KANNUR UNIVERSITY

(Abstract)

Revised Scheme, Syllabus and Pattern of Question Paper of M.Sc Biotechnology Programme (CBCSS) - implemented in the University Department - w.e.f. 2020 Admission – Orders issued.

ACADEMIC C SECTION

Acad/C4/12615/2020 Dated: 17.02.2021

Read:-1. The Minutes of the meeting of the Syndicate held on 26.10.2019, vide item No. 2019.676

2. U.O.No.ACAD C3/22373/2019. dated 08.10.2020

3. U.O.No.Acad/C3/22373/2019, dated 12.11.2020

4. Department Council Minutes, Dept. of Biotechnology & Microbiology dated 10.09.2020

5. E.mail dated 18.01.2021, from the HoD, Dept. of Biotechnology & Microbiology along with revised Scheme, Syllabus and Pattern of Question Paper of M.Sc. Biotechnology programme.

ORDER

1. The meeting of the Syndicate held on 26.10.2019 resolved vide paper read (1) above to revise the Scheme and Syllabus of all Post Graduate Programmes under Choice Based Credit Semester System (CBCSS) in the Schools/Departments of University with effect from 2020 admission.

2. Subsequently, the Curriculum Committee was reconstituted as per paper read (2) above to monitor and co-ordinate the working of the Choice based Credit Semester System.

3. Accordingly, the revised Regulations for P.G. Programmes under Choice Based Credit Semester System were implemented in the Schools/Departments of the University with effect from 2020 admission as per paper read (3) above.

4. Further, the Department Council, vide paper read (4) above approved the revised Scheme, Syllabus and the Pattern of Question paper of the M.Sc. Biotechnology programme, prepared in line with the revised Regulations for Choice Based Credit Semester System, for implementation w.e.f 2020 admission in the Dept. of Biotechnology & Microbiology, Dr. Janaki Ammal Campus,Thalassery of the University.

5. Subsequently, the revised Scheme, Syllabus & Pattern of Question Paper of the M.Sc. Biotechnology programme, prepared in line with the revised Regulations for Choice Based Credit Semester System, duly scrutinized by External Subject Expert and he recommended the Syllabus for implementation.

6. Thereafter, the revised Scheme, Syllabus and Pattern of Question Paper of M.Sc Biotechnology Programme was forwarded by the Head, Dept. of Biotechnology & Microbiology, Dr. Janaki Ammal Campus, as per paper read (5) above, for implementation with effect from 2020 admission.

7. The Vice Chancellor after considering the matter in detail and in exercise of the powers of the Academic Council conferred under section 11 (1) of Kannur University Act 1996 accorded sanction to implement the revised Scheme, Syllabus and the Pattern of Question Paper of the M.Sc.

Biotechnology & Microbiology, Dr. Janaki Ammal Campus, Palayad,Thalassery of the University with effect from 2020 admission, subject to reporting to the Academic Council.

8. The revised Scheme, Syllabus and Pattern of Question Paper of the M.Sc. Biotechnology Programme(CBCSS) implemented with effect from 2020 admission are uploaded in the University Website.**(www.kannuruniversity.ac.in).**

Orders are issued accordingly.

Sd/-

BALACHANDRAN V K

DEPUTY REGISTRAR (ACAD)

For REGISTRAR

To: The Head, Dept. of Biotechnology & Microbiology
Dr. Janaki Ammal Campus, Palayad, Thalassery, Kannur - 670661

Copy To: 1. The Examination Branch (through PA to CE).
2. PS to VC / PA to PVC / PA to R / PA to CE
3. DR / AR 1 (Acad).
4. The Computer Programmer (for uploading in the Website)
5. SF / DF /FC /.

Forwarded / By Order

SECTION OFFICER

KANNUR UNIVERSITY
CIVIL STATION P.O.
KANNUR
Pin-670 002
THAVAKKARA

KANNUR UNIVERSITY

DEPARTMENT OF BIOTECHNOLOGY AND MICROBIOLOGY

SCHEME AND SYLLABUS

MSc BIOTECHNOLOGY

2020 ADMISSION ONWARDS

Scheme and Syllabus of M.Sc. Biotechnology Program
Under the Choice Based Credit Semester System with
effect from 2020Admission

About the Department

The Department of Biotechnology and Microbiology of Kannur University established in the year 2000 at Palayad, Thalassery offers M.Sc., Ph.D. and Post-doctoral programs in Biotechnology and Microbiology. The Department is a **Centre of Excellence** in **Biosciences,** receiving research funds from state, national and international agencies. Our vision is to improve quality of life through research and molding future scientists and individuals who will be a work force to make a better tomorrow.

M.Sc. PROGRAMMES

M.Sc. Biotechnology – 12 Seats
M.Sc. Microbiology – 12 Seats

Programme Specific Outcomes (PSOs):

A post-graduate student upon completion of the programme is expected to gain the following attributes:

- To train students drawn from different disciplines at Post-Graduate level in frontier and multidisciplinary areas of Biotechnology so as to equip them to be future scientists, teachers and entrepreneurs.
- Competence for research and innovation in Biotechnology.
- Gaining technical skills for the betterment of planet Earth.
- Critical thinking ability to review scientific literature as steppingstone to research
- Gain confidence for career choice.
- Gain ability to work independently in choosing research topics as well as be part of teamwork. with collaborative skills.
- To attain confidence in scientific conversation and writing skills and knowing ethical behavior.

DURATION OF THE PROGRAMME

The whole program is divided into four semesters (two years)

ELIGIBILITY FOR ADMISSION

Bachelor's degree in any of the subjects such as Biotechnology/ Microbiology/ Biochemistry/ Chemistry/ Zoology/ Botany/ Plant Science/ Life Science or any other subject with Microbiology/ Biotechnology as one of the subjects of study at degree level with not less than 50% marks in aggregate (excluding languages). Those who are awaiting final year B.Sc. results also can apply but will have to fulfil the eligibility criteria before the admission. Eligible relaxation in the percentage of marks will be given to candidates belonging to SC and ST. Reservation policies of the University/State are followed for admission.

ADMISSION PROCEDURE

Admissions are notified in national newspapers inviting applications for the M.Sc programmes (Biotechnology and Microbiology) of the Department.

All the eligible applicants must appear for a written entrance test. Duration of the entrance test will be 120 minutes with 200 objective type multiple choice questions for 100 marks. Questions will be of undergraduate level. There will be 25% negative marks for the wrong answers. A rank list will be prepared based on the entrance test. The admission will be as per the rank in the list and reservation policy.

The subjects and their weightages in the Entrance Test will be as given below.

Physics	10%
Chemistry	15%
Botany and Zoology	25%
Biotechnology, Microbiology, Biophysics, Biochemistry, Molecular biology etc	50%

MSc CURRICULUM

The M.Sc curriculum of both Biotechnology and Microbiology closely follows the level and extent as conceived by the national curricula development centers of UGC/ DBT. The Choice Based Credit System (CBCS) provides an opportunity for the students to choose courses from the prescribed courses comprising core and elective courses. The evaluation of the courses will be through grading system evaluation and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in internal and external examinations.

COURSES AND CREDITS

Definitions

(i) '**Academic Programme'** means the entire course of study including its programme structure, details of the course, evaluation methods etc. This will be carried out by teaching and evaluation process in the parent department / centre or jointly under more than one such Department/ Centre

(ii) **'Course'** means is a subject that is part of an Academic Programme

(iii) **'Programme Structure'** includes the list of courses (Core, Elective, Open Elective) that forms an Academic Programme which specifies the syllabus, credits, hours of teaching, evaluation process and examination schemes, the minimum credits required for successful completion of the programme etc. prepared in conformity to University Rules and eligibility criteria for admission

(iv) **'Core Course'** means a course that a student admitted to a particular programme must successfully complete compulsorily to receive the degree and that which cannot be substituted by any other course

(v) **'Elective Course'** means an optional course to be selected by a student out of such courses offered in the same or any other Department/Centre

(vi) '**Open Elective'** means an elective course which is available from recognized online resources like Swayam/ MOOCS or offered by other departments within the frame work of the subject.

(vii) **'Credit'** is the value assigned to a course which indicates the level of instruction; 1 lecture per week equals 1 Credit, 3 hours practical class per week equals 1 credit.

(viii) '**SGPA'** means Grade Point Average of the semester calculated for individual semester.

(ix) **'CGPA'** is Cumulative Grade Points Average calculated for all courses completed by the students at the end of the programme. A formula for conversion of CGPA into percentage marks will be given in the mark sheet.

A minimum of 80 credits are mandatory for the successful completion of the programme.

Students can opt for **one elective (open elective)** course relevant to Biotechnology program from **online sources approved by the University (Swayam Platform or similar platforms) or other Departments** during second and third semester. The choice of the student must be reported to the Head of the Department and approved by the Department Council. **The minimum credits per semester is 16 and the maximum credits per semester (core and elective inclusive) cannot cross 24. All students have to opt for equal number of electives in each semester.**

If the student does not earn the required credits by not appearing for the exam or due to other reasons, the course will have to be repeated along with the concurrent semester of the next batch after the approval by the DC.

PROJECT WORK

Students have to take up a research project of 5 months duration in the fourth semester for which they are encouraged to go to national research institutes. The students may also get opportunity to undergo 1-2 weeks training in industrial / research institutions in the field of applied biology.

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EVALUATION

The marks for Continuous Evaluation and End Semester Examination will be in the ratio 40:60. Allocation of marks for each component under continuous evaluation of theory courses shall be as given below.

Continuous Evaluation: Theory Paper (40 Marks)

Assignment	Test papers	Seminar	Total
8	16	16	40

Continuous Evaluation: Practical (40 Marks)

Midsemester test/viva	Record	Total
30	10	40

End Semester Examination Practical: (60 Marks)

The teacher conducting the practical examination will decide the components of the exam

End Semester Examination Theory: Written examination for **60 Marks**

ATTENDANCE:

The minimum attendance required for each course in a semester shall be 60% of the total number of classes conducted for the course. Only those who secure the minimum attendance requirement in the semester will be allowed to register for the End Semester Examination.

