Revised 2019

DR. HARISINGH GOUR VISHWAVIDYALA[illegible]GAR
(A CENTRAL UNIVERSITY)

M.Sc. Biotechnology: 04 Semester Cour
Curriculum: 2019 - 2021 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 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
   [15 marks: Assignment/presentation/group discussion; 05 marks: Attendance]
      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
   c) End Semester Examination* : 60 marks

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

End semester Examination for Practical course (60 Marks)
   a) Assessment of performance in the experiment : 50 marks
   b) Viva-voce of experiment : 10 marks

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(Ashok K. Bhargal)

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(Naveen Kango)

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Biotechnology: M. Sc. Program Structure and Scheme

Semester	Paper Code	Title of the Paper	Credit			
			L	T	P	C
I	BIT CC 121	Cell Biology	4	0	0	4
	BIT CC 122	Biochemistry	4	0	0	4
	BIT CC 123	Microbiology	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	0	0	2	2
	BIT SE 127	Bioentrepreneurship	0	0	4	4
II	BIT CC 221	Molecular Biology	4	0	0	4
	BIT CC 222	Bioinstrumentation & Bioinformatics	4	0	0	4
	BIT CC 223	Immunology	4	0	0	4
	BIT CC 224	Lab Course 3	0	0	2	2
	BIT CC 225	Lab Course 4	0	0	2	2
	BIT SE 226	Critical analysis of classical research papers	0	0	4	4
	BIT SE 227	Basic virology	4	0	0	4
III	BIT CC 321	Animal Biotechnology	4	0	0	4
	BIT CC 322	Plant Biotechnology & Genetic Engineering	4	0	0	4
	BIT CC 323	Bioprocess Engineering and Technology	4	0	0	4
	BIT CC 324	Lab Course 5	0	0	2	2
	BIT CC 325	Lab Course 6	0	0	2	2
	BIT SE 326	Lab based Project Work	0	0	4	4
	BIT SE 327	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

	L	T	P	C
Course code: **BIT CC 121**	4	0	0	4

Course name: **Cell Biology**

Objectives: To provide basic information about structure and functions of various cell organelles.

Outcome: Students will learn basic of cell structure and functions along with basic techniques.

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.	12
II	**Techniques in cell biology:** Sub-cellular fractionation, microscopic techniques (light microscopy, electron microscopy, fluorescence and confocal microscopy, flow cytometry), cytochemical methods	12
III	**Cellular Energy Transactions:** Glycolysis, Kreb's cycle and respiration (role of mitochondria and chloroplast), Protein localization: synthesis of secretory and membrane proteins, import into nucleus, mitochondria, chloroplast and peroxisomes	12
IV	**Cell signaling:** mechanisms of signal transduction, types of signal molecules and response, cell surface and intracellular receptors, classes of cell surface receptors. Signal transduction via GPCRs. Receptor mediated endocytosis	12
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.	12

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
5) Bakers, The world of the Cell, Jeff Hardin, Pearson Education, 8th

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 CC 122**

L	T	P	C
4	0	0	4

Course name: **Biochemistry**

Objectives: To build upon master level knowledge of biochemical principles with specific emphasis on different metabolic pathways.

Outcome: Students would be able to analyse and interpret various biochemical pathways of the cell and their significance in metabolism.

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.	12
II	Carbohydrates- classification and reactions. Carbohydrates metabolism, Lipids- classification, structure and functions. Glycolipids and phospholipids, structure and function plasma membrane	12
III	Amino acids and peptides- classification, chemical reactions and physical properties. Proteins- classification and separation, protein primary, secondary, Tertiary and quaternary structure. Concept of protein folding & denaturation, Ramachandran plot	12
IV	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.	12
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	12

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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4	0	0	4

Course code: **BIT CC 123**
Course name: Microbiology

Objectives: The students will understand the significance and importance of microorganisms. The course is designed to introduce students to the basics of microbial growth, nutrition, structure and classification. The course will introduce students to microbial genetics, diseases caused by microbes and their treatment.
Outcomes: The student would be able to: articulate the importance of microbes in various aspects of human life and environment; Identification and classify microorganisms; demonstrate to culture and control the growth of microorganisms; analyze the transfer of genetics of microorganisms.

