Department of Microbiology

(DST-FIST Supported Department)

School of Biosciences

Periyar University

(NAAC A Grade - State University - NIRF Rank 68)

Salem - 636 011, Tamil Nadu

M.Sc. Microbiology

Syllabus

OBE REGULATIONS AND SYLLABUS

(Effective from the academic year 2018-2019 and thereafter)

PERIYAR UNIVERSITY

M.Sc. MICROBIOLOGY

CHOICE BASED CREDIT SYSTEM

[Students admitted from 2018 – 2019 onwards]

REGULATIONS

PROGRAMME SPECIFIC OUTCOME

Students who Postgraduate with Masters of Science in Microbiology will :

- Gain an understanding and acquire thefundamental knowledge in to the bacterial, fungal, algal and viral morphology and physiology and competently be able to cultivate and characterize them.
- Understand the fundamental concepts of immunity and the contributions of various organs and cells to immunity.
- Understand the various applications in Pharmaceutical Induistries.
- Understand the various concepts and disease development prevention and treatment of microbes in animals, plants and human.

1. CONDITIONS FOR ADMISSION

A. ELIGIBILITY CONDITIONS FOR ADMISSION

Candidate who has passed the B.Sc. degree in any Life Sciences [Microbiology/ Applied Microbiology/ Industrial Microbiology/ Botany/ Plant Sciences and Plant Biotechnology/ Zoology/ Biochemistry/ Bioinformatics/ Biology/Chemistry with Botany/ Zoology as Allied Subjects] of this university or an examination of any other university accepted by the syndicate as equivalent thereto shall be eligible for admission to M.Sc. Degree Course in Microbiology.

B. METHOD OF SELECTION

Candidates have to appear for an entrance examination in the respective subjects to be conducted by the respective departments and thereafter an interview.

2. ELIGIBILITY FOR THE AWARD OF DEGREE

A candidate shall be eligible for the award of the degree only if he/she has undergone the prescribed course of study in a college affiliated to the University for a period of not less than two academic years, passed the examination of all the four semesters prescribed earning 90 credits (plus 2 credits for Human Rights and Mooc Course) and fulfilled such conditions as have been prescribed therefore.

3. DURATION OF THE COURSE

The duration of the course is for two academic years consisting of four semesters.

4. EXAMINATIONS

There shall be four semester examinations: first semester examinations at the middle of the first academic year and the second semester examination at the end of the first academic year. Similarly, the third and fourth semester examinations shall be held at the middle and end of the second academic year, respectively.

5. COURSE OF STUDY AND SCHEME OF EXAMINATIONS

Semester	Paper code	Course	Hrs/ week	Credits	Marks		
					CIA	EA	Total
Sem - I	18MBC01	Core I - Basics of Microbiology	5	5	25	75	100
	18MBC02	Core II - Immunology & Immunotechnology	5	5	25	75	100
	18MBC03	Core III - Pharmaceutical Biochemistry	5	5	25	75	100
	18MBCE01	Elective -1	5	4	25	75	100
	18MBCP01	Core Practical I - General Microbiology	5	4	40	60	100
	18MBCP02	Core Practical Il - Immunology & Pharmaceutical chemistry	5	4	40	60	100
Sem - II	18MBC04	Core IV - Medical Bacteriology and Parasitology	4	5	25	75	100
	18MBC05	Core V - Medical Mycology and Virology	4	5	25	75	100
	18MBC06	Core VI - Bioresource Technology	5	5	25	75	100
	18MBCE02	Elective - 2	4	4	25	75	100
	18MBCS01	Supportive – 1	3	3	40	60	100
	18MBCP03	Core Practical III - Medical Microbiology	5	4	40	60	100
	18MBCP04	Core Practical IV - Industrial Microbiology	5	4	40	60	100
	18MBCI01	Internship	2 wks	-	40	60	100
		Swayam / Mooc Course		4	-	-	-
Sem - III	18MBC07	Core VII - Molecular Biology and Applied Biotechnology	4	5	25	75	100
	18MBC08	Core VIII – Bio Nano-technology and Infectomics	4	5	25	75	100
	18MBC09	Core IX – Food, Soil and Environmental Microbiology	4	5	25	75	100
	18MBCS02	Supportive – 2	4	4	25	75	100
	18MBCP05	Core Practical V: Molecular Biology and Biotechnology	6	4	40	60	100
	18MBCP06	Core Practical VI: Applied Microbiology	6	4	40	60	100
		Value Education	2	-	40	60	100
Sem - IV	18MBC10	Core XI- Research Methodology and Computational biology	6	5	25	75	100
	18MBCPR01	Project	24	4	40	60	100
		Total			725	1575	2300

Elective courses

1. Biocontrol and Entomology
2. Entrepreneurship in Microbiology
3. Algal Biotechnology
4. Quality Control in Industries
5. IPR, Biosafety and Bioethics
6. Mushroom and SCP Technology

Supportive courses for other departments

1. Microbiology
2. Medical Laboratory Technology
3. Quality Control in Industries
4. Health Science Management

Details of the course

1. No. of courses

(Core paper + Practical's) : 16

2. Elective - Major : 2
3. Supportive -Non Major : 2
4. Internship : 1
5. Value Education : 1
6. Mooc / Swayam course : 2

SCHEME OF EXAMINATIONS

The scheme of examinations for different semesters shall be as follows:

Theory Paper

External	: 75 Marks
Internal	: 25 Marks
Total	: 100 Marks
Time	: 3 hours

The following procedure will be followed for Internal Marks:

Theory Papers Internal

Best two tests out of 3	: 10 marks
Attendance	: 5 marks
Seminar	: 5 marks
Assignment	: 5 marks
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	25 marks

Practical : 40 Internal Marks

Attendance	: 5 marks
Practical Test	: 30 marks
(Best 2 out of 3)	
Record	: 5 marks

Project

Internal Mark	: 20 marks
Viva - voce	: 20 marks
Project Report	: 60 marks

Break-up details for attendance

Below 60%	: No Marks
60 to 75%	: 3 Marks
76 to 90%	: 4 Marks
91 to 100%	: 5 Marks

6. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENTSEMESTERS:

(i) Candidates shall register their names for the first semester examination after the admission in the PG courses.

(ii) Candidates shall be permitted to proceed from the first semester up to the final semester irrespective of their failure in any of the semester examination subject to the condition that the candidates should register for all the arrear subjects of earlier semesters along with current (subject) Semester subjects.

(iii) Candidates shall be eligible to proceed to the subsequent semester, only if they earn sufficient attendance as prescribed therefore by the Syndicate from time to time.

Provided in case of candidate earning less than 50% of attendance in any one of the semester due to any extraordinary circumstance such as medical grounds, such candidates who shall produce Medical Certificate issued by the Authorized Medical Attendant (AMA), duly certified by the Principal of the College, shall be permitted to proceed to the next semester and to complete the course of study. Such candidate shall have to repeat the missed semester by rejoining after completion of final semester of the course, after paying the fee for the break of study as prescribed by the University from time to time.

7. PASSING MINIMUM

(i) There shall be no passing minimum for internal.

(ii) For external examination, passing minimum shall be of 50%of the maximum marks prescribed for the paper.

(iii) In the aggregate (external + internal) the passing minimum shall be of 50% for each paper/practical/project and viva-voce.

(iv) Grading shall be based on overall marks obtained (internal + external).

8. CLASSIFICATION OF SUCCESSFUL CANDIDATES

Candidates who secured not less than 60% of aggregate marks (internal + external) in the whole examination shall be declared to have passed the examination in the first class.All other successful candidates shall be declared to have passed in second class. Candidates who obtain 75% of the marks in the aggregate (internal + external) shall be deemed to have passed the examination in first class with distinction, provided they pass all the examinations (theory papers, practical's, project and viva-voce) prescribed for the course in the first appearance.

9. GRADING SYSTEM

The term grading system indicates a seven (7) point scale of evaluation of the performances of students in terms of marks obtained in the internal and external examination, grade points and letter grade.

SEVEN POINT SCALE (As per UGC notification 1998)

GRADE	GRADE POINT	PERCENTAGE EQUIVALENT
'O' = Outstanding	5.50 - 6.00	75 - 100
'A' = Very Good	4.50 - 5.49	65 - 74
'B' = Good	3.50 - 4.49	55 - 64
'C' = Average	3.00 - 3.49	50 - 54
'D' = Below Average	1.50 - 2.99	35 - 49
'E' = Poor	0.50 - 1.49	25 - 34
'F' = Fail	0.00 - 0.49	0 - 24

10. RANKING

Candidates who pass all the examinations prescribed for the course in the first appearance itself alone are eligible for Ranking / Distinction.

Provided in the case of candidates who pass all the examinations prescribed for the course with a break in the First Appearance due to the reasons as furnished in the Regulations under "Requirements for Proceeding to subsequent Semester" are only eligible for Classification.

11. PATTERN OF QUESTION PAPER

Theory Paper External (75 Marks**)**

[Part A: 20 x 1=20 Marks (Objective type Questions to be filled in the OMR sheet and submitted]

[Part B: Analytical Questions 5 x 3= 15Marks (Either or type, One question from each unit)

[Part C: 5×8= 40 Marks (Either or type Descriptive Questions]

12. APPEARANCE FOR IMPROVEMENT

Candidates who have passed in a theory paper/papers are allowed to appear again for theory paper/papers only once in order to improve his/her marks, by paying the fee prescribed from time to time. Such candidates are allowed to improve within a maximum period of 10 semesters counting from his/her first semester of his/her admission. If candidate improve his marks, then his improved marks will be taken into consideration for the award of classification only.Such improved marks will not becounted for the award of prizes/medals, rank and distinction. If the candidate does not show improvement in the marks, his previous marks will be taken intoconsideration. Candidate will be allowed to improve marks in the practical's, project, Viva-Voce and field work.

