

DR. HARISINGH GOUR VISHWAVIDYA
(A CENTRAL UNIVERSITY)

M.Sc. Biotechnology: IV Semester Course
Curriculum: 2017
Onwards

A) General:

1. Name of the Program: M. Sc. Biotechnology

2. Duration of the Program:

- a) Minimum duration: 2 years
- b) Maximum duration: 4 years

3. Structure of the Program:

- a) Number of core courses: 16 (60 credits)
- b) Minimum number of Elective courses to be opted by the student: 5 (18 credits)
(Note: 4 elective course of 4 credits (at least 2 should be from the department) each and one elective of 2 credits)
- c) Minimum number of Open elective courses to be opted by the student: 1 (2 credits)

4. Scheme of Examination:

- a) Mid Semester Examination: 20 marks
- b) Internal Assessment: 20 marks
- c) End Semester Examination*: 60 marks

Internal Assessment:

a) Theory:

- Assignment/presentation/group discussion: 15 Marks
- Attendance: 05 Marks

The marks for attendance shall be awarded as follows:

- i) 75% and below : 00 marks
- ii) >75% and upto 80% : 01 marks
- iii) >80% and upto 85% : 02 marks
- iv) >85% and upto 90% : 02 marks
- v) >90% and upto 95% : 04 marks
- vi) >95% : 05 marks

b) Practical/Lab Course:

- (i) Performing and getting the experiment checked regularly and incorporating the suggestions in the practical note book : 15 Marks
- (ii) Attendance : 05 Marks

The marks for attendance shall be awarded as follows:

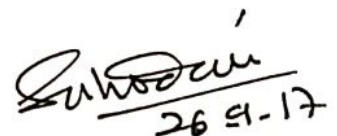
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|------------------------|------------|
| i) 75% and below | : 00 marks |
| ii) >75% and upto 80% | : 01 marks |
| iii) >80% and upto 85% | : 02 marks |
| iv) >85% and upto 90% | : 02 marks |
| v) >90% and upto 95% | : 04 marks |
| vi) >95% | : 05 marks |

(iii) End Semester Examination for Practical/Lab Courses (60 marks)

- | | |
|---|------------|
| (a) Assessment of performance in the experiment | : 50 Marks |
| (b) Viva-voce of experiment | : 10 Marks |

* To appear in the End Semester Examination the student must appear in Mid Semester Examination and Internal Assessment.




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M. Sc. Program (Biotechnology) Structure and Scheme

Semester	Paper Code	Title of the Paper	Credit			
			L	T	P	C
I	BIT CC 121	Cell Biology and Genetics	4	0	0	4
	BIT CC 122	Biochemistry	4	0	0	4
	BIT CC 123	Microbial Physiology	4	0	0	4
	BIT CC 124	Lab Course 1	0	0	2	2
	BITCC 125	Lab Course 2	0	0	2	2
	BIT OE 126	Scientific Writing and Presentation	1	0	1	2
	BIT SE 127	Biofuel Technology	3	0	1	4
	BIT SE 128	Instrumentation	3	0	1	4
II	BIT CC 221	Molecular Biology	4	0	0	4
	BIT CC 222	Bioinstrumentation & Bioinformatics	4	0	0	4
	BIT CC 223	Immunology	0	0	2	2
	BIT CC 224	Lab Course 3	0	0	2	2
	BIT CC 225	Lab Course 4	0	0	4	4
	BIT SE 226	Lab Based Project Work	3	0	1	4
	BIT SE 227	Environmental Biotechnology	3	0	1	4
	BIT SE 228	Biostatistics	3	0	1	4
III	BIT CC 321	Animal Biotechnology	3	0	1	4
	BITCC 322	Genetic Engineering	3	0	1	4
	BIT CC 323	Bioprocess Engineering and Technology	3	0	1	4
	BIT CC 324	Lab Course 5	0	0	2	2
	BIT CC 325	Lab Course 6	0	0	2	2
	BIT SE 326	Plant tissue culture	3	0	1	4
	BIT SE 327	Basic Virology	4	0	0	4
	BIT SE 328	Biostatistics	3	0	1	4
IV	BIT CC 421	Semester Long Dissertation/Project Work/Practical Training/Field Work, and Technical Writing.	12 Credits			

BIT: Biotechnology
SE: Self Elective
P: Practical

CC: Core Course
L: Lecture
C: Credits

OE: Open Elective
T: Tutorial

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Semester-I

Course code: BIT C 121

Course name: Cell Biology and Genetics

L	T	P	C
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UNIT	Content	Contact Hours
I	Cell organelles: Structure & Function: Structure of Prokaryotic and Eukaryotic cell, Plasma membrane, Cell wall, Nucleus, Mitochondria, Golgi bodies, Lysosomes, Endoplasmic Reticulum, Peroxisomes, Plastids, Vacuoles and Chloroplast. Cell motility- cilia and flagella.	14.5
II	Techniques in cell biology: Sub-cellular fractionation, microscopic techniques (light microscopy, electron microscopy, fluorescence and confocal microscopy, flow cytometry), cytochemical methods	14.5
III	Cellular Energy Transactions: Glycolysis, Krebs's cycle and respiration (role of mitochondria and chloroplast), Protein localization: synthesis of secretory and membrane proteins, import into nucleus, mitochondria, chloroplast and peroxisomes	14.5
IV	Cell signaling: mechanisms of signal transduction, types of signal and response, cell surface and intracellular receptors, classes of cell surface receptors. Signal transduction via GPCRs. Receptor mediated endocytosis	14.5
V	Cell division: mitosis and meiosis, homologous recombination. Cell cycle- steps and control of cell cycle. Cancer and cell cycle. Development in drosophila: spatial and temporary regulation of gene expression.	14.5

