

CURRICULUM

OF

MICROBIOLOGY

BS (HONS) & MS (HONS)

(Revised 2006)



HIGHER EDUCATION COMMISSION

ISLAMABAD

CURRICULUM DIVISION, HEC

Prof. Dr. Altaf Ali G. Shaikh	Adviser (Acad/R&D)
Malik Ghulam Abbas	Deputy Director
Miss Ghayyur Fatima	Deputy Director (Curri)
Mr. M. Tahir Ali Shah	Assistant Director
Mr. Shafiullah Khan	Assistant Director

Composed by Mr. Zulfiqar Ali, HEC Islamabad

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PREFACE

Curriculum of a subject is said to be the throbbing pulse of a nation. By looking at the curriculum one can judge the state of intellectual development and the state of progress of the nation. The world has turned into a global village; new ideas and information are pouring in like a stream. It is, therefore, imperative to update our curricula regularly by introducing the recent developments in the relevant fields of knowledge.

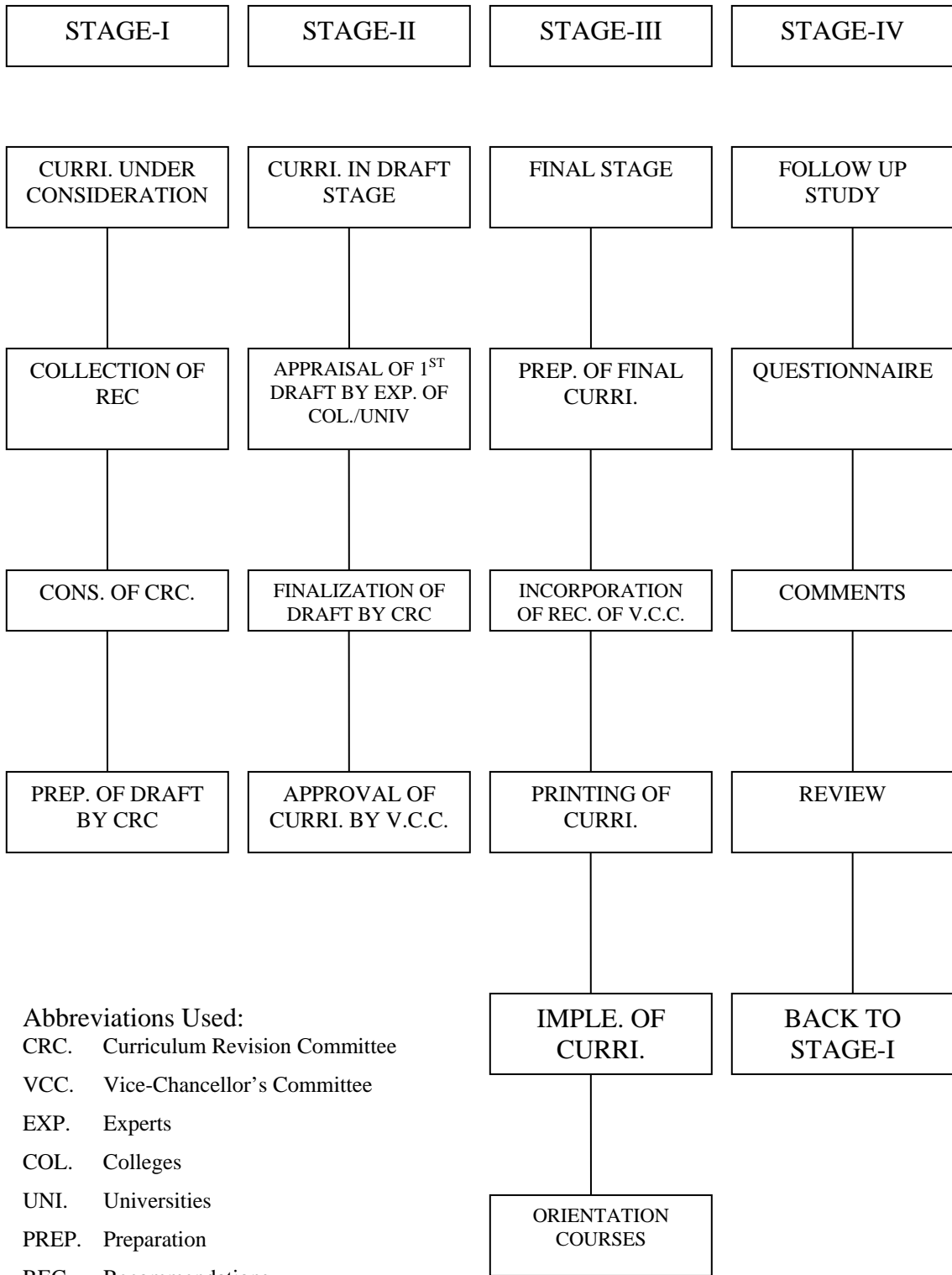
In exercise of the powers conferred by sub-section (1) of section 3 of the Federal Supervision of Curricula Textbooks and Maintenance of Standards of Education Act 1976, the Federal Government vide notification no. D773/76-JEA (Cur.), dated December 4, 1976, appointed University Grants Commission as the competent authority to look after the curriculum revision work beyond class XII at 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-Chancellors' Committee, curriculum of a subject must be reviewed after every 3 years. For the purpose, various committees are constituted at the national level comprising senior teachers nominated by universities. Teachers from local degree colleges and experts from user organizations, where required, are also included in these committees. The National Curriculum Revision Committee for **Microbiology** in its meeting held in **June 5-7, 2006** at the HEC Regional Centre, Lahore revised the curriculum after due consideration of the comments and suggestions received from universities and colleges where the subject under consideration is taught. The final draft prepared by the National Curriculum Revision Committee duly approved by the Competent Authority is being circulated for implementation by the institutions.

Prof. Dr. Altaf Ali G. Shaikh
Adviser (Acad/R&D)

August 2006

CURRICULUM DEVELOPMENT



Abbreviations Used:

- CRC. Curriculum Revision Committee
- VCC. Vice-Chancellor's Committee
- EXP. Experts
- COL. Colleges
- UNI. Universities
- PREP. Preparation
- REC. Recommendations

INTRODUCTION

The final NCRC meeting was held on June, 5-7, 2006 at HEC Regional Centre, Lahore. Following were the experts of preliminary and final meetings.

- 1 Dr. Nusrat Jamil, Convener
Department of Microbiology,
University of Karachi, Karachi.
- 2 Dr. Yasmeen Faiz Kazi, member
Professor,
Department of Microbiology,
Shah Abdul Latif University,
Khairpur
- 3 Dr. S. Khursheed Hasan Hashmi, Member
Associate Professor Pathology,
Department of Pathology,
Sindh Medical College, Karachi.
- 4 Syed Nisar Hussain Shah Member
Department of Pharmacy,
B.Z. University, Multan.
- 5 Dr. Rani Faryal, Member
Assistant Professor,
Department of Bio-Sciences,
COMSATS Institute of Information Tech.
Sector H – 8/1, Islamabad.
- 6 Mr. Ahsan Sattar Sheikh, Member
Assistant Professor,
Institute of Molecular Biology & Biotechnology,
University of Lahore,
1- Km Raiwind Road, Lahore.
- 7 Dr. Mansur-ud-Din Ahmad, Member
Chairman, Department of Microbiology,
University of Veterinary Animal Sciences,
Lahore.
- 8 Dr. Sikander Ali, Member
Assistant Professor,
Bio-Technology Research Centre,
Department of Botany,
Government College University, Katchery Road,
Lahore.

