Scheme of Examination and Syllabus

Affiliated Colleges

(2018-19 w.e.f. Sem-III and 2019-20 w.e.f. Sem-I)

B. Sc. (MEDICAL GROUP WITH BIOTECHNOLOGY)

BASED ON
CHOICE BASED CREDIT SYSTEM

Department of Bio and Nano Technology
Guru Jambheshwar University of Science & Technology
Hisar-125001

Course Curriculum of B. Sc. (Medical Group with Biotechnology)
Semester I

Paper Code	Course	Nomenclature	Credits	hr/week	Marks		
					Ext.	Int.	Total
CXL-101L	Language Skill Compulsory Course-I	English-I	2	2	80	20	100
CYL-111L	Awareness Program Compulsory Course-I	Environmental Studies	2	2	80	20	100
BIT 101 L	**Core course – Biotechnology Paper I**	**Introduction to Biotechnology**	**3**	**3**	**80**	**20**	**100**
BIT 102 L	**Core course - Biotechnology Paper II**	**Biochemistry – I**	**3**	**3**	**80**	**20**	**100**
BOT-101 L	Core course - Botany Paper I	Biodiversity of Microbes, Algae and Fungi	2	2	80	20	100
BOT- 102 L	Core course - Botany Paper II	Biodiversity of Archegoniate	2	2	80	20	100
ZOO-101 L	Core Course-I (Zoology)	Animal Biodiversity I	2	2	80	20	100
ZOO-102 L	Core Course-II (Zoology)	Animal Biodiversity II	2	2	80	20	100
CCL-104 L	Core Course-I (Chemistry)	Inorganic Chemistry-I (Atomic Structure & Bonding)	2	2	80	20	100
CCL-105 L	Core Course-II (Chemistry)	Organic Chemistry-I (General Organic Chemistry & Aliphatic Hydrocarbons)	2	2	80	20	100
BIT 103 P	**Core Course – Practical- Paper III**	**Laboratory Practical- Paper III (Biochemistry)**	**3**	**6**	**100**	**-**	**100**
BOT- 103P	Practical -I (Botany)	Laboratory Practical- Paper III (Biodiversity of Microbes, Algae, Fungi and Archegoniate)	2	4	100	-	100
ZOO 103 P	Practical -I (Zoology)	Laboratory Practical of Animal Biodiversity I & II	2	4	100	-	100
CCP-109 P	Practical-I (Chemistry)	Chemistry Lab-I	2	4	100	-	100

Semester II

Paper Code	Course	Nomenclature	Credits	hr/week	Marks		
					Ext.	Int.	Total
CXL-201L	Language Skill Compulsory Course-II	English-II	2	2	80	20	100
BIT201 L	**Core course-Biotechnology Paper IV**	**General Microbiology**	**3**	**3**	**80**	**20**	**100**
BIT 202 L	**Core Course-Biotechnology Paper V**	**Biochemistry – II**	**3**	**3**	**80**	**20**	**100**
BOT-201 L	Core course-Botany Paper IV	Plant Ecology	2	2	80	20	100
BOT- 202 L	Core Course- Botany Paper V	Plant Taxonomy	2	2	80	20	100
ZOO-201 L	Core Course-IV (Zoology)	Comparative Anatomy and Developmental Biology of Vertebrates I	2	2	80	20	100
ZOO-202 L	Core Course-V (Zoology)	Comparative Anatomy and Developmental Biology of Vertebrates I	2	2	80	20	100
CCL-204 L	Core Course-III (Chemistry)	Physical Chemistry-I (Chemical Energetics and Equilibria)	2	2	80	20	100
CCL-205 L	Core Course-IV (Chemistry)	Organic Chemistry-II (Functional Group Organic Chemistry)	2	2	80	20	100
BIT 203 P	**Core Course-Biotechnology Paper VI Practical/Tutorial**	**Laboratory Practical-Paper VI (Microbiology)**	**3**	**6**	**100**	**-**	**100**
BOT 203 P	Practical-II Botany	Laboratory Practicals - Paper VI (Plant Ecology and Taxonomy)	2	4	100	-	100
ZOO 203 P	Core Course-VI (Zoology Practical)	Laboratory Practicals of Comparative Anatomy and Developmental Biology of Vertebrates I & II	2	4	100	-	100
CCP-209 P	Practical-II (Chemistry)	Chemistry Lab-II	2	4	100	-	100

Semester III

Paper Code	Course	Nomenclature	Credits	hr/week	Marks		
					Ext.	Int.	Total
CXL-301L	Language Skills Compulsory Course-I	Hindi-I	2	2	80	20	100
BIT301 L	**Core course-Biotechnology Paper VII**	**Molecular Biology**	**3**	**3**	**80**	**20**	**100**
BIT302 L	**Core Course-Biotechnology Paper VIII**	**Bio-analytical techniques**	**3**	**3**	**80**	**20**	**100**
BOT- 301 L	Core course - Botany Paper VII	Plant Anatomy	2	2	80	20	100
BOT -302 L	Core course - Botany Paper VIII	Plant Embryology	2	2	80	20	100
ZOO-301 L	Core Course-VII (Zoology)	Physiology and Biochemistry I	2	2	80	20	100
ZOO-302 L	Core Course-VIII (Zoology)	Physiology and Biochemistry II	2	2	80	20	100
CCL-304 L	Core Course-I (Chemistry)	Physical Chemistry-II (Solutions, Phase equilibrium, Conductance and Electrochemistry)	2	2	80	20	100
CCL-305 L	Core Course-II (Chemistry)	Organic Chemistry-III (Functional Group Organic Chemistry-II)	2	2	80	20	100
BIT 303 P	**Core Course-Biotechnology Paper IX Practical/Tutorial**	**Laboratory Practical-Paper IX (Molecular Biology & Bio-analytical techniques)**	**3**	**6**	**100**	**-**	**100**
BOT 303P	Practical-III (Botany)	Laboratory Practical-Paper IX (Plant Anatomy and Embryology)	2	4	100	-	100
ZOO 303 P	Core Course-IX (Zoology Practical)	Laboratory Practicals of Physiology and Biochemistry I & II	2	4	100	-	100
CCP-309 P	Practical-III (Chemistry)	Chemistry Lab-III	2	4	100	-	100
BOT 304 L/ BOT 305 L/ BOT 306L/ BOT 307L	Skill Enhancement Course -1	Any one of the following: I. Ethnobotany (BOT 304 L) II. Biofertilizers (BOT 305 L) III. Mushroom Culture Technology (BOT 306 L) IV. Plant Diversity and Human Welfare (BOT 307 L)	2	2	80	20	100

