Course Structure of
Biotechnology

Basket-V

Code	***Subject Title***	***Type***	***Credit***	***Prerequisite***
DEBT0101	*Proteomics and Protein Engineering*	*Theory*	***2***	*Biochemistry*
DEBT0401	*Developmental Biology*	*Theory + Practice*	***5***	*Cell Biology*
DEBT0402	*Food Biotechnology*	*Theory + Practice*	**5**	*Enzyme Technology*
DEBT0403	*Plant Tissue Culture Engineering*	*Theory + Practice*	**5**	*Nil*
DEBT0404	*Cancer Biology*	*Theory + Practice*	***5***	*Nil*
DEBT0501	*Bio Nanotechnology*	*Theory + Project*	***5***	*Biochemistry*
DEBT0502	*Biosensors and Diagnostics*	*Theory + Project*	***5***	*Nil*
DEBT0503	*Biomaterials*	*Theory + Project*	***5***	*Biochemistry*
DEBT0504	*Bio-fertilizers and Bio-pesticides*	*Theory + Project*	***5***	*Microbiology*
DEBT0505	*Genetics and Cytogenetics*	*Theory + Project*	**5**	*Nil*
DEBT0506	*Molecular Modeling and Drug Designing*	*Theory + Project*	***5***	*Nil*
DEBT0601	*Genetics Lab*	*Project & Practical*	***5***	*Nil*
DEBT0602	*Bimolecular Analysis Lab*	*Project & Practical*	***5***	*Nil*
DEBT0603	*Cancer Stem Cell Biology Lab*	*Project & Practical*	***5***	*Nil*
DEBT0604	*Fermentation Technology*	*Project & Practical*	***5***	*Nil*

Syllabus

Proteomics and Protein Engineering

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Proteomics And Protein Engineering	DEBT0101	Theory	2-0-0	Biochemistry

1. Objective

- Proteomics in Drug Development;
- Diagnosis of diseases by Proteomics

2. Learning outcome

- Introduction to Protein design and Engineering, protein splicing and its application

3. Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*20*	Written examination
	Assignment	*20*	Report and Presentation
	Experiments		Lab work, report
	Project		Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*60*	Written examination
Total		*100*	

4. Course outline

Module I: Proteomics: 11hrs

Introduction to proteomics; Two dimensional electrophoresis (2-D PAGE): Protein pre-fractionation and sample preparation, IEF, SDS-PAGE, visualization of protein spot. Protein identification by mass spectrometry: ESI-TOF, MALDI-TOF, MS/MS, PMF, protein sequencing; Post translational modification, Application of proteome analysis;

Module II: Proteomics In Drug Discovery, Delivery And Diagnosis: 11hrs

Proteomics in Drug Development; Diagnosis of diseases by Proteomics; Protein array; Discovery of new biomarker; identification of protein-protein interactions and protein complexes; proteomics in drug delivery, Functional genomics: Reverse genetics, Transcription and replication of negative strand viruses;

Module III: Protein Engineering: **12hrs**

Introduction to steps of Protein design and Engineering, protein splicing and its application; Solid phase peptide synthesis, Production of Novel Proteins; Random and site directed mutagenesis, Methods for Expressing Recombinant Proteins; Characterization of Proteins structure: Crystallography and X-Ray Diffraction, Spectroscopy (UV-VIS, NMR and Fluorescence Spectroscopy) and Calorimetric Methods. Industrial applications of Protein Engineering (Engineering of Stability, affinity for substrate, Protease Specificity, Cofactor requirements of Protein).

Module IV: Protein Stability And Folding: **11 hrs**

Overview of protein structure, Higher level structure, Protein stability, Mechanism of protein folding (types, level, thermodynamics, Anfinsen's dogma & Levinthol paradox& kinetics), Folding Rate, Molten globule; Techniques for studying of protein folding;: NMR, CD spectroscopy, Proteolysis, Optical tweezers; Computational method; Location and functions of Molecular chaperones, chaperonin and co-chaperons, HSP chaperone system in Ecoli & Human; Proteasomes and proteosome mediated protein degradation; Protein folding errors: Alzheimer's, prions and Mad Cow (BSE, CJD), Cystic Fibrosis and cancer. Polyketides and non-ribosomal peptides; Combinational manipulation of polyketides and non ribosomal peptides; application of protein folding to design new drug.

5. Reference

Text Books

1. R.M. Twyman ; Principles of Proteomics, Bioscientific Publishers
2. Daniel C. Liebler, Introduction to Proteomics: Tools for the New Biology, Humana Press
3. Biochemistry & Molecular Biology Practical by Wilson and Walker
4. Protein engineering and design by Paul R. Carey, academic press, 1996, 361 pages.

Reference Books

1. B.Alberts,D.Bray, J.Lewis et al, Molecular Biology of the Cell, Garland Pub. N.Y 1983
2. Richard J. Simpson, Proteins and Proteomics, I.K. International Pvt Ltd
3. Branden, C., Tooze, R., Introduction of Protein structure, Garland, 1st Edition, 1993.
4. Lilia Alberghina., Protein Engineering in Industrial Biotechnology, Harwood Academic publishers, 2003

6. Session Plan

Topic coverage and Internal Test	***No. of Sessions*** *(in hrs.)*	***Activity*** *(lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)*	***Assignment*** *(project, assignment, field study, seminar, etc.)*	***Suggested Reading*** *(Book, Video, Online source, etc.)*
Module I		*lecture, tutorial*	*project,*	*Book, Video,Notes*

HGP – background, timeline, findings	**3**		*assignment,*	
Patterns of Genome organization	**4**			
Personalized medicine and Pharmacogenomics	**3**			
Module II		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Genome mapping techniques	4			
Genome sequencing	4			
Genome sequence assembly and annotation	4			
Module III		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Sequence based approaches	**3**			
Constructing minimal genome	**4**			
Lateral gene transfer	**4**			
Module IV		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
SNPs and Haplotype maps	3			
QTL mapping	4			
Genomics basis of polygenic disorders	4			
Total (hrs)	**45**			

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Developed on (Month and Year): June, 2018

Developmental Biology

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Developmental Biology	DEBT0401	Theory & Practice	3-0-2	Cell Biology

1. Objective

- To learn about human embryo and stages of development.

