

**CURRICULUM
OF
MICROBIOLOGY
BS (4-YEAR)**

2008



**HIGHER EDUCATION COMMISSION
ISLAMABAD.**

CURRICULUM DIVISION, HEC

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PREFACE

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-economics 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.

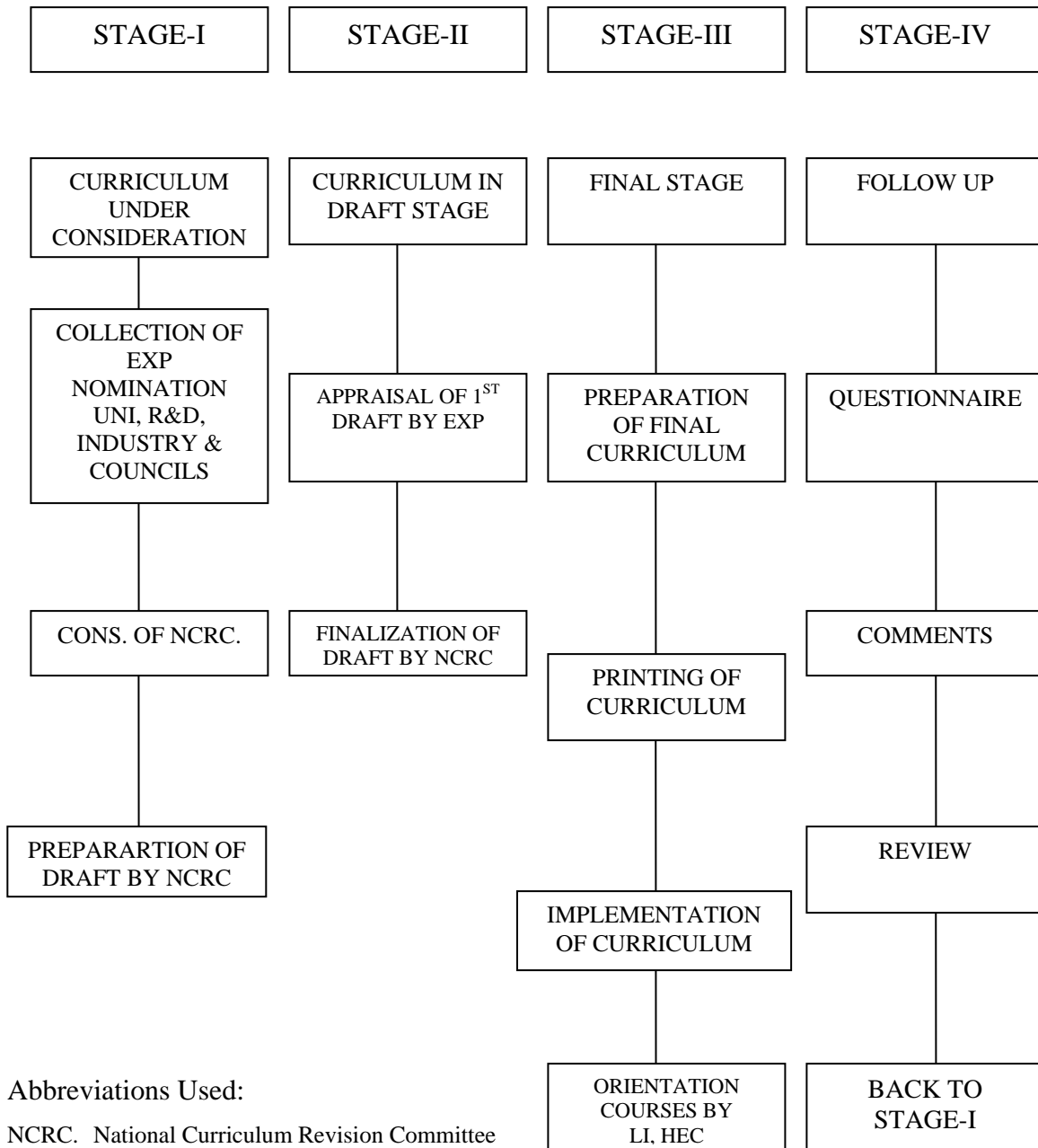
A committee of experts comprising of conveners from the National Curriculum Revision of HEC in Basic, Applied Social Sciences and Engineering disciplines met in April 2007 and developed a unified template to standardize degree programs in the country to bring the national curriculum at par with international 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



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,
Department of Microbiology,
University of Karachi,
Karachi | Convener |
| 2 | Dr. Arifa Tahir,
Assistant Professor of Microbiology,
Department of Env. Science
Lahore College Women University,
Lahore | Member |
| 3 | Prof. Dr. A. Hameed,
Chairman,
Department of Microbiology
Quaid-e-Azam University,
Islamabad | Member |
| 4 | Dr. Bashir A. Channar,
Chairman,
Department of Microbiology,
University of Sindh,
Jamshoro | Member |
| 5 | Dr. Iftikhar Hussain,
Professor/Chairman,
Department of Microbiology,
University of Agriculture,
Faisalabad. | Member |

- | | | |
|---|--|-----------|
| 6 | Dr. Anjum Nasim Sabri,
Associate Professor
Department of Microbiology and Molecular
Genetics,
University of the Punjab,
Lahore. | Member |
| 7 | Dr. Yasmeen Faiz Kazi,
Professor,
Department of Microbiology,
Shah Abdul Latif University,
Khairpur | Secretary |

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)

Compulsory Requirements (the student has no choice)		General Courses to be chosen from other departments		Discipline Specific Foundation Courses	
9 courses		7-8 courses		9-10 courses	
Subject	Cr. Hr	Subject	Cr. Hr	Subject	Cr. hr
1. English I	3	1. Human Phy-I	2+1	1. Gen.Microbiology-I	2+1
2. English II	3	2. Human Phy-II	2+1	2. Gen.Microbiology-II	2+1
3. English III	3	3. Biochemistry-I	2+1	3. Gen.Microbiology-III	2+1
4. Pakistan Studies	2	4. Biochemistry-II	2+1	4. Gen.Imunology	2+1
5. Islamic Studies / Ethics	2	5. Sociology	3+0	5. Microbial Taxonomy	2+1
6. Mathematics-I	3	6. Environmental Current Issues	2+1	6. Gen.Virology	2+1
7. Mathematics II	3	7. Biostatistics	2+1	7. Cell Biology-I	2+1
9. Introduction to Computer	2+1			8. Mycology	2+1
				9. Research Methodology	2+1
				10. Biotechnology	2+1
				11. Biosafety and Risk Management	3+0
	22		21		33

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

* 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

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492

2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506
- b) Writing
1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.
- c) Reading/Comprehension
1. Reading. Upper Intermediate. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.
- 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 resources

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
 - 1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.
- b) Writing
 - 1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 45-53 (note taking).
 - 2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).
- c) Reading
 - 1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
 - 2. Reading and Study Skills by John Langan
 - 3. Study Skills by Richard Yorke.

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
 1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
 2. College Writing Skills by John Langan. Mc=Graw-Hill Higher Education. 2004.
 3. Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.
- b) Presentation Skills
- c) Reading
The Mercury Reader. A Custom Publication. Compiled by northern Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharon. (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

- a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.
- 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

1. Burki, Shahid Javed. *State & Society in Pakistan*, The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy*. Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. *Pakistan's Foreign policy: An Historical analysis*. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. *Pakistan Political Roots & Development*. Lahore, 1994.
5. Wilcox, Wayne. *The Emergence of Banglades.*, Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. *Pakistan Kayyun Toota*, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. *Ethno - National Movement in Pakistan*, Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. *Enigma of Political Development*. Kent England: WmDawson & sons Ltd, 1980.
9. Zahid, Ansar. *History & Culture of Sindh*. Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. *Political Parties in Pakistan*, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. *The Political System of Pakistan*. Boston: Houghton Mifflin, 1967.

12. Aziz, K.K. *Party, Politics in Pakistan*, Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, *Pakistan Under Martial Law*, Lahore: Vanguard, 1987.
14. Haq, Noor ul. *Making of Pakistan: The Military Perspective*. Islamabad: National Commission on Historical and Cultural Research, 1993.

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 SELLECTED 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 SELLECTED 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

SELLECTED 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,"
- 5) Hussain Hamid Hassan, "**An Introduction to the Study of Islamic Law**" leaf Publication Islamabad, Pakistan.
- 6) Ahmad Hasan, "**Principles of Islamic Jurisprudence**" Islamic Research Institute, International Islamic University, Islamabad (1993)
- 7) Mir Waliullah, "**Muslim Jrisprudence and the Quranic Law of Crimes**" Islamic Book Service (1982)
- 8) H.S. Bhatia, "**Studies in Islamic Law, Religion and Society**" Deep & Deep Publications New Delhi (1989)
- 9) Dr. Muhammad Zia-ul-Haq, "**Introduction to Al Sharia Al Islamia**" Allama Iqbal Open University, Islamabad (2001).

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:

1. Anton H, *Calculus: A New Horizon* (6th edition), 1999. John Wiley, New York.
2. Stewart J, *Calculus* (3rd edition), 1995, Brooks/Cole (suggested text)
3. Thomas G. B, Finney A. R., *Calculus* (10th edition), 2002. Addison-Wesley, Reading, Ma, U.S.A.

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:

1. Anton, H., 1999. *Calculus: A New Horizon*, 6th Edition, John Wiley, New York.
2. Stewart J, 1995. *Calculus*, 3rd Edition, Brooks/Cole
3. Thomas, G. B. and Finney, A. R, 2002. *Calculus* 10th Edition, Addison-Wesley, Reading, Ma, U.S.A.

