CURRICULUM
OF
MICROBIOLOGY
BS (4-YEAR)

2008

HIGHER EDUCATION COMMISSION
ISLAMABAD.
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Curriculum development is a highly organized and systematic process and involves a number of procedures. Many of these procedures include incorporating the results from international research studies and reforms made in other countries. These studies and reforms are then related to the particular subject and the position in Pakistan so that the proposed curriculum may have its roots in the socio-economic setup in which it is to be introduced. Hence, unlike a machine, it is not possible to accept any curriculum in its entirety. It has to be studied thoroughly and all aspects are to be critically examined before any component is recommended for adoption.

In exercise of the powers conferred by sub-section (1) of section 3 of the Federal Supervision of Curricula Textbooks and Maintenance of Standards of Education Act 1976, the Federal Government vide notification No. D773/76-JEA (cur.), dated December 4th 1976, appointed the University Grants Commission as the competent authority to look after the curriculum revision work beyond class XII at the bachelor level and onwards to all degrees, certificates and diplomas awarded by degree colleges, universities and other institutions of higher education.

In pursuance of the above decisions and directives, the Higher Education Commission (HEC) is continually performing curriculum revision in collaboration with universities. According to the decision of the special meeting of Vice-Chancellor’s Committee, the curriculum of a subject must be reviewed after every 3 years.

A committee of experts comprising of conveners from the National Curriculum Revision of HEC in Basic, Applied Social Sciences and Engineering disciplines met in April 2007 and developed a unified template to standardize degree programs in the country to bring the national curriculum at par with international standards, and to fulfill the needs of the local industries. It also aimed to give a basic, broad based knowledge to the students to ensure the quality of education. The new BS degree shall be of 4 years duration, and will require the completion of 130-136 credit hours. For those social sciences and basic sciences degrees, 63.50% of the curriculum will consist of discipline specific courses, and 36.50% will consist of compulsory courses and general courses offered through other departments.

For the purpose of curriculum revision various committees are constituted at the national level, comprising of senior teachers nominated by universities, degree awarding institutions, R&D organizations and respective accreditation councils. The National Curriculum Revision Committee for Microbiology meeting held on March 18, 2008 at HEC Islamabad in continuation of its earlier meeting on November 9-10, 2007 at HEC Regional Centre, Karachi and April 30, 2007 revised the curriculum in light of the unified template. The final draft prepared by the National Curriculum Revision Special Committee, duly approved by the competent authority, is being circulated for implementation in the concerned institutions.

DR.RIAZ-UL-HAQ TARIQ
Member Academics

August 2008
CURRICULUM DEVELOPMENT

STAGE-I

CURRICULUM UNDER CONSIDERATION

COLLECTION OF EXP NOMINATION UNI, R&D, INDUSTRY & COUNCILS

CONS. OF NCRC.

PREPARARTION OF DRAFT BY NCRC

STAGE-II

CURRICULUM IN DRAFT STAGE

APPRASIAL OF 1ST DRAFT BY EXP

FINALIZATION OF DRAFT BY NCRC

STAGE-III

FINAL STAGE

PREPARATION OF FINAL CURRICULUM

PRINTING OF CURRICULUM

STAGE-IV

FOLLOW UP

QUESTIONNAIRE

COMMENTS

IMPLEMENTATION OF CURRICULUM

ORIENTATION COURSES BY LI, HEC

BACK TO STAGE-I

Abbreviations Used:
NCRC. National Curriculum Revision Committee
VCC. Vice-Chancellor’s Committee
EXP. Experts
COL. Colleges
UNI. Universities
PREP. Preparation
REC. Recommendations
LI Learning Innovation
R&D Research & Development Organization
HEC Higher Education Commission
Introduction

A meeting of the Special National Curriculum Revision Committee to review the final draft of the curriculum of Microbiology for BS (4 years program) in Microbiology at various Universities / Institutions was held on November 9-10, 2007 at Regional Centre, Karachi and on March 18, 2008 at the HEC, Islamabad. The objective of the meeting was to finalize the curriculum of Microbiology in the light of standardized template/framework developed by a joint meeting of conveners of NCRCs in basic and social sciences on April 30, 2007 at HEC Islamabad, so the curriculum developed may be brought at par with international standards.

The meeting started with recitation of few verses from the Holy Quran by Prof. Dr. Bashir Ahmad Channar, Ms. Ghayyur Fatima, Deputy Director Curriculum, HEC welcomed the members and explained the aims and objectives of the meeting. The meeting was chaired by Prof. Dr. Nusrat Jamil, Convener and Prof. Dr. Yasmeen F. Kazi acted as Secretary of the committee.

The Following attended the meeting:

1. Dr. Nusrat Jamil, Convener
   Department of Microbiology,
   University of Karachi,
   Karachi

2. Dr. Arifa Tahir, Member
   Assistant Professor of Microbiology,
   Department of Env. Science
   Lahore College Women University,
   Lahore

3. Prof. Dr. A. Hameed, Member
   Chairman,
   Department of Microbiology
   Quaid-e-Azam University,
   Islamabad

4. Dr. Bashir A. Channar, Member
   Chairman,
   Department of Microbiology
   University of Sindh,
   Jamshoro

5. Dr. Iftikhar Hussain, Member
   Professor/Chairman,
   Department of Microbiology,
   University of Agriculture,
   Faisalabad.
The meeting discussed the agenda in detailed and thoroughly reviewed the curriculum. The following decision were made.

The compulsory courses were finalized as total 9 courses with 25 credit hours.

The general courses chosen from other departments comprise 7-8 courses with 21 credit hours.

The discipline foundation courses comprised 11 courses were finalized with 33 credit hours.

A total of 14 courses of 42 credit hours under the heading of “Major Courses” were finalized from various disciplines of Microbiology.

A list of 25 courses was finalized for 4 elective courses from various disciplines of Microbiology.

It was decided that the Research Project and Internship should be compulsory in Major Courses.

In 1st and 2nd academic year*, students will take compulsory and general courses to be chosen from other departments in addition to one foundation course per semester.

In 2nd and 3rd academic year, students will take foundation courses and major courses.

In final year of BS programme, students will take elective courses.

Internship and Project will be taken in 3rd and 4th academic year. Internship will be completed during summer vacation during 3rd and 4th academic year.

* One academic year contain two semesters.

Distribution of courses as per semester may be decided by the concerned universities according to their facilities and faculty available.
CURRICULUM FOR BS MICROBIOLOGY

Objective

The curriculum designed for the BS Microbiology will prepare the graduates to cope up with the issues for wide spectrum of areas including Medicine, Dairy, Poultry, Agriculture and Industry. These groomed man power will play a vital role in the economic growth would bring qualitative change in the above mentioned areas in the country. Internship in the curriculum will provide hands on experience in different fields mentioned above. It will also create awareness about public health and safety and facilitate the establishment of liaison between Microbiologist and societien industry.
FRAME WORK FOR BS MICROBIOLOGY (4 YEAR PROGRAMME)

- Total numbers of Credit hours: 133
- Duration: 4 years
- Semester duration: 16-18 weeks
- Semesters: 8
- Course Load per Semester: 15-18 Cr hr
- Number of courses per semester: 4-6 (not more than 3 lab / practical courses)

<table>
<thead>
<tr>
<th>Compulsory Requirements (the student has no choice)</th>
<th>General Courses to be chosen from other departments</th>
<th>Discipline Specific Foundation Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 courses</td>
<td>7-8 courses</td>
<td>9-10 courses</td>
</tr>
<tr>
<td>Subject</td>
<td>Cr. Hr</td>
<td>Subject</td>
</tr>
<tr>
<td>2. English II</td>
<td>3</td>
<td>2. Human Phy-II</td>
</tr>
<tr>
<td>5. Islamic Studies / Ethics</td>
<td>2</td>
<td>5. Sociology</td>
</tr>
<tr>
<td>9. Introduction to Computer</td>
<td>2+1</td>
<td>7. Biostatistics</td>
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</tbody>
</table>

**22**  **21**  **33**

<table>
<thead>
<tr>
<th>Major courses including research project/internship</th>
<th>Elective Courses within the major</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-13 courses</td>
<td>4 courses</td>
</tr>
<tr>
<td>12 Credit Hours</td>
<td></td>
</tr>
<tr>
<td>Subject</td>
<td>Cr. hr</td>
</tr>
<tr>
<td>1. Cell Biology-II</td>
<td>2+1</td>
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<tr>
<td>2. Microbial Anatomy &amp; Physiology</td>
<td>2+1</td>
</tr>
<tr>
<td>3. Fresh Water Microbiology</td>
<td>2+1</td>
</tr>
<tr>
<td>3. Bacterial Genetics</td>
<td>2+1</td>
</tr>
<tr>
<td>4. Clinical Bacteriology</td>
<td>2+1</td>
</tr>
<tr>
<td>5. Soil Microbiology</td>
<td>2+1</td>
</tr>
<tr>
<td>6. Epidemiology</td>
<td>2+1</td>
</tr>
<tr>
<td>7. Environment Biotechnology</td>
<td>2+1</td>
</tr>
<tr>
<td>8. Molecular Mechanism of Antimicrobiological Drugs</td>
<td>2+1</td>
</tr>
<tr>
<td>9. Genetic Engineering</td>
<td>2+1</td>
</tr>
<tr>
<td>10. Medical microbiology</td>
<td>2+1</td>
</tr>
<tr>
<td>11. Immunobiology</td>
<td>0+6</td>
</tr>
<tr>
<td>12. Research Project</td>
<td>0+3</td>
</tr>
<tr>
<td>13. Internship</td>
<td>0+6</td>
</tr>
<tr>
<td></td>
<td>42</td>
</tr>
</tbody>
</table>

**Note**** University has the option to recommend any other course in lieu of English IV

** University may recommend any other course in lieu of Mathematics II

*** University may recommend other courses according to their available faculty i.e. Zoology, Botany, Animal Physiology, Chemistry.

**Note**** Student may take 11 courses out of the list of 12 courses in major other than Research Project and Internship.
List of Elective Courses

University may recommend elective courses according to the faculties within the department.