9	Dr. Azra Yasmin, Assistant Professor, Department of Env. Sciences, Fatima Jinnah Women University, The Mall, Rawalpindi.	Member
10	Dr. Shamim Mumtaz, Associate Professor, Foundation University, Medical College, Islamabad.	Member
11	Prof. Dr. M. Rafi Shaikh, Department of Pathology, Hamdard University, Karachi.	Member
12	Ms. Rafia Khanam, Associate Professor, Microbiology, University College of Home Economics, AJK, University, Muzaffarabad, Mirpur.	Member
13	Dr. Anjum Nasim Sabri, Department of Microbiology, University of the Punjab. Lahore.	Member
14	Mr. Bashir Ahmed Sindh University, Jamshoro.	Member
15	Dr. Arifa Qadeer, Lahore College for Women University, Lahore.	Member
16	Saraphine Salik Assistant Professor, Botany Department, Forman Christian College, Lahore.	Member
17	Ms. Parveen Akhtar Kinnaird College for Women, Lahore.	Member
18	Dr. Kamran Tariq, Associate Professor, Govt. Shalimar College, Lahore.	Member
19	Dr. M. Khalid Mansoor Lecturer, Department of Vet. Microbiology, Agriculture University Faisalabad.	Member

- | | | |
|----|--|-----------|
| 20 | Mrs. Parveen Akhtar,
Associate Professor Biology,
Government Islamia College for Women,
Lahore. | Member |
| 21 | Dr. Abdul Ghaffar,
Foreign Faculty Member,
University of Health Sciences, Lahore. | Secretary |

The preliminary meeting was inaugurated by Dr. S. Altaf Hussain, Member Acad (R&D). He described the role of HEC in curriculum development under act of parliament while describing the procedure of curriculum development. He requested the committee to develop 4 years bachelor degree and two years MS program. After introduction of the participants the session was opened for discussion on different issues related to curriculum.

The experts said that before introduction of 4 years bachelor degree program there should be a training program for all teachers. Dr. Nusrat stressed that we should teach to coordinate and design and she also said curriculum should stress on applied knowledge. Dr. Ihsan Sattar while discussing the curriculum issues said that there should be benchmark.

The final meeting was held on 5-7 June 2006. Ms. Ghayyur Fatima, Dy. Director (Curriculum) while welcoming the participants said that this meeting is the continuation of first meeting. The Committee would finalize the draft curriculum prepared in the preliminary meeting and hopefully members have brought some recommendations in consultation with their colleagues for the improvement of the draft. She also informed that the draft curriculum was sent to an expatriate Pakistani expert, Dr. Sattar, Ministry of Ottawa, Canada and the ex-convener of the NCRC Microbiology, Dr. Shakeel, University of Karachi for analytical study. Analytical / evaluation report of both, the experts have already been circulated amongst all the members. Then Dr. Nusrat Jamil, convener of the Committee started the proceeding of the meeting. The Committee thoroughly discussed the comments of Dr. Sattar and the corrections made in the draft. The Committee appreciated the efforts of Dr. Sattar for preparing suggestions to make improvement in the draft.

The National Committee finalized the draft curriculum for BS level. Due to shortage of time the Committee could not finalize the curriculum for MS level. Therefore another sub-committee meeting held on July 20th, 2006 finalized the curriculum of MS level.

**CURRICULUM FOR BS (HONS)
SCHEME OF STUDIES**

**SUBJECT SCHEME OF MICROBIOLOGY FOR BS (FOUR YEAR)
PROGRAM**

Semester – I		
Course. No.	Title of Course	CR: HRS.
	English – I	03
	Pakistan Studies	02
	Mathematics – I	03
	Microbiology – I (Theory)	02
	Microbiology – I (Practical)	01
	Human Physiology – I (Theory)	02
	Human Physiology – I (Practical)	01
	Biochemistry – I (Theory)	02
	Biochemistry –I (Practical)	01
	Total	17

Semester – II		
Course. No.	Title of Course	CR: HRS.
	English – II	03
	Islamic Studies /Ethics	02
	Mathematics – II	03
	Microbiology – II (Theory)	02
	Microbiology – II (Practical)	01
	Human Physiology – II (Theory)	02
	Human Physiology – II (Practical)	01
	Biochemistry – II (Theory)	02
	Biochemistry – II (Practical)	01
	Total	17

Semester – III		
Course. No.	Title of Course	CR: HRS.
	English – III	03
	Sociology	02
	Computer Applications	01
	Computer Application (Practical)	02
	Microbiology – III (Theory)	02
	Microbiology – III (Practical)	01
	General Immunology (Theory)	02
	General Immunology (Practical)	01
	Cell Biology – I (Theory)	02
	Cell Biology – I (Practical)	01
	Total	17

Semester – IV		
Course. No.	Title of Course	CR: HRS.
	English – IV (Communication Skills)	03
	Environmental Current Issues	02
	Biostatistics (Theory)	02
	Biostatistics (Practical)	01
	Microbial Taxonomy (Theory)	02
	Microbial Taxonomy (Practical)	01
	Cell Biology –II (Theory)	02
	Cell Biology – II (Practical)	01
	Marine / Fresh water Microbiology (Theory)	02
	Marine / Fresh water Microbiology (Practical)	01
	Total	17

Semester – V		
Course. No.	Title of Course	CR: HRS.
	Microbial Anatomy & Physiology (Theory)	02
	Microbial Anatomy & Physiology (Practical)	01
	Bacterial Genetics (Theory)	02
	Bacterial Genetics (Practical)	01
	Clinical Bacteriology (Theory)	02
	Clinical Bacteriology (Practical)	01
	Mycology (Theory)	02
	Mycology (Practical)	01
	Soil Microbiology (Theory)	02
	Soil Microbiology (Practical)	01
	Total	15

Semester – VI		
Course. No.	Title of Course	CR: HRS.
	General Virology (Theory)	02
	General Virology (Practical)	01
	Epidemiology (Theory)	02
	Epidemiology (Practical)	01
	Environmental Biotechnology (Theory)	02
	Environmental Biotechnology (Practical)	01
	Molecular Mechanisms Of Antimicrobial Drugs (Theory)	02
	Molecular Mechanisms Of Antimicrobial Drugs (Practical)	01
	Cell & Tissue Culture Technology (Theory)	02
	Cell & Tissue Culture Technology (Practical)	01
	Total	15

Semester – VII		
Course. No.	Title of Course	CR: HRS.
	Introductory Microbial Technology (Theory)	02
	Introductory Microbial Technology (Practical)	01
	Plant Microbiology (Theory)	02
	Plant Microbiology (Practical)	01
	Research Methodology & Instrumentation	02+01 = 03
	Food & Dairy Microbiology (Theory)	02
	Food & Dairy Microbiology (Practical)	01
	Genetic Engineering (Theory)	02
	Genetic Engineering (Practical)	01
	Total	15

Semester – VIII		
Course. No.	Title of Course	CR: HRS.
	Biotechnology (Theory)	02
	Biotechnology (Practical)	01
	Medical Virology (Theory)	02
	Medical Virology (Practical)	01
	Mini Research Project	06
	Optional Subject *	03
	Total	15

Total: 128 Cr. Hrs.

*** As decided by the department**

DETAILS OF COURSES

SEMESTER – I

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.