COMPUTER APPLICATIONS

Courses Detail:

- Introduction to Computer and Window 98/2000.
- Word processing (Microsoft Word).
- Spread Sheets (Microsoft Excel) and other related soft ware 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:

1. Shier, D., Butler, J., Lewis, R., 2003. Hole's Essentials of Human Anatomy and Physiology, 8th ed; McGraw-Hill,.
2. Tortora, G. J. J., and Grabowski, S. R., 2000. Principles of Anatomy and Physiology, 9th ed; John Wiley and Sons,
3. Guyton, A. C. and Hall, J. E. 2005. Textbook of Medical Physiology, 12th ed; W. B Saunders,
4. Waugh, A., Grant, 2002. A., Ross and Wilson Anatomy and Physiology in Health and Illness, 9th ed; Churchill Livingstone,
5. Marieb, E. N., 1997 .Human Anatomy and Physiology, 4th ed; Benjamin/Cummings Science Publishing,
6. Hall, J. E and Guyton, A. C., 2005. Guyton and Hall Physiology Review Elsevier Health Sciences.
7. Seifter, J., 2005. Concepts in Medical Physiology. Lippincott Williams and Wilkins.
8. Martini, F. H., and Ober, W. C., 2005. Fundamentals of Anatomy and Physiology, Pearson Education.
9. Marieb, E.N., 2005. Human Anatomy and Physiology Laboratory Manual: Fetal Pig Version, Update, Pearson.
10. Martini, F. H. 2005. Fundamentals of Anatomy and Physiology - Study Guide, Pearson.
11. Wood, M., 2005 Laboratory Manual for Anatomy and Physiology, Cat Version Pearson.
12. Wood, M, G., 2005. Anatomy and Physiology: Main Version Pearson Education.
13. Moore, K, L., Dalley, A. F. and Dalley, A. F., 2005. Clinically Oriented Anatomy .Lippincott Williams and Wilkins

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:

1. Shier, D., Butler, J., Lewis, R., 2003. Hole's Essentials of Human Anatomy and Physiology, 8th ed; McGraw-Hill.
2. Tortora, G. J. J., and Grabowski, S.R., 2000. Principles of Anatomy and Physiology, 9th ed; John Wiley and Sons,

3. Guyton, A. C. and Hall, J. E. 2005. Textbook of Medical Physiology, 12th ed; W. B Saunders.
4. Waugh, A., Grant, (2002). A., Ross and Wilson Anatomy and Physiology in Health and Illness, 9th ed; Churchill Livingstone,
5. Marieb, E.N., 1997. Human Anatomy and Physiology, 4th ed; Benjamin/Cummings Science Publishing,
6. Hall, J. E and Guyton, A. C., 2005. Guyton and Hall Physiology Review Elsevier Health Sciences
7. Seifter, J., 2005. Concepts in Medical Physiology Lippincott Williams & Wilkins.
8. Martini, F. H. and Ober, W. C., 2005. Fundamentals of Anatomy and Physiology, 2005. Pearson Education.
9. Marieb, E. N., 2005. Human Anatomy and Physiology Laboratory Manual: Fetal Pig Version, Update, Pearson.
10. Martini, F. H. 2005. Fundamentals of Anatomy and Physiology - Study Guide, Pearson.
11. Wood, M., 2005. Laboratory Manual for Anatomy and Physiology, Cat Version Pearson.
12. Wood, M. G., 2005. Anatomy and Physiology: Main Version. Pearson Education
13. Moore, K, L., Dalley, A. F. and Dalley, A. F., 2005. Clinically Oriented Anatomy. Lippincott Williams and Wilkins.

BIOCHEMISTRY-I

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.
4. Non 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.
13. Paper chromatography of various amino acids.
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:

1. Voet, D., Voet, J. G. and Pratt, C. W., 2002. Fundamentals of Biochemistry; John Wiley and Sons. Inc., New York.
2. Berg, J. M., Tymoczko, J. L. and Stryer, L., 2002. Biochemistry 5th Edition. W.H. Freeman and Company, New York.
3. Devlin, T. M., 2002. Textbook of Biochemistry with Clinical Correlations 5th Edition. John Wiley and Sons. Inc., New York,
4. Berg, J.M., Tymoczko, J.L., Stryer, L., 2006. Biochemistry: International 6th edition. W. H. Freeman and Co Ltd;

5. Cox, M. and Nelson, D. L., 2005. Lehninger Principles of Biochemistry 4th edition, Palgrave Macmillan.
6. Murray, R., Granner, D., Mayes, P., and Rodwell, V., 2006. Harper's Illustrated Biochemistry 27th Edition. McGraw-Hill Education.
7. Denniston, S., 2006. General, Organic and Biochemistry 5th Edition. McGraw-Hill.

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 absorbtion.
- 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:

1. Voet, D., Voet, J. G. and Pratt, C. W., 2002. Fundamentals of Biochemistry; John Wiley and Sons. Inc., New York.
2. Berg, J. M., Tymoczko, J. L. and Stryer, L., 2002. Biochemistry 5th Edition. W.H. Freeman and Company, New York.
3. Devlin, T. M., 2002. Textbook of Biochemistry with Clinical Correlations 5th Edition. John Wiley and Sons. Inc., New York.
4. Zubay, G., 1995. Biochemistry 4th Edition. W. C. Brown Publishers, Inc., Oxford England.
5. Plummer, D. T., 1990. An Introduction to Practical Biochemistry 4th Edition. McGraw-Hill Book Company, London,
6. Wilson, K. and Walker, J., 1994. Practical Biochemistry: Principles and Techniques, 4th Edition. Cambridge Univ. Press, London
7. Berg, J. M., Tymoczko, J. L., Stryer, L., 2006. Biochemistry: International 6th edition. W.H. Freeman & Co Ltd.
8. Cox, M. and Nelson, D.L., 2005. Lehninger Principles of Biochemistry 4th edition, Palgrave Macmillan.
9. Murray, R., Granner, D., Mayes, P., and Rodwell, V., 2006. Harper's Illustrated Biochemistry 27th Edition. McGraw-Hill Education.
10. Denniston, S., 2006. General, Organic And Biochemistry 5th Edition. McGraw-Hill

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
- Genetically Engineered Foods: Safety, Benefits, Public concerns, Food patents.
- 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:

1. Andrew, L., Stephen, H., and Paul, A., 2004. Ecological Genetics, Blackwell Publishing.
2. Cooper, G.J., 2003. The Science of The Struggle For Existence (On The Foundation Of Ecology, Cambridge University Press.
3. Baker, A.J., 2000. Molecular Methods in Ecology, Science.
4. Nico, M., Straalen, V., and Roelofs, D., 2006. An Introduction to Ecological Genomics. Oxford University Press.

5. Aston, A., Harris, S., Lowe, A., 2004. Ecological Genetics: Planning and Application. Blackwell Science (UK).
6. Costa, L. G., and Eaton, D. L., 2006. Gene-Environment Interactions: Fundamentals of Ecogenetics. John-Wiley and Son Limited.
7. Freeland, J. R., 2005. Molecular Ecology. John-Wiley and Son Limited.
8. Light, A and Rolston III. H. 2003. Environmental Ethics. Blackwell Publishers Ltd. U.S.A.
9. Wenz, P. S., 2001. Environmental Ethics Today, Oxford University Press.
10. Louis P. and Pojman, L. P., 2004. Environmental Ethics: Readings in Theory and Application, 4th edition. Wadsworth Publishing.
11. Light, A., and Rolston, III. H., 2005. Environmental Ethics. Blacwell Publishing Incorporated.
12. Raven, P. H., and Berg, L. R., 2005. Environment, 5th Edition. John-Wiley and Son Limited
13. Bradshaw, V., 2006. The Building Environment: Active and Passive Control Systems, 3rd Edition. John-Wiley and Son Limited

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, ED₅₀ (LD₅₀ 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.
- Probability: Concept of Probability, Laws of Probability.
- 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

1. Stanton, A.G., 2001. Primer of Biostatistics. McGraw Hill.
2. Jekel, J., Elmore, J.G., Katz, D.L., 2001. Epidemiology, biostatistics and preventive medicine. W. B. Saunders.
3. Quinn, G., 2002. Experimental Design and Data Analysis for Biologists. Cambridge University Press.
4. Fernholz L.T, Morgenhaler, S., Stahel, W., 2000. Statistics in Genetics and in Environmental Sciences, Birkhauser Verlag.
5. Kuzma J. W. and Bohnenblust, S. E. 2001, Basis Statistics for the Health Sciences, McGraw-Hill International Education.

LIST OF FOUNDATION COURSES

1. Gen. Microbiology-I
2. Gen. Microbiology-II
3. Gen. Microbiology-III
4. Gen. Immunology
5. Microbial Taxonomy
6. Gen. Virology
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.
2. An introduction to microscopy.

3. Principles of Staining Procedures: Simple staining, Gram's staining, Acid-fast staining, cell-wall staining, flagellar staining, capsule staining, spore staining and spirochaete staining. Study of cell motility by hanging drop preparation.
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:

1. Kathleen P. T., and Arthur, T. 2001. Foundations in Microbiology: Basic Principles McGraw-Hill Companies/
2. Tortora, G. J., Funke, B. R., Case, C. L. 2000. Microbiology: An Introduction, Study Guide. Benjamin-Cummings Publishing Company.
3. Tortora, G. J., Funke, B. R. and Case, C. L. 2004. Microbiology: an introduction 8th Edition, Pearson Education, USA.
4. Tortora, G. J., Christine, L. Case, C. L., Funke, B. R., Funke, B., Case, C., 2006. Microbiology: An Introduction, Publisher: Pearson Education.
5. Alcamo, I. E., 2001. Fundamentals of Microbiology *published by* Jones and Bartlett Publishers, USA.
6. Black, J. G., 2005. Microbiology: principles and explorations, *by* 6th Edition, J. Wiley & Sons, USA.
7. Cappuccino, J. G. and Sherman, N. 2004, Microbiology: a laboratory manual. Pearson Education, USA.
8. Pollack, R. A. Findlay, L., Mondschein, W. Modesto R. R., 2004. Laboratory Exercises in Microbiology *by* 2nd Edition, J. Wiley and Sons, USA.
9. Baker, S., Khan, N., Nicklin, J. and Killington, R., 2006. Instant Notes in Microbiology, 3rd Ed edition, Taylor and Francis.
10. Madigan, M. T. and Martinko, J., 2005. Brock Biology of Microorganisms 11 International Ed edition Prentice Hall.
11. Talaro, K. P., 2006. Foundations in Microbiology: Basic Principles. McGraw Hill. Publisher.