Essential Readings:

- 1) B. Alberts et. al., Molecular Biology of Cell, Garland Science, 2014, 6th edition
- 2) H. Lodish et.al., Molecular Cell Biology, W H Freeman & Co (Sd), 2016, 8th edition
- 3) E. D. P De Robertis, Cell and Molecular biology, Wolter Kluwer, 2011.
- 4) G. Karp, Cell Biology, Wiley, 2013, 7th edition

Suggested Reading:

- 1) S. F. Gillbert, Developmental Biology, Sinauer, 2016, 11th edition
- 2) B. Lewin, Cells, Jones & Bartlett Pub, 2006, 1st edition

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Course code: BIT C 122
Course name: Biochemistry

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4	0	0	4

UNIT	Content	Contact Hours
I	Nucleotides, DNA: Structure, types and functions. RNA: Structure, types and functions. Molecular structure of Ribosome structure & function. Chromosome organization & histone proteins.	14.5
II	Enzymes: Structure and classification. Enzymes as biological catalysts. Isozymes, Vitamins and cofactors, Ribozymes: structure and function, Mechanism of enzyme action, Enzyme inhibition: competitive, non-competitive, allosteric inhibition.	14.5
III	Carbohydrates- classification and reactions. Lipids- classification, structure and functions. Glycolipids and phospholipids, structure and function plasma membrane.	14.5
IV	Amino acids and peptides- classification, chemical reactions and physical properties. Proteins- classification and separation, protein primary, secondary, Tertiary and quaternary structure. Basic concept of protein folding & denaturation	14.5
V	Concept of Photosynthesis, Light reaction of photosynthesis, Biochemistry of C3 and C4 cycle, pentose phosphate pathway and its regulation, Glycogen metabolism: synthesis and metabolism	14.5

Essential Readings:

- 1) D. Voet and J. G. Voet, Biochemistry, J. Wiley & Sons, 2011, 4th edition
- 2) L. Pauling, General Chemistry, www.bnpublishing.com, 2011
- 3) D. L. Nelson and M. Cox, Lehninger Principles of Biochemistry, WH Freeman, 2017, 7th edition
- 4) J. M. Berg, et. al., Biochemistry, WH Freeman, 2015, 8th edition

Suggested Readings:

- 1) H. Lodish, et.al., Molecular Cell Biology, W H Freeman & Co (Sd), 2016, 8th edition
- 2) E. D. P De Robertis, Cell and Molecular biology, Wolter Kluwer, 2011.

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Course code: BIT C 123

Course name: Microbial Physiology and Genetics

UNIT	Content	L	T	P	C
		4	0	0	4
		Contact Hours			
I	The history and development of Microbiology, contribution of Leeuwenhoek, Pasture, Jenner, Koch. Microbial nutrition, Microbial growth: Culture media (Synthetic and complex), batch and continuous culture, Factors affecting microbial growth. Growth curve. Physical and chemical control of microorganisms.				14.5
II	Microbial metabolism and its importance: Anaerobic respiration, fermentation, chemolithotrophy, phototrophy, CO ₂ fixation				14.5
III	Gene structure, mutation and mutagenesis: UV and chemical mutagens; types of mutations, methods of genetic analysis. Bacterial Genetic System: transposable elements, plasmids, transformation, conjugation, transduction, bacterial genetic map with reference to E. Coli.				14.5
IV	Etiology, prevention and cure of Microbial diseases: Tuberculosis, AIDS and Malaria. Antimicrobial agents, Antibiotics, Sulfa drugs, Antifungal drugs.				14.5
V	Applied microbiology: Microbiology of fermented food, probiotics, microorganisms used in industrial microbiology, major products of industrial microbiology				14.5

Essential Readings:

- 1) J. Willey, et. al., Prescott's Microbiology, McGraw Hill Education, 2011, 8th edition
- 2) M. J. Pelczar, et. al., Microbiology, McGraw Hill Education, 2001, 5th edition
- 3) R. Ananthanarayan, A & P Textbook of Microbiology, Orient Blackswan, 2013, 9th edition
- 4) G. J. Tortora, et. al., Microbiology, Pearson Education India, 2016, 11th edition

Suggested Readings:

- 1) D. Anderson, Nester's Microbiology: A Human Perspective, McGraw Hill Education, 2016, 8th edition

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Course code: BIT C 124
Course name: Lab Course 1

L	T	P	C
0	0	2	2

1. Observation of cells by light microscopy.
2. Staining of mitochondria
3. Staining of DNA and RNA
4. Cytochemical techniques
5. Observation of mitosis and meiosis.
6. Sub cellular fractionation.
7. Preparation of liquid and solid media for growth of microorganisms.
8. Isolation of pure culture from soil by serial dilution method.
9. Maintenance of organisms by plating, streaking, slants and stab cultures.
10. Preparation of glycerol stocks.
11. Gram staining

Essential Readings:

- 1) J. Davey and J.M. Lord, Essential Cell Biology Vol 1: Cell Structure (A practical approach), Oxford University Press, 2003
- 2) J. Davey and J.M. Lord, Essential Cell Biology Vol 2: Cell Function (A practical approach), Oxford University Press, 2003
- 3) J. P. Harley, Laboratory exercises in Microbiology, McGraw-Hill Higher Education, 2004, 6th edition

Suggested Readings:

- 1) J. E. Celis, Cell Biology: A laboratory handbook (Vol 1-4), Elsevier Academic Press, 2008, 3rd edition
- 2) E. Goldman and L. H. Green, Practical Handbook of Microbiology, CRC press, 2015, 3rd edition

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Course code: BIT C 125
Course name: Lab Course 2