Contents: 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, USA

MICROBIOLOGY-I

A. Fundamentals of microbiology

1. Microorganisms and their respective place in the living world.
2. Differentiation between pro- and eukaryotic cells.
3. Historical development of Microbiology and its scope.
4. Microscopy: An outline of the principles and applications of light and electron microscope.
5. Morphology, arrangement and detailed anatomy of bacterial cell.
6. Bacterial taxonomy and nomenclature, basis of classification of bacteria.
7. 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.
8. General methods of studying microorganisms: cultivation, isolation, purification and characterization.
9. Control of microorganisms by physical and chemical methods.
10. Chemotherapeutic agents and antibiotics. Modes of action of antibiotics on microorganisms.
11. Basic properties of fungi, protozoa and algae.
12. A brief introduction to structure and propagation of viruses and bacteriophages.

List of 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. MacKane, L. and Kandal, J. (1986) Microbiology: essential and application. McGraw-Hill Inc.
2. Nester, E.W., Pearsall, N.N., Roberts, C.E., Nester, M.T. and Lidstrom, M.E. (1983) Microbiology. Saunders College Publishing, Philadelphia
3. Pelczar Jr. M.J., Chan, E.C.S. and Krieg, N.R. (1993) Microbiology, Concepts and applications. MacGraw-Hill Inc. N.Y.
4. Wistreich, G. A., and Lechtman, M. D. (1990) Microbiology. 5th Ed. MacMillan Publishing Co. N. Y.
5. Kathleen P. T., and Arthur, T. (2001) Foundations in Microbiology: Basic Principles McGraw-Hill Companies
6. Tortora, G.J., Funke, B.R., Case, C. L. (2000) Microbiology: An Introduction, Study Guide. Benjamin-Cummings Publishing Company
7. Tortora, G.J., Funke, B.R. and Case, C. L. (2004) Microbiology: an introduction 8th Edition, Pearson Education, USA
8. Tortora, G.J., Christine L. Case, C. L., Funke, B.R., Funke, B., Case, C., (2006) Microbiology: An Introduction, Publisher: Pearson Education
9. Alcamo, I. E., (2001) Fundamentals of Microbiology *published by* Jones & Bartlett Publishers, USA
10. Black, J. G. (2005). Microbiology: principles & explorations, *by* 6th Edition, J. Wiley & Sons, USA.
11. Cappuccino, J. G. and Sherman, N. 2004, Microbiology: a laboratory manual. Pearson Education, USA
12. Pollack, R. A. Findlay, L., Mondschein, W. Modesto R. R., 2004. Laboratory Exercises in Microbiology *by* 2nd Edition, J. Wiley & Sons, USA
13. Baker, S., Khan, N., Nicklin, J. and Killington, R., 2006. Instant Notes in Microbiology, 3rd Ed edition, Taylor & Francis
14. Madigan, M.T. and Martinko, J., 2005. Brock Biology of Microorganisms 11 International Ed edition Prentice Hall.
15. [Talaro](#), K.P., 2006. Foundations in Microbiology: Basic Principles. Mcgraw Hill. Publisher.

HUMAN PHYSIOLOGY-I

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
 - 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
- 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 secretion
- Phenomenon of deglutition
- Gastric and pancreatic juice
- 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 & 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 & Wilkins

BIOCHEMISTRY-I

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
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
- Isoprenoids.

Practicals:

Normal Solutions, Acid and Bases, Electrolytes, Non Electrolytes, Buffers and pH. Study of hydrolysis of starch by using mineral acids Various qualitative tests for Monosaccharide, oligosaccharides and polysaccharides Preparation of calibration curve for glucose Estimation of serum glucose by using calibration curve Detection of reducing sugars in the presence of non-reducing sugars Qualitative tests for different lipids. Paper and thin-layer chromatography of sugars. Paper chromatography of various amino acids. Determination of pK values of amino acids (Glycine, Alanine) by preparation of titration curves. 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. 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, 2006. General, Organic and Biochemistry 5th Edition. McGraw-Hill.

SEMESTER – II

MATHEMATICS - II

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, USA

MICROBIOLOGY PAPER-II

A. Immunology

1. Introduction, development and scope of immunology.
2. Classification and types of immunity (specific and non-specific).
3. Cells and tissues of immune systems.
4. The antigens: definition, parameters, specificity, antigenic determinance and valence. Modulation of the antigen for the preventive and therapeutic purposes.
5. Immunoglobulins: structure, chemical nature, classification, physico-chemical properties and antibody specificity.

6. Antigen-antibody reactions: precipitation reaction, zone phenomenon, lattice theory methods and applications of immunodiffusion tests and immunoelectrophoresis. Agglutination reaction: methods and applications.
7. General properties, activation and complement fixation test.
8. Hypersensitivity: types, mechanism of anaphylaxis and delayed type of hypersensitivity.

B. Medical Microbiology:

1. Basic concept of epidemiology.
2. Microbial virulence: factors responsible.
3. Study of etiology, pathogenesis, symptomatology, immunology, Lab. diagnosis, treatment, epidemiology, prevention and control of the following diseases:

I. Bacterial Diseases:

- a. Infections caused streptococci (sore throat).
- b. Infections of *Staphylococci*: carbuncle, acne, furuncle and scalded skin syndrome
- c. Typhoid
- d. Bacillary dysentery
- e. Cholera
- f. Diphtheria
- g. Tetanus
- h. Tuberculosis
- i. Sexually transmitted diseases (STD): gonorrhoea

II. Viral diseases:

- a. Influenza
- b. Poliomyelitis
- c. Rabies
- d. Hepatitis
- e. AIDS

III. Fungal Diseases:

- a. Dermatophytosis: including *Tinea unguum*, *Tinea corporis* and *Tinea capitis*

IV. Protozoa Diseases:

- a. Dysentery: amoebiasis
- b. Malaria
- c. Leishmaniasis

Practical contents:

1. 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*.
2. Microscopic study of *Leishmania*, *Entamoeba*, *Plasmodium* and *Giardia*.

3. Total blood count (Erythrocyte and WBC count).
4. Differential leukocyte count
5. Blood grouping (ABO & Rh)
6. Estimation of hemoglobin
7. ESR
8. Antibacterial activity of serum
9. Agglutination test (Widal test).
10. Precipitation tests.
11. Urine analysis (physical, chemical and microbiological)