UNIT	Content	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.	12
II	Morphology and structure of bacteria, Berger's manual classification of microorganisms, three domain system, Scientific nomenclature, phylogenic and taxonomic hierarchy, morphological, biochemical and molecular identification methods.	12
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. C coli.*	12
IV	Etiology, prevention and cure of Microbial diseases: Tuberculosis, AIDS and Malaria. Antimicrobial agents, Antibiotics, Sulfa drugs, Antifungal drugs.	12
V	Applied microbiology: Microbiology of fermented food, probiotics, microorganisms used in industrial microbiology, major products of industrial microbiology	12

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 Prespective, McGraw Hill Education, 2016, 8th edition

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L	T	P	C
0	0	2	2

Course code: **BIT CC 125**
Course name: **Lab Course 2**

Objective: To introduce and train students in various techniques used for biochemical analysis of biomolecules.

Outcomes: The students would be able to analyze biomolecules qualitatively and quantitatively.

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, Elsevirer Academic Press, 1998, 1st edition
3) David Plummer, An Introduction To Practical Biochemistry, Tata McGraw Hill Education; 3rd edition (2006)

Suggested Reading:

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

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Course code: BIT SE 127

Course name: **Bioentrepreneurship**

L	T	P	C
0	0	4	4

Objectives: To teach students about concepts of entrepreneurship including identifying a business opportunity in the area of biotechnology through resource generation and launching a biotech business, growing and nurturing the organization as well as harvesting the rewards.

Outcomes: The students should be able to visualize and consider bioenterpreneurship as a viable career option.

UNIT	Content	Contact Hours
I	Introduction to bioentrepreneurship – biotechnology in a global scale; Importance of entrepreneurship; advantages of being entrepreneur - freedom to operate; types of bio-industries – bioservices bioindustrial, agribio and biopharma; business incubators	12
II	Innovation – types, out of box thinking; skills for successful entrepreneur – creativity, leadership, managerial, team building, decision making.; R&D for technology development and up-gradation; assessment of technology development	12
III	Industry visits to successful biotech-enterprises, regulations for transfer of profitable technologies; quality control; technology transfer agencies; Understanding of regulatory compliances and procedures.	12
IV	Business Strategy; Entry and exit strategy; pricing strategy; negotiation with financiers, bankers, government and law enforcement authorities dispute resolution skills; global thinking; mergers & acquisitions.	12
V	Business plan preparation; business feasibility analysis by SWOT, socio-economic costs benefit analysis; funds/support from Government agencies like MSME/banks and private agencies like venture capitalists, business plan proposal for virtual startup, statutory and legal requirements for starting a company/venture.	12

Essential readings:

1. Adams, D. J., & Sparrow, J. C. (2008). Enterprise for life scientists: Developing innovation and entrepreneurship in the biosciences. Bloxham: Scion.
2. Shimasaki, C. D. (2014). Biotechnology entrepreneurship: Starting, managing, and leading biotech companies. Amsterdam: Elsevier. Academic Press is an imprint of Elsevier.
3. Onetti, A., & Zucchella, A. (n.d.). Business modeling for life science and biotech companies: Creating value and competitive advantage with the milestone bridge. Routledge.

Suggested Reading:

1. Jordan, J. F. (2014). Innovation, Commercialization, and Start-Ups in Life Sciences. London: CRC Press.
2. Desai, V. (2009). The Dynamics of Entrepreneurial Development and Management. New Delhi: Himalaya Pub. House.

Course code: **BIT CC 222**
Course name: **Bioinstrumentation & Bioinformatics**

L	T	P	C
4	0	0	4

Objectives: To provide students with the theory and practical experience of various instruments used in the Biotechnology and also the use of common computational tools and databases which facilitate investigation of molecular biology.

Outcomes: The student would be able to operate the sophisticated instruments and use online bioinformatic tools.