Semester IV

Paper Code	Course	Nomenclature	Credits	hr/week	Marks		
					Ext.	Int.	Total
CXL-401L	Language Skills Compulsory Course-II	Hindi-II	2	2	80	20	100
BIT 401 L	**Core course - Biotechnology Paper X**	**Immunology**	**3**	**3**	**80**	**20**	**100**
BIT 402 L	**Core course - Biotechnology Paper XI**	**Recombinant DNA Technology**	**3**	**3**	**80**	**20**	**100**
ZOO-404 L/ ZOO-405 L/ ZOO-406 L/ ZOO-407 L	Skill Enhancement Course-I (Zoology)	Any one of the following: I. Apiculture II. Aquarium Fish Keeping III. Medical Diagnostics IV. Sericulture	2	2	80	20	100
BOT-401 L	Core course-Botany Paper X	Plant Physiology	2	2	80	20	100
BOT -402 L	Core Course- Botany Paper XI	Plant Metabolism	2	2	80	20	100
ZOO-401 L	Core Course-X (Zoology)	Genetics and Evolutionary Biology I	2	2	80	20	100
ZOO-402 L	Core Course-XI (Zoology)	Genetics and Evolutionary Biology II	2	2	80	20	100
CCL-404 L	Core Course-III (Chemistry)	Inorganic Chemistry-II (Transition Metal and Coordination Chemistry)	2	2	80	20	100
CCL-405 L	Core Course-IV (Chemistry)	Physical Chemistry-III (States of Matter and Chemical Kinetics)	2	2	80	20	100
BIT 403 P	**Core Course – Practical- Paper XII**	**Laboratory Practical- Paper XII (Immunology & Recombinant DNA Technology)**	**3**	**6**	**100**	**-**	**100**
BOT 403 P	Practical-IV Botany	Laboratory Practicals - Paper XII (Plant Physiology and Metabolism)	2	4	100	-	100
ZOO 403 P	Core Course-XII (Zoology Practical)	Laboratory Practicals of Genetics and Evolutionary Biology I & II	2	4	100	-	100
CCP-409 P	Practical-IV (Chemistry)	Chemistry Lab-IV	2	4	100	-	100

Semester V

Paper Code	Course	Nomenclature	Credits	hr/week	Marks		
					Ext.	Int.	Total
BIT 501 L	**Discipline Specific Elective - Biotechnology Paper I**	**Plant biotechnology**	**3**	**3**	**80**	**20**	**100**
BIT 502 L	**Discipline Specific Elective - Biotechnology Paper II**	**Microbial biotechnology**	**3**	**3**	**80**	**20**	**100**
BOT 501L/504 L**	Discipline Specific Elective - Botany Paper I	Cell Biology (BOT501L)/ Analytical Techniques in Plant Sciences-I (BOT504L)	2	2	80	20	100
BOT 502L/505 L**	Discipline Specific Elective - Botany Paper II	Molecular Biology (BOT502L)/ Analytical Techniques in Plant Sciences-II (BOT505L)	2	2	80	20	100
ZOO- 501 L Or ZOO- 504 L	Discipline Specific Elective Course-I (Zoology)	Applied Zoology I Or Aquatic Biology I	2	2	80	20	100
ZOO- 502 L Or ZOO- 505 L	Discipline Specific Elective Course-II (Zoology)	Applied Zoology II or Aquatic Biology II	2	2	80	20	100
CCL-503 (i) or CCL-503 (ii)	Discipline Specific Course-I (Chemistry)	Polymer Chemistry-I or Chemistry of Main Group Elements, Theories of Acids and bases-I	2	2	80	20	100
CCL-504 (i) or CCL-504 (ii)	Discipline Specific Course-II (Chemistry)	Polymer Chemistry-II or Chemistry of Main Group Elements-II	2	2	80	20	100
CCS-505L	Skill Enhancement Course-I (Chemistry)	Any one of the following: Pesticide Chemistry or Green Methods in Chemistry	2	2	80	20	100
BIT 503 P	**Laboratory Practical Biotechnology Paper III**	**Laboratory Practical- Paper II (Plant Biotechnology & Microbial Biotechnology)**	**3**	**6**	**100**	**-**	**100**
BOT 503P/506P **	Discipline Specific Elective Practical - III Botany	Laboratory Practical- Paper - III Cell biology and Molecular Biology (503 P)/ Analytical Techniques in Plant Sciences (506P)	2	4	100	-	100
ZOO 503 P or ZOO 506 P	Discipline Specific Course-III (Zoology Practical)	Laboratory Practicals of Applied Zoology I & II or Aquatic Biology I & II	2	4	100	-	100
CCP-509 (i) or CCP-509 (ii)	Practical-V (Chemistry)	Chemistry Lab-V(i) or Chemistry Lab-V(ii)	2	4	100	-	100

Semester VI

Paper Code	Course	Nomenclature	Credits	hr/week	Marks		
					Ext.	Int.	Total
BIT 601 L	**Discipline Specific Elective - Biotechnology Paper IV**	**Animal biotechnology**	**3**	**3**	**80**	**20**	**100**
BIT 602L	**Discipline Specific Elective - Biotechnology Paper-V**	**Bioinformatics**	**3**	**3**	**80**	**20**	**100**
BOT 601L/604L	Discipline Specific Elective -Botany Paper IV	Economic Botany (BOT601L)/ Genetics (BOT604L)	2	2	80	20	100
BOT 602L/605 L	Discipline Specific Elective-Botany Paper V	Biotechnology(BOT602L)/Plant Breeding (BOT605L)	2	2	80	20	100
ZOO- 601 L or ZOO- 604 L	Discipline Specific Elective Course-IV (Zoology)	Reproductive Biology I or Insect, Vector and Diseases I	2	2	80	20	100
ZOO- 602 L Or ZOO- 605 L	Discipline Specific Elective Course-V (Zoology)	Reproductive Biology I Or Insect, Vector and Diseases I	2	2	80	20	100
CCL-603 (i) or CCL-603(ii)	Discipline Specific Course-III (Chemistry)	Organomatellics and Bioorganic Chemistry or Quantum Chemistry	2	2	80	20	100
CCL-604 (i) or CCL-604 (ii)	Discipline Specific Course-IV (Chemistry)	Polynuclear Hydrocarbon and UV-IR Spectroscopy or Spectroscopy and Photochemistry	2	2	80	20	100
BIT 603 P	**Laboratory Practical Biotechnology Paper VI**	**Laboratory Practical- Paper VI (Animal Biotechnology & Bioinformatics)**	**3**	**6**	**100**	**-**	**100**
BOT603P or 606P	Discipline Specific Elective - Practical-VI	Laboratory Practical - Paper VI (Economic Botany and Biotechnology (BOT603P)/ Genetics and Plant Breeding (606P)(BOT606P)	3	6	100	-	100
ZOO 603 P or ZOO 606 P	Discipline Specific Elective Course-VI (Zoology Practical)	Laboratory Practicals of Reproductive Biology I & II or Insect, Vector and Diseases I & II	2	4	100	-	100
CCP-609 (i) or CCP-609 (ii)	Practical-V (Chemistry)	Chemistry Lab-VI(i) or Chemistry Lab-VI(ii)	2	4	100	-	100
BIT 604L /605L/ 606P	**Skill Enhancement Course Biotechnology Paper-I**	**Molecular Diagnostics (604 L)/Basics in Forensic Science (605L)/ Project Work (606P)**	**3**	**3**	**80**	**20**	**100**