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*.
9. Microscopic study of *Leishmania*, *Entamoeba*, *Plasmodium* and *Giardia*.
10. Antibacterial activity of serum
11. Agglutination test (Widal test).
12. Precipitation tests.

13. Urine analysis (physical, chemical and microbiological)

Recommended Books:

1. Talaro, K. P., 2006. Foundations in Microbiology: Basic Principles. Mcgraw Hill. Publisher.
2. Black, J. G., 2005. Microbiology: principles and explorations, by 6th Edition, J. Wiley & Sons, USA.
3. Cappuccino, J. G. and Sherman, N. 2004, Microbiology: a laboratory manual. Pearson Education, USA.
4. Pollack, R. A. Findlay, L., Mondschein, W. Modesto R. R., 2004. Laboratory Exercises in Microbiology by 2nd Edition, J. Wiley and Sons, USA.
5. Tortora, G. J., Funke , B. R. and Case, C. L. 2008. Microbiology: an introduction 9th Edition, Pearson Education, USA.
6. Maier, R.M., I.L. Pepper and C.P. Gerba. 2000. *Environmental Microbiology*. Academic Press, NY.
7. Pepper, I.L., C.P. Gerba, and J.W. Bredecke. 2004. *Environmental Microbiology - A Laboratory Manual*. Second Edition. Academic Press, San Diego.
8. Pepper, I. L., C. P. Gerba and M. L. Brusseau. 2006. *Environmental and Pollution Science*, Second Edition. Academic Press, San Diego.
9. Haas, C.N., J.B. Rose, and C.P. Gerba. 1999. *Quantitative Microbial Risk Assessment*. John Wiley, NY.

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:

1. Hawkey, P and Lewis, D., 2004. Medical Bacteriology: A Practical Approach. 2nd Edition .Oxford University Press;
2. Mims ,C Dockrell, H., Goering, R., Roitt, I Wakelin, D. and Zuckerman, M., 2004. Medical Microbiology. 3rd Edition. Mosby.
3. Stephen, J., Mims, C.A., Nash, A. 2000. Mims' Pathogenesis of Infectious Disease. 5th Edition. Academic Press Inc., U.S.A.
4. Greenwood, D., Slack, C. B. R., and Peutherer, J. F., 2002. Medical Microbiology: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control. 16th Edition. Churchill Livingstone.
5. Cowan, S. T., Steel, K. J., Barrow ,G. I and Feltham, R. K. A., 2004. Cowan and Steel's Manual for the Identification of Medical Bacteria. 3rd Edition Cambridge University Press.
6. Flint, S. J., Racaniello, V. R., Enquist, L. W. and Skalka, A. M. 2003. Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses. Cambridge University Press.
7. Nigel J. J., Dimmock, K. L. and Andrew E., 2001. Introduction to Modern Virology Blackwell Science, Inc.

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.
6. Gel diffusion 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

1. Nigel, J. J., Dimmock, N. J. J., Keith, L., Andrew, E., 2001. Introduction to Modern Virology . Blackwell Science, Inc.
2. Garrity, G. M., Krieg, N. R., Brenner, D. J., 2006. Bergey's Manual of Systematic Bacteriology: The Proteobacteria, Vol. 2. Williams and Wilkins Co, Baltimore.
3. Ogunseitan, O., 2000. Microbial diversity. John Wiley and Sons.

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).
6. Sample preparation for electron microscopy.
7. Isolation and identification of phages from various sources.

Recommended Books

1. Cann, A. J., 2001. Principles of Molecular Virology Academic Press
2. Griffin, R., Martin, M. A, Straus, H., Griffin, D. E., Robert, G., Lamb, A., Howley, P. M., Roizman, B., Straus, S. E., David, M., 2001. Fundamental Virology Lippincott Williams and Wilkins.
3. Brian, W., Mahy, B., Mahy, W., 2001. A Dictionary of Virology. Academic Press Incorporated.

4. Flint, S. J., Racaniello, V. R., Enquist, L. W. and Skalka, A. M. 2003. Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses. Cambridge University Press.
5. Nigel J. J., Dimmock, K. L. and Andrew E., 2001. Introduction to Modern Virology Blackwell Science, Inc.
6. Zuckerman, A. J., Banatvala, J. E., Pattison, J. R., Griffiths, P., Schoub, B., 2004. Principles and Practice of Clinical Virology, 5th Edition. John Wiley and Sons Limited.
7. Cann, A. J., 2005. Principles of Molecular Virology. Elsevier Science and Technology Books.
8. Wagner, E. K., Hewlett, M. J., 2003. Basic Virology, Blackwell Publishers.
9. Howley, P. M., Roizman, B., Straus, S. E., Martin, M. A., Griffin, D. E., 2001. Fundamental Virology, Lippincott Williams and Wilkins.

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

1. De Robertis, E. D. P and De Robertis Jr. E. M. F. 2001. Cell and Molecular Biology. 8th Edition. Lippincott, Williams and Wilkins Publishers.
2. Karp, G. 2000. Cell and Molecular Biology. Concepts and Experiments. John Wiley and Sons Publishers.
3. Lodish, H. 2001. Molecular and Cell Biology. W.H. Freeman and Co.
4. Gilmartin, P. M. and Bowler, C. 2002. Molecular Plant Biology. Vol 1 and 2. Oxford University Press. UK.
5. Malacinski. G. M. 2003. Essentials of Molecular Biology. 4th Edition. Jones and Bartlett Publishers, Massachusetts.
6. Watson J. D. 2004. Molecular Biology of the Gene. Pearson Education, Singapore.
7. Weaver, R. F. 2005. Molecular Biology. McGraw Hill, St. Louis.
8. Lodish, H., Matsudaira, P., Berk, A., Ploegh, H., Scott, M., Kaiser, C.A., Krieger, M., Bretscher, A., 2007. Molecular Cell Biology. W. H. Freeman Company.
9. Gartner, L. P., Hiatt, J. L. and Strum, J. M., 2003. Cell Biology and Histology. Lippincott Williams and Wilkins.
10. Walker, D., 2007. Cells and Life Processes. Smart Apple Media.
11. Alberts. B., 2007. Molecular Biology of the Cell Taylor and Francis, Inc.
12. Pollard, T. D., Lippincott-Schwartz, J., Earnshaw, W. C., 2007. Cell Biology: Saunders W. B. Co.
13. Karp, G., 2007. Cell and Molecular Biology, Study Guide: Concepts and Experiments. 5th Edition. Wiley, John and Sons Incorporated
14. Bruce Alberts, B., Bray, D., Roberts, K., Lewis, J., Raff, M. 2003. Essential Cell Biology Taylor and Francis Inc.
15. Alberts, E.A., 2006. Essential Cell Biology Academic Internet Publisher
16. Kierszenbaum, A., 2007. Histology and Cell Biology: An Introduction to Pathology Elsevier Health Sciences.
17. Gartner, L. P., Hiatt, J. L., and Strum, J. M., 2003. Cell Biology and Histology. Elsevier Health Sciences.

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

1. Hocking, A.D., Pitt, J.I., Samson, R.A., Thrane, U., 2006. Advances in Food Mycology, Springer.
2. Tkacz, Jan S., Lange, L., 2004. Advances in Fungal Biotechnology for Industry, Agriculture, and Medicine. Springer.
3. Eugene, N., Milton, P. G. and Allen, K., 2004. Agrobacterium tumefaciens: From Plant Pathology to Biotechnology. APS Press.
4. Gioconda, S-B. and Richard, C. A., 2008. Pathogenic Fungi: Insights in Molecular Biology. Caister Academic Press.

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:

1. Hully, S., Cummings, S., Browner, W., Grady, D., Hearst, N. and Neuman, T. 2001. Designing Clinical Research, 2nd ed; Lippincott Williams and Wilkins, Philadelphia.
2. Baumgartner, T. and Hensley, L. 2006. Conducting and Reading Research in Health and Human Performance 4th ed McGraw Hill, New York.
3. Minkler, M. and Walderstein, N., 2003. Community-Based Participatory Research for Health. Josey Boss, San Francisco, CA.
4. Patton, M., 2002. Qualitative Research and Evaluation Methods 3rd ed. Sage Publications Inc., Thousand Oakes, CA
5. Ann Bowling, A. and Ebrahim S. 2005. Handbook of Health Research Methods. Open University Press, Two Penn Plaza, New York, NY.

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

1. David, B., Jewell, T. R. 2000. Biotechnology: demystifying the concept, Oxford University Press.
2. Sedivy, J. M., Joyner, A. L. 2000. Gene targeting, Oxford University Press.
3. Mukhopadhyay, S.N, 2004. Process Biotechnology Fundamentals, 2nd Edition: Viva Books Pvt. Limited, New Delhi.
4. Goodsell, D.S., 2004. Bionanotechnology: Lessons from Nature . John Wiley & Sons Limited.
5. Purohit, S.S., 2002, Biotechnology: Fundamentals and Applications, Agrobios publishers.
6. Prave, P., Faust, U., Sittig, W., and Sukatsch, D.A., 2002. Fundamentals of Biotechnology, John Wiley & Sons.
7. Thauer, R., and Wagner,, F., 1991. Biotechnology Focus: Fundamentals - Applications – Information, Helen Cooper-SchluterCarl Hanser , Verlag GmbH & Co.

8. Kalaitzandonakes, N., 2003. The Economic and Environmental Impacts of Agrobiotech" A Global Perspective. Kluwer.
9. Tourte, Y., and Tourte, C., 2005. Genetic Engineering and Biotechnology: Concepts, Methods, and Agronomic Applications. Science Publishers
10. Christou, P., and Harry Klee, H., 2004. Handbook of Plant Biotechnology, 2-Volume Set. John Wiley and Sons Limited.

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, Marine, Atmosphere.
- Designing of Labs based on Biosafety and Containment Parameters.
- Details of Biological Containment: Plants, Animals, Microbes.

