GURU NANAK COLLEGE (AUTONOMOUS)

(Affiliated to University of Madras and Re-Accredited at 'A' Grade by NAAC)

Guru Nanak Salai, Velachery, Chennai – 600042.

B.Sc. Biotechnology

(SEMESTER PATTERN WITH CHOICE BASED CREDIT SYSTEM)

Syllabus

(For the candidates admitted in the Academic year 2018-19 and thereafter)

Vision

To enable the students to be ready to fill the talent gaps in the field of Biotechnology particularly in the lateral emerging areas of Biotechnology.

Mission

- To attain the center of excellence in the environment and product resource sustainability.
- To develop special skill set programmes which prepare the students readily employable and sustain the industrial challenges.

Programme Outcomes

PO 1: Dissipate knowledge of fundamental conceptual approach in the fields of Biotechnology.

PO 2: Familiarize the mechanisms involved in the specific fields of Biotechnology.

PO 3: Opportunities and challenges discussions pertaining to the field of Biotechnology.

PO 4: Analysis and apply the new cut edge technologies in the field of Biotechnology.

PO 5: Demonstration of sustainable development through the skills acquired through Biotechnology.

Programme Specific Outcomes

PSO 1: Critical knowledge and analytical skills will be acquiring to be readily placed in various jobroles in industry.

PSO2: Professional status attainment in the core fields like Fermentation technology, Health care industries: therapeutic agent development like Vaccine production and formulation nutraceutical productdevelopment and formulations, diagnostic kit development, Food industry, and also in the lateral fields like as Patent officers, Biostatisticians, *In-silico* fields like bioelectronics, bioinformatics, in the field of environmental sustainability, Bioentrepreneurs to support the biobased industries, Science communicators which are the need of the hour in today's world.

B.Sc. Biotechnology

Academic Year: 2018-2019 batch

Semester	Part	Course Component	Subject Code	Subject Name	Credit	Hours	CIA	ESE	Total
Semester- I	I	Language	17UTAMF01/ 16UHINF01	Tamil-I/Hindi-I/ French- I / Sanskrit-I	3	6	50	50	100
	II	English	16UENGF41	English-I	3	4	50	50	100
	III	Core-I	17UBTKC01	Cell Biology	4	6	50	50	100
	III	Core-II	17UBTKC02P	Practical I-Cell and Molecular Developmental Biology	-	2	*	*	*
	III	Core-III	17UBTKA02P	Microbiology Practical	-	2	*	*	*
	III	Allied-I	17UBTKA01	Microbiology-I	3	6	50	50	100
	IV	1. NME/ Basic Tamil	17UNME01D/ 16UBAT401	Laboratory Quality System	2	2	-	100	100
	IV	**2.** Skill based subjects	16UGSLS01	Soft skill I	3	2	-	100	100
Total Credit: 18 / Total Hours per week: 30									
Semester- II	**I**	Language	17UTAMF02/ 16UHINF02/	Tamil-II/Hindi-II/ French-II/ Sanskrit-II	3	6	50	50	100
	II	English	16UENGF42	English II	3	4	50	50	100
	III	Core-IV	17UBTKC03	Molecular Developmental Biology	4	6	50	50	100
	III	Core-II	17UBTKC02P	Practical I – Cell and Molecular Developmental Biology	4	2	50	50	100
	III	Core-III	17UBTKA01	Practical II : Microbiology	4	2	50	50	100
	III	Allied-II	17UBTKA03	Microbiology II	3	6	50	50	100
	IV	1. NME/ Basic Tamil	17UNME02D/ 16UBTA402/ 16UADT402	Laboratory Instrumentation	2	2	---	100	100
	IV	2. Skill based subjects	16UGSLS02	Soft skill II	3	2	---	100	100
Total Credit: 26 / Total Hours per week: 30									
Semester- III	**I**	Language	16UTAMF03/ 16UHINF03/	Tamil-III/Hindi-III/ French-III/ Sanskrit-III	3	6	50	50	100
	II	English	16UENGF43	English III	3	4	50	50	100
	III	Core-V	17UBTKC04	Genetics	4	6	50	50	100
	III	Core-VI	17UBTKC05P	Practical III – Genetics and Plant Biotechnology	-	2	*	*	*
	III	Core-VII	18UBTKA05P	Practical IV– Biochemistry	-	2	*	*	*
		Core-VIII	18UBTKA04	Biochemistry	4	6	50	50	100
	IV	1. Skill based subjects	16UGSLS03	Soft skill III	3	2	---	100	100
	IV	2. EVS	16UVES401	Environmental science	---	2	*	*	*
Total Credit: 17 / Total Hours per week: 30									

Semester	Part	Course Component	Subject Code	Subject Name	Credit	Hours	CIA	ESE	Total
Semester- IV	I	Language	16UTAMF04 /16UHINF04/	Tamil IV	3	6	50	50	100
	II	English	16UENGF44	English IV	3	4	50	50	100
	III	Core-VIII	17UBTKC06	Plant Biotechnology	4	6	50	50	100
	III	Core-VI	17UBTKC05P	Practical III – Genetics and Plant Biotechnology	4	2	50	50	100
	III	Core-VII	18UBTKA05P	Practical-IV Biochemistry	4	2	50	50	100
	III	Allied-IV	17UBTKA06	Biochemistry II	3	6	50	50	100
	IV	1..Skill based subjects	16UGSLS04	Soft skill III	3	2	-	100	100
	IV	2. EVS	16UVES401	Environmental Studies	2	2	-	100	100
Total Credit: 26 / Total Hours per week: 30									
Semester- V	III	Core -IX	17UBTKC07	Animal and Medical Biotechnology	4	4	50	50	100
	III	Core- X	17UBTKC08	Bioinformatics	4	4	50	50	100
	III	Core - XI	17UBTKC09	Immunology	4	4	50	50	100
	III	Core XII	17UBTKC10	Biostatistics and Computer Applications for Life Sciences	4	4	50	50	100
	III	Core XIII	17UBTKC11P	Practical III - Animal, Medical Biotechnology and Immunology	-	4	50	50	100
	III	Core XIV	17UBTKC12P	Practical IV - Genetic engineering and Bioprocess Technology	-	4	*	*	*
	III	Elective – I	17UBTKE01	Pharmaceutical Biotechnology	5	5	50	50	100
	IV	Value Education	16UVED401	Value education	2	1	*	100	100
Total Credit: 23 / Total Hours per week: 30									
Semester- VI	III	Core XI	17UBTKC13	Genetic Engineering	5	6	50	50	100
	III	Core XII	17UBTKC14	Bioprocess technology	5	5	50	50	100
	III	Core XIII	17UBTKC15	Biotechnology and Nanotechnology	5	5	50	50	100
	III	Core XV	17UBTKC12P	Practical-IV Genetic Engineering and Bioprocess technology	4	4	50	50	100
	III	Elective II	17UBTKE02	Microbial Biotechnology	5	5	50	50	100
	III	Elective III	17UBTKE03	Environmental Biotechnology	5	5	50	50	100
	IV	Extension Activities		Extension Activities	1	--	-	-	-
Total Credit:30 / Total Hours per week: 30									
Grand Total Credit: 140 / Total Hours per week: 180									

GURU NANAK COLLEGE (AUTONOMOUS), CHENNAI – 600 042
(Effective for the batch of candidates admitted in 2018 – 19 only)

Core Paper: CELL BIOLOGY

Subject Code:17UBTKC01	**Theory**	**Marks: 100**
Semester: I	**Credits:** 4	**Total Hours:** 60

COURSE OBJECTIVES:

- To explain various levels of organization .in multicellular organisms
- To sketch the structural design of various types of cells and their organelles
- To demonstrate the active and passive cell membrane transport mechanisms
- To emphasize the importance of structure, properties and functions of biomolecules
- To discuss the significance of cellular processes like cell regulation, cell division, cell communication etc.

UNIT-I **(12 hrs.)**

Organization of living organisms–Unicellular to higher organisms– organs– tissues– cells.

UNITII **(12 hrs.)**

Cell: The dynamic cell– the molecules of life- the architecture and types of cells-differentiation of cells into tissues. Molecular aspects of cell division and cell cycle-cellular energetic -cell motility-cell-to-cell signaling- hormones and receptors.

UNIT-III **(12 hrs.)**

Biomembranes, transport across cell membranes- subcellular organization of eukaryotic cells-microscopy and cell architecture.

UNIT-IV **(12 hrs.)**

Genetic code and the synthesis of macromolecules: structure of nucleic acids- nucleic acid synthesis- DNA replication- repair- recombination- protein secretion and sorting, folding, modification and degradation of proteins.

UNIT–V **(12 hrs.)**

Molecular structure of genes and chromosomes: Regulation of transcription in bacteria and eukaryotic cell. RNA processing and post-transcriptional control - Regulation of gene expression. Hormones, viruses and gene expression; Nuclear- Cytoplasmic interaction.

Recommended Texts:

1. Cooper, G.M. 2000.The Cell- A molecularapproach,II Edn.,A.S.M. Press,WashingtonDC.
2. Lodish, H., Berk, A., Zipursky, S.L., Matusudaria, P., Baltimore, D. and Darnell,

J.,2000.Molecular Cell Biology, Media Connected, W.H. Freeman and Company,NewYork.

Reference Books:

1. Brown,T.A2001.Gene Cloning&DNAanalysis.BlackwellScience,London.
2. Benjamin Lewis,2000.GenesVII. OxfordUniversityPress,London.