1. Cell & Tissue Culture Technology
2. Introductory Microbial Technology
3. Plant Microbiology
4. Food and Dairy Microbiology
5. Animal Virology
6. Clinical Bacteriology
7. Marine Microbiology
8. Diagnostic Virology
9. Molecular Immunology
10. Clinical Parasitology
11. Food Preservation Technology
12. Immunohaematology
13. Plasmids, Episomes and Insertion Sequences
14. Microbial Enzyme Technology
15. Bioinformatics and Protein Structure/Function
16. Advances in Soil Microbiology
17. Environmental Microbiology and Public Health
18. Diagnostic Chemistry for Microbial Diseases
19. Veterinary Microbiology
20. Systemic Mycosis
21. Cutaneous and Subcutaneous Mycosis
22. DNA Damage, Repair and Carcinogenesis
23. Management of Infectious Waste
24. Epidemiology: Analytical and Experimental Approaches
COMPULSORY COURSES

1. English I
2. English II
3. English III
4. Pakistan Studies
5. Islamic Studies/Ethics
6. Mathematics-I
7. Mathematics-II
8. Introduction to Computer
DETAILS OF COURSES

**Functional English**

**Objectives:**
To enhance language skills and develop critical thinking

**Course Contents**
Basics of Grammar
Parts of speech and use of articles
Sentence structure, Active and passive voice
Practice in unified sentence
Analysis of phrase, clause and sentence structure
Transitive and intransitive verbs
Punctuation and spelling

**Comprehension**
Answers to questions on a given text

**Discussion**
General topics and every day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

**Listening**
To be improved by showing documentaries/films carefully selected by subject teachers

**Translation skills**
Urdu to English

**Paragraph writing**
Topics to be chosen at the discretion of the teacher

**Presentation skills**
Introduction

**Note:** Extensive reading is required for vocabulary building

**Recommended books:**
1. **Functional English**
   a) **Grammar**
d) Speaking

Communication Skills

Objectives:
To enable the students to meet their real life communication needs

Course Contents

Paragraph writing
Practice in writing a good, unified and coherent paragraph

Essay writing
Introduction

CV and job application

Translation skills
Urdu to English

Study skills
Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

Academic skills
Letter / memo writing and minutes of the meeting, use of library and internet recourses

Presentation skills
Personality development (emphasis on content, style and pronunciation)

Note: Documentaries to be shown for discussion and review
Recommended books:  
Communication Skills

a) Grammar  

b) Writing  

c) Reading  
2. Reading and Study Skills by John Langan
3. Study Skills by Riachard Yorky.

Technical Writing and Presentation Skills

Objectives:  
To enhance language skills and develop critical thinking

Course Contents

Presentation skills

Essay writing  
Descriptive, narrative, discursive, argumentative

Academic writing  
How to write a proposal for research paper/term paper

How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

Technical Report writing

Progress report writing

Note: Extensive reading is required for vocabulary building
Recommended books:

Technical Writing and Presentation Skills

a) Essay Writing and Academic Writing
      (particularly suitable for discursive, descriptive, argumentative and report writing).

b) Presentation Skills

c) Reading

The Mercury Reader. A Custom Publication. Compiled by norther Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

Pakistan Studies (Compulsory)

(As Compulsory Subject for Degree Students)

Introduction / Objectives

Objectives

- To develop vision of Historical Perspective, Government, Politics, Contemporary Pakistan, ideological background of Pakistan.
- To study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Course Outline

1. Historical Perspective
   b. Factors leading to Muslim separatism
   c. People and Land
      i. Indus Civilization
ii. Muslim advent  
iii. Location and Geo-Physical features.

2. Government and Politics in Pakistan

Political and constitutional phases:

a. 1947-58  
b. 1958-71  
c. 1971-77  
d. 1977-88  
e. 1988-99  
f. 1999 onward

3. Contemporary Pakistan

a. Economic institutions and issues  
b. Society and social structure  
c. Ethnicity  
d. Foreign policy of Pakistan and challenges  
e. Futuristic outlook of Pakistan

Books Recommended

ISLAMIC STUDIES
(Compulsory)

Objectives:

This course is aimed at:
1 To provide Basic information about Islamic Studies
2 To enhance understanding of the students regarding Islamic Civilization
3 To improve Students skill to perform prayers and other worships
4 To enhance the skill of the students for understanding of issues related to faith and religious life.

DETAIL OF COURSES

INTRODUCTION TO QURANIC STUDIES
1) Basic Concepts of Quran
2) History of Quran
3) Uloom-ul -Quran

STUDY OF SELECTED TEXT OF HOLLY QURAN
1) Verses of Surah Al-Baqra Related to Faith (Verse No-284-286)
2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
5) Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154)

STUDY OF SELECTED TEXT OF HOLLY QURAN
1) Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)
2) Verses of Surah Al-Hashar (18, 19,20) Related to thinking, Day of Judgment
3) Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14)

SEERAT OF HOLY PROPHET (S.A.W) I
1) Life of Muhammad Bin Abdullah ( Before Prophet Hood)
2) Life of Holy Prophet (S.A.W) in Makkah
3) Important Lessons Derived from the life of Holy Prophet in Makkah
SEERAT OF HOLY PROPHET (S.A.W) II
1) Life of Holy Prophet (S.A.W) in Madina
2) Important Events of Life Holy Prophet in Madina
3) Important Lessons Derived from the life of Holy Prophet in Madina

INTRODUCTION TO SUNNAH
1) Basic Concepts of Hadith
2) History of Hadith
3) Kinds of Hadith
4) Uloom –ul-Hadith
5) Sunnah & Hadith
6) Legal Position of Sunnah

SELECTED STUDY FROM TEXT OF HADITH

INTRODUCTION TO ISLAMIC LAW & JURISPRUDENCE
1) Basic Concepts of Islamic Law & Jurisprudence
2) History & Importance of Islamic Law & Jurisprudence
3) Sources of Islamic Law & Jurisprudence
4) Nature of Differences in Islamic Law
5) Islam and Sectarianism

ISLAMIC CULTURE & CIVILIZATION
1) Basic Concepts of Islamic Culture & Civilization
2) Historical Development of Islamic Culture & Civilization
3) Characteristics of Islamic Culture & Civilization
4) Islamic Culture & Civilization and Contemporary Issues

ISLAM & SCIENCE
1) Basic Concepts of Islam & Science
2) Contributions of Muslims in the Development of Science
3) Quranic & Science

ISLAMIC ECONOMIC SYSTEM
1) Basic Concepts of Islamic Economic System
2) Means of Distribution of wealth in Islamic Economics
3) Islamic Concept of Riba
4) Islamic Ways of Trade & Commerce

POLITICAL SYSTEM OF ISLAM
1) Basic Concepts of Islamic Political System
2) Islamic Concept of Sovereignty
3) Basic Institutions of Govt. in Islam

ISLAMIC HISTORY
1) Period of Khlaft-e-Rashida
2) Period of Ummayyads
3) Period of Abbasids

SOCIAL SYSTEM OF ISLAM
1) Basic Concepts of Social System Of Islam
2) Elements of Family
3) Ethical values of Islam

REFERENCE BOOKS:
1) Hameed ullah Muhammad, “Emergence of Islam”, IRI, Islamabad
2) Hameed ullah Muhammad, “Muslim Conduct of State”
3) Hameed ullah Muhammad, “Introduction to Islam”
4) Mulana Muhammad Yousaf Islahi,”
6) Ahmad Hasan, “Principles of Islamic Jurisprudence” Islamic Research Institute, International Islamic University, Islamabad (1993)

MATHEMATICS - I

Objectives and Goals:
This is the first course of the basic sequence, Calculus I-III, serving as the foundation of advanced subjects in all areas of mathematics. The sequence, equally, emphasizes basic concepts and skills needed for mathematical manipulation. Calculus I & II focus on the study of functions of a single variable.

Course Detail:
- Limits and continuity.
- Derivative of a function and its applications.
- Optimization problems.
- Mean value theorem (Taylor’s theorem and the infinite Taylor series with applications) and curve sketching; anti-derivative and integral.
- Definite integral and applications.
- The fundamental theorem of Calculus.
- Inverse functions (Chapters 1-6 of the text)
Recommended Books:

**MATHEMATICS - II**

Course Detail:
- Continuation of Calculus I.
- Techniques of integration.
- Further applications of integration.
- Parametric equations and polar coordinates.
- Sequences and series.
- Power series representation of functions.

Recommended Books:

**COMPUTER APPLICATIONS**

Courses Detail:
- Word processing (Microsoft Word).
- Spread Sheets (Microsoft Excel) and other related software packages (at least two).
- Internet access and different data bases available on the internet.
LIST OF GENERAL COURSES

1. Human Physiology-I
2. Human Physiology-II
3. Biochemistry-I
4. Biochemistry-II
5. Sociology
6. Environmental Current Issues
7. Biostatistics
DETAILS OF COURSES

HUMAN PHYSIOLOGY-I

AIMS AND OBJECTIVES:

- This course particularly imparts the concepts and mechanisms of integration in the different functional systems of humans.
- To understand coordination among various systems.

Course Detail

- Introduction to Organization of human body including chemical and cellular levels.
- Tissue: Structure and function, Epithelial, Connective, Muscle and Nervous tissues, Bone and Cartilage, Adaptive cellular and tissue behavior, Hyperplasia, Hypertrophy, Atrophy and Genetic abnormalities.
- Blood: Physical characteristics and components of blood, Origin and development of blood cells, Structure and function of RBC, WBC, Platelets, Clotting Cascade, Blood groups and Homeostasis.
- Cardiovascular System: Cardiac Cycle, Heart Sounds, Cardiac Conduction System, Structure and Function of Blood Vessels.
- Lymphatic System: Overview of Lymph, Structure and function of lymphatic tissues and organs.
- Antibodies and Immune cells. Specific and non specific immune reactions.
- Respiratory System: Lung volumes and capacities, Non-respiratory air movements, Alveolar ventilation; mechanism of alveolar gas exchange.
- Digestive System: Structure and function of the digestive organs, Salivary glands and their secretions, Phenomenon of deglutition, Gastric and pancreatic juice and Digestion, absorption and movements of GIT.