13. TRANSITORY PROVISION

Candidates who have undergone the course of study prior to the academic year 2008-2009 will be permitted to appear for the examinations under those regulations for a period of three years i.e., up to and inclusive of April/May 2012 Examinations. Thereafter, they will be permitted to appear for the examination only under the regulations then in force.

Course Specific Outcome (CS0) - Microbiology

- Students will acquire and demonstrate competency in laboratory safety and develop specialized microbiological laboratory skills applicable to microbiological research or clinical methods, including accurately reporting, observations and analysis.
- Student will develop the ability to design, conduct experiments and analyze data in the field of Microbiology.
- Students will develop skills to become a good microbiologist and will have placements in various industries.

CORE - I: BASICS OF MICROBIOLOGY (18MBC01)

Course Objectives

The course contents are designed to gain knowledge about the different forms of bacteria, fungi, algae, protozoan's along with the basic principles of microbial taxonomy. The learner will understand about the microbial metabolism and microbes thriving in extreme environments.

Course Outcome

At the end of the course, the learner will be able to

1. Know about the basic aspects of microbiology, different methods of isolation of microorganism, preservation and controlling of microorganism.
2. Learn the basic morphology of different class of microorganism, its cellular components and the classification of different types of microorganism.
3. Know about the basic aspects of microbial taxonomy, classification systems and the life cycle of important class of microorganisms.
4. Know the basis of microbial physiology with its biochemical pathway and the ecology of the microbes with reference to Extreme Ecosystems.
5. Know the distribution of microorganism, its diversity and the various microbial interactions present in the ecosystem.

UNIT – I

Introduction – Development of microbiology and the early discoveries - Isolation of different types of bacteria – fungi – actinobacteria – cyanobacteria. Preservation methods of microbes for storage and microscopy studies, culture collections. Sterilization and disinfection – physical and chemical methods for controlling microorganisms.

UNIT - II

Morphological types - Gram negative and Gram positive, Cyanobacteria, Archeabacteria and Eubacteria. Ultrastructure of prokaryotic and eukaryotic cells. Fungi: Cell wall - chemical composition and functions, membranes and their functions. Algae: Structure of algal cells, classification, reproduction and characteristics of Chlorophyta (green algae), Chrysophyta (golden-brown and yellow), Green algae, Diatoms, Euglenophyta (Euglenoids), Rhodophyta (Red algae), Cyanophyta, Xanthophyta, Phaeophyta (Brown algae).

UNIT - III

Microbial taxonomy: Definition, systematics, Nomenclature rules and identification, Hierarchical organization and the position of microbes in the living world, classification systems – Haeckel's three kingdom concept- Whittaker's five kingdom concept- three domain concept of Carl Woese. Characterization of microorganisms - Morphological, physiological and metabolisms. Modern classification of fungi - Ascomycetes (*Aspergillus*), Deuteromycetes (Candida), Zygomycetes (Mucor), Basidiomycetes (Agaricus), Acrasiomycetes (Dictyostelium), oomycetes (Saproleina) and Myxomycetes (Ceratiomyxa).

UNIT – IV

Microbial respiration and fermentative pathway - respiratory metabolism - Embden Mayer Hoff pathway - ED pathway - Glyoxalate pathway - Kreb's cycle - ETC - oxidative and substrate level phosphorylation - TCA cycle - gluconeogenesis - Fermentation of carbohydrates - homo and hetero lactic fermentation. Bioenergetics, Cell division - endospore - structure and properties.

UNIT – V

Microbial Ecosystems - Principles of microbial ecology, Metabolic diversity - phototrophy, auxotrophy and lithotrophs. Microbial Habitat, Microbial ecosystems - Fresh water, soil, plant, hydrothermal vents, hot springs, volcano, Marine (Open oceans and Deep sea organisms), barophiles and space. Nutrient cycles - Nitrogen, Sulphur, Phosphorus and Iron, Animal - Microbial symbiosis, Plant - Microbial symbiosis - Microbial communications - Quorum sensing, Cell signaling, Biofilm.

References

1. Tortora, G.J., Funke, B.R. and Case, C.L. (2016) *Microbiology: An Introduction*, 11th Edition, Pearson Education, India
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3. Baveja, C.P. and Baveja, V. (2017) *APC Text Book of Microbiology*.4thEdition, Arya Publications, New Delhi.
4. Johanne, M.W., Linda, M.S. and Christopher, J.W. (2017) Willey Prescott's Microbiology 10E.10th Edition. McGraw Hill Education, India.
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9. Alexopoulus, C.J. and Mims, C.W. (1996) *Introductory Mycology*. 4TH Edition, Wiley Eastern Ltd. New Delhi.
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8. https://microbiologyinfo.com/top-and-best-microbiology-books/

CORE - II: IMMUNOLOGY AND IMMUNOTECHNOLOGY (18MBC02)

Course Objectives

The course contents are designed to provide students with knowledge on how the immune system works and to state the role of immune system, be able to compare and contrast humoral and cell mediated immune responses, to distinguish and characterize various immune cells, to understand the mechanism of antibody diversity, to understand the role of cytokines in immunity, to understand the significance of the major histocompatibility and to provide an overview of the interaction between the immune system and pathogens.

Course Outcome

At the end of the course, the learner will be able to

1. Describe the basic mechanism of innate and acquired immunity; humoraland cell mediated immunity.
2. Describe the cellular and molecular mechanism of lymphocyte production and activation.
3. Understand the cellular process involved in inflammation and immunity, hypersensitivity reactions.
4. Understand the mechanism of clonal selection, antibody diversity and various serological diagnostic techniques based on antigen – antibody interaction.

UNIT - I

History and scope of immunology: Types of immunity - Innate and acquired, active and passive, Cell mediated immunity and Humoral immunity, Haematopoeisis. Ontogeny, origin, development and differentiation of immune cells. Toll – like receptors Antigen presenting cells. T-helper and T-cytotoxic cells, Natural killer cells, Dendritic cells, Langerhan cells, Macrophages, Microphages.

UNIT - II

Lymphoid tissues and organs - Primary lymphoid organs - Thymus, Bone marrow: Secondary lymphoid organ - Lymph node, spleen, MALT and GALT. Phagocytosis process. Clonal selection theory. B-lymphocytes and their activation, mechanism of T-cell activation. Thymus derived lymphocytes, Major histocompatibility complex. Structure and functions of Class I and II molecules. Immunoglobulins - Structure, distribution and function. Generation of antibody diversity. Organisation and expression of immunoglobulin genes.

UNIT - III

Antigenicity: factors governing antigenicity. Antigen types, haptens, epitopes, adjuvants, carriers, bacterial, viral and tumour antigens, autoantigens, blood group antigens, T dependent, T independent antigens. Kinetics of antibody production - primary and secondary antibody response. Antigen antibody reactions- precipitation, agglutination, immunoflouroscence, haem agglutination, RIA, ELISA. Factors governing antigen-antibody interactions: Affinity, avidity, valency, cross reactivity.

UNIT - IV

The complement systems: Mode of activation, classical, alternate and lectin pathway; Immuno haematology, Transplantation immunity - Organ transplantation and HLA tissue typing. Introduction to autoimmune disorders and immunology of infectious diseases. Tumour Immunology-Immuno diagnosis and Immunotherapy of Cancer.

UNIT - V

Hypersensitivity reactions. Immunological tolerance. Immunosuppression. Immunotherapy. Hybridoma and monoclonals. Recombinant antibodies. DNA vaccines and edible vaccines. Immunotechniques - ELISA, Immuno electrophoresis,Flow cytometry-Fluorescent activated cell sorter- Applications in immunology.

References

1. Coico, R. and Sunshine, G. (2015) *Immunology: A Short Course*, 7th Edition, John Wiley & Sons, 432 pages.
2. William E. Paul (2018) *Fundamental Immunology*, 8th Edition, Willams and Wilkins Publishing.
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5. http://www.mednotes.net/notes/immunology/

CORE - III: PHARMACEUTICAL BIOCHEMISTRY (18MBC03)

Course objectives

The course contents are designed with the basic science knowledge in Chemistry, Microbiology and Pharmaceutical science as prerequisites, to cover basic chemistry knowledge needed to understand cell biological functions. The learners will understand the atomic chemistry and role of macromolecules involved in cell activities.

Course outcome

At the end of the course, learners will be able to

1. Gain knowledge about the drug biotransformation reactions and drug interactions in living systems.
2. Acquire knowledge of GLP providing guidelines and better control for maintenance of instruments, environment control, preservation of test records.
3. Gain well-rounded knowledge and are fully prepared for employment within the pharmaceutical and biomedical sciences industries.
4. Understand the methodologies of making certain the finished pharmaceutical products sterile.
5. Gain in-depth theoretical knowledge on biochemistry in pharmaceutical components.

UNIT - I

Basic concepts **-** Standard periodic table of the chemical elements - Atomic structure: Atom - Atomic orbital - Molecular orbital - Chemical element - Valence - Atomic nucleus - Isotope. Bonding: Chemical bond - Ionic bond - Covalent bond - Metallic bond - Hydrogen bond - Intermolecular force - Dipole - Electron pair - Unpaired electron. Chemical formula - Structural formula - Mole - Stoichiometry - Chemical composition of cells.

UNIT - II

Macromolecular components of the cell - Structural conformation and biological functions of macromolecules. Carbohydrates - Monomers, oligomers, polymers, isomers. Lipids - simple lipids, compound lipids and derived lipids. Lipid beta oxidation. Proteins - Primary, secondary, tertiary and quaternary structures. Enzyme - Classification, nomenclature, properties and mechanisms of enzyme action. Classification and uses of vitamins.