Books Recommended

1. Brooks, G.F., Morse, S.A., Butel, J., and Butel, J.S.,2001. [Jawetz, Melnick, and Adelberg's Medical Microbiology](#). McGraw-Hill Companies.
2. [Pfaller](#), M.A., [Rosenthal](#), K.S., [Murray](#), P.R. 2005. Medical Microbiology. Mosby Publishers
3. Cliver, R., 2001. [Foodborne Diseases](#). Morgan Kaufmann Publishers
4. Nigel J. J., Dimmock, K. L.and Andrew E., 2001. [Introduction to Modern Virology](#) Blackwell Science, Inc.
5. Riott, I .1994. Essential Immunology. 8th Edition. Blackwell Scientific Publisher, London
6. Volk W.A. 1999. Essentials of medical microbiology. 4th Edition. J B. Lippincott Co. Philadelphia
7. Burgy, D.and Holt, JG. 1993. Bergey's Manual of determinative Bacteriology. Williams & Wilkins Co, Baltimore
8. Greenwood, D., Slack, R. and JPeutherer, J., 2002. Medical Microbiology: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control Churchill Livingstone
9. Gladwin, M., Trattler,B., and Trattler. B., 2004. Clinical Microbiology Made Ridiculously Simple, 3rd Edition, MedMaster, Incorporated
10. Murray, P.R., Rosenthal, K.S., Pfaller, M.A., Rosenthal, K.S., 2005, Medical Microbiology: Elsevier Health Sciences
11. Jones, S.L., and Jones, R. 2001, Clinical Laboratory Pearls. Lippincott Williams & Wilkins
12. Keren, D.F., Hackel, E., Lewandrowski, K., Alkan, S., 2001. Clinical Laboratory Medicine. Publisher: Lippincott Williams & Wilkins
13. Pfaller, M.A., Rosenthal, K.S., Murray, P.R., 2006. Medical Microbiology. Mosby Publishers.
14. Abbas, A.K and Lichtman, A.H., 2006. Basic Immunology: Functions and Disorders of the Immune System. 2Rev Ed edition. Saunders (W.B.) Co Ltd.
15. Heitman, J., Edwards, J.E., Mitchell, A., Filler, S.G., and Mitchell, A.P., 2006.Molecular Principles of Fungal Pathogenesis. ASM Press
16. Greenwood,D., Finch ,R., Davey, P., Wilcox ,M.,2007. Antimicrobial Chemotherapy. Oxford University Press; 5Rev Ed edition

HUMAN PHYSIOLOGY-II

- **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 & Wilkins.

BIOCHEMISTRY-II

- Metabolism:
 - Carbohydrate, Lipid and Protein
 - Gluconeogenesis
 - Biosynthesis and breakdown of glycogen in animals;
 - Regulation of glycogen metabolism.
- Bioenergetics and Thermodynamics
 - Electron transport chain and oxidative phosphorylation in mitochondria
 - Role of mitochondria in Apoptosis and oxidative stress

- Photosynthesis
 - Photophosphorylation and light absorption;
- Biosynthesis of Lipids
 - Mobilization and transport of fats
 - Biosynthesis of fatty acids and Eicosanoids
 - Biosynthesis of triacylglycerols
 - Membrane phospholipids
 - Cholesterol and steroids.
- Biosynthesis of amino acids
- Integration and hormonal regulation of mammalian metabolism

Practicals:

Extraction and salting out of proteins.

Isolation and purification of proteins by various column chromatographic techniques (gel filtration and ion exchange).

Quantitative analysis of proteins by UV spectrophotometry

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, 2006. General, Organic and Biochemistry 5th Edition. McGraw-Hill

SEMESTER III

SOCIOLOGY

I Introduction

Sociology — The Science of Society
Scope and significance
Fields of Sociology
Sociology and other Social Sciences

II Social interaction and social structure

Social Interaction
The Nature and Basis of Social Interaction
Social Processes
Social Structure
Status, Roles, Power and Authority, Role Allocation

III 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

IV Deviance and social control

Deviance and conformity
Mechanism and techniques of social control
Agencies of social control

V 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)

VI Social change

Processes of social change
Social change and conflict
Social change and social problems
Resistance to social change

VII Human ecology

Ecological processes
Ecological problems of Pakistan

COMPUTER APPLICATIONS

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.

CURRENT ISSUES IN ENVIRONMENT

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. Fred, A.S., 1999. The Ecological Design Handbook. McGraw-Hill Professional.
5. Smith, E. E. and Bradly, F., 2000. , Field and Laboratory Activities. Environmental Science 7th edition. McGraw-Hill Science
6. Nico, M., Straalen, V., and Roelofs, D., 2006. An Introduction to Ecological Genomics. Oxford University Press
7. Aston, A., Harris,S., Lowe, A., 2004. Ecological Genetics: Planning and Application. Blackwell Science (UK).
8. Costa, L. G., and Eaton, D.L., 2006. Gene-Environment Interactions: Fundamentals of Ecogenetics John-Wiley and Son Limited.
9. Freeland, J.R., 2005. Molecular Ecology. John-Wiley and Son Limited.
10. Light. A and Rolston III. H., 2003. ,Environmental Ethics, Blackwell Publishers Ltd. U.S.A
11. Wenz, P.S., 2001. Environmental Ethics Today, Oxford University Press.
12. Louis P. and Pojman, L.P., 2004. Environmental Ethics: Readings in Theory and Application, 4th edition. Wadsworth Publishing.
13. Light, A., and Rolston, III. H., 2005. Environmental Ethics. Blacwell Publishing, Incorporated.
14. Raven, P.H., and Berg, L.R., 2005. Environment, 5th Edition. John-Wiley and Son. Limited
15. Bradshaw, V., 2006. The Building Environment: Active and Passive Control Systems, 3rd Edition. John-Wiley and Son. Limited

MICROBIOLOGY-III

1. Introduction: Host-parasite interactions
2. Determinants of pathogenicity and molecular mechanisms of pathogenesis.
3. Chemotherapy and drug resistance.
4. Study of bacterial infections with emphasis on mechanisms of pathogenesis of the following groups:
 - i. *Streptococcus*
 - ii. *Staphylococcus*
 - iii. *Niesseria*
 - iv. *Pseudomonas*
 - v. *Corynebacterium*
 - vi. *Bordetella*
 - vii. *Vibrio*
 - viii. Enterobacteraceae
 - ix. *Clostridium, Bacillus*
 - x. *Campylobacter, Aeromonas* and *Helicobacter*
 - xi. *Legionella*
 - xii. *Mycobacterium*
 - xiii. *Actinomyces / Nocardia*
 - xiv. *Chlamydia*
 - xv. *Mycoplasma*
 - xvi. Zoonotic infections
5. Study of viral and rickettsial diseases including epidemic and endemic typhus, AIDS, Hepatitis. Poxviruses and Herpes viruses.
6. Protozoal infections with emphasis on Leishmaniasis and Toxoplasmosis.
7. Pathogenesis of mycotic infections with particular emphasis on mycetoma.
8. Classical and newly emerging pathogens.

Practicals

Collection and transportation of clinical samples:
Infections of ear, nose, throat, eye, GIT, urogenital tract and bone
Isolation and identification of selected pathogens.
Antibiotic assays by disc diffusion methods and dilution method.
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., Medical Microbiology.2004. 3rd Edition .Mosby.
3. Stephen, J., Mims, C.A., Nash, A.2000. Mims' Pathogenesis of Infectious Disease. 5th Edition. Academic Press Inc.,U.S.

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

1. Introduction: chronological development and scope of immunology.
2. Immunity and immune responses: Definitions and types (specific and non specific). Humoral and cellular immunity.
3. Complement system.
4. Cells and tissues of immune system.
5. The antigens: structure (simple and complex molecules, proteins and polysaccharides) and immunogenicity.
6. Tissue antigens: the Allo- and heterophile antigens. The ABO and Rh blood group systems, their chemical basis, inheritance & clinical significance
7. Immunoglobulins: structure and function; classes, subclasses, types and subtypes; immunoglobulin genetics.
8. Immuneresponse to an antigen
9. Introduction to antigen-antibody reactions: methods for detecting antigens and antibodies (agglutination, precipitation, complement fixation, EIA, etc.).
10. HLA & MHC and its role in immune response, disease and its significance in tissue transplantation.
11. Immunoregulation and tolerance.
12. Cancer immunology.
13. Introduction to immunopathology: hypersensitivity reactions, autoimmune diseases and immunodeficiencies.
14. 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.