TENURE

A student must complete the entire program within four years from the date of registration

Courses offered in the M.Sc Biotechnology Programme - Total credits 80

Semester I

Courses: Core: 6 (Theory:4, Practical:2), Elective: 2

Credits: Core: 16, Elective: 6, Total: 22

Sl. No	Course Code	Title of the course	Contact hours /week			Marks			Credits
			L	T/ S	P	ESE	CE	Total	
	Core Courses								
1	MSBTC01C01	Biochemistry	3	2		60	40	100	3
2	MSBTC01C02	General Microbiology	3	2		60	40	100	3
3	MSBTC01C03	Cell Biology	3	2		60	40	100	3
4	MSBTC01C04	Genetics	3	2		60	40	100	3
5	MSBTC01C05	Practical I (Biochemistry and General Microbiology			3+3	60	40	100	2
6	MSBTC01C06	Practical II (Cell Biology and Genetics)			3+3	60	40	100	2
	Elective Courses								
7	MSBTC01E01	Biostatistics	3	2		60	40	100	3
8	MSBTC01E02	Instrumentation	3	2		60	40	100	3

Semester II

Courses: Core: 3 (Theory: 2, Practical: 1), Elective: 4

(Students have to choose 4 elective courses from 5)

Credits: Core: 8, Elective: 12, Total: 20

Sl. No.	Course Code	Title of the course	Contact hours/week			Marks			Credits
			L	T/S	P	ESE	CE	Total	
	Core courses								
9	MSBTC02C07	Intermediary Metabolism	3	2		60	40	100	3
10	MSBTC02C08	Molecular Biology	3	2		60	40	100	3
11	MSBTC02C09	Practical III (Intermediary Metabolism and Molecular Biology)			3+3	60	40	100	2
	Elective courses (4/5)								
12	MSBTC02E03	Biophysics	3	2		60	40	100	3
13	MSBTC02E04	Immunology	3	2		60	40	100	3
14	MSBTC02E05	Human Physiology and Developmental Biology	3	2		60	40	100	3
15	MSBTC02E06	Food Microbiology	3	2		60	40	100	3
16	MSBTC02E07	Ethics, Patency and Intellectual Property Rights	3	2		60	40	100	3

Semester III

Courses: Core: 6 (Theory: 4, Practical: 2), Elective: 2

(students have to choose 2 out of 4 available elective courses)

Credits: Core: 16, Elective: 6, Total: 22

Sl. No.	Course Code	Title of the course	Contact hours/week			Marks			Credits
			L	T/S	P	ESE	CE	Total	
	Core courses								
17	MSBTC03C10	Microbial Technology	3	2		60	40	100	3
18	MSBTC03C11	Enzymology	3	2		60	40	100	3
19	MSBTC03C12	Cell and Tissue Manipulation	3	2		60	40	100	3
20	MSBTC03C13	Recombinant DNA Technology	3	2		60	40	100	3
21	MSBTC03C14	Practical IV (Microbial Technology and Enzymology)			3+3	60	40	100	2
22	MSBTC03C15	Practical V (Cell and Tissue Manipulation and Recombinant DNA technology)			3+3	60	40	100	2
	Elective courses (2/4)								
23	MSBTC03E08	Bioinformatics	3	2		60	40	100	3
24	MSBTC03E09	Biotechnology in Medicine, Health, Agriculture and Environment	3	2		60	40	100	3
25	MSBTC03E10	Virology, Mycology and Parasitology	3	2		60	40	100	3
26	MSBTC03E11	Environmental Microbiology	3	2		60	40	100	3

Semester IV

Courses: Core: 1 Credits: 16

Sl. No.	Course Code	Title of the course	Contact hours/week			Marks			Credits
		Core	L	T/S	P	ESE	CE	Total	
27	MSBTC04C16	Project Research & Dissertation		5	25	60	40	100	16

The continuous evaluation of the project work shall be done by the research supervisor based on the performance of the student in the lab. The end semester evaluation consists of a presentation and a viva voce based on the project.

SEMESTER I (Total Credits Required: 22)

MSBTC01C01
BIOCHEMISTRY

3 CREDITS **(48 Hours)**

Course Objectives:

1. Understand structure and function of biological macromolecules.
2. Understand Chemical changes taking place in the living cells.
3. Understand transport across biological membranes.
4. Understand the role of small molecules in the biological system.

Course Outcome:

Upon completion of this course, students will be able to explain and demonstrate the structure, function and dispersal of the basic building blocks of life - the chemical components of living organisms

Course Content

Module I

Introduction: Molecular logic of living system, Biological macromolecules. Importance of Biochemistry in contemporary medicine and its perspectives.

Membranes: Structure and functions of different membranes and reasons for their composition. Membrane transport: Passive transport, co-transport, anti-port, active transport, secondary active transport, Pumps and channels and their significance, Membrane proteins.

(10 Hrs)

Module II

Carbohydrates: Definition and classification, Structure, conformation and functions of monosaccharides, disaccharides, polysaccharides. Starch, glycogen, dextrin, cellulose, amino sugars, Glycoproteins, Glycolipids, Mucopolysaccharides.

Lipids: Definition and classification, structure, function, physical and chemical properties – Fatty acids, Fats, Waxes, Phospholipids, Sphingolipids, Cerebrosides, Gangliosides, Sterols, lipoproteins. Eicosanoids - Formation of prostaglandins; prostacyclin and thromboxane from unsaturated fatty acids, Saponification number, acid number and iodine number of fats.

(14 Hrs)

Module III

Proteins: Properties of peptides and proteins, Amino acids, their properties, and their classification according to the polarity of their side chains and according to the acid-base properties. Essential and non-essential amino acids, Structure of peptides and proteins, their primary structure, structures of higher order and their meaning for the function of peptides and proteins. Protein - protein interaction.

Nucleic acids: Definition and classification, structure, function, physical and chemical

properties - Purines and pyrimidines, base pairing, Hoogsteen base pairing.

(12 Hrs)

Module IV

Vitamins and minerals: chemistry, source and functions of water soluble and fat-soluble vitamins. Role of vitamins as cofactors. Source and functions of macro elements and trace elements, Hormones & Related Molecules: Chemistry, synthesis and functions of various hormones (Plant & Animal), pigments (Plant & Animal), Pheromones and neurotransmitters

(12 Hrs)

REFERENCE

1. Lehninger's Principle of Biochemistry. Nelson L D and M M Cox.
2. Biochemistry. Jeremy M.Berg John and Tymoczko Lubert Stryer.
3. Biochemistry with Clinical Correlation. Thomas M Devlin. Wiley- Liss
4. Biochemistry. Donald Voet, Judith G Voet, Charlottew pratt. John Wiley
5. Biochemistry. Jeoffrery Zubay. Wm C Brown Pub.
6. Biochemistry. Mathews CK and KE.van Holde. Benjamin Cumming Pub.
7. Biochemistry. Vol 1&2 David Metzler.

MSBTC01C02
GENERAL MICROBIOLOGY
3 Credits **(48 Hours)**

Course Objectives:

1. Students will be able to isolate and identify bacteria and fungi
2. They will be able to characterize microorganisms
3. Students will acquire sufficient skills to analyses microorganisms present in various substances
4. Students will get skills to do basic microscopic analysis

Course Outcome:

On completion of the General Microbiology course students will get theoretical knowledge and laboratory skills to do basic operations in a Microbiology Laboratory.

Course Content:

MODULE I
Milestones in the history of Microbiology. Early discoveries and scientists. (**12 Hrs)** Five Kingdoms and Woese's Three Domain classifications of living system. Bacterial, fungal and viral classifications. Bergey's Manual of determinative bacteriology. Laboratory procedures for identification of bacteria. Molecular phylogeny.

MODULE II
Microbial morphology and colony characteristics. Microscopy: Bright field, dark field, fluorescent, phase contrast, interference, polarization and electron microscopies. Specimen preparation and staining in microscopy. Growth curve, Cultivation of bacteria, Culture media and methods, Storage and transport of microbes **(10 Hrs)**

MODULE III
Ultra-structure of bacterial cells. Difference between bacterial and fungal cells: Different staining procedures and study of bacterial and fungal morphology. Cell wall, cell membrane and transport system, chromosome and extra chromosomal genetic materials; flagella, pili, capsule, endospore. Virus, Structure and multiplication of Virus, Viral Diseases – Emerging and re-emerging viral infections. Fungal Reproduction **(10 Hrs)**

MODULE IV

Microbial nutrition and Nutritional groups of bacteria. Photo autotrophy and bacterial photosynthesis, Chemoautotrophy, Heterotrophic metabolism. Aerobic and anaerobic respiration (fermentation). Physical and chemical methods of sterilization, Methods of testing
antimicrobial substances, Drug resistance of microbes. Genetically Modified Microorganisms. **(16 Hrs)**

REFERENCE

1. Microbiology – Prescott
2. General Microbiology – Stanier
3. Fundamentals of Microbiology – Frobischer
4. Principles of Microbiology – Ronald M Atlas
5. Antimicrobial Drug Resistance, Bryan, L E (eds.) Academic Press
6. Microbiology- Bernad D Davis et al, Harper International edition.
7. Microbiology Concepts and Applications Pelzar Jr. Chan. Kreic. McGraw- Hill, Inc. Microbiology.
8. Zinsser Microbiology Prentice- Hall International Inc. Manual of Methods for General Bacteriology. Gerhaldt P et al (eds.) American Society for Microbiology
9. Textbook of Microbiology 9th Edition, Ananthanarayan, Paniker, Universities Press

MSBTC01C03
CELL BIOLOGY

3 Credits **(48 Hours)**

Course Objectives:

1. Understand the molecular nature and functioning of the cell components and how they interact with the external environment.
2. Understand the molecular nature of replication of the cell
3. Understand the consequences arising out of error in replication including cancer and how the cell passes from one phase of replication to the next.
4. Understand how a cell responds to an external signal and the mechanisms involved.

Course Outcome:

Students will gain knowledge about the complexities of the cell.They will be able to gain advance knowledge of molecular cell mechanisms.

Course content:

MODULE I

General organization of prokaryotic and eukaryotic cells.

Differentiation of the cell surface, Constituents of the Extra-cellular matrix.

Cell junctions: tight junctions, desmosomes and gap junctions, cell coat. Cell- cell adhesion.

Cytoskeleton: microtubules, microfilaments and intermediate filaments **(12 Hrs)**

MODULE II

Cell communication: general principles, signaling pathways.