Note:

1. Students of B. Sc. General (Medical Group with Biotechnology) will have to choose any two discipline core course out of Botany, Zoology and Chemistry
2. Definition of Credit:
   1 credit =1 Hr. Lecture (L) per week
   1 credit= 2 Hrs. Practical (P) per week
   2 Hrs. = 3 Lectures of approx. 40 minutes

3. Each theory paper will be of 100 marks. The distribution of marks for external and internal assessment will be of 80 and 20 respectively. The distribution of internal assessment marks of 20 is based on the marks obtained by the student in one minor test of 12 marks to be conducted preferably in the month of November for Odd Semester and in the month of March for Even Semester. A student is required to pass the individual paper with 35% marks including internal assessment. The student also needs to pass the external examination individually with 35% marks. There will be maximum 4 marks for attendance (1 mark for attendance of 71-75%, 2 marks for attendance of 76-80%, 3 marks for attendance of 81-85% and 4 marks for attendance above 85%.). The remaining 4 marks are for extracurricular activities including assignments.

4. Practical examinations to be held annually with even semesters. The marks of odd semester practical may be reflected in the DMC of Even semester with code and nomenclature, to be shown separately for each semester.

5. The Batches of 20 or more can be opted for various courses as per requirement for all practical purposes by the college/institution. Each practical will be of 100 marks. The evaluation of practical may be distributed as 20% marks for lab record, 50% marks for performance during the examination and 30% marks for Viva Voce examination.

Semester I **Credit: 3+0**

Biotechnology Paper I
Introduction to Biotechnology
(BIT 101 L)

Max. Marks:80
Internal Assessment: 20
Time: 3 Hours **Total Marks: 100**

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit-I

Introduction to Biotechnology: History and major landmarks in the development of biotechnology, Introduction to gene and genomes, Proteins and proteome, Fermentation technology: General introduction, basic technique and applications, Plant Tissue Culture: General introduction, basic technique and applications, Animal Tissue Culture: General introduction, basic technique and applications **(8 Lectures)**

Unit-II

Genetic Engineering: Introduction and history, Recombinant DNA technology, Genetically modified organisms (GMOs), DNA finger printing and forensic analysis. **(6Lectures)**

Unit-III

Applications of biotechnology: Applications of biotechnology in agriculture, animal husbandry, veterinary sciences, food & feed industry, chemical industry, environment, bioremediation & waste water treatment, solid waste management, biofuels, human health and medicine (Monoclonal antibodies, hybridoma technology and embryo transfer technology) **(8 Lectures)**

Unit-IV

Bio-safety and Ethics: Biotechnology research in India, Biotechnology in context of developing world, Brief account of safety guidelines and risk assessment in biotechnology, Ethics in Biotechnology, Intellectual property rights.

Nanotechnology: Introduction, history and scope (Brief account) **(8 Lectures)**

Recommended Books:

1. Das H.K. (2004), Textbook of Biotechnology, Willey Dreamtech. Pvt. Ltd, New Delhi.
2. Natesh S., Chopra V.L. and Ramachandran S. (1987), Biotechnology in Agriculture Oxford & IBH, New Delhi.
3. Kumar H.D. (2004), A Text Book of Biotechnology, Eastern Willey Press, New Delhi.
4. Bhushan, Bharat (Ed.) 2012 Encyclopedia of Nanotechnology. Springer.
5. Bhushan, Bharat (Ed.) 2010 Handbook of Nanotechnology. Springer.
6. Gupta P.K. (2010), Biotechnology & Genomics, 5th Reprint, Rastogi Publications Meerut.
7. Singh B.D. (2010), Biotechnology, 4th edition, Kalyani Publication.
8. Black J.G (2008) Microbiology- Principles and Explorations, 7th edition, John Wiley & Sons

Semester I **Credit: 3+0**

Biotechnology Paper II
Biochemistry-I
(BIT 102 L)

Max. Marks: 80
Internal Assessment: 20
Time: 3 Hours **Total Marks: 100**

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit I

Biochemistry: Introduction, History and major landmarks in the development of biochemistry, Chemical Foundations of Life – biomolecules and biological chemistry. Interactions in biological systems: Intra and intermolecular forces, Electrostatic and hydrogen bonds, Disulfide bridges, Hydrophobic and hydrophilic molecules and forces, Water and weak interactions, pH and buffers.

Carbohydrates: Structure, Function and properties of biologically important monosaccharides, disaccharides and polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions.

(8 Lectures)

Unit-II

Amino acids and Proteins: Structure and properties of amino acids, Essential amino acids, rare and non-protein amino acids, acid base behaviour/zwitterions; pKa value and titration curve. Proteins: Peptide bond, Structure and function of some biologically important peptides Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins. **(8 Lectures)**

Unit-III

Lipids: Introduction and Classification – simple and complex lipids, Fatty acids – structure and nomenclature, soap value, acid value, iodine number, rancidity. Essential fatty acids, A general account of structure and function of Triacylglycerols, Phospholipids, Glycolipids.

(8 Lectures)

Unit-IV

Nucleotides and Nucleic acids: Building blocks: bases, sugars and phosphates, Structure and nomenclature of nucleosides and nucleotides; polynucleotides, DNA (A, B, Z-DNA) and RNA (rRNA, mRNA, tRNA). Properties of DNA – absorption, denaturation, renaturation, hybridization, Tm/Cot values. Biological importance of ATP and GTP **(6 Lectures)**

Recommended Books:

1. Nelson, D.L. and Cox, M.M. (2013), Lehninger Principles of Biochemistry, 6th Edition Freeman and Company, New York.
2. Voet D., Voet J.G. and Pratt C.W. (2013), Principles of Biochemistry,4th Edition John Wiley and Sons Inc., New York.