L	T	P	C
0	0	2	2

1. Preparation of different buffers in biochemistry buffers and pH measurement
2. Isolation and quantization of protein by spectrophotometric method.
3. Enzyme isolation, quantification and kinetic analysis.
4. Reactions of amino acids, sugars including diagnostic tests
5. Isolation, purity & quantization of DNA and RNA.
6. Electrophoresis of proteins-native and under-denaturing conditions.
7. Methods for immobilization of enzymes.
8. Enzyme isolation from various tissues, precipitation methods for purification of enzyme proteins

Essential Reading:

- 1) H. Miller, et al., Molecular Biology Techniques, Elsevier Academic Press, 2011, 3rd edition
- 2) W. Ream and K. G. Field, Molecular Biology Techniques: An Intensive Laboratory Course, Elsevier Academic Press, 1998, 1st edition

Suggested Reading:

- 1) M. R. Green and J. Sambrook, Molecular Cloning: A Laboratory Manual (3 Volumes), Cold Spring Harbor Laboratory Press, 2012, 4th edition

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Course code: BIT E 126 (Open)
Course name: Scientific Writing and Presentation

L	T	P	C
1	0	1	2

UNIT	Content	Contact Hours
I	Searching and reviewing scientific articles. Publishing in scientific journals.	3.5
II	Art of scientific presentations. PowerPoint presentations, animations. Do's and Don'ts of presentations. Efficient speech.	3.5
III	Making Posters. Presenting a poster in record time. Do's and Don'ts of posters.	3.5
IV	Dissertation writing. Thesis writing. Article writing. Fellowship/scholarship application writing.	3.5
V	Reading - understand scientific texts in science.	3.5

Practicals:

- 1) Prepare a PowerPoint Presentation
- 2) Deliver a scientific seminar.
- 3) Write a given assignment.

Essential Readings:

- 1) M. Davis, et al., Scientific Papers and Presentations, Elsevier Academic Press, 2012, 3rd edition
- 2) J. Giba and R. Ribes, Preparing and Delivering Scientific Presentations: A Complete Guide for International Medical Scientists, Springer, 2011

Suggested Readings:

- 1) Recent research and review articles from reputed impact journals.

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Course code: BIT E 127

Course name: Biofuel Technology

L	T	P	C
4	0	0	4

UNIT	Content	Contact Hours
I	Introduction and history of Biofuels, energy units, terminologies. Energy security, renewable energy sources, types of biomass and available bioresources. Concept of first and second generation bioenergy. International regulations and recommendations.	14.5
II	Overview of Biorefinery and Biomass Process. Biochemical Conversion Process, bioethanol production from 1st and 2nd generation biomass feedstocks. Biohydrogen and biomethane energy.	14.5
III	Lignocellulosic bioethanol: current status and future perspectives. Techno-economic analysis of lignocellulosic ethanol Pretreatment technologies for lignocellulose-to-bioethanol conversion. Production of bioethanol from agroindustrial residues as feedstocks.	14.5
IV	Production of biodiesel from vegetable oils. Biotechnological methods to produce biodiesel, Biodiesel production in supercritical fluids.	14.5
V	Production of biofuels from algae. Production of biodiesel from algal biomass: current perspectives and future. Cultivation of algae in photobioreactors for biodiesel production.	14.5

Essential Reading:

- 1) R. C. Brown and T. R. Brown, Biorenewable Resources: Engineering New Products from Agriculture, Wiley-Blackwell, 2014, 2nd edition
- 2) D. Klass, Biomass for Renewable Energy, Fuels, and Chemicals, Elsevier Academic Press, 1998, 1st edition
- 3) R. B. Gupta and A. Demirbas, Gasoline, Diesel and Ethanol Biofuels from Grasses and Plants, Cambridge University Press, 2010, 1st edition

Suggested Readings:

- 1) C. Drapcho, et al., Biofuels Engineering Process Technology, McGraw Hill Education, 2008.




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Course code: BIT E 128
Course name: Instrumentation

L	T	P	C
3	0	1	4

UNIT	Content	Contact Hours
I	Good lab practice and laboratory safety procedure. Preparation of solutions. General lab setup and waste disposal.	11
II	Lab instruments: handling and principle of Autoclave, pH meter, CO ₂ incubator, Biosafety cabinets, water purifier.	11
III	Basics of centrifugation and types of centrifugation (differential, density gradient and ultracentrifugation), Nanobiotechniques, analysis of nanoparticles.	11
IV	Analysis of biomolecules: UV transilluminator, PCR and RT-PCR, DNA sequencer, FRET.	11
V	Specialized instruments: Flow Cytometer, Fermentor, Patch-clamp.	11

Practicals

- 1) Study of various types of Microscope.
- 2) Sterilization by autoclave.
- 3) Cell fractionation by Centrifuge.
- 4) Separation of proteins by SDS-PAGE.
- 5) Study of DNA bands by Transilluminator.
- 6) Quantification of DNA by UV spectrophotometer.
- 7) DNA sequencing.
- 8) Demonstration of fermentation.