Cellular Organelles and Membrane Trafficking Endoplasmic reticulum, Golgi complex, processing and trafficking of biomolecules, lysosomes, plant vacuoles, endocytosis, posttranslational modification of proteins **(14Hrs)**

MODULE III

Nucleus: Nuclear envelope, nuclear matrix. Organization of chromatin: nucleosomes, higher order folding of chromatin. Structure of centrioles, structure of mitotic spindle, synaptonemal complex. Nucleolus in ribosome synthesis. Replication of prokaryotic, eukaryotic DNA. Enzymes and proteins of replication. DNA repair. **(10 Hrs)**

MODULE IV

Cell cycle: Phases of cell cycle. Cascade of phosphorylation and dephosphorylation associated with cell cycle progress. Kinases, cyclins and related proteins and their role in cell cycle regulation. Apoptosis and Introduction to Cancer biology. **(12 Hrs)**

REFERENCE

Molecular Cell Biology Gerald Karp 8th Edition Wiley 2015
Molecular Biology of The Cell Alberts 6th Edition 2014 Garland Science
Molecular Cell Biology Lodish 8th Edition. W.H. Freeman 2016
Genes XI Benjamin Lewin Jones and Bartlett Learning 2014
Molecular Biology of the Gene Watson 7th Edition Pearson India 2017.

MSBTC01C04
GENETICS

3 Credits **(48 Hours)**

Course Objectives:
1. Understand the basic principles of genetics and heredity and Mendelian laws of inheritance
2. Understand chromosome theory of inheritance, sex determination, linkage and mapping.
3. Familiarize with prokaryotic gene transfer methods.
4. Understand extra chromosomal inheritance and population genetics

Course Outcome
Completion of the course would familiarize the student with carriers of heridity and mechanisms of inheritance in eukaryotes and prokaryotes.

Course Content:

MODULE I

Mendel and his contribution to Genetics. Monohybrid crosses and principle of segregation. Dihybrid crosses and principle of independent assortment. Rediscovery of Mendel's principles**.** Multiple alleles. Modification of dominance relationships. Gene interactions. Essential and lethal genes. Environmental impact on genes **(12 hrs)**

MODULE II

Genetic linkage. Chromosomal exchange. Genetic maps. Tetrad analysis, Mitotic recombination. Chromosomal and gene mutations. Mitosis & Meiosis. Chromosome theory of inheritance. Sex determination. Analysis of sex-linked traits in humans.

(12 Hrs)

MODULE III

Cellular basis of differentiation, Gametogenesis and fertilization. Genetic basis of cell

differentiation. Gene expression control. Oncogenes and tumour suppressor genes Conjugation in bacteria. Transformation in bacteria. Transduction in bacteria. Mapping of genes in bacteria. Mapping of genes in bacteriophages.. **(12 Hrs)**

MODULE IV

Bacterial transposons. Eukaryotic Transposable elements Cytosomic inheritance, Inheritance through mitochondria and chloroplasts and their mapping. Genetic variation in populations and measuring. Hardy - Weinberg Equilibrium, Inbreeding. Genetic Drift. Gene flow. Natural selection. Molecular evolution. **(12Hrs)**

REFERENCE

1. Genetics by Strick Berger
2. Plant breeding by B D Singh
3. A text Book of Genetics by Veer Bala Rastogi
4. Genetics by Gardner, Simmons and Snustad
5. Genetics by Ursula Goodenough
6. Basic Genetics. Robert F. Weaver II edn. Philip W. C. B 1995.
7. An Introduction to genetic Analysis Griffith etal

MSBTC01C05
PRACTICAL I

BIOCHEMISTRY AND GENERAL MICROBIOLOGY

2 CREDITS (96 Hours)

Biochemistry

1. Qualitative analysis of carbohydrates.
2. Qualitative analysis of proteins.
3. Qualitative analysis of lipids.
4. Estimation of protein.
5. Estimation of lipids (cholesterol, phospholipids, triacylglycerols).
6. Estimation of carbohydrates (glucose, fructose, lactose, starch).
7. Denaturation studies on proteins.
8. Estimation of lycopene from tomato.
9. Estimation of Urea.
10. Estimation of Uric acid.
11. Determination of acid values of fat and oils.
12. Determination of iodine number of fats and oil.
13. Extraction and estimation of total lipids from seed.
14. Extraction of total nucleic acids from plant tissue.
15. Preparation of buffers of required pH.
16. Purification of proteins using dialysis.
17. Separation of amino acids using paper chromatography.

REFERENCE

1. David Plummer, An Introduction to Practical Biochemistry, McGraw Hill
2. Harold Varley, Practical Clinical Biochemistry, by Gowenlock A. H., CBS.
3. Hans Bisswanger, Practical Enzymology. Wiley VCH.
4. Robert Eisenthal, Enzyme Assays: A Practical Approach, Oxford University Press
5. Sadasivam & Manickam, Biochemical Methods, New Age International
6. DM Vasudevan & Subir Kumar Das, Practical Textbook Of Biochemistry, Jaypee Brothers
7. SK. Sawhney, Randhir Singh, Introductory Practical Biochemistry. Alpha Science International

Practical

General Microbiology

1. Microscopy- structure and organization of compound microscope
2. Sterilization Techniques
3. Staining: simple, negative, Gram's, capsular, spore, metachromatic Granule, Fungal staining
4. Preparation of media & inoculation, Isolation of organisms from various environments. Serial Dilution
5. Growth curve using breeds count, turbidimetry and CFU
6. Effect of pH, temp, oxygen and salinity on bacterial growth in liquid media.
7. Anaerobic culturing by liquid paraffin overlay and pyrogallol.
8. Starvation induced sporulation of bacteria.
9. Efficiency testing of bacteria proof filters and autoclave
10. Fungal culture and sporulation
10. Antibiotic sensitivity tests, Biochemical Tests for identification of bacteria

REFERENCE

Techniques in Microbiology: A Student Handbook 1st Edition by John M. Lammert (Author). ISBN-13: 978-0132240116

Handbook of Techniques in Microbiology: A Laboratory Guide to Microbes Paperback – 1 December 2007. by A.S. Karawa (Author), M. K. Rai (Author), H.B.T. Singh (Author) Scientific Publishers

Basic Practical Microbiology- A Manual. Society for General Microbiology (SGM). ISBN 0 95368 383 4. www.microbiologyonline.org.uk o

MSBTC01C06
Practical II

CELL BIOLOGY AND GENETICS

2 CREDITS **(96 Hours)**

Cell Biology

1. Cell Fractionation: chloroplast: differential centrifugation.
2. Cell Fractionation: mitochondria: differential centrifugation.
3. Isolation of DNA/RNA from liver/spleen.
4. Estimation of nucleic acid by spectrophotometric method.
5. Estimation of RNA by Orcinol test.
6. Estimation of DNA by Diphenylamine test.
7. Study of Barr Body (Buccal smear).
8. Polytene Chromosome (Drosophila).
9. Karyotyping.
10. Study of staining methods.
11. Determination of melting temperature of DNA.

REFERENCE:

Cell Biology A Laboratory Handbook 3rd Edition Elsevier Inc 2006
Cell and Molecular Biology Lab Manual David A Thompson 2009

Genetics

1. Study of mutations by Ames test.
2. Assay of antibiotics and demonstration of antibiotic resistance.
3. Bacterial transformation.
4. Transduction.
5. Conjugation
6. Isolation of plasmids.
7. Mitosis
8. Meiosis

REFERENCE

1.Cell and Molecular Biology Lab Manual David A Thompson 2009.
2,Molecular Cloning- A Laboratory Manuel Sambrook, J., Fritsch, E. F. and Maniatis, T. 1989.. Second Edition. Cold Spring Harbor Laboratory Press.
3.Zinsser Microbiology Prentice- Hall International Inc. Manual of Methods for General Bacteriology. Gerhaldt P et al (eds.) American Society for Microbiology.

4.Hayes, W., 1994. Genetics of Bacteria and their viruses. 2nd Edn, CBS Publishers and Distributors, New Delhi
5.Methods in Molecular Biology Vol. 28. Protocols for Nucleic acid analysis by non - radioactive probes. Edited by Issac P. G. Human Press,

MSBTC01E01

BIOSTATISTICS

3 CREDITS **(48 Hours)**

Course Objectives:

1. Understand data types and data presentations.
2. Understand the concepts of averages and dispersion of measurement values.
3. Understand the concept of probability and probability distributions.
4. Understand the method of testing statistical hypotheses.

Course Outcome:

Students shall be able to

1. Make graphical/diagrammatic representation of given statistical data.
2. Calculate measures of central tendencies and measures of dispersion of a given set of values.
3. Explain different probability distributions.
4. Test hypothesis using normal, students-t, chi square and F distributions.

Course content:

Module I

Collection, classification and diagrammatic representation of statistical data: Variables and constants, Different types of numerical data, Collection of data, Sampling techniques, Random sampling, Stratified random sampling. Classification and tabulation of data, frequency distribution. Graphical/diagrammatic representation of data: line charts, Bar charts, Pie-chart, Histograms, frequency polygons, ogives. **(12 hrs)**

Module II

Measures of central tendency: Arithmetic mean, Median, Mode, Geometric and Harmonic mean. Measures of dispersion: Range, Inter-quartile range, Variance and Standard Deviation, coefficient of variation.
Correlation and Regression: Relation between two variables, scatter diagram, definition of correlations, Pearson's correlation coefficient, Spearman Rank correlation coefficient. Definition of regression: regression lines. Fitting lines using method of least squares. **(14 hrs**

Module III

Probability and probability distributions: Permutation and combination, types of events,

Definition of probability, addition and multiplication theorems of probability. Probability distributions: Binomial, Poisson and Normal distributions. Skewness and Kurtosis: Definitions, Karl Pearsons coefficients of Skewness and Kurtosis, moments. **(10 hrs)**

Module IV

Normal distribution and statistical inference: Central Limit Theorem, Concept of confidence interval: Estimation, confidence limit, level of significance, standard error. Statistical hypotheses, Tests of significance of means, difference between two means and proportion. Student's t-distribution and testing of hypothesis for small samples. Chi-square distribution, Chi-squared tests for independence and for goodness of fit, F-distribution and Analysis of variance. **(12 hrs)**

REFERENCE:

1. Principles of Biostatistics - Pagano M. & Kimberlee G. Duxbury Press
2. Probability and Statistical Inference - Hogg R. V. Tanis E. A., Prentice Hall, New Jersey
3. Experimental Design Data Analysis for Biologists- Quinn G. P. & Keough M. J. Cambridge University7 Press
4. Statistical Methods in Biology - 3rd edition, Bailey N.T.J., Cambridge University Press
5. Biostatistical analysis - 4th edition, Zar, J.H. Pearson Education.
6. Fundamentals of Biostatistics – P. Hanmanth Rao and K. Janardhan, I.K. International Publishing House, New Delhi.
7. Introduction to Biostatistics and Research Methods- P.S.S. Sundar Rao and J. Richard, PHI learning Pvt Ltd, New Delhi.

