay, Olwyn M.R.Westwood (2002) Blackwell Science Publishing Company, USA.
2. **Biochemical Methods**- 2nd Edition- Sadasivam, S. & Manickam, A. (2004), New Age International LTD Publishers, New Delhi
3. **Practical Application of Plant Molecular biology**, R.J. Henry (1997) Chapans and Hall.
4. **An Introduction to Plant Tissue culture**, Razdan. M.K. (1993). Oxford & IBH Publishing Co, New Delhi.
5. **Culture of Animal cells: A Manual of basic Techniques**, R. Ian Freshney, (2003) A John Wiley & Sons Inc publications, NY.
6. **Animal Cell Biotechnology- Methods and Protocols**, Ed. Nigel Jenkins, (1999), Humana Press, New Jersey.
7. **Molecular Cloning: a Laboratory manual** (2000), Sambrook, J., Fritsch, E.F., and Maniatis, T., Cold Spring Harbor Laboratory Press, New York.

Semester V

COURSE: B.Sc., Biotechnology

SUBJECT TITLE: CORE PRACTICAL IV- RECOMBINANT DNA TECHNOLOGY MICROBIAL BIOTECHNOLOGY AND BIOPROCESS TECHNOLOGY

NUMBER OF HOURS/WEEK: 3 Hrs

SUBJECT DESCRIPTION
This course deals with the study of Recombinant DNA Technology, Microbial Biotechnology, and applications of bioprocess technology.

GOALS
To learn the various techniques in Bioprocess, Recombinant DNA technology and microbial biotechnology

OBJECTIVES
After the successful completion of the course the students will be aware of various techniques in Bioprocess, Recombinant DNA Technology and Microbial Biotechnology.

CONTENTS:

rDNA Technology:

1. Restriction Digestion.
2. Ligation.
3. PCR.
4. Southern Blotting (demo).
5. Western blotting (demo).
6. Bacterial transformation.
7. Conjugation.

Microbial & Bioprocess technology

8. Isolation of industrially important actinomycetes from soil sample.
9. Screening & Isolation of amylase producing microbes from soil sample.
10. Screening & Isolation of protease / cellulase producing microbes from soil sample.
11. Production of amylase enzyme.
12. Influence of different carbon sources on amylase production.
13. Influence of different nitrogen sources on amylase production.
14. Effect of different pH on amylase production.
15. Effect of different temperature on amylase production.
16. Assay of amylase enzyme.
17. Purification of a product from fermentation broth.
18. Immobilization of yeast.
19. Wine production.
20. Antibiotic Sensitivity Test.

REFERENCES:

1. **Practical Biochemistry – Principles and Techniques**, 2nd Edition- Keith Wilson& John Walker (2000), Cambridge University Press.
2. **Biochemical Methods-** 2nd Edition- Sadasivam, S. & Manickam, A. (2004), New Age International LTD Publishers, New Delhi.

3. **Principles of Fermentation Technology** - Stanbury, P.F. and H.Whitaker, (1997). Aditya Books (P) Ltd, New Delhi.
4. **Industrial Microbiology** - Casida,L. E. Jr(2005). New Age International Publishers.
5. **Industrial Microbiology** - Prescott, Dunn, (2005), 6th Edition Agrobios (India).
6. **Biotechnology** - W. Crueger and A. Crueger. (2004). Panima Publication, New Delhi.
7. **Molecular Cloning: a Laboratory manual** (2000), Sambrook, J., Fritsch, E.F., and Maniatis, T., Cold Spring Harbor Laboratory Press, New York.

Semester V

COURSE: B.Sc., Biotechnology

SUBJECT TITLE: ELECTIVE PAPER I: FERMENTATION TECHNOLOGY

NUMBER OF HOURS/WEEK: 4 Hrs

Subject description
This paper presents the basics of fermentation technology, types of bioreactors

Goals
To provide information on the design and use of bioreactors

Objectives
On successful completion of the course the students should have:

1. Understood the basics of fermentation technology
2. Learnt the concepts of upstream & downstream processing

CONTENTS:

UNIT I:
Designing & functions of fermentor, body construction, primary steps for fermentation process, maintenance of aseptic conditions, types of aeration and agitation and sensors.