Essential Reading:

- 1) B. Sivasankar, Instrumental Methods of Analysis, Oxford University Press, 2012
- 2) K. Wilson and J. Walker, Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, 2013, 7th edition
- 3) J. Masters, Animal Cell Culture: A Practical Approach, Oxford University Press, 2000, 3rd edition

Suggested Reading:

- 1) R. I. Freshney, Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, Wiley-Blackwell, 2016, 7th edition

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Semester-II

Course code: BIT C 221

Course name: Molecular Biology

L	T	P	C
4	0	0	4

UNIT	Content	Contact Hours
I	Introduction to Molecular Biology and Genetics. Flow of genetic information. Anatomy of gene, gene structure of prokaryotes and eukaryotes. Genome organization.	14.5
II	DNA Replication: Prokaryotic and Eukaryotic DNA replication, enzymes and accessory proteins involved in DNA replication. DNA repair and recombination.	14.5
III	Transcription: Prokaryotic and Eukaryotic transcription, RNA polymerase. Transcription factors, regulatory elements and mechanisms of transcriptional regulation. Alternative splicing. Modification in RNA: 5'-Cap formation, transcription termination, 3-end processing and polyadenylation, splicing, editing, nuclear export of mRNA, mRNA stability.	14.5
IV	Translation: Prokaryotic and Eukaryotic translation, translation machinery, mechanisms of initiation, elongation and termination, regulation of translation. Co- and post-translation modification in proteins.	14.5
V	Control of gene expression in Prokaryotes: DNA binding proteins, posttranscriptional control of gene expression. Control of gene expression in Eukaryotes: enhancers, chromatin remodeling, posttranscriptional control of gene expression. Antisense RNA, role of epigenetics in regulation of gene expression.	14.5

Essential Reading:

- 1) B. Lewin, Gene IX, Oxford University press, 2007, 9th edition
- 2) H. Lodish, et.al., Molecular Cell Biology, W H Freeman & Co (Sd), 2016, 8th edition
- 3) G. Karp, Cell Biology, Wiley, 2013, 7th edition
- 4) D. Voet and J. G. Voet, Biochemistry, J. Wiley & Sons, 2011, 4th edition

Suggested Reading:

- 1) J. M. Berg, et. al., Biochemistry, WH Freeman, 2015, 8th edition
- 2) B. Alberts and A. Johnson, Molecular Biology of Cell, Garland Sciences, 2014, 2014.

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Course code: BIT C 222

Course name: Bioinstrumentation & Bioinformatics

L	T	P	C
4	0	0	4

UNIT	Content	Contact Hours
I	Principle of centrifugation, preparative and analytical centrifugation, Principle of Chromatography, planar and column chromatography, paper chromatography, Thin layer chromatography, High performance liquid chromatography and Gas Chromatography	14.5
II	Spectroscopic techniques: Principle of spectroscopy (emission and absorbance), Visible, UV, atomic absorption and fluorescence spectroscopy and NMR spectroscopy.	14.5
III	Microscopy: Light and compound microscopy, Phase contrast, confocal, scanning & transmission electron microscopy.	14.5
IV	Introduction of digital computers: organizations; low-level and high-level and languages. Binary number system. Introduction to MS- office software, covering word processing, spreadsheets and presentation software. Introduction to internet and various search engines and their applications.	14.5
V	Tools for sequence alignment. Alignment of pairs of sequence. Alignment of multiple sequences. Primer designing, Gene analysis, Gene Prediction method.	14.5

Essential Reading:

- 1) K. Wilson and J. Walker, Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, 2013, 7th edition
- 2) B Sivasankar, Instrumental Methods of Analysis, Oxford University Press, 2012
- 3) P.K. Sinha, Computer Fundamentals, BPB publications, 2004
- 4) Lesk, Introduction to Bioinformatics, Oxford University Press, 2014, 4th edition

Suggested Reading:

- 1) B. Williams and S. Sawyer, using information technology: a practical introduction to computers & communications, McGraw Hill Education, 2005, 6th edition
- 2) R. Greenlaw, inline/online: fundamentals of the internet & the world wide web, McGraw Hill Education, 2005, 2nd edition

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Course code: BIT C 223
Course name: Biology of Immune System

L	T	P	C
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UNIT	Content	Contact Hours
I	I Introduction to immune system, features of innate and adaptive immunity, Cells, tissues and organs of the immune system. Innate immunity: recognition of microbe by innate immunity, properties and components of innate immunity, innate immune cells and mechanism.	14.5
II	Antigen capture and presentation: major histocompatibility complex (MHC), classification: MHC Class I and Class II, structure, genes, antigen peptides binding to MHC complex, processing and presentation of antigen proteins.	14.5
III	Antigen recognition: Antibody structure, T cell receptor complex (TCR complex) structure, types of antibodies and function, antibody production, production of diverse antigen receptors: antibodies and T cell receptors, B cell maturation process and T cell maturation process.	14.5
IV	T-cell activation mechanism, clonal expansion and development of memory T cells, functions of helper T cells and cytotoxic T cells, B cell activation mechanism, primary and secondary immune response, T cell dependent antibody response, antibody mediate effector functions.	14.5
V	Immune regulation: significance and mechanisms, T cell tolerance and B cell tolerance, autoimmunity: Pathogenesis, genetic factors and role of infection and environment.	14.5

Essential Reading:

- 1) A. K. Abbas, et. al., Basic Immunology: Functions and Disorders of the Immune System, Elsevier, 2015, 5th edition
- 2) A. K. Abbas, et. al., Cellular and Molecular Immunology, Elsevier, 2017, 9th edition
- 3) J. A. Owen, et. al., Kuby Immunology, W H Freeman & Co, 2013, 7th edition
- 4) I. Tizard, Immunology: An Introduction, Cengage Learning, 2005

Suggested Reading:

- 1) P. J. Delves, Roitt's Essential Immunology, Wiley-Blackwell, 2017, 13th edition
- 2) W. E. Paul, Fundamental Immunology, Lippincott Williams & Wilkins, 2012, 7th edition

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Course code: BIT C 224
Course name: Lab Course 3

L	T	P	C
0	0	2	2

Practicals:

1. Isolation of genomic DNA.
2. Visualization of DNA using EtBr.
3. Restriction digestion of genomic DNA.
4. Plasmid DNA isolation.
5. Electrophoresis of DNA- linear, circular and super coiled plasmid.
6. Plasmid restriction map.
7. RFLP and RAPD
8. Western blotting.
9. Blood film preparation and identification of cells.
10. Isolation of WBCs using density gradient centrifugation
11. Radial immunodiffusion
12. Immuno-electrophoresis.
13. Immunodiagnosics (demonstration using commercial kits).