MSBTC01E02

INSTRUMENTATION

(3 CREDITS) **(48 Hours)**

Course Objectives:

1. Understand basic principles and applications of biomolecular separation techniques.

2. Understand basic principles and applications of spectrophotometric, colorimetric and radioactivity based analytical techniques.

3. Understand spectroscopic techniques for characterization of biological molecules.

4. Understand various analytical techniques based on intermolecular interactions

Course Outcome:

Students shall be able to

1. Explain working principles and applications of biomolecular separation techniques such as chromatography, electrophoresis, centrifugation and density gradient sedimentation.
2. Explain the principles and applications of colorimetry, fluorometry, flame photometry, radioimmunoassay and autoradiography.
3. Explain the principles and applications of UV, IR, ORD, CD, NMR, ESR, Microwave, Raman and Mass spectroscopic techniques.
4. Explain the principles and applications of Surface Plasmon Resonance, Isothermal Titration Calorimetry, Differential Scanning Calorimetry, Atomic force microscopy, ELISA and ion selective electrodes.

Course Content:

Module I:

Centrifugation and density gradient sedimentation: Basic principles and applications. Chromatography: Basic principles and applications, partition coefficient and relative mobility, Types of chromatography: paper, thin layer, size exclusion, ion exchange, affinity, GLC, HPLC, HPTLC. Electrophoresis: Basic principles and application. Various types of electrophoresis, PAGE, Specialized electrophoresis techniques, Isoelectric

focusing, Capillary electrophoresis. Immunoelectrophoresis, PFGE. **(14 hrs)**

Module II:

Spectrophotometry and colourimetry: Absorption and emission spectrum, Beer-Lambert law, qualitative and quantitative spectrophotometric assays, Fluorescence and fluorometry, flame photometry, Radioimmunoassay and Autoradiography. **(10 hrs)**

Module III:

Spectroscopic techniques: Basic principles and biological applications of UV, IR, ORD, CD, NMR, ESR, Microwave and Raman spectroscopies. Mass spectrometric techniques: various modes of ionization principles and applications. GCMS, LCMS, MALDI. **(12 hrs)**

Module IV

Principles and applications of Surface Plasmon Rsonance, Isothermal Titration Calorimetry, Differential Scanning Calorimetry, Atomic force microscopy, ELISA, Light scattering experiments. Ion selective electrodes and pH meter. **(12 hrs)**

REFERENCE

Physical biochemistry- David Seeshan
Chromatography- Brown D.R., Ivy Publishing House, Delhi.
Encyclopedia of Separation Technology - Ruthren D. M. (Ed), JohnWiley & Sons
Experimental Biochemistry - 3 rd edition, Switzer, R.L. & Garrity, L. F. W.H.Freeman & Company
Foundations of Spectroscopy- Duckett, S. & Gilbert, B., Oxford University Press.

SEMESTER II
(Total Credits Required: 20)

MSBTC02C07
INTERMEDIARY METABOLISM

3 CREDITS **(48 Hours)**

Course Objectives:

1. Understand metabolic pathways and energy production in cells.
2. Understand electron transport chains and energy storage in living system.
3. Understand metabolisms of different nutrient molecules.
4. Understand the production of complex macromolecules

Course Outcome:

Upon completion of this course, students will be able to explain and demonstrate how the chemical reactions in the metabolic pathways drive various biological processes in cells and organisms, and how alteration in these pathways lead to biological impairments

Module I

Bio-energetic principle, activated carriers in metabolism and importance of ATP. Digestion and absorption of carbohydrate, breakdown of Polysaccharides and disaccharides. Glycolysis and its regulation, Entry of other carbohydrates into glycolytic sequences, alcoholic fermentation, Citric acid cycle and its regulation, Glyoxylate cycle, Pentose phosphate pathway and its regulation. Glycogenesis, glycogenolysis, gluconeogenesis, regulation of pathways, disaccharide biosynthesis, role of nucleoside biphosphate sugars in carbohydrate biosynthesis and in sugar inter-conversion. Metabolism of storage and structural polysaccharides (bacterial and animal coats Photosynthetic CO2 fixation, Rubisco. Mitochondrial and Photosynthetic Electron transport. Reducing equivalents, High energy molecules.

(16 Hrs)

Module IÍ

Digestion and absorption lipids, Biosynthesis and oxidation of fatty acids and conjugate lipids, Biosynthesis and conversion of cholesterol to steroid hormones, Metabolism of ketone bodies

(10 Hrs)

Module IÍI

Digestion and absorption of protein. Protein degradation, role of Ubiquitin, transamination, oxidative deamination, urea cycle, Biosynthesis and degradation of

individual amino acids, one carbon metabolism; THF, SAM, enzymes and regulation of amino acid metabolism.

(10 Hrs)

Module IV

Function of nucleotides, sugar nucleotide complexes, purine ribonucleotide metabolism; denovo synthesis (purines and pyrimidines) and its regulation, Salvage pathway, inter conversion of purine and pyrimidine ribonucleotides, catabolism of purine and pyrimidine nucleotides, deoxy ribonucleotides, regulation deoxy nucleotide metabolism, biosynthesis of nucleotide coenzymes. Integration of metabolism

(12 Hrs)

REFERENCE:

1. Biochemistry. Jeremy M.Berg, John Tymoczko & Lubert Stryer.
2. Biochemistry with Clinical Correlation. Thomas M Devlin. Wiley- Liss
3. Biochemistry. Donald Voet, Judith G Voet, John Wiley
4. Biochemistry. Jeoffrery Zubay. Wm C Brown Pub.
5. Biochemistry. Lubert Strayr
6. Biochemistry. Mathews CK & vanHolde. Benjamin Cumming pub.
7. Biochemistry. Vol. 1& 2 Metzler
8. Biochemistry, Harper's.
9. Lehninger's Principle of Biochemistry. Nelson LD & MM Cox.

MSBTC02C08
MOLECULAR BIOLOGY

(3 CREDITS) **(48 Hours)**

Course Objectives:

1. Understand the organization of genome.
2. Familiarize with cellular processes like transcription and translation
3. Study the methods to measure the level of expression of RNA and protein.
4. Understand regulation of gene expression

Course Outcome:

Familiarize the student with the mechanisms and components involved in expression of genes in prokaryotic and eukaryotic systems.

Course Content:

MODULE I

The genome: Content, Mapping (Linkage, Restriction cleavage, Sequencing), Variations, Repetitive and Non-repetitive sequences, Organalle DNA – Mitochondrial and Chloroplast. Genome sequences and Gene numbers. Transcription in Prokaryotes -Biosynthesis of RNA, Enzymatic machinery, Promoter selection and role of RNA Polymerase and ancillary factors.

(12 Hrs)

MODULE II

Transcription in eukaryotes: RNA polymerases, Eukaryotic promoter structure, enhancer elements and transcription factors, transcriptionally active chromatin, biosynthesis of ribosomal, transfer and messenger RNAs. Post transcriptional modifications, transfer and messenger RNAs, antibiotic inhibitors of transcription. Gene silencing.**(12 Hrs)**

MODULE III

Protein synthesis: Genetic code and gene protein relationships, nonsense and missense mutations and suppressers, ribosome structure (prokaryotic and eukaryotic) mRNA structure, polycistronic v/s monocistronic, specificity of aminoacyl tRNA synthetases, polypeptide chain elongation and termination, factors of protein synthesis (pro & eukaryotic) and their role, inhibitors of protein synthesis and their mechanism of action, translational regulation, post- translational modification, biosynthesis of secretory

proteins. **(12 Hrs)**

MODULE IV

Regulation of gene expression, bacterial operons (lac, gal, ara, trp, hut, etc) and viral models (T4 and T7), stringent and relaxed control, regulation in eukaryotes, chromatin activity and gene regulation. Methods, measurements of RNA synthesis and protein synthesis, complementary sequence analysis by nucleic acid hybridization including southern blotting, isolation methods for eukaryotic mRNA, identification of translation products (flurography, western blotting). Genome sequencing - chemical. Next generation sequencing. **(12Hrs)**

REFERENCE

1. Lodish, H., Baltimore, D. Berk, A., Zipursky, S. L. Matsudaira, P. and Darnell. J. 1995 molecular Cell Biology, 3rd ed, WH.Freeman & Co.
2. Stent, G. S. and Calender, R. Molecular Genetics 1986. An Introductive Narrative, CBS Publishers and Distributors, NewDelhi.
3. Weaver, RE & Hedrick, PW. 1985 Basic Genetics, WMC.Brown Publishers.
4. Alberts, B., Bray, D. Lewis, Julian, Raffn M. Roberts, K. and J. D. Watson, J. D. 1994. Molecular Biology of the Cell, 3rd edn, Garland Publishing Inc..
5. Hayes, W., 1994. Genetics of Bacteria and their viruses. 2nd Edn, CBS Publishers and Distributors, New Delhi.
6. Genes XII Benjamin Lewin

MSBTC02C09
Practical III
INTERMEDIARY METABOLISM AND MOLECULAR BIOLOGY
2 CREDITS (98 Hours)

Intermediary Metabolism

1. Estimation of SGOT and SGPT
2. Estimation of ALP AND ACP
3. Estimation of creatinine
4. Estimation of GGT
5. Estimation of glutathione peroxidase
6. Estimation of Bilirubin
7. Quantitative analysis of Amino acids
8. Determination of SOD & Catalase activity
9. Isolation and estimation of protein
10. C and N terminal analysis of peptide
11. Enzymatic estimation of glucose in blood
12. Estimation of DNA by Diphenylamine method
13. Determination of RNA by Orcinol method
14. Quantitative estimation of Sodium, Potassium and Calcium
15. Estimation of ascorbic acid in lemon juice.