UNIT II:
Batch, Fed Batch and Continuous fermentation, types of reactors- packed bed reactor, continuous stirred tank reactor, tower reactor, fluidized bed reactor, major types of microbes used in food industries , methods and advantages of immobilized microbes in fermentation technology .

UNIT III:
Growth kinetics of microbes-batch culture, transport phenomena, rheological properties of fermentation broths, oxygen mass transfer & its determination, scale-up and scale-down process and medium optimization-statistical method.

UNIT IV:
Downstream processing - foam separation, precipitation. Cell disruption methods-physical chemical & enzymatic methods. Types of centrifuges: The Basket centrifuge, the tubular-bowl centrifuge, multi chamber centrifuge, filtration- ultra filtration and pressure leaf filtration.

UNIT V:
Liquid liquid extraction-cocurrent extraction and counter current extraction, super critical fluid extraction. Chromatography-affinity, gel, ion exchange, Spray drier, freeze driers and crystallization.

Text Books:

1. **Principles of Fermentation Technology** - Stanbury, P.F. and H.Whitaker, (1997).
2. **Microbial Biotechnology** - Glazer *et al*.,(1995.) W.H. Freeman & Co. New York.

References:

1. **Industrial microbiology** - A. H. Patel, (1985) Macmillan Publication, New Delhi. Aditya Books (P) Ltd, New Delhi.
2. **Biotechnology**. W. Crueger and A. Crueger. (2004.) Panima Publication, New Delhi.
3. **Fermentation Microbiology & Biotechnology**. E.M.T.El Mansi, Bryce.C.F.A, 2nd edition, Taylor & Francis group.

Semester V

COURSE: B.Sc., Biotechnology

SUBJECT TITLE: SKILL BASED SUBJECT 3 - ADVANCED BIOTECHNIQUES

NUMBER OF HOURS/WEEK: 3 Hrs

SUBJECT DESCRIPTION
This course presents the advanced aspects of Bioinstrumentation.

GOALS
To make the student to understand the technical aspects of bioinstruments.

OBJECTIVES
On successful completion of the subject student should have understood the fundamentals of Bioinstrumentation.

CONTENTS:

UNIT I
Blotting: Western, Southern and Northern (including Hybridization), Colony and Plaque hybridization, Dot blot Hybridization and FISH.

UNIT II
Thermal Cyclers and various types of PCR, RAPD, RFLP, AFLP, SSCP and PFGE.

UNIT III
Haemocytometer, ELISA, Immunoblotting, Complement Fixation Test, Flow cytometry, and FACS.

UNIT IV
Particle Counting Methods, Autoradiography, Homogenizers, Autoanalyzers for Biochemical Analysis and Hematological Indices.

UNIT V
Methods of Cryopreservation (the use of Deep Freezers and Liquid Nitrogen); Lyophilization.

REFERENCES:

TEXT BOOKS:

1. **Analytical Biochemistry-** P. Ashokan (2001) Chinna Publications.]
2. **Essentials of Immunology**. Ivan Roit (1988), 6th edition, Blackwell Scientific Publications, Oxford.
3. **Gene Biotechnology** (1997), Jogdand, Himalaya Publishing House, Mumbai

REFERENCE BOOKS:

1. **A Biologist guide to principles and Techniques of practical Biochemistry.**-Keith Wilsin, Kenneth H.Goulding, 3rd (1992). Cambridge University Press.
2. **Instrumental methods of chemical analysis** -Sharma.B.K., 11th edition (1981), Blackwell Publications.

Semester VI

COURSE: B.Sc., Biotechnology

SUBJECT TITLE: Core paper XI: RECOMBINANT DNA TECHNOLOGY- II

NUMBER OF HOURS/WEEK: **4 Hrs**

SUBJECT DESCRIPTION
This course presents the principles and applications of recombinant DNA Technology explaining the molecular techniques, cloning strategies and applications of Genetic Engineering.