Recommended Books:

1. Biological Safety. Principles and Practices, 4th edition, 2006. by D. O. Fleming and D.L. Hunt (ed.). ASM Press, Washington, D.C.
2. Biological Weapon Defence: Infectious diseases and counter bioterrorism. 2004. L. E. Lindler, F. J. Lebeda, G. W. Korch. Humana Press.
3. Biodefence. M. S. Bronze and R. A. Greenfield. 2005. Horizon Biosciences.
4. Laboratory Biosafety Manual, 3rd edition, 2004. WHO, Geneva.
5. Biosafety in Microbiological and Biomedical laboratories. Centers for Disease Control and Prevention and National Institutes of Health., 5th edition, 2007.
6. Laboratory biosafety guidelines. Kennedy, M.E., et al., eds. 3rd ed. Ottawa: Office of Laboratory Security, Public Health Agency of Canada, 2004

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.
4. Ames test for identification of mutagenic agents.

Recommended Books

1. De Robertis, E. D. P and De Robertis Jr. E. M. F. 2001. Cell and Molecular Biology. 8th Edition. Lippincott, Williams and Wilkins Publishers.

2. Karp, G. 2000. Cell and Molecular Biology. Concepts and Experiments. John Wiley and Sons Publishers.
3. Lodish, H. 2001. Molecular and Cell Biology. W. H. Freeman and Co.
4. Gilmartin, P. M. and C. Bowler. 2002. Molecular Plant Biology. Vol 1 and 2. Oxford University Press. UK.
5. Malacinski. G. M. 2003. Essentials of Molecular Biology. 4th Edition. Jones and Bartlett Publishers, Massachusetts.
6. Watson J. D. 2004. Molecular Biology of the Gene. Pearson Education, Singapore.
7. Weaver, R. F. 2005. Molecular Biology. McGraw Hill, St. Louis.
8. Lodish, H., Matsudaira, P., Berk, A., Ploegh, H., Scott, M., Kaiser, C. A., Krieger, M., Bretscher, A., 2007. Molecular Cell Biology. W. H. Freeman Company.
9. Gartner, L. P., Hiatt, J. L. and Strum, J. M., 2003. Cell Biology and Histology. Lippincott Williams and Wilkins.
10. Walker, D., 2007. Cells and Life Processes. Smart Apple Media.
11. Alberts. B., 2007. Molecular Biology of the Cell Taylor and Francis, Inc.
12. Pollard,T.D., Lippincott-Schwartz, J., Earnshaw, W.C., 2007. Cell Biology: Saunders W. B. Co.

MICROBIAL ANATOMY AND PHYSIOLOGY

Learning Objectives

- Identify the basic components of all cells.
- Distinguish the features of procaryotic cells.
- Distinguish the characteristics of eucaryoatic 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.
- Microbial enzymes and metabolites. Classifications, chemistry, mechanism of action and inhibition.

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

1. Atlas, R. M. 1998. Microbiology: fundamentals and applications. MacMillan Publishing Co. U.S.A.
2. Davis, B. D., Dulbecco, R., Eisen, H. N., Ginsberg, H., Wood, J. R. 1990 Microbiology 4th Ed. Harper and Row Publisher, U.S.A.
3. Levin, B., 1996. Genes VI. Oxford University, Oxford.

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

1. Gerhard, G., 1994. Aquatic Microbiology. John Wiley and Sons, Inc.
2. Laybourn-P. and Johanna., 2006. Freshwater Biology, Volume 51, Number 10. Blackwell Publishing.
3. David, S., 2004. Freshwater Microbiology: Biodiversity and Dynamic Interactions of Microorganisms in the Aquatic Environment. Wiley Publisher.
4. Robson, G. D, van West P. and Gadd, G. M., 2007. Exploitation of Fungi. Cambridge University Press.
5. Gjedrem, T., 2005., Selection and Breeding Programs in Aquaculture. Springer-Verlag New York, LLC
6. Lutz, C.G.G., and Lutz, C.G., 2001. Practical Genetics for Aquaculture . Iowa State Press.
7. Greer, D., and Harvey, B., 2004. Blue Genes: Sharing and Conserving the World's Aquatic Biodiversity, Earthscan/James & James Publishers.
8. Paul Southgate, P., and Lucas, J., 2003. Aquaculture: Farming Aquatic Animals. Iowa State Press.
9. Doyle , R. W.,Gall ,G. A., Herbinger, C. M., Ball , M.,1996. Genetics in Aquaculture V. Elsevier Science & Technology Books.
10. Shimizu, N., Aoki, T. and Shimizu, N., 2003. Aquatic Genomics: Step toward a Great Future. 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 archaeobacterial 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-phylogenetic 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

1. Uldis, N., Streips, U. N., Ronald, E., Yasbin, R. E., 2002. Modern Microbial genetics. Wiley, John and Sons, Inc.
2. Pierca, B. A., 2005. Genetics. A conceptual approach, W. H. Freeman and Company, New York.
3. Synder, L. and Champness, W. 2004. Molecular Genetics of Bacteria. ASM Press, Washington D.C.
4. Gardner, E. J., 2004. Principles of Genetics, John Willey and Sons, New York.
5. Ringo, J., 2004. Fundamental Genetics, Cambridge University Press.
6. Griffiths, A. J. F., Wessler, S. R., Lewontin, R. C., Gelbart, W. M., Suzuki, D.T., and Miller, J. H., 2005, Introduction to Genetic Analysis, W. H. Freeman and Company.
7. Snyder, L. and Champness W., 2003, Molecular Genetics of Bacteria, ASM Press.
8. Hartl, D. L. and Jones, E. W., 2005, Genetics - Analysis of Genes and Genomes, Jones and Bartlett Publishers. Sudbary, U.S.A.

9. Hedrick, P.W., 2005. Genetics of Population. Jones and Bartlett Publisher, Sudbury, U.S.A.
10. Trun, N and Trempy J., 2004, Fundamental Bacterial Genetics, Blackwell Publishing House.
11. Winnacker, E. L., 2003, From Gene to Clones – Introduction to Gene Technology, Panima Publishing Corporation, New Delhi.
12. Beaycgamp, T. L. and Walters L., Contemporary Issues in Bioethics, Wadsworth Publishing Company.
13. Brown, T.A., 2002. Genomes, Bios Scientific Publishers Ltd.
14. The Genome of Homo Sapiens, 2003, Cold Spring Harbor Laboratory Press.
15. Ignacimuthu, S., 2005, Basic Bioinformatics, Narosa Publishing House, India.
16. Lwein, B., 2004, Gene VIII, Pearson Education Int.
17. Miglani, 2003, Advanced Genetics, Narosa Publishing House, India,.
18. Primrose, S. B., Twyman, R. M. and Old R.W. 2004. Principles of Gene Manipulation, an Introduction to Genetic Engineering (6th edition), Blackwell Scientific Publications.
19. Primrose, S. B., and Twyman, R. M., 2006. Principles of Gene Manipulation. And Genomics. Blackwell Scientific Publications.
20. Wilson, J. and Hunt, T., 2004. Molecular Biology of the cell – the problems book, Garland publishing Inc.
21. Snustad, D. P. and Simmons, M. J., 2005. Principles of Genetics, 4th Edition. John-Wiley and Son Limited.
22. Kornberg,A. and Baker, T. A., 2005. DNA Replication, 2^d edition, University science books, Sausalito, California,
23. Jack, J. P., 2005. An Introduction to Human Molecular Genetics, 2nd edition New Jersey Wiley.
24. Tamarin, R. H., 2002. Principles of Genetics. McGraw-Hill Science.
25. Brooker, R. J., Genetics. 2005. McGraw-Hill Science.
26. Leland, H., Leroy, H., Michael, G.L., Silver, L., Lee M., Veres, R. C. and Ann. R., 2004. Genetics. McGraw-Hill Science.
27. Costa, L.G., and Eaton, D. L., 2006. Gene-Environment Interactions: Fundamentals of Ecogenetics, John Wiley and Sons Limited.

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

1. Gladwin, M., Trattler, B., Trattler, B., 2004 Clinical Microbiology Made Ridiculously Simple, 3rd Edition, MedMaster, Incorporated.
2. Jones, S. L., and Ed. Jones, R., 2001, Clinical Laboratory Pearls . Lippincott Williams and Wilkins.
3. Murray, P. R., Rosenthal, K. S., Tenover, M. C., Tenover, K. S., 2005, Medical Microbiology: Elsevier Health Science.
4. McClatchey, K. D., Keren, D. F., Hackel, E., Lewandrowski, K. and Alkan, S., 2001. Clinical Laboratory Medicine . Lippincott Williams and Wilkins.
5. Hawkey, P and Lewis, D., 2004. Medical Bacteriology: A Practical Approach. 2nd Edition .Oxford University Press.
6. Mims, C Dockett, H., Goering, R., Tenover, J. C. and Tenover, M., 2004. Medical Microbiology. 3rd Edition. Mosby.
7. Greenwood, D., Slack, C. B. R., and Peutherer, J. F., 2002. Medical Microbiology: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control. 16th Edition. Churchill Livingstone.
8. Cowan, S.T., Steel, K.J., Barrow, G. I. and Feltham, R. K. A., 2004. Cowan and Steel's Manual for the Identification of Medical Bacteria. 3rd Edition. Cambridge University Press.

SOIL MICROBIOLOGY

Learning objectives

- Discovery how microbial ecologists view relationship of microorganisms
- Examine the major kinds of interactions microorganisms enter into
- Examine 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

1. Tate, R. L., 2000. Soil Microbiology. Wiley, John and Sons, Inc.
2. Davet, P. 2004. Microbial ecology of soil and plant growth. Science Publishers.

3. Ellass, V., 2006. Modern Soil Microbiology. 2nd Edition.
4. Sylvia, D. M., Fuhrmann, J. J., Hartel, G., Zuberer, D. A. 1998. Principles and applications of soil microbiology, Oxford University Press.
5. Diane Tice, D., 2005. Principles and Applications of Soil Microbiology. 2nd Edition.

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 countries.
- Detailed study of predisposing factors in developed countries and a comparison with the existing factors in Pakistan.