REFERENCE

1. David Plummer, An Introduction to Practical Biochemistry, McGraw Hill
2. Harold Varley, Practical Clinical Biochemistry, by Gowenlock A. H., CBS.
3. Hans Bisswanger, Practical Enzymology. Wiley VCH.
4. Robert Eisenthal, Enzyme Assays: A Practical Approach, Oxford University Press
5. Sadasivam & Manickam, Biochemical Methods, New Age International
6. DM Vasudevan & Subir Kumar Das, Practical Textbook Of Biochemistry, Jaypee Brothers
7. SK. Sawhney, Randhir Singh, Introductory Practical Biochemistry. Alpha Science International

Molecular Biology

1. Demonstration of electrophoresis using DNA or Proteins.

2. Isolation of genomic DNA.

3. Southern blotting.

4. Isolation of RNA.
5 Northern blotting.
6. Western blotting.
7. In vitro translation
8. Metabolic labeling of proteins and immunoprecipitation.

REFERENCE

1. Molecular Cloning- A Laboratory Manuel Sambrook, J., Fritsch, E. F. and Maniatis, T. 1989.. Second Edition. Cold Spring Harbor Laboratory Press

2.Cell and Molecular Biology Lab Manual David A Thompson 2009.

3.Methods in Molecular Biology Vol. 28. Protocols for Nucleic acid analysis by non - radioactive probes. Edited by Issac P. G. Human Press,

MSBTC02E03
BIOPHYSICS

(3 CREDITS) **(48 Hours)**

Course Objectives:

1. Understand the basic principles of flow of energy and other important biophysical properties in living system.

2. Understand the structure and conformation biological macromolecules.

3. Understand inter-molecular interactions involving biological molecules.

4. Understand biophysical techniques used for determining molecular structures.

Course Outcome:

The students shall be able to

1. Explain the basic principles of thermodynamics, kinetics and biophysical properties like diffusion, osmosis, viscosity, surface tension and adsorption.

2. Explain the structure and conformation of biological molecules like DNA, t-RNA and protein.

3. Explain the interactions between biological molecules.

4. Explain the techniques like x-ray crystallography and NMR spectroscopy

Course content:

Module I

Thermodynamics: Laws of thermodynamics, thermodynamic equilibrium, concept of enthalpy, entropy and free energy, free energy of ATP hydrolysis. Conservation of energy in living systems, Entropy and Life, Coupled reactions. Chemical kinetics: rate, order and molecularity of reactions. Concepts and importance of following in biology: Diffusion, Dialysis, Osmosis, Viscosity, Surface tension, Adsorption. Detergents and formation micelles. **(12 hrs)**

Module II

Basic principles of nucleic acid structure: Conformation of nucleotides and its constituents, double helical structure, Watson-Crick model, Forces stabilizing double

helix, DNA polymorphism: A,B and Z DNA, DNA supercoiling. Secondary and tertiary structure of t-RNA, modified nucleotides in t-RNA. Basic principles of protein structure: Main chain and side chain torsion angles, cis and trans peptides, Globular structures: primary, secondary, tertiary and quaternary structure of proteins, Ramachandran plot. Structure of membrane proteins. Motifs and domains in proteins: All alpha helix motifs (helix-turn-helix and helix bundles), all β sheet motifs (β sandwich, β barrel, Greek Key topology and β propellers), α / β motifs (Tim barrel, Rosman fold, α/β horseshoe). **(14 hrs)**

Module III

Protein folding: Forces stabilizing macromolecular structures, thermodynamics of protein folding, driving forces, Protein folding pathways, Molten globular structures. Folding accessory proteins. Intermolecular interactions: Protein-Nucleicacid interactions: DNA binding proteins, H-L-H, Zn-finger and Leucine zipper motifs, Example. Histone-DNA interaction. Virus structure. Ligand-receptor interactions. **(12 hrs)**

Module IV

X-ray crystallography: Crystallization techniques, crystal symmetry, Bragg's law. Data collection, Structure solution: outline of methods to solve phase problem, Refinement and validation of structures. NMR spectroscopy: Shielding constant and chemical shift, spin-spin splitting, coupling, non-equivalent proton. Carbon-13 NMR spectra of protein. Nuclear Overhauser effect. **(10 hrs)**

REFERENCE

1. Biological thermodynamics - Donald T. Haynie, Cambridge University Press, Cambridge.

2. Biopolymers - A. G. Walson and J. Blackwell, Associated Press.

3. Essentials of Biophysics - P. Narayanan, New Age International publishers

4. Introduction to Protein Structure - C. Branden and I. Tooz. , Garland Press, New York

5. Principles of Protein Structure - G.E.Schulz & R.H.Schirmer, Springer Verlag, Berlin.

6. Principles of Nucleic Acid Structure - W. Saenger,

7. Protein Folding - Thomas E. Creighton (Ed),

8. Structure and Mechanism in Protein Science - Alan Fersht

9. Biophysical Chemistry- Part I, II, III - Charles R. Cantor and Paul R. Schimmel, W.H. Freeman & Company, New York.

MSBTC02E04
IMMUNOLOGY

3 CREDITS **(48 Hours)**

Course Objectives:

1. Understand the components and functioning of the immune system.
2. Determine the deficiencies arising out of the immune system.
3. Analyze the overreaction of the immune system.
4. Understand the methods of exploiting the specificity of the immune system for quantification, diagnosis, and immunization protocols.

Course Outcome:

1. Evaluate usefulness of immunology at the application level.
2. Apply their knowledge and design immunological experiments

3Understand the role of immune responses in the setting of infection (viral or bacterial).

Course Content

MODULE I

History of the Immune system, Cells of the Immune system, Innate immune mechanisms**,** TLR, PRR, PAMP Phagocytosis, classical and alternative pathways of complement activation, regulation and functions of complement. Adaptive immunity: Properties of immunogens and antigens. Pathways of antigen processing and presentation**.** (**10 Hours)**

MODULE II

Primary and secondary lymphoid organs, structure and cellular organization**.** Structure of immunoglobulins. Antigen binding site of antibody. Forces involved in antigen - antibody complex formation. Receptors, co-receptors and CD antigen on B cells, Generation of receptor diversity. B cell development in activation and differentiation. **(15 Hrs)**

MODULE III

T cell development, activation and differentiation to helper, cytotoxic T cells. Signal transduction in B&T cell. Role of cytokines. Humoral and cytotoxic response, MHC

complex and MHC restriction.

Introduction to Immunology of infectious diseases, Hypersensitivity and immunology of transplantation, Immuno-deficiencies, autoimmunity, immune suppression, tolerance. Tumor immunology. **(15 Hrs)**

MODULE IV

Factors governing immunogenicity, haptens and its applications, epitopes, adjuvants. Principle and applications of Antigen - antibody interactions.

Agglutination, immunodiffusion, immunoelectrophoresis, immunofluorescence, RIA and ELISA and assays for cytotoxic responses. Monoclonal Antibodies. Vaccines **(8 Hrs)**

REFERENCE

5. 1.Immunology Kuby 2019 Eighth Edition| 2019 Jenni Punt; Sharon Stranford; Patricia Jones; Judy Owen Macmillan Learning Eighth Edition
2. Immunobiology Janeway 2017 9th Edition Garland Science.
3. Essential Immunology. Roitt 2017 13th Edition. Wiley Blackwell

MSBTC02E05
HUMAN PHYSIOLOGY AND DEVELOPMENTAL BIOLOGY

3 CREDITS (48 Hours)

Objectives:

Introduction about human physiology, familiarize with the homeostatic mechanism. Introduction of electrical properties associated with the neurons and conduction of nerve impulse.

Introduction of plant developmental biology taking Arabidopsis as the model organism, introduction of animal developmental biology using Drosophila as a model organism. Study of stem cell and its application

Outcomes:

By understanding normal physiological aspects, pathological conditions can be identified and understood. Developmental biology opens a path to understand the normal organogenesis process. The theoretical aspects along with the genetic engineering tools will be helpful in tackling the hereditary diseases.

Course Content:

MODULE- I
Introduction to human physiology, Homeostasis. Mechanism of Homeostasis
Heart: Structure and electrical activity, Neuromuscular junction: Electrical properties, and ionic fluxes. Structure of neuron and synapse, Synaptic transmission, neurotransmitter systems.
Endocrine system, General features and mechanism of action of hormones, Signaling mechanism by hormones - Insulin and Estrogen. **(15 Hrs)**

MODULE-II
Development of the Eukaryotic system*; Saccharomyces cerevisiae* as a model organism: Life cycle, cell differentiation and mechanism for determining cell type, mating, cell-cell communication.
(9 Hrs)

MODULE-III
Plant development, *Arabidopsis thaliana*- as a model organism: Brief out line on meristem, root shoot axis, growth regulators, homeotic selector gene **(9 Hrs)**

MODULE-IV

Introduction to animal developmental Biology*: Drosophila melanogaster* as model: Structure and organization of drosophila genome, Life cycle, Techniques for genetic analysis, Genetic analysis of body plan development in Drosophila.

Brief introduction to Stem Cell Biology: Embryonic, Adult and induced Pluripotent Stem Cells. Use of stem cells in understanding development and regenerative medicine.
(15 Hrs)

REFERENCE:

1. Human Physiology, Guyton
2. Physiology, Ganong
3. Physiology, Best and Taylor
4. Developmental Biology-11th Edition, Scott F.Gilbert ,Michael J.F.Barresi Oxford University
5. Molecular Developmental Biology T.Subramoniam
6. Analysis of Biological Development ,Kalthoff ,McGraw-Hill Science,New Delhi, India

MSBTC02E06
FOOD MICROBIOLOGY
3 CREDITS **(48 Hours)**

Course Objectives:

1. To give a general knowledge on various factors affecting microbial spoilage of food.
2. To give detailed information on various strategies that can be adopted for preservation of food.
3. To give detailed knowledge on various microbially derived food products.
4. To give detailed information on regulatory mechanisms in maintaining quality of food.