Practicals:

1. Methods of obtaining blood samples, choice of anticoagulants and preservation.
2. To determine the Clotting Time.
3. To determine total leukocytes count (TLC).
4. To Determine Differential leukocytes count (DLC).
5. To determine the specific gravity and viscosity of blood and plasma.
6. To record the human blood pressure by using Palpatory and Auscultatory methods.
7. To observe and record normal heart activity in exposed frog heart by Kymography.
8. To observe respiratory movement and determination of respiratory rate by Kymography.
9. To determine the normal chemical composition of human saliva.

**Recommended Books:**

**HUMAN PHYSIOLOGY-II**

**AIMS AND OBJECTIVES:**

- To study the details of physiological systems maintaining the homeostasis.
- Interrelations of the systems.
- Regulatory features of the each system's function.
- To study the details of nervous and hormonal coordination at molecular and cellular level in animal.
• Bio synthetics, secretary and regulatory aspects of coordination.

Course Detail

• Excretory system: System organization, Kidneys, Urine formation, Glomerular filtration, Processes of tubular reabsorptions and secretion.

• Endocrine System: Cellular secretions and their types, Structure and function of endocrine glands, Basic mechanism of hormone action, Control of hormone secretion by Hypothalamo-pituitary axis, Secretions of nonendocrine glands of body.

• Reproductive System: Female reproductive system, Oogenesis and its hormonal regulation, Menstrual cycle: Phases of menstruation, hormonal regulation, Overview of secondary sex characteristics, external genitalia and mammary glands, Male reproductive system, Testes and Spermatogenesis, Male sex hormones and their role in spermatogenesis, Accessory sex glands and composition of semen.

• Musculo-skeletal System: Structure and function of muscle, Neuromuscular junction.

• Nervous System: Structure and function of neuron, Membrane potential and nerve impulse, Synaptic transmission, Sensory and motor system.

• Spinal Cord: Nerve Pathways, Sensory and motor tracts and Spinal nerves, Reflexes and reflex arc.

• Brain: Functional areas of brain and cranial nerves, Formation and regulation of cerebrospinal fluid, Cerebral blood flow and blood brain barrier, Receptors and their classification.

Practicals:

To observe and determine the normal physical and chemical properties of urine sample.
Detection of abnormal constituents of urine in detail.
To determine (quantitative) blood urea nitrogen/Creatinine in the provided pathological sample for the detection of uremia.
Spectrophotometric determination of urinary calcium/Uric acid concentration.
Spectrophotometric determination of urinary phosphate concentration.
To study the muscular contraction kymography
Isolation of nerve and muscle (Sciatic and Gastrocnemius) in frog and to observe irritability on mechanical and electrical stimulation.

Recommended Books:
Aims & Objectives:

- The course will provide in depth knowledge about the polymerized organic compounds of life. The dynamism of the life proceeds with inter-conversion of the chemicals from feeding to the liberation of energy for work.

- In this course the concepts of the chemical basis of life and all the mechanisms involved in harvesting of energy for growth, duplication etc., are given.

Course Detail

- Amino Acids; Peptides and Proteins; The Covalent and 3-D structure of proteins sequences and evolution.

- Carbohydrates: Monosaccharides, Oligosaccharides, Polysaccharides, Glycoconjugates, Glycosaminoglycans, Proteoglycans, Glycoproteins, Carbohydrates as informational molecules.
• Enzymes: Nature and Function of enzyme, Classification and Nomenclature.
• Mechanism of enzyme action and enzyme kinetics, Regulatory enzyme precursors and associates and Buffer and pH.
• Nucleic Acids: Nucleosides and nucleotides, Structure and function of DNA and RNA.
• Lipids: Storage Lipids, Fatty acids and their types, Triacylglycerols, Structural Lipids, Phospholipids, Sphingolipid, Glycolipid, Steroles and Isoprenoids.

Practicals:

1. Normal Solutions.
2. Acid and Bases.
3. Electrolytes.
5. Buffers and pH.
6. Study of hydrolysis of starch by using mineral acids.
7. Various qualitative tests for Monosaccharide, oligosaccharides and polysaccharides
8. Preparation of calibration curve for glucose
9. Estimation of serum glucose by using calibration curve
10. Detection of reducing sugars in the presence of non-reducing sugars
11. Qualitative tests for different lipids.
12. Paper and thin-layer chromatography of sugars.
14. Determination of pK values of amino acids (Glycine, Alanine) by preparation of titration curves.
15. Qualitative and quantitative analysis of proteins by colorimetric methods (Biuret and Lowry’s)

Recommended Books:

**BIOCHEMISTRY-II**

**AIMS & OBJECTIVES:**

- The course will provide in depth knowledge about the polymerized organic compounds of life. The dynamism of the life proceeds with inter-conversion of the chemicals from feeding to the liberation of energy for work.

- In this course the concepts of the chemical basis of life and all the mechanisms involved in harvesting of energy for growth, duplication etc., are given.

**Course Detail**

- Metabolism: Carbohydrate, Lipid and Protein, Gluconeogenesis, Biosynthesis and breakdown of glycogen in animals, Regulation of glycogen metabolism.

- Bioenergetics and Thermodynamics, Electron transport chain and oxidative phosphorylation in mitochondria, Role of mitochondria in Apoptosis and oxidative stress, Photosynthesis, Photophosphorylation and light absorption.

- Biosynthesis of Lipids: Mobilization and transport of fats, Biosynthesis of fatty acids and Eicosanoids.
  - Biosynthesis of triacylglycerols.
  - Membrane phospholipids
  - Cholesterol and steroids.

- Biosynthesis of amino acids.

- Integration and hormonal regulation of mammalian metabolism.

**Practicals:**

1. Extraction and salting out of proteins.
2. Isolation and purification of proteins by various column chromatographic techniques (gel filtration and ion exchange).
3. Quantitative analysis of proteins by UV spectrophotometry
4. Extraction and quantitative analysis of amino acids.

**Recommended Books:**

**SOCIOLoGY**

**AIMS AND OBJECTIVES**

- The course is designed to introduce the basic concepts of sociology with particular reference to environment and social relationships.
- It provides understanding of the role of human being in creating and recreating the environment.
- It evaluates the development and environment relationships, environmental policies and environmental movements with reference to environmental issues.

**Course Detail**

- Introduction: Sociology, the Science of Society, Scope and significance, Fields of Sociology, Sociology and other Social Sciences.
- Social interaction and social structure, Social Interaction, the Nature and Basis of Social Interaction.
• Social Processes, Social Structure, Status, Roles, Power and Authority and Role Allocation.
• Culture, Meaning and nature of culture, Elements of culture, Norms, values, beliefs, sanctions, and customs.
• Culture and Socialization Formal and non-formal socialization, and Transmission of Culture.
• Cultural Lag. Cultural Variation, Cultural Integration, Cultural Evolution, Cultural Pluralism Culture and personality.
• Deviance and social control, Deviance and conformity, Mechanism and techniques of social control, Agencies of social control.
• Social organization, Social organization-Definition, meaning and forms, Social groups -Types and functions of groups, Social Institutions: forms, nature and inter-relationship.
• Community: definition and forms (Urban and rural).
• Social change, Processes of social change, Social change and conflict, Social change and social problems, Resistance to social change.
• Human ecology, Ecological processes, Ecological problems of Pakistan.

**CURRENT ISSUES IN ENVIRONMENT**

**AIMS AND OBJECTIVES**

- This course aims to provide knowledge about various environmental issues in multidimensional perspectives. It uses critical approach to global, regional and local environmental issues.
- The course provides review of the different environmental issues including ecological, conservation, pollution, resources, population and socioeconomic issues.
- It deals with the management and planning issues using case studies. This will enable the students to identify and analyze various environmental issues critically.
- They will be able to draw and formulate different strategies to address the multidisciplinary issues in different countries in general and in Pakistan in particular.

**Course Detail**

- The Atmosphere: Composition, Minor and major gases, Water in atmosphere, Aerosols, Global circulation pattern.
• Human Population: Population trends, Causes of population growth, Biological reasons, Social reasons, Increasing population and Anticipated changes.

• Drought and Famine: Types, Human responses to drought, Seasonal drought, Drought and Famine in different regions, Desertification.

• Pollution: Air pollution, Water pollution, Land pollution, Thermal pollution, Radiation pollution, Noise pollution.

• Acid Rain: Nature and Development, Source, Acid rain and Geology.

• Effects of Acid Rain on: Aquatic environment, Terrestrial environment, Built environment, Human health.

• Climate Change: Green House Effect and Global Warming.

• Global chilling, Green house effect, Green house gases, Changes in CO₂-Carbon Cycle, Changes in temperature, Socioeconomic effect, Environmental effects.

• Ozone Depletion: Ozone-structure, Properties/Significances, Ozone destroying catalysts, Natural, Anthropogenic, Antarctic zone hole, Changing ozone Level, Impact on biosphere.

• Natural Resources and Reserves: Use, Renewable and Nonrenewable, Depletion and Management.

• Waste: Type, Disposal and Management.

• Biodiversity: Concept and Significance, Causes of extinction, Conservation practices, Biodiversity and Climate changes, Introduced species and their effects.

• Deforestation: Causes, Effects, Reforestation


• Cloning, Use and Misuse, Threat to environment, Ethical and Religious reasoning.

• Natural Disasters: Earthquakes, Volcanoes, Lava, Cyclones, Tornadoes, Asian disasters (Tsunami disaster, Earthquake etc.).

Recommended Books:

**BIO STATISTICS**

**AIMS AND OBJECTIVES:**

- It will help the students to analyze data pertaining to their research work
- To assess the significance of their experimental designs. Without statistical analysis research articles are not accepted for publication by the scientific journals.
- Students must have sound knowledge of the statistical programs.