IMMUNOBIOLOGY

1. The immune system: organs constituting the immune system, their location in the human body and basic architecture.
2. The immunocompetent cells: their origin, surface markers, population and sub-populations. Immunological characterization and functions.
3. Antibody induction and production: antigen and antibody metabolism. Cells involved in cellular sequence of events. Kinetics of antibody synthesis.
4. The role of T-cells and immunoglobulins in the immune response.
5. Immunologic memory: positive and negative. Phenomenon of natural tolerance.
6. Manifestations of antigen-antibody reactions including precipitation, agglutination, Complement fixation and neutralization.
7. Cellular immune response and its characterization.
8. Basics and applications of ELISA, RIA, immunofluorescence and immunoblotting. Lab work pertaining to above course.
9. Immune suppression a need, agents.

Recommended Books:

1. Levinson, W.E., 2004. Medical Microbiology & Immunology McGraw-Hill Medical
2. Falus, A., 2006. Immunogenomics and Human Disease, 2006, 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 & Francis, Inc.
14. Paul, W., 2006., Fundamental Immunology. Fifth Edition. Lippincott Williams & 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 & 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 & Wilkins.

CELL BIOLOGY I

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:

Study of different types of Prokaryotic and Eucaryotic cell ,

Study of different cell organelle by staining. Karyotyping

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 C. Bowler. 2002. Molecular Plant Biology. Vol 1 & 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 & Wilkins.
10. Walker, D., 2007. Cells and Life Processes. Smart Apple Media.
11. Alberts. B., 2007. Molecular Biology of the Cell Taylor & 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 & Sons, Incorporated
14. Bruce Alberts, B., Bray, D., Roberts, K., Lewis, J., Raff, M. 2003. Essential Cell Biology Taylor & 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.

SEMESTER IV

CURRENT ISSUES IN ENVIRONMENT

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. Paul Collinvaux, P., 2001. *Ecology II*, Willey International Edition. John Willey & Sons Inc. NewYork, Toronto.
2. Raven, P.H., and Berg, L.R., 2005. *Environment*, 5th Edition. John-Wiley and Son. Limited Bradshaw, V., 2006. *The Building Environment: Active and Passive Control Systems*, 3rd Edition. John-Wiley and Son. Limited.
3. Light. A and Rolston III. H., 2003., *Environmental Ethics*, Blackwell Publishers Ltd. U.S.A
4. Wenz, P.S., 2001. *Environmental Ethics Today*, Oxford University Press.
5. Louis P. and Pojman, L.P., 2004. *Environmental Ethics: Readings in Theory and Application*, 4th edition. Wadsworth Publishing.
6. Light, A., and Rolston, III. H., 2005. *Environmental Ethics*. Blacwell Publishing, Incorporated.

BIO-STATISTICS

1. Introduction to Biostatistics and its scope in Microbiology
2. Collection of Primary and Secondary data
3. Editing of data
4. Presentation of data: Tabulation , Classification, Visual Presentation (Diagrams and Graphs)

5. Measures of Central Tendency: Arithmetic Mean by direct and short-cut method, Geometric Mean, Harmonic Mean, Mode, Median, ED_{50} (LD_{50} in detail), Quantile
6. Measures of Dispersion: Range , Quartile Deviation , Mean Deviation , Standard Deviation by direct and short-cut method , Variance ,and their Coefficient.
7. Correlation : Simple ,Correlation Table , Rank Correlation , Partial and Multiple Correlation
8. Regression and method of least square
9. Probability : Concept of Probability , Laws of Probability
10. Permutation and Combination
11. Probability distributions : Binomial distribution , Poisson distribution and their fitting to observed data , Normal distribution
12. Sampling and Basic Design
13. Hypothesis Testing
14. Chi-square test , Student's t-test ,Analysis of variance
Laboratory Experiments pertaining to the course.

Recommended Books

1. Essex-Sorlie, D. (1995) Medical Biostatics & Epidemiology, International Edition , Appleton & Lange
2. Dawson-Saunders, B.1994. Basic & Clinical Biostatistics, 2nd Edition, Appleton & Lange
3. Samuels, M.L. 1991. Statistics for the Life Sciences, Dellen Publishing Company
4. Yule, G.U. and Kendall, M.G.1991.Introduction to the Theory of Statistics Charles Griffin & Co.
5. Rosner, B.,1990. Fundamentals of Biostatistics , Third Edition, PWS-KENT Publishing Company
6. Marzillier, L.F., 1990. Elementary statistics , Wm.C.Brown Publisher
7. Stanton, A.G.,2001. Primer of Biostatistics. McGraw Hill
8. Beth, D.D., Robert, G.T 2000. Basic and clinical biostatistics. Appleton & Lange
9. Streiner, N., Norman, G.R., 2000. Biostatistics: The bare essentials B.C. Decker, Inc.
10. Rosner, B.,2000. Fundamentals of biostatistics. Cole Pub. Co.
11. Jekel, J., Elmore, J.G., Katz, D.L., 2001. Epidimiology, biostatistics and preventive medicine. W. B. Saunders
12. Quinn, G., 2002. Experimental Design and Data Analysis for Biologists. Cambridge University Press.
13. Bailey, N.T.J., 1994. Statistical Methods in Biology, Cambridge University Press.
14. Wonnacott, T.H, and Wonnacott. R.J.,1990, Introductory Statistics, John Wiley and Sons.
15. Fernholz L.T, Morgenhaler, S., Stahel, W., 2000. Statistics in Genetics and in Environmental Sciences, Birkhauser Verlag.
16. Zar J.H. 1999. Biostatistical Analysis., Pearson Education,

17. Kuzma J.W. and Bohnenblust, S.E. 2001, Basis Statistics for the Health Sciences, McGraw-Hill International Education.

MICROBIAL TAXONOMY

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

Practicals

Characterization of bacteria and fungi on the basis of different biochemical and cultural characteristics
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. Burgy, D. and Holt, JG., 1993. Bergey's Manual of determinative Bacteriology. Williams & Wilkins Co, Baltimore.
3. Garrity, G.M., Krieg, N.R., Brenner, D.J., 2006. Bergey's Manual of Systematic Bacteriology: The Proteobacteria, Vol. 2. Williams & Wilkins Co, Baltimore.
4. Ogunseitan, O., 200. Microbial diversity.

CELL BIOLOGY II

1. *E. coli* and yeast as representative prokaryotic and eukaryotic models for molecular differentiation.
2. Molecular mechanism of Replication.
3. Transcription and Translation.
4. Transcriptional and translational regulation of gene expression.
5. Regulation of gene expression in prokaryotes and eukaryotes.
6. Types of recombination
7. Mutations and chromosomal aberrations.
8. DNA damage and repair.
9. Gene sequencing.
10. Principles of Recombinant DNA technology.
11. Role of Recombinant DNA Technology in economic development.
12. Human Genome Project.

13. 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 & 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 & Wilkins
10. Walker, D., 2007. Cells and Life Processes. Smart Apple Media.
11. Alberts, B., 2007. Molecular Biology of the Cell Taylor & Francis, Inc.
12. Pollard, T.D., Lippincott-Schwartz, J., Earnshaw, W.C., 2007. Cell Biology: Saunders W B Co.

FRESH-WATER MICROBIOLOGY

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 & Sons, Inc.
2. Any other recent literature.