Course Outcome:

1. Students will acquire theoretical knowledge in analysis of microbial load in food and beverages
2. Students will be able to analyse food poisoning microorganisms in food and beverages
3. Students will be able formulate strategies for preservation of food and beverages.
4. Students will be able to do quality checking in food industry

Course Content:

MODULE I

Factors which influence microbial growth, survival and death in foods, spores and their significance, indicator microorganisms and microbiological criteria. Microbial spoilage of foods: Factors affecting food spoilage at different levels – intrinsic and extrinsic factors. (**16Hrs)**

MODULE II

Spoilage of meat, poultry and sea foods, milk and dairy products, fruits, vegetables and grains. Preservation methods and preservatives: physical methods of preservation, chemical preservatives and natural antimicrobial compounds, biologically based preservation system. Problems associated with preservatives (**10 Hrs).**

MODULE III

Food fermentations : fermented dairy products, fermented vegetables, fermented meat, poultry and fish products, traditional fermented foods, cocoa and coffee, beer and wine. Probiotics and prebiotics **(12 Hrs).**

MODULE IV

Food borne pathogens: Food poisoning, intoxications like botulism and aflatoxins. Food hygiene and control. Single Cell Protein. HACCP. Molecular techniques in food microbiology. Food security, food safety and GM foods **(10 Hrs).**

References

1. Food microbiology – Adams MR and Moss MO
2. Food Microbiology – Frazier WC and Westhoff
3. Food Microbiology (2nd Ed) – Doyle et al.
4. Basic food microbiology – Banwart GJ
5. Dairy Microbiology – Robinson RK
6. Valorization of Food Processing By-Products, Fermented Foods and Beverages Series, (Ed) M Chandrasekaran CRC Press

MSBTC02E07

ETHICS, PATENCY AND INTELLECTUAL PROPERTY RIGHTS

3 CREDITS (48 Hours)

Objectives:

To understand how precious each life forms are, the risks associated with altering the genetic makeup of an organism and their ethical aspects. Importance of maintaining the biosafety measures while handling with dangerous microorganism. Importance of maintaining the guide lines while handling the rDNA products. The essential steps to be followed to get an invention patented.

Course Outcome:

Importance of individual life forms, understanding biosafety levels, patents and patent procedures.

Course Content:

MODULE 1

Ethical aspects of interfering in natural process, Hidden dangers in altering genetic make-up. **(3hrs**)

MODULE 2

Patent, Objectives of Patent system and general requirement of Patent law, Patent office, Patent Office Practices, Infringement problems, Harmonization of Patent laws, International treaties on IPR, International convention for the protection of new varieties- Strasbourg convention, UPOV convention. **(15hrs)**

MODULE 3

Patentability of micro-organism- Claims, characterization and repeatability, Deposition of Culture collection, Legal protection plants and animals, Transfer of Technology, TRIPS, FDA. **(15hrs)**

MODULE 4

Biosafety, Definition, Objectives, Biological Containment (BC) and Physical Containment (PC), Biosafety levels, Biosafety level1, Biosafety level 2, Biosafety level 3, Biosafety level 4. The containment laboratory design and facilities.

Guidelines for rDNA research, Quality control of biologicals produced by rDNA technology. **(15hrs)**

REFERENCE

1. Beir, F.K, Crespi, R.S and Straus J: 1982 Biotechnology and patent protection- Oxford and IBH Publishing Co. New Delhi.
2. Chowdhary, N. K and Aggarwal J. C: Dunkal's Proposals I. Implications for India and the third world.
3. Chowdhary, N. K and Aggarwal J. C: Dunkal's Proposals II. The Final Act. Significance for India and World trade.
4. Department of Biotechnology (1990) Recombinant DNA Safety guidelines. Govt. of India, New Delhi.
5. Krattinger, A.F Lesser, W and Mudge G: Implementation of Biosafety Regulatory Mechanisms under the Biodiversity Convention.
6. Narayanaswami K: 1994 Safety and regulatory arrangements in Biotechnology in Sohal and Srivastava (eds) Environment and Biotechnology.

SEMESTER III
Total Credits Required: 22

MSBTC03C10
MICROBIAL TECHNOLOGY
3 CREDITS **(48 Hours)**

Course Objectives:

1. To impart knowledge on the importance of Microbial Bioprocess for commercial production of metabolites and biomass.
2. To give general information about the operation of different types of bioreactors.
3. To give over all information about upstream and downstream processing.
4. To impart knowledge in detail on various applications of microbial technology

Course Outcome:

1. Students get theoretical and laboratory skills in isolation and screening of commercially important microorganisms.
2. Acquire knowledge on production of various fermented food items.
3. Students will be able to operate small fermenters.
4. Students will be able to formulate bio-process media for commercial production of microbial metabolites and biomass.
5. They will be able to do preservation of industrially important microorganisms

Course Content:

MODULE I

Introduction to fermentation processes - range and components**.** Isolation and screening and preservation of industrially important microbes. The improvement of industrial microorganisms with special reference to primary and secondary metabolite over production. Bioreactors - design and types **(7 Hrs).**

MODULE II

Bioprocess control instrumentation. Devices for Monitoring variables such as, temperature, aeration, agitation, pressure and pH. Biosensors in Bioprocess monitoring. Bioprocess media- formulation and sterilization of media, Sterilization of fermenter, Agro-Industry byproducts as bioprocess media. Development of inoculum. Upstream and Downstream processing **(18 Hrs)**

MODULE III

Kinetics of fermentation process, Transport phenomena in bioprocess-Mass transfer and Heat transfer. Scale up of bio- process**.** Cell Immobilization and its applications. Solid State Fermentation and its advantages. Tray Fermenters. Semi-Solid Fermentation **(15 Hrs)**

MODULE IV

Microbial production of, Amino acids, Vitamins, Polysaccharides, Antibiotics, vaccines, Enzymes, Biopesticides, Biocontrol agents, Biofertilizers. Industrial alcohol,

Bioremediation, Industrial waste treatment - aerobic/anaerobic systems. **(8Hrs)**

References

1. Principles of Fermentation Technology by Peter F Stanbury, A.Whittaker, S.J, Hall
2. Fermentation Microbiology and Biotechnology by E.M.T El-Mansi, C.F.A Bryce, A.L Demain, A.R. Allman (Second Edn)
3. Bioprocess engineering principles Pauline M Doran
4. Biotechnology- The Science and the Business by V. Moses & R. E. Capes.
5. Comprehensive Biotechnology Ed. By Murray Mono Young.
6. Biological fundamentals- Biotechnology Ed. By H. J. Rehm and G. Reed.
7. Fundamentals of Biotechnology Ed. By Paul Prave et al.
8. Industrial Microbiology by Prescott and Dunns.

MSBTC03C11
ENZYMOLOGY
(3 CREDITS) **(48 Hours)**

Course Objectives:

1. Understand the nomenclature, methods of isolation and purification, activity and uses of enzymes.
2. Understand the structure and function of enzymes.
3. Understand enzyme kinetics and kinetic parameters
4. Understand the mechanism of enzyme inhibition

Course Outcome:

The students shall be able to
1. Explain the methods of isolation and purification, measurement of activity and uses of enzymes.
2. Explain the structure and function of enzymes.
3. Explain the kinetics of enzyme-substrate interactions.
4. Explain the mechanism of enzyme inhibition.

Course Content:

Module I

Enzymes: basic definitions, nomenclature (EC recommended and classical), enzyme isolation and purification, measurement of enzyme activity, specific activity, molar activity (turn over number), criteria for purity. Coenzymes. Synthetic enzymes, abzymes, isoenzymes and ribozymes. Use of enzymes in medicine and industry. Immobilized enzymes. **(12 hrs)**

Module II

Enzyme structure and function: folding of the polypeptide chain, active site and its location, binding site. Allosteric enzymes: Subunit Interactions, regulation of enzyme activity, Jacob and Monod model of allosteric enzymes, Koshland model, detailed discussion using haemoglobin, ATPase (Effects of ATP and CTP) as examples.K class and V class allosteric enzymes. Structure and their function in metabolism. **(12 hrs)**

Module III

Enzyme kinetics: Single substrate – single intermediate, Michaelis – Menten and Briggs –

Haldane kinetics, graphical analysis of kinetic data, progress curves and linear plots, determination of Vmax and Km – experimental aspects. Importance of Km and Vmax. **(12 hrs)**

Module IV

Enzyme inhibition: Mechanisms and rate studies, degree of inhibition, competitive, non-competitive and uncompetitive inhibition, activation, graphical analysis (primary and secondary kinetic plots), two substrate reactions, sequential and Ping –Pong mechanisms, nature of rate equations, examples. Irreversible inhibition. Alteration of Km and Vmax in various types of inhibition. Feedback inhibition. **(12 hrs)**

REFERENCES

1. Enzymes- Dixon and Webb

2. Enzyme Kinetics- Bowden and Wharton

3. Immobilised Enzymes- Trevan

4. Hand book of Enzyme Technology- Alan Weisman- 3 rd ed Prentice- Hall

5. Enzyme Technology- Chapline and Bucke – Cambridge University Press

6. Biochemistry – Donald Voet & Judith Voet 1995. John Wiley and Sons, In

MSBTC03C12
CELL AND TISSUE MANIPULATION
(3 CREDITS) **(48 Hours)**

Course Objectives:

1. Understand the principles, practices and methodology of plant tissue culture
2. Familiarize with protoplast culture methods.
3. Understand the principles and practices in plant genetic transformation.
4. Understand the principles and methods of animal tissue culture.

Course Outcome:

The course familiarizes the student with the techniques and methodologies in plant and animal tissue culture.

Course Content:
MODULE I
Plant tissue culture: Laboratory requirements and general techniques. Tissue culture media. Major plant cell types; cell types in culture, growth regulators and control of growth and differentiation of plant cells in culture. Hormone habituation growth of cells in suspension. Pathways of plant regeneration, factors controlling regeneration, organogenesis, root - shoot transformation in vitro. Induction, development and maturation of somatic embryogenesis. Haploid production of plant tissues, triploid production of plant tissues, embryo culture and embryo rescue.