WebSites:

1.http://www.spc.cc.tx.us/biology/bio_links1.htm

END SEMESTER EXAMINATION QUESTION PAPER PATTERN FOR THEORY PAPERS

QUESTION PAPER PATTERN:

Section	Numbers	Question Component	Marks	Total
Section A	**Question 1–12**	**Definition** Answer **ANY 10** out of **12** questions	2	**20**
Section B	**Question 13–19**	**Short Answer** Answer **ANY 5** out of **7** questions	8	**40**
Section C	**Question 20–25**	**Detailed Answer** Answer **ANY 2** out of **4** questions	20	**40**
TOTAL MARKS				**100**

ISTRIBUTION OF QUESTIONS:

Sections	Units	No. of Questions
Section A	Unit – 1	2
	Unit – 2	2
	Unit – 3	2
	Unit – 4	3
	Unit – 5	3
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	Unit – 3	1
	Unit – 4	2
	Unit – 5	2
Section C	Unit – 1	1
	Unit – 2	1
	Unit – 3	1
	Unit – 4	1
	Unit – 5	2

Core Paper-II
Practical- Cell Biology and Molecular Developmental Biology

Subject Code:17UBTKC02P	**Practical**	**Marks: 100**
Semester: I	**Credits:** 4	**Total Hours:** 30

COURSE OBJECTIVES:

- To apply the use of microscopes in study of cells
- To enumerate cells and to interpret the results with normal and diseased conditions
- To demonstrate the processes of cell division

A. Cell Biology: Microscopy- RBC and WBC counting- Enumeration of WBC- Differential leukocyte Count - Salivary gland preparation from Chironomous larva- Mitosis preparation from onion root tip and meiosis preparation from grasshopper testis- Enumeration of prokaryotic cell- Buccal smear preparation- Cell fractionation (nucleus, mitochondria- Demonstration).

B. Molecular Developmental Biology: Observation of living gametes (Grasshopper / Frogs). Induction of ovulation and early fertilization in Bull frog - observation of development stages- gastrulation and organogenesis.- Observation of living chick embryos- cleavage and gastrulation- Wound healing- cell aggregation in frog embryos- hormones in amphibian metamorphosis

Core Practical-III
Microbiology

Subject Code:17UBTKA02P	**Theory**	**Marks: 100**
Semester: I	**Credits:** 4	**Total Hours:** 30

COURSE OBJECTIVES:

- To classify microbes and to relate the subcellular structures of microbes.
- To interpert the various microbes.
- To illustrate the application of the sterilisation process.
- To recognise the motile microbes
- To explain the role of microbes in different habitats.

SEMESTER-I

1. Microbiology lab set-up: overview, Sterilization techniques (Fumigation, Autoclave, Hot air oven, Membrane sterilization unit), Laboratory ethics
2. Staining techniques: Simple stain: Methylene blue staining, Differential stain: Gram's Staining, Special staining (Spore staining and Capsular staining)
3. Examination of bacterial motility by Hanging drop technique
4. Study of photomicrographs of different bacteria, viruses and fungus:

- **Bacteria:**

➢ **Gram positive bacteria:**

❖ *Bacillus anthrax, Bacillus subtilis, Staphylococcus aureus, Streptococcus pyogens, Streptococcus pneumonia, Clostridium, Corynebacterium spp. Mycobacterium tuberculae, Streptomyces spp.*

➢ **Gram negative bacteria:**

❖ *E.coli, V. cholera, Salmonella typhi, Shigella spp., Proteus vulgaris, Neisseria gonorrhoeae, Pseudomonas spp. Azotobacteria, Xanthomonas*

❖ **Viruses:** HIV, Hepatitis A+B, Polio virus, pox virus, Arbo virus, Adeno virus

❖ **Fungi:** *Aspergillus* spp., *Penicillium*spp., *Fusarium* spp., *Basdiomyces*spp.

5. Identification of organisms that spoil the following: Citrus fruits, grapes, Emblica, coconut kernel, milk products, jam products (*Fusarium* spp., *Aspergillus* spp., Yeast cells, *Mucor*spp., *Rhizopus stolonifera, Penicillum spp.*,)
6. Pond water examination (*Volvox, Chlorella, Paramecium, Oscillatoria, Entamoeba, Euglena*)
7. Culture preparation in liquid medium- nutrient broth
8. Culture preparation in solid medium- nutrient agar (Spread plate- Quadrant streak, lawn culture, pour plate, Zig-zag streak)

9.Examination of colony morphology of selected Bacteria upon selective media (*Staphylococcus aureus* - Mannitol salt agar, *Streptococcus* spp. - Blood agar, *E.coli* - EMB agar, *Vibrio* spp. - TCBS, *Pseudomonas* spp. - King's medium, *Azotobacter*spp. - YEMA medium)

Demo:

- Sterilization techniques
- Preparation of pure culture from mixed culture
- Bacterial growth curve generation

SEMESTER – II

1. Isolation, biochemical characterization and identification of *E.coli*
2. Isolation of bacteria from soil (*Rhizobium* spp., *Agrobacterium* spp.) using YEMA medium
3. Isolation of *Streptomyces* and confirmation of lipase production
4. Isolation of bacteria from curd - *Lactococcus*spp., *Lactobacilli* spp.,
5. Isolation of Phosphate solubilizing bacteria from soil sample
6. Isolation of siderophore producing bacteria from soil sample and IAA detection
7. Air quality check: Open plate technique and colony count
8. Water quality check : MPN test

Demo:

- Antibiotic sensitivity test

REFERENCE BOOKS:

1. Ananthanarayanan, R. and Panicker, J. 1986. Text Book of Microbiology. Orient Longmans.
2. Boyd, R.F. 1988. General Microbiology. Times Mirror/Mosby College publishers.
3. Burrows., W. 1978. Text book of Microbiology. W.B. Saunders.
4. Carpenter. P.L. 1990. Microbiology. W.B. Saunders.
5. Frazier, W.C. 1978. Food Microbiology. McGraw Hill.
6. Frobisher, M. 1974. Fundamentals of Microbiology. W.B. Saunders.
7. Jay J.M. 1970. Modern Food Microbiology. Van Nostrand.
8. Ketchum P.A. 1988. Microbiology John Wilcy& Sons.
9. Lakshmanan, M. *et.al.*,1971.Laboratory Experiments in Microbiology and Molecular Biology. Higgin Bothams (Private) Ltd.
10. Pelczar and Reid. 1986. Microbiology. Tata McGraw Hill.
11. Purohit S.S. 1991. Microbiology. Agro Botanical Publishers (India)
12. Salle, A.J. 1986.Fundamental Principles of Bacteriology. Tata McGraw Hill.
13. 1964.Bacterial flora of milk and milk products in India. ICAR Publishers.

Allied Paper–I: Microbiology I

Subject Code:17UBTKA01	Theory	Marks: 100
Semester: I	Credits: 3	Total Hours: 30

COURSE OBJECTIVES:

- To identify the evolution of microbes and their classification.
- To demonstrate the presence of microbes in various habitats.
- To identify and interpret the different sterilisation techniques.
- To relate the importance of microbes in the field of agriculture and plant growth.
- To evaluate the role of microbes in the aquatic system.

Unit I **(12 hrs.)**

Evolution of Microbiology .Classification of microorganisms.

Unit II **(12 hrs.)**

Structural characteristics of Bacteria. Actinomycetes, Mycoplasma and viruses. Structural characteristics of micro algae (Oscillatoria, Volvox and Chlorella), fungi (molds and yeasts) and Protozoa Entamoeba, Plasmodium and Euglena)

Unit III: **(12 hrs.)**

Basic microbiological techniques: Cleaning of glassware. Sterilization of glassware and media. Streak plate, spread plate, and pour plate enrichment culture, single spore isolation, serial dilution, standard plate count. Lyophilization. Types of culture media. Staining techniques –simple and differential.

Unit IV **(12 hrs.)**

Microbiology of Soil. Microbes in soil, rhizophers and rhizoplane. Nitrogen-fixing, nitrifying and denitrifying bacteria. Sulphur bacteria. Biofertilizers.

Unit V **(12 hrs.)**

Microbiology of water. Potable water. Municipal water purification. Sewage disposal and treatment-Physical and biological. Measurement of microbial growth (turbidity, biomass, cellcount, pigments).

RECOMMENDED TEXTS:

- Pelczar, M.J., Chan, E.C.S., King, N.R.,2001.Microbiology- Concepts and Applications. Tata McGraw – Hill, New Delhi.

- Ananthanarayan, R. and Paniker, C.K.J. 2000. A text book of Microbiology. 6th edition. Orient Longman Ltd., Hyderabad.
- Pelczar. 2000. Microbiology. 5th edition. Tata McGraw Hill., New Delhi.
- Ingraham, J.L., and Ingraham, C.A. 2000.Introduction to microbiology, 2nd edition. Brooks/Cole, Thomson Learning, USA.

REFERENCE BOOKS :

- Kathleen Park Talaro and Talaro, A. 1999. Foundation in Microbiology, 3rd edition, McGraw-Hill, New York.
- Cappuccino, J.G and Sharman, N. 1999. Microbiology: A Laboratory manual, 4th edition. Addition Wesley Longman Inc., New York.
- Daniel Lim. 1998. Microbiology, 2nd edition. McGraw-Hill, New York.

WEBSITE :

http://science.nhmccd.edu/biol/microbio.html

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	Unit – 3	2
	Unit – 4	3
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	Unit – 2	1
	Unit – 3	1
	Unit – 4	2
	Unit – 5	2
Section C	Unit – 1	1
	Unit – 2	1
	Unit – 3	1
	Unit – 4	1
	Unit – 5	2

Non Major Elective-I: LABORATORY QUALITY SYSTEM

Subject Code:17UNME01D	Theory	Marks: 100
Semester: I	Credits: 2	Total Hours: 30

COURSE OBJECTIVES:

- To explain the various aspects of lab organisation and safety rules
- To describe the role the of CPCSEA in animal experiments
- To calculate the unit wise measurements in reagent preparation
- To explain the better ways of reagents storage
- To identify the different types waste disposal

UNIT- I **(6 hrs.)**

Organization of the lab – lab routines – safety rules.

UNIT- II **(6 hrs.)**

CPCSEA and ethics in animal experiments. Maintenance of data book – data presentation.

UNIT- III **(6 hrs.)**

Making reagents and buffers – normality, molarity calculations.

UNIT- IV **(6 hrs.)**

Weighing and mixing reagents. pH adjustments. Sterilization. Storing reagents.

UNIT- V **(6 hrs.)**

Laboratory waste disposal – hazardous and non- hazardous.