**Course Detail**

- Introduction to Biostatistics and its scope in Microbiology.
- Collection of Primary and Secondary data.
- Editing of data.
- Presentation of data: Tabulation, Classification, Visual Presentation (Diagrams and Graphs).
- Measures of Central Tendency: Arithmetic Mean by direct and short-cut method, Geometric Mean, Harmonic Mean, Mode, Median, \( ED_{50} \) (\( LD_{50} \) in detail), Quantile.
- Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation by direct and short-cut method, Variance, and their Coefficient.
- Correlation: Simple Correlation Table, Rank Correlation, Partial and Multiple Correlation.
- Regression and method of least square.
- Permutation and Combination.
- Probability distributions: Binomial distribution, Poisson distribution and their fitting to observed data, Normal distribution.
- Sampling and Basic Design
- Hypothesis Testing.
- Chi-square test, Student’s t-test, Analysis of variance.
- Laboratory Experiments pertaining to the course.

**Recommended Books**

LIST OF FOUNDATION COURSES

1. Gen. Microbiology-I
2. Gen. Microbiology-II
3. Gen. Microbiology-III
4. Gen. Immunology
5. Microbial Taxonomy
7. Cell Biology-I
8. Mycology
9. Research Methodology
10. Biotechnology
11. Biosafety and Risk Management
DETAILS OF FOUNDATION COURSES

GENERAL MICROBIOLOGY-I

AIMS AND OBJECTIVES:

- The course is designed to enable the students to work with microorganisms.
- The basic techniques of sterilization, culturing, isolation and determining different characteristics of the microorganisms are included.

Course Detail

- Fundamentals of microbiology.
- Microorganisms and their respective place in the living world.
- Differentiation between pro- and prokaryotic cells.
- Historical development of Microbiology and its scope.
- Microscopy: An outline of the principles and applications of light and electron microscope.
- Morphology, arrangement and detailed anatomy of bacterial cell.
- Bacterial taxonomy and nomenclature, basis of classification of bacteria.
- Growth, nutrition (physical and nutritional requirement and nutritional types; sources of energy, C, N, H, O, S, P, H2O, trace elements, growth factors) and reproduction.
- General methods of studying microorganisms: cultivation, isolation, purification and characterization.
- Control of microorganisms by physical and chemical methods.
- Chemotherapeutic agents and antibiotics. Modes of action of antibiotics on microorganisms.
- Basic properties of fungi, protozoa and algae.
- A brief introduction to structure and propagation of viruses and bacteriophages.

Practical:

1. Laboratory safety: Containment and decontamination.
4. Preparation and sterilization of bacteriological media and glassware.
5. Inoculation techniques. Study of colony characteristics of microorganisms.
6. Enumeration of bacteria from milk, water, food and soil by standard plate count technique (SPC) and/or most probable number technique (MPN).
7. Microbiological analysis of air. Microscopic study of fungi isolated from air.

**Recommended Books:**


**GENERAL MICROBIOLOGY – II**

**AIMS AND OBJECTIVES:**

- Aims of this course to let the students know about the applications of the science of microbiology in the different fields of life.
- The course may initiate their interest in agricultural, industrial and/or environmental microbiology.
Course Detail

- Structure and chemical composition of nucleic acid. Role of RNA, DNA in protein synthesis.
- Cell division, mitosis and meiosis, bacterial mutation and variation. Introduction to the genetical intermixing of bacteria including transformation, transduction and conjugation.
- Introduction to metabolism and role of phosphorus in energy transfer. Glycolysis and T.C.A. cycle.
- Microbiology of water and wastewaters. Water as a source of infection and methods of water purification. Methods of sewage treatment and disposal.
- Introduction to food and dairy microbiology. Methods of food preservation.
- Differentiation between food intoxication and food-infection.
- Microbiology of soil with particular reference to nitrogen cycle.
- Microbiology of air.

Practicals

1. Isolation of Chromosomal DNA from E.coli
2. Electrophoresis of Microbial DNA
3. Effect of UV light on phenotype and genotype of bacteria.
4. Enumeration of bacteria in drinking water
5. Enumeration of bacteria in milk.
6. Enumeration of bacteria in soil
7. Enumeration of bacteria in air
8. Pure culture study of (on the basis of morphological, cultural and biochemical characteristics): E. coli, Salmonella sp, Shigella sp, Staphylococcus aureus, S. epidermidis and S. fecalis, Corynebacterium.
10. Antibacterial activity of serum
11. Agglutination test (Widal test).
12. Precipitation tests.
13. Urine analysis (physical, chemical and microbiological)

Recommended Books:

**GENERAL MICROBIOLOGY-III**

**AIMS AND OBJECTIVES:**
This course will impart knowledge
- Pathogenesis of microorganisms
- Mechanism of infection
- Molecular mechanism of Pathogenesis

**Course Detail**
- Introduction: Host-parasite interactions.
- Determination of pathogenicity and molecular mechanisms of pathogenesis.
- Chemotherapy and drug resistance.
- Study of bacterial infections with emphasis on mechanisms of pathogenesis of the following groups: *Streptococcus, Staphylococcus,*
Niesseria, Pseudomonas, Corynebacterium, Bordetella, Vibrio, Enterobacteraceae, Clostridium, Bacillus, Campylobacter, Aeromonas and Helicobacter, Legionella, Mycobacterium, Actinomycetes/ Nocardia, Chlamydia and Mycoplasma.

- Zoonotic infections.
- Study of viral and rickettsial diseases including epidemic and endemic typhus, AIDS, Hepatitis. Poxviruses and Herpes viruses.
- Protozoal infections with emphasis on Leishmaniasis and Toxoplasmosis.
- Pathogenesis of mycotic infections with particular emphasis on mycetoma.
- Classical and newly emerging pathogens.

Practicals

1. Collection and transportation of clinical samples:
2. Infections of ear, nose, throat, eye, GIT, urogenital tract and bone
3. Isolation and identification of selected pathogens.
4. Antibiotic assays by disc diffusion methods and dilution method.
5. Determination of MIC, MBC and E-Test.

Recommended Books:
GENERAL IMMUNOLOGY

Learning Objectives

• Present a general perspective of acquired immunity
• To examine the nature of antibodies and process whereby antibodies are induced in response to antigens.
• Discuss the process of immunization

Course Detail

• Introduction: chronological development and scope of immunology.
• Immunity and immune responses: Definitions and types (specific and non specific). Humoral and cellular immunity.
• Complement system.
• Cells and tissues of immune system.
• The antigens: structure (simple and complex molecules, proteins and polysaccharides) and immunogenicity.
• Tissue antigens: the Allo- and heterophile antigens. The ABO and Rh blood group systems, their chemical basis, inheritance & clinical significance.
• Immunoglobulins: structure and function; classes, subclasses, types and subtypes; immunoglobulin genetics.
• Immuneresponse to an antigen.
• Introduction to antigen-antibody reactions: methods for detecting antigens and antibodies (agglutination, precipitation, complement fixation, EIA, etc.).
• HLA & MHC and its role in immune response, disease and its significance in tissue transplantation.
• Immunoregulation and tolerance.
• Cancer immunology.
• Introduction to immunopathology: hypersensitivity reactions, autoimmune diseases and immunodeficiencies.
• Immunization (methods of immunization, vaccines and adjuvants).

Practicals

1. Differential leukocyte count.
2. Blood grouping (ABO & Rh).
3. Agglutination test (Widal test).
4. Precipitation tests.
5. Complement fixation test.

**MICROBIAL TAXONOMY**

**Learning Objectives**

- Identify the objectives of classification
- Identify traits used to classify microorganisms
- Locate microorganisms in the realm of living world

**Course Detail**

- Basic concepts and aims of classification.
- Classical and molecular basis of classification of prokaryotes.
- Bacterial nomenclature.
- Classification of Enterobacteriaceae, spore formers, Actinomycetes (*Mycobacterium & Nocardia*), Spirochaetes (*Treponema & Leptospira*).
- Detailed classification of viruses, fungi, protozoa and Algae.
- A brief introduction of Rickettsia, Chlamydia and Mycoplasma.
- An introduction to Prions and Viroids.

**Practicals**

1. Characterization of bacteria and fungi on the basis of different biochemical and cultural characteristics.
2. Study of phylogenetic relationship using appropriate computer software.

**Recommended Books**

GENERAL VIROLOGY

Learning Objectives

• To identify major components of viruses
• System of traits used for classification of viruses
• Describe how viruses interact with cells
• Examine the ways that viruses persist in host cells

Course Detail

• Principles of electron microscopy.
• Nature of animal and plant viruses.
• Classification: structural and functional groups.
• Cell culture: various types of cell lines (plants and animals).
• Replication of viruses (RNA & DNA).
• Principles of viral diagnostic procedures.
• Introduction to bacterial viruses.
• Receptors for bacteriophages, somatic, non-somatic viruses and sex specific viruses. Adsorption sites and mode of replication.
• Transducing viruses of eukaryotes and cross-phylogenetic transfer.
• Prion and viriod.

Practicals

1. Detection and quantification of viruses.
2. Hemagglutination Inhibition assay.
3. Chick embryo inoculation.
4. Plaque assay.
5. Transmission electron microscopy (field trip).
7. Isolation and identification of phages from various sources.

Recommended Books


CELL BIOLOGY I

AIMS & OBJECTIVES:

Objectives of the course are to impart knowledge about

- The cell and its organization of architecture and the unified role it plays for the ultimate sustainability of the organisms.
- The various ultra-structural, molecular and functional aspects of the cells.

Course Detail

- Introduction to cell biology.
- Difference between prokaryotes and eukaryotes.
- Physico-chemical properties of protoplasm.
- Ultra-structure, chemical composition and functions of cell wall, cell membrane, cellular organelles (mitochondria, endoplasmic reticulum, golgi apparatus, lysosome, glyoxysome, nucleus, ribosomes, etc.) cytoskeleton.
- Chemical composition and molecular structure of chromosomes.
- Cell cycle and apoptosis.
- Cell reproduction.
- Signal transduction.
- Cell culture
Practicals:

1. Study of different types of Prokaryotic and Eucaryotic cell.
2. Study of different cell organelle by staining: Karyotyping.
3. Study of meiosis (pollen) and mitosis (onion root).