12 Hrs)

MODULE II
Principles and commercial practices of plant micro propagation, in vitro phenomena in mass propagation like genetic instability, vitrification, and contamination. Germplasm conservation: Synseeds, Cryopreservation, Slow growth and DNA banks, genetic stability assessment, Disease indexing and eradication. **(12 hrs)**

MODULE III
Isolation, purification and viability factors affecting protoplasts. Protoplast culture, culture conditions, culture media. Introduction to protoplast fusion. Techniques of protoplast fusion. Enzymes involved in cell wall digestion. Factors affecting protoplast fusion and fate of products of protoplast fusion. Symmetric and asymmetric hybrids, cybrids. Plant genetic transformation: Concepts, gene constructs, selection systems, transformation methods – agrobacterium mediated, biolistics**. (12 Hrs)**

MODULE IV

Animal cell culture: Conditions of viability of animal cells in culture. Growth factors of animal cells in culture. Production of hybridomas and monoclonal antibodies. Cloning of hybrid cells. Biology and charecterisation of cultured cells, Parameters of growth, Scaling up of animal cell culture.animal cell transformation, cell culture- applications, Vaccines. Organ and histotypic cultures, apoptosis, measurement of cell death, 3-D culture. (**12 Hrs)**

REFERENCE

1. Principles of Gene manipulation by R. M. Old and S. B Primrose
2. Plant tissue culture by S.S Bhojwani.
3. Methods in Molecular Biology Vol. 28. Protocols for Nucleic acid analysis by non - radioactive probes. Edited by Issac P. G. Human Press,
4. Molecular Cloning: A laboratory manual by Maniatis, Fritsch E. R and Sambrook J. Volume Series.
5. A guide to Genetic Engineering- Pamela Peterson.
6. Biotechnology by Trehan.
7. Cutlure of Animal Cells- Basic Techniques - Ian Freshney

MSBTC03C13
RECOMBINANT DNA TECHNOLOGY
3 CREDITS (48 Hours)

Course Objectives:

To familiarize with the advanced genetic engineering techniques. Appropriate application of genetic engineering technique for the mass production of protein of interest. The technology behind transgenic microorganisms, plants and animals.

Course Outcomes:

Complete understanding of genetic engineering tools such as RFLP, AFLP, RAPD, PCR, DNA finger printing etc.

Course Content:

MODULE 1

Historical events that led to the methods of recombinant DNA technology, Gene cloning, Steps of gene cloning, enzymes involved in recombinant DNA technology- Polymerases, Klenow fragment, Nucleases, Restriction endonucleases, Ligases, Poly nucleotide kinases, Terminal deoxy nucleotidyl transferases, Alkaline phosphatases. (**10Hrs)**

MODULE 2

Vectors used in Recombinant DNA technology, Plasmids, Cosmids, Phagemids, Artificial chromosomes, Shuttle vectors, Viral vectors, Expression vectors. Linkers, Adapters, Homopolymer tailing. Transformation, Transfection, Transient transfection, Selectable marker gene to identify the transfer of genes in cells. (**14Hrs**)

MODULE 3

Preparation of Gene libraries, cDNA libraries, Expression libraries, Storage of libraries and Screening of libraries, Screening by DNA hybridization, Screening by Immunological Assay, Screening by protein activity, Screening by Genetic complementation, Hybrid Arrest Translational systems. (**10Hrs**)

MODULE 4

RFLP, AFLP, RAPD Analysis, PCR, Various types of PCR and its applications, Fluorescent in-situ hybridization, Chromosome micro dissection and micro cloning

Genetic engineering of animals and generation of transgenic animals. Knock out Technology and Knock-in technology, Anti-sense RNA technology and its Application. (**14Hrs**)

REFERENCES

1. Principles of gene manipulation- An Introduction to Genetic Engineering. Old, RW & Primrose, S.B – 1994 5th Edn. Blackwell Sci Pub.
2. Molecular Cloning- A Laboratory Manuel Sambrook, J., Fritsch, E. F. and Maniatis, T. 1989.. Second Edition. Cold Spring Harbor Laboratory Press.
3. Recombinant DNA technology- Concepts and Biomedical Applications Steinberg, M., Guyden, J., Calhann, D, Staiano- Coico, L.,Coico, R,1993. Ellice Horwood Prentice Hall.
4. Recombinant DNA Watson, J. D., Gilman, M., Witkowski, J. and Zoller, M. 1992. Second Edition. Scientific American Books, WH Freeman & Co.
5. From Genes to Clones: Introduction to Gene - Winnacker, E. L. 1987.

MSBTC03C14
Practical IV
MICROBIAL TECHNOLOGY AND ENZYMOLOGY
2 Credits (96Hours)

MICROBIAL TECHNOLOGY

1. Strain development
2. Determination of Dissolved oxygen (DO)
3.Determination of Biological oxygen demand
4. Study of industrially important Yeast and Molds
5. The fermenter and Types
6. Production of Enzymes under Submerged Fermentation (Upstream and Downstream processing)
7. Production of Enzymes under Solid State Fermentation (Upstream and Downstream processing)
8. Production of red wine and alcohol
9. Alcohol fermentation using molasses
10. Production of Mushrooms

REFERENCE

1. Microbial Biotechnology- A Laboratory Manual for Bacterial Systems
Authors: Das, Surajit, Dash, Hirak Ranjan. Springer
2. Laboratory Bioprocess Technology Paperback – 1 January 2013
by A.N. Shukla, Arjun publishing house.
2. Practical Fermentation Technology, Brian McNeil and Linda M Harvey. Publisher: John Wiley & Sons Inc

ENZYMOLOGY

1. Determination of Km and Vmax of peroxidase enzyme.
2. Determination of turnover number {Kcat} of peroxidase.
3. Immobilization of enzyme peroxidase on activated charcoal
4.Inhibition assay of peroxidase enzyme.
5. Velocity time graph of peroxidase activity.
6. Determination of specific activity of peroxidase enzyme in radish extract.

REFERENCE

1. I.H. Segel. 2010. Biochemical Calculations (2nd Ed), John Wiley and Sons, California, USA. ISBN: 978-0-471-77421-1. 2. P. F. Cook, W.W. Cleland. 2007.
2. Enzyme Kinetics and Mechanism, Garland Science Publishing, London, England and New York, USA. ISBN: 978-0815341406.
3. 3. T. Palmer, P. Bonner. 2007. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry (2nd Ed.), Woodhead Publishing House, Chichester, England. ISBN: 978-0- 857099921.
4. 4. R. Burgess, M. P. Deutcher. 2009. Guide to Protein Purification, Academic Press, San Diego, USA. ISBN: 978-0-12-374978-9.
5. 5. D. Purich. 2010. Enzyme Kinetics: Catalysis and Control (1st Ed.), Academic Press, San Diego, USA. ISBN: 978-0-123809247.
6. 6. N.C. Price, L. Stevens. 2000. Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins, Oxford University Press, USA. ISBN: 978-0-198- 502296.

MSBTC03C15
Practical V

CELL AND TISSUE MANIPULATION AND RECOMBINANT DNA TECHNOLOGY

(2 Credits) (96 Hours)

CELL AND TISSUE MANIPULATION

1. Preparation of media.
2. Surface sterilization.
3. Organ culture – shoot tip, meristem, node, leaf, embryo, orchid seed
4. Callus induction
5. Organogenesis
6. Protoplast isolation and culture.
7. Anther culture.
8. Preparation of media and membrane filtration (animal cell culture).
9. Preparation of single cell suspension from spleen and thymus.
10. Cell counting and cell viability.
11. Trypsinization of monolayer and subculturing.

REFERENCE

1.Plant tissue culture by S.S Bhojwani
2. Culture of Animal Cells- Basic Techniques - Ian Freshney

RECOMBINANT DNA TECHNOLOGY

1. Isolation of genomic DNA
2. Southern blotting-Preparation of proteins
3. RFLP analysis
4. Bacterial & antibiotic culture media preparation of compliment cells
5. Isolation of plasmid DNA
6. Isolation of Lamda phage DNA
7. Agarose gel electrophoresis&restriction mapping of DNA
8. Construction of restriction map of plasmid DNA

9. Cloning in plasmid/phagmid vectors
10. Preparation of single stranded DNA template
11. DNA sequencing
12. Gene experiment in E.coli& analysis of gene product
13. PCR
14. Reporter Gene assay (GUS/CAT/b-GAC)

REFERENCE

1. Recombinant DNA manual 1st edition by Judith W. Zyskind, Sanford I, Bernstein
2. Recombinant DNA technology by Keya Chaudhuri
3. Molecular Biology & r DNA technology by Ashok Kumar

MSBTC03E08
BIOINFORMATICS
3 Credits (48 Hours)

Course Objectives:

1. Get knowledge about biological databases and understand sequence alignement methods.

2. Understand methods in genomics and proteomics.

3. Understand the molecular level interactions and molecular modeling.

4. Understand the method of structure-based drug design and gain basic knowledge of systems biology.

Course Outcome:

The students shall be able to

1. Access different biological databases, retrieve protein and nucleic acid sequences and perform sequence alignment.

2. Explain different methods used in genome and proteome analysis.

3. Explain different molecular interactions, techniques of molecular modeling, protein structure prediction

4. Explain the method of structure based drug design and basic concept of systems biology.

Course Content:

Module I

Biological databases and sequence alignments: Nucleic acid databases, Protein databases (sequence, structure, classification), genome databases, specialized databases, data format (FASTA, PDB), Data storage and retrieval. Pair-wise sequence alignment: Global and local alignment: methods, scoring matrices (PAM, BLOSUM). Database searching: FASTA and BLAST. Multiple sequence alignment: methods, tools and applications. Phylogenetic analysis: type of phylogenetic trees, methods of its construction-distance based methods and character-based methods. **(13 Hrs)**

Module II

Genomics and proteomics: genome projects, Identification of sequence patterns, motifs and profiles, gene prediction methods, Genome mapping, genome sequencing, annotation. Comparative genomics, Functional genomics- ESTs, SAGE, DNA micro arrays, pharmacogenomics. An introduction to data science.
Proteomics: 2D Gel Electrophoresis, MALDI, Tandem mass spectroscopy, peptide mass fingerprinting, Protein micro arrays, protein expression analysis, protein-protein interactions. **(13 Hrs)**