REFERENCE BOOK:

K. Barker, "At the bench: A laboratory navigator". I. K. International Pvt. Ltd., New Delhi, 1998.

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	Unit – 3	1
	Unit – 4	2
	Unit – 5	2
Section C	Unit – 1	1
	Unit – 2	1
	Unit – 3	1
	Unit – 4	1
	Unit – 5	2

CORE PAPER-IV

MOLECULAR DEVELOPMENTAL BIOLOGY

Subject Code:18UBTKC03	**Theory**	**Marks: 100**
Semester: I	Credits: 4	Total Hours: 60

COURSE OBJECTIVES:

- To explain the cell viability processes
- To identify the role of laboratory animals and the role of genes involved in development and evolution.
- To illustrate development of muscle and nervous systems.
- To explain the role of specific genes in development during embryogenesis.

UNIT- I **(12hrs.)**

Cellular regulation–cell cycle (Overview, mechanism involved, control- role of check point proteins); Cell signaling pathways (GPCR pathway, Tyrosine Kinase pathway-JAK– STAT, Serine threonine pathway with TNF-alpha, Notch delta pathway)and differentiation (Epithelial cell to mesenchymal cells during the development and Ectodermal cells to Skin cells and Neural cells).

UNIT-II **(12 hrs.)**

Transcription (Eukaryotic mechanism-Overview), expression (Eukaryotic gene expression control mechanism) and regulation in eukaryotic development with slime mould and *C.elegans*as model systems

UNIT-III **(12 hrs.)**

Myogenesis in mammals (Overview only)- growth factors: Mitogens and Oncogenes (Role in developmental biology only overview).

UNIT-IV **(12 hrs.)**

Neurogenesis in Drosophila (Neurulation and Neurogenes is mechanism) and Mice (Neurogenesis only the overview)- Regional specification in Drosophila

UNIT-V **(12 hrs.)**

Embryogenesis (Drosophila as the model animal) - Genes (Maternal effect genes, Zygotic genes, Homeotic genes) involved in the development (Explanation using Drosophila as themodel),Mammalian(MiceandHumans)homologsinDrosophilaANT-CandBC-X(overviewonly).

RECOMMENDED TEXTS:

1. Gilbert, S. 2000. Developmental Biology. Seventh edition. Sinaver Associates Inc. Publishers, MA. USA.
2. Tait, R.C. 1997. An Introduction to Molecular Biology, Horizon Scientific Press, England.

REFERENCE BOOKS:

1. Lodish, H., Berk, A., Zipursky, S.L., Matsudaria, P., Baltimore, D. and Darnell, J. 2000. Molecular Cell Biology. Media Connected. W.H. Freeman and Company, New York.
2. Freifelder, D. 1990. Essentials of molecular biology. Narosa Publishing House, New Delhi.
3. Watson, J.D., and Hopkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, A.M. 1988, Molecular biology of the gene. 4th edition. Benjamin and Cummings Publishing Company, Inc., California.

WEBSITE:

http://web.wi.mit.edu/sive/pub/generallinks.html

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	Unit – 3	2
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	Unit – 5	3
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	Unit – 2	1
	Unit – 3	1
	Unit – 4	2
	Unit – 5	2
Section C	Unit – 1	1
	Unit – 2	1
	Unit – 3	1
	Unit – 4	1
	Unit – 5	2

Allied Paper-II: MICROBIOLOGY-II

Subject Code:18UBTKA03	Theory	Marks: 100
Semester: II	Credits: 3	Total Hours: 60

COURSE OBJECTIVES:

- To conclude the microbes present in the atmosphere.
- To illustrate the microbial role in the food industry.
- To relate the role of microbes in the food industry.
- To correlate the suitable microbes with the specific product production.
- To relate the medical microbiology.

UNIT-I **(12 hrs.)**

Microbiology of air: Layers of Atmosphere, Microbes in atmosphere: types and their beneficial role, Air sampling methods, Air borne infections: Bacterial: Tuberculosis, Pneumonia, diphtheria; Viral: Influenza and Fungal: Histoplasma, *Aspergillus* spp.

UNIT-II **(12 hrs.)**

Food microbiology: Microbial spoilage of food, Microbes involved in food preservation (natural-pasteurization and chemical preservation), Microbes involved in food preparation: Alcoholic beverages-wine, Indian traditional food, Oriental food preparation (bread making, pickling and cheese).

UNIT-III **(12 hrs.)**

Microbiology of Milk: Microbes that causes milk spoilage, Milk quality test: Reductase test, Phosphatase test, Food quality testing (microbial load estimation), Application of pre and probiotics. Permissible limits of microbes in food: Fruits and vegetables, meat and fishes and prawn, Uncooked, semi-cooked and cooked packed food items (FDA and Indian standard guidelines).

Unit – IV **(12 hrs.)**

Industrial microbiology: Screening and selection of microbes with beneficial properties, Strain improvisation, Role of microbes in restoration of soil and water quality, SCP, Role of microbes in beer, oriental, continental food preparation, Microbes in the production of organic acids, antibiotics, medical and commercial enzymes.

Unit – V **(12 hrs.)**

- Microbes and diseases: Case study: Black Death, Cholera: 1849 (Britain) and 1961(Kolkata),Staphylococcus infection (MRSA strain), Pneumonia, Small pox, Polio virus,

HINI Infection, Ebola hemorrhagic, SARS virus, AIDS, Yellow virus. Dengue, Malaria, Hepatitis.

- Host parasite interaction
- Antibiotics and its mechanism

Recommended Books:

- Jacquelyn G.Black, "Microbiology -Principles and Explorations" Wiley publications 2008.
- VarunShastri, Microbes by Isha Books, Ist Ed., 2006.
- Microbiology Laboratory by V.R. Ramamurthy, Black Prints India Inc., Ist Ed., 2013.
- Handbook of Food Technology by NIIR, National Institute of Sciencepublication.
- Hans-Joachim Jördening, Josef Winter, "Environmental Biotechnology: Concepts and Applications", Wiley, 2006.
- Chandrawati Jee, Shagufta,"Environmental Biotechnology", APH Publishing, 2007.
- Environmental Toxicology and Biotechnology by S. K. Dubey& S. Ghose, Dominant Publishers & Distributors (P) Ltd., 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

FOR THEORY PAPERS

QUESTION PAPER PATTERN:

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Section A	**Question 1–12**	**Definition** Answer **ANY 10** out of **12** questions	2	**20**
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	Unit – 3	1
	Unit – 4	2
	Unit – 5	2
Section C	Unit – 1	1
	Unit – 2	1
	Unit – 3	1
	Unit – 4	1
	Unit – 5	2

NON MAJOR ELECTIVE-II

LABORATORY INSTRUMENTATION

Subject Code:17UNME02D	**Theory**	**Marks: 100**
Semester: II	**Credits**: 2	**Total Hours:** 30

COURSE OBJECTIVES:

- To describe the principles and use of the instruments used in Centrifugation.
- To describe the principle and working of Electrophoresis and its types
- To describe the principle and working of Blotting Techniques
- To explain the principle and working of Chromatography and its types
- To explain the various types and applications of spectrophotometer

UNIT- I **(6 hrs.)**

Centrifuges and centrifugation – rotor types, type of gradients- calculation of 'g' force.

UNIT- II **(6 hrs.)**

Electrophoresis - basic rules, types of electrophoresis – agarose, SDS-PAGE, iso electric focussing and 2-dimensional gel, PFGE, constant power supplies.

UNIT- III **(6 hrs.)**

Blotting Techniques: Southern blotting, Northern blotting and Western blotting.

UNIT- IV **(6 hrs.)**

Chromatography – types of Chromatography – Paper, TLC, Columns, GLC, HPLC.

UNIT- V **(6 hrs.)**

Spectroscopy – UV-visible spectrophotometry, Spectrofluorometers, Luminometers, ELISA readers.

REFERENCE BOOK:

Wilsen K and Walker J (1996) Practical Biochemistry: Principles and Techniques, 4th edition, Cambridge University press, London.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN
FOR THEORY PAPERS

QUESTION PAPER PATTERN:

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Section B	**Question 13–19**	**Short Answer** Answer **ANY 5** out of **7** questions	8	**40**
Section C	**Question 20–25**	**Detailed Answer** Answer **ANY 2** out of **4** questions	20	**40**
TOTAL MARKS				**100**

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	Unit – 2	1
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CORE PAPER-V: GENETICS

Subject Code:17UBTKC04	**Theory**	**Marks: 100**
Semester: III	**Credits:** 4	**Total Hours:** 60

COURSE OBJECTIVES:

- To discuss the concepts of classical genetics, mendelian experiments and organization of chromosome structures
- To explain the non mendelian concepts of genetics and to classify sex chromosomal disorders in humans
- To demonstrate the mechanisms of crossing over, genetic recombination and chromosome mapping techniques.
- To emphasize the history & discovery of DNA and its role in heredity.
- To classify the types of mutagens, effects of mutation and to connect the concepts of genetics with the principles of evolution.

UNIT – I **(12 hrs.)**

Classical Genetics – Mendelian laws, monohybrid and dihybrid inheritance.

Chromosome structure and organization in prokaryotes and eukaryotes.

UNIT – II **(12 hrs.)**

Multiple alleles and blood group antigens. Sex chromosomes and sex linked inherited disorders-

X linked recessive, dominant inheritance, gender defective phenotypes.

UNIT – III **(12 hrs.)**

Linkage, Crossing over and genetic mapping of chromosomes.

UNIT – IV **(12 hrs.)**

Identification of the DNA as the genetic material. Classical experiments of Hershey Chase, Avery McLeod etc. Genetic recombination in bacteria: Conjugation, transduction, andtransformation.

UNIT – V **(12 hrs.)**

Mutagens and Mutations. Principles of variation and selection process of speciation genetic drift, pedigree analysis and Human genome project.

RECOMMENDED TEXTS :

- Lewis, R.2001. Human genetics- concepts and application. 4th edition. McGraw Hill.
- Griffiths, Miller, J.H., An introduction to genetic analysis W.H.Freeman. New York.
- Winter, P.C., Hickey, G.J. and Fletcher, H.L.2000. Instant notes in genetics. Viva books, Ltd.
- Gardener E.J. Simmons M.J.Slustad DP. 1991. Principles of Genetics.