UNIT - III

Pharmacokinetics and pharmacodynamics **-** Routes of drug administration-volume of distribution - biotransformation - Phase I and Phase II reactions - bioavailability - excretion of drugs and their metabolites as defined by Hendersson Hassle Batch equation. Drug physical and chemical actions - drug interactions - therapeutic applications of beneficial interactions. Adverse drug reactions. Principles of toxicity, evaluation and determination of LD50, ED50 and therapeutic Index.

UNIT - IV

Current good manufacturing practices, Good laboratory practices, Good documentation practices, Standard operating procedures, Instrumentation operating procedures, Calibration of equipment's, HACCP, ISO Standards,Laboratory information management system (LIMS).Microbial spoilage, Infection risk and contamination control. Chemical disinfectants, antiseptics, antibiotics, anti-infectives, endocrine and human growth hormone and preservatives. Pharmacopaea–Pharmacopaea updates, US, Europea, British and Indian Standard Organization, Audit related to pharma. United States Federal Drug Administration Audits.

UNIT - V

Growth promotion test(GPT), Disinfectant efficacy study for different types of Disinfectants, Container Closure Integrity test(CCIT),Preservative efficacy study (PET), Qualitative and quantitative methods of environmental monitoring samples, Gowning qualifications, Isolation and identification of isolates - VITEK - Biochemical method, Trend analysis, Results and Discussions reporting (OOS & OOT), Out of specifications and Out of trend. Bacterial endotoxin test (BET), Bio-burden analysis, Water analysis in pharmaceutics, Biological indicators, Raw material samplings and sterility checking for finished products. Cosmetic microbiology-testing methods and preservation

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3 David L. Nelson, Michael Cox. **(**2017**).** Lehninger Principles of Biochemistry.7th ed. International Edition. Publisher: WH Freeman, 1328 Pages

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5 John E. McMurry (2015). The Organic Chemistry of Biological Pathways (2nd Edition). Publisher: WH Freeman and Company. 576 Pages

6 John L. Tymoczko, Jeremy M. Berg, LubertStryer. (2015). Biochemistry: A Short Course. Third Edition**.** Publisher. WH Freeman. 896 Pages

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3. http://jonspharmacy.weebly.com/uploads/2/1/9/2/21923694/hugo_and_russells_pharmaceutical_microbiology.pdf
4. http://fda.gov/downloads/ScienceResearch/FieldScience/UCM397228.pdf

PRACTICAL - I

PRACTICAL EXAM: 7 HRS / DAY: 2 CONSECUTIVE DAYS

CORE PRACTICAL I: GENERAL MICROBIOLOGY, (18MBCP01)

Course Objectives

The learners will be able to gain adequate knowledge and acquire adequate skill to perform different staining techniques, growth rate of bacteria and biochemical test.To impart thorough knowledge and understanding of practical skills in immunology and means of applying these principles in diagnostic and therapeutic techniques and research.

Course Outcome

At the end of the course, learners will be able to:

1. Perform the various staining techniques of bacteria and study the growth rateof bacteria.
2. Competently cultivate algae in different types of media.
3. Demonstrate knowledge and understanding of immunology and the means of applying in the diagnostic and therapeutic techniques and research.
4. Understand the safe working practice in an immunology laboratory.
5. Develop skills to design diagnostic kits.

General Microbiology

1. Microscopy- Phase contrast, Dark Field, Fluorescent Microscopy- Principle and Functions.
2. Gram Staining
3. Metachromatic granular Staining
4. Spore Staining
5. Capsule Staining
6. Flagella staining
7. Lactophenol Cotton Blue Staining
8. Micrometry
9. Motility Test
10. Fungal Slide Culture
11. Growth Curve- Growth rate and Generation Time
12. Effect of pH, temperature and osmotic pressure on growth of bacteria.
13. Isolation and cultivation of Algae
14. Isolation of Arbuscular mycorrizae (AM)
15. IMVIC tests
16. Carbohydrate fermentation
17. Starch hydrolysis Test

18. Cellulose hydrolysis Test
19. Gelatin Hydrolysis Test
20. Casein Hydrolysis Test
21. Catalase Test
22. Oxidase Test
23. Urease Test
24. Nitrate Test
25. Triple Sugar Ion Agar Test
26. Preparation of Millique water
27. Fumigation technique.

References

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7. http:// www.asmscience.org/content/book/10.1128/9781555815905
8. http://www.pleasanton.k12.ca.us/avhsweb/thiel/apbio/labs/Lab_Topic19.pdf

CORE PRACTICAL II

7 Hrs/ day. Two Consecutive days

IMMUNOLOGY & PHARMACEUTICAL CHEMISTRY, (18MBCP02)

Course Objectives

The students will be able to gain adequate knowledge and understanding of practical skills in immunology and means of applying these principles in diagnostic and therapeutic techniques and research.

Course Outcome

At the end of the course, learners will be able to:

1. .Demonstrate knowledge and understanding of immunology and the means of applying in the diagnostic and therapeutic techniques and research.
2. Understand the safe working practice in an immunology laboratory.
3. Develop skills to design diagnostic kits.

Immunology& Pharmaceutical Microbiology

1. Collection of human peripheral blood
2. Separation of serum and plasma from human blood
3. Blood grouping
4. Isolation of Buffy coat
5. Antibody titration of human blood group antigen
6. Ouchterlony's Double Immuno-diffusion test
7. Counter Immuno electrophoresis
8. Quantification of Ig
   a) Radial immunodiffusion
   b) Rocket immune electrophoresis
9. Serotyping
   a) Antistreptolycin-O
   b) C-Reactive protein
   c) Rheumatoid Factor
   d) Beta-HCG
   e) TPHA
10. Bacterial agglutination – WIDAL
11. Serum bactericidal Activity
12. Isolation & Separation of T-cell & B Lymphocytes
13. Dead/fresh cell counting using Tryphan blue dye
14. ELISA
15. Fluorescent Microscopy(Demonstration)
16. Sterility Testing (Tablet, Needle and Syringes, Parentral's)
17. Phenol co-efficient Testing

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SEMESTER - II

Core IV – MEDICAL BACTERIOLOGY AND PARASITOLOGY(18MBC04)

Course Objectives

The students will gain knowledge about the different types of bacteria and protozoan. Collection and processing of specimens for microbiological analysis. Virulence factors of bacterial and protozoan pathogens. The mechanism of Pathogenesis, laboratory diagnosis and treatment of bacterial and protozoan infections.

Course Outcome

At the end of the course, learners will be able to:

1. Learn the methods of collection, transport and processing of clinical specimens.
2. Know the morphological, biochemical, cultural properties of medically important bacteria and protozoan.
3. Get complete information on pathogenesis of bacterial and protozoan diseases.
4. Comprehend the diagnosis of bacteria and protozoan infections and preventionmethods.
5. Gain knowledge on nosocomial infections and ethical committee.

UNIT - I

Microscopic appearance and Colony characteristics of different bacteria. Various Synthetic and Non – synthetic media for bacterial cultivation. Applications of basal, Differential, Enriched and Selective media in bacterial growth. Maintenance and preservation techniques – Refrigeration, Freeze drying, Oil overlaying, Periodic transfers. Indigenous normal microbial flora of human system and their importance. Virulence factors of pathogenic bacteria.

UNIT – II

Collection and lab processing of clinical specimens – Urine, Sputum, CSF, Blood Pus and Stool. Gram positive bacteria – The epidemiology, pathogenesis, diagnosis and treatment of infections caused by pathogenic species of bacteria belonging to the genus – *Staphylococci*, *Streptococci*, *Enterococci*, *Corynebacterium*,*Treponemapallidum*,*Mycobacterium*, and *Clostridium*. Hospital waste disposal – Nosocomial infections – Functions of Hospital Infection control and related ethical committee.

UNIT - III

Gram Negative bacteria - The epidemiology, pathogenesis, symptoms, diagnosis and treatment of infections caused by medically important pathogenic

species of bacteria belonging to the genus – *Escherichia, Klebsiella, Proteus*, *Salmonella, Shigella, Vibrio, Pseudomonas*, *Neisseria* and Zoonotic infections.

UNIT – IV

Parasitology- introduction and classification. Sarco Mastigophora – Sarcodina - Intestinal amoeba – *Entamaeba histolytica*. Free living amoebae – *Naegleria fowleri*, *Acanthamoeba* spp. Mastigophora – Intestinal and genital flagellates – Giardia, Trichomonas. Blood and tissue flagellates – *Leishmania donovani, Trypanosoma cruzi* and *T. brucei* complex. Apicomplexa – Haemosporina – Malarial Plasmodium, Ciliates – *Balantidium coli*.

UNIT – V

Helminthology – Cestodes – *Taenia solium, Taenia saginata.* Trematodes – *Schistosoma haematobium, Faciola hepatica, Faciola buski*. Nematodes – *Trichuris trichura*, Intestinal nematode-*Enterobius vermicularis, Ascaris lumbricoides*. Filarial nematode - *Wucheriria bancrofti*. Extra intestinal nematodes –*Trichinella spiralis*.

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Core V - MEDICAL MYCOLOGY AND VIROLOGY (18MBC05)

Course Objectives

The course contents are designed to understand the basic information about the fungi, viruses and their associated diseases based on the signs and symptoms.

Course Outcome

At the end of the course, learners will be able to:

1. To understand the basic aspects of fungi with its taxonomy, various fungal databases, know about fungal immunity and the methods used in the specimen collections.
2. Know about the different classes of antifungals, their mode of action, methods followed in diagnosis of fungal infections and its treatment.
3. Know about the different types of fungal infections, properties of the fungi causing these infections, the diagnostics methods and the treatment of these infections.
4. To know the basis concepts of viruses with its taxonomy, multiplication and the different types of animal viruses and its classification.
5. To understand the disease causing nature of different class of animal viruses, new emerging viral diseases, its pathogensis and treatment methods.