GOALS
To enable the students to learn the various molecular biology techniques, principles and applications of recombinant DNA Technology.

OBJECTIVES
On successful completion of the course the students will be aware of

I) The guidelines for Genetic Engineering research which involves all the molecular Biology techniques.
II) Cloning strategies
III) Application of recombinant DNA Technology.

CONTENTS:

UNIT I
DNA Synthesis and Sequencing: Chemical synthesis of oligonucleotides, cDNA synthesis, DNA Sequencing.
DNA Libraries: Construction of Genomic and cDNA libraries. Types and methods of gene probe generation, methods for labeling gene probes, nucleic acid hybridization.

UNIT II
Analysis of gene structure and gene function. Ligase chain reaction, Q- β replicase system, Site Directed Mutagenesis. Gene mapping techniques

UNIT III
Strategies for identifying desirable recombinant clones, genetically modified microorganisms, genetically engineered plants and genetically engineered animals.

UNIT IV
Cloning and expression of commercially useful proteins in bacteria, yeasts, plants and animals. Molecular techniques in prenatal diagnosis, DNA based detection of Microbial infection, rDNA methods in vaccine development, drug development using rDNA approaches, genetic engineering of recombinant antibodies.

UNIT V
DNA Fingerprinting, Gene therapy, Molecular diagnosis and therapy of cancer, Human Genome Project, Ethical issues involving rDNA technology.

REFERENCES

TEXT BOOKS:

1. **Introduction to gene cloning**- 3rd Ed, (1998), Brown T.A, Stanley Thomas Pub ltd, Germany.
2. **Principles of gene manipulation** -6th Ed, (2003), Primrose S.B, Black well Sci ltd, Germany.
3. **Gene Biotechnology** (1997), Jogdand, Himalaya Publishing House, Mumbai.
4. **Genetic Engineering** (1996), Mitra, S. MacMillan India Ltd., New Delhi.

REFERENCE BOOKS:

1. **From genes to clones**- 2nd edition (2003), Ernst.L.Winnacker, Panima publishing Corporation, New Delhi.
2. **Genes VIII,** Benjamin Lewin (2004), Pearson Education Corporation, New Jersy
3. **Molecular biology of the cell** (1994), Alberts B, Garland publishing Inc New York
4. **Molecular biology** -II Ed, (1987) Friefielder. D, Narosa publishing house, New Delhi.
5. **Recombinant DNA technology**-2nd Ed, (2001), J.d.Watson, WH Freeman and Company, New York
6. **Molecular biotechnology** (1996), Glick and Pasternak, Panima Publishing Corporation, New Delhi.
7. **Molecular Cloning: a Laboratory manual** (2000), Sambrook, J., Fritsch, E.F., and Maniatis, T., Cold Spring Harbor Laboratory Press, New York.
8. **Route maps in Gene Technology** (1997), Walker, M.R.and Rapley, R., Blackwell Science Ltd, Oxford.

Semester VI

COURSE: B.Sc., Biotechnology

SUBJECT TITLE: Core Paper X: BIOINFORMATICS

NUMBER OF HOURS/WEEK: **4 Hrs**

SUBJECT DESCRIPTION:

This paper presents the basics of Bioinformatics, Concepts applied to Structural and functional analysis of genomes and proteomes and Drug discovery**.**

GOALS:
This paper is introduced to impart advanced training to the students with graduate qualification in Biotechnology to carry out characterization of genomes and proteomes leading to the design and development of novel drugs.

OBJECTIVES:
On successful completion of the course the students should have:

1. Understood the Basics of Genomes and Proteomes.
2. Learnt the concepts of structural and functional analysis of Genomes, Proteomes and Transcriptomes.