- Goodenough U. 1985. Genetics. Hold Saunders international.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN
FOR THEORY PAPERS

QUESTION PAPER PATTERN:

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	Unit – 3	1
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	Unit – 5	2
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	Unit – 3	1
	Unit – 4	1
	Unit – 5	2

Core Practical- VII: GENETICS and PLANT BIOTECHNOLOGY

Subject Code:17UBTKC05P	**Practical**	**Marks: 100**
Semester: III	**Credits:** 4	**Total Hours:** 60

COURSE OBJECTIVES:

- To demonstrate the culture techniques of drosophila, a genetic model organism
- To distinguish the characteristics between wild type and mutant type of drosophila
- To differentiate the characteristics of male drosophila and female drosophila
- To explain the steps and stages in mitosis and meiosis processes
- To visualize the structure of chromosomes by staining techniques

A. Genetics Practical

- Preparations of culture medium and culture of Drosophila: methods of maintenance – identifications of species and mutants.
- Identifications of human blood groups
- Observation of mitotic stages of onion (*Allium cepa*) root tip
- Demonstration of Meiotic stages of grasshopper testes
- Observation of giant chromosomes from Chironomous larvae/ Drosophila salivary glands.

B. Plant Biotechnology Practical

- To describe an overview of plant biotechnology with focus on industrial applications.
- To describe the various aspects of plant biology, plant molecular biology and plant biochemistry.
- To explain the plant tissue culture techniques and micropropagation
- To demonstrate the isolation of bacteria from soil sample and production of hormones using the isolated bacteria
- To demonstrate the culture of Spirulina

Experiments:

1. Hands on training in cell and tissue culture and maintenance of culture lines
2. Isolation of protoplast cells from Tomato Leaf Sample and fusion
3. Collection of explants
4. Surface sterilization of explants
5. Callus propagation using fenugreek/chick pea
6. Identification of different stages of callus
7. Isolation of *Agrobacterium* Spp. from Soil Sample

8. Isolation of Azotobacter Spp. and demonstration of IAA Production
9. Culture of Spirulina

Demo:

- Southern Hybridization and Northern Hybridization
- Electroporation
- Biolistic methodology

Recommended Books

- Sudhir, M.2000. Applied Biotechnology and plant genetics. Dominant publishers and distributors.
- Trivedi, P.C. 2000. Applied Biotechnology: Recent Advances. PANIMA Publishing Corporation.
- Reynolds P.H.S.(ed).1999. Inducible gene expression in plants. CABI Publishing, U.K.pp1-247.
- Chrispeels, M.J. and Sadava, D.F. 1994. Plants, genes and agriculture. Jhones and Bartlett.
- Ignacimuthu.1996. Applied Plant Biotechnology. Tata McGraw–Hill.
- Lycett, G.W. and Grierson, D.(ed). 1990.Genetic Engineering of crop plants.
- Grierson and Covey,S.N. 1988. Plant Molecular biology. Blackie.

  Trigiano,R.N .and Gray, D.J. 1996. Plant tissue culture concepts and laboratory exercise. CRC Press. Boca Ratin, New York.
- Street, H.E.1977.Plant tissue culture. Blackwell Scientific Publications Oxford, London.
- Narayanaswamy S. 1994. Plant cell and tissue culture. Tata McGraw Hill Publishing Company limited, New Delhi.

Core Paper Practical-III: BIOCHEMISTRY

Subject Code:18UBTKA05P	**Practical**	**Marks: 100**
Semester: III	**Credits:** 4	**Total Hours:** 30

COURSE OBJECTIVES

- To explain the principle and procedure for volumetric analysis of ascorbic acid and calcium from the given test samples
- To demonstrate the principle and procedure for qualitative analysis of carbohydrates and amino acids
- To estimate the total amount of proteins and phosphorous from the given sample using colorimetry
- To discuss the methods of biological preparations of samples such as starch and casein.
- To develop skills in using lab instruments for bio assays.

Practical:

1. Volumetric analysis
   a. Estimation of ascorbic acid using 2,6 – dichlorophenol indophenol as link solution.
   b. Estimation of calcium in milk.
2. Qualitative analysis
   a. Qualitative analysis of carbohydrates- glucose, fructose, galactose, lactose, maltose and sucrose.
   b. Qualitative analysis of amino acids – arginine, cysteine, tryptophan and tyrosine.
3. Quantitative analysis: (only for demonstration)
   a. Colorimetric estimation of protein by Biuret method.
   b. Colorimetric estimation of phosphorous.
4. Biochemical preparations
   a. Preparation of casein from milk.
   b. Preparation of starch from potato.

Recommended Books:

- Prem Prakash Gupta, Neelu Gupta. (2017). Essentials of Practical Biochemistry by Jaypee digital.
- David Plummer. T. (2017). An Introduction to Practical Biochemistry. McGraw-Hill Inc. ,US

ALLIED PAPER-II: BIOCHEMISTRY-I

Subject Code:18UBTKA04	**Theory**	**Marks: 100**
Semester: III	Credits: 3	Total Hours: 60

COURSE OBJECTIVES

- To sketch the structure and describe the classification of bio-molecules, carbohydrates, lipids and proteins.
- To explain the structural and functional properties of pigments, vitamins and hormones
- To illustrate the metabolic pathways of bio-molecules, carbohydrates, lipids and proteins.
- To discuss the bioactive potentials of chemical substances such as Prostaglandins, leukotrienes, thromboxines, interferons and interleukins, antibodies etc.
- To demonstrate the principle and instrumentation of bio separation techniques such as centrifugation, chromatography, electrophoresis etc.

UNIT I **(12 hrs.)**

Structure, chemistry and properties of Carbohydrates; Lipids and Proteins

UNIT II **(12 hrs.)**

Classification of porphyrins, their structure and properties; structure of metalloporphyrins- haeme and chlorophyll; Vitamins and Hormones – (Classification and Examples only – NoStructures).

UNIT III **(12 hrs.)**

Principles of Bio-energetic(Introduction of 3-thermodynamic laws);Metabolism of carbohydrates – (Glycolysis, TCA Cycle. Glucogenesis, Gluconeogenesis), fats– (β –Oxidation & Synthesis of Palmetic Acid), proteins – (Urea Cycle, purines, pyrimidines (Over view of both de novo and salvage pathway) - their biosynthesis & degradation; mechanism of oxidative phosphorylation & its inhibitors, photo phosphorylation (overview).

UNIT IV **(12 hrs.)**

Prostaglandins, leukotrienes, thromboxines, interferons and interleukins; antibodies– (Basic structure and functions); alkaloids–(Types and Examples);(classification and Examples), Plant (carotenoid and flavonoids) and animal pigments (melanin and Hemoglobin).

UNITV **(12 hrs.)**

Separation methods: Chromatography - electrophoresis and immuno electrophoresis, high voltage electrophoresis and isoelectric focusing. Isolation methods – centrifugation, ultra – centrifugation, density gradient centrifugation (principle, overview of types and application).

RECOMMENDED TEXTS:

1. Sathyanarayana. U. 2002. Biochemistry. Books and Allied Pvt. Ltd.
2. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. 2000.
3. Harper's Biochemistry, 4th edition. McGraw-Hill.
4. Stryer, L. 1999. Biochemistry, 4th edition. W. H. Freeman & Company, New York.
5. Zubey, G.L. 1998. Biochemistry, 4th edition. McGraw-Hill.
6. Voet, D. and Voet, J.G.1995. Biochemistry, 2nd edition. John Willey and Sons, Inc.
7. Lehninger, A.L., Nelson, D.L and Cox, M.M.1993. Principles of Biochemistry, 2nd edition. CBS Publishers and Distributors, Delhi.

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	Unit – 3	1
	Unit – 4	1
	Unit – 5	2

CORE PAPER: PLANT BIOTECHNOLOGY

Subject Code:17UBTKC06	**Theory**	**Marks: 100**
Semester: III	**Credits:** 4	**Total Hours:** 30

COURSE OBJECTIVES:

- To describe the details of plant genome organization
- To illustrate the mechanism of gene transfer in plants
- To categorize the various seed storage proteins and regeneration of gene expression
- To describe the role of plant hormone in photo-morphogenesis and in the regulation of gene expression
- To explain plant tissue culture techniques and its applications

UNIT – I **(12 hrs.)**

Plant genome: Organization, structure of representative plant genes and gene families in plants – chloroplast genome organization of mitochondrial genome.

UNIT – II **(12hrs.)**

Agrobacterium and crown gall tumors – Mechanism of T-DNA transfer to plants, Ti Plasmid vectors and its utility – Plant viral vectors. Symbiotic nitrogen fixation in Rhizobia

UNIT – III **(12hrs.)**

Seed storage proteins. Regeneration of gene expression in plant transgenic plants and applications – plant vaccine and plant development.

UNIT – IV **(12hrs.)**

Plant Hormones – IAA, GA and cytokinins – molecular basis of action – phytochrome – role in photo morphogenesis – Regulation of gene expression – abscisic acid – and stress – induced promoter switches in the control of gene expression – Ethylene and fruit ripening.

UNIT – V **(12hrs.)**

Plant tissue culture – suspension cultured cells – haploid plants – Cloning of hosts – micropropagation – somatic embryogenesis – protoplast isolation and applications.

RECOMMENDED TEXTS:

- Kojima, Lee, H. and Kun, Y. 2001. Photosynthetic microorganisms in Environmental Biotechnology. Springer – Verlag.
- Sudhir, M. 2000. Applied Biotechnology and plant Genetics. Dominant publishers and

distributors.