2. Learning outcome

- *Stages of life and early and late developmental stages.*

3. Evaluation Systems

Key points: State clearly the components, weights and methods of evaluation system.

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*10*	Written examination
	Assignment	*10*	Report and Presentation
	Experiments	*30*	Lab work, report
	Project		Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*50*	Written examination
Total		*100*	

4. Course outline

Module I: History & Basic Concepts Of Development 5hrs

Overview of how the modern era of developmental biology emerged through multidisciplinary approaches stages of development- zygote, blastula, gastrula ,neurula cell fate & commitment – potency-concept of embryonic stem cells, differential gene expression, terminal differentiation ,lineages of three germ layers, fate map. Mechanisms of differentiation- cytoplasmic determinants, embryonic induction, concept of morphogen, mosaic and regulative development Pattern formation-- axis specification, positional identification (regional specification). Morphogenetic movements, Model organisms in Developmental biology.

Module II: Early Development In Invertebrate /Vertebrate Models 5hrs

Drosophila, C.elegans, Xenopus, Mouse/ human.Cleavage, gastrulation, Axis specification (Dorsoventral, anterior posterior), & body plan patterning, left right asymmetry in vertebrates.

Module III: Late Development In Invertebrate /Vertebrate Models **5hrs**

Organogenesis- development of central nervous system in vertebrates, vulval formation in C.elegans

Module IV: **5hrs**
Germ Cell Specification& Migration

Module V : **5hrs**

Overview Of Plant Development

Module VI: **5hrs**

Medical Implications Of Developmental Biology - Genetic Errors/ Teratogenesis/ Stem Cell Therapy Etc

Developmental Biology Practice:

1. Cell Sorting
2. Tumor Cell Isolation
3. Growth of pluripotent cells in different media (Egg White, DMEM, RPMI)
4. Study of different stages of life with fertilized egg.
5. Isolation of different cells from different animals and study of gene regulation.

5. Reference

Text Books:

1. Developmental Biology, Eighth Edition" by Scott F Gilbert.
2. Essential Developmental Biology by Jonathan Slack

Reference Books:

1. Developmental Biology, Werner A Muller
2. Principles of Development - Lewis Wolpert

6. Session Plan

Topic coverage and Internal Test	***No. of Sessions*** *(in hrs.)*	***Activity*** *(lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)*	***Assignment*** *(project, assignment, field study, seminar, etc.)*	***Suggested Reading*** *(Book, Video, Online source, etc.)*
Module I		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
stages of development	**3**			

differential gene expression	**3**			
Morphogenetic movements	**2**			
Module II		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Cleavage, gastrulation	3			
Axis specification	2			
left right asymmetry in vertebrates	3			
Module III		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
central nervous system in vertebrates	**4**			
vulvae formation in C.elegans	**4**			
Module IV		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Germ Cell Specification	3			
Germ Cell Migration	3			
Module V		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Plant Development	5			
Module VI		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Medical Implications Of Developmental Biology	2			
Genetic Errors	4			
Stem Cell Therapy	4			
Total (hrs)	**45+30**			

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Developed on (Month and Year): June, 2018

Food Biotechnology

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Food Biotechnology	DEBT0402	Theory & Practice	3-0-2	Enzyme Technology

1. Objective

- To learn about food technology, food safety

2. Learning outcome

- *Procurement of knowledge of food industry*

3. Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*10*	Written examination
	Assignment	*10*	Report and Presentation
	Experiments	*30*	Lab work, report
	Project		Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*50*	Written examination
Total		*100*	

4. Course outline

Module I: Fermentation Process **9hrs**

Introduction to fermentation – definition – benefit of fermentation – nutritive value of fermented foods – microbial changes in fermented foods – micro organism – proteolytic, liploytic and fermentative bacteria.

Module II: Fermentation Types **9hrs**

Selection of industrial importance microorganism -production of single cell protein. Media for industrial fermentation – Medium Composition – Energy, CO2, nitrogen and other growth factors, buffering and foam agents. Types of fermentation – Ethonolic fermentation – mixed alcoholic and acid fermentation – Lactic acid fermentation.

Module III: Sterilization **9hrs**

Sterilization – Principles, sterilization of fermentation media, fermenter – in-batch & continuous process – development of inoculum for industrial fermentation – criteria for transfer of inoculums – aseptic inoculation.

Module IV: Fermentor II **9hrs**

Basic functions of fermenter – Design of fermenter – types of fermenter – different parts – agitator, impellers, aerator, baffles, process control, function and maintenance of various parts of fermenter. Recovery and purifications of food products – filtration – batch and continuous types – fermenter accessories.

Module V: Technology Of Fermented Food Products **9hrs**

Traditional fermented foods – Curd, yoghurt, dhokla, miso, shrikand, cheese, butter milk, dosa. Modern fermented products – Wine, beer, brandy, vinegar, baker's yeast, sauerkrauts, sausages, fermentation of milk, meat, fruits and vegetables.

5. Reference

Text Books:

1. Stanbury, P.F., Allan Whitaker and S.J. Hall. 1997. Principles of Fermentation Technology. Aditya books private Ltd., New Delhi.

Reference Books:

1. Pederson, C.S. 1971. Microbiology of food fermentations, AVI Publishing company. Westport, Connecticut
2. Biotechnology: Food Fermentation by V.K, Joshi and Ashok Pandey.

Food Biotechnology (Practical)(Any 5)

1. Isolation and Characterization of food fermenting organism from idli batter.
2. Estimation of ascorbic acid from given food sample by titrimetric method.
3. Analysis of mycotoxin (Aflatoxin) in fungus contaminated food material.
4. Microscopic examination of Food/Milk by breed method.
5. Estimation of lactose from milk.
6. Quality characterization of pasteurized milk by MBRT method.
7. To judge efficiency of pasteurization of milk by Phosphatase test.
8. Detection of microbial count in Milk by SPC method.