Recommended Books


MYCOLOGY

Learning Objectives

- Describe how to classify fungi.
- Examine fungal metabolism.
- Define mycotoxins.
- Role of fungi in plant and animal diseases.
Course Detail

- Introduction to mycology.
- Fundamentals of fungal classification.
- Structure and physiology of fungi.
- Physical and nutritional factors affecting the growth of fungi.
- Structural development and reproduction in fungi including cell cycle.
- Fungal metabolism (with reference to food and beverages).
- Economic impact of fungal plant diseases and their control.
- Fungi of medical importance.
- Mycotoxins.
- Use of fungi in biotechnology.

Practicals:

1. Isolation and identification of fungi from:
   - Environment
   - Rhizosphere
   - Clinical samples.
2. Effect of temperature on growth of fungi.
3. Determination of antifungal activity of (nystatin, actidion, amphotericin B etc.)

Recommended Books


RESEARCH METHODOLOGY

Course Detail

- Introduction: Research and professions.
- Understanding the research process.
- Plagiarism and its professional consequences.
- History and Principles of research ethics.
- Originality of Research.
Conflicts of interest.
Copyright and Patent Law.
Aims of research, The research topic.
Title and research problem.
Literature review: Search, Retrieve and manage information.
Research design.
Parametric, non-parametric and semi-parametric methods.
Qualitative Methodologies and interpretation of results.
Conclusions and its Validity.
Report writing and the research proposal.
Community Research.
Principles of presentation.
Communication-oral, posters.
Abstract and manuscript preparation.
Communicating your own credentials.
Communicating own work-CV.
Development of a grant proposal using the grant format of national and international agencies, Interviewing techniques.

**Recommended Books:**

**BIOTECHNOLOGY**

**Course Detail**

- Introduction to Biotechnology.
- Advances in vaccine development.
Recombinant products expression, and transgenics.

Bioreactor design: Introduction to factors affecting bioreactor design.

Description of a typical aseptic bioreactor. Bioreactor configurations and scale-up of bioreactor system.

Design of sterilization systems.

Oxygen mass transfer and heat transfer in bioreactor systems.

Fermentation broth rheology.

Product recovery, waste treatment and safety.

Biosensors: applications of biosensors, transducer technology, principles of biosensors.

Recombinant Protein Production, General aspects of heterologous protein expression.

Bacterial expression systems - *Escherichia coli* and *Bacillus subtilis*.

*Saccharomyces cerevisiae* as a system for expression of heterologous proteins.

Expression in non-*Saccharomyces* yeast species and filamentous fungi.

Enzymes and industry, extremozymes, enzyme evolution.

Microbial productions of: pharmaceuticals, diagnostic proteins, vaccines, microbial toxins and insecticides.

**Practical**

1. Field trip to an industry with a large scale fermenter.
2. Construction of aerobic and anaerobic bioreactor model.
3. Field trip to vaccine production unit.

**Recommended Books**

BIO-SAFETY AND RISK MANAGEMENT

Objectives:

To have the practice to conduct on microbes.

Details of Courses

- Detailed concept of Risk and Hazardous: Environment, Factors, Chemicals, Biological Radiations.

- Risk Management: Preventions, Surveillance, Monitoring Committee.

- Judicial Rights / Penalties.

- Concepts of Biosafe Environment: Terrestrial, Marim, Atmosphere.

- Designing of Labs based on Biosafety and Containment Parameters.

- Details of Biological Containment: Plants, Animals, Microbes.

Recommended Books:


LIST OF MAJOR COURSES

1. Cell Biology-II
2. Microbial Anatomy & Physiology
3. Fresh Water Microbiology
4. Bacterial Genetics
5. Clinical Bacteriology
6. Soil Microbiology
7. Epidemiology
8. Environmental Biotechnology
9. Molecular Mechanism of Antimicrobial Drugs
10. Genetic Engineering
11. Medical microbiology
12. Immunobiology
13. Research Project
14. Internship
DETAILS OF MAJOR COURSES

CELL BIOLOGY II

AIMS & OBJECTIVES:

Objectives of the course are to impart knowledge about

• The cell and its organization of architecture and the unified role it plays for the ultimate sustainability of the organisms.
• The various ultra-structural, molecular and functional aspects of the cells.

Course Detail

• *E. coli* and yeast as representative prokaryotic and eukaryotic models for molecular differentiation.
• Molecular mechanism of Replication.
• Transcription and Translation.
• Transcriptional and translational regulation of gene expression.
• Regulation of gene expression in prokaryotes and eukaryotes.
• Types of recombination.
• Mutations and chromosomal aberrations.
• DNA damage and repair.
• Gene sequencing.
• Principles of Recombinant DNA technology.
• Role of Recombinant DNA Technology in economic development.
• Human Genome Project.
• Stem Cell Research.

Practicals:

1. Karyotyping.
2. Study of DNA damage by physical and chemical methods.
3. Case study of chromosomal abnormalities in human and agricultural specimen.

Recommended Books

MICROBIAL ANATOMY AND PHYSIOLOGY

Learning Objectives

- Identify the basic components of all cells.
- Distinguish the features of procaryotic cells.
- Distinguish the characteristics of eucaryotic cells.
- Understand the use and characteristics of microscope.

Course Detail

- Detailed organization of microbial cells.
- Chemical composition and biosynthesis of macromolecules in microbial cells.
- Genomic organization of prokaryotes.
- Regulation of gene expression (operon, catabolite repression).
- Uptake and secretion of molecules.
- Aerobic and anaerobic respiration and fermentation.
- Cell metabolism: protein, nucleic acid and fat.
Practicals

1. Isolation of polysaccharides from bacteria.
2. Isolation of lipids from bacteria.
3. Estimation of total protein from bacterial cell.
4. Isolation and purification of a bacterial enzyme.

Recommended Books

FRESH-WATER MICROBIOLOGY

Course Detail

- Introduction to fresh-water environment and its microbiology.
- Stratifications in lakes and ponds.
- Laws of ecology with particular reference to fresh-water ecosystem: environmental factors (biotic and abiotic) and their influence on the distribution of microorganisms.
- Enumeration of bacteria: sampling and samplers, processing and actual enumeration procedures.
- Fresh-water microorganisms: some important groups of fresh-water microorganisms.
- Detailed study of biogeochemical cycling of C, N, S & P.
- Advantages and disadvantages of fresh-water microorganisms including their importance in fresh-water biotechnology.
- An introduction to aqua-culture and some common microbiological problems.
- Some common diseases of fresh-water fauna.

Practical
1. Study of microbial population from fresh water.
2. Study of Microbial counts.
3. Biological oxygen demand of fresh water sample.
4. Effect of physical factors on microbial fresh water flora.
Recommended Books

5. Gjedrem, T., 2005., Selection and Breeding Programs in Aquaculture. Springer-Verlag New York, LLC

BACTERIAL GENETICS

AIMS AND OBJECTIVES:
The continuity of the life from one generation to other generation is based on the mechanisms involving nucleus, chromosomes and genes etc. The process of continuity not only transfers the traits of the parents but also imparts variations that render the generations sustainable in changing environment. These concepts will be imparted to the students in this course.

Course Detail

- Nucleic acids structure and functions.
- DNA replication: replicon origins, events that occur at the replication fork, the structure and functions of DNA polymerases, and replication strategies.
- Control of DNA replication: dichotomous replication in prokaryotes.
- Control of gene expression in prokaryote: polycistrons, transcriptional initiation and termination, the operon, catabolite repression and attenuation control.
• Protein synthesis - mRNA translation: Genetic code - non universality, codon usage. Events on ribosomes (c.f. prokaryotes), ribosome structure-function relationships, organelle and archaeabacterial systems.
• Plasmids, episomes and transposons.
• DNA mutagenesis and mutagenic agents, repair and mutation suppression.
• Genetic recombination: generalized recombination, site specific recombination and illegitimate recombination.
• Gene transfer mechanisms and their role in evolution.
• Transformation, transduction, conjugation and cross-phylogenic transfer.
• Gene mapping by conjugation and transduction.
• Circular chromosomal maps of bacteria.
• Introduction to genetic rearrangements.

Practicals

1. Plasmid extraction.
2. Nucleic acid extraction (DNA & RNA).
3. Transformation, transduction, conjugation.
4. Catabolite repression through growth curve.
5. Beta galactosidase assay.

Recommended Books

7. Snyder, L. and Champness W., 2003, Molecular Genetics of Bacteria, ASM Press.

**CLINICAL BACTERIOLOGY**

**Learning objectives**

- Explore the general nature of relationship between human and microorganisms
- Identify the major factors determining whether microorganisms cause disease
- Examin the genetic basis of virulence factors
Course Detail

- An introduction to clinical bacteriology.
- Hazards in clinical microbiology laboratory.
- Role and importance of normal flora in different parts of body.
- Respiratory tract infections.
- Infections of eye, ear and skin.
- Fluids from infected joints, CSF, pleural and peritoneal fluids.
- Differential diagnosis of selective systemic bacterial infections of GIT, genito-urinary, cardiovascular and central nervous system.
- Nosocomial infections: prevention and control.
- Principles of latest diagnostic procedures.
- Post operative infections.

Practical

1. Good laboratory practices
2. Collection and processing of different clinical specimen.
3. Isolation and identification of pathogens from different clinical specimen.
4. Antibiotic sensitivity test by various techniques.

Recommended Books

SOIL MICROBIOLOGY

Learning objectives

- Discovery how microbial ecologists view relationship of microorganisms
- Examin the major kinds of interactions microorganisms enter into
- Examin the habitats where we find microorganisms

Course Detail

- Elements of soil formation and conservation.
- Soil microbial population and methods of study with their advantages and disadvantages.
- Role of microorganisms in mineral transformations with special and detailed emphasis on Carbon and Nitrogen transformations. Brief introduction to Sulphur and Phosphorus.
- Introduction to soil ecology. Plant-microbe interactions and microbe-microbe interactions and their impact on soil fertility and formation of compost and humus.
- Biotechnological potentials of soil microorganisms.
- Importance of the subject in the agricultural development of Pakistan.
- Problems of salinity and water logging and the methods of land reclamations.
- Microbial remediation: salt, heavy metals, etc.
- Pesticides and their biodegradation.
- Mycorrhiza,

Practicals

1. Role of microbes in soil formation.
2. Reduction of metallic salts by microbial activity.
3. Buried slide technique.
4. Symbiotic and antagonistic relationship of soil microflora.
5. Cellulolytic activity of soil microorganisms.
6. Isolation of antibiotic producing and pesticide degrading microbes from soil.