Semester I

Laboratory Practical- Paper III (Biochemistry)
BIT: 103P (Credits: 0+3)

Max. Marks: 100

Time: 3 Hours

List of Practicals

1. Preparation of Buffers and Solutions
2. Determination of pKa value
3. Qualitative tests for Carbohydrates
4. Estimation of Carbohydrates
5. Determination of reducing sugars
6. Qualitative tests for amino acids and proteins
7. Quantitative estimation of proteins
8. Determination of saponification and iodine value of lipids
9. Demonstration of Enzyme activity: starch hydrolysis by salivary amylase
10. To study Kinetics of Enzyme activity: Effect of temperature, pH and concentration on enzyme activity
11. Titrimetric analysis of Vitamin C
12. Estimation of phenolic compunds
13. Estimation of antioxidant activity
14. Estimation of Total soluble solids
15. Estimation of titrable acidity

Semester II **Credit: 3+0**

Biotechnology Paper IV
General Microbiology
(BIT 201 L)

Max. Marks: 80
Internal Assessment: 20
Time: 3 Hours **Total Marks: 100**

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit I

Introduction, Importance and Scope of Microbiology: Definition and history of microbiology, contributions of Antony van Leeuwenhoek, Louis Pasteur, Robert Koch etc., Branches of microbiology, Microscope Construction and working principles of different types of microscopes – compound, dark field, Phase contrast, Fluorescence and Electron (Scanning and transmission) **(8 Lectures)**

Unit-II

Sterilization techniques: Principles and Applications of Physical Methods, Autoclave, Hot air oven, Laminar airflow, Seitz filter, Sintered glass filter, and membrane filter, Chemical Methods; Alcohol, Aldehydes, Phenols, Halogens and Gaseous agents, Radiation Methods: UV rays and Gamma rays, Staining techniques: Principles of staining, types of stains – simple stains, structural stains and Differential stains. **(6 Lectures)**

Unit III

Microbial Taxonomy: Concept of microbial species and strains, classification of bacteria based on – morphology (shape and flagella), cell wall, nutrition, extreme environment and 16S rRNA techniques. Viruses and Bacteria: Bacteria – Ultrastructure of bacteria cell (both Gram positive and Gram negative) including endospore and capsule. Viruses – Structure and classification (A brief account), Plant viruses – CaMV, Animal viruses – FMDV, Bacterial Virus – Lambda Phage. Pathogenic Microorganisms: Bacterial diseases of man – tetanus, Tuberculosis, Pneumonia, Cholera and Typhoid. Viral diseases: AIDS (HIV), Ebola, Swine Flu, Hepatitis, Papilloma virus **(8 Lectures)**

Unit-IV

Microbial Growth and Metabolism: Kinetics of microbial growth, growth curve, synchronous growth, factors affecting bacterial growth. Methods to study growth. Respiration: Glycolysis, Kreb's cycle (TCA), Oxidative Phosphorylation. Bacterial Photosynthesis: Photosynthetic apparatus in prokaryotes, Photophosphorylation & Dark reaction. **(8Lectures)**

Recommended Books:

1. Tauro, P., Kapoor, K.K. and Yadav, K.S. (1996). Introduction to Microbiology, New Age Pub., New Delhi
2. Pelczar, M.J. et. al (2001), Microbiology- Concepts and Applications, International Ed. McGraw Hill Publication, New York
3. Black, J.G. (2012), Microbiology: Principles and Explorations, 8thEdition, John Wiley and Sons, USA.

Semester II **Credit: 3+0**

Biotechnology Paper V
Biochemistry II
(BIT 202 L)

Max. Marks: 80
Internal Assessment: 20
Time: 3 Hours **Total Marks: 100**

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit I

Enzymes: Introduction, active site, energy of activation, transition state hypothesis, lock and key hypothesis, induced fit hypothesis. Enzyme classification (Major classes only). Enzyme Kinetics –Hyperbolic curve, Km, V_{max}, MM equation, Lineweaver Burk plot/Double reciprocal plot. Effect of pH and temperature on enzyme activity. Enzyme Inhibition – Competitive, non-competitive and uncompetitive inhibition. Allosteric enzymes (A brief account)

(8 Lectures)

Unit-II

Vitamins: Introduction, Types of vitamins – structure of water soluble vitamins and their coenzyme derivatives, Fat soluble vitamins. Deficiency symptoms and dietary sources. Hormones: Steroid Hormones: structure and importance. Peptide Hormones: structure and function of important peptide hormones. **(8 Lectures)**

Unit-III

Metabolism: General introduction, catabolism and anabolism, Bioenergetics, Carbohydrates metabolism: Glycolysis, Tricarboxylic acid cycle, Gluconeogenesis Glycogenolysis, glycogen synthesis and their regulation. **(8 Lectures)**

Unit-IV

Lipid Metabolism: β-oxidation of saturated fatty acids. Degradation of Triacylglycerols. Synthesis of Fatty acids, Amino acid Metabolism: Transamination, oxidative deamination and decarboxylation reactions in context of amino acid degradation. **(8 Lectures)**

Recommended Books:

1. Freifelder D. (1982), Physical Biochemistry- Application to Biochemistry and Molecular Biology, 2nd Edition, W.H. Freemen and Company, San Fransisco.
2. Nelson, D.L. and Cox, M.M. (2013), Lehninger Principles of Biochemistry, 6th Edition Freeman and Company, New York.
3. Voet D., Voet J.G. and Pratt C.W. (2013), Principles of Biochemistry,4th Edition John Wiley and Sons Inc., New York.
4. Conn E.E., Stumpf P.K., Bruening G. and Doi R.H. (1997,) Outlines of Biochemistry. John Willey and Sons Inc. New York and Toronto.
5. Price N.C. and Stevens L. (1999), Fundamentals of Enzymology 3rd Edition Oxford University Press, New York.
6. Dixon M. and Webb E.C. (1979), Enzyme, 3rd Edition, Academic Press, New York