6. Session Plan

Topic coverage and Internal Test	***No. of Sessions*** *(in hrs.)*	***Activity*** *(lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)*	***Assignment*** *(project, assignment, field study, seminar, etc.)*	***Suggested Reading*** *(Book, Video, Online source, etc.)*
Module I		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Introduction to fermentation	**3**			
nutritive value of fermented foods	**3**			
proteolytic, liploytic and fermentative bacteria	**3**			
Module II		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
industrial importance microorganism	3			
buffering and foam agents	3			
Types of fermentation	3			
Module III		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Sterilization	**3**			
development of inoculum for industrial fermentation	**3**			
aseptic inoculation	**3**			
Module IV		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Basic functions of fermenter	3			
different parts – agitator, impellers, aerator, baffles	3			
fermenter accessories	3			
Module V		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Traditional fermented foods	3			
Modern fermented products	3			
fermentation of milk, meat, fruits and vegetables	3			

Total (hrs)	**45**			

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Developed on (Month and Year): June, 2018

Plant Tissue Culture Engineering

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Plant Tissue Culture Engineering	DEBT0403	Theory & Practical	3-0-2	

1. Objective

- To impart knowledge on production of transgenic plants
- To make the students to understand the concepts and applications

2. Learning outcome

- This course deals with the DNA isolation and transfer to plants and animals and production of transgenic animals and plants

3. Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*10*	Written examination
	Assignment	*10*	Report and Presentation
	Experiments	*30*	Lab work, report
	Project		Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*50*	Written examination
Total		*100*	

4. Course outline

Module I: Plant Tissue Culture – Theory And Methods: 9hrs

Brief history of Plant tissue culture, physico-chemical conditions for propagation of plant cells and tissues, composition of media, nutrient and hormone requirement, mode of action of auxin and cytokinin. Micropropagation , somaclonal variation and haploid culture, cell suspension culture.
Agrobacterium mediated gene transfer –Ti-plasmid-process of T- DNA transfer and integration, transformation in plant, Direct gene transfer methods. Binary vectors- basic features of vectors-optimization-clean gene technology.

Module II: Metabolic Plant Physiology 9hrs

Overview of photosynthesis.- Light absorption and energy conversion; the reaction center complex; the photosystem - Carbon reactions in C3 plants – Photorespiration - Variations in mechanisms of CO2

fixation- Carbohydrate metabolism- sucrose and starch- cell wall polysaccharides- non-starch storage polysaccharides Nitrogen and sulphur metabolism- Transport processes

Module III: Plant Breeding And Plant Protection 9hrs

Plant reproductive systems- germplasm - variation- types and origin - Plant genetic resources for plant breeding- Sexual hybridization and wide crosses- Mutagenesis - Polyploidy- selected breeding objectives- Cultivar release and commercial seed production. Biotic stress factors- plant-pathogen interactions- natural disease resistance pathways- abiotic stress factors - tolerance mechanisms plant-pathogen interactions-natural disease resistance pathways-biotechnological -Approaches to disease resistance. Plant viruses- types-entry and replication-transgenic approach-PDR Stress tolerance-abiotic stress-water deficit stress and various approaches for tolerance.

Module IV: Molecular Farming And Gm Crops Future Prospects: 9hrs

Introduction-carbohydrates and lipids production-molecular farming of proteins-economic considerations for molecular farming.GM crops-current status-concerns about GM crops- regulations of GM crops and products-Greener genetic engineering.

Module V: Plant Genomes and Plant Genetic Engineering: 9hrs

Structure and organisation of plant genome, regulation of plant genome expression, transcriptional, translational and post transcriptional regulation of plant genome, plant growth regulator. Transposons, chloroplast and mitochondrial genome. (Arabidopsis should be taken as the model for study of plant genome).
Direct transformation by electroporation and particle gun bombardment. Agrobacterium, Ti plasmid vector and other plant based vectors. Theory and techniques for the development of transgenic plants, conferring resistance to herbicide (Glyphosate, Basta), pesticide (Bt gene), plant pathogens PR-Proteins. Plant engineering towards development of enriched food products – Golden rice.

Plant Tissue Culture Engineering (Practical)(Any 5)

1. Explant selection sterilization and inoculation
2. Various media preparations: MS, B5.
3. Callus and cell suspension culture; induction and growth parameters
4. Chromosomal variability in callus culture
5. Plant regeneration from embryo, meristem and callus culture.
6. Androgenesis: Anther and pollen culture.
7. Somatic embryogenesis-study of different stages of cells

5. Reference

Text Books:

1. Slater.A., Nigel W.S,Flower. R.Mark , Plant Biotechnology: The Genetic Manipulation of Plants, 2009, Oxford Univesity Press.

2. Ramawat.K.G. ,Goyal, S. Comprehensive Biotechnology 2009, S.Chand & Company, New Delhi

Reference Books:

1. Buchaman, Gursam, Jones, Biochemistry and Molecular Biology of Plants, 1ed, 2000, L.K.International.
2. Bhozwani and Razdan –PlantTissue Culture: Theory and Practice 1996 Elsevier
3. Butterworth & Heineman, Invitro Cultivation of Plant Cells, Biotol Series.
4. H.E Street(ed): Tissue culture and Plant science, Academic press, London, 1974
5. Gamborg O.L.,.Phillips G.C, Plant Cell, Tissue and Organ Culture, Narosa Publishing House
6. Das.H.K. Text Book of Biotechnology-First Edition 2004,Wiley Dreamtech.

7. Session Plan

Topic coverage and Internal Test	***No. of Sessions*** *(in hrs.)*	***Activity*** *(lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)*	***Assignment*** *(project, assignment, field study, seminar, etc.)*	***Suggested Reading*** *(Book, Video, Online source, etc.)*
Module I		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Plant tissue culture	**3**			
Micropropagation	**3**			
Agrobacterium mediated gene transfer	**3**			
Module II		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Overview of photosynthesis	**3**			
Photorespiration	**3**			
Transport processes	**3**			
Module III		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Plant reproductive systems	**3**			
Biotic stress factors	**3**			
Stress tolerance-abiotic stress	**3**			
Module IV		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
carbohydrates and lipids production	**3**			

economic considerations for molecular farming	**3**			
Greener genetic engineering	**3**			
Module V		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Structure and organisation of plant genome	3			
Transposons, chloroplast and mitochondrial genome	3			
Direct transformation	3			
Total (hrs)	**45+20**			

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Developed on (Month and Year): June, 2018

Cancer Biology

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Cancer Biology	DEBT0404	Theory & Practice	3-0-2	

1. Objective

- To impart basic concepts of cancer biology, various stages in carcinogenesis, molecular cell biology of cancer, cancer metastasis, and cancer therapy.