Recommended Books

1. Salyers, A. A. and Whitt, D. D., 2002. Microbiology: Diversity, Disease, and the Environment. John-Wiley and Son Limited.
2. Ziegler, A., and Koenig, I. R., 2006. A Statistical Approach to Genetic Epidemiology: Concepts and Applications. John-Wiley and Son Limited.
3. Haines, J. L., Pericak-Vance, M. A., 2006. Genetic Analysis of Complex disease. Wiley, John and Sons Incorporated.
4. Adami, H.O., Hunter, D., Trichopoulos D., 2002. Textbook of Cancer Epidemiology. Oxford Press.
5. Seedhouse, D., 2003. Health Promotion: Philosophy, Prejudice and Practice, 2nd Edition. John Wiley and Sons limited.
6. Robine, J.M., Jagger,C., Mathers, C.D., Crimmins, E.M. and Suzman , R.M., 2002.Determining Health Expectancies. John Wiley and Sons limited.
7. Tan, J., 2005. E-Health Care Information Systems: An Introduction for Students and Professionals. John Wiley and Sons limited.
8. Boss, M.J.J., and Day, D.W. and Day, D.W., 2002.Biological Risk Engineering Handbook: Infection Control and Decontamination. Lewis Publishers.
9. Novak, J.S.S., Novak, J.S., Sapers, G.M. and Juneja, V.K., 2006. Microbial Safety of Minimally Processed Food. CRC Press.
10. Crosby, R.A.,. DiClemente, R.J., Salazar, L.F and Green, L.W., 2006. Research Methods in Health Promotion. John Wiley and Sons limited.
11. Khardori, N., 2006. Bioterrorism Preparedness: Medicine - Public Health Policy. John Wiley and Sons limited.
12. Fay, A., Rozovsky, J. D., Woods, Jr., J.M. and Bellamy, M., 2005. The Handbook of Patient Safety Compliance: A Practical Guide for Health Care Organizations. John Wiley and Sons limited.
13. DiNardi, S.R., 2003.Occupational Environment: Its Evaluation, Control, and Management. American Industrial Hygiene Association.

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

1. Ho- Yu, M., 2004. Environmental Toxicology, 2nd edition, CRC press
2. Kofi asanteduah, D., 2002. Public health risk assessment for human exposure to chemicals, Springer.
3. Caravati, E. M., Michael, A., and Lippincott, M., 2003. Medical Toxicology, Williams and Wilkins.
4. Tickner, J. A., 2002. Precaution, environmental science, and preventive public policy, 2002, island press.
5. Borlak, J., 2005. Handbook of Toxicogenomics: Strategies and Applications John-Wiley and Son Limited.
6. Heikki, M., Hokkanen, T. and Hajek, A. E., 2004. Environmental impacts of microbial insecticide: needs and methods for risk assessment, Science.
7. Sunahara, G.I., Agnes Y., Renoux, A.Y., Thellen, C., Gaudet, C.L., and Pilon, A., 2002. Environmental Analysis of Contaminated Sites. John-Wiley and Son Limited.
8. Barnett, V., 2003. Environmental Statistics: Methods and Applications . John-Wiley and Son Limited.
9. Douben, P. E. T., 2003. PAHs: An Ecotoxicological Perspective. John-Wiley and Son Limited.
10. Kalaitzandonakes, N., 2003. The Economic and Environmental Impacts of Agbiotech" A Global Perspective. Kluwer.

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, antimetabolic 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

1. Greenwood, D. 2000 Antimicrobial chemotherapy. Oxford Univ. Press.
2. Greenwood ,D., Finch ,R., Davey ,P., Wilcox ,M., 2007. Antimicrobial Chemotherapy.5th Edition. Oxford University Press.
3. Franklin, Trevor J., Snow, G.A. 2005. Biochemistry and Molecular Biology of Antimicrobial Drug Action. Springer.
4. Hauser, A. R., 2007. Antibiotic Basics for Clinicians. Wolters Kluwer Health.
5. Häusler, T., 2006. Viruses VS. Superbugs A solution to the Antibiotics Crisis? Macmillan Science.
6. Greenwood, D., Finch ,R., Davey, P., Wilcox ,M., 2007. Antimicrobial Chemotherapy. Oxford University Press; 5Rev Ed edition.

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.
- Properties of restriction endonucleases, their occurrence and recognition sequences. Assay procedures for restriction endonucleases and slab gel electrophoresis. Practical uses of endonucleases. Role in genetic engineering.
- Exchange of genes between a lambda phage and Col EI 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. Electroblothing.
6. Transformation.

Recommended Texts

1. Robert F.W., 2005. Molecular Biology . McGraw-Hill.
1. Dale, J.W. and von Schantz , M. 2002. From Genes to Genomes: Concepts and Applications of DNA Technology . John-Wiley and Son Limited.
2. Meyers, R.A., 2006. Genomics and Genetics . John-Wiley and Son Limited.
2. Primrose, S.B., and Twyman, R.M. 2006. Gene Manipulation and Genomics 6th edition. Blackwell Publishing

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.
7. Animal inoculation.
8. Fluorescent Antibody Test (FAT).
9. Polymerase Chain Reaction (PCR).

Recommended Books

1. Alan, J. C., 2001. Principles of Molecular Virology. Academic Press,
2. Roizman, Griffin, Malcolm A. Martin, *et al.* 2001. Fundamental Virology Lippincott Williams and Wilkins.
3. Lamb, R., Malcolm, A., Martin, D. E. *et al.* 2001. Fields Virology Lippincott Williams and Wilkins.
4. Brian, W., Mahy, B. W. M., 2001. A Dictionary of Virology Academic Press.
5. Nigel J. J. D., K., Leppard, A. E., A., Easton, K. L., 2001. Introduction to Modern Virology. Blackwell Science, Inc.
6. Flint, S. J., Enquist, L. W., Racaniello, V. R., Skalka, A. M., 2003. Principles of Virology: molecular biology, pathogenesis, and control of animal viruses 2nd Edition, American Society for Microbiology, U.S.A.
7. Wagner, E. K. and Hewlett, M. J., 2003. Basic Virology. 2nd Edition. Blackwell Publishers, U.S.A.

8. Fields, B. N., Peter, M., Howley, M. D., Diane, E., Griffin, A. Roberts, A., Malcolm, M. D., Martin, B., Roizman, E., Stephen, M. D., Straus, M., David, K., 2001. Field's Virology. CD Edition. Lippincott Williams & Wilkins, U.S.A.
9. Harper, D. R., Harper, D. R., Kinchington, P. R., 1999. Molecular Virology. 2nd Edition, BIOS Scientific Publishers, U.S.A.
10. Hull, R., 2001. Matthew's Plant Virology. 4th Edition, Academic Press, U.S.A.

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.
- Antibody induction and production: antigen and antibody metabolism. Cells involved in cellular sequence of events. Kinetics of antibody synthesis.
- 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.
8. Complement fixation test.
9. Gel diffusion test.

Recommended Books:

1. Levinson, W. E., 2004. Medical Microbiology and Immunology. McGraw-Hill Medical.
2. Falus, A., 2006. Immunogenomics and Human Disease. Blackwell Publishers.
3. Abbas, A. K., Lichtman, A. H., 2005. Cellular and Molecular Immunology, 5th Edition. Elsevier Saunders Pennsylvania.
4. Jonathan, M. and Austyn, J. M., 1993. Principles of Cellular and Molecular Immunology Oxford University Press.
5. Singh, B., 1993. Advances in Molecular and Cellular Immunology, Elsevier.
6. Pollard, K.M., 2005. Autoantibodies and Autoimmunity: Molecular Mechanisms in Health and Disease . John-Wiley and Son Limited.
7. Deretic, V., 2006. Autophagy in Immunity and Infection: A Novel Immune Effector . John-Wiley and Son Limited.
8. Coico, R., Sunshine, G., and Benjamini, E., 2003. Immunology: A Short Course, 5th Edition. John-Wiley and Son Limited.
9. Hamann, A., and Engelhardt, B., 2005. Leukocyte Trafficking: Molecular Mechanisms, Therapeutic Targets, and Methods. John-Wiley and Son Limited.
10. Eales, L-J., 2003. Immunology for Life Scientists, 2nd Edition. John-Wiley and Son Limited.
11. Meager, A., 2006. The Interferons: Characterization and Application. John-Wiley and Son Limited.
12. Goldsby, D. A., Kuby, J., Kindt, T. J., Osborne, B. A., Kindt, O., and Kuby W. Immunology. H. Freeman Company
13. Janeway, C., Travers, P., Walport, M., Shlomchik, M., 2004. Immunobiology: The Immune System in Health and Disease. Taylor and Francis, Inc.
14. Paul, W., 2006., Fundamental Immunology. Fifth Edition. Lippincott Williams and Wilkins.
15. Lichtman., A. H., 2007. Basic Immunology. Elsevier Health Sciences.
16. Abbas, A. K., Lichtman, A. H., and Pillai., S., 2007. Cellular and Molecular Immunology: Elsevier Health Sciences.
17. Chen, E. R., Kasturi, S., 2006. DeJa Review: Microbiology and Immunology. McGraw-Hill Companies.
18. Johnson, A. G. G., Ziegler, R. J., Lukasewycz, O. A., Lukasewycz, O. A., 2006. Microbiology and Immunology: Board Review Series. Lippincott Williams and Wilkins.
19. Van Emon, V. M., Van Emon J. M., 2006. Immunoassay and Other Bioanalytical Techniques. CRC Press.
20. Sears, B. W., Saenz, R. E., Spear, L. M., 2006. Hardcore Microbiology and Immunology: Lippincott Williams and Wilkins.

RESEARCH PROJECT

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.