UNIT - I

Medical Mycology- Introduction-Historical Perspectives and Miles stones in Mycology, Fungal Taxonomy- Binomial nomenclature,fungal repository and databases, Classification of medically important fungi, Immunity to fungal diseases-cellular and humoral Immunity. Collection and Transport of fungal specimens.

UNIT – II

Antifungal therapy- Historical Perspectives and Current scenario, Classification of Antifungals-Polyene, Synthetic and Miscellaneous antifungals, Antifungal Susceptibility testing-CLSI guidelines, Diagnosis of Fungal infections-Conventional and non-conventional methods, Current techniques in fungal diagnosis.

UNIT - III

Superficial mycosis - Tinea, Piedra, Cutaneous mycosis - Dermatophytosis. Subcutaneous mycosis - Sporotrichosis, Mycetoma, Systemic mycosis-Blastomycosis and Histoplasmosis. Opportunistic mycosis - Candidiasis, Aspergillosis and Mucoromycosis,Miscelleneous mycosis- oculomycosis, Emerging fungal diaseases.

UNIT – IV

Discovery, nomenclature and classification of virus. Life cycle of Bacteriophage - Lytic and Lysogenic cycles. Definitions - Lysogen, Prophage,

Temperate phage, Viroids, Virusoids, Satellite RNAs, Prions. Morphology and distinctive properties of phages - T4, Lambda, M13 and PI. Bacteriophage typing and its applications. Comparison of multiplication of bacteriophages and animal viruses. Grouping of animal viruses based on Baltimore system of classification

UNIT – V

Clinical virology - Epidemiology, life cycle, pathogenicity, diagnosis, prevention and treatment of human viral infections caused by animal viruses - Pox virus, Parvo virus, Reo virus, Retro virus, Hepadna virus. Zoonotic viral infections - Rabbies, Yellow fever, Pappataci fever. Newly emerging viral diseases in Asia - SARS, Swine Flu, Hepatitis-C, Dengue fever, Chicken kunya, Zika virus, Nipah virus. Cultivation of viruses.

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CORE - VI: BIORESOURCE TECHNOLOGY (18MBC06)

Course Objectives

The aim of Bioresource Technology course is to know current bio-resources and their exploitations on the production of microbial products. The content of the precise course include nature of the bio-resources, industrially important microorganisms, up and down stream process, functions of the fermentors, primary and secondary metabolites and production of recombinant products. It also covers production of steroids, sterols and non-steroid compounds through microbial transformations.

Course Outcome

1. By the end of the course, the students will be able to know about the nature and current status of the bio-resources.
2. The students will clearly get in-depth information about utilization of natural resources on the production of microbial products like enzymes, organic acids, antibiotic, vitamins, alcoholic beverages, steroid and non-steroid components.
3. The course will provide in-depth theoretical knowledge on exploitation of natural resources.
4. The course will also provide meticulous ideas on different types of fermentors and their functions.
5. After the study, the course contents will give several opportunities for the students to develop bio-entrepreneur for the production of microbial products by utilizing natural wastes.

UNIT - I

Bioresource technology - Introduction - Biomass, Biological wastes from domestic, agriculture and industries. Biological waste treatment, Bioenergy – Biofuels-Production of Biofuels, Acetone-butanol production, Biotransformations and bioresource systems analysis. Bioproducts: Biocatalysis and fermentations.

UNIT - II

Bioprocess technology - Fermentation process - The range of fermentation process -Chronological development –Component parts of a fermentation process - Fermentation economics. Industrially important microorganisms - Isolation, preservation and improvement of strains -Handling, media for industrial fermentation -Formulation and sterilization, development of inoculum for various upstream process.

UNIT - III

Fermentor types and design –Parts of a fermentor, body construction, heat production - gas liquid exchange - mass transfer - heat transfer - oxygen transfer -

stirring and mixing. Scale up and scale down fermentation process. Control of temperature, pH, form pressure - Sterilization of bioreactors and nutrients. Computer application in fermentation technology.Fermentation types –Submerged, solid state, batch and continuous fermentation.

UNIT - IV

Downstream processing - Recovery of intracellular and extra cellular products - Biomass separation by centrifugation, filtration, chemical and Electro flocculation. Cell disintegration - physical, chemical and enzymatic methods. Extraction - solvent, two phase, liquid extraction, whole broth, aqueous multiphase extraction. Purification by different methods, Concentration by precipitation, ultrafiltration, reverse osmosis. Drying and crystallization.

UNIT - V

Microbial Products - Organic acids - Amino acids, Antibiotics, Enzymes, Vitamins, Alcoholic beverages - wine and beer, Fermented foods - bread, cheese and soy sauce. Recombinant Products - insulin, interferon and growth hormone, Fermentation products from natural wastes - molasses, starch wastes and cellulosic wastes. Microbial transformations - steroids and sterols. Non-steroid compounds –Antibiotics.

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PRACTICAL - III

PRACTICAL EXAM: 7 HRS / DAY: 2 CONSECUTIVE DAYS

CORE PRACTICAL - III: MEDICAL MICROBIOLOGY (18MBCP03)

Course Objectives

The course contents are designed to gain adequate hand on knowledge and acquire adequate skill to identifybacteria, fungi and parasites from clinical samples,cultivate viruses in embryonated eggs and identify the various pathogenic bacteria, fungi and parasites based on morphology, cultural and biochemical characteristics.

Course Outcome

At the end of the course, learners will be able to:

1. Gain knowledge on identification of bacteria and parasites from clinical specimens.
2. Analyze the clinical specimensandunderstand the different methods to cultivate fungi.
3. Understand the methods to collect and transport of clinical specimens.
4. Gain knowledge on examination of parasites from clinical specimens.
5. Understand the various methods to cultivate viruses

List of Experiments

1. Collection and transport of clinical specimens for microbiological examinations.
2. Cultivation of Microbes- Basal, Differential and Selective media.
3. Isolation and identification of bacterial pathogens from clinical specimens viz. Throat swab, pus, urine, sputum and stool.
4. Antimicrobial sensitivity testing by disc-diffusion technique and determination of MIC.
5. Examination of parasites in clinical specimens- Floatation and sedimentation techniques of stool examination.
6. Blood smear examination for malarial parasites.
7. Cultivation and Identification of fungi by Lactophenol cotton blue (LPCB) mount of *Mucor, Rhizopus, Aspergillus, Penicillium, Fusarium, Curvularia, Bipolaris*&*Trichophyton*).
8. Identification of Non sporulating fungi- Slide culture method, Cornmeal/Tapwater agar.
9. Identification of *Candida* species- Germ tube method,Sugar assimilation/ fermentation test, species differentiation on Hichrome agar.

10. Isolation and characterization of bacteriophage from natural sources.
11. Animal tissue culture – Egg inoculation methods of virus.
12. Spotters of viral inclusions.

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PRACTICAL - IV

PRACTICAL EXAM: 7 HRS / DAY: 2 CONSECUTIVE DAYS

CORE PRACTICAL - IV: INDUSTRIAL MICROBIOLOGY (18MBCP04)

Course Objectives

The aim of this course is to know various methods adopting to isolate, screen the industrially important microorganism and apply for the production of microbial products like enzyme, antibiotic, alcohol and biosurfactants. It also covers purification and characterization of the products by appropriate methods.

Course Outcome

1. By the end of the course, the students will able to know about the techniques to isolate and screen the significant microorganisms capable to produce products.
2. The course will provide meticulous ideas for the production of ethanol from natural and industrial wastes.
3. The course will also provide in-depth knowledge and ideas for the production of biosurfactant and its characterization.
4. From this course, the students will get an idea to isolate and characterize the microbial products for further applications.
5. After the study, the course contents will give several opportunities for the students to develop bio-entrepreneur for the production of microbial products by utilizing natural wastes.

List of Experiments

1. Screening of antibiotic producing microorganisms from soil.
2. Screening of enzyme producing organisms (e.g. Amylase and Cellulase).
3. Production of industrially important enzymes by Submerged fermentation (Any one enzyme).
4. Production of industrially important enzymes by solid state fermentation (Any one enzyme).
5. Assay of extracellular enzymes produced by bacteria: a) Amylase, b) Protease and c) Lipase.
6. Purification of enzymes by filtration method/chemical method by ammonium sulphate.
7. Production of wine.

8. Production of alcohol from agricultural wastes (sugarcane molasses and beetroot).
9. Characterization of alcohol: Nutritive value, Colour, Haze, Viscosity, foam Characteristics, gurting flavor
10. Microbial production of citric acid by using *Aspergillus*.
11. Production of extracellular metabolites from actinomycetes.
12. Production and extraction of biosurfactant.
13. Quantification and characterization of biosurfactant.
14. Synthesis and separation of bioactive compounds - TLC or Column Chromatography.
15. Immobilization of cells and enzymes.
16. Antibiotic sensitivity test: a) Kirby Bauer's method and b) MIC determination by filter paper assay and broth dilution assay.
17. Biofuel Production- Alcohol & Hydrogen

References

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CORE - VII: MOLECULAR BIOLOGY AND APPLIED BIOTECHNOLOGY (18MBC07)

Course Objectives

1. To import the knowledge on structure of gene, genome organization and functions of genetic materials.
2. To focus on, transcription, translation, mutation and DNA repair in microbial system.
3. To teach protein synthesis and translation modification process
4. To give a better understanding of the cloning and expression of foreign genes in the bacterial system.
5. To produce genetically modified organisms for various applications

Outcome of the course

1. End of the course, learners will understand structure of gene, genome organization and functions of genetic materials.
2. Students will have deeper understanding on the transcription, translation, mutation and DNA repair
3. Learners will have better understanding on protein synthesis and translation modification process
4. Students will have thorough knowledge on cloning and expression of foreign genes
5. Students will be able to produce genetically modified organisms.