2. Learning outcome

- To provide knowledge about biological aspects of cancer

3. Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*10*	Written examination
	Assignment	*10*	Report and Presentation
	Experiments	*30*	Lab work, report
	Project		Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*50*	Written examination
Total		*100*	

4. Course outline

Module I: Cancer Cell Biology **9hrs**

Introduction to Cancer --Cell cycle—pRb--Tumor suppressor genes--Knudson's two-hit hypothesis--p53--Myc oncoprotein--TGF-b --Cell cycle and cancer-- Different forms of cancer--Diet and Cancer

Module II: Carcinogenesis **9hrs**

Stages of Carcinogenesis-Environment, Genetics, and Cancer—Causes of cancer—Classes and Types of Carcinogens—Ecogenetics and Cancer risk— Carcinogen Metabolism—Epigenetics--DNA repair, pathways, and Human Cancer

Module III: Signal Transduction: Cell Division, Differentiation, And Apoptosis **9hrs**

Signal Transduction-Growth factor signaling-EGF signaling-Oncogenes—Wnt signaling--Immune system in cancer—B cell, T cell, and Cytokine signaling— Neuroendcrine system in cancer-Hormone and Neurotransmitter signaling— Apoptosis—Cancer stem cells

Module IV: Metastasis And Angiogenesis **9hrs**

Tumor microenvironment in cancer progression—Invasion and Metastasis-Stages in metastasis and the factors involved in the invasive process—Angiogenesis- VEGF signalling

Module V: Cancer Therapy, Prevention And Diagnosis 9hrs

Current modalities of treatment-Radiation therapy-Surgery-Chemotherapy- Classification of properties of chemotherapeutic drugs—Biological therapy-Cancer prevention and early detection -Imaging and cancer

Cancer Biology Practice:

1. Tumor cell isolation using MACS
2. Tumor cell growth in different media.
3. Tumor cell growth with different proteins
4. Tumor cell regression using plan extract.
5. Morphological analysis of different cancer cell lines.

5. Reference

Text Books:

1. Robert A. Weinberg, "The Biology of Cancer," Garland Science; 1 Cdr Edition, 2010.

Reference Books:

1. Lauren Pecorino, "Molecular Biology of cancer: Mechanisms, Targets, and Terapeutics," Oxford University Press. 3rd edition, 2012.

6. Session Plan

Topic coverage and Internal Test	***No. of Sessions*** *(in hrs.)*	***Activity*** *(lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)*	***Assignment*** *(project, assignment, field study, seminar, etc.)*	***Suggested Reading*** *(Book, Video, Online source, etc.)*
Module I		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Introduction to Cancer	**3**			
Tumor suppressor genes	**3**			
Different forms of cancer--Diet and Cancer	**3**			
Module II		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Stages of Carcinogenesis	3			
Eco genetics and Cancer risk	3			

DNA repair, pathways, and Human Cancer	3			
Module III		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Stages of Carcinogenesis	3			
Cytokine signaling	3			
Cancer stem cells	3			
Module IV		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Tumor microenvironment in cancer progression	**3**			
Invasion and Metastasis	**3**			
Angiogenesis	**3**			
Module V		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Current modalities of treatment	3			
Classification of properties of chemotherapeutic drugs	3			
Cancer prevention and early detection	3			
Total (hrs)	**45**			

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Developed on (Month and Year): June, 2018

Bio nanotechnology

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Bio nanotechnology	DEBT0501	Theory & Project	*3-2-0*	*Biochemistry*

1. Objective

- To focus on principles of Bio nanotechnology and its applications

2. Learning outcome

- This course deals with applications resulting from the combination of biotechnology and nanotechnology in the fields of medicine and environment

3. Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*10*	Written examination
	Assignment	*10*	Report and Presentation
	Experiments		Lab work, report
	Project	*30*	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*50*	Written examination
Total		*100*	

4. Course outline

Module I

Introduction To Bio-nanotechnology 9hrs

From Biotechnology to Bionanotechnology-Bionanomachines in action-Modern Biomaterials –The Legacy of Evolution

Module II

Bimolecular Design And Biotechnology 9hrs

Recombinant DNA technology-Monoclonal antibodies-Biomolecular structure determination-Molecular Medicine

Module III

Functional Principles Of Bio-nanotechnology 9hrs

Information –Driven Nanoassembly-Energetics-Chemical transformation-Regulation-Biomolecular MotorsBiomolecular sensing- Self-replication- Machine –Phase Bionanotechnology

Module IV

Nanomedicine **9hrs**

Anti-AIDS drugs-Immunotoxins as cell killers-Artificial blood- Cyclic peptides from nanotubes

Module V

Applications Of Bio-nanotechnology **9hrs**

Harnessing molecular Motors-DNA computers-Molecular design using Biological selection-Artificial life-Hybrid materials-Biosensors

5. Reference

Text Books:

1. Bionanotechnology by David S.Goodsell, 2004, Wiley Publications. Pages-337.

6. Session Plan

Topic coverage and Internal Test	***No. of Sessions*** *(in hrs.)*	***Activity*** *(lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)*	***Assignment*** *(project, assignment, field study, seminar, etc.)*	***Suggested Reading*** *(Book, Video, Online source, etc.)*
Module I		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Biotechnology to Bio nanotechnology	**3**			
Bionanomachines	**3**			
Modern Biomaterials	**3**			
Module II		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Recombinant DNA technology	**3**			
Bimolecular structure determination	**3**			
Molecular Medicine	**3**			
Module III		*lecture, tutorial*	*project,*	*Book, Video,Notes*

Driven Nano assembly	**3**		*assignment,*	
Biomolecular Motors	**3**			
Phase Bionanotechnology	**3**			
Module IV		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Anti-AIDS drugs	**3**			
Artificial blood	**3**			
Cyclic peptides from nanotubes	**3**			
Module V		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
DNA computers	**3**			
Artificial life	**3**			
Biosensors	**3**			
Total (hrs)	**45+Project**			

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Developed on (Month and Year): June, 2018

Biosensors and Diagnostics

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Biosensors And Diagnostics	DEBT0502	Theory & Project	3-2-0	Nil

1. Objective

- To learn about the Diagnostics systems and equipments

2. Learning outcome

- Sensor architecture and Classification; Medically significant measurements, functional specifications of medical sensors;

3. Evaluation Systems

Key points: State clearly the components, weights and methods of evaluation system.