Essential Reading:

- 1) T. Brown, Essential Molecular Biology: Volume I: (Practical Approach Series), Oxford University Press, 2000, 2nd edition
- 2) T. Brown, Essential Molecular Biology: Volume II: (Practical Approach Series), Oxford University Press, 2000, 2nd edition
- 3) F. C. Hay and O. M. R. Westwood, Practical Immunology, Wiley-Backwell, 2002, 4th edition

Suggested Reading:

- 1) M. R. Green and J. Sambrook, Molecular Cloning: A Laboratory Manual (3 Volumes), Cold Spring Harbor Laboratory Press, 2012, 4th edition

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Course code: BIT C 225
Course name: Lab course 4

L	T	P	C
0	0	2	2

Practicals:

1. Operating system commands.
2. Document preparation and formatting.
3. Power point presentation.
4. Web development using front page.
5. Website surfing on the basis of Unit V.
6. Sequence analysis, BLAST, NCBI search methods
7. Separation by Chromatography.
8. Analysis of DNA and protein by electrophoresis.
9. Experimental demonstration of TEM, SEM and Confocal Microscopy
10. Measurement of bacterial population by turbidometry and photometry.

Essential Reading:

- 1) K. M. Mooring, Computer Fundamentals: A Practical Guide, Kendall Hunt Pub Co, 2009
- 2) J. J. Parsons and D. Oja, Practical Microsoft Office 2013, South-Western College Publishing, 2013
- 3) M. Agostino, Practical Bioinformatics, Garland Sciences, 2012, 1st edition
- 4) M. R. Green and J. Smbrook, Molecular Cloning: A Laboratory Manual (3 Volumes), Cold Spring Harbor Laboratory Press, 2012, 4th edition

Suggested Reading:

- 1) J. Pevsner, Bioinformatics and Functional Genomics, Wiley-Backwell, 2015, 3rd edition
- 2) K. Wilson and J. Walker, Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, 2013, 7th edition



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Course code: BIT E 226

Course name: Lab Based Project Work

L	T	P	C
0	0	4	4

The purpose of the course is to improve the student's ability to apply basic concepts and knowledge through laboratory based project work. The course will comprise of a mini project to solve or address a simple question or to improve/develop expertise of a particular technique through hands on experiments and generate data. The data will be interpreted and submitted as a project report and also be presented.

Evaluation:

- a) First periodic assessment of the progress after 08 weeks : 20 marks
- b) Second periodic assessment of the progress after 12 weeks : 20 marks
- c) End semester examination will consist of : 50 marks
 - i) Evaluation of project report/presentation : 10 marks
 - ii) Viva-Voce of the project

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Course code: BIT E 227

Course name: Environmental Biotechnology

L	T	P	C
3	0	1	4

UNIT	Content	Contact Hours
I	Wastewater Treatment Technologies: Sampling Techniques - Methods of Analysis - Characterization, origin of wastewater, sources and classification of water pollutants. Primary treatment, sedimentation, flocculation, flotation.	11
II	Solid Waste Management: Definition of solid wastes-types of domestic solid wastes, collection, transportation, characteristics of solid waste, segregation, types of disposal methods, sanitary land fill, incineration, composting techniques, vermicompost, recovery of energy from solid wastes.	11
III	Sanitation: Sanitation-Communicable diseases, methods of infection transmission, water and air contamination, spread of infectious diseases and control measures.	11
IV	Industrial Pollution: Waste generation and characterization from different industries like paper and pulp, breweries and distilleries, refinery industry, detergent industry, bulk agricultural industry and techniques of bioconversion.	11
V	Environmental Quality Assessment And Monitoring: Quality of environment for life. Methods of assessment of environmental quality and rapid assessment technique. Short and long term monitoring of environment quality. Deterioration of environmental quality with reference to anthropogenic impact and their conservation	11

Practicals:

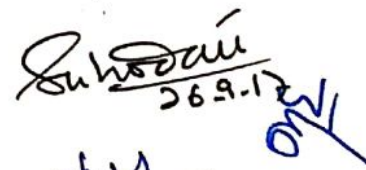
- 1) Quality of water, air and general public utilities
- 2) Vermicomposting
- 3) Plastic waste/lab waste/ biowaste management
- 4) Agricultural waste management
- 5) Microflora analysis of soil
- 6) Modules of composting
- 7) Water harvesting
- 8) Treatment of wastewater
- 9) Visit to local and nearby industries
- 10) Social outreach/extension activity

Essential Reading:

- 1) G. M. Evans and J. C. Furlong, Environmental Biotechnology: Theory and Application, Wiley India, 2012, 2nd edition
- 2) B.C. Bhattacharyya and R. Banerjee, Environmental Biotechnology, Oxford University Press, 2007
- 3) V. M. Ehlers, Municipal and Rural Sanitation, McGraw-Hill, 1986, 7th edition

Suggested Reading:

- 1) B. E. Rittman and P. L. McCarty, Environmental Biotechnology: Principles and Applications, McGraw-Hill Higher Education, 2000, 2nd edition