UNIT - I

Structure, types and functions of DNA, RNA and peptide nucleic acid (PNA), Replication methods: Requirement for DNA replications and post replication event. Inhibition of DNA replication. DNA damage and repair mechanisms. Inhibitors of replication. Mutagens: Types, Physical and chemical mutagens. Gene transfer in bacteria - transformation - conjugation - transduction.

UNIT - II

Transcription: Types and functions of RNA polymerases, Various factors involved in transcription process - Initiation, elongation and termination. Regulatory elements of transcription. Inhibitors of Transcription. Operon models - *lac, trp, ara* operons.

UNIT - III

Protein synthesis: Steps in translation process - Details of initiation, elongation and termination. Post translation modifications, Inhibitors of Protein synthesis. Elucidation of genetic code - Wobble hypothesis.

UNIT - IV

Principles of recombinant DNA technology, Gene cloning in bacteria, Construction of genomic and cDNA libraries, Transposons. Screening of recombinants - Phenotypic expression of characters - Hybridization techniques. DNA sequencing methods - strategies for genome sequencing.

UNIT -V

Applications of recombinant DNA technology – enzymes, vectors, plasmids and cosmids, and Bacmids. Production of recombinant products like insulin, interferon, tissue plasminogen activator, subunit vaccines. Genetically modified organisms (GMO's). Gene silencing - Gene knockouts and gene therapies, antisense technologies. Genetic engineering of plants for viruses, herbicide tolerance.

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1. Thomas D. Borck (1990). The emergence of bacterial genetics. Cold Spring Harbor Laboratory, USA
2. David Freifelder (2001). Microbial Genetics. Narosa Publishing House, New Delhi Larry Snyder and Wendy Champness (2002). Molecular Genetics of Bacteria. ASM press, USA.
3. Benjamin Lewin (2000). Genes VII. Oxford Univ. Press.
4. Principles of gene manipulation – An introduction to genetic engineering. R.W. Old& S.B. Primrose
5. Genomics – Construction of BAC, YAC libraries – *E. coli* genome – MIcroarray – Preparation and Application - Analysis of transcripts – Gene expression; Agricultural, industrial and medical applications of cloning technology.
6. Winnaker, EL 1987. From Genes to Clones : Introduction to Gene Technology. VCH Publications, Federal Republic Germany.
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CORE - VIII: BIONANOTECHNOLOGY AND INFECTOMICS (18MBC08)

Course Objective

The objective of this course is to provide an insight into the fundamentals of Nanoscience and Nanotechnology. Further this course also deals with the understanding between pathogens and their hosts.

Course Outcome

1. To acquire the knowledge of basic science required to understand the fundamentals of nanoscience
2. To get familiarize with the basic concepts characterization of nanoparticles.
3. To realize the biomedical applications of nanoscience
4. To obtain a sound understanding in genomics and proteomics
5. To understand the high throughput omic approaches

UNIT - I

The Journey and History of biotechnology to nanotechnology. Opportunities, challenges, definition and principles of nanoscience and nanotechnology. Types of nano-biomaterials. Generation of biomaterials. Top down and bottom up approaches - Physical, Chemical and Microbial synthesis of nanomaterials - Silver, Gold, Titania, Carbon nanotubes, polymer nanocomposites etc.

UNIT - II

Characterization Techniques for Nanoparticles: Particle size analyser - X-ray diffraction (XRD) - Fourier transformer infrared spectroscopy (FTIR), Field Emission Scanning Electron Microscopy (FESEM)-High Resolution Transmission Electron Microscope (HRTEM) - Atomic force Microsopy (AFM)- Surface enhanced Raman spectroscopy (SERS) - X - ray Photoelectron Spectroscopy (XPS) - Auger electron spectroscopy (AES). *In vitro* and *In vivo* analysis of nanoparticles.

UNIT - III

Nanoscience in biomedical application: Nanosensors in diagnosis - Nanorobotics in surgery Nanotechnology in tissue regeneration - Nanotechnology durg targeted delivery. Nanotechnology in Food industry - Nanoscience in agriculture: fertilizers and pesticides. Nanoscience for water treatment and fermentation process. Nanotechnology in textiles and Cosmetics - Nanotechnology in energy conversion - Nanocatalysts - Nanotoxicology - Risks and Ethics. Future of nanobiotechnology.

UNIT - IV

Genomics: Introduction and concepts of microbial genomics. Methods of gene sequencing. Genome prediction. Types of genomics - Structural, functional, comparative and environmental genomics. SNPs, RAPD, RFLP. DNA microarray - Types and applications. Genomic databases, Future of genomics. Proteomics: Introduction and basic principles of proteomics. Relation between gene and protein. Approaches for study of proteomics. Types of proteomics - Expression proteomics, structural proteomics and functional proteomics. Protein sequences databases - SWISS-PROT, PDB, etc. Human Genome Project.

UNIT - V

Infectomics: Introduction and definitions of Infectomics. Infectomes. Genomics and proteomics of microbial infections - Structural and functional strategies. Types of infectomics - ecological, immuno and chemical infectomics. DNA and protein microarrays, cloning, PCR, gene knockout and knockin, antisense strategies. Pharmacomes - definition and functions. Future of Infectomics.

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CORE - IX: FOOD, SOIL AND ENVIRONMENTAL MICROBIOLOGY (18MBC09)

Course Objectives

This course aims to communicate the students with basic principles of microbiology and their applications to soil, food, dairy and environment. It also prepares the student to address pressing environmental challenges by developing a fundamental understanding of the microbial communities and processes in natural and built environments. It lays and builds upon the foundation of basic microbiology, microbial energetics and diversity to applying the tools provided by microbiology ranging from traditional to state of art for addressing relevant environmental concerns. It provides an in depth exploration of the diverse role of microbes and microbial communities in each sector.

Course Outcome

1. By the end of the course, the students will be able to know about the significance of the microbes in soil, food, dairy and environment.
2. The students will clearly get in-depth information about the harmful effects and beneficial role of microbes in each sector.
3. This course provides in depth knowledge on water and waste water treatment to tackle the current environmental problems.
4. The course will also provide meticulous thoughts on the task of microbes in waste water treatment and solid waste management.
5. After the study, the course contents will give several opportunities for the students to develop as a researcher in food, dairy, agriculture and conservation sectors.

UNIT - I

Food microbiology: Food as a substrate for microorganisms. Sources of contamination of microorganisms in foods, Factors influencing microbial growth in foods. Food borne diseases. Spoilage of fruits, vegetables, meat, poultry, fish and seafoods. Methods of food preservation: Traditional, physical and chemical methods. Applications of food microbiology: Beneficial uses of microorganisms in food, Intestinal beneficial bacteria, Probiotics, Prebiotics – Definition, functional foods, types, importance and economic values, Recombinant foods, Biosensors in food industry.

UNIT - II

Dairy microbiology: Microflora of milk and milk products, Fermented milk and milk products: Sauerkraut, Buttermilk, Cream, Yogurt, Cheese, Kafir and

kumiss. Microbes involved in fermentation: Starter lactic acid cultures. Spoilage of milk and milk products, Milk borne diseases, Milk quality testing. Preservation of milk and milk products. Sanitation of dairy processing plant, food control agencies and their regulations.

UNIT - III

Soil microbiology: Distribution of microorganisms in soil, Factors influencing the soil microflora, Biogeochemical cycles: Carbon, Nitrogen, Phosphorus and Sulfur, Interactions among microorganisms: Mutualism, commensalism, ammensalism, synergism, parasitism, predation and competition. Interaction of microbes with plants: Rhizosphere, phyllosphere, mycorrhizae. Nitrogen fixation: Symbiotic and asymbiotic. Soil reclamation.

UNIT - IV

Microbiology of air and water: Composition of air, Number and types of microorganisms in air, Distribution and sources of air borne organisms, Aerosol, Airborne diseases, Assessment of air borne microbes, Air sanitation - Physical and chemical methods. Microbiology of water: Physico-chemical properties of water, Microbial assessment of water. Aquatic micro flora and fauna of lake, ponds, river, estuary, mangrove and sea. Extremophiles – Thermophiles, mesophiles, psychrophiles, Deep sea, Desert, Acidophilic, Alkalophilic and Halophilic microorganisms. Impact of environmental factors on the aquatic biota.

UNIT - V

Environmental Microbiology: Microbes and environment, Classification of wastes. Waste treatment - Types and characterization of solid and liquid wastes. Treatment of solid wastes - composting, vermiform composting, silage, pyrolysis and saccharifications. Treatment of liquid wastes - Primary, secondary (anaerobic and aerobic) - trickling, activated sludge, oxidation pond and oxidation ditch-tertiary - disinfection. Xenobiotic compounds and their degradation: Crude oil, hydrocarbon, pesticides and heavy metals. Bioaccumulation of heavy metals, Biofouling, Bioleaching and Bioremediation. Bioluminescence and microbes. Biodegradation of natural substances - Cellulose, xylan, hemicellulose, starch, fructose, mannan, pectin and lignin.

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PRACTICAL - V

PRACTICAL EXAM: 7 HRS / DAY: 2 CONSECUTIVE DAYS

CORE PRACTICAL - V: MOLECULAR BIOLOGY AND BIOTECHNOLOGY (18MBCP06)

Course Objectives

The contents for above practicals are designed to impart hand on experimental knowledge on the various techniques in molecular biology and biotechnological experiments. This would enable them to design experiment for the production of recombinant products using above molecular techniques.

Coarse Outcome

At the end of the course, learners will be able to

1. Isolate plasmid, chromosomal DNA from the bacteria.
2. Became skillful in the inserting foreign DNA in to various vectors and transform.
3. Express foreign DNA in *E.coli* and other system.
4. Evaluate the presence of recombinant DNA in the different host used in the cloing
5. Isolate mutants from normal organisms.