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*10*	Written examination
	Assignment	*10*	Report and Presentation
	Experiments		Lab work, report
	Project	*30*	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*50*	Written examination
Total		*100*	

4. Course outline

Module I: Introduction : 8hrs

Sensor architecture and Classification; Medically significant measurands, functional specifications of medical sensors; Sensor characteristics: linearity, repeatability, hysteresis, Overview of Biosensors, Fundamental elements of biosensor devices, Immobilization key to biosensor construction. Redox mediated systems, FET's (Field Effect Transistors), Thermistors, Conductimeters, Piezoelectric crystals.

Module II: Different Types Of Biosensor: 8hrs

Electrochemical Biosensors : Electrochemical principles, Amperometric biosensors and charge transfer pathways in enzymes, Glucose biosensors, Engineering electrochemical biosensors. Optical Biosensors: Optics for biosensors, Attenuated total reflection systems. Mass and Acoustic Biosensors: Saubrey formulation, Acoustic sensor formats, Quartz crystal microblalance. Immunosensor.

Module III: Modern Biosensors 8hrs

Variations on the biological biochemical component, Bioaffinity principles, whole cell biosensors. Lab-on-chip technologies: Microfluidic interfaces for biosensors, DNA and protein microarrays, Microfabricated PCR technology. Overview on Nanobiosensor, Fiber Optic Biosensors, Nanobarcodes.

Module IV: Diagnostics For The Real World: **6hrs**

Communication and tracking in health monitoring, Detection in resource limited settings. Applications and uses of biosensors, Clinical chemistry, medicine and health care, Veterinary, Agriculture and Food production, Environmental control and pollution monitoring, Gene Expression analysis.

5. ***Reference***

Text Books:

1. Biosensors : Tran Minh Canh, Chapman & Hall
2. Biosensors: Oxford University Press, USA; 2 edition, 2004

Reference Books:

1. Turner, A.P.F, Karube. I.,and Wilson, G.S, Biosensors Fundamentals and applications, Oxford Univ. Press.
2. D.Thomas and J.M. Laval – Enzyme Technology in concepts in Biotechnology by Balasubramaniam et al, Univ. Press, 1996.
3. Handbook of Biosensors and Electronic Noses: Medicine, Food and the Environment: CRC-Press; 1 edition;1996
4. Steven S. Saliterman, Fundamentals of BioMEMS and Medical Microdevices ,SPIE Press Monograph Vol. PM153, 2006
5. D. L. Wise, Biosensors: Theory and Applications, CRC Press,1993

6. Session Plan

Topic coverage and Internal Test	***No. of Sessions*** *(in hrs.)*	***Activity*** *(lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)*	***Assignment*** *(project, assignment, field study, seminar, etc.)*	***Suggested Reading*** *(Book, Video, Online source, etc.)*
Module I		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Sensor architecture and Classification	**4**			
Sensor characteristics	**4**			
Immobilization key to biosensor construction	**3**			
Module II		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Electrochemical Biosensors	4			
Engineering electrochemical biosensors	4			
Optical Biosensors	4			
Module III		*lecture, tutorial*	*project,*	*Book, Video,Notes*

Bioaffinity principles	**4**		*assignment,*	
Microfluidic interfaces for biosensors	**3**			
Overview on Nano biosensor	**4**			
Module IV		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Communication and tracking in health monitoring	4			
Applications and uses of biosensors	3			
Gene Expression analysis	4			
Total (hrs)	**45**			

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Developed on (Month and Year): June, 2018

Biomaterials

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Biomaterials	DEBT0503	Theory & Project	3-2-0	Biochemistry

1. Objective

- biologically derived materials or materials compatible with biology

2. Learning outcome

- Production of polyphenol resins by the enzyme soybean peroxidase;
- Evaluation of the properties of biopolymers to make good biomaterials

3. Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*10*	Written examination
	Assignment	*10*	Report and Presentation
	Experiments		Lab work, report
	Project	*30*	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*50*	Written examination
Total		*100*	

4. Course outline

Module I: Introduction: 11hrs

Definition of biomaterials – biologically derived materials or materials compatible with connective tissues): Structure production and its use. Fibroin (protein in silk): Production a and its use. Production of these proteins by conventional cloning methods.

Module II: Carbohydrates: 11hrs

Modified carbohydrates actin gas lubricants for biomedical applications; Polydextrose made from bacteria; Carbohydrates modified from enzymes; artificial wood.

Module III: Biopolymers: 12hrs

Synthesis from a simple biological monomer (eg hyaluronate polymers); Dextrans (used in chromatography columns); Rubberllike materials produced by bacteria and fungi (Polyhydroxybutyrate PHB), Polycaprolactone(PCL); Production of a copolymer of PHB and PHV(polyhydrovaleric acid), sold as Biopol by fermentation on Alcaligenes eutrophus; Biodegradable polymers

Module IV: Industrial Biopolymers: **11hrs**

Production of polyphenol resins by the enzyme soybean peroxidase; Evaluation of the properties of biopolymers to make good biomaterials; Tensile strength(both elasticity and breaking strength); Hydration, visco – elastic properties; viscosity.

5. Reference

Text Books:

1. Ratledge C and Kristiansen B, Basic Biotechnology, Cambridge University Press, 2nd Edition, 2001

Reference Books:

1. Doi Y, Microbial Polyesters, VCH Weinheim, 1990

6. Session Plan

Topic coverage and Internal Test	***No. of Sessions*** *(in hrs.)*	***Activity*** *(lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)*	***Assignment*** *(project, assignment, field study, seminar, etc.)*	***Suggested Reading*** *(Book, Video, Online source, etc.)*
Module I		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
materials compatible with connective tissues	**4**			
Fibroin (protein in silk)	**3**			
conventional cloning methods	**4**			
Module II		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Modified carbohydrates	3			
Polydextrose	4			
artificial wood	4			
Module III		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
simple biological monomer	**2**			
Rubber llike materials produced by bacteria and fungi	**5**			

Production of a copolymer of PHB and PHV	**5**			
Module IV		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
polyphenol resins	3			
Evaluation of the properties of biopolymers	4			
visco – elastic properties	4			
Total (hrs)	**45**			

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Developed on (Month and Year): June, 2018

Bio-fertilizers and Bio-Pesticides

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Bio-fertilizers and Bio-pesticides	DEBT0504	Theory & Project	3-2-0	Microbiology

1. Objective

- Importance of Bio-fertilizer use in agriculture. Knowledge of bacterial and fungal suspensions as inoculate and their preparations.