Recommended Books


**EPIDEMIOLOGY**

**Learning objectives**

- Define epidemiology.
- Describe the different mathematical tools of epidemiology.
- Define and examine descriptive and analytical epidemiology.

**Course Detail**

- Introduction to epidemiology: Types of epidemiology, clinical, occupational, experimental, interrelation of factors.
- Epidemiological methods, incidence, prevalence, rate, susceptibility etc.
- Types of studies, cross sectional, cohort, case control.
- Epidemiologic consideration in disease process.
- Health information and biostatistics.
- Sampling methodology: procedure, sample size, cluster sampling, sampling error, bias, risk, data collection of infectious disease cases, antibiotic resistance profile of infectious agents.
- Screening tests, accuracy of screening tests, predictive value, reliability.
- Hypothesis testing, statistical significance, (p values, confidence interval etc.)
- Epidemiological polarization.
- Disease pattern in community & Social diversity.
- Cyclicity of diseases: Chicken Pox, measles, Rota virus infections, mumps.
- Flu, common cold and prevailing pandemics and epidemics.
- Surveillance prevention, control and eradication of disease.
- Status of health services in Pakistan: comparison with other counties.
- Detailed study of predisposing factors in developed countries and a comparison with the existing factors in Pakistan.
Recommended Books


ENVIRONMENTAL BIOTECHNOLOGY

Learning Objectives

- Discuss role of microbial activities on chemical and geologic processes.
- Examine the roles microorganisms play in pollution.

Course Detail

- Introduction to environmental biotechnology.
- Microbial techniques for pollution control.
- Role of microorganisms for the production of food and fodder products from agricultural and forestry wastes.
• Biological and chemical pesticides: their advantages and disadvantages.
• Microbial degradation of toxic and poorly degradable (recalcitrant) compounds.
• Bioremediation of environment contaminated with wood preservatives, petroleum products, hydrocarbons, fuels and industrial wastes etc.
• Bioaccumulation of heavy metals and phytoremediation.
• Applications of recombinant microorganisms in reducing environmental pollution.
• Microbes as a tool for the assessments of risks associated with the environment.
• Recent advances in agricultural and environmental biotechnology.

Practical

1. Isolation of Oil degrading bacteria from environment.
2. Isolation of microorganisms from industrial effluent.
3. Detoxification of metal ions through microbes.
4. Effects of industrial effluents on germination and growth of seedlings.

Recommended Books

MOLECULAR MECHANISMS OF ANTIMICROBIAL DRUGS

Learning Objectives

- To understand the mechanism of chemotherapy.
- Form a general understanding of microbial control.
- Examine factors that influence microbial control.
- Discuss major chemical methods.

Course Detail

- Nature and historical background of chemotherapy.
- Paths to drug discovery: empirical screening, observation of side effects, molecular targets and models.
- Range of antimicrobial targets.
- Chemical structure and biological activity.
- Molecular basis for selective action against the prokaryotes.
- Antimicrobial agents affecting: Cell wall synthesis, Protein Synthesis, DNA/RNA synthesis and others.
- Cytoskeleton.
- Antifungal drugs affecting cell membrane and cell wall biosynthesis in fungi.
- Mechanism of action of antiviral drugs, antimitotic agents, benzimidazole carbamates, alkaloids and taxol.
- Antiparasitic agents.
- Resistance mechanisms.
- New approaches in Therapy.
- By the use of Blockers for: Selective microbial enzymes, substrates, and receptors.
- Blockers for biochemical processes.
- Action of antibiotics on biofilms,
- Drug design and delivery.

Practical

1. Isolation of antibiotic resistant bacteria from environment.
2. Effect of antibiotics on peptidoglycan content.
3. Effect of antibiotics on total soluble protein content.
4. Determination of extended spectrum beta lactamase in bacteria resistant to beta lactam antibiotics.
5. Determination of protein profile of antibiotic sensitive and resistant bacteria by Polyacrylamide Gel Electrophoresis (PAGE).
6. Effect of antibiotic on bacteria present in biofilm.

Recommended Texts


GENETIC ENGINEERING

Learning Objectives

- Describe the basic techniques used in recombinant DNA technology.
- Explore the practical uses of genetic engineering.
- Consider potential problems related to genetic engineering.

Course Detail

- Introduction and scope.
- Restriction and modification system.
- Exchange of genes between a lambda phage and Col El factor.
- In vitro genetic engineering; cloning vehicles: plasmids, cosmids and phagemids, YAC and BAC etc.
- Principles of nucleic acid isolation (DNA & RNA).
- Cloning strategies: construction of chimera plasmids.
- Methods of introducing exogenous DNA.
- Methods for screening the clones.
- DNA sequencing.
- PCR: its application and primer designing.
- Expression systems for Pro- and Eukaryotes.
- Markers for labeling methods of probes.
- Concept of construction of genomic library.

**Practical**
1. Methods of nucleic acid isolation (DNA & RNA).
2. Slab gel electrophoresis.
3. Restriction enzyme digestion of DNA.
4. Southern blotting.
5. Electroblotting.

**Recommended Texts**

**MEDICAL VIROLOGY**

**Learning Objectives**
- Define system of classification of viruses.
- Discuss virus multiplication in host cells.
- Examine the role of viruses in cancer.

**Course Detail**
- Classification and structure of medically important viruses.
- Viral infections.
- Host cells for viral multiplication, productive infections.
- One-step multiplication curve.
- Impact of viral infection on host cell.
- General comments on the replication of viral genome.
- Maturation and release of viruses.
• Special features of molecular biology, biochemistry and genetics of the following viruses: Picornaviruses, Poxviruses, Myxoviruses.

• Paramyxoviruses, Rubella viruses, Rhabdoviruses, Reoviruses, Herpes viruses, Hepatitis viruses, Retroviruses and Tumor viruses (DNA & RNA), Adenoviruses, Coronaviruses.

• Viruses of Zoonotic significance.

• Virus-host interactions.

• Genetics of viruses shift and drift.

• Diagnostic procedure for viral infections including isolation identification and serology.

• Antiviral agents, viral prophylaxis.

• Interferon and chemotherapeutic agents.

Practicals

1. Chick embryo inoculation.
2. Enzyme Linked Immunosorbent Assay (ELISA).
3. Haemagglutination Inhibition (HI).
4. Haemagglutination (HA).
5. Precipitation.
6. Cytopathic effects.
8. Fluorescent Antibody Test (FAT).
9. Polymerase Chain Reaction (PCR).

Recommended Books


IMMUNOBIOLOGY

Course Detail

- The immune system: organs constituting the immune system, their location in the human body and basic architecture.
- The immunocompetent cells: their origin, surface markers, population and sub-populations. Immunological characterization and functions.
- The role of T-cells and immunoglobulins in the immune response.
- Immunologic memory: positive and negative. Phenomenon of natural tolerance.
- Manifestations of antigen-antibody reactions including precipitation, agglutination, complement fixation and neutralization.
- Cellular immune response and its characterization.
- Basics and applications of ELISA, RIA, immunofluorescence and immunoblotting. Lab work pertaining to above course.
- Immuno suppression a need, agents.

Practical

1. Differential leukocyte count.
2. Blood grouping (ABO & Rh).
3. Agglutination test (Widal test).
4. Hemagglutination Inhibition test.
5. Effect of Serum on bacteria.
6. Use of MT as test of delayed hypersensitivity.
7. Precipitation tests.
Recommended Books:

RESEARCH PROJECT

INTERNSHIP
List of Elective Courses

University may recommend elective courses according to the faculties within the department.

2. Introductory Microbial Technology.
3. Plant Microbiology.
4. Food and Dairy Microbiology.
5. Animal Virology.
7. Marine Microbiology.
9. Molecular Immunology.
11. Food Preservation Technology.
12. Immunohaematology.
13. Plasmids, Episomes and Insertion Sequences.
14. Microbial Enzyme Technology.
16. Advances in Soil Microbiology.
18. Diagnostic Chemistry for Microbial Diseases.
19. Veterinary Microbiology.
20. Systemic Mycosis.
22. DNA Damage, Repair and Carcinogenesis.
24. Epidemiology: Analytical and Experimental Approaches.
DETAILS OF COURSES

CELL & TISSUE CULTURE TECHNOLOGY

Learning Objectives

- Nutritional Discuss the process of tissue culture technology.
- To study requirements.

Course Detail

- History and application of cell culture.
- The eukaryotic cell: general structure and function, cell cycle, chromosomes, polyploidy, polytene and karyotypes.
- Nutritional requirements, growth and metabolism of cells, serum and growth control, topoinhibition, source substitutes, pH regulation.
- Outlines of methodology of plant, insect and animal cell and tissue culture.
- Cell culture, cell types and morphology of cells in culture.
- Primary and secondary culture, cell strains and established cell lines.
- Establishment of cell lines.
- Establishment of clones of plant and animal cells.
- Lymphoid cells culture.
- Transformed cells: growth control of mouse fibroblasts and malignancy, the normality of 3T3 fibroblasts cell lines from tumors.
- Genetics of cells in culture. Origin of mutant cell lines. Negative selection: heterokaryons, malignancy of hybrids.
- Differentiated, serum dependent normal cells. Role of cyclic nucleotides.
- Selective cell line and their specialized uses (HeLA, Vero, 3T3 fibroblast, WEHI, etc.)
- Tissue culture and virology (CPE, Plaque Assay).
- Applications of plant tissue culture.
- Stem cell technology.

Practical

1. Preparation of glassware and media.
2. Starting a primary culture (tissue digestion, cell count and cell culture).
3. Establishing a cell line.
4. Cryopreservation of cell line.
5. Plant cell culture.