Module III

Structural bioinformatics and Molecular modelling: Structure visualization. Structure comparison, RMSD, Intra and inter-molecular interactions, Potential energy functions, Energy minimization, local and global minima, Molecular Dynamics and Monte Carlo simulations. Protein structure prediction: Secondary and tertiary structure prediction-homology modeling, ab initio prediction.**(11 Hrs)**

Module IV

In silico drug design: Drugs and drug targets. Computer aided drug design: Ligand databases. Molecular docking, virtual screening, lead compounds, pharmacophore, QSAR, ADME property prediction. An introduction to systems biology and biological networks, its applications in the drug development. **(11 Hrs)**

REFERENCES

1. Bioinformatics - Baxevanis AD & Quellette BFF, John Wiley & Sons Inc.
2. Bioinformatics – Sequence and Genome anlysis, Mount DW, Cold Spring Harbour Laboratory Press, New York
3. Bioinformatics- A beginner's guide by Jean-Michel Claverie, John Wiley & Sons.
4. Bioinformatics-Methods and applications, Rastogi,S.C. Mendiratta, N. and Rastogi P, Prentice-Hall of IndiaPvt. Ltd, New Delhi
5. Essential Bioinformatics-Jin Xiong, Cambridge University Press
6. Evolutionary computations in Bioinformatics – Fogel & Corne, Morgan Kafman publishers
7. Introduction to Bioinformatics – Attwood & Parry-Smith, Pearson Education
8. Medicinal Chemistry – Patrick G, Viva Books Pvt Ltd.
9. Pharmacology & Pharmacotherapeutics – Sataskar, Bhandakan & ainapur, Popuar Prakashan Mumbai
10. Principles of Medicinal chemistry – William O & Foye BI , Waverks Pvt. Ltd

11. Protein folding – Creighton TE (ed) WH Freeman & Co.
12. Structural Bioinformatics by Philip E. Bourne and Helge Weissing, Wiley
13. Structure and Mechanism in Protein science – Fersht WH freeman & Co
14. Fundamental concepts of Bioinformatics – Krane D.E and Raymer M.L., Pearson Education
15. Bioinformatics: Databases and Algorithms- N. Gautham, Narosa Publishing House, New Delhi.

MSBTC03E09

BIOTECHNOLOGY IN MEDICINE, HEALTH, AGRICULTURE AND ENVIRONMENT

3 Credits (48 Hours)

Course Objectives:

Understand the latest application of Biotechnology in the field of Medicine, Health, Agriculture and Environment for improvement in quality of life.

Course Outcome:

Ability to understand the use of Biotechnology for better living

MODULE I

Developments in gene therapy. Molecular basis, identification and cure of genetic disorders: like Immunodeficiencies, Diabetes mellitus, Coronary artery disease, Neurogenetic disorders, cancer, Muscular Dystrophy, mitochondrial disease.
Diagnosis based on genomic and cDNA microarray. Therapies based on RNA and stem cells.

(15 Hrs)

UNIT II

Bioreactors in plant production and scale up. Plants as bioreactors. Engineering for secondary metabolites, herbicide resistance and improvement of food quality. Biofertilizers, Types of biofertilizers, Biopesticides **(10 Hrs)**

UNIT III

Biotechnological monitoring of air water and soil pollution. Biosensors. Biological indicators.

Strategies for waste management and control. **(10Hrs)**

UNIT IV

Biotechnologically produced clinical products.
Nanomedicine: Nanodevices medical microbots, nanorobotics, nanomedicine, nanosurgery for cancers and neurological disorders. Nanoparticles for biological assays as drug delivery vehicles

Applications of Biotechnology in aquaculture, forestry, wildlife and veterinary sciences. **(13Hrs)**

REFERENCE

1. Molecular Biotechnology 5th Edition Bernard R. Glick, Jack J. Pasternak, Cheryl L. Pattern ASM Press 2017
2. Gene cloning and DNA analysis: An Introduction 6th Edition T.A. Brown Wiley Blackwell 2013

3. Modern Biotechnology: Connecting Innovations In Microbiology and Biochemistry to Engineering Fundamentals Nathan S. Mosier, Michael R. Ladisch Wiley 2009
4. Nanomedicine - Design and Application of Magnetic Nanomaterials, Nanosensors and Nanosystems.,(2008) Vijay Varadan, Linfeng Chen and Jining Xie
5. Techniques for Wildlife Investigation and Management, 6th Ed., C. Braun ,2005., The Wildlife Society, Bethesda, MD.
6. Introduction to Forest Science., (2006) 2nd Edition by Raymond A. Young , Ronald L. Giese (Editor)
7. Introduction to Veterinary Science (2003) by James Lawhead , MeeCee Baker
8. Biotechnology in Agriculture and Forestry 66: Editors: Jack M. Widholm and Toshiyuki Nagata : Springer 2012
9. Environmental Biotechnology : New Approaches and Prospective Application : Marian Petre (Editor) 2013

MSBTC03E10
VIROLOGY, MYCOLOGY AND PARASITOLOGY
3 Credits (48 Hours)

Course Objectives:

- To impart detail understanding in viral taxonomy, viral replication and cultivation methods.
- To describe various viral diseases of human importance, it's prevention, laboratory diagnosis and control with special emphasis on vaccines.
- To provide adequate knowledge about pathogenic molds and yeasts causing diseases to humans.
- To enable students to understand the pathogenesis, clinical presentation, laboratory diagnosis, prevention/ control of various protozoan diseases.

Outcomes:

- The students will understand about current and emerging human viral diseases.
- Will acquired with knowledge of various human parasites and its management.
- To provide adequate knowledge about pathogenic fungus diseases to humans and it management

Unit I: (5 hrs)

General properties of viruses and bacteriophages: morphology, classification, replication, cultivation, virus host interaction and laboratory diagnosis.

Unit II (15 Hrs)

Properties and infections of human viruses- Herpesviruses, Poxviruses, Hepatitis viruses, Picornaviruses, , Arbo viral diseases, Rhabdoviruses, Orthomyxoviruses, Paramyxoviruses; Oncogenic viruses, HIV and other retro viruses, miscellaneous DNA and RNA viruses. Antiviral chemotherapy, Interferons, Viral vaccines

Unit III: (13 Hrs)

Fungal diseases of humans: classification and lab diagnosis,

Study the morphology, pathogenesis and laboratory diagnosis of the causative agents of superficial and cutaneous mycoses, subcutaneous mycoses, systemic/deep mycoses and opportunistic mycoses. Pneumocystis *jiroveci*. Mycotoxicoses, Antifungal agents and its mechanism of action, antifungal susceptibility testing.

Unit IV: (15 Hrs)

Classification of human parasites. Morphology, life cycle, pathogenesis, laboratory diagnosis of important protozoans and helminthes ;. Intestinal and hemoflagellates: tissue flagellates, cestodes, trematodes, nematodes.,laboratory diagnosis of parasitic diseases. Other sporozoans: *Cryptosporidium parvum, Toxoplasma gondii*. *Antiparasitic agents*

MSBTC03E11
ENVIRONMENTAL MICROBIOLOGY

(3 Credits) (48 Hours)

Course Objectives:

Objectives of this course are to study and understand

1. Microbial biodiversity in different environments and factors affecting microbial population
2. Environmental, agricultural, medical and industrial applications of microorganisms.

Course Outcome:

Upon completion of this course, students will be able to explain and demonstrate the dispersal and adaptability of diverse microorganisms in different environments and their beneficial roles in environment, agriculture, health and industry.

Course Content:

Module I

Microbial behavior in ecosystems: Microbial biodiversity, Interactions among microbial populations. Animal-microbe and plant-microbe interactions.

Microbiology of soil: Soil as habitat for microorganisms. Soil microflora, Decomposition of organic matter - Soil as source of industrial strains. Biodegradation of recalcitrants by soil microbes. Geocycles of C, N, S, P. iron and sulphur oxidation. N2 fixation.

(11 Hrs)

Module II

Microbiology of water: Microbial communities in aquatic environments, factors affecting microbial population in natural waters, Air water interface, Microbial Corrosion, Bacteriological analysis of drinking water. Water purification and various steps involved.

Microbiology of air: Composition of air microflora, Significance of air microflora, Airborne diseases, Hazards of laboratory techniques, Air sanitation. Biological weapons, their regulation and precautions.

Microorganisms in extreme environments: Environmental Determinants that Govern Extreme environments, Extremes of pH & temperature, salinity, Hydrostatic pressure, Nutrient limitation.

(15 Hrs)

Module III

Pollution and environment, Biosensors and Biological indicators, Waste water management and sewage treatment, BOD concepts, Solid waste management and land filling, Degradation of xenobiotics, Microbes and bioremediation. Microbial Biofilms: Physiology, Morphology and Biochemistry of microbial biofilms

(11 Hrs)

Module IV

Production of microbial biofertilizers –cyanobacteria, Rhizobium, Azotobacter, , Azospirillum, Phosphobacteria and VAM, Biopesticides, Microbes as a health food (SCP)- Spirulina and its production methods. Probiotics - use of Lactobacilli and Bifidobacterium- therapeutic and nutritional value, Microbial enhanced oil recovery, Microbial production of fuels. Microbial leaching of ores and biomining, Biopolymers and biosurfactants.

(13 Hrs)

REFERENCES

1. R.M.Atlas and R. Bartha (1998) Microbial Ecology-Fundamentals and Applications. Addison Wesley Longman, Inc.
2. Buckley R G, Environmental Microbiology by, CBS
3. N.S. Subbarao, Biological Nitrogen Fixation
4. Alexander and Martin , Microbiology of Soil
5. Soil Microbiology. Mark Coyne Thompson Learning
6. Ivanov, Environmental Microbiology for Engineers, Taylor & Francis Exclusive(Cbs)

SEMESTER IV
MSBTC04C16

Total Credit:16 Credits **Period :5 Months**

Project Research & Dissertation

MSMBY01C03/MSBTC01C03

Cell Biology

Time : 3 Hours Total Marks: 60

Part A

Answer **any 5**

1.

2 .

3.

4.

5.

6. (5x3=15 Marks)

Part B

Answer **any 3**

7.

8.

9.

10.

11. (3x5 =15 Marks)

Part C

Answer **any 3**

12.

13.

14.

15.

16. (3x10=30 Marks)