Semester II **(Credits: 0+3)**

Laboratory Practical- Paper VI
(Microbiology)
BIT: 203P

Max. Marks: 100

Time: 3Hours

List of Practical

1. Safety measures and Laboratory precautions
2. Cleaning, drying and sterilization of glassware
3. Disposal of laboratory waste and cultures
4. Principles and working knowledge of laboratory instruments: Compound Microscope, Autoclave, Hot Air Oven, pH meter, laminar airflow hood, Centrifuge, B.O.D. Incubator, Colony counter etc.
5. Media preparation (Nutrient agar, Nutrient broth, Luria broth etc.) and sterilization.
6. Observation of bacteria in curd by simple staining
7. Demonstration of ubiquitous nature of microorganism
8. Hanging drop technique to demonstrate bacterial motility
9. Enumeration of microorganism from soil, water etc. by serial dilution technique
10. Pure culture technique: Pour plate, Spread plate and Streak plate methods
11. Staining of microorganisms: Bacterial staining – Simple, Gram's, Endospore, Capsule, Negative staining and Fungal staining – wet mount technique
12. Study of effect of physical agents on bacterial growth: Effect of pH, effect of temperature, effect of osmotic pressure (NaCl and sucrose)
13. Antibiotic sensitivity testing by disc diffusion method

Semester III **Credit: 3+0**

Biotechnology Paper VII
Molecular Biology
(BIT 301 L)

Max. Marks: 80
Internal Assessment: 20
Time: 3 Hours **Total Marks: 100**

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit-I

Molecular Biology: Introduction to molecular aspects of life. DNA as the genetic material – experiments proving DNA and RNA as genetic material. Nucleic acids: Structure, function and properties of DNA and RNA. Watson and Crick model of DNA. DNA forms (A, B and Z), their characteristic. Different types of RNA, their structure and function. Eukaryotic genomes: Chromosomal organization and structure. Euchromatin, heterochromatin, centromere, telomere. Chromatin structure (nucleosome), histone and non-histone proteins.

(8 Lectures)

Unit-II

DNA Replication: Central dogma of molecular biology. Semi-conservative mode of DNA replication, experimental proof. Unidirectional and bidirectional mode of DNA replication, theta model. DNA replication in prokaryotes and eukaryotes, different stages, proteins and enzymes involved. DNA damage and repair: causes of DNA damage, mutations. Repair mechanisms- photo reactivation, excision repair, mismatch repair. **(6 Lectures)**

Unit-III

Transcription in prokaryotes and eukaryotes, diff. stages, mechanism, promoters, transcription factors, RNA polymerases. Post transcriptional modifications- 5' cap formation, 3'-end processing/polyadenylation and gene splicing and generation of mature mRNA. Inhibitors of transcription. Genetic Code: concept, elucidation or cracking of genetic code, features of genetic code, Wobble hypothesis. Structure of gene- introns/exons, regulatory sequences, structure of prokaryotic gene. **(8 Lectures)**

Unit-IV

Translation/Protein synthesis: Mechanism of initiation, elongation and termination of protein synthesis in prokaryotes and eukaryotes. Inhibitors of translation. Post-translational modifications. Regulation of Gene Expression in prokaryotes and eukaryotes, induction and repression, positive and negative regulation. Operon model- lac, ara, trp, catabolite repression, transcription attenuation. **(8 Lectures)**

Recommended Books:

1. Fundamentals of Molecular Biology, Pal, J. K. and Ghaskadbi, S. S., Oxford University Press
2. Cell and Molecular Biology by P K Gupta
3. Molecular Biology of the Cell by Alberts
4. Molecular Cell Biology by David Baltimore
5. Gene XII by Lewin
6. Cell and Molecular Biology by Gerald Karp
7. Molecular Cell Biology by Darnell
8. Molecular Biology of the Gene by Watson

Semester III **Credit: 3+0**

Biotechnology Paper VIII
Bio-analytical Techniques
(BIT 302 L)

Max. Marks: 80
Internal Assessment: 20
Time: 3 Hours **Total Marks: 100**

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

UNIT I

Microscopy: Simple microscopy, phase contrast microscopy, florescence and electron microscopy (TEM and SEM), pH meter. **(8 Lectures)**

UNIT-II

Spectroscopy: Principle and law of absorption, colorimetry, spectrophotometry (visible, UV, infrared), cell fractionation techniques, isolation of sub-cellular organelles and particles. **(8 Lectures)**

UNIT-III

Chromatography: Principle of chromatography, Paper chromatography, thin layer chromatography, column chromatography, silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC. **(8 Lectures)**

UNIT-IV

Electrophoresis: Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno-electrophoresis, isoelectric focusing, Western blotting. **(6 Lectures)**

Recommended Books:

1. Principles and Techniques of Biochemistry and Molecular Biology by Wilson and Walker.
2. Introductory Practical Biochemistry by Sawhney and Singh
3. Bioanalytical Techniques by Abhilasha Shourie
4. Cell and Molecular Biology : Concepts and Experiments by Gerald Karp
5. An Introduction to Practical Biochemistry by Plummer

Semester III **(Credits: 0+3)**

Laboratory Practical- Paper IX
(Molecular Biology & Bio-analytical techniques)
BIT: 303P

Time: 3 Hours **Maximum Marks: 100**

List of Practicals

1. Principles, handling and working of Microscopes, Spectrophotometer, Centrifuge, pH meter, colorimeter etc.
2. Isolation and quantification of genomic DNA from bacteria (E. coli), animals or Plants
3. Analysis of DNA by Agarose Gel Electrophoresis.
4. Estimation of DNA by DPA method.
5. Estimation of RNA by orcinol method.
6. Absorption spectra of proteins and nucleic acids.
7. Separation of amino acids/sugars by Paper Chromatography.
8. Thin layer chromatography (TLC) of sugars/lipids/amino acids.
9. Native gel electrophoresis of proteins.
10. SDS-polyacrylamide slab gel electrophoresis of proteins under reducing conditions.
11. Preparation of protoplasts from leaves.
12. To verify the validity of Beer's law and determine the molar extinction coefficient of NADH.
13. Cellular fractionation and separation of cell organelles using centrifuge.
14. Protein/Enzyme purification by Gel filtration and Ion exchange chromatography/affinity chromatography.