List of Experiments

1. Isolation and quantification of DNA and RNA
2. Isolation of plasmid DNA from bacteria
3. Restriction digestion of plasmid
4. Determination of molecular weight of DNA
5. Cloning of fragment in plasmid
6. Preparation of competent *E.coli* cells
7. Transformation of plasmid DNA to the E.coli cells
8. Screening for transformants - Blue white selection
9. PCR amplification of DNA fragment
10. Screening for recombinant proteins by SDS - PAGE
11. Screening by TLC
12. Isolation of auxotrophic mutants
13. Isolation of antibiotic resistant bacteria.

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PRACTICAL - VI

PRACTICAL EXAM: 7 HRS / DAY: 2 CONSECUTIVE DAYS

CORE PRACTICAL - VI: APPLIED MICROBIOLOGY (18MBCP06)

Course Objectives

This course is designed to prepare the students for sensible knowledge in a wide range of profession. This paper providesthe scientific discipline that deals with the application of microorganisms and the knowledge about them. Applications include microbial biotechnology, agriculture, food microbiology and bioremediation.It also covers significant experiments linked with soil, food, dairy and environment.

Course Outcome

6. By the end of the course, the students will able to know about the techniques to isolate and assess the harmful microorganisms in food, milk and milk products..
7. The course will also provide meticulous ideas for the enumeration of air and water borne microorganisms.
8. From this course, the students will get an idea to isolate and characterize the microbes in extreme environmental conditions.
9. After the study, the course contents will give several practical knowledge opportunities for the students.

List of Experiments

1. Detection of number of bacteria in milk by breed count.
2. Determination of quality of milk sample by methylene blue reductase test and resazurin method.
3. Detection of number of bacteria in milk by standard plate count.
4. Isolation of yeast and molds from spoiled nuts, fruits and vegetables.
5. Bacteriological examination of specific food (a) Curd (b) Raw meat (c) Fish (d) Ice cream.
6. Isolation and enumeration of soil microorganisms (bacteria, fungi and actinomycetes).
7. Isolation of phosphate solubilizers from fertile soil.
8. Isolation of nitrogen fixers (a) *Rhizobium* from root nodule and (b) *Azotobacter* from rhizosphere.
9. Evaluation of root nodule by cross section of legume roots.
10. Screening of antagonistic bacteria in soil by agar block overlay method.
11. Isolation of plant pathogens - Study of the following diseases: Tobacco mosaic, Bacterial blight of paddy, Red root of sugarcane, Citrus cancer,

Downy mildew of bajra, Powdery mildow of cucurbits, Head smut of sorghum, Leaf rust of coffee, Leaf spot of mulberry, Red rot of sugarcane, Root knot of mulberry.

12. Physical, chemical and microbial assessment of water and potability test for water. Colour, pH, alkalinity, acidity, COD, BOD, TS, TDS and TSS.
13. Microbiological assessment - MPN index presumptive, confirmatory and completed tests.
14. Quantification of microorganisms in air: Open plate, liquid impingement techniques and through air sampler.
15. Isolation of dye degrading microbes from soil samples.
16. Screening of nitrate reducers using aqueous potassium nitrate broth.
17. Bacterial reduction of nitrate from ground waters.
18. Bacterial reduction of hexavalent chromium in aqueous medium.

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CORE X: RESEARCH METHODOLOGY AND COMPUTATIONAL BIOLOGY (18MBC10)

Course Objectives

The coarse contents are designed to gain a general insight in to the research aspects of microbiology with a basic understanding in to the handling and working of instruments; use of biostatics tools in research and application of bioinformatics to problem solving in real research problems

Coarse Outcome

At the end of the course, learners will be able to

1. Know the basic aspects of research to frame a research problem, analyse the various methods used in research and to write a research report.
2. Know the various measurements used in calculations of buffers and understand the basic instruments used in laboratory.
3. Learn the principles, working and uses of sophisticated instruments and their usage in research.
4. Know the various biostatical formula used in the interpretation of experimental data to analyze the results statistically.
5. Learn and apply the various bioinformatics tools to perform sequence-based searches, and analyze the results using bioinformatics software's.

UNIT - I

Research Methodology **-** Meaning and importance. Review of literature - Review and synopsis presentation. Types of Research and research tools, Research designs - Experimental and non-experimental. Preparation of research report. Guidelines for preparing an article - ISSN, ISBN, impact factor, citation index, h-index, I- index, Google scholar, Scopus, Thomson& Reuters, Web of Science. Plagarism and Antiplagarism software, Computational- RSM.

UNIT - II

Units of measurements (Mole, equivalents - Molarity-Molality and normality), Cleaning of laboratory glassware's. Laboratory Instruments - Balances - Centrifuges - Water Bath - Incubator - Colorimeter (Photometer). Bioinstrumentation - Principles and applications of pH meter, Centrifuge, UV-Vis spectrophotometer.

UNIT - III

Bioinstrumentation- Chromatographic Technique- Principles, types and applications of Chromatography -Thin layer chromatography(TLC), Gas Liquid Chromatography (GLC) ,High pressure liquid chromatography (HPLC),Fast performance liquid chromatography (FPLC), Gas chromatography - Mass

spectrometry (GC-MS). Compound Microscope- Transmission Electron Microscope (TEM) and Scanning Electron microscope (SEM)- Principles, Procedure and Specimen preparation, Fluorescent Microscope.

UNIT – IV

Biostatistics **-** Introduction - Basic concepts, Sampling and data collection, Data presentation, Descriptive Statistics - Measures of central tendency and Measures of dispersion, Population parameters, sample estimates and confidence intervals. Basic concepts of probability. Probability distributions, Z-scores, Student's t- test, Chi square test, Correlation, regression, ANOVA,

UNIT - V

Biological databases- Database searching, Sequence analysis, Pair alignment, Visualizing protein structures, Predicting structure and function of protein using sequences, computer based drug designing. Submission of nucteotides in NCBI-FASTA, Construction of phylogenetic tree. SPSS software- Genomics and Proteomics- identification softwares.

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ELECTIVE COURSES

ELECTIVE PAPER - 1: BIOCONTROL AND ENTOMOLOGY

Course Objectives

The aim of Biocontrol and Entomology course is to introduce necessary and application relevance of biofertilizers and biocontrol agents for the students who are in more attentiveness in the development of sustainable agriculture. The content of rigorous course includes significance of microbial lbiofertilizers namely, bacteria, fungi, cyanobacteria and actinorhiza. It also covers various methods applications of biocontrol agents and biomanures for the current agriculture.

Course Outcome

1. By the end of the course, the students will be able to know about the importance and applications of the biofertilizers for the sustainable agriculture.
2. The students will clearly learn in-depth knowledge in order to foster biofertilizers to overcome the applications of chemical fertilizers in the modern farming's.
3. The course will also provide opportunities for the students to develop bio-entrepreneur for the production of bioferilizers.
4. The students will clearly get in-depth information about exploitation of natural wastes by producing bioorganic fertilizers.
5. The students will gain meticulous ideas on production of biopesticides as biocontrol agents

UNIT - I

History, importance and present status of different types of fertilizers and their application to crop plants. Importance of macro and micro nutrients - Nutritional deficiency in plants. Biological fixation of nitrogen. CyanobacterialBiofertilizers: *Nostoc*, *Anabaena*, *Gloeocapsa* and *Scytonema*. Symbiotic association with *Azolla*, Lichens, Bryophytes and Higher plants. Bacterial biofertilizers: Free living forms - *Azatobacter*, *Azospirillum*. Symbiotic forms: Rhizobium-Legume association. Isolation and screening and mass production of bacterial biofertilizers.

UNIT - II

Fungal biofertilizers: Types of fungal biofertilizers - Ecto, endo and ect-endomycorrhiza, Ectomycorrhizal association with pines, Arbuscularmycorrizal association (AM) *Glomusspp.*,Nutrient uptake and exchange.Isolation and field enrichment of mycorrhiza. Actinomycetes as biofertilizers: History and biology of actinorhiza, Actinorhizal associations in higher plants, *Frankia spp*.

UNIT - III

Biomanures technology: A general account of manures - Moulds, Composts Farm yard manure, Oil seed cakes - Castor and neem, Green leaf manures -

Gyricidia, Sesbania and Crotalaria, Agro-industrial wastes - Poultry manure and saw-dust, Vermi Compost, Microbial compost - pure culture and consortium as an inoculums. Application of biofertilizers and manures - A combination of biofertilizer and manure applications with reference to soil, seed and leaf sprays.

UNIT - IV

History, principles and scope of biological control. Important groups of parasitoids, predators and pathogens. Principles of classical biological control-importation, augmentation and conservation. Biology, adaptation, host seeking behaviour of predatory and parasitic groups of insects. Role of insect Entomopathogenic nematodes, viruses, bacteria, fungi and protozoa in biocontrol and their mode of action.

UNIT - V

Biocontrol agents: Definition and importance of biological pests and bio-pesticides in agriculture. Brief conception of Integrated Pest Management (IPM), Integrated Pest and Disease Management (IDPM). Biopesticides - Advantages of bio-pesticides over chemical pesticides, Types of bio-pesticides, *Bacillus thuringiensis* and its importance. Mass production of quality biocontrol agents - techniques, formulations, economics, field release/application and evaluation.

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ELECTIVE PAPER - 2: ENTREPRENEURSHIP IN MICROBIOLOGY

Course Objectives

Entrepreneurship in Microbiology course is to make the student understand the importance of entrepreneurship. It is also designed to make the students develop new products and processes from microbes. The course is intended to train the students in market analysis, financial management, process development and other skills required to become a successful entrepreneur.