- Trivedi, P.C.2000. Applied Biotechnology: Recent Advances. PANIMA Publishing Corporation.
- Reynolds, P.H.S. (ed). 1999. Inducible gene expression in plants. CABI Publishing, U.K. pp 1-247.
- Chrispeels, M. J. and sadava, D.F. 1994. Plants, genes and agriculture. Jhones and Bartlett.
- Ignacimuthu. 1996. Applied Plant Biotechnology. Tata McGraw – Hill.
- Lycett, G.W. and Grierson, D. (ed). 1990. Genetic Engineering of crop plants.
- Grierson and Covey, S.N.1988. Plant Molecular biology. Blackie.
- Trigiano, R.N. and Gray, D.J. 1996. Plant tissue culture concepts and laboratory exercise. CRC Press. BocaRatin, New York.
- Street, H.E. 1977. Plant tissue culture. Blackwell Scientific Publications oxford, London.
- Narayanaswamy S. 1994. Plant cell and tissue culture. Tata McGraw Hill Publishing Company limited, New Delhi.

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	Unit – 3	1
	Unit – 4	2
	Unit – 5	2
Section C	Unit – 1	1
	Unit – 2	1
	Unit – 3	1
	Unit – 4	1
	Unit – 5	2

Allied Paper- IV: BIOCHEMISTRY-II

Subject Code:17UBTKA06	**Theory**	**Marks:** 100
Semester: IV	**Credits:** 3	**Total Hours:** 60

COURSE OBJECTIVES

- To discuss the various types of structural forms of monosaccharides, disaccharides and polysaccharides.
- To classify the types and discuss the properties of amino acids and proteins
- To explain the classification, types, properties, functions and significance of lipids
- To describe the primary and secondary structure, forms and functions of nucleic acids: DNA &RNA
- To explain the types, classification, functions and deficiency disorders of vitamins

UNIT I **(12 hrs.)**

Definition and classification of carbohydrates, linear and ring forms (Haworth's formula)for glucose, fructose and mannose and disaccharides (maltose, lactose, sucrose).General properties of monosaccharides and disaccharides.Occurrence and significance of polysaccharides (Homopolysaccharies- starch and cellulose, Heteropolysaccharies–Chitosan,Pectin, Chondritin sulfate)

UNIT II **(12 hrs.)**

Amino acids, various classifications, amphoteric nature, isoelectric point. Reactions due to carboxyl, amino and both the groups. Proteins- classification-shape, solubility and composition, biological functions. Proteins- physical properties-ampholytes, isoionic point, salting in and salting out, denaturation, peptide bond (structure and importance), Secondary structure - helix and pleated sheet, tertiary structure, various forces involved- quaternary structure (Hemoglobin as example). Deamination, transamination and urea cycle (Overview).

UNIT III **(12 hrs.)**

Fat function, classification, simple lipids (Triacylglycerols), fatty acids (saturated and unsaturated) complexlipids (Arachidonic acid, Oleic Acid), derived lipids (Lipopolysaccharides), properties-saponification, rancidity, reduction, oxidation, halogenation. Functions of phospholipids, Cholesterol structure –biological importance, chemical properties.

UNIT IV **(12 hrs.)**

Purine and pyrimidine bases: nucleosides, nucleotides, polynucleotides, DNA structure,various types, properties-absorbance, effect of temperature. Different types of RNA, structure andfunction. Genetic code. Enzyme definition, units, various classifications, nomenclature, specificity, isoenzymes, factors affecting enzyme activity- substrate, pH and temperature. (Overview of MM equation) Enzyme inhibition, competitive and non-competitive.

UNIT V **(12 hrs.)**

Vitamins: definition, classification, water soluble vitamins: B1, B2, B3, B6, B12 and Vitamin C. Deficiency diseases. Fat soluble vitamins-A, D, E and K-Deficiency diseases.

RECOMMENDED TEXTS:

1. Fundamentals of Biochemistry - JL Jain
2. Text book of Biochemistry - AVS Rama Rao
3. Fundamentals of Biochemistry - AC Deb.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

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	Unit – 5	2
Section C	Unit – 1	1
	Unit – 2	1
	Unit – 3	1
	Unit – 4	1
	Unit – 5	2

Core Paper-IX: ANIMAL, MEDICAL BIOTECHNOLOGY

Subject Code:17UBTKC07	**Theory**	**Marks:** 100
Semester: IV	**Credits:** 4	**Total Hours:** 60

COURSE OBJECTIVES:

- To emphasize the types and importance of advanced biotechnological principles in manipulation of reproductive processes in humans and animals
- To classify the types of infectious diseases
- to demonstrate the types of advanced molecular techniques in disease diagnosis
- To summarize the types and production of recombinant vaccines
- To discuss the types and applications of animal cell culture techniques

UNITI **(12 hrs.)**

BasicprinciplesofBiotechnology(IntroductiontoAnimalBiotechnologyonly)– manipulation of reproductive process – Artificial insemination – freezing of semen –Embryo technology – *in vitro* maturation and fertilization – Pregnancy diagnosis –Assisted reproductive technology – cloning strategies (Eg: Dolly) – transgenic animals (Overview of the transgenesis process and Applications with Mice, cow, hen, pig, sheep, fishes and Silk worm as examples).

UNITII **(12 hrs.)**

Historicalaspects(ofAnimalBiotechnology)–MedicalBiotechnology(Vaccinesand Examples of construction of engineered tissues with skin as example and theirapplication) – Pathogenic microbes – Bacterial, Viral, Fungal and Protozoan disease (inCow, hen and sheep) – diagnosis (pertaining to humans) using modern techniques –probes– Cure, control and prevention.

UNIT III **(12 hrs.)**

Health Disease Diagnosis: Hybridoma Technique (Steps involved and application), Monoclonal antibodies (definition and application), application of Probes for diagnosis of existing and emerging disease in animal and human disease.

UNIT IV **(12 hrs.)**

Vaccines – Production of recombinant vaccines – bacterial, viral or parasitic infections – DNA Vaccines (pertaining to humans). Synthetic peptide, anti-idiotype, deletion mutant and vaccine viral vector vaccine –Prophylaxis.

UNITV **(12 hrs.)**

Genetic engineering of Microorganisms (Recombinant bacteria and virus) and molecules (Recombinant monoclonal antibodies)– Recombinant DNA, DNA/RNA.

RECOMMENDED TEXTS:

1. Glick, B.R. and Pasternark. 2002. Molecular Biotechnology: Principle and applications of recombinant DNA. ASM press.
2. Ramasamy. P. 2002. Trends in Biotechnology, University of Madras of Publications, Pearl Press.
3. Kreuzer, H. and Massey, A. 2001. Recombinant DNA and Biotechnology: A guide for teachers, 2nd edition. ASM Press Washington.
4. Traven. 2001. Biotechnology. Tata McGraw – Hill.
5. Walker, J.M. and Gingold, E.B. 1999.Molecular biology and Biotechnology, 3rd edition. Panima Publishing Corporation.
6. Jenkins, N. (ed). 1999 Animal cell Biotechnology: Methods and protocols. Humana press, New Jesey. Pp 1-302.
7. Ignacimuthu. 1996. Basic Biotechnology. Tata McGraw-Hill.
8. Puhler, A.V.C.H. 1993. Genetic engineering of Animals. VCH Publishers, Weinbeiim, FRG.
9. Watson, J.D., Gilman, M., Witknowski, J. and Zoller, M. 1992. Recombinant DNA (2nded) Scientific American Books, NY.
10. Murray, E.T. 1991. Gene transfer and expression protocols – Methods in Molecular biology Vol.7. Humana Press.
11. Watsen, J.D., Hopkins, N.H., Roberts, J.W. Steitz, J.A. and Weiner, A.M. 1987.Molecular biology of gene. Benjamin/ Cummings 4th Ed. Vol.1&2.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

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Section C	Unit – 1	1
	Unit – 2	1
	Unit – 3	1
	Unit – 4	1
	Unit – 5	2

Core Paper-X: BIOINFORMATICS

Subject Code:17UBTKC08	Theory	Marks: 100
Semester: V	Credits: 4	Total Hours: 60

COURSE OBJECTIVES:

- To apply the genomic DNA sequences for population studies.
- To illustrate gene therapy
- To compare the role of genes in cancer biology progression , diagnosis and therapy.
- To recognize the sequence of protein and DNA for structural prediction.
- To demonstrate the Protein and DNA databases for sequence retrieval.

UNIT I **(12 hrs.)**

(Scope of Bioinformatics, Biological Databases and their importance) Genomic and cDNA sequences – (Sequence retrieval from NCBI portal) : output management from different biological output sources (Sequence retrieval from Uniprot), gene prediction rules and software –Human Genome Project – Mutations (Homology Modelling – Among Humans and Rats,Case Study– BRCA1gene),Population studies (Case Study-ASPAgene).

UNIT II **(12 hrs.)**

Gene therapy: Analysis of genomic and proteomic information with respect tobiological systems (online tools for docking, Protein ligand interaction and Protein DNA interactions)–Genome application– Transgenic animals (databases involved in Xenobiotics) and plants (Bt cotton, Bt-brinjal)– pathway regulatory networks (KEGG Pathway). Drug design/ discovery and identification, synthesis of new drugs; Management of diverse chemical libraries (Pubchem).

UNIT III **(12 hrs.)**

Gene expression: Microarrays and recent developments in expression analysis: (Databases only) Genes; Oncogenes–protooncogenes– Classification of Cancer types– (Overview of Carcinoma, Sacroma and Lymphoma and their specific marker genes and proteins- and their databases):Application of Microarrays in Drug toxicity testing, metabolic pathways (DDBJ, KEGG).

UNITIV (12 hrs.)

Sequence analysis (Proteins and Nucleic acids) Sequence alignment- Methods (FASTA, Expasy) – Proteomics: Proteins analysis – structural comparisons (PyMol) – 2D gel (Introduction to

Softwares for Protein 2D gel analysis only), Mass spec (Introduction to mMASS Open source mass spectroscopy tool), protein (Cancer Diagnosis) and antibody arrays (Cancer Diagnosis).

UNIT V **(12 hrs.)**

Protein Database (Introduction to Uniprot): Comparison of Protein sequences and Database searching– methods for protein structure prediction (Principle, Instrumentation and Application of X-Ray Crystallography and NMR) – conserved patterns in protein sequences and structures (Databases)– Comparison of protein 3Dstructures–predicting functions based on DNA and protein sequences(PyMol).