Semester IV **Credit: 3+0**

Biotechnology Paper X
Immunology
(BIT 401 L)

Max. Marks: 80
Internal Assessment: 20
Time: 3 Hours **Total Marks: 100**

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit I

Immunology: Introduction, History and Scope. Terminology of immune system Immunity: Cells and Organs of the Immune System – Haematopoiesis, B and T cells (types and receptors), Null cells, Monocytes, Polymorphs. Primary and Secondary Lymphoid organs- Thymus, Spleen, Lymph nodes, MALT, GALT, BALT. Innate and Adaptive Immunity: Definition, types of Immunity- Innate, Adaptive/acquired (active, passive, natural/artificial, Humoral and Cell mediated immunity). Features of Immune Response – memory, cell specificity/diversity, recognition of self and non-self. **(8 Lectures)**

Unit-II

Antigens: Concept, Types of Antigens, Antigenic determinants/epitopes, Hapten. Antigen and Immunogen. Antigenicity and Immunogenicity. Factors affecting antigenicity, Adjuvants
Antibodies: Structure, Types/Classes, properties and functions of immunoglobulins. Antigen – Antibody Interactions: Binding sites, Binding forces, Affinity, Avidity, Cross reactions. Precipitation and Agglutination reactions, RIA, ELISA, Immunofluorescence, Flow cytometry and Fluorescence activated cell sorter (FACS). **(7 Lectures)**

Unit III

Complement system: Structure, components, properties and functions. MHC and Antigen processing and presentation: Structure and function of Major Histocompatibility Complex – Class I and Class II MHC molecules, Endocytic pathway and Cytosolic pathway of Antigen processing and presentation. **(7 Lectures)**

Unit-IV

Immune Response: Introduction, Humoral Immunity and Cell mediated immunity– Primary and Secondary immune response. Hypersensitivity, Types of hypersensitivity, Autoimmunity, autoimmune disease Immunological tolerance. Vaccines: concept, types of vaccines- Inactivated, Attenuated and Recombinant vaccines (Peptide and DNA vaccines) **(8 Lectures)**

Recommended Books:

1. Delves P. J., Martin J. S., Burton R. D., Roitt M. I. Roitt's Essential Immunology, Wiley Blackwell (2011) 12th ed.
2. Khan F.H. The Elements of Immunology, Pearson Education
3. Janeway'sImmunobiology by Murphy, Walport and Travers
4. Immunology by Kuby
5. Immunology at a glance by Playfair& Chain

Semester IV **Credit: 3+0**

Biotechnology Paper XI
Recombinant DNA Technology
(BIT 402 L)

Max. Marks: 80
Internal Assessment: 20
Time: 3 Hours **Total Marks: 100**

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

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Unit I

Recombinant DNA Technology and Genetic Engineering: Introduction, history, scope and applications. Tools of Recombinant DNA technology: Steps in gene cloning. Gene cloning tools - Restriction enzymes and their features. Ligases, polymerases, alkaline phosphatases, kinases, transferases and other DNA engineering enzymes. Linkers and adapters (**8 Lectures)**

Unit-II

Gene Cloning Vectors: Introduction, Properties of host. nomenclature of vectors, properties of a suitable vector. Plasmid vectors, bacteriophage. M13 vectors. Expression vectors, BACs
Transformation: Techniques of introducing r-DNA into the desired host, competent cells, electroporation and microinjection. Screening and selection of transformants and their characterization, selection of clone having the specific DNA insert - immunological screening and colony hybridization. Marker genes- selectable and scorable markers. **(7 Lectures)**

Unit-III

Gene Libraries: Construction of Genomic and cDNA library, advantages and limitations, screening of gene libraries. DNA amplification through PCR: Basic features and applications of PCR, types and modifications like inverse PCR, RT-PCR, anchored PCR, nested PCR. DNA sequencing techniques: Maxam – Gilbert's method, Sanger's dideoxy chain termination method, Automated DNA sequencing. **(7 Lectures)**

Unit-IV

Genome Mapping: Concept and applications. Restriction enzyme digestion and restriction mapping. Southern and Northern analysis. DNA finger printing, Western blotting, dot blots and slot blots. RFLP, RAPD (brief only). Applications of Recombinant DNA technology: Production of recombinant proteins of pharmaceutical importance- insulin, human growth hormone, recombinant vaccines (hepatitis B) etc. Genetically modified organisms (GMOs)
(8 Lectures)

Recommended Books:

1. Biotechnology: Expanding Horizons by B D Singh
2. Elements of Biotechnology by P K Gupta
3. Principles of Gene Manipulation and Genomics by Twyman and Primrose
4. Gene Cloning and DNA Analysis by T A Brown
5. Genome 3rd Edition by T A Brown.
6. From Genes to Genomes by Dale and Schantz.

Semester IV **(Credits: 0+3)**

Laboratory Practical- Paper XII
(Immunology & Recombinant DNA Technology)
BIT: 403P

Max. Marks: 100

Time: 3Hours

List of Practical

1. ABO blood grouping and Rh typing.
2. Differential leukocyte count.
3. RBC counting using a haemocytometer.
4. Dot ELISA.
5. Radial Immunodiffusion analysis.
6. Diagnosis of infectious disease – Widal test and VDRL
7. Separation of DNA by Agarose Gel Electrophoresis.
8. Restriction digestion of DNA and Agarose Gel Electrophoresis
9. Amplification of DNA by PCR using random primers
10. Methods for cell lysis: rupture Osmotic/Chemical/Enzymatic lysis of cells (RBC's) followed by centrifugation.
11. Extraction and estimation of proteins from plant or animal source
12. Protein purification by Gel filtration and Ion exchange chromatography.
13. Protein separation by PAGE/SDS-PAGE

Semester V **Credit: 3+0**

Discipline Specific Elective Biotechnology Paper-I
Plant Biotechnology
(BIT 501 L)

Max. Marks: 80
Internal Assessment: 20
Time: 3 Hours **Total Marks: 100**

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit I

Plant Tissue Culture: Introduction, Concept, History, Scope and Applications. Plant Tissue Culture Laboratory: Layout, organization, equipments, instruments and other requirements. Aseptic Techniques: General sanitation/cleanliness of PTC laboratory and precautions regarding maintenance of aseptic conditions, Washing, drying and sterilization of glassware, sterilization of media. Culture Media: Nutritional requirements for plant tissue culture, role of different media components, plant growth regulators, different culture media viz. MS, B5 Nitsch and White's medium. In-vitro methods in plant tissue culture: Explants, their cellular characteristics, dedifferentiation and redifferentiation, cellular totipotency, organogenesis and somatic embryogenesis. **(8 Lectures)**

Unit-II

Micropropagation, (different routes of multiplication-axillary, bud proliferation etc.), Synthetic seeds (a brief account), Meristem culture. Callus and suspension culture techniques: Introduction, principle, methodology, applications and limitations. Somaclonal variation (Brief account only) Organ culture: Anther & Pollen culture, ovary, ovule, embryo and endosperm culture-concept, technique, applications and limitations. Protoplast culture: Protoplast isolation, viability test and its culture. Somatic hybridization – protoplast fusion techniques (chemical and electro-fusion), selection of hybrids, production of symmetric and asymmetric hybrids and cybrids. Practical applications of somatic hybridization. **(7 Lectures)**

Unit-III

Production of secondary metabolites in vitro: introduction, technique and utilities. Plant germ plasm conservation and cryopreservation. Genetic Engineering in plants: Introduction, *Agrobacterium tumefaciens* and *A. rhizogenes* mediated transformation. Ti plasmid. Strategies for gene transfer to plant cells. Binary and cointegrate vectors. Direct DNA transfer/Physical methods of gene transfer in plants –biolistic method, electroporation, liposome mediated, Calcium phosphate mediated, microinjection etc. **(8 Lectures)**

Unit-IV

Transgenic Plants: Introduction and applications. Developing insect resistance, bacterial, fungal and viral disease resistance and abiotic stress tolerance in plants. Improving food quality – nutritional enhancement of plants (carbohydrates, seed storage proteins and vitamins). Plants as Bioreactors: antibodies, polymers, industrial enzymes (Brief account only), Edible vaccines.