SEMESTER – V

MICROBIAL ANATOMY AND PHYSIOLOGY

1. Detailed organization of microbial cells.
2. Chemical composition and biosynthesis of macromolecules in microbial cells.
3. Genomic organization of prokaryotes.
4. Regulation of gene expression (operon, catabolite repression).
5. Uptake and secretion of molecules.
6. Aerobic and anaerobic respiration and fermentation.
7. Cell metabolism: protein, nucleic acid and fat.
8. 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. USA
2. Davis, B.D., Dulbecco, R., Eisen, H.N., Ginsberg, H., Wood, J.R (1990) Microbiology 4th Ed. Harper & Row Publisher, USA
3. Levin B (1996) Genes VI. Oxford University, Oxford

BACTERIAL GENETICS

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

Practicals

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

Recommended Books

1. Davis, B.D., Dulbecco, R., Eisen, H.N., Ginsberg, H., Wood, J.R. .1990. Microbiology 4rd Ed. Harper & Row Publisher, USA
2. Levin, B., 1996. Genes VI. Oxford University, Oxford
3. Uldis N. Streips, U.N., Ronald E. Yasbin, R.E., 2002. Modern Microbial genetics. Wiley, John & Sons, Inc
4. Wagner, R., 2000 Transcription regulation in lower prokaryotes. Oxford University Press
5. Gelvin, S,B. 2000. Plant Molecular Biology Manual. Kluwer Academic Publishers.
6. Pierca, B.A. 2005. Genetics. A conceptual approach, W. H. Freeman and Company, New York.
7. Synder, L, and Champness, W. 2004. Molecular Genetics of Bacteria. ASM Press, Washington D.C.

8. Klug, W.S. and Cummings, M.R. 1997. Concepts of Genetics, Prentice Hall International Inc.
9. Roth Well, N.V. 1997. Understanding Genetics, second edition, Oxford University Press Inc.
10. Gardner, E.J., 2004. Principles of Genetics, John Willey and Sons, New York.
11. Ringo J, 2004. Fundamental Genetics, Cambridge University Press.
12. 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.
13. Snyder, L and Champness W, 2003, Molecular Genetics of Bacteria, ASM Press.
14. Hartl, D.L. and Jones, E.W. 2005, Genetics - Analysis of Genes and Genomes, Jones and Bartlett Publishers. Sudbury, USA.
15. Hedrick, P.W. 2005. Genetics of Population. Jones and Bartlett Publisher, Sudbury, USA.
16. Trun, N and Trempey J.,2004, Fundamental Bacterial Genetics, Blackwell Publishing House.
17. Winnacker, E.L.2003, From Gene to Clones – Introduction to Gene Technology, Panima Publishing Corporation, New Delhi.
18. Beaycgamp T.L. and Walters L., Contemporary Issues in Bioethics, Wadsworth Publishing Company.
19. Brown, T.A.,2002 Genomes, Bios Scientific Publishers Ltd.
20. The Genome of Homo Sapiens, 2003, Cold Spring Harbor Laboratory Press.
21. Ignacimuthu, S. 2005, Basic Bioinformatics, Narosa Publishing House, India.
22. Lwein, B. 2004, Gene VIII, Pearson Education Int.
23. Miglani, 2003, Advanced Genetics, Narosa Publishing House, India,.
24. 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.
25. Primrose, S.B., and Twyman, R. M. 2006. Principles of Gene Manipulation. And Genomics. Blackwell Scientific Publications.
26. Wilson, J. and Hunt, T. 2004. Molecular Biology of the cell – the problems book, Garland publishing Inc.
27. Snustad, D.P. and Simmons, M. J., 2005. Principles of Genetics, 4th Edition. John-Wiley and Son Limited.
28. Kornberg,A., and Baker, T.A., 2005. DNA Replication, 2^d edition, University science books, Sausalito, California,
29. Jack.J.P., 2005. An Introduction to Human Molecular Genetics, 2nd edition new Jersey Wiley.
30. Tamarin, R. H., 2002. Principles of Genetics. McGraw-Hill Science.
31. Brooker,R. J., Genetics. 2005. McGraw-Hill Science.
32. Leland, H., Leroy, H., Michael, G.L., Silver, L., Lee M., Veres, R. C. and Ann. R., 2004. Genetics. McGraw-Hill Science.

33. Costa, L.G., and Eaton, D.L., 2006. Gene-Environment Interactions: Fundamentals of Ecogenetics, John Wiley and Sons Limited.

CLINICAL BACTERIOLOGY

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, genitourinary, 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. Cortan, R.S., Kumar, V., Collins, T., Robbins, S.L. and Schmitt, B. (1999) Robbins Pathologic basis of diseases 6th Edition, W.B. Saunders Co.
2. Baron, E.J. and Tenover, M. (1998) Bailey and Scott's Diagnostic Microbiology, 10th Edition, The C.V. Mosby Company
3. Henry, J.B. and Day, L. (1996) Clinical Diagnosis and Management by Laboratory Methods, 19th Edition, W.B. Saunders Co.
4. Inglis, T.J.J. (1996) Microbiology and Infection, 1st Edition, Churchill Livingstone Medical Division of Pearson Professional Limited
5. Jenson, H.B. Baltimore, R.S. (1995) Pediatric Infectious Diseases, 1st Edition, Appleton & Lange, Stamford, CT
6. Cheesbrough, M. (1994) Medical Laboratory Manual for Tropical Countries, Volume II, ELBS Edition, Butterworth-Heinemann Ltd.
7. Gladwin, M., Trattler, B., Trattler, B., 2004 Clinical Microbiology Made Ridiculously Simple, 3rd Edition, MedMaster, Incorporated
8. Jones, S.L., and Ed. Jones, R., 2001, Clinical Laboratory Pearls. Lippincott Williams & Wilkins
9. Murray, P.R., Tenover, K.S., Tenover, M.A., Tenover, K.S., (2005), Medical Microbiology: Elsevier Health Science
10. McClatchey, K.D., Keren, D.F., Hackel, E., Lewandrowski, K. and Alkan, S., 2001. Clinical Laboratory Medicine. Lippincott Williams & Wilkins.

11. Hawkey, P and Lewis, D., 2004. Medical Bacteriology: A Practical Approach. 2nd Edition .Oxford University Press;
12. Mims, C Dockrell, H., Goering,R., Roitt ,I Wakelin, D. and Zuckerman M., Medical Microbiology.2004. 3rd Edition .Mosby.
13. Stephen, J., Mims, C.A., Nash, A.2000. Mims' Pathogenesis of Infectious Disease. 5th Edition. Academic Press Inc.,U.S.
14. 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
15. 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.

MYCOLOGY

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.

Practical:

Isolation and identification of fungi from:

Environment

Rhizosphere

Clinical samples.

Effect of temperature on growth of fungi.

Determination of antifungal activity of (nystatin, actidion, amphotericin B etc.)

Recommended Books

1. C. J. Alexopoulos, C. W. Mims & M. Blackwell. 4th Edition 1996. Introductory Mycology. John Wiley & Sons, INC.
2. Harold C Bold, C. J. Alexopoulos & T. Delevoryas. 1980. "Morphology of Plants and Fungi". Harper & Row.