Course Outcome

1. The students will be able to know about the importance, need of entrepreneurship for socio-economic gains
2. The students will gain knowledge on the schemes of the government and will be able to understand the ways of fund generation
3. The course will also provide opportunities for the students to develop the necessary skills to become a successful entrepreneur
4. The students will understand the importance of process development for successful entrepreneurship.
5. The students will gain skills for developing commercial products from microbes.

UNIT - I

Evolution of the concept of entrepreneur - Entrepreneurship: Definitions - concept of Entrepreneurship, development - need - role of resource, talent and spirit - process of Entrepreneurship to socio-economic gains.

UNIT - II

Institutions and schemes of government of India - Schemes and programmes, Department of science and technology schemes, Nationalized banks - other financial institutions etc - SIDBI - NSIC - NABARD - IDBI - IFCI - ICICI etc.

UNIT - III

Skills for entrepreneurs - communication skills, problem solving skills. Business plan development. Market need - market research, SWOT analysis, identify your competition. Financial plan - obtain financing for your business, insure your business, Marketing - mix - product, distribution, price, promotion, and set marketing goals.

UNIT - IV

Successful entrepreneur - Steps, Characteristics. Entrepreneurship opportunities - Composting from domestic waste, agricultural and industrial waste. Vermicomposting - SCP production - Mushroom cultivation.

UNIT - V

Biofertilizers and biopesticides. Production of teaching kits (plasmid DNA isolation, serum electrophoresis) and diagnostic kits (WIDAL test kits, ABO blood grouping kits)

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ELECTIVE PAPER - 3: ALGAL BIOTECHNOLOGY

Course Objectives

Algal Biotechnology course is to make the student understand the potential of algae and its applications in various fields. The course intends a thorough understanding of the classification and cultivation of algae. The students will also be able to understand the biotechnological potentials of algae at the end of the course.

Course Outcome

1. The students will be able gain knowledge in the structure, classification and characteristics of algae
2. The students will gain knowledge on various cultivation methods adopted for algae
3. The course will also give insights on optimization of culture methods for effective production of algal products
4. The course will train the students for developing new commercial products from algae

UNIT - I

Classification, structure, reproduction and other characteristics of algal divisions, Distribution of algae, Characteristics of- blue green algae, dinoflagellates, Microalgae, thallus organization. Characteristics of various micro and macro algal morphology, Salient features of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta. Algal blooms.

UNIT - II

Algal production systems: Isolation method, Screening methods, Plating methods, Strain selection, Algal growth curve, Culture media, Measurement of algal growth. Nutritional requirements, reproduction, evaporation and uniform dispersal of nutrients, Harvesting of algae, drying methods.

UNIT - III

Estimation studies: Lipid, protein, carbohydrates, chlorophyll, biomass, medium selection, optimization of medium, pH, temperature, light sources, CO_2 supplements. Types of bioreactors. Extraction methods - lipid, pigments, Carbohydrate.

UNIT - IV

Commercial utility of algae: Algae as a source of food and pigments. Role of algae in agriculture **-** Blue-green algal bio-fertilizer: Method of preparation, application and its advantages over inorganic fertilizers bio-fertilizers. Liquid seaweed fertilizer: Method of preparation and application, algae for pollution control and other novel applications.

UNIT - V

Biotechnological approaches for production of important algae, pigments, biofuels, hydrogen production, important bioactive molecule. Aqua, cattle feed and bio-fertilizer conversion methods. Biodiesel separation and conversion methods, Transesterfication methods.

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3. https:// www.northinlet.sc.edu/training/media/2012/.../Science-of-Algae.pdf
4. https:// www.dbs.nus.edu.sg/biofuel2012/.../22%20Borowitzka%20(ok).pdf
5. https:// www.enlightened-designs.com/growing_algae.html
6. https:// www.iimsam.org/images/growthtech.pdf
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8. https:// www.jpsr.pharmainfo.in/Documents/Volumes/.../jpsr06011408.pdf

9. https:// www.biomara.org/schools/Lesson%205%20-%20uses%20of%20algae.pdf
10. https:// www.uni-bielefeld.de/biologie/Zellbiologie/publik/paper/2007tpj.pdf

ELECTIVE PAPER - 4: QUALITY CONTROL IN INDUSTRIES

Course Objectives

The main objective of this course is to make the learner a potential candidate for Quality control and Quality assurance in pharmaceutical, food and other biotechnology industries.

Course Outcome

1. The students will be able to understand the importance of GLP and GMP in biotechnology industries
2. The students will gain knowledge on the production of sterile medicinal products in pharmaceutical industries
3. The course will equip the students on the various methods of quality control and quality assurance that are followed in pharmaceutical industries.
4. The course will train the students in quality control and quality audits in bio industries

UNIT - I

Introduction to laboratory safety: Good Laboratory Practice (GLP), Personal hygiene practice, regulatory agencies, safety of working lab, emergency response. Handling of hazardous materials, Operational qualification and performance Qualification of facilities. Applications of computers in quality control laboratory

UNIT - II

Quality control in food industries: Quality of raw materials, finished product Release: Food quality evaluation - nutritional, functional, microbial, shelf life and physicochemical analysis. Rapid test for food quality and safety, Quality review, Quality audits, Batch release, Document warehousing - Good ware housing practices materials management.

UNIT - III

Quality control in pharmaceutical industries: Qualitative and quantitative analysis of tablets, capsules, ointments, suppositories, creams, modified release products (controlled release, sustained release products and etc), parenteral, ophthalmic and surgical products. WHO guidelines for impurity and related substances in the drugs. Quality management in the pharmaceutical industry.

UNIT - IV

Quality control in clinical laboratories: Role of laboratory in human health and diseases, Designing of laboratory sections, Anticipating demand and ensuring availability of adequate medical and diagnostic supplies (Contents of all diagnostic and medical kits), Internal and external quality control programmes. Universal safety precautions

UNIT - V

Laboratory and industrial calculations: Abbreviations and terms used in the industries, The international system of units, Unit conversion between SI and US, common laboratory calculations - Units of measures (Mole, equivalents and normality) dilutions and percentages; Volume calculations. Using Microsoft Excel's graphing utility.

References

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4. Henry D. Isenberg (2007) *Clinical Microbiology Procedure Handbook*. 2nd edition, Vol. 1 ASM press, Washington, DC 20036-2904.
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6. Quality Assurance of Pharmaceuticals - *A compendium of guidelines and related materials*, Vol. I-WHO Publications.
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8. Burn, Finiey and Godwin (1996) *Biological Standardization*, 2nd Edition, Oxford University Press, London.
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3. http://apps.who.int/prequal/info_applicants/guidelines/qa_pharmaceuticals-vol2.pdf
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ELECTIVE PAPER – 5: INTELLECTUAL PROPERTY RIGHTS (IPR), BIO-SAFETY AND BIOETHICS (18MBCE02)

Course Objectives

This part of the curriculum helps students to have an ability to understand and conduct research to meet desired needs within the legal, social, ethical, safety & sustainability aspects in biology and the biocontainment.

Course Outcome

Students can know rules on how to protect patents, copyrights, trademarks, and other forms of IPRs have become a standard component of international trade agreements. He / she may become patent attorney, who has the specialized qualifications necessary for representing clients in obtaining patents and acting in all matters and procedures relating to patent law and practice, such as filing an opposition. So to become such expert in that patent and IPR, in addition to PG degree, Diploma in Law may be necessary.

UNIT - I

Introduction to Intellectual Property: IPR - Definition - Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Plant varieties, Trade Secrets, Geographical Indications, IP as a factor in R&D; IPs of relevance to Microbiology / Biotechnology and few Case Studies.WTO - Definition - Functions - Forms of IPR Protection.

UNIT - II

Agreements and Treaties: History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments. Paris Convention.

UNIT - III

Basics of Patents and Concept of Prior Art: Introduction to Patents; Concept related to patents novelty, non-obviousness, utility, anticipation, etc. Types of patent applications: Ordinary, Patent Co-operation treaty (PCT), Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees Invention in context of "prior art"; Patent databases; Searching InternationalpatentDatabases; Country-wise patent searches (USPTO, esp@cenet (EPO), Patents scope (WIPO), IPO, EPO, etc.).National & Patent Cooperation treaty(PCT) filing procedure; Time frame and cost; Status of the patent applications filed; Revocation of patent, Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting - introduction to existing schemes Patent licensing and agreement Patent infringement- meaning, scope, litigation, case studies – Neem, Turmeric and Pasmati rice , Commercialization and Licensing.

UNIT - IV

Biosafety: Introduction: Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Biosafety guidelines and regulations (International); Biosafety guidelines –National ; Definition of GMOs & LMOs; Bioresponse of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Biosafety in relation to transgenic research and applications. Biopiracy.

UNIT - V

Bioethics: Definition - Ethical implications of cloning: Reproductive cloning, therapeutic cloning; Ethical, legal and socioeconomic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research. Animal ethics - Norms in India - Licensing of animal house - Ethical clearance norms for conducting studies on human subjects. Ethical implications of human genome project. Bioethics committees – IAEC, CPCSEA, OECD, etc.

References

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2. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, ManupatraInformation Solution Pvt. Ltd., 2007.
3. Gurumani, N. Research Methodology,; For Biological Sciences . MJP Publishers,Chennai 2006.
4. Jose B. Cibelli, Robert P. Lanza, Keith H. S. Campbell, Michael D.West. 2002.Principles of Cloning, Academic Press, SanDiego, Gurdon.
5. Senthil Kumar Sadhasivam and Mohammed, Jaabir. 2008. IPR, Biosafety and Biotechnology Management. Jasen Publications, India.
6. Singh K. Intellectual Property Rights on Biotechnology, BCIL, and Newdelhi-1993.