DETAILS OF CORUSES

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

1. Smith, R., 2000. Plant Tissue Culture. Academic Press.
2. Freshney, II., .2000. Culture of animal cells: A manual of basic techniques Wiley, John and Sons
3. Masters, J. R., 2000. Animal cell culture. Oxford University Press.
4. Lanza, R. P., Lanza, B., Atala, A., 2001. Methods of tissue engineering Academic Press Inc.
5. Doyle, A., Griffiths, J. B., 1998. Cells and tissue culture: Laboratory. procedures in biotechnology. Wiley, John and Sons.
6. Barnum, S., 2004. Biotechnology: An Introduction (with Infotrac) Brooks /Cole.
7. Halford, N., 2006. Plant Biotechnology: Current and Future Applications of Genetically Modified Crops .John Wiley and Sons Limited.
8. Christou, P., and Harry Klee, H., 2004. Handbook of Plant Biotechnology, 2-Volume Set. John Wiley and Sons Limited.
9. Slater, A., Scott, N. W., and Fowler, M. R., 2003. Plant Biotechnology: The Genetic Manipulation of Plants. Oxford University Press, U.S.A.
10. Nguyen , H. T., and Blum, A., 2004. Physiology and Biotechnology Integration for Plant Breeding, Vol. 100. Marcel Dekker.
11. Tourte, Y., and Catherine, T. C., 2005. Genetic Engineering and Biotechnology: Concepts, Methods, and Agronomic Applications. Science Publishers.
12. Houdebine, L-M., 2003. Animal Transgenesis and Cloning. John Wiley and Sons Limited.

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 *Corynebacterium glutamicum*.
Tryptophan biosynthesis in *Neurospora crassa*.

Recommended Books

1. David, B., Jewell, T.R. 2000. Biotechnology: demystifying the concept, Oxford University Press.
2. Sedivy, J. M., Joyner, A. L. 2000. Gene targeting, Oxford University Press.
3. Baumberg, S. 1999. Prokaryotic gene expression, Oxford University Press.
4. Stanbury, P. F. and Whitaker, A., 1995. Principles of Fermentation Technology, Pergamon Press
5. Fell, D., 1996. Understanding the control of metabolism, Portland Press
6. Serageldin, I., and Persley, G. J., 2003. Biotechnology and Sustainable Development: Voices of the South and North. Oxford University Press.
7. Ricardo Melendez-Ortiz, R., and Sánchez, V., 2005. Trading in Genes: Development Perspectives on Biotechnology, Trade and Sustainability. Earthscan/James and James.

8. Olguin, E., Sanchez, G., and Elizabeth Hernandez, E., 1999. Environmental Biotechnology and Cleaner Bioprocesses. CRC Press.
9. Agathos, S.N.N. and Reineke, W., 2002. Biotechnology for the Environment: Soil Remediation. Springer-Verlag New York, LLC.
10. Zhong, J-J., 2004. Biomanufacturing. Springer-Verlag New York, LLC.
11. Stevens, C., Verhe, R., Verhé, R., 2004. Renewable Bioresources: Scope and Modification for Non-Food Applications. Wiley, John and Sons, Incorporated.
12. Prasad, B. N. N., 2003. Biotechnology in Sustainable Biodiversity and Food Security. Science Publishers, Incorporated.
13. Groves, M. J., 2005. Pharmaceutical Biotechnology. CRC Press.
14. Glick, B. R., and Pasternak, J., 2002. Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press.
15. Klefenz, H., 2002. Industrial Pharmaceutical Biotechnology, Wiley-VCH Verlag GmbH.
16. Mukhopadhyay, S. N., 2004. Process Biotechnology Fundamentals, 2nd Edition: Viva Books Pvt. Limited, New Delhi.
17. Goodsell, D. S., 2004. Bionanotechnology: Lessons from Nature . John Wiley and Sons Limited.
18. Purohit, S. S., 2002, Biotechnology: Fundamentals and Applications, Agrobios publishers.
19. Prave, P., Faust, U., Sittig, W., and Sukatsch, D. A., 2002. Fundamentals of Biotechnology, John Wiley and Sons.
20. Thauer, R., and Wagner, F., 1991. Biotechnology Focus: Fundamentals - Applications – Information, Helen Cooper-SchluterCarl Hanser, Verlag GmbH and Co.

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

1. Hull, R., 2001. Matthews' Plant virology. Academic Press.
2. Prell, H. H., Day, P. R., 2001. Plant-fungal pathogen interactions: A classical and molecular view. Springer Verlag.
3. Skinner, F.A., Rhodes-Roberts, M. E., 1982. Bacteria and plants. Academic Press Inc.
4. Zadoks, J. C., Schein, R. D., 1979. Epidimiology and plant disease management. Oxford University Press.
5. Agrios, G. N., 1997. Plant Pathology. Morgan Kaufmann Publishers
6. Lucas, J. A., Dickinson, C. H., 1998. Plant Pathology and Plant Pathogens. Blackwell Science Inc.
7. Vedhaysekar, P., 1997. Fungal Pathogenesis in Plants and crops: Molecular biology and host defence mechanisms. Marcell Dekker.
8. Ingram, D. S., 1985. Advances in plant Pathology. Academic Press Inc.
9. Maloy, O. C., Murray, T. D., 2000. Encyclopedia of plant pathology. Wiley, Johns and Sons.

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 organoleptic 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

1. Jay, J. M. M., 2000. Modern Food Microbiology. Aspen Publishers.
2. Steele, Sr., JL Marth, E. H., 2001. Applied Dairy Microbiology. Marcel Dekker.
3. Molins, R. A., 2001. Food irradiations: Principles and applications. Wiley, John and Sons.
4. Reuter, H., 1989. Aseptic packaging of foods. CRC Press, LLC.
5. Barbosa-Canovas, P, E., Swanson P. U. R., 1997. Nonthermal preservation of food. Marcel Dekker.
6. Luck E., Jager, M., Laichen, S. F., 2000. Antimicrobial food additives: Characteristics, uses, effects. Springer-Verlag, NY, Inc.

7. Jay, J. M., Loessner, M. J. and Golden, D. A., 2006. Modern Food Microbiology. 7th Edition, Springer Science, Inc., U.S.A.
8. Karl, R. and Matthews, M. P., 2006. Doyle Microbiology. ASM Press.
10. Han, J., 2005. Innovations in Food Packaging, Elsevier Science and Technology Books.
11. James, G., 2006. Brennan Food Processing Handbook. Wiley, John and Sons, Incorporated.

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

1. Alan, J. C., 2001. Principles of Molecular Virology. Academic Press.
2. Roizman, Griffin, Malcolm A. Martin, *et al.* 2001. Fundamental Virology. Lippincott Williams and Wilkins.
3. Robe, L., Malcolm, A. M., Diane, E. *et al.* 2001. Fields Virology Lippincott Williams and Wilkins.
4. Brian, W. M. and Mahy, B. W., 2001. A Dictionary of Virology Academic Press.
5. Nigel J. J. D., K., Leppard, A. E., A., Easton, K. L., 2001. Introduction to Modern Virology. Blackwell Science, Inc.

6. Alan J. C., 2000. Virus Culture: A Practical Approach Oxford University Press.

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

1. Gladwin, M., Trattler, B., Trattler, B., 2004. Clinical Microbiology Made Ridiculously Simple, 3rd Edition, MedMaster, Incorporated.
2. Jones, S. L., and Ed. Jones, R., 2001. Clinical Laboratory Pearls. Lippincott Williams and Wilkins.
3. Murray, P.R., Rosenthal, K.S., Pfaller, M.A., Rosenthal, K.S., 2005. Medical Microbiology: Elsevier Health Science.
4. McClatchey, K. D., Keren, D. F., Hackel, E., Lewandrowski, K. and Alkan, S., 2001. Clinical Laboratory Medicine. Lippincott Williams and Wilkins.
5. Hawkey, P and Lewis, D., 2004. Medical Bacteriology: A Practical Approach. 2nd Edition .Oxford University Press.
6. Mims, C Dockrell, H., Goering, R., Roitt, I., Wakelin, D. and Zuckerman M., 2004. Medical Microbiology. 3rd Edition. Mosby.
7. Stephen, J., Mims, C. A., Nash, A. 2000. Mims' Pathogenesis of Infectious Disease. 5th Edition. Academic Press Inc.,U.S.

8. Greenwood, D., Slack, C. B. R., and Peutherer, J. F., 2002. Medical Microbiology: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control. 16th Edition. Churchill Livingstone
9. Cowan, S. T., Steel, K. J., Barrow, G. I. and Feltham, R. K. A., 2004. Cowan and Steel's Manual for the Identification of Medical Bacteria. 3rd Edition. Cambridge University Press.
10. Brooks, G. F., Morse, S, A., Butel, J., and Butel, J. S., 2001. Jawetz, Melnick, and Adelberg's Medical Microbiology. McGraw-Hill Companies.
11. Pfaller, M. A., Rosenthal, K. S., Murray, P. R. 2005. Medical Microbiology. Mosby Publishers.
12. Cliver, R., 2001. Foodborne Diseases. Morgan Kaufmann Publishers
13. Nigel J. J., Dimmock, K. L. and Andrew E., 2001. Introduction to Modern Virology Blackwell Science, Inc.
14. Heitman, J., Edwards, J. E., Mitchell, A., Filler, S. G., and Mitchell, A. P., 2006. Molecular Principles of Fungal Pathogenesis. ASM Press.

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

1. Paul, J., 2001. Marine Microbiology (Methods in Microbiology Vol. 30). Academic Press, Inc.
2. Kirchman, D. L., Kirchman, D. L., 2000. Microbial ecology of the ocean. Wiley, Johns and Sons Inc.
3. Munn, C., 2003. Marine microbiology: Ecology & application. Lavoisier.

4. Paul F. and Andrew H. K., 2007. Evolution of Primary Producers in the Sea. Academic Press.
5. Horst, D. S. and Matthias Z., 2006. Marine Geochemistry. Springer
6. Stuart, F. and Robert L. S., 2002. Aquatic Ecosystems: Interactivity of Dissolved Organic Matter. Academic Press.

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, hepatitis viruses, enteroviruses, retroviruses, poxviruses, orthomyxoviruses, paramyxoviruses and arboviruses.
- DNA amplification by PCR and DNA based detection systems.
- Interpretation of Lab, investigation.