RECOMMENDED TEXTS:

1. Pennington, S.R. and Punn, M.J. 2002.Proteomics: from protein sequence to function. Viva books Pri. Ltd.
2. Maleolm and Goosfship. J. 2001. Genotype to phenotype, 2nd edition. Bios Scientific Publishers Ltd.
3. Misener, S. and Krawetz. S.A. 2000. Bioinformatics: Methods and Protocols. Humana press.
4. Attwood, T.K. and Parry-Smith, D.J.1999. Introduction to Bioinformatics. Pearson Education Asia.
5. Primrose, S.B. 1998. Principle of genome analysis. 2nd edition. Blackwell Science.
6. Durbin, R., Eddy, S., Krogh, A. and Mitchison, G. 1998. Biological sequence analysis. Cambridge University Press.
7. Friedman, C.P. and Wyatt. J.C. 1997. Computers and Machine: Evaluation methodsin medicinal information. Springer-verlag, New York.
8. Bishop, M.J. and Rawhings. C.J. 1997. DNA and protein sequence analysis: A practical approach. Oxford University press. New press.
9. Kolodner, R.M. 1997. Computer in Health care: Computerizing large integrated health networks. Springer – Verlag, New York.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN FOR THEORY PAPERS

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Section C	Unit – 1	1
	Unit – 2	1
	Unit – 3	1
	Unit – 4	1
	Unit – 5	2

Core Paper-XI: IMMUNOLOGY

Subject Code:17UBTKC09	**Theory**	**Marks: 100**
Semester: V	**Credits:** 4	**Total Hours**: 60

COURSE OBJECTIVES:

- To explain about the human immune system and overall immune response.
- To demonstrate the isolation, culture of immune cells.
- To describe the hybridoma technology
- To explain the hypersensitivity reaction and to illustrate delayed type hypersensitivity reaction.
- To correlate HLA typing suitable for tissue matching for tissue transplantation.
- To articulate the vaccine technology

UNIT I **(12 hrs.)**

(Basics of Immunology: Immune system: Immune cells & role, immune system,types of immune response: Innate immune response and Acquired immune response),Antigen:Isolation,purificationandcharacterizationofvariousantigensandhaptensfrompathogensand other biological molecules.

UNIT II **(12 hrs.)**

Purification of mononuclear cells from peripheral blood: Isolation and Characterization of T-cell subsets; B-cells and macrophages; Macrophage cultures; Assay for Macrophage activation; Isolation of dendriticcells [Immune reactions: Agglutination and precipitation reactions].

UNIT III **(12 hrs.)**

Hybridoma and monoclonal antibody production, purification of antibodies, Quantification of Immunoglobulins, Immunodiagosis and Applications of Monoclonal antibodies in biomedical research (Therapeutic approaches).

UNITIV **(12 hrs.)**

[Hypersensitivity (Type-I, Type-II, Type-III, Type- IV)], Assessment of delayedhypersensitivity reactions; *in situ* and *in vivo* characterization of cells from tissues; (MHC-I,MHC-II)HLA typing.

UNI TV **(12 hrs.)**

Biology and assay of cytokines; Vaccine technology including DNA vaccines; Immunotechnology and infectious diseases (Tuberclusosis and HIV infection diagnosis and treatment).

RECOMMENDED TEXTS:

1. Ramasamy, P and R.E.B.Henna, 2002. Immunity and inflammation. University of Madras Publications Division, M/S. Pearl press, Chennai, India.
2. Parslow, T.G., Stites, D.P. and Terr, A.L. 2001. Medical immunology, 10th edition. McGraw-Hill publishing.
3. Goldsby, R.A., Kindt, T.J. and Osborne, B.A. 2000. Kuby immunology. 4th edition. Freeman and company.
4. Zola, H. 2000. Monoclonal antibodies. Bios Scientific Publishers ltd.
5. Roitt, I. 1996. Immunology. Black well Scientific Publications.
6. Weir, D. M. 1992. Immunological techniques. 3 Volumes. Black well Scientific Publishers.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN FOR THEORY PAPERS
QUESTION PAPER PATTERN:

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Section A	**Question 1–12**	**Definition** Answer **ANY 10** out of **12** questions	2	**20**
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Section C	**Question 20–25**	**Detailed Answer** Answer **ANY 2** out of **4** questions	20	**40**
Total Marks				**100**

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	Unit – 3	2
	Unit – 4	3
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	Unit – 2	1
	Unit – 3	1
	Unit – 4	2
	Unit – 5	2
Section C	Unit – 1	1
	Unit – 2	1
	Unit – 3	1
	Unit – 4	1
	Unit – 5	2

Core Paper- XII: BIOSTATISTICS AND COMPUTER APPLICATION IN LIFE SCIENCE

Subject Code:17UBTKC10	**Theory**	**Marks: 100**
Semester: V	Credits: 4	Total Hours: 60

COURSE OBJECTIVES:

- To tell the various types of data, its collection and classification
- To describe the Normal distribution, Simple Correlation and Hypothesis testing
- To tell the history of computers and to explain the organizations and applications
- To describe the data storage devices
- To explain the various operations of MS-WORD and MS-EXCEL

UNIT– I **(12 hrs.)**

An introduction, Types of data, Collection, Classification and Tabulation of the Primary data, Secondary Data, Discrete data and Continuous data, Diagrammatic and Graphical representation of grouped data, Frequency Distribution [univariate and bivariate], Cumulativefrequency distribution and their graphical representation, Histogram frequency polygon Concept of central tendency or location and measures of dispersion

COURSE OUTCOMES:

- Summarize the types of data collection, classification and tabulation of various data.
- Explain Normal distribution, simple correlation including Student's T Test, Chi – Square Analysis.
- Explain about Computers, their organization, types and milestones in hardware and software applications.
- Relate the various types of data storage devices and output devices.
- Illustrate MS – Office including MS-Word, MS-Excel and uses of the internet for solving biological problems.

UNIT– II **(12 hrs.)**

Normal distribution. Simple Correlation. Hypothesis testing- Student's t-test; Chi-square analysis.

UNIT– III **(12 hrs.)**

Computers: General introduction to computers, Organization to computers, Digital and Analogue computers, Computers algorithms: Milestones in hardware and software-batch oriented/online/real

Time applications.

UNIT– IV **(12 hrs.)**

Data storage devices: Primary storage: Storage addressed and capacity, ROM, RAM, Input/output devices: Key-tape/diskette devices, light pen Mouse, Joystick, Source data automation. Printed outputs: Serial, ine, page, Printers, Plotters, Voice Response Units.

UNITV **(12 hrs.)**

MS – Word: File operations – New, Open, Save & Print – Editing – Cut, Copy, Paste, Find& Replace – Insert – Page numbers & Pictures – Format – Font, Bullet and Numbering, Paragraph & Background–Tools – Spelling & Grammar– Data– Sort. MS – Excel: Presentation of Biostatistical data using Excel – Auto-sum, Paste function, Chart wizard, Sort function & Drawing. Usesof Internet, Networking of computers.

REFERENCE BOOKS:

1. P.N. Arora & P.K. Malhotra (1996). Biostatistics (Himalaya Publishing House, Mumbai).
2. Sokal & Rohlf (1973). Introduction to biostatistics (Toppan Co. Japan).
3. W.J. Evens, G.R. Grant (2005). Statistical methods in bioinformatics: An introduction (Springer).
4. P.K. Sinha (2004). Computer fundamentals (BPB).
5. Suresh K. Basandra (2008). Computers today (Galgotia Publications Pvt. Ltd., New Delhi).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

FOR THEORY PAPERS

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Section C	**Question 20–25**	**Detailed Answer** Answer **ANY 2** out of **4** questions	20	**40**
TOTAL MARKS				**100**

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	Unit – 4	3
	Unit – 5	3
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	Unit – 2	1
	Unit – 3	1
	Unit – 4	2
	Unit – 5	2
Section C	Unit – 1	1
	Unit – 2	1
	Unit – 3	1
	Unit – 4	1
	Unit – 5	2

Core Paper-XIII: Practical- Animal, Medical and Biotechnology a& Immunology

Subject Code:17UBTKC11P	**Practical**	**Marks: 100**
Semester: V	**Credits:** 4	**Total Hours:** 30

COURSE OBJECTIVES:

- To design and prepare solutions and medium for culturing animal cells
- To develop practical skills in isolation and culture of animal cells
- To demonstrate the applications of animal cell culture in medicine and research

A. ANIMAL AND MEDICAL BIOTECHNOLOGY

Preparation of tissue culture medium and membrane filtration; preparation of single cell suspension from spleen and thymus; Cell counting and cell viability; Macrophage monolayer from PEC and measurement of phagocytic activity; Trypsinization of monolayer and sub culturing; Cryopreservation and thawing; Measurement of doubling time; Role of serum in cell culture.

B. IMMUNOLOGY

Blood groups and Rh Typing – Handling of animals and Raising Antibodies – Direct agglutinations – Slide and Tube methods:- Whole cell agglutination – Slide and Tube methods – Serotyping by slide Agglutination – Indirect Agglutination test: Particle Agglutination – Letex Hbs Ag, ASLO – Passive Haemagglutination – TPH – Precipitation – Single Radial Immuno Diffusion (SRID) – Double Immuno Diffusion – Amboceptor titration (Demonstration) – ELISA (Demonstration) – Skin test fordemonstration cutaneous hypersensitivity.

Elective Paper- I: PHARMACEUTICAL BIOTECHNOLOGY

Subject Code:17UBTKE01	**Practical**	**Marks: 100**
Semester: V	Credits: 5	Total Hours: 60

COURSE OBJECTIVES:

- To give strong foundation and advanced information on biopharmaceutical aspects in relation to drug development.
- The core responsibilities for the development and monitoring of the drug and the preparation of medicines according to the norms.
- Knowledge in physicochemical properties, pharmacology and the formulation of commonly used biopharmaceuticals.