CONTENTS:

UNIT I:
An Over view of Bioinformatics: Scope, Bioinformatics and internet, useful bioinformatics sites on WWW. Databases- Contents, Structure, annotation. Types of biological databases, information retrieval from biological databases. Classification of biological databases, Introduction to Genomes, Transcriptomes and Proteomes.

UNIT II:
Data acquisition in Genomics: Genome sequencing, Genome mapping- overview of physical mapping, EST and STS, Shotgun sequencing and sequence assembly, Human Genome Project, Methods of gene family identification.
Data acquisition in proteomics: Structure based protein classification, X-ray crystallography, Proteome analysis- 2D PAGE Analysis, LCMS (MALDI-TOF), Protein chips and Microarrays.

UNIT III:
Retrival of Biological data: ENTREZ, DBGET, SRS. Searching sequence databases using FASTA and BLAST, Sequence filters, searches using PSI Blast. Multiple Sequence alignment: Gene and protein families.

UNIT IV:
Phylogenetics: Phylogenetics, Cladistics and Ontology, Building Phylogenetic trees.
Sequence Annotation- Genome annotation, Annotation tools and resources.

Structural Bioinformatics: Obtaining, viewing and analyzing structural data, structural alignment, CATH and SCOP, structure prediction by comparative modeling, secondary structure prediction.

UNIT V:

Applications of Bioinformatics:

Pharmaceutical industry - Drug discovery, Pharmainformatics, cheminformatics- Representing molecules and resources.

Proteome analysis- 2D gel analysis, MASS spectromentry.

Genome analysis- Microarray data analysis, SAGE.

REFERENCES:

TEXT BOOKS:

1. **Instant Notes Bioinformatics** - D.R. Westhead, J.H. Parish and R.M. Twyman (2002)
2. **Introduction to Bioinformatics**-Attwood. T. K. and Parry Smith. D.J. (2004), Pearson
3. **Proteomics** – Pennington & Dunn (2002).Viva Books Pub. New Delhi.
4. **Genomes 3**, - T.A.Brown (2002) Garland Science, Taylor & Francis Group, NY & London.
5. **Principles of genome analysis and genomics** - S.B. Primrose and Twyman. (2003) Third Edition, Blackwell Publishing.

REFERENCE BOOKS:

1. **Essential Bioinformatics -** Jin Xiong (2006), Cambridge University Press.
2. **Bioinformatics Sequence and genome Analysis** – David W. Mount, (2005) Second Edition, CBS Publishers & Distributors.
3. **Bioinformatics: a practical guide to the analysis of genes and proteins -** Andrew D.Baxevanis, B.F.Francis Ouellette. Second edition.(2002), John Wiley and Sons, inc.

Semester VI

COURSE: B.Sc., Biotechnology

SUBJECT TITLE: CORE PRACTICAL III - MOLECULAR BIOLOGY, PLANT TISSUE CULTURE AND ANIMAL CELL CULTURE.

NUMBER OF HOURS/WEEK: 4 Hrs

Refer Semester V

Semester VI

COURSE: B.Sc., Biotechnology

SUBJECT TITLE: CORE PRACTICAL IV- RECOMBINANT DNA TECHNOLOGY, MICROBIAL BIOTECHNOLOGY AND BIOPROCESS TECHNOLOGY.

NUMBER OF HOURS/WEEK: 4 Hrs

Refer Semester V

Semester VI

COURSE: B.Sc. Biotechnology

SUBJECT TITLE: ELECTIVE PAPER II: NANOBIOTECHNOLOGY

NUMBER OF HOURS/WEEK: **4 Hrs**

SUBJECT DESCRIPTION

This paper presents the basics of biochemistry and molecular biology of bionano compounds and molecules, methods of isolation and characterization of Bionanos as applied to Drug designing, Drug discovery, Molecular modeling, Molecular docking, High throughput screening, Microarray analysis and Nanotechnology .

GOALS

This paper is introduced to impart advanced training to the students with post graduate qualification in Biotechnology to understand the new concept of Nanotechnology applied to the area of Biotechnology and to acquire requisite skills for the design and development of High throughput screening and assay methods leading to the novel drug discovery and designing.