Books Recommended

1. Grist, N. R., Elanor, J. B., Follett, E. A. C. and Urqhart, E. G. D. (Latest edition) Diagnostic methods in clinical virology. Blackwell Scientific Publishing.
2. Knipe, DM. *et al.*, 2001. Virology. MacMillan Press.
3. Robe, L., Malcolm, A., Martin, D. E. 2001. Fields Virology Lippincott Williams and Wilkins.
4. Alan J. C., 2000. Virus Culture: A Practical Approach. Oxford University Press.
5. Zuckerman, A.J., Banatvala, J.E., Pattison, J.R., Griffiths, P., and Schoub, B., 2004. Principles and Practice of Clinical Virology, 5th Edition. John Wiley and Sons Limited.
6. Cann, A.J., 2005. Principles of Molecular Virology. Elsevier Science & Technology Books.
7. Flint, S.J., Racaniello, V.R., Enquist, L.W., and Skalka, A.M., 2003. Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses American Society Microbiology.
8. Wagner, E.K. and Hewlett, M.J., 2003. Basic Virology, Blackwell Publishers.
9. Howley, P.M., Roizman, B., Straus, S.E., Martin, M.A. and Griffin, D.E., 2001. Fundamental Virology, Lippincott Williams & Wilkins.

MOLECULAR IMMUNOLOGY

Course Detail

- Molecular basis of immunogenicity and antigenic specificity: distinction and parameters.
- Basis of immunodominance.
- 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

1. Abbas, K., Lichtman and Jordan, S. P., 2001. Cellular and Molecular Immunology. W. B. Saunders.
2. Stites, D.P., Terr, A. I. and Parslow, T. J., 2001. Immunology. Appleton and Lange.
3. Glick, B.R. and Pasternak, J. J., 2001. Molecular Biotechnology. ASM Press.
4. Journal of Immunology (2001 issues).
5. Infection and Immunity – ASM Press, USA.
6. Frank C. H. and Olwyn. M. R.W., 2002. Practical Immunology. Blackwell Publishing.

CLINICAL PARASITOLOGY

Course Detail

- Etiology, life cycle, epidemiology, symptomatology, pathogenesis, lab. diagnosis, treatment, prevention and control of:
Protozoa, Entamoeba histolytica, Giardia lamblia, Plasmodium spp, Balantidium coli, Trypanosoma spp, Leishmania spp, Toxoplasma gondii, Trichomonas vaginalis.
- Brief introduction to others.
- Helminthes, *Ascaris lumbricoides, Enterobius vermicularis, Trichuris trichiura, Ancylostoma duodenum and Necator americanus, Wucherria bancrofti, Taenia solium & Taenia saginata, Echinococcus granulosus, Hymenolepsis nana, Schistosoma haematobium, Fasciola hepatica*, Brief introduction to others.
- Recent advances in the control of parasitic infections³).

Books Recommended

1. Dwight, D. B., Charles, M. H., David, S. L. and Stephen C. B., 2002. Feline Clinical Parasitology. Blackwel publishing.
2. Anne, Z. and Gary C., 2006. Veterinary Clinical Parasitology. Blackwel publishing.
3. Judith S. Heelan., 2001. Essentials of Human Parasitology. Delmar Pub.
4. Hannah, A., Mats, W., Inger, L., Ewert, L., 2003. Parasites of the Colder Climates. Taylor and Francis.

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

1. Jay, J. M. M., 2000. Modern Food Microbiology. Aspen Publishers.
2. Steele Sr., J. L., Marth, E. H., 2001. Applied Dairy Microbiology. Marcel Dekker.

3. Molins, R. A., 2001. Food irradiations: Principles and applications. Wiley, John and Sons
4. Luck E., Jager, M laichen, S. F., 2000. Antimicrobial food additives: Characteristics, uses, effects. Springer-Verlag, NY, Inc.

IMMUNOHAEMATOLOGY

Courses Detail

- General aspects of hematology, processes of hematopoises.
- 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.
- Methods for detection of cellular immunity. Separation and identification of lymphocytes and macrophages. Applications of CD markers and monoclonal antibodies. Flow cytometry and cell sorting.
- Complications and consequences of blood transfusions.
- Blood complement therapy.

PRACTICAL

Books Recommended

1. Eva, D. Q., 2000, "Immunoematology: Principles and Practice" , Lippincott Williams and Willkins.
2. Kimball, J. W., 2000. " Introduction to Immunology", New York: MacMillan.
3. Noel Rose – Friedman and Fahey 2002. " Manual of Clinical Laboratory Immunology" . ASM Press.

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 insertion 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 P1. 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

1. Schleef, M., 2001. Plasmids for therapy and vaccination. Wiley, John and Sons, Inc.
2. Howe, C., 2007. *Gene Cloning and Manipulation* Cambridge University Press.
3. Snyder, L. and Champness W., 2007. *Molecular Genetics of Bacteria, 3rd edn* American Society for Microbiology.
4. Watson, J. D., Caudy, A. A., Myers, R. M. and Witkowski, J. A., 2007. *Recombinant DNA Genes and Genomes - A Short Course* Palgrave Macmillan Ltd.
5. Tagu, D. and Moussard, C., 2006. *Techniques for Molecular Biology, Eds* Science Publishers, Inc.

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*.

- *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

1. Ray, R. C., 2005. Microbial Biotechnology in Agriculture and Aquaculture. NBN International.
2. Kreuzer, H. and Massey, A., 2005. Biology and Biotechnology Science, Applications, and Issues American Society for Microbiology.
3. Harding, S. E., 2004. Biotechnology and Genetic Engineering Reviews: Volume 21 Intercept Ltd.
4. Parekh, R., 2004. The GMO Handbook: Genetically Modified Animals, Microbes and Plants in Biotechnology Humana Press.

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

1. Higgins, D., Taylor, W., 2000. Bioinformatics: Sequence, structure and databanks, Oxford University Press.
2. Kanessa, M., 2000. Post-genome informatics, Oxford Univ. Press.
3. Pain, R., 2000. Mechanisms of protein folding, Oxford university Press.

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

1. Van Elsas, J. D., Jack, T. T., Jack, T. T., Janet, K. J., Janet, J., Janet, K. J., Violante, A., Huang, P. M., Gianfreda, L., Pan M. H., J. M. J., 2002. Soil Mineral-Organic Matter-Microorganism Interactions and Ecosystem Health: Ecological Significance of the Interactions Among Clay Minerals, Organic Matter and Soil Biota. Elsevier Science Ltd.
2. Violante, A., Huang, P. M., Gianfreda, L., 2002. Soil Mineral-Organic Matter-Microorganism Interactions & Ecosystem Health: Dynamics, Mobility, and Transformation of Pollutants and Nutrients (1st edition). Elsevier Science Ltd.
3. Huang, P. M., Senesi, N., Bollag, J. M., N. Senesi, N., 2002. Interactions Between Soil Particles and Microorganisms: Impact on the Terrestrial Ecosystem. John Wiley and Sons Inc.

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

1. Hurst, C. J., Crawford, R. L., 2001. Manual of Environmental Microbiology. ASM Press.
2. Vernam, A. H., Evans, M. G. 2000. Environmental Microbiology. ASM Press.
3. Jay, J. M. M. 2000. Modern Food Microbiology. Aspen Publishers.

4. Ho- Yu, M., 2004. Environmental Toxicology, 2nd edition, CRC press
5. Kofi asanteduah, D., 2002. Public health risk assessment for human exposure to chemicals, Springer.
6. Caravati, E.M., Michael, A., and Lippincott, M., 2003. Medical Toxicology, Williams and Wilkins.
7. Tickner, J.A., 2002. Precaution, environmental science, and preventive public policy, 2002, island press.
8. Borlak, J., 2005. Handbook of Toxicogenomics: Strategies and Applications John-Wiley and Son Limited.
9. Heikki , M., Hokkanen, T. and Hajek, A. E., 2004. Environmental impacts of microbial insecticide: needs and methods for risk assessment, Science.
10. Sunahara, G.I., Agnes Y., Renoux, A.Y., Thellen, C., Gaudet, C.L., and Pilon, A., 2002. Environmental Analysis of Contaminated Sites. John-Wiley and Son Limited.
11. Barnett, V., 2003. Environmental Statistics: Methods and Applications . John-Wiley and Son Limited.
12. Douben , P.E.T., 2003. PAHs: An Ecotoxicological Perspective. John-Wiley and Son Limited.

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.
 - Intestinal digestion: a brief description of intestinal secretions, pancreatic enzymes, pancreatic hormones and liver secretions involved in digestion, tests and their interpretation: amylase activity in serum and urine, faeces Examination: Physical, chemical and microscopic examination, test for endocrine function of pancreas: Glucose estimation in blood and urine, Glucose Tolerance Test (GTT), Renal Threshold, Ketone bodies in urine and Intestinal absorption: a brief description of intestinal absorption, test and its interpretation: Xylose excretion test.
- Role of gastrointestinal tract disturbances in development of anaemia

- Kidney Function Tests: a brief description of kidney functions, tests and their interpretations.
- Urinalysis: Collection of urine, Physical, chemical and microscopic examination, Estimation of waste products: blood urea and serum creatinine, tests for specific functions of kidney: Test for Glomeruli Filtration Rate: Urea clearance test, Creatinine clearance test. Phenolsulphonaphthalein Excretion test and test for maximal tubular capacity: Concentration test , Dilution test.
- Liver Function Tests: a brief description of liver Functions (Circulatory, Excretory, Metabolic, Protective and Haematologic functions), Tests based on Abnormality of pigment metabolism, Qualitative Test: Van den Bergh Test, Quantitative Test, Estimation of Serum Bilirubin, Detection of Bile Pigments and Urobilinogen in urine, Plasma Proteins: Plasma Total Proteins, Albumin, Globulins, A/G Ratio, Flocculation Test, Lipid metabolism: A brief description of lipid profile, Blood Cholesterol estimation, Liver's part in carbohydrate metabolism: galactose tolerance test, excretion of Injectables, Bromosulphthalein Retention Test, Detoxification Function: Hippuric acid synthesis, a brief description of tests based on Blood Ammonia, Prothrombin Time, Serum enzyme activity (Transaminases, Alkaline phosphatases, lactic dehydrogenase).
- A brief description of cerebrospinal fluid (CSF).