UNIT	Content	Contact Hours
I	Microscopy: Light and compound microscopy, confocal microscopy, electron microscopy; Atomic Force Microscopy	12
II	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	12
III	Spectroscopic techniques: Principle of spectroscopy (emission and absorbance), Visible, UV, fluorescence spectroscopy and NMR spectroscopy.	12
IV	Introduction of biostatistics. Types of data, types of variables, tabulation of data and its graphical representation. Measures of central tendency and dispersion: Mean median, model range, standard deviation and variance.	12
V	Tools for sequence alignment through NCBI database; Alignment of pairs of sequence; Alignment of multiple sequences; Primer designing tools and characteristics of primers; Accessing and retrieving genome project information for microbes, plants and animals from database-case study	12

Essential Reading:

1) K. Wilson and J. Walker, Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, 2013.
2) B Sivasankar, Instrumental Methods of Analysis, Oxford University Press, 2012
3) Sharma, Munjal and Shanker, Text book of Bioinformatics: Rastogi publisher, India 2017
4) Attood, Parry-Smith and Phukan, Introduction to Bioinformatics, Fourth edition, Pearson Publisher

Suggested Reading:

1) B. Williams and S. Sawyer, using information technology: a practical introductino 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

Course code: **BIT CC 224**	L	T	P	C
Course name: **Lab Course 3**	0	0	2	2

Objective: To train students in various basic techniques of molecular biology. To introduce students to basic immunological techniques.

Outcome: The student should be able to isolate, manipulate, visualize and quantify nucleic acids and proteins. Able to qualitatively analyze blood cells and serum components.

Practicals:

1. Plasmid DNA isolation.
2. Visualization of DNA using EtBr.
3. Restriction digestion of genomic DNA.
4. Isolation of genomic DNA.
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. Immunodiagnostics (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. Smbrook, Molecular Cloning: A Laboratory Manual (3 Volumes), Cols Spring Harbor Laboratory Press, 2012, 4th edition

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Course code: BIT SE 226

Course name: **Critical Analysis of Classical Papers**

L	T	P	C
4	0	0	4

Objectives: to familiarize the students with classic literature to make them appreciate how ground-breaking discoveries were made without, necessarily, use of high-end technologies.

Outcomes: Students should be able to appreciate the techniques and thought process in design experiments that have made seminal contribution to field of basic biological sciences.

Syllabus: How does the Course Module work? There are sixteen (or more) classical papers. Students will be divided in to groups and each group will be responsible for two papers. There will be three hour presentation cum discussion for each of the papers. At the end of the semester, each student will be asked to write a mini-review on any of the sixteen papers, other than the one he/she has presented/discussed.

A list of seventeen classic papers and some suggested reference materials: The research paper may also be decided by the course coordinator but the paper must be a classical paper with outstanding recognition.

Suggested classical research paper

Molecular Biology	
1	Avery OT, Macleod CM, McCarty M (1944) Studies on the chemical nature of the substance inducing transformation of Pneumococcal types: Induction of transformation by a desoxyribonucleic acid fraction isolated from Pneumococcus type III. J Exp Med. 79(2):137-58. Note: This paper demonstrates that DNA is the transforming Principle originally described by Fredrick Griffith
2	Hershey AD and Chase M (1952) Independent functions of viral protein and nucleic acid in growth of bacteriophage. J Gen Physiol. 1952 May;36(1):39-56. Note: This paper demonstrates that DNA, and not protein, component of phages enter bacterial cells.
3	Watson JD and Crick FH (153) Molecular structure of nucleic acids; a structure for deoxyribose nucleic acid; Nature. 25;171(4356):737-8 Note: In this one page paper Watson and Crick first described the structure of DNA double helix
4	James Hicks, Jeffrey N. Strathern & Amar J.S. Klar (1979) Transposable mating type genes in *Saccharomyces cerevisiae*. Nature 282, 478-483, Note: This paper provided evidence for „cassette hypothesis" of yeast mating type switches i.e. interconversion of mating types in yeast (S. cerevisiae) occurs by DNA rearrangement.
5	Meselson M and Stahl FW (1958) Messelson and Stahl experiment demonstrating semi-conservative replication of DNA. Proc Natl Acad Sci U S A; 15;44(7):67182 Note: The experiment demonstrating semi-conservative mode of DNA replication is referred to as "the most beautiful experiment in biology"
6	Guo-Liang Yu, John D. Bradley, Laura D. Attardi & Elizabeth H. Blackburn (1990) In vivo alteration of telomere sequences and senescence caused by mutated Tetrahymena telomerase RNAs. Nature 344, 126-132, Note: This paper demonstrates that the telomerase contains the template for telomere synthesis.