(7 Lectures)

Recommended Books:

1. Biotechnology: Expanding Horizons by B D Singh
2. Elements of Biotechnology by P K Gupta
3. Plant Tissue Culture: Theory and Practice by M K Razdan and SS Bhojwani
4. Plant Breeding and Biotechnology by Denis Murphy.
5. Medical Biotechnology by Glick, Delovitch and Patten.

Semester V **Credit: 3+0**

Discipline Specific Elective Biotechnology Paper-II

Microbial Biotechnology

(BIT 502 L) **Max. Marks: 80**

Internal Assessment: 20

Time: 3 Hours **Total Marks: 100**

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit I

Microbial Biotechnology: Historical landmarks, General concept. Screening and Isolation of Microorganisms: Industrially important microbes, their screening and isolation, enrichment culture. Strain improvement- bacterial genetics, mutant selection, recombination, recombinant DNA technology. Strain preservation and maintenance. Nutrition and cultivation of microorganisms: Basic nutrition and metabolism, Natural and Synthetic media, Sterilization techniques. **(7 Lectures)**

Unit-II

Microbial Fermenters/Bioreactors: Basic design of fermenters. Physco-chemical standards used in bioreactors (agitation, aeration, pH, temp., dissolved oxygen etc.). Types of fermenters-stirred tank, airlift etc. Fermentation types – Continuous, Batch culture, Solid state and Submerged. Quantification of growth, thermodynamics of growth, effect of different factors on growth. **(8 Lectures)**

Unit-III

Process Development and Downstream Processing: Shake flask fermentation, scale up of the process. Separation of particles, disintegration of cells, extraction, concentration, purification and drying of the products. Microbial Products: a brief discussion about production of certain industrial products such as Alcohol, Alcoholic beverage (Beer), Organic acids (citric acid), Antibiotics (penicillin), Amino acids (glutamic acid), enzymes (protease, alpha-amylase). Microbial Foods: Single Cell Proteins. **(8 Lectures)**

Unit-IV

Sewage waste water treatment: Aerobic and anaerobic digestion. Bioremediation. Biodegradation of xenobiotic compounds. Biotransformation, Biomining, bioleaching, biogas production. Microbial technology in agriculture- Bioinsecticides, bioherbicides, biocontrol agents for disease control, advantages over chemical methods. Biofertilizers. **(7 Lectures)**

Recommended Books:

1. Biotechnology: Expanding Horizons by B D Singh
2. Elements of Biotechnology by P K Gupta
3. Microbial Biotechnology by Glazer
4. Principles of Fermentation Technology by Stanbury
5. Fermentation Biotechnology: Principles, Process and Technology by Owen P Ward
6. Modern Biotechnology by Nathans
7. Biotechnology: A textbook of Industrial Microbiology by Crueger and Crueger
8. Medical Biotechnology by Glick, Delovitch and Patten.

Semester V **(Credits: 0+3)**

Laboratory Practical- Paper III
BIT 503 P
(Microbial Biotechnology and Plant Tissue Culture)

Max. Marks: 100

Time: 3 Hours

List of Practicals

1. Demonstration/operation of large scale fermenters handling and working of Autoclave, Laminar Air Flow Hood, and Hot Air Oven.
2. Preparation and Sterilization of plant tissue culture media viz. MS (1962), Nitsch (1969) or White's medium.
3. Callus and Suspension culture.
4. Induction of organogenesis/differentiation through hormonal balance modulation.
5. Micro propagation through Shoot Tip Culture, Nodal Culture, Axillary bud culture. 6. Anther or Pollen culture.
6. Plant protoplast preparation through enzymatic or physical method and to perform protoplast viability test
7. Somatic embryogenesis and preparation of synthetic seeds.
8. Growth Curve Study – Bacteria and Yeast.
9. Biomass production (Baker's yeast, spirulina, Agaricus, Aspergillus)
10. Production of alcohol and wine.
11. Estimation of alcohol in wine/fermented broth
12. Estimation of lactic acid and lactose.
13. Estimation of fermentation products by titration methods.
14. Production of Primary and Secondary metabolites (one organic acid and one antibiotic)

Semester VI **Credit: 3+0**

Discipline Specific Elective Biotechnology Paper-IV
Animal Biotechnology
(BIT 601 L)

Max. Marks: 80
Internal Assessment: 20
Time: 3 Hours **Total Marks: 100**

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

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Unit I

Animal Cell & Tissue Culture: Introduction, Principles & practice. History and Development of animal cell culture. Scope and Applications. Culture Media: Media components, Serum containing and serum free media. Natural media- Plasma clot, biological fluids, tissue extracts. Growth factors required for proliferation of animal cells. Chemically defined media, balanced salt solutions. Physical requirements for growing animal cells in culture **(8 Lectures)**

Unit-II

Primary Cell Culture techniques: Initiation of cell culture-substrates (glass, plastic, metals) their preparation and sterilization. Isolation of tissue explants, disaggregation- enzyme disaggregation and mechanical disaggregation of the tissue. development of primary culture and cell lines. Contamination in animal cell cultures. Suspension culture, Growth curve of animal cells in culture. Secondary cell culture – transformed cell and continuous cell lines. Finite and infinite cell lines. Cell lines: Commonly used cell lines- their organization and characteristics. Organ Culture: technique, advantages, applications and limitations. Artificial skin. **(8 Lectures)**

Unit-III

Transfection of animal cells: transfection methods, Selection markers. Cloning and expression of foreign genes in animal cells: Expression vectors. Over production of recombinant proteins. Hybridoma Technology: Production of monoclonal antibodies and their applications. Embryo transfer technology- technique, its applications. Artificial insemination. Animal clones.
(8 Lectures)

Unit-IV

Transgenic Animals: transgenic sheep, cow, pig, goat etc. Production of transgenic mice, Gene targeting in mice, applications of gene targeting. Therapeutic products through genetic engineering – blood proteins, insulin, growth hormone etc. Gene Therapy: introduction, types of gene therapy, major achievements, problems and prospects. Stem cells in gene therapy.
(7 Lectures)

Recommended Books:

1. Biotechnology: Expanding Horizons by B D Singh
2. Elements of Biotechnology by P K Gupta
3. Animal Cell Culture by Freshney
4. Animal Cell Culture and Technology: The Basics by Butler
5. Medical Biotechnology by Glick, Delovitch and Patten.