Recommended Books


INTRODUCTORY MICROBIAL TECHNOLOGY

Learning Objectives

- Discuss role of microbial activities on chemical and geologic processes
- Examine the roles microorganisms play in pollution

Course Detail

- Properties of microorganisms useful to the bio-industry. Biotechnology, brewing, antibiotic production, recombinant protein production, vaccine production and waste treatment industries.
- Scope of fermentation biotechnology In Pakistan
- Scientific disciplines used in microbial biotechnology.
• Immobilized enzymes and microbial cells and their applications
• Principles of Biochemical Engineering and historical perspective.
• Large-scale microbial fermentation, the principles and problems.
• An introduction to downstream processing.
• Strain Development spectrum of for microbial, Isolation and identification of industrially important microorganisms. Different approaches improvement of industrial microbes. Empirical and Semi-empirical strain development, mutagenesis, screening and selection.
• Use of auxotroph and analogue resistant mutants in strain development.
• Growth and Development of Microorganisms in Bioreactors.
• Quorm (r) myco-protein, a product produced by continuous flow fermentation.
• Continuous culture technologies for strain improvement.
• Metabolic Control Analysis: principles and means of rational strain development.

Practicals

1. Citric Acid production.
2. Ethanol production.
3. Lactic Acid.
4. Estimation of Microbial cell mass.
5. Mutagenesis (Physical and Chemical).
6. Field trips:
   Industrial alcohol production from sugar cane; Citric acid production.
   Amino acid biosynthesis in Corynbacterium glutamicum.
   Trytophan biosynthesis in Neurospora crassa.

Recommended Books

PLANT MICROBIOLOGY

Learning Objectives

- To discuss microbial plant diseases and their importance.
- To identify fungal and bacterial diseases.
- Discuss control of plant diseases.

Course Detail

- Study of major microbial plant diseases in Pakistan.
- Importance of plant diseases.
- Nature and classification of plant diseases.
- Causes of plant diseases.
- Fungal diseases: Rusts, Smuts, Wilts and Root rots.
- Diseases of fruits and vegetables.
- Bacterial diseases: Blights, Cankers, Leaf spots and Rots.
• Viral diseases: Mosaics, Dwarfs, Stunts, Yellows, Leafcurl, Witches Broom, Ring spots and Wilts.
• Quarantine, eradication and International Plant Protection.
• Cultural practices in disease control, chemical control.
• Resistant varieties.
• Future problems and prospects of Plant Microbiology.

Practical

1. Sample collection and identification of plant pathogen (farms, orchards, nurseries etc.).
2. Field trips.

Recommended Books


FOOD & DAIRY MICROBIOLOGY

Learning Objectives

• Discuss the major roles of microorganisms in production, reservation and spoilage of food.
• Review roles microorganisms play in industrial manufacture nonfood products.
Course Detail

- Scope of food and dairy microbiology.
- World food problems.
- Microorganisms important in food industry.
- Principles of food spoilage and their preservation.
- Spoilage and preservation of food products.
- Food preservation in warm countries.
- Food hygiene, sanitation and legislation.
- Quality assurance in food industries.
- Recent advances in food industry.
- Technology of food processing.
- Preservative agents for improving the quality, shelf-life and organolaptic properties of foods.
- Neutralizers, stabilizers, firming agents, coating and wrapping agents.
- Food Preservation Technology.
- Principles and methods of food preservation.
- Bacteriology of preserved foods.
- Packaging and related problems.

Practicals

1. Isolation of starter culture from: Cheese and Yogurt.
2. Isolation of phages from lactobacilli.
3. Enumeration of bacteria from: Poultry, Beef, Milk, Eggs and Fish.
4. Field trips to: Brewery industry and Milk plant.

Recommended Books

ANIMAL VIROLOGY

Learning Objectives

- To identify traits for viral identification.
- Review virus penetration in host cell.
- Discuss viral replication.
- Chemotherapeutic agents.

Course Detail

- Classification and structure of animal viruses.
- Host cells for viral multiplication, productive infections.
- One-step multiplication curve.
- Impact of viral infection on host cell.
- General comments on the replication of viral genome.
- Maturation and release of animal viruses.
- Special features of molecular biology, biochemistry and genetics of the following viruses: Picornaviruses, Poxviruses, Myxoviruses, Paramyxoviruses, Rubella viruses, Rhabdoviruses, Reoviruses, Herpes viruses, Hepatitis viruses, Retroviruses and Tumor viruses (DNA & RNA).
- Interference with viral multiplication.
- Interferon and chemotherapeutic agents.

Books Recommended

CLINICAL BACTERIOLOGY

Course Detail

- An introduction to clinical bacteriology
- Hazards in clinical microbiology laboratory
- Role and importance of normal flora in different parts of body
- Respiratory tract infections.
- Infections of eye, ear and skin
- Fluids from infected joints, CSF, pleural and peritoneal fluids
- Differential diagnosis of selective systemic bacterial infections of GIT, genito-urinary, cardiovascular and central nervous system.
- Nosocomial infections: prevention and control
- Principles of latest diagnostic procedures
- Post operative infections

Practical

1. Good laboratory practices.
2. Collection and processing of different clinical specimen.
3. Isolation and identification of pathogens from different clinical specimen.
4. Antibiotic sensitivity test by various techniques.

Recommended Books


MARINE MICROBIOLOGY

Course Detail

- Introduction to marine microbiology.
- Zonation and stratification in marine environment.
- Movement of water in marine environment.
- Laws of ecology with particular reference to marine ecosystem: environmental factors (biotic and abiotic) and their influence on the distribution of microorganisms.
- Enumeration of bacteria: sampling and samplers, processing and actual enumeration procedures.
- Marine microorganisms: some important groups of marine microorganisms.
- Detailed study of biogeochemical cycling of C, N, S & P.
- Advantages and disadvantages of marine microorganisms including their importance in marine biotechnology.
- Some common diseases of marine fauna.

Books Recommended


**DIAGNOSTIC VIROLOGY**

**Course Detail**

- History and introduction.
- General approaches to the laboratory diagnosis of viral diseases.
- Laboratory management and biosafety.
- Collection, transportation and processing of specimen.
- Methods for the diagnosis of herpesviruses, adenoviruses, rotaviruses, coronaviruses, viruses associated with rash diseases, hepatititis viruses, enteroviruses, retroviruses, poxviruses, orthomyxoviruses, paramyxoviruses and arboviruses.
- DNA amplification by PCR and DNA based detection systems.
- Interpretation of Lab, investigation.

**Books Recommended**

MOLECULAR IMMUNOLOGY

Course Detail

- Molecular basis of immunogenicity and antigenic specificity: distinction and parameters.
- Basis of immunodominence.
- Immunochemical aspects of polysaccharide antigens of selective group of microorganisms and their significance.
- Structure and functions of human immunoglobulins: Sequence studies, genetic variants, three dimensional configurations and location of paratope in the molecule of IgG, IgM, and IgA. Antibody diversity, maturation of B lymphocytes and expression of Immunoglobulin genes.
- Structure function of the T-cell Receptor: Molecular basis of T-cell antigen recognition and activation, Immunoglobulin superfamily. T-cell gene rearrangement and generation of diversity.
- Human Leukocyte Antigens: classes, distribution, chemistry and basis of polymorphism.
- Complement System: Chemistry, components, activation via classical and alternate pathway, complement genes, their expression and regulation.
- Molecular basis of antigen antibody interactions: Chemical bonds involved, study and kinetics employing mono and polyvalent ligands. Quantitative measurements of antibody precipitated in an immune complex.

Recommended Text and Reference Journals

5. Infection and Immunity – ASM Press, USA.
CLINICAL PARASITOLOGY

Course Detail

- Etiology, life cycle, epidemiology, symptomatology, pathogenesis, lab. diagnosis, treatment, prevention and control of:

- Brief introduction to others.


- Recent advances in the control of parasitic infections.

Books Recommended


FOOD PRESERVATION TECHNOLOGY

Course Detail

- Principles and methods of food preservation.
- Bacteriology of preserved foods.
- Technology of food processing.
- Preservative agents for improving the quality, shelf-life and organolaptic properties of foods.
- Neutralizers, stabilizers, firming agents, coating and wrapping agents.
- Packaging and packaging problems.

Books Recommended


**IMMUNOHAEMATOLOGY**

**Courses Detail**
- General aspects of hematology, processes of hematopoiesis.
- Features and functioning of polymorpho- and mononuclear phagocytic system.
- Mechanism of intra and extracellular killing of pathogens.
- Antigen processing and presentation.
- Humoral mediations of natural immunity.
- Role of T-helper population in humoral and cellular immunity.
- Involvement of immunocompetent cells in delayed hypersensitivity, immunity to intracellular parasites and tumors and in transplant rejection.
- Complications and consequences of blood transfusions.
- Blood complement therapy.

**PRACTICAL**

**Books Recommended**

**PLASMIDS, EPISOMES AND INSERTION SEQUENCES**

**Course Detail**
- Introduction and scope.
- Repeated DNA sequences in plasmids, phages and bacterial chromosome.
- Definitions of transposable elements in prokaryotes.
• Mutations caused by isertion sequences.
• The mutations of *E.coli* caused by insertion sequence elements, transposons and plasmids.
• Types of plasmids and their significance
• Plasmid entry & exclusion: super-infection immunity & curing
• Formation of conjugative drug resistance R-plasmids. Antibiotic resistant transposons, their integration and excision.
• X mutations in Mu. G segment of Mu and PI. Integrative recombination of bacteriophage lambda.
• Controlling elements in Maize, insertion mutations in Drosophila and transposition of mating type genes in fission yeast.

Practical

**Books Recommended**

**MICROBIAL ENZYME TECHNOLOGY**

**Course Detail**
• *Introduction to enzymes*: Nature, structure & function, Biological role of enzymes, their sources and biosynthesis, Enzyme turnover.
• *Multi-enzyme complexes*.
• *Kinetics of enzyme reaction*.
• *Mechanisms of enzyme reaction, Reversible and irreversible changes*.
• *Regulatory enzymes and the control of metabolic pathways*- feedback inhibition.
• *Allosteric enzymes*. 

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• **Industrial enzymes**: Types, their sources, uses and applications, Fermentative production of industrial enzymes, A brief outline to the methods of purification.

• Enzyme immobilization: methods of immobilization and kinetics; properties of immobilized enzymes, Uses of free and immobilized enzymes in industries.

• **Analytical application of enzymes**: enzymes as biosensors, Clinical and therapeutic application of enzymes.