2. Learning outcome

- Importance of biological pests and bio-pesticides in agriculture. Brief conception of Integrated Pest Management (IPM), Integrated Pest and Disease Management (IDPM)

3. Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*10*	Written examination
	Assignment	*10*	Report and Presentation
	Experiments		Lab work, report
	Project	*30*	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*50*	Written examination
Total		*100*	

4. Course outline

Module I **11hrs**

Definition of Bio-fertilizers; composition and nutritional role based classification of different bio-fertilzers viz., Composts – vermicompost and nitrogen fixers. Basic knowledge and procedure of bacterial, fungal and composite bio-fertilizer production. Role of Azola, Tichoderma Cianobacteria, Trichogramma in bio-fertilization. Importance of Bio-fertilizer use in agriculture. Knowledge of bacterial and fungal suspensions as inocula and their priparations.

Module II **12hrs**

Basic outline of processes, characteristics and significance of Biological nitrogen fixation (BNF) and Phosphate solubilizing bacteria/ micro organisms(PSB & PSM) functioning. Outline of biological nitrogen fixation from biochemical and biological points of view with special reference to different enzymes and other key role players. Biological and biochemical process of symbiosis in nitrogen fixation by Rhizobium sp. with legume plants and others.

Module III **11hrs**

Biological and biochemical process of symbiosis in nitrogen fixation by Rhizobium through root nodulation process and nitrogen fixation by it. Brief concept of nitrogen fixing genes (nif genes) --- their organization and role in the different steps of biological nitrogen fixation. Rhizosphere engineering.

Module IV **11hrs**

Definition and importance of biological pests and bio-pesticides in agriculture. Brief conception of Integrated Pest Management (IPM), Integrated Pest and Disease Management (IDPM) . Advantages of bio-pesticides over chemical pesticides and developing them . Types of Bio-pesticides with special reference to protein with anti-pest activity; the Bt gene from Bacillus thuringenensis and its proteins as biopesticide

5. Reference

Textbook

1. Stacey, Burris and Evans (ed), Biological Nitrogen Fixation, Chapman & Hall, 1992

References :

1. J K Ladha, M B Peoples, Management of Biological Nitrogen Fixation for the Development of More Productive and Sustainable Agricultural Systems, Springer
2. P.S. Nutman, Symbiotic Nitrogen Fixation in Plants, Cambridge University Press
3.Sushil K Khetan, Microbial Pest Control, Marcel Dekker
4. Opender Koul, G S Dhaliwal, Microbial Biopesticides, Taylor & Francis

6. Session Plan

Topic coverage and Internal Test	***No. of Sessions*** *(in hrs.)*	***Activity*** *(lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)*	***Assignment*** *(project, assignment, field study, seminar, etc.)*	***Suggested Reading*** *(Book, Video, Online source, etc.)*
Module I		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Definition of Bio-fertilizers	**3**			
Basic knowledge and procedure of bacterial, fungal and composite bio-fertilizer production	**4**			
Importance of Bio-fertilizer use in agriculture	**4**			

Module II		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Biological nitrogen fixation (BNF) and Phosphate solubilizing	4			
biological nitrogen fixation from biochemical and biological points of view	4			
Biological and biochemical process of symbiosis	4			
Module III		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
nitrogen fixation by Rhizobium	**3**			
Brief concept of nitrogen fixing genes	**4**			
Rhizosphere engineering	**4**			
Module IV		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
biological pests and bio-pesticides in agriculture	3			
Advantages of bio-pesticides over chemical pesticides and developing them	4			
Bt gene from Bacillus thuringenensis and its proteins as biopesticide	4			
Total (hrs)	**45**			

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Developed on (Month and Year): June, 2018

Genetics and Cytogenetic

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Genetics And Cytogenetic	DEBT0505	Theory & Project	3-0-2	

1. Objective

- The student will be able to understand and develop the concept of recombinant DNA technique
- Fundamental laws of genetics
- Types of blood groups and antigen
- Concept of sex chromosome, links, disorders and gene mapping
- Methods of identification of genetic material
- Types of genetic transfer

2. Learning outcome

- Provides an opportunity to experimentally verify the theoretical concepts of genetic engineering already studied. it also helps in understanding the theoretical principles in a more explicit and concentrated manner.
- This course introduces the fundamentals of genetics. It discusses the basics laws of chromosome structure sex linked chromosomes and inherited disorders, identification of genetic material and genetic transfer.

3. Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*10*	Written examination
	Assignment	*10*	Report and Presentation
	Experiments		Lab work, report
	Project	*30*	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*50*	Written examination
Total		*100*	

4. Course outline

Module I: Classical Genetics & Its Exceptions: 8hrs

Mendelian inheritance; multiple alleles, pseudoallele, gene interaction, complementation, Codominance, incomplete dominance, linkage, pleiotropy; recombination and chromosome mapping, sex determination; extrachromosomal inheritance, special types of chromosomes; Alterations of chromosomes: euploidy and aneuploidy, deletion, duplication, inversion and translocation their genetic implications; pedigree analysis, lod score for linkage testing, karyotypes, chromosomal abnormalities.

Module II: Linkage and Recombination Mapping: 8hrs

Chromosome structure and organization, giant chromosomes, Linkage and crossing over, cytological basis of crossing over – Sterns experiment, Mapping – two and three factor cross, preparation of linkage map, somatic cell hybridization, CGH.

Module III: Gene Mutation and Cancer: 8hrs

Gene Mutation: Induced and spontaneous mutation, mutation Types, causes and detection, mutant types. Molecular basis of genetic diseases. Applications of genetic disorders: Cancer Genetics: Genetic rearrangements in progenitor cells, oncogenes; proto-oncogenes; tumour suppressor genes – p53, RB and others, virus-induced cancer, cancer and the cell cycle.