OBJECTIVES

On successful completion of the course the students will be aware of:

1. The basics of characterization of bionano compounds and molecules.
2. The concepts of Drug development.
3. The modern trends in Nano level application of biochemical and biomedical sciences.

CONTENTS:

UNIT I:

Introduction to Nanobiotechnology & nanoscale materials, Overview of nanodevices and techniques, Synthesis and characterizations of Nanoscale, Using biology to make nanostructures, Preparation techniques for Nanobiotechnology, Nanofluidics: surfactants, polymers, emulsions and colloids.

UNIT II:

Functional Principles of Nanobiotechnology- Information Driven nanoassembly, energetics, chemical transformation, regulation, traffic across membranes and biomolecular sensing.

UNIT III:

Inorganic Nanoscale systems for biosystems, characteristics and applications of carbon nanotubes, Quantum Dots, Gold Nanoparticles, Nanopores. DNA based artificial nanostructure and Proteins as components in nanodevices.

UNIT IV:

Nanobiotechnology in drug Delivery, Nanoscale Devices and micelles for Drug Discovery , Protein targeting: Small Molecule-Protein Interactions, Micro-array and Genome Chips. Nanoparticle synthesis in plants, bacteria, and yeast.

UNIT V:

Nanoscale applications**:** nanobiocrystallography, nanomechanics, nanooptics, nanotechnology for cancer diagnostics and treatment of cancer biology, nanotechnology for imaging and detection, environmental and safety aspects of nanobiotechnology.

REFERENCES:

TEXT BOOKS:

1. **Bionanotechnology - Lessons from Nature**- David S.Goodsell, (2004.) Wiley-Liss Publications, New Jersey, 2004.
2. **Bionanotechnology**- Elisabeth S. Papazoglou & Aravind Parthasarathy, (2007) Morgan & Claypool Publishers.

REFERENCE BOOKS:

1. **Bionanotechnology - Proteins to Nano Devices-** edited by V.Renugopalakrishnan and Randolph V.Lewis, Springer press.
2. **Protein Nanotechnology-Protocols, Instrumentation and applications** edited by Tuan Vo-Dinh, Humana Press.
3. **Hand Book of Nanotechnology** edited by Bhushan – Chapter No: 24, Mechanics of Biological Nanotechnology, Springer publications.
4. **Nanomaterials for Cancer Diagnosis & Therapy**- Challa Kumar, Vol 6,(2007), LEYVCH, edition.

Semester VI

COURSE: B.Sc., Biotechnology

SUBJECT TITLE: ELECTIVE PAPER III: PHARMACEUTICAL BIOTECHNOLOGY

NUMBER OF HOURS/WEEK: **4 Hrs**

SUBJECT DESCRIPTION:
This course presents the Basic concepts of Biopharmaceuticals.

GOAL:
The information gained will help the students to serve in pharma industries.

OBJECTIVE:
To enable the students to know the biopharmaceuticals and drug discovery.

CONTENTS:

UNIT I:
Introduction to Biopharmaceuticals and pharmaceutical biotechnology, History of the pharmaceutical industry, the age of biopharmaceuticals, Biopharmaceuticals: current status and future prospects.

UNIT II:
Pharmaceutical substances of microbial origin: Antibiotics (penicillin, streptomycin, tetracycline, Peptides), vitamins, probiotics, therapeutic proteins- Insulin, Human Growth Hormone, Tissue Plasminogen Activator, Interleukin.

UNIT III:
Pharmaceutical substances of plant origin: Drugs derived from plants, natural resources of medicine, antitumor agent - Colchicine, Taxol, Vinblastine, Vincristine. Cardiotonic – Convallatoxin, Acetyldigoxin, Antiinflammatory – Aescin, Bromelain, Local anaesthetic – Cocaine, Choleretic – Curcumin, Cynarin, Topical antifungal –Thymol, Antihypertensive, tranquilizer – Rescinnamine, Reserpine.