Semester VI **Credit: 3+0**

Discipline Specific Elective Biotechnology Paper-V
Bioinformatics
(BIT 602 L)

Max. Marks: 80
Internal Assessment: 20
Time: 3 Hours **Total Marks: 100**

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit I

Basics of computer and Bioinformatics: Fundamental aspects of computer and Internet in relation to bioinformatics, database management systems (Object-oriented and relational), Introduction, History, goals and Scope, applications and limitations of Bioinformatics. Information Networks (EMB-NET, NIC-NET, INFLIBNET). **(7 Lectures)**

Unit-II

Introduction to Genomics and genome projects – information flow in biology, DNA sequence data, experimental approach to genome sequence data, genome information resources. Functional Proteomics – protein sequence and structural data, protein information resources and secondary data bases. **(8 Lectures)**

Unit-III

Computational Genomics - Internet basics, biological data analysis and application, sequence data bases, NCBI model, File format. Protein primary sequence comparison, pairwise alignment and analysis, algorithm BLAST, Variants of BLAST, multiple sequence alignment. DATA base searching using BLAST and FASTA. **(8 Lectures)**

Unit-IV

Predictive methods using DNA and protein sequences (protein prediction, motif, tertiary structure), Structural data bases – Small molecules data bases, protein information resources, protein data bank. **(7 Lectures)**

Recommended Books:

1. David W. Mount. (2004) Bioinformatics: Sequence and Genome Analysis, 2nd ed. Cold Spring Harbor.
2. Arthur M. Lesk (2002) Introduction to Bioinformatics, Oxford University Press Inc., New York
3. Jin Xiong (2012) Essential Bioinformatics, Cambridge University Press.
4. V. Kothekar (2004) Introduction to Bioinformatics. Dhruv Publications
5. Attwood and Parry Smith (June 9, 2001) Introduction to Bioinformatics, Benjamin Cummings; 1 edition.
6. Harisha S (2013) Fundamentals of Bioinformatics, I. K. International Pvt Ltd.
7. Krane and Raymer (2003) Fundamental Concepts of Bioinformatics, Pearson.

Semester VI **(Credits: 0+3)**

Laboratory Practical- Paper VI
Animal Biotechnology& Bioinformatics
BIT 603 P

Time: 3 Hours **Max. Marks: 100**

List of Practicals

1. Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization
2. Sources of contamination and decontamination measures
3. Preparation of Hanks Balanced salt solution
4. Preparation of Minimal Essential Growth medium
5. Isolation of lymphocytes for culturing
6. Lymphocyte culture/Animal tissue culture
7. DNA isolation from animal tissue
8. Quantification of isolated DNA
9. Resolving DNA on Agarose Gel
10. Acquaintance of biological databases through internet.
11. Introduction to NCBI websites (Pubmed and GenBank).
12. Retrieval of biomacromolecular sequence from online databases.
13. Curation of sequence homology through BLAST.
14. Multiple Sequence Alignment of reference protein/nucleotide sequence by Clustal-ω
15. Molecular Phylogeny by MEGA 7.0
16. Primer designing by bioinformatics tool.
17. Protein prediction and characterization
18. Virtual Restriction digestion using Restriction Mapper.
19. Searching Open Reading Frames using ORF Finder.
20. Molecular structure visualization tool (RASMOL)

Semester VI **Credit: 3+0**

Skill Enhancement Course Biotechnology Paper-I
Molecular Diagnostics
(BIT 604 L)

Max. Marks: 80
Internal Assessment: 20
Time: 3 Hours **Total Marks: 100**

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

UNIT I

Enzyme Immunoassays: Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays. Enzyme immunoassays after immuno blotting. Enzyme immunohistochemical techniques. Use of polyclonal or monoclonal antibodies in enzymes immuno assays. Applications of enzyme immunoassays in diagnostic microbiology.

(8 Periods)

UNIT II

Molecular methods in clinical microbiology:Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide and plasmid finger printing in clinical microbiologyLaboratory tests in chemotherapy:Susceptibility tests: Micro-dilution and macro-dilution broth procedures. Susceptibility tests: Diffusion test procedures. Susceptibility tests: Tests for bactericidal activity. Automated procedures for antimicrobial susceptibility tests.

(8 Periods)

UNIT III

Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies. Concepts and methods in idiotypes. Antiidiotypes and molecular mimicry and receptors. Epitope design and applications. Immunodiagnostic tests. Immuno florescence. Radioimmunoassay. **(8 Periods)**

UNIT IV

GLC, HPLC, Electron microscopy, flow cytometry and cell sorting. **(6 Periods)**

Recommended Books:

1. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
2. Bioinstrumentation, Webster
3. Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe, Kluwer Academic
4. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.
5. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
6. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
7. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Centuary-Crofts publication.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.Microscopic Techniques in Biotechnology, Michael Hoppert.

Semester VI **Credit: 3+0**

Skill Enhancement Course Biotechnology Paper-I
Basics of Forensic Science
(BIT 605 L)

Max. Marks: 80
Internal Assessment: 20
Time: 3 Hours **Total Marks: 100**

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit I

Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science, causes of crime, role of modus operandi in criminal investigation. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.

(8 Lectures)

Unit II

Classification of fire arms and explosives, introduction to internal, external and terminal ballistics. Chemical evidence for explosives. General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of ink various samples.

(8 Lectures)

Unit III

Role of the toxicologist, significance of toxicological findings, Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification. **(8 Lectures)**

Unit IV

Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security. **(6 Lectures)**

Recommended Books:

1. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
2. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, SelectPublishers, New Delhi (2001).
3. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi(2002).
4. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques,2nd Edition, CRC Press, Boca Raton (2005).
5. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRCPress, Boca Raton (1997).
6. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
7. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene Investigation, CRC Press,Boca Raton (2013).