**Practical**

**Books Recommended**


**BIOINFORMATICS AND PROTEIN STRUCTURE/FUNCTION**

**Course Detail**

• Amino acids and their properties.

• Protein structure classification and superfolds.

• Mechanisms of protein folding and folding pathways.

• Role of chaperones in protein folding.

• Experimental techniques for characterizing membrane protein structure and function.

• A case study: proteases - function and mechanisms.

• Simple sequence analysis - use of hydropathy plots.

• Introduction to sequence databases.

• Comparing sequences against sequence databases.

• Predicting protein coding regions.

• Prediction of protein structure from sequence data.

• Genome sequencing projects.
• Bioinformatics and genome analysis.
• Introduction to protein structure.
• Experimental methods for determining protein structure.
• Protein domains.

Practical Content

Although there are no formal practicals for this course, there will be optional practicals to demonstrate the use of Web based tools for Bioinformatics analysis and to allow students to practice using these computational tools for sequence analysis.

Recommended Texts


ADVANCES IN SOIL MICROBIOLOGY

Course Detail

• Introduction: agricultural microbiology and field management technology.
• Soil ecology: kinetics of ecosystems and ecosphere.
• Interactions: Dynamics and interaction of microbial population in rhizosphere, rhizoplane and phylloplane.
• Soil hydrology: different forms of water present in the soil, their physico-chemical and biological properties.
• Soil colloidal system: its significance in soil, Organic matter and its role in soil processes.
• Detailed study of cation exchange capacity of the soil: its role in the availability and uptake of the nutrients.
• Composting and its role in enhancing soil fertility, Biofertilizers.
• Microbe mediated nutrient uptake and losses, Recent advances in N uptake and losses from soil.
• Phosphorus and role of mycorrhiza in P solubilization, Effective microorganisms (EM).
• Biological control, Bioinsecticides and fungicides.
Books Recommended


ENVIRONMENTAL MICROBIOLOGY & PUBLIC HEALTH

Course Detail

- An introduction to environmental pollutants and their impact.
- Aeromicrobiology.
- Microbiology of water including water pollution. Detection and elimination of polluting bacteria from waters.
- Water purification by various means.
- Microbiology of wastewater including disposal and treatment.
- Microbiology of food and milk.
- Epidemiology and its principles.
- Prevention and control of epidemic diseases.
- An introduction to bioremediation.
- Environmental pollution: an introduction to environmental diseases.
- Nosocomial infections.

Books Recommended


**DIAGNOSTIC CHEMISTRY FOR MICROBIAL DISEASES**

**Course Detail**

- The concept of visually detectable and undetectable changes, direct and indirect evidences for the diagnosis of microbial diseases.

- Gastrointestinal function test: Test based on:
  - Salivary digestion: a brief description of salivary digestion, the role of saliva in prevention of dental diseases and digestion and test based on salivary enzyme and its interpretation.
  - Gastric digestion: a brief description of gastric digestion, test: Collection, analysis, and interpretation of Fasting content, Fractional Test Meal (FTM) secretion, Basal acid secretion, Alcohol test meal secretion, Augmented histamine test secretion, Insulin hypoglycaemic test secretion.


- Role of gastrointestinal tract disturbances in development of anaemia


A brief description of cerebrospinal fluid (CSF).

Books Recommended


**VERTERINARY MICROBIOLOGY**

**Course Detail**

- Study of major animal diseases in Pakistan. Etiology, Symptomatology, Immunology, Epidemiology, diagnosis, and prevention.

- Tuberculosis, Anthrax, Brucellosis, Johne’s Disease, Bovine Mastitis, tick fever, Salmonellosis (including Pullorum).

- Rabies, Foot and Mouth Disease. New castle Disease, Infectious laryngotracheitis, Fowl pox, Sore Mouth of sheep and goats, avian influenza, infectious bursal disease (Gumboro), hydropericardium syndrome (Angara).

- Importance of Zoonoses in Pakistan.

- Quarantine and international control of animals live stock farming.

**Books Recommended**


SYSTEMIC MYCOSIS

Course Detail

- Host parasite interactions and molecular mechanisms.
- Study of the following human diseases with particular reference to etiology, epidemiology, symptomatology, lab. diagnosis and therapeutic considerations of: Actinomycosis, nocardiosis, candidiasis, histoplasmosis, blastomycosis, coccidiomycosis, geotrichosis, aspergillosis, and zygomycosis.
- Immunity in fungal infections.

PRACTICAL

Books Recommended


CUTANEOUS AND SUBCUTANEOUS MYCOSIS

- Etiology, epidemiology, symptomatology, immunity, lab. diagnosis, and treatment of: chromoblastomycosis, mycetoma, sporotrichosis, cryptococcosis, Dermatophytes and dermatomycosis, Tinea versicolor, white and black Piedra, Tinea nigra. Prohylaxis and chemotherapy.
Books Recommended


DNA DAMAGE, REPAIR AND CARCINOGENESIS

Course Detail

- Introduction.
- Radiation (ionizing and non-ionizing) as damage inducing agents. DNA, the critical site for damage and interaction. Biological consequences of damage.
- Inactivation of biological systems: bacterial cells and bacteriophages by UV radiations. Post-irradiation macromolecular system.
- Chemical as damage inflicting agents. Exogeneously and endogeneously induced base modifications and their biological consequences.
- Repair of DNA damages: excision repair processes, mismatch repair, tolerance mechanism, conditioned repair phenomenon (phenomenology and genetic control of SOS functions, adaptive responses to DNA alkylation and oxidative stress.
- Relevance of inducible repair to carcinogenesis.
• Somatic theory of cancer. Chemistry of carcinogenesis, cellular transformation.
• Repair and spontaneous mutagenesis, plasmid gene mediated repair, genetic control of repair phenomenon.
• Enzymology of DNA repair.
• Cancer and gene therapy.

Practical

MANAGEMENT OF INFECTIOUS WASTE

Detail of Courses

- An introduction to the management of infectious material/waste.
- Various types of infectious materials: handling and methods of their disposal.
- Infectious diseases and methods of spread of agents involved.
- Laboratory and Hospital acquired infections: possible sources and causes.
- Hazardous groups of microorganisms including genetically modified organisms.
- Basic containment rules and laboratory containment levels.
- Control measures and maintenance of control. Guidelines for workers in pathological Labs. and post mortem rooms.
- Rules for safe conduct of field work expeditions in outdoor activities.
- Risk assessment: recognition of hazards, competence, elimination of hazards, collection of data etc.
- Risk group personnel: their education, training and monitoring.
- Radiation hazards and disposal of radioactive wastes.

Practical

Books Recommended


**EPIDEMIOLOGY: ANALYTICAL AND EXPERIMENTAL APPROACHES**

**Detail of Courses**

- An introduction to epidemiology: Diseases: including cancer, malnutrition, road accidents & mental illness, population, ecological approaches.
- Analytical and experimental epidemiology.
- Epidemiology of communicable diseases: Agents, Reservoir, Host, Route of transmission.
- Epidemiology of non-communicable diseases.
- Tropical environment: Physical, Biological, Social.
- Health statistics.
- Natural immunity (innate) and factors affecting host immunity.
- Control of communicable diseases: general principles of prevention.
- Nosocomial infections.
- Infection Gastrointestinal tract
- Infection through skin and mucous membrane.
- Air and arthropod borne infections.
- Life threatening diseases and their control (AIDS, hepatitis B & C etc).
- Epidemiology and control of nutritional diseases.
- Environmental health and health education: infection and concept.
- Fundamental principles of environmental sanitation and hygiene.
- Public health: quality of life and life style.

**PRACTICAL**

**Books Recommended**


RECOMMENDATIONS

At the end of session the committee recommended that:

1. The committee strongly recommended that there be no mid-point entry into the B.S programme unless they have already had prerequisite courses.

2. Field trips given in the practical session of different courses of BS. programme may be funded by the HEC.

3. Refresher courses in biosafety program may be conducted by the HEC.

4. Survey of undergraduate labs in different universities may be conducted by HEC and funds (partial or total) may be arranged by HEC to cater the basic infrastructure and other requirement for BS. Program.

5. After implementation of BS. program, opinion from students and teachers of microbiology may be obtained by the HEC.

6. Reference culture collection centers may be established in the Karachi University to get the NTCC & ATCC and auxotrophs and prototrophs, culture, maintenance.

7. Separate Microbiology department should be established (with adequate funding) in universities of the provinces other than Sindh.

8. Teaching of Microbiology should be started in some representative colleges in all the provinces of Pakistan. The subject should be taught after appointing a qualified (M.Phil /MS /M.Sc) Microbiologist.

9. The department of Microbiology in all the medical colleges should be administered by a qualified microbiologist with the basic degree in the subject of Microbiology. All the staff members should also be the trained Micro biologists with at least M.Sc. (Microbiology).

10. The committee has strongly felt that Microbiology has been ignored by the Public Service Commissions and scholarship/fellowship awarding agencies. It is therefore recommended that the HEC and Ministry of Science and Technology whenever announcing a scholarship/fellowship must clearly mention Microbiology as one of the discipline in their advertisement. Further more Federal and Provincial Public Service Commissions should be requested to include Microbiology as one of the subjects in their list.

11. Application of biotechnology should be promoted by establishing interaction between industry and universities in the last two years of BS.
Program. Student should get the training (during summer vacation) in industry, hospitals, pharmaceutical industry.

12. **Teachers Training Programm:**
   It is recommended that all the newly appointed Teachers (in microbiology) must be asked to undergo a training to develop the skills of Presentation and communication. Furthermore, the Department of Microbiology, University of Karachi and other elite institutions of the country may be identified as a focal point to train teachers from various colleges/universities having newly established or are establishing departments of Microbiology.

13. **Continuing Education Programme**
   HEC should encourage all the universities to organize programmes for continuing education in the form of workshops/seminars of a day or two, by providing a moderate grant for this purpose solely; some of the areas identified are as follows.
   a. Presentation Skills.
   b. Writing a Paper
   c. How to plan and execute a research program.
   d. Writing and submitting a PC-I
   e. Presentation of dissertation and quality research thesis.