2	Anderson KV and Nüsslein-Volhard C (1984) Information for the dorsal--ventral pattern of the Drosophila embryo is stored as maternal mRNA Nature. 311(5983):223-7 Note: This landmark paper demonstrated that early dorsal-ventral pattern information is stored as maternal mRNA in flies and devised the method of identifying genes encoding such genes
3	Huangfu D, Liu A, Rakeman AS, Murcia NS, Niswander L, Anderson KV (2003) Hedgehog signalling in the mouse requires intraflagellar transport proteins. 6;426(6962):83-7 Note: One of the architects of original fly mutagenesis screens conducted a mouse mutagenes screen which identified a gene Kif3a as a major component of hedgehog signaling pathway. Eventually this discovery revolutionizes our understanding of mechanisms of action of signaling pathways by demonstrating central role of cillia in it

Mode of Assessment:
At the end of the course, assessment will be done. Student will write a mini-review on any of the sixteen papers, other than the one paper the student have to presented/discussed in the class.

Mode of end semester examination: Internal only

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Semester-III

	L	T	P	C
Course code: BIT CC 321	4	0	0	4

Course name: Animal Biotechnology

Objective: Animal Biotechnology is fast growing area, therefore knowledge of DNA technology, cell, tissue, organ and embryo culture, transgenic animals, knock-out, knock-in and gene editing, functional genomics will help students for future endeavour.

Outcomes: The students should be able to analyze and comprehend the requirement and principles of animal cell and tissue culture.

UNIT	Content	Contact Hours
I	Animal cell and tissue culture, Equipments and materials for animal cell culture technology. Balanced Salt Solutions (BSS), Culture medium. Chemical, physical and metabolic functions of different constituents of culture medium. Role of carbon dioxide, serum and supplements. Serum and protein-free media and their applications. Scaling up of monolayer and suspension cultures.	12
II	Primary culture, Subculture. Disaggregation of tissue in primary culture, Cell lines, their maintenance, large scale cell culture and their applications, Stem cells: Types and applications Biology of cultured cells: cell adhesion, proliferation, differentiation, signaling, metabolism and origin. Characterization of cultured cells: parameters of growth. Cell transformation and immortalization.	12
III	Organ culture, Whole embryo culture, *In-vitro* fertilization, artificial insemination and embryo transfer, Animal cloning: Methods and applications. Transfection methods	12
IV	Transgenic animals: Production methods and their commercial applications,. Regulation of GE animals, Vaccines and Cell culture based vaccines, Diagnostics and Forensic applications	12
V	Gene therapy, Vectors and other delivery systems, *ex-vivo* and *in-vivo* therapy, application for genetic diseases, Aquaculture: Types, methods and prospects, Animal biodiversity and Animal Genetic Resources (AnGR), National Biodiversity Authority (NBA), Intellectual Property Rights (IPR), Patents, Trade secretes, Copy right, Trade Mark,	12

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
2) P.K.Gupta, Animal Biotechnology, Rastogi Publication, Meerut, 2018

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Course code: BIT CC 323

Course name: Bioprocess Engineering and Technology

L	T	P	C
4	0	0	4

Objectives: The course is designed to introduce students to Bioprocessing with emphasis on importance of microbes in bioprocessing, growth of these microbes, fermentation, downstream processing, applications of bioprocessing and effluent treatment.

Outcomes: The student would be able to demonstrate the ability to conceptualize various aspects that are involved in bioprocessing. The ability to understand important aspects of bioprocessing such as isolation of industrially important microbes and their preservation, fermentation, product isolation, effluent treatment, scope and economics of bioprocessing plant.

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	12
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.	12
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.	12
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.	12
V	Effluent Treatment: Need for effluent treatment, Physical, chemical and biological methods of effluent treatment. Plant design and economics, Cost of production.	12

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 CC 325**
Course name: **Lab Course 06**

L	T	P	C
0	0	2	2

Objectives: To introduce students to various basic techniques of animal cell culture. To introduce students to bioprocessing and product isolation techniques.

Outcomes: The students should be able to demonstrate ability to isolate cells from animals and grow them. To isolate industrially important microbes and isolate commercially important components from raw materials.