7. Shaleesha A. Stanley, Bioethics, Wisdom educational service-2010

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2. http://www.wipo.int/portal/index.html.en
3. http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
4. www.patentoffice.nic.in
5. www.iprlawindia.org/
6. http://www.cbd.int/biosafety/background.shtml
7. http://www.cdc.gov/OD/ohs/symp5/jyrtext.htm
8. http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section3.html

SUPPORTIVE COURSES

SUPPORTIVE-I: MEDICAL LABORATORY TECHNOLOGY

Course Objectives

The course contents are designed to gain a general insight in to the basic aspects of medical laboratory, measurements, equipment's used, the various microbiological and biochemical procedures and the safety aspects in a Medical laboratory.

Course Outcome

At the end of the course, learners will be able to:

1. Learn the handling of instruments and various measurements used in the laboratory.
2. Learn about the basics of laboratory techniques its significance in diagnostic evaluation.
3. Identify and differentiate the different types of bacteria and fungi in clinical samples.
4. Learn the differential diagnosis by the help of different serological techniques.
5. Learn the various methods used in Sterilization.

UNIT - I

General Laboratory Techniques and procedures: Chemicals and related substance, concept of solute and solvent, buffer solutions and their actions, safety measures in a Laboratory. Cleaning of glassware's. Laboratory instruments - Balance - Centrifuge - Ovens - Water Bath - Incubator – Laminar Airflow-Calorimeter-Working and applications.

UNIT - II

Medical laboratory rules, ethics and professional code of conduct: Rules of medical laboratory - Medical laboratory request form - Maintenance of laboratory records - Delivery of laboratory results. General precautions for avoidance of laboratory accidents. Biomedical wastes – Introduction, categories of waste, standard protocol of waste disposal.

UNIT - III

Methods of Collection, transport and processing of clinical specimens - Blood, Urine, Sputum, CSF, Pus &Faeces for microbiological examination.Types of media- Semi synthetic, Synthetic, Enriched, Selective and Differential media.Staining techniques-Simple and differential- Gram's. Lactophenolcotton blue (LPCB).

UNIT - IV

Hematology - Introduction to hematology, collection of blood sample and anticoagulants, Specimen collection and processing in hematology, haemocytometer and procedure for RBC,WBC, ESR count, haemoglobin estimation, bleeding time, whole blood coagulation time, platelet count, normal values and interpretation

UNIT - V

Biochemical analysis - Urine analysis, physical, chemical, microscopic, routine test viz., sugar, albumin and phosphates, other tests - bile salt, bile pigment, urobilin ketone bodies, chyle, specific gravity, total protein.

References

1. Monica Cheesbrough (2006) *District Laboratory Practice in Tropical Countries Part 1 & 2*, 2nd Edition, Cambridge University Press.
2. Tortora, G.J., Funke, B.R. and Case, C.L. (2016) *Microbiology: An Introduction*, 11th Edition, Pearson Education, India
3. Madigan, T.M., Martinko, M.J., Bender, S.K., Buckley, H.D., Stahl, A.D. and Brock, T. (2017) *Brock Biology of Microorganisms*. 14th Edition, Licensing agency, UK.
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2. http://www.cartercenter.org/health/ephti/learning_materials/lecture_notes/medical_lab_technology_students.html
3. http://apps.who.int/iris/bitstream/10665/37042/1/WHO_OFFSET_21.pdf
4. http://www.sciencedirect.com/science/book/97814831679.

SUPPORTIVE - II: MICROBIOLOGY

Course Objectives

The course contents are designed to gain knowledge about the different forms of bacteria, fungi, algae, protozoan's along with the basic principles of microbial taxonomy. The learner will understand about the microbial metabolism and microbes that are of commercial importance.

Course Outcome

At the end of the course, the learner will be able to

1. Know about the basic aspects of microbiology, different methods of isolation of microorganism, preservation and controlling of microorganism.
2. Know about the basic aspects of microbial taxonomy, classification systems and the life cycle of important class of microorganisms.
3. Know the basis of microbial physiology with its biochemical pathway and the ecology of the microbes with reference to Extreme Ecosystems.
4. Know the commercial importance of microorganisms.

UNIT - I

History and discovery of microorganisms - Microscopical appearance and Staining techniques -. Colony characteristics of different bacteria. Microbial cellular morphology : Cellular structures - Capsule, Cell, Periplasmic space, Spores, Flagella, Cilia, Pili and other cellular inclusions.

UNIT - II

Sterilization and culturing techniques - Types of culture media and their preparation for bacterial cultivation. - Broth tubes, slants, stabs and plate media.

Pure culture techniques. Anaerobic culturing techniques. Maintenance and preservation techniques

UNIT - III

Microbial physiology - Aerobic and anaerobic respiration in microbes. Biochemical test characteristics - carbohydrate fermentation, IMVIC tests, starch hydrolysis, cellulose, gelatin, casein, catalase test, oxidase test, urease test, nitrate reduction, TSI and antibiogram.

UNIT - IV

Medical microbiology - Epidemiology, pathogenicity, diagnosis and treatments of bacterial diseases - diarrhea, typhoid, cholera, leptospirosis, tuberculosis, Fungal diseases - Athlete's foot, aspergillosis and dermatitis. Parasite diseases - amoebiasis, malaria and taeniasis.

UNIT - V

Microbial biotechnology - Microbial metabolites - Production and use of enzymes, organic solvents, single cell proteins, beverages (beer and wine), baker's yeast and milk products. Production of microbes as biofertilizers and biopesticides. Production of genetically engineered microbial products.

References

1. Prescott, L.M., Harley, J.P. and Klein, D.A. (2003) *Microbiology,* 5th Edition, McGraw Hill, New York.
2. Madian, M.T., Martinko, J.M., Parker, J. and Brock, T.D. (1997) *Biology of Microorganisms, 8th edition*. Prentice Hall International Inc. London.
3. Elizabeth Moore Landecker (1996) *Fundamentals of the Fungi,* 4th edition, Prentice Hall International Inc, London.
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Supportive – III: Health Science Management

Course Objective

The objective of this course is to enhance and develop the knowledge on health care system and policies on health care management

Course Outcome

1. To acquire the knowledge health policy and policy making process
2. To get familiarize with the health care system in India.
3. To understand the health care delivery structure in central and state.

4. To realize the importance of health care reforms
5. To obtain a sound understanding in maintenance of records

UNIT - I

Introduction to health policy - Public health law - Individual rights vs. public interest - Analyzing Policy Options for Health System Improvement, Health policymaking and the policy process – factors influencing the policy.

UNIT - II

Health care system – primary health care institutions, government health scheme, health insurance schemes, private health care system, indigenous systems – Ayureda, Homeopathy and unani

UNIT - III

Health care delivery structure – central level – union ministry of health and family welfare, state, district, village and block levels; State level – ministry of health, state health directorate, district health organisations, Health care system i developing and developed countries.

UNIT - IV

Introduction, Importance and scope of Health care reform - Health care workforce, Understanding the Major Elements of the Patient Protection and Affordable Care Act

UNIT - V

Professionalism: Communication − Maintaining accurate records − Communicating with others. Professional Development Action Plans − Sharing − Self Evaluation and Peer Evaluation.

Reference Books

1. Management of Hospitals: S.L. Goel, R.Kumar
1. Hospital & Health Services administration-Principles & practices, Tabish, OUP
2. Statistical Methods in the Biological & Health Science: J.Susan Milton (McGraw-Hill)
3. An Introduction to Biostatistics, a manual for students in health sciences: P.S.S. Sunder Rao: J. Richard
4. An Introduction to Health Planning for Developing Health Systems, Andrew Green, Third Edition, Oxford university press.

Web sites

1. http://www.oxfordjournals.org/our_journals/heapol/bookrev.html
2. http://onlinelibrary.wiley.com
3. http://www.bmj.com/content/
4. http://www.who.int/topics/health_policy/en/

Supportive – IV: Quality Control in Industries

Course Objective

The objective of this course is to enhance knowledge on quality control management in the various industries.

Course Outcome

1. To acquire the knowledge quality control in pharmaceutical industry
2. To learn the quality control audits in industries.
3. To understand the basics of food safety and food quality.

4. To realize the microbial quality control in hospitals
5. To acquire knowledge on environment monitoring and regulations

UNIT - I

Quality Control in pharmaceutical industry: Basic of pharmaceutical products and their quality control: bulk drugs, forms, vaccines – both chemical and microbiological parameters. Environmental Monitoring – Pharmaceutical industry, Manufacture of Sterile Medicinal Products – British, European, USA-US and Indian pharmacopoeias.

UNIT - II

Industrial quality control and quality audits: Process quality control- sterile and non sterile preparations, Quality control – raw materials, purity check, quality check of finished products, Industrial responsibilities – social and environmental safety.

UNIT - III

Food safety and Food Quality: Microbiological criteria of food, food products, beverages. Monitoring of factory hygiene and sanitation, Microbiological quality of ingredients, processing and finished products. Food Safety and Standards Authority of India (FSSAI). Food contaminants and diseases.

UNIT - IV

Microbial quality control in Hospitals: Control of Healthcare associated infections (HAI) - Culture Identification, Sensitivity pattern, report preparations, HAI surveillance, resistance surveillance, Monitoring water quality in hospital, healthcare infrastructures. Corrective action system, Environmental monitoring and clean room commission

UNIT - V

Microbes and their applications: Quality control in biodegradation and bioremediation. Microbes used in the biofertilizers and bio-pesticides and bio-fuels.

References

1. Nally, J. D. (Ed.) (2007). Good Manufacturing Practices for Pharmaceuticals, Sixth Edition,Informa Healthcare USA, Inc., ISBN 10: 0-8593-3972-3 & ISBN 13: 978-0-8493-3972-1, New York.
2. The training manual for Food Safety Regulators. (2011) Food Safety regulations and food safety management. Food Safety and Standards Authority of India, New Delhi (*http://www.fssai.gov.in/trainingmanual.aspx*)

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5. EPA. "Noise Pollution." 2010-05-18