Books Recommended

1. Corke, C. F., 2002. Medical Microbiology: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis, and Control. Elsevier Science.
2. Ellen, J. B., James, J., Ellen, J. B., Marie, L. L., Michael, A. P., 2007. Manual of Clinical Microbiology. ASM Press.
3. Paul, G. E., Janet, D. E., 2007. Laboratory Diagnosis of Infectious Diseases: Essentials of Diagnostic. Lippincot Williams and Wilkins.
4. Ronald, M. A., 2000. Many Faces, Many Microbes: Personal Reflections in Microbiology. Williams and Wilkins.
5. Slaven, E. M., Carol, S.S., and Lopez, A. A. 2006. Infectious Diseases McGraw-Hill Professional division.
6. Southwick, F. S., 2005. Infectious Diseases At-A-Glance McGraw-Hill Professional.
7. Gillespie, S., and Hawkey, P. 2006. Principles and Practice of Clinical Bacteriology, 2nd Edition . John Wiley & Sons, Inc U.S.A.
8. Frosch, M., Martin C. and Maiden, J., 2006. Handbook of Meningococcal Disease: Infection Biology, Vaccination, Clinical Management .John Wiley & Sons, Inc U.S.A.

9. Hacker, J. and Heesemann, J., 2002. Molecular infection Biology: Interactions between Microorganisms and Cells, John Wiley & Sons, Inc U.S.A.
10. Charles, H., Penn, W., Smyth, C.J., 1992. Molecular Biology of Bacterial Infection: Current Status and Future Perspectives, Melanie Scourfield Cambridge University Press.
11. Warren, K.S., 1993. Immunology and Molecular Biology of Parasitic Infections, 3rd edition. Blackwell Publishers;
12. Wilson, W. R. and Sande, M. A. 2001. Current Diagnosis & Treatment in Infectious Diseases McGraw-Hill Professional
13. Michael R., 2001. Resolving Human Wildlife Conflict , Conover CRC press
14. Hogg, S., 2005. Essential Microbiology. John-Wiley and Son Limited
15. Noah, N and O'Mahony, M., 1997. Communicable Disease: Epidemiology and Control .John-Wiley and Son Limited
16. Salyers, A.A. and Whitt, D.D., 2002. Microbiology: Diversity, Disease, and the Environment. John-Wiley and Son Limited
17. Ziegler, A., and Koenig, I.R., 2006. A Statistical Approach to Genetic Epidemiology: Concepts and Applications. John-Wiley and Son Limited
18. Haines, J.L. and Pericak-Vance, M.A., 2006. Genetic Analysis of Complex disease. Wiley, John & Sons, Incorporated.

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

1. Quinn, P. J., Leonard, F. C., Markey, B. K., 2002. Veterinary Microbiology and microbial diseases. Blackwell Science Inc.
2. Kornerup, A., Hansen, K., 1999. Handbook of laboratory animal bacteriology. CRC Press, LLC.

3. Mettenleiter, T. C and F. Sobrino, F., 2008. Animal Viruses: Molecular Biology Caister Academic Press.
4. Aarestrup, F. M., 2005. Antimicrobial Resistance in Bacteria of Animal Origin American Society for Microbiology.
5. Acha P.N. and Szyfres, B., 2003. Zoonoses and communicable Diseases common to Man and animals, Volumel, II, III, Pan American Health Organization.U.S.A.
6. Martin E., Jones,H., William T. and Hubbert,V. H., 2005. Zoonoses: Recognition, Control and Prevention, Blackwell Publishing.

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

1. Conant, N. F. and Smith. D. J. MANUAL OF CLINICAL MYCOLOGY. Recent Edition. W.B. Saunders Company.
2. Holmberg K. and Meyer. R. D. Recent Edition. DIAGNOSIS & THERAPY OF SYSTEMIC FUNGAL INFECTIONS. Raven Press U.S.A.
3. A practical guide to Generic Identification of Actinomycetes. An amended reprint of a chapter by Hubert Lechevealier in volume 4 of Bergey's Manual of Systematic Bacteriology.
4. Calderone, R. A., 2001. *Candida and Candidiasis* ASM Press.

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. Prophylaxis and chemotherapy.

PRACTICAL

Books Recommended

1. Conant, N. F. and Smith, D. J., manual of clinical mycology. Recent Edition. W.B. Saunders Company.
2. Holmberg, K. and Meyer, R. D. Recent Edition. diagnosis and therapy of systemic fungal infections. Raven Press U.S.A.
3. Lechevalier, H., A practical guide to Generic Identification of Actinomycetes. Volume 4 of Bergey's Manual of Systematic Bacteriology.
4. Esser, K. and Bennett, J.W., 2004. The Mycota: A Comprehensive Treatise on Fungi as Experimental Systems for Basic and Applied Research, Vol. XII Human Fungal Pathogens Springer.
5. Dismukes, W. E., Pappas, P. G. and Sobel, J. D., 2003. Clinical Mycology. Oxford University Press.
6. Wolf, K., Breunig, K. and Barth, G., 2003. Non-Conventional Yeasts in Genetics, Biochemistry and Biotechnology: Practical Protocols Springer.
7. Calderone, R. A. and Cihlar, R. L., 2001. Fungal Pathogenesis: Principles and Clinical Applications. Mycology Series, Vol. 14. Marcel Dekker.

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.
- Restoration of DNA damages: photo-enzymatic restoration and dealkylation. Environmental and physiological factors influencing recovery phenomenon viz. Liquid holding recovery, thermal and UV reactivation.
- 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.
- Anticarcinogenesis: role of repair processes in tumor progression. Molecular genetics of human cancer: diagnostic and therapeutic indices.
- Repair and spontaneous mutagenesis, plasmid gene mediated repair, genetic control of repair phenomenon.
- Enzymology of DNA repair.
- Cancer and gene therapy.

Practical

1. Snustad, D.P. and Simmons, M. J., 2005. Principles of Genetics, 4th Edition. John-Wiley and Son Limited.
2. Kornberg, A., and Baker, T.A., 2005. DNA Replication, 2^d edition, University science books, Sausalito, California,
3. Jack, J.P., 2005. An Introduction to Human Molecular Genetics, 2nd edition New Jersey Wiley.
4. Tamarin, R. H., 2002. Principles of Genetics. McGraw-Hill Science.
5. Brooker, R. J., 2005. Genetics. McGraw-Hill Science.
6. Leland, H., Leroy, H., Michael, G.L., Silver, L., Lee M. Veres, R. C. and Ann. R., 2004. Genetics. McGraw-Hill Science.
7. Howe, H., 2007. Gene Cloning and Manipulation Cambridge University Press.
8. L. Snyder, L. and W. Champness, W., 2007. Molecular Genetics of Bacteria, 3rd edn American Society for Microbiology.
9. Watson, J. D., Caudy, A. A., Myers, R. M. and Witkowski, J. A., 2007. Recombinant DNA Genes and Genomes - A Short Course Palgrave Macmillan Ltd.
10. Dennis Lo, Y. M., Chiu, R. W. K. and Chan, K. C., 2006. Clinical Applications of PCR, 2nd edn. Humana Press.
11. Franks, L.M., and Teich, N.M., 1997. and Introduction to the Cellular and Molecular Biology of Cancer, 1997, Oxford University Press.
12. Holland, E.C., 2004. Mouse Models of Human Cancer. John-Wiley and Son Limited
13. Brenner, C., and Duggan, D., 2006. Oncogenomics: Molecular Approaches to Cancer John-Wiley and Son Limited.
14. Stuhler, G., and, Walden, P., 2002. Cancer Immune Therapy: Current and Future Strategies. John-Wiley and Son Limited.
15. Hausen, H.Z., 2006. Infections Causing Human Cancer . John-Wiley and Son Limited.

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

1. World Health Organization. 2001. WHO biosafety manual, WHO, Geneva.
2. Gillespie, S., and Hawkey, P. 2006. Principles and Practice of Clinical Bacteriology, 2nd Edition . John Wiley& Sons, Inc U.S.A.
3. Frosch, M., Martin C. and Maiden, J., 2006. Handbook of Meningococcal Disease: Infection Biology, Vaccination, Clinical Management. John Wiley & Sons, Inc U.S.A.
4. Hacker, J. and Heesemann, J., 2002. . Molecular infection Biology: Interactions between Microorganisms and Cells, John Wiley& Sons, Inc U.S.A.
5. Santoro, M.A., Gorrie,T.M., 2005. Ethics and the Pharmaceutical Industry, Cambridge University Press
6. Fay, A., Rozovsky, J. D., Woods, Jr., J.M. and Bellamy, M., 2005. The Handbook of Patient Safety Compliance: A Practical Guide for Health Care Organizations. John Wiley and Sons limited.

7. DiNardi, S.R., 2003. Occupational Environment: Its Evaluation, Control, and Management. American Industrial Hygiene Association.
8. Kreuzer, H. and Massey, A., 2005. Biology and Biotechnology Science, Applications, and Issues American Society for Microbiology.

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

1. Wesley, O. P., 2001. Bacterial indicator of pollution. CRC Press Inc. Boca Raton.
2. Alcamo, I. E., 2000. Fundamentals of Microbiology. The Benjamin/Cumming Publishing Co.

3. Beaglotude, R., Benita, R., 1993. WHO Bulletin, Geneva.
4. Jekel, J., Elmore, J. G., Katz, D. L., 2001. Epidemiology, biostatistics and preventive medicine. W. B. Saunders.
5. Seedhouse, D., 2003. Health Promotion: Philosophy, Prejudice and Practice, 2nd Edition. John Wiley and Sons limited.
6. Robine, J.M., Jagger, C., Mathers, C.D., Crimmins, E.M. and Suzman, R.M., 2002. Determining Health Expectancies. John Wiley and Sons limited.
7. Tan, J., 2005. E-Health Care Information Systems: An Introduction for Students and Professionals. John Wiley and Sons limited.
8. Boss, M.J.J., and Day, D.W. and Day, D.W., 2002. Biological Risk Engineering Handbook: Infection Control and Decontamination. Lewis Publishers.

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 Microbiologists 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.