Surroundings setting atmosphere background

SOIL MICROBIOLOGY

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

Practicals

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

Recommended Books

1. Alef, K., Nannipieri, P., 1995. Methods in applied soil microbiology and biochemistry. Academic Press
2. Coyne, M. S., (1999) Soil Microbiology: an exploratory approach. International Thompson Publishing
3. Sylvia, D.M., Hartel, W.P., Fuhrmann, W.J., 1997 Principles and application of soil microbiology. Prentice Hall PTR.
4. Van Elsas, J.D., Trevors, J.T., 1997. Modern Soil Microbiology. Marcel Dekker
5. Tate, R.,L., 2000. Soil Microbiology. Wiley, John & Sons, Inc.
6. Subbarao, N.S. 1999. Soil Microbiology. Science Publisher
7. [Coyne](#), M. 1999. Introduction to Soil Microbiology
8. Davet, P. 2004. Microbial ecology of soil and plant growth. Science Publishers
9. Ellass, V., 2006. Modern Soil Microbiology 2nd Edition.
10. Sylvia, D.M., Fuhrmann, J.J., Hartel, G., Zuberer, D.A. (1998). Principles and applications of soil microbiology, Oxford University Press
11. Diane Tice, D., 2005. Principles and Applications of Soil Microbiology: 2nd Edition.

SEMESTER – VI

GENERAL VIROLOGY

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

Practicals

1. Detection and quantitation of viruses:
 - a. Hemagglutination Inhibition assay
 - b. Chick embryo inoculation.
 - c. Plaque assay.
2. Transmission electron microscopy (field trip).
3. Sample preparation for electron microscopy.
4. Isolation and identification of phages from various sources.

Recommended Books

1. Krug, R., Racaniello, V., Lynn W. E, Vincent Racaniello, R., Enquist, L.W., Flint S.J. 1999. Principles of Virology: Molecular Biology, Pathogenesis and Control . ASM Press
2. Cann, A.J., 2001 Principles of Molecular Virology Academic Press
3. 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 & Wilkins
4. Wagner, E.K., and Hewlett, M., 1999. Basic Virology. Blackwell Science, Inc.
5. Brian W., Mahy, B., Mahy, W., 2001. A Dictionary of Virology. Academic Press, Incorporated
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.
8. 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.
9. Cann, A.J., 2005. Principles of Molecular Virology. Elsevier Science & Technology Books

10. Wagner, E.K., Hewlett, M.J., 2003. Basic Virology, Blackwell Publishers.
11. Howley, P.M., Roizman, B., Straus, S.E., Martin, M.A., Griffin, D.E., 2001. Fundamental Virology, Lippincott Williams & Wilkins.

EPIDEMIOLOGY

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.

Cyclicality 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. Statistical models in epidemiology (1993) By Dwyer.
2. Prevention Effectiveness (1996) By Haddix.
3. Genetics & public Health in 21st Century (2000) by Koury, Burke & Thomson.
4. Noah, N and O'Mahony, M., 1997. Communicable Disease: Epidemiology and Control. John-Wiley and Son Limited
5. Salyers, A.A. and Whitt, D.D., 2002. Microbiology: Diversity, Disease, and the Environment. John-Wiley and Son Limited
6. Ziegler, A., and Koenig, I.R., 2006. A Statistical Approach to Genetic Epidemiology: Concepts and Applications. John-Wiley and Son Limited
7. Haines, J.L., Pericak-Vance, M.A., 2006. Genetic Analysis of Complex disease. Wiley, John & Sons, Incorporated.

ENVIRONMENTAL BIOTECHNOLOGY

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

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

Recommended Books

1. Schmauder, H.P. (1997). Methods in biotechnology, Tyler & Francis Publishers.
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

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

Others (Cytoskeleton,

Antifungal drugs affecting membrane and wall biosynthesis in fungi.

Mechanism of action of antiviral drugs, antimitotic agents, benzimidazole carbamates, alkaloids and taxol.

Antiparasitic agents.

Resistance mechanisms.

New approaches

Blockers of:

- a) Selective microbial enzymes or substrates
Receptors
Other biochemical processes
- b) Action of antibiotics on biofilms.
Drug design and delivery

PRACTICAL

Isolation of antibiotic resistant bacteria from environment.

Effect of antibiotics on peptidoglycan content.

Effect of antibiotics on total soluble protein content.

Determination of extended spectrum beta lactamase in bacteria resistant to beta lactam antibiotics.

Determination of protein profile of antibiotic sensitive and resistant bacteria by Polyacrylamide Gel Electrophoresis (PAGE).

Effect of antibiotic on bacteria present in biofilm.

Recommended Texts

1. Franklin, TJ and Snow, GA 1988. Biochemistry of Antimicrobial Action, 4th edn., Chapman and Hall
2. Coulson, C.J. 1994. Molecular mechanisms of drug action. Tyler and Francis Inc. USA
3. Greenwood, D. 2000 Antimicrobial chemotherapy. Oxford Univ. Press.
4. Greenwood ,D., Finch ,R., Davey ,P., Wilcox ,M., 2007. Antimicrobial Chemotherapy.5th Edition. Oxford University Press.

CELL & TISSUE CULTURE TECHNOLOGY

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.

Limiting dilution and 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

Preparation of glassware and media.

Starting a primary culture (tissue digestion, cell count and cell culture).

Establishing a cell line.

Cryopreservation of cell line.

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 & 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 & 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, USA.
10. Nguyen, H.T., and Blum, A., 2004. Physiology and Biotechnology Integration for Plant Breeding, Vol. 100. Marcel Dekker
11. Tourte, Y., and Catherine Tourte, 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.

SEMESTER – VII

INTRODUCTORY MICROBIAL TECHNOLOGY

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.

Biochemical Engineering - a historical perspective.

Large-scale microbial fermentation, the principles and problems.

An introduction to downstream processing.

Strain Development

Isolation and identification of industrially important microorganisms.

Different approaches improvement of industrial microbes

A spectrum of for microbial strain development

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

Citric Acid production

Ethanol production

Lactic Acid

Estimation of Microbial cell mass

Mutagenesis (Physical and Chemical)

Field trips:

Industrial alcohol production from sugar cane; Citric acid production.

Amino acid biosynthesis in *Corynebacterium glutamicum*.

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, PF 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 Perseppectives on Biotechnology, Trade and Sustainability. Earthscan/James & 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 & 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 & 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 & Sons.
20. Thauer, R., and Wagner, F., 1991. Biotechnology Focus: Fundamentals - Applications – Information, Helen Cooper-SchluterCarl Hanser, Verlag GmbH & Co.

PLANT MICROBIOLOGY

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

Root rots

Diseases of fruits and vegetables.

Bacterial diseases:

Blights

Cankers

Leaf spots

Rots

Viral diseases:

Mosaics

Dwarfs

Stunts

Yellows

Leafcurl

Witches

Broom

Ring spots

Wilts

Quarantine, eradication and International Plant Protection. Cultural practices in disease control, chemical control. Resistant varieties.

Future problems and prospects.

PRACTICAL

Sample collection and identification of plant pathogen (farms, orchards, nurseries etc.).

Field trips

Recommended Books

1. Hull, R (2001) Matthews' Plant virology. Academic Press
2. Prell, HH., Day, PR (2001) Plant-fungal pathogen interactions: A classical and molecular view. Springer Verlag.
3. Skinner, FA., Rhodes-Roberts, ME (1982) Bacteria and plants. Academic Press Inc.
4. Zadoks, JC., Schein, RD (1979) Epidemiology and plant disease management. Oxford University Press.
5. Agrios, GN (1997) Plant Pathology. Morgan Kaufmann Publishers
6. Lucas, JA., Dickinson, CH (1998) Plant Pathology and Plant Pathogens. Blackwell Science Inc.