L	T	P	C
4	0	0	4

Course code: BIT C 321

Course name: Animal Biotechnology

UNIT	Content	Contact Hours
I	Introduction: comparison of tissue culture and animal studies. Types of tissue culture. Equipments and materials for animal cell culture technology. Introduction to the balanced salt solutions and simple growth medium. Chemical, physical and metabolic functions of different constituents of culture medium. Role of carbon dioxide, role of serum and supplements. Serum and protein-free defined media and their applications.	14.5
II	Primary culture: Initiation, isolation and types. Subculture. Biology of cultured cells: environment, cell adhesion, proliferation, differentiation, signaling, metabolism and origin. Characterization of cultured cells: parameters of growth. Cell transformation and immortalization.	14.5
III	Cell cloning and selection: Dilution cloning, stimulation of plating efficiency, suspension cloning, isolation of clones, replica plating, selective inhibitors, isolation of genetic variants, Interaction with substrate. Methods for cell separation. Types of micromanipulation. Measurement of cell viability and cytotoxicity.	14.5
IV	Cell synchronization. Organ, organotypic and histotypic cultures. Three dimensional culture and tissue engineering. Vaccines and Cell culture based vaccines. Stem cell cultures, embryonic stem cells and their applications.	14.5
V	Scaling-up of animal cell culture: comparison of culture processes, scaling up of monolayer and suspension cultures. Applications of animal cell culture.	14.5

Essential Reading:

- 1) R. I. Freshney, Culture of Animal Cells A Manual of Basic Technique and Specialized Applications, Wiley-Blackwell, 2016, 7th edition
- 2) B. Singh, et. al., Textbook of Animal Biotechnology, TERI, 2013
- 3) A. Verma and A. Singh, Animal Biotechnology: Models in Discovery and Translation, Elsevier Academic Press, 2014

Suggested Reading:

- 1) M. M. Ranga, Animal Biotechnology, Agrobios India, 2007, 3rd edition

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Course code: BIT C 322
Course name: Genetic Engineering

L	T	P	C
4	0	0	4

UNIT	Content	Contact Hours
I	Restriction enzymes: types and uses. Restriction mapping. DNA modifying enzymes. Joining DNA molecules: DNA ligase. Plasmid vectors and Bacteriophage vectors for prokaryotic expression. Eukaryotic vectors. Getting DNA in cells: transformation and transfection	14.5
II	Cloning strategies: synthesis and cloning of cDNA. Cloning of DNA with blunt end and sticky end, Methods of cloning using different modern vectors, Method of cloning in binary vectors and gene pyramiding. Selection, screening and analysis of recombinants	14.5
III	Introduction of plant tissue culture and cell suspension culture, physico-chemical conditions for propagation of plant cells and tissues, composition of media, nutrient and hormone requirement, Single cell culture mechanism, Concept of artificial seeds. Somatic hybridization	14.5
IV	Methods for the plant genetic transformation, Particle bombardment method, Electroporation, Microinjection, Mechanism of Agrobacterium mediated gene transformation	14.5
V	Promoters and genetic markers, Methods of molecular analysis of GMO, Biosafety related issue to transgenic plant and animals, Intellectual property management and patent	14.5

Essential Reading:

- 1) D. S. T. Nicholl, Introduction to Genetic Engineering, Cambridge University Press, 2008 3rd edition
- 2) T. A. Brown, Gene Cloning and DNA Analysis, Wiley-Backwell, 2016, 7th edition
- 3) J. Hammond, Plant Biotechnology: New products and applications, Springer, 2000

Suggested Reading:

- 1) M. R. Green and J. Sambrook, Molecular Cloning: A Laboratory Manual (3 Volumes), Cold Spring Harbor Laboratory Press, 2012, 4th edition




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Course code: BIT C 323

Course name: Bioprocess Engineering and Technology

L	T	P	C
4	0	0	4

UNIT	Content	Contact Hours
I	Introduction to bioprocess engineering. Isolation, preservation and maintenance of industrial microorganisms. Kinetics of microbial growth. Media for industrial fermentation. Media sterilization. Thermal death kinetics of microorganisms	14.5
II	Fermentation: General introduction, Range of fermentation, Design and construction of fermenter, Aerobic and anaerobic fermentation processes, Solid and submerged fermentations and Types of bioreactors.	14.5
III	Downstream processing: Introduction, removal of microbial cells and solid matter foam separation, precipitation, filtration, centrifugation, cell disruptions, liquid-liquid extraction. Chromatography, membrane process, drying and crystallization.	14.5
IV	Enzyme immobilization and their industrial applications. Protein engineering: native and fusion proteins, strategies to maximize protein expression, industrial production of ethanol, citric acid, antibiotics and glutamic acid.	14.5
V	Effluent Treatment: Need for effluent treatment, Physical, chemical and biological methods of effluent treatment. Plant design and economics, Cost of production.	14.5

Essential Reading:

- 1) D. G. Rao, Introduction to Biochemical Engineering, Tata McGra-Hill Education, 2010, 2nd edition
- 2) P. F. Stanbury, et. al., Principles of Fermentation Technology Butterworth-Heinemann, 2016, 3rd edition
- 3) D. S. Kompala, Bioprocess Engineering: Fundamentals and Applications, CRC press, 2012

Suggested Reading:

- 1) P. Doran, Bioprocess Engineering Principles, Elsevier Academic Press, 2012, 2nd edition
- 2) M. L. Shuler and F. Kargi, Bioprocess Engineering: Basic Concepts, Pearson, 2002, 2nd edition

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Course code: BIT C 324
Course name: Lab Course V

L	T	P	C
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Practicals:

1. Bacterial culture and antibiotic selection media, preparation of competent cells.
2. Isolation of plasmid DNA and quantification
3. Preparation of media & Surface sterilization and organ culture with suitable explants.
4. Cloning in plasmid and screening.
5. RNA isolation and synthesis of c-DNA
6. Construction of restriction map of plasmid DNA.
7. PCR and DNA sequencing.
8. Agrobacterium culture, transformation method, reporter gene (GUS) assays.