UNIT IV:
Pharmaceuticals of animal origin: The sex hormones- Androgens, Oestrogens ,Progesterone and progestogens , Corticosteroids , Catecholamines, Prostaglandins, Monoclonal antibody OKT3, Vaccines(conventional & modern vaccine), Transgenic animals in production of therapeutic Tissue culture production of alkaloids, flavanoids, steroids, terpenoids; animal vaccines and proteins.

UNIT V:
Downstream processing-filtration, centrifugation, precipitation, chromatography, drying-freeze drying, crystallization, Good manufacturing practices, biosafety levels for handling RG1, RG2, RG3, RG4 groups of microbes, plants, animals and total quality management.

REFERENCES:

TEXT BOOKS:

1. **Pharmaceutical Biotechnology**. Daan JA Crommelin, RD Sindelar (1997)Harwood Acad Pub.
2. **Biopharmaceuticals: Biochemistry and biotechnology-** Gary Walsh, 2nd Ed, (2003), John Wiley & Sons Ltd, England.

REFERENCE BOOKS:

1. **Pharmacology and Pharmacotherapeutics -** Satoskar, R.S.,Bhandarkar, S.D.and S.S. Ainapure. 14th Ed. (1995). Popular Prakashan Bombay.
2. **Principles of medicinal chemistry-** William Foye (Ed) 3rd Ed. (1986).
3. **An Introduction to medicinal chemistry** -Patrick.L.Graham (1995). Oxford Univ Press
4. **T.B.of clinical pharmacology and drug Therapy-**Grahame, D.G.,Smith and Aronson, J.K.Oxford
5. **Text book of Biochemistry** -West. S.E, Todd.R.W , Mason S.R and Bruggen T .J Fourth edition (1974) Oxford University press.
6. **Color Atlas of Pharmacology** -Luellmann, Thieme Press, (2005).
7. **Lippincotts Illustrated Reviews: Pharmacology** - Mary J. Mycek, Richard A. Harvey and Pamela C. Champe
8. **Drug discovery and development**-edited by Mukund S. Chorghade, (2006), John Wiley & Sons, Inc.
9. **Drug discovery handbook** - edited by Shayne Gad, (2005), John Wiley & Sons, Inc.

Semester VI

SUBJECT TITLE:

SKILL BASED SUBJECT IV: BIOINSTRUMENTATION PRACTICALS

NUMBER OF HOURS/WEEK: 3 Hrs

SUBJECT DESCRIPTION:
This course presents the Basic concepts of Bioinstrumentation.

GOALS:
To make the student to understand the technical aspects of bioinstruments.

OBJECTIVES:
On successful completion the student should have understood the fundamentals of Bioinstrumentation.

Experiments:

1. Demonstration of Fluorescence Microscope
2. Density Gradient Centrifugation and Differential Centrifugation
3. Flame Photometry
4. Absorption Spectra of chlorophyll
5. Agarose Gel Electrophoresis
6. Non-Denaturing and Denaturing PAGE
7. Western Blotting
8. Southern Blotting
9. Operation of Benchtop fermentor
10. Chromatography techniques: Ion exchange chromatography.

REFERENCES:

TEXT BOOKS:

1. **Biochemical Methods** – Sadasivam, S.and Manickam, A. Second Edition (2006), New age International (P) Ltd, Publishers, New Delhi.
2. **Molecular Cloning, A Laboratory Manual** - Sambrook and Russell. 3rd Edition (2001), Volume I. Cold Spring Harbor Laboratory Press, New York
3. **An introduction to practical Biochemistry -** David T. Plummer, 3rd Edition (1989), University Press
4. **Analytical Biochemistry** - P. Asokhan (2001), Chinna Publications

REFERENCE BOOKS:

1. **A Biologist guide to principles and Techniques of practical Biochemistry-** Keith Wilson, Kenneth H.Goulding, 3rd (1992). Cambridge University Press.
2. **Instrumental methods of chemical analysis** -Sharma.B.K 11th edition (1981), Blackwell Publications.