UNIT I **(12 hrs.)**

Pharmaceutical biotechnology an introduction. Microbes in pharmaceutical industry (*Penicillium*-antibiotics, *Bacillus*-Enzymes, *Lactobacills* and *Sacharomyce* –Probiotics, Clostridium–amino acids, Fungus Niacin). Formulation (Oral and Parenteral) of biotech products including biopharmaceutical considerations (Microbiological Considerations). Shelf life of protein based pharmaceuticals (antibody based vaccines, insulin and oral enzyme formulations). Delivery of proteins – Rate and target site – specific delivery. Site specific delivery of protein drugs(antibody vaccines, liposome based vaccines and viral based vaccines).

UNIT II **(12 hrs.)**

Pharmacokinetics and Pharmacodynamics – Peptide and protein drugs (Insulin).Elimination of protein Therapeutics and Distribution of therapeutics, Protein binding of proteins therapeutics, Heterogeneity of protein therapeutics. Chemical modification of protein therapeutics and immunogenicity(antibody vaccines).

UNITIII **(12 hrs.)**

Protein engineering, Peptide chemistry and Peptidomimetics (idiotyping antibody based vaccines), catalytic Antibodies, Glycobiology (introduction, mechanism of producing recombinant, fusion receptor proteins) and biosensors (introduction, types and examples). Impact of biotechnology on drug discovery. Gene therapy – *ex vivo* and *in-vivo* gene therapy (Definition, mechanisms and examples).Hematopoietic growth Factors, Chemical description, pharmacology-Pharmaceutical Concerns, clinical and Practice aspects (Indian Pharmacopoeia).

UNIT IV **(12 hrs.)**

Pharmacology and Formulations–Vaccines, Modern vaccine technologies, pharmaceutical aspects. Formulation of monoclonal antibody – Based pharmaceuticals, development of antibody based therapeutics.

UNITV **(12 hrs.)**

Biotechnology products in pipeline – Drug development, Protein Pharmaceuticalin development. Development of Nucleic acid therapies (Introduction). Development of Adhesion molecules (Collagen, Hyaluronic Acid).Examplesofglycoproteinandcarbohydratebased pharmaceuticals.

RECOMMENDED TEXTS:

1. Daniel Figeys (Ed.) 2005. Industrial proteomics: Applications for Biotechnology and Pharmaceuticals. Wiley and Sons, Incorporated.
2. O. Kayser, R.H. Muller. 2004. Pharmaceutical Biotechnology – Drug Discovery and clinical applications. Wiley – VCH.
3. Heonrich Klefenz. 2002. Industrial Pharmaceutical Biotechnology.
4. Leon Shargel, Andrew B. C. Yu, Susanna Wu-Pong and Yu Andrew B.C.2004. Applied Biopharmaceutics and pharmacokinetics. McGraw- Hill Companies.
5. Sefania Spada, Garywalsh. 2004. Directory of approved biopharmaceutical.
6. Garywalsh. 2003. Biopharmaceutical, biochemistry and biotechnology.
7. Thomas Lengauer (Ed) 2002. Bioinformatics – from Genomes to drugs. Vol.I and II. Wiley – VCH.
8. JOHN F. Corpenter (ed.) Mark C. Manning. 2002. Rational design of stable formulation theory and practice (Pharmaceutical Biotechnology). Plenum, US. I Edition.
9. D.I.A. Crommelin et al, 2002. Pharmaceutical biology. Amazon prome publications.
10. Werner kalow, UA Meyer and Rachel F Tyndale. 2001.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN FOR THEORY PAPERS

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TOTAL MARKS				**100**

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	Unit – 3	1
	Unit – 4	2
	Unit – 5	2
Section C	Unit – 1	1
	Unit – 2	1
	Unit – 3	1
	Unit – 4	1
	Unit – 5	2

Core Paper: GENETIC ENGINEERING

Subject Code:17UBTKC13	**Practical**	**Marks: 100**
Semester: VI	**Credits:** 4	**Total Hours:** 60

COURSE OBJECTIVES:

- To explain the specialized topics and advances in the field of genetic engineering and their application in plant improvement.
- To summarize the techniques involved in gene cloning and genome analysis.
- To define and explain the various cloning methods and tools.
- To explain the production of recombinant proteins and PRC Techniques.

UNIT I **(12 hrs.)**

Restriction and modification systems in bacteria (DAM methylase). Restriction enzymes (Restriction enzymes: Endo & Exonucleases) Modifying enzymes-DNA & RNA polymerase, reverse transcriptase, terminal transferase; nucleases (DNases, RNases, S1) T4 polynucleotidekinase, Alkaline Phosphatase and ligase (*E.coli* & T4). Ligation Cloning vectors (plasmid -definition, properties and types. pUC19 & pBR322- phage vectors (λ &M13) Core techniques ingene manipulation: Cloning strategies; Construction of gene libraries & cDNA libraries and probes (radioactive & non-radioactive) detection

UNITII **(12 hrs.)**

Recombinant technology: gene cloning–Selection and screening for recombinant –RFLP, DNA fingerprinting.

UNIT III **(12 hrs.)**

DNA sequencing Maxam Gilbert (chemical & Sanger's), Polymerase chain reaction (Principle,typesand applications); Ligase chain reaction, Site directed mutagenesis (Introduction)

UNITIV **(12 hrs.)**

Expression systems and their applications (Bacteria- pBR322, Yeast-*Sacchromyces cervicisae*: Production of protein from cloned genes.

UNITV **(12 hrs.)**

Gene cloning and manipulation in Research (*E.coli, Pichiapastoris*), Medicine (Human insulin and recombinant vaccines hepatitisB) agriculture (βcarotene, Banana– Vaccines against Streptococcus mutants, Mango–Increase carotenoid and sugar content).

RECOMMENDED TEXTS:

1. Thiel. 2002. Biotechnology DNA to Protein: A laboratory Project. Tata McGraw- Hill.
2. Ring, C.J.A. and Blair, E.D.2001. Genetically Engineered viruses. Development and application. Bios Scientific publishers.
3. Davidson, E.H.2001. Genomic regulatory systems: Development and evaluation. Academic press.
4. Kreuzee and Massey, A. 2001. Recombinant DNA & Biotechnology. ASM Press.
5. Mukhopadhyay, S.N.2001. Process Biotechnology fundamentals. Viva books.
6. Jognand, S.N. 2000.Gene Biotechnology. Hemalaya publishers.
7. Walker, M. and Gingold, E.B. 1999. Molecular biology and Biotechnology, 3rd edition.Panama Publishing Corporation.
8. Old, R.W. and Primrose, S.B.1998. Principles of An introduction to Genetic Engineering Blackwell Science. U.K.
9. Brown, T.A. 1995. Gene cloning an introduction. Chapman & Hall. London.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN FOR THEORY PAPERS

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Section C	**Question 20–25**	**Detailed Answer** Answer **ANY 2** out of **4** questions	20	**40**
TOTAL MARKS				**100**

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	Unit – 4	3
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	Unit – 2	1
	Unit – 3	1
	Unit – 4	2
	Unit – 5	2
Section C	Unit – 1	1
	Unit – 2	1
	Unit – 3	1
	Unit – 4	1
	Unit – 5	2

Core Paper: BIOPROCESS TECHNOLOGY

Subject Code:17UBTKC14	**Practical**	**Marks: 100**
Semester: VI	**Credits:** 4	**Total Hours:** 60

COURSE OBJECTIVES:

- To identify the overall industrial bioprocess so as to help them to manipulate the process to the requirement of the industrial needs.
- To explain the application of various types of fermenter
- To perform the media formulation.
- To interpret the kinetics and dynamics behind the bioprocess technology.
- To compare the batch fermentation and to illustrate the various metabolite

UNIT I **(12 hrs.)**

Introduction to bioprocess: An overview of traditional and modern applications of biotechnological process, [difference between fermentation and bioprocess] integrated bioprocess and the various (Upstream and downstream) unit operations involved in bioprocesses (overview).

UNIT II **(12 hrs.)**

Fermentation processes: General requirements of fermentation processes (valves involved), main parameters to be monitored and controlled in fermentation processes, aerobic an anaerobic fermentation processes and their application in the Biotechnology industry.

UNITIII **(12 hrs.)**

Enzymatic bioconversion processes: Kinetics and thermodynamics of enzyme –catalyzed reactions, basic design and configuration of immobilized enzyme reactors, applications of immobilized enzyme technology. Media design and sterilization for fermentation processes: Medium requirements for fermentation processes andfor industrial fermentation.

UNIT IV **(12 hrs.)**

Metabolic stoichiometry and energetics: Stoichiometry of cell growth and product fermentation, elemental balances, degrees of reduction of substrate and biomass,yield coefficients of biomass and product formation, maintenance coefficients energetic analysis of microbial growth and product formation.

UNIT V **(12 hrs.)**

Kinetics of microbial growth and product formation: Phases of cell growth in batch cultures,

simple unstructured kinetic models for microbial growth – Growth associated (primary) and non-growth associated (secondary) product formation kinetics–Leudeking Piret models.

RECOMMENDED TEXTS:

1. Shuler, M.L. and Kargi, F. 2002. Bioprocess engineering – Basic concepts.Prentice Hall of India.
2. Shuler, M.L. and Kargi, F. 1992. Bioprocess engineering, Prentice Hall.
3. Bailey and Ollis, 1986. Biochemical Engineering Fundamentals, McGrawHill (2^{nd} Ed.).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

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Section A	**Question 1–12**	**Definition** Answer **ANY 10** out of **12** questions	2	**20**
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	Unit – 3	1
	Unit – 4	2
	Unit – 5	2
Section C	Unit – 1	1
	Unit – 2	1
	Unit – 3	1
	Unit – 4	1
	Unit – 5	2

Core Paper: BIOTECHNOLOGYANDNANOTECHNOLOGY

Subject Code:17UBTKC15	**Practical**	**Marks: 100**
Semester: VI	**Credits:** 4	**Total Hours:** 60

COURSE OBJECTIVES:

- To describe the basics of biotechnology and the major areas of Biotechnology
- To explain the different types of plant vectors and their applications
- To illustrate the processes of gene cloning and its applications
- To compare the constituents and applications of Plant and animal tissue culture media
- To discover the synthesis of various nanomaterials and illustrate the multi-faceted applications of the nano materials.