Module IV: Microbial Genetics : 8hrs

Biochemical genetics. Bacterial Genetics: plasmids, transposon; Gene transfer: transformation, transduction, conjugation; recombination and complementation analysis; gene mapping. Viral genetics: genetics of animal virus: polio, HIV and adenovirus, Bacteriophage: genetics of lambda, M13, T4 and T7;

Module V: Recombination and Mapping in Bacteria: 6hrs

Mechanisms of recombination, Mapping – transformation, Transduction mapping – generalized and specialized transduction, conjugation – interrupted mating analysis, Fine structure in merozygotes.

Module VI: Population Genetics 5hrs

Hardy Weinberg equilibrium, calculating allelic frequency, Application of Hardy Weinberg equilibrium, Random genetic drift, founders effect, genetic equilibrium.

5. Reference

Text Books:

1. Gardner, Simmons, Sunstad, "Principles of Genetics," 8 th edition – John Wiley and Sons, Inc., 2003.

2. Introduction to Genetic Analysis, 8th edition, Anthony J. F. Griffiths, Jeffrey H. Miller, David T. Suzuki, Richard C. Lewontin, and William M. Gelbart. Pub: W.H. Freeman & Co.
3. Principles of Genetics, 5th edition. D. Peter Snustad, Arthur J. Simmons. Pub: John Wiley & Sons.
4. iGenetics: a Conceptual Approach, 3rd edition, Peter J. Russell. Pub: WH Freeman & Co.
5. Microbial Genetics, 2nd edition, Stanley R. Maloy, John E. Cronan, David Freifelder. Pub: Jones and Bartlett Publisher Inc.

Reference Books:

1. Genetics: Principles and Analysis, 4th edition. D.L. Hartl, D.W. Jones. Pub: Jones and Barlett Publishers
2. Introduction to Biostatistics, 2nd edition, Pranab Kumar Banerjee. Pub: S. Chand & Co.
3. Genetics, 9th revised multicolor edition. P.S. Verma & V.K. Agarwal. Pub: S. Chand & Co.
4. Freifelder`s Essentials of Molecular Biology 4th Edn. G.M. Malacinski , Narosa pub

7.Session Plan

Topic coverage and Internal Test	***No. of Sessions*** *(in hrs.)*	***Activity*** *(lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)*	***Assignment*** *(project, assignment, field study, seminar, etc.)*	***Suggested Reading*** *(Book, Video, Online source, etc.)*
Module I		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Mendelian inheritance	**2**			
special types of chromosomes	**3**			
Alterations of chromosomes	**3**			
Module II		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Chromosome structure and organization	3			
Linkage and crossing over	3			
somatic cell hybridization	2			
Module III		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Gene Mutation	**3**			
Molecular basis of genetic diseases	**2**			
Cancer Genetics	**3**			
Module IV		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Biochemical genetics	3			
Gene transfer	3			
Viral genetics	2			
Module V		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Mechanisms of recombination	3			
Transduction mapping	2			

Fine structure in merozygotes	3			
Module VI		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Hardy Weinberg equilibrium	2			
Application of Hardy Weinberg equilibrium	1			
Random genetic drift	2			
Total (hrs)	**45**			

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Developed on (Month and Year): June, 2018

Molecular Modeling and Drug Designing

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Molecular Modeling And Drug Designing	DEBT0506	Theory & Project	3-2-0	

1. Objective

- Fundamentals of Computer Aided Drug Designing (CADD)
- Drug development
- Methods and applications

2. Learning outcome

- This subject portraits the fundamentals and applications of computer aided drug designing

3. Evaluation Systems

Key points: State clearly the components, weights and methods of evaluation system.

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*10*	Written examination
	Assignment	*10*	Report and Presentation
	Experiments		Lab work, report
	Project	*30*	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*50*	Written examination
Total		*100*	

4. Course outline

Module I: Introduction To Molecular Simulation Techniques: 5hrs

Monte Carlo Methods-Metropolis Monte Carlo Algorithm, Flow calculations in Metropolis Monte Carlo Algorithm with examples- Ising Lattice, Gibbs Ensemble Monte Carlo Simulations. Molecular Dynamics Methods-different methods for the integration of Dynamical Equations, Molecular Dynamics of rigid non linear poly atomic molecules in other ensembles, Structural information from M.D.

Module II: Drug Delivery System **5hrs**

Various dosage forms, advantages and disadvantages. Controlled and Sustained drug delivery mechanism and the role of biopolymers. Futuristic perspective on bio - watches for serological analysis, titration of dose and release of the medication.

Module III: Drugs Acting On Nervous System **5hrs**

Molecular mechanism of neuro-transmission – Action potential, Threshold potential, RMP, EPSP and IPSP.Various neurotransmitter and cross-talk.Effects of agonist and antagonist in adrenergic and cholinergic receptors.

Module IV: Biotechnology In Cardio Vascular Disorders **5hrs**

Introduction to CVS disorders – pulmonary thrombo-embolism, valvular disorders, heart bloc, ischemia and myocardial infarction. Biopolymers – stents, artificial blood vessels and valves. Pace maker and artificial heart - lung machine. Rennin - angiotensin mechanism for blood pressure regulation. Dialyzer.

Module V: Biocatalysis **5hrs**

Prostaglandin synthesis, biocatalytic routes for the synthesis of – antiinflammatory drugs, anticholesterol drugs, calcium channel blockers, potassium channel openers and anti-arrhythmic agents.Chiral compound (teratogenecity) synthesis (ACE inhibitors) with help of biocatalysis.

Module VI: Vaccine Technology **5hrs**

Conventional vaccines, antiidiotype vaccine, naked DNA vaccine and ISCOM's. Vaccines against Hepatitis A, Malaria,Typhoid and HIV (in clinical trials).

5. Reference

Text Books:

1. Tripathi.K.D, "Essentials of Medical Pharmacology," 6th Edition, Jaypee publications, 2008.
2. Crommelin.D.J.A, Robert D. Sindela, "Pharmaceutical Biotechnology," 2nd Edition - 2004.
3. Remington,"The science and Practice of Pharmacy," by Vol. I and II, 20th Edition, 2007.