Essential Reading:

- 1) K. Lindsey, Plant tissue culture manual, Springer, 2007
- 2) J. S. Vennison, Laboratory manual for Genetic Engineering, PHI Learning, 2010, 1st edition

Suggested Reading:

- 1) M. R. Green and J. Sambrook, Molecular Cloning: A Laboratory Manual (3 Volumes), Cold Spring Harbor Laboratory Press, 2012, 4th edition
- 2) R. H. Smith, Plant Tissue Culture: Techniques and Experiments, Elsevier Academic Press, 2012, 3rd edition



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Course code: BIT C 325
Course name: Lab Course VI

L	T	P	C
0	0	2	2

Practicals:

1. Preparation of tissue culture medium and membrane filtration.
2. Preparation of single cell suspension from spleen and thymus.
3. Cell counting and cell viability.
4. Isolation of amylase producing bacteria and fungus.
5. Production of curd by fermentation/isolation of bacteria from curd.
6. Production of bread dough by yeast fermentation.
7. Crystal formation heating and cooling methods.
8. Extraction of essential oils from lemon grass/orange peel

Essential Reading:

- 1) R. I. Freshney, Culture of Animal Cells: A Manual of Basic Technique, Wiley-Backwell, 2000, 4th edition
- 2) J. Masters, Animal Cell Culture – Practical approach, Oxford University Press, 2000, 3rd edition
- 3) T. Palvannan, Laboratory Manual on Biochemistry, Bioprocess & Microbiology, Scitech publications, 2006

Suggested reading:

- 1) J. Davis, Basic Cell Culture, Oxford University Press, 2002, 2nd edition

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Course code: BIT E 326

Course name: Plant Tissue Culture

L	T	P	C
3	0	1	4

UNIT	Content	Contact Hours
I	Tissue cultures, introduction and history of tissue culture. Application of plant tissue culture in industry. Clonal propagation: Micropropagation, Somaclonal variation and their selection.	11
II	Media preparation and compositions. Totipotency and cell suspension culture. Use of growth regulators. Practical applications of tissue culture, Somatic hybridization.	11
III	Callus culture: Principle and significance of Callus culture. Single cell culture: Principle and methods of Single cell culture; Factors affecting Single cell culture; Importance of single cell culture.	11
IV	Protoplast isolation, Culture of protoplast, factors affecting protoplast culture. Application of protoplast culture in industry.	11
V	Introduction of genetic transformation in plants, methods of plant gene transformation. Mechanism of Agrobacterium mediated GM crops and applications.	11

Practicals

- 1) Preparation of MS medium and organ culture with suitable explants.
- 2) Experimental demonstration of Liquid culture.
- 3) Experimental demonstration of callus induction.
- 4) Experimental demonstration of artificial seeds synthesis.
- 5) Isolation of Plant Genomic DNA.
- 6) Polymerase Chain reaction.

Essential Reading:

- 1) S. S. Bhojwani and M. K. Razdan, Plant Tissue Culture: Theory and Practice, Elsevier Imprint, 1996, 1st edition
- 2) J. Hammond, Plant Biotechnology: New products and applications, Springer, 2000
- 3) G. C. Phillips and O. L. Gamborg, Plant Cell, Tissue and Organ Culture: Fundamental Methods, Narosa, 2005
- 4) R. H. Smith, Plant Tissue Culture: Techniques and Experiments, Elsevier Academic Press, 2012, 3rd edition

Suggested Reading:

- 1) M. Laimer and W. Rucker, Plant Tissue Culture: 100 years since Gottlieb Haberlandt, Springer, 2003, 1st edition



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Course code: BIT E 327
Course name: Basic Virology

L	T	P	C
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UNIT	Content	Contact Hours
I	History and introduction: Significance, characteristics and morphology, classification: Shape, Size genome and Baltimore, virology techniques.	14.5
II	Viral life cycle: Entry, uncoating, Viral replication (of various types of viruses), Assembly and release	14.5
III	Virus host interaction: Interferon response and adaptive immune response	14.5
IV	Vaccination: Types of vaccines, Antiviral vaccines, small pox vaccine, vaccine production.	14.5
V	Oncogenic virus: Study of molecular mechanisms of DNA and RNA oncogenic viruses.	14.5

Essential Reading:

- 1) E. K. Wagner, et al., Basic Virology, Wiley, 2007, 3rd edition
- 2) T. Shores, Understanding Viruses, Jones and Bartlett, 2009, 1st edition
- 3) J. S. Flint, et al., Principles of Virology: Molecular Biology, Pathogenesis, and Control, American Society for Microbiology, 2009

Suggested Reading:

- 1) D. M. Knipe and P. M. Howley, Fields Virology, Lippincott Williams & Wilkins, 2013, 6th edition

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Introduction of biostatistics. Types of data, types of variables, tabulation of data and its graphical representation. Measures of central tendency and dispersion: Mean median, mode range, standard deviation and variance.

Multiplicity of data, major bioinformatics databases, data integration, data analysis, Modern biology in bioinformatics. Molecular biology and Bioinformatics. Information molecules and information flow. Biological databases.

Two types of errors and level of significance, tests of significance (F and t test, chi-square tests). Simple linear regression and correlation. Use of linear regression in biological experiments.