UNIT I **(12 hrs.)**

Nanobiology – concepts, definitions, prospects; nanoparticles – size, shape, properties. Bionano particles nanostarch, nanocomposites– dendrimers. Hot– Dot nanoparticles. Types of biomaterials. Biodegradable polymers.

UNIT II **(12 hrs.)**

Synthesis of Nanomaterials: Top down – ball milerling; Bottom up – co-precipitation – sol-gel– electrodeposition–using natural nanoparticles–chemical vapor deposition.

UNIT III **(12 hrs.)**

Characterization:X-raydiffraction–Scherrer"sformula–ScanningElectronMicroscopy– Transmission Electron Microscopy– Fluorescence Microscopy.

UNIT IV **(12 hrs.)**

The Carbon Nanotube – New Forms of Cabon – Types of Nanotubes – Formation of Nanotubes– Uses for nanotubes – Biological Applications.

UNITV **(12 hrs.)**

Nanotechnology in Agriculture and Food Technology Nanotechnology in Agriculture – Precision farming, Smart delivery system– Nanofertilizers: Nanourea and mixed fertilizers, Nanofertigation – Nanopesticides, Nanoseed Science. Nanotechnology in Food industry –Nano packaging for enhanced shelf life -Smart/Intelligent packaging - Food processing and food safety and bio-security – Electrochemicalsensors for food analysis and contaminant detection.

RECOMMENDED TEXTS:

1. Purohit Mathur, 1999 .Biotechnology Fundamental and applications. Botanica Publications.
2. Shah H.A and Tokeer Ahmad, 2011. Principles of nanoscience and nanotechnology. Narosa Publishing House.

REFERENCE BOOKS:

1. T.A. Brown .2010. Gene cloning and Introduction. Wiley Blackwell.
2. Brown J.A. 2001 – Genetics – A Molecular approach 3rd edition – Nelson Tornes.
3. Old R. W and S.B. Primrose. 1994. Principles of Gene manipulation – 5th edition – Blackwell Scientific publications.
4. John. R. W. Masters 2000. Animal cell culture – A practical approach 3rdEdition. Oxford univ press.
5. Glick B.R. and Jack J. Pasternak, 1994. Molecular biotechnology ASM press.
6. P.Ramdoss, 2009.Animal BiotechnologyRecent Concepts and Developments, MJP Publishers.
7. SubbiahBalaji, 2010. Nanotechnology. MJP Publishers.
8. S Shanmugam, 2011. Nanotechnology. MJP Publishers.
9. Rakesh Rathi, Nanotechnology, S. Chand & Co.
10. B K Parthasarathy, 2007.Nanotechnology in Life Science Gyan Books.

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	Unit – 3	1
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	Unit – 5	2
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	Unit – 2	1
	Unit – 3	1
	Unit – 4	1
	Unit – 5	2

Core Paper-XVII: Practical- Genetic Engineering and Bioprocess Technology

Subject Code:17UBTKC12P	**Practical**	**Marks: 100**
Semester: V	**Credits:** 4	**Total Hours:** 30

COURSE OBJECTIVES:

- To describe the basic recombinant DNA techniques.
- To explain to the students the theory behind each technique and to describe the common applications of each methodology in biological research.
- To describe the process of enzyme characterization, immobilization and medium optimization methods.
- To describe the methods used to investigate the growth of microorganisms in different systems under different conditions.

A. GENETIC ENGINEERING

Extraction and estimation of intracellular proteins from *E. Coli* – Lowry's Method– Production of competent cells for transformation – Bacterial transformation – Isolation of genomic DNA – Extraction of RNA – Restriction Digestion of DNA – Absorption spectra of Nucleic acid – Estimation of DNA by Diphenyl amine method – Melting temperature of DNA, Agarose gel electrophoresis – SDS – PAGE – Isolation of plasmid DNA – Screening of Recombinants- Southern hybridization (DEMO) – Western Blotting (DEMO) – DNA amplification – PCR (DEMO).

BIOPROCESS TECHNOLOGY

Bioprocess – Fermentor – Part and design, types of fermentor / Bioreactor – Production of Biomass and its estimation (dry weight) – Isolation and characterization of microorganisms involved in biodegradation of amylolytic activity by DNS method – Compost making – Production of wine from grapes using Baker's yeast – Production of alcohol by *S. cerevisae*– Isolation of Rhizobial colonies involved in biofertilization – Isolation of lactic acid bacteria.

Elective Paper-II: MICROBIAL BIOTECHNOLOGY

Subject Code:17UBTKE02	**Practical**	**Marks: 100**
Semester: VI	Credits: 5	Total Hours: 60

COURSE OBJECTIVES:

- To illustrate microbial biotechnology, the use of microbes to generate useful products or to degrade wastes (bioremediation).
- To familiarize about the various microbial processes/systems/activities, which have been used for the development of industrially important products/processes.

UNIT I **(12 hrs.)**

History and scope of microbial biotechnology, microbial diversity and its use, cultivation and preservation of microorganisms (Slant, glycerol stock, lyophilisation and liquid nitrogen storage), Types of fermenter and their application, Pilot scale in fermentors, bioreactors, immobilized cells and microbial polysaccharides- Microbial Biomass (Strain improvisation and estimation of Biomass)

UNIT II **(12 hrs.)**

Production of microbial enzymes and applications, production of organic solvents-single cell proteins (*Spirulina* spp.., and *Candida utilis*).

UNIT III **(12 hrs.)**

Beverages Production of beverages, beer, wine, microbes in banking- production of baker yeast, milk products (Cheese and Curd).

UNIT IV **(12 hrs.)**

Biofertilizers and Biopesticides, Biomass from carbohydrates, higher alkanes, methanol, biofertilizers (*Rhizobium*spp., *Azotobacter*spp., and Cyanobcater)–manufacture, formulation and utilization, biopesticides (*Bacillus thuringenesis*).

UNIT V **(12 hrs.)**

Bioremediation: Microbes in mining, ore leaching, oil recovery, waste water treatment, biodegradation of noncellulose and cellulosic wastes (Bioethanol) for environmental conservation, protein.

RECOMMENDED TEXTS:

1. El-mans, E.M.T., and Bryce, C.F.A 2002. Fermentation microbiology and Biotechnology. Taylor and Francis group.
2. Prave, P., Faust, V., Sitting W. and Sukatseh, D.A. (eds.). 1987. Fundamentals of Biotechnology. WCH Weinhein.
3. Moo-Young, M. (ed.) 1985. Comprehensive biotechnology - Volume 2, 3 and 4. Pergamon Press.
4. Stanbury, P.F. and Whitaker. A. 1984.Principles of fermentation Technology. Pergamon Press.
5. Coulson, J.M. and Rocjardspm, J.F. 1984. Chemical Engineering. Pregamon press.

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	Unit – 2	1
	Unit – 3	1
	Unit – 4	1
	Unit – 5	2

Elective Paper-II: ENVIRONMENTAL BIOTECHNOLOGY

Subject Code:17UBTKE03	**Practical**	**Marks: 100**
Semester: VI	**Credits:** 5	**Total Hours:** 60

COURSE OBJECTIVES:

- To illustrate environmental biotechnology and focuses on the utilization of microbial processes in waste and water treatment, and bioremediation.
- To demonstrate biotechnological methods for pollution mitigation.

UNIT I **(12 hrs.)**

Biofilm Kinetics: Soluble microbial products and inert biomass. Reactors: Reactors types–A batch reactor– Acontinuous-flowstirred-tankreactorwitheffluentrecycle–APlugflowreactorwitheffluent recycles–Reactors with recycle of settled cells.

UNITII **(12 hrs.)**

Linking stoichiometric equations to mass balance equations – Engineering design of reactors– Reactors in series. Reactor configurations (Generation I, II and III) –Special factors for the designof anaerobic sludge digesters.

UNITIII **(12 hrs.)**

Denitrification: Physiology of denitrifying bacteria–Tertiary denitrification–sludge denitrification– Drinking water treatment: Anaerobic treatment by methanogenesis – Uses for methanogenic treatment and aerobic process (microalgae phytoremediation)

UNITIV **(12 hrs.)**

Detoxification of Hazardous chemicals: oil spill clearance, Factors causing molecular recalcitrance – Biodegradations of problem environmental contaminants –Bioremediation of problem environmental contaminants – Bioremediation: Engineering strategies for Evaluating bioremediation.

UNITV **(12 hrs.)**

Sewage and waste treatment: Types of waste, Pollution monitoring control (Global and Indian monitoringStandards), and remediation (petroleum industry, paper industry, chemical industry etc).

RECOMMENDED TEXTS:

1. Rittmann, B.E. and McCarty, P.L. 2001. Environmental Biotechnology: Principles and applications. McGraw – Hill, New York.

2. Ahmed, N. Qureshi, F.M. and Khan, O.Y. 2001. Industrial Environmental Biotechnology. Horizon press.
3. Smith, J.E. 1996. Biotechnology, 3rd edition. Cambridge Low price edition. Cambridge University press.
4. Sohal, H.S and Srivastava, A.K. 1994. Environmental and Biotechnology, 1st Edition. Ashish Publishing House, New Delhi.

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FOR THEORY PAPERS

QUESTION PAPER PATTERN:

Section	Numbers	Question Component	Marks	Total
Section A	**Question 1–12**	**Definition** Answer **ANY 10** out of **12** questions	2	**20**
Section B	**Question 13–19**	**Short Answer** Answer **ANY 5** out of **7** questions	8	**40**
Section C	**Question 20–25**	**Detailed Answer** Answer **ANY 2** out of **4** questions	20	**40**
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	Unit – 4	3
	Unit – 5	3
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	Unit – 2	1
	Unit – 3	1
	Unit – 4	2
	Unit – 5	2
Section C	Unit – 1	1
	Unit – 2	1
	Unit – 3	1
	Unit – 4	1
	Unit – 5	2