Reference Books:

1. "Medicinal chemistry: A molecular and biochemical approach," 3 rd Edition, OUP, 2005.
2. Gary Walsh, "Pharmaceutical Biotechnology-Concepts and Applications," Wiley, 2007.
3. Stanbury.P.F, Whitaker.A and Hall.S.J, "Principles of Fermentation Technology", 2nd Edition, Aditya Books (P) Ltd, 1995.
4. Hugo.W.B and Russel.A.D, "Pharmaceutical Microbiology", 6th Edition, Blackwell Science, 2003

6. Session Plan

Topic coverage and Internal Test	***No. of Sessions*** *(in hrs.)*	***Activity*** *(lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)*	***Assignment*** *(project, assignment, field study, seminar, etc.)*	***Suggested Reading*** *(Book, Video, Online source, etc.)*
Module I		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Monte Carlo Methods	**3**			
Gibbs Ensemble Monte Carlo Simulations	**2**			
Molecular Dynamics Methods	**3**			
Module II		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Various dosage forms	3			
Controlled and Sustained drug delivery mechanism	3			
titration of dose and release of the medication.	2			
Module III		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Molecular mechanism of neuro-transmission	**3**			
Various neurotransmitter	**2**			
Effects of agonist and antagonist	**3**			
Module IV		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Introduction to CVS disorders	3			
Biopolymers	2			
Pace maker and artificial heart	3			
Module V		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Prostaglandin synthesis	3			
anti inflammatory drugs	3			
Chiral compound	2			
Module VI		*lecture, tutorial*	*project, assignment,*	*Book, Video,Notes*
Conventional vaccines	1			

naked DNA vaccine	2			
Vaccines against Hepatitis A, Malaria, Typhoid and HIV (in clinical trials)	2			
Total (hrs)	**45**			

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Developed on (Month and Year): June, 2018

Genetics Lab

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Genetics Lab	DEBT0601	Project &Practical	0-2-3	

1. **Objective**

- To impart knowledge about practical importance of Cell biology and genetics that was taught in the earlier Semesters

2. Learning outcome

- Provides an opportunity to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner .

3. Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test		Written examination
	Assignment		Report and Presentation
	Experiments	*30*	Lab work, report
	Project	*30*	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*40*	Written examination
Total		*100*	

4. Course outline

1. Preparation of different stages of Mitosis and Meiosis
2. Karyotype analysis and Ideogram preparation of plant/animal/human chromosomes.
3. Estimation of mitotix index
4. Study of chromosomal aberrations in mouse bone marrow cell and plant cells.
5. Barr body preparation from buccal smear.
6. Pedigree analysis
7. Finding statistical significance of a given data using ‘t test’
8. Analysis of Sister chromatid exchange
9. Extraction of Chromatin
10. Extraction and Electrophoresis of Histones

5. *Reference*

Text Books:

1. Lab Manual

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Bimolecular Analysis Lab

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Bimolecular Analysis Lab	DEBT0602	Project & Practical	0-2-3	

1. Objective

- To learn about the biomolecules in practical

2. Learning outcome

- Provides an opportunity to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner .

3. Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test		Written examination
	Assignment		Report and Presentation
	Experiments	*30*	Lab work, report
	Project	*30*	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*40*	Written examination
Total		*100*	

4. Course outline

1. Theory, operation and handling of instruments to be used in this Lab course;
2. Estimation of DNA in solution;
3. Estimation of protein in solution;
4. Estimation of carbohydrate;
5. Enzyme Linked Immuno Assay;
6. Purification of protein by chromatography;
7. Equilibrium unfolding of a protein;
8. Gel electrophoresis of protein;
9. Study of Enzyme kinetics.

5. Reference

Text Books:

Lab Manual

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Developed on (Month and Year): June, 2018

Cancer Stem Cell Biology Lab

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Cancer Stem Cell Biology Lab	DEBT0603	Project & Practical	0-2-3	

1. Objective

- To provide knowledge about biological aspects of cancer

2. Learning outcome

- To impart basic concepts of cancer biology, various stages in carcinogenesis, molecular cell biology of cancer, cancer metastasis, and cancer therapy.

3. Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test		Written examination
	Assignment		Report and Presentation
	Experiments	*30*	Lab work, report
	Project	*30*	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*40*	Written examination
Total		*100*	

4. Course outline

1. General Safety/use of micropipettes and other equipment
2. ELISA/Epidemiology
3. ATCC resource
4. Laboratory Safety Training and Working with Biohazardous Materials
5. MTT/XTT Assay/IC50 determination
6. RNA extraction & rtPCR Cell Culture Techniques
7. Immunofluorescence –Flow Cytometry/Cell cycle analysis
8. Cell Lysis and Protein Assay

5. Reference

Text Books:

Lab Manual

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Developed on (Month and Year): June, 2018

Fermentation Technology

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Fermentation Technology	DEBT0604	Project & Practical	0-2-3	

1. Objective

- To impart knowledge about enzyme kinetics, fermenters, and industrial biotechnology

2. Learning outcome

- Enable the student to understand the practical aspects of fermentation technology

3. Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test		Written examination
	Assignment		Report and Presentation
	Experiments	*30*	Lab work, report
	Project	*30*	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		*40*	Written examination
Total		*100*	

4. Course outline

1. Batch Fermentation and Recovery and Assay of Antibiotics (Penicillin/Streptomycin or any enzyme of the institutions choice)
2. Production of Alcohol (Fermentation and Recovery) (i) Using Molasses/ Sugarcane Juice (Batch) (ii) Using Immobilized Mo's (Batch and Continuous)
3. Batch Fermentation of Organic Acid
4. Batch and Immobilized Fermentation of Bacterial/Fungal Enzymes (Amylases / Proteases or any enzyme of the institutions choice) (Fermentation, Recovery and Assay).
5. Solid State Fermentation (Moulds/ Fungus).
1. Effect of pH on enzyme activity
2. 4. Effect of temperature on enzyme activity
6. Effect of inhibitors on enzyme activity
7. Immobilization of enzymes – Entrapment Method

5. Reference

Text Books:

Lab Manual

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