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

Course code: **BIT SE 327**
Course name: **Biostatistics**

L	T	P	C
3	0	1	4

Objectives: To provide the basic concepts of the statistics and their applications in the data analysis of the biological research.

Outcomes: The students should be able to perform statistical analysis of scientific data for drawing plausible conclusions.

UNIT	Content	Contact Hours
I	Introduction of biostatistics. Types of data, types of variables, tabulation of data and its graphical representation. Measures of central tendency and dispersion: Mean median, model range, standard deviation and variance.	12
II	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.	12
III	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.	12
IV	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, Annova analysis	12
V	Linear regression & goodness of curves, Significance of r2 value, Single and double side binding curves equations	12

Practicals

1) Tabulate and present graphs in excel.
2) Using excel to do simple maths on data tables.
3) Calculate descriptive statistics through excel.
4) Calculate regression and correlation through excel.
5) Statistical tests through excel (t-test)
6) How to download and install biostat softwares from internet.
7) Sorting lowest to highest and highest to lowest in excel (bubble sort).

Essential Reading:

1) P. K. Banerjee, Introduction to Bio-Statistics, S. Chand Publishing, 2006, 3rd edition
2) G. W. Snedecor and W. G. Cochran, Statistical Methods, Wiley India, 2014, 8th edition
3) T. J. Bailey, Statistical Methods in Biology, Cambridge University Press, 2000, 3rd edition

Suggested Reading:

1) R. N. S. Pillai, Statistics (Theory and Practice), S. Chand Publishing, 2010

Ph. D. COURSE SYLLABU

DEPARTMENT OF BIOTECHNOLOGY

2019 Onwards

SCHOOL OF BIOLOGICAL SCIENCES

DR. HARISINGH GOUR VISHWAVIDYALAYA

SAGAR-470003 M. P.

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Department of Biotechnology

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 (2) BIT SE 504	Biotechnology Techniques and Applications Cell and Molecular Biology	4
	BIT CC 505	Review of Published Research	8
		Total	20

CC- Core Course
SE- Self Elective

School of Biological Sciences

Core Course Code BIT C 501 Title: Research Methodology

Total Credits: 4 (60 hrs)

Course content:

L	T	P	C
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 respository 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.

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

31/5/19

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

Total Credits: 4 credits

(Instructor: Prof. Subodh 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. Subodh Jain)

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

DR. HARISINGH GOUR VISHWAVIDYALAYA, SAGAR – 470003 (M.P.)

DEPARTMENT OF BIOTECHNOLOGY

May 31, 2019

Relevant and Cognate subjects in Biotechnology:

Relevant subject: One

1. Biotechnology

Cognate subjects: Nine subjects

1. Zoology
2. Botany
3. Microbiology
4. Biochemistry
5. Bioinformatics
6. Genetics
7. Life Science
8. Bioscience
9. Molecular Biology

31/5/2019

31/5/19

31/5/19

31/5/19.

Ph. D. COURSE SYLLABUS

DEPARTMENT OF BIOTECHNOLOGY

2019 Onwards

SCHOOL OF BIOLOGICAL SCIENCES

DR. HARISINGH GOUR VISHWAVIDYALAYA

SAGAR-470003 M. P.

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 (2) BIT SE 504	Biotechnology Techniques and Applications Cell and Molecular Biology	4
	BIT CC 505	Review of Published Research	8
		Total	20

CC- Core Course
SE- Self Elective

Department of Biotechnology

School of Biological Sciences

Core Course Code BIT C 501 Title: Research Methodology

Total Credits: 4 (60 hrs)

Course content:

L	T	P	C
4	0	0	4

12 hrs

Unit-1 (Zoology)

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.

12 hrs

Unit-2 (Botany)

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 respository in knowledge bank (Gene Bank, Shodh Ganga, INFLIBNET etc.)

12 hrs

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

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.

12 hrs

Unit-4 (Biotechnology)

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).

12 hrs

Unit-5 (Microbiology)

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.

Department of Biotechnology

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

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

Total Credits: 4 credits

(Instructor: Prof. Subodh 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
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Total Credits: 8 credits (Instructor: Prof. Subodh Jain)

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