Computer-oriented statistical techniques: Frequency table of single discrete variable. Bubble sort through excel, computation of mean, variance and standard deviation; t-test, correlation coefficient, Anova analysis

Linear regression & goodness of curves, Significance of r^2 value, Single and double side binding curves equations

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ate and present graphs in excel.
excel to do simple maths on data tables.
late descriptive statistics through excel.
late regression and correlation through excel.
tical tests through excel (t-test)
to download and install biostat software

Semester IV

Course code: BIT C 421

Course name: Semester Long Dissertation/Project Work/Practical Training/Field Work, and
Technical Writing: Credits: 12

Course Instructors:

Prof. Subodh Kumar Jain

Dr. Chandrama Prakash Upadhyaya

Dr. Rajaneesh Anupam

Evaluation:

- | | |
|--|------------|
| a) First periodic assessment of the progress after 08 weeks | : 20 marks |
| b) Second periodic assessment of the progress after 12 weeks | : 20 marks |
| c) End semester examination will consist of | : 50 marks |
| i) Evaluation of project report/presentation | : 10 marks |
| ii) Viva-Voce of the project | |

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Ph. D. COURSE SYLLABUS
DEPARTMENT OF BIOTECHNOLOGY



2017 Onwards

SCHOOL OF BIOLOGICAL SCIENCES

DR. HARISINGH GOUR UNIVERSITY

SAGAR-470003 M. P.

Mr.
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Danu Mishra
24.10.17

Suhodan
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Department of Biotechnology

PhD course, Session 2017-18

Ph. D. Course Work: Minimum of 20 credits should be completed as follows in one semester

Paper	Code	Title	Credits
Paper I	Core course SBS CC 141	Research Methodology	4
Paper II	Core Course BIT CC 502	Instrumentation	4
Paper III	Elective Course One (1) BIT SE 503	Biotechnology Techniques and Applications	4
	(2) BIT SE 504	Cell and Molecular Biology	
	BIT CC 505	Review of Published Research	8
		Total	20

CC- Core Course

SE- Self Elective

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School of Biological Sciences

Core Course Code BIT C 501 Title: Research Methodology

Total Credits: 4 (60 hrs)

Course content:

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4	0	0	4

Unit-1 (Zoology)

12 hrs

Hypothesis and Research Design: Defining, formulating and development of research hypothesis. Testing and development of working hypothesis. Types of research (descriptive, analytical, applied, fundamental, qualitative, conceptual and empirical) and research methods. Importance of literature review in defining a problem. Thrust area and innovation.

Unit-2 (Botany)

12 hrs

Computer Applications in Biological Research: Basics, Programmes (microsoft excel, word, power point) and software (SPSS) used in research. Networking and modelling. Data mining and interpretation by use of computer. Data repository in knowledge bank (Gene Bank, Shodh Ganga, INFLIBNET etc.)

Unit-3 (Botany, Zoology, Microbiology and Biotechnology)

12 hrs

Scientific Presentation and Writing: Structure and components of scientific reports, Types of scientific reports and their preparation, review, paper and thesis writing. Bibliography, referencing and citation for scientific writing.

Unit-4 (Biotechnology)

12 hrs

Basic Principle and Application of Sophisticated Instruments used in Biological Research: Microscopy (Confocal, Phase contrast, TEM, SEM), Centrifuge, Chromatography, Spectroscopy, Immunochemical Techniques (ELISA), Electrophoresis (DNA, Protein), PCR (Routine and real time).

Unit-5 (Microbiology)

12 hrs

Biosafety and Good Laboratory Practices: International standards and concepts of biosafety, bio safety levels and biohazards. Chemical and radiological hazards. Removal and disposal of biohazards. Concepts of good laboratory practices, safety related with genetically modified organisms.

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Core Course Code BIT E 502 Title: Instrumentation

Total Credits: 4 credits

(Instructor: Dr. C. P. Upadhyaya)

Course content:

- 1) pH determination
- 2) Spectrometry
- 3) Chromatography
- 4) Electrophoresis
- 5) Centrifugation
- 6) Gene sequencing
- 7) Proteomics
- 8) Microscopic techniques
- 9) Blotting techniques
- 10) ELISA
- 11) Flow cytometry

Practical will be based on the theory content

Elective Course Code BIT E 503 Title: Biotechnology Techniques & Applications

Total Credits: 4 credits

(Instructor: Dr. R. Anupam)

Course content:

- 1) Brief introduction and history of Biotechnology
- 2) Concept of recombinant DNA technology particularly in molecular cloning
- 3) Tissue culture techniques: plant and animal
- 4) Animal biotechnology: transgenic and knockout animals, animal disease models and animal model systems
- 5) Plant biotechnology: Development of transgenic plants and their application in various areas
- 6) Applications of biotechnology

Practical will be based on the theory content



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Elective Course Code BIT E 504 Title: Cell and Molecular Biology

Total Credits: 4 credits

(Instructor: Dr. S. K. Jain)

Course Content

- 1) Introduction to genetic material, genes and gene products and functions
- 2) Investigating protein interactions
- 3) RNA structure-function studies
- 4) Cancer biology
- 5) siRNA technology
- 6) Southern, Northern and Western blotting
- 7) Current trends in molecular and cell biology

Practical will be based on the theory content

Code BIT C 505 Title: Review of Published Research

Total Credits: 8 credits (Instructor: Prof. S. K. Jain)

The student will prepare a draft of a review under the supervision of a teacher allotted.



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1. Allied Subjects:

- 2. Relevant Subjects:**

- i. Biochemistry
 - ii. Bio-informatics
 - iii. Bio-physics
 - iv. Biomedical Sciences
 - v. Cell Biology
 - vi. Genetics
 - vii. Life/Biosciences
 - viii. Molecular Biology
 - ix. Environmental Biology/Biotechnology
- Total 09**

The above allied and relevant subjects were recommended by the BoS meeting held on 31.03.2016.

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