7. Vedhayasekaran, P. (1997) Fungal Pathogenesis in Plants and crops: Molecular biology and host defence mechanisms. Marcell Dekker
8. Ingram, DS (1985) Advances in plant Pathology. Academic Press Inc.
9. Maloy, OC., Murray, TD (2000) Encyclopedia of plant pathology. Wiley, Johns & Sons.

RESEARCH METHODOLOGY

1. Introduction: Research and professions
2. Understanding the research process
3. Plagiarism and its professional consequences
4. History and Principles of research ethics,
5. Originality of Research
6. Conflicts of interest
7. Copyright and Patent Law
8. Aims of research, The research topic
9. Title and research problem
10. Literature review: Search, Retrieve and manage information
11. Research design
12. Parametric, non-parametric and semi-parametric methods
13. Qualitative Methodologies and interpretation of results
14. Conclusions and its Validity
15. Report writing and the research proposal
16. Community Research
17. Principles of presentation,
18. Communication-oral, posters,
19. Abstract and manuscript preparation
20. Communicating your own credentials,
21. Communicating own work-CV,
22. 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. Designing Clinical Research, 2nd ed; Lippincott Williams and Wilkins, Philadelphia, 2001.
2. Baumgartner, T. and Hensley, L. Conducting and Reading Research in Health and Human Performance 4th ed McGraw Hill, New York, 2006,
3. Community-Based Participatory Research for Health (2003), by M. Minkler and N. Walderstein, Josey Boss, San Francisco, CA
4. Qualitative Research and Evaluation Methods 3rd ed (2002), by M. Patton, Sage Publications Inc., Thousand Oakes, CA
5. Handbook of Health Research Methods (2005), by Ann Bowling,A., and Shah Ebrahim Open University Press, Two Penn Plaza, New York, NY.

FOOD & DAIRY MICROBIOLOGY

1. Scope of food and dairy microbiology
2. World food problems
3. Microorganisms important in food industry
4. Principles of food spoilage and their preservation
5. Spoilage and preservation of food products
6. Food preservation in warm countries
7. Food hygiene, sanitation and legislation
8. Quality assurance in food industries.
9. Recent advances in food industry
10. Technology of food processing
11. Preservative agents for improving the quality, shelf-life and organolaptic properties of foods
12. Neutralizers, stabilizers, firming agents, coating and wrapping agents.
13. Food Preservation Technology
14. Principles and methods of food preservation
15. Bacteriology of preserved foods
16. Packaging and related problems

PRACTICALS

1. Isolation of starter culture from
 - a. Cheese
 - b. Yogurt
2. Isolation of phages from lactobacilli
3. Enumeration of bacteria from
 - Poultry
 - Beef
 - Milk
 - Eggs
 - Fish
4. Field trips to (minimum 2 trips)
 - Brewery industry
 - Milk plant
5. Use of microorganisms in beverages

Recommended Books

1. Jay, JMM (2000) Modern Food Microbiology. Aspen Publishers
2. Steele Sr., JL., Marth, EH (2001) Applied Dairy Microbiology. Marcel Dekker
3. Molins, RA. (2001) Food irradiations: Principles and applications. Wiley, John & Sons
4. Reuter, H (1989) Aseptic packaging of foods. CRC Press, LLC.
5. Barbosa-Canovas, Paolu, E., Swanson, Pothakamury, UR (1997) Nonthermal preservation of food. Marcel Dekker
6. Luck E., Jager, M laichen, SF (2000) Antimicrobial food additives: Characteristics, uses, effects. Springer-Verlag, NY, Inc.

7. Modern Food Microbiology *by* J. M. Jay, M. J. Loessner, D. A. Golden, 7th Edition, 2006 *published by* Springer Science, Inc., USA
8. Renner, E. (1989) Micronutrients in milk and milk based food products. Elsevier Applied Science.
9. Robinson, R.K. (1983) Dairy Microbiology I & II. Applied Science Publishers.
10. Lampert, L.M. (1985) Modern Dairy Products. Chemical Publishing Company.
11. Jay, J.M. (1990) Modern Food Microbiology. D. Van Nostrand Company
12. Guthrie, R.K. (1980) Food Sanitation. AVI Publishing Company Inc.

Microbiology of Fresh Produce

by [Karl R. Matthews](#), [Michael P. Doyle](#) (Editor)2006. ASM Press

Microorganisms in Foods 6: Microbial Ecology of Food Commodities
by [International Commision on Microbiologic](#) Springer-Verlag New York, LLC
Edition Number: 22005

Innovations in Food Packaging

by [Jung Han](#), 2005. Elsevier Science & Technology Books

Food Processing Handbook

by [James G. Brennan](#) 2006Wiley, John & Sons, Incorporated

GENETIC ENGINEERING

1. Introduction and scope.
2. Restriction and modification system.
3. 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
4. Exchange of genes between a lambda phage and Col EI factor.
5. *In vitro* genetic engineering; cloning vehicles: plasmids, cosmids and phagemids, YAC and BAC etc.
6. Principles of nucleic acid isolation (DNA & RNA).
7. Cloning strategies: construction of chimera plasmids.
8. Methods of introducing exogenous DNA.
9. Methods for screening the clones.
10. DNA sequencing
11. PCR its application and primer designing.
12. Expression systems for Pro- and Eukaryotes.
13. Markers for labeling methods for probes.
14. Concept of construction of genomic library.

PRACTICAL

Methods of nucleic acid isolation (DNA & RNA).
Slab gel electrophoresis
Restriction enzyme digestion of DNA
Southern blotting
Electroblotting
Transformation

SEMESTER – VIII

BIOTECHNOLOGY

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.

Design of sterilization systems.

Oxygen mass transfer and heat transfer in bioreactor systems.

Fermentation broth rheology.

Bioreactor configurations and scale-up of bioreactor system.

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 and 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. Baumberg, S. (1999). Prokaryotic gene expression, Oxford University Press.
4. Stanbury, PF and Whitaker, A (1995). Principles of Fermentation Technology, Pergamon Press
5. Fell, D (1996). Understanding the control of metabolism, Portland Press
6. Moses, V and Cape, RE (1999). Biotechnology, Smith, JE
Biotechnology: The Science and the Business,
7. Primrose, SB Molecular Biotechnology

MEDICAL VIROLOGY

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.
Anti viral agents, viral prophylaxis
Interferon and chemotherapeutic agents

Practicals

Chick embryo inoculation
Enzyme Linked Immunosorbent Assay (ELISA)
Haemagglutination Inhibition (HI)
Haemagglutination (HA)
Precipitation
Cytopathic effects
Animal inoculation
Fluorescent Antibody Test (FAT)
Polymerase Chain Reaction (PCR)

Recommended Books

1. Krug, R., Racaniello, V., Lynn W. E, Vincent Racaniello, R., Enquist, L.W., Flint S.J. 1999 [Principles of Virology: Molecular Biology, Pathogenesis and Control](#) ASM Press.
2. Alan J. Cann (2001) **Principles of Molecular Virology** Academic Press,
3. Roizman, Griffin, Malcolm A. Martin, *et al.* (2001) [Fundamental Virology](#) Lippincott Williams & Wilkins.
4. Robe Lamb, Malcolm A. Martin, Diane E. *et al.* (2001) *Fields Virology* Lippincott Williams & Wilkins
5. David O. O. White, F. J. Fenner, W. F., Fenner J. (1994) [Medical Virology](#) Academic Press.
6. Edward K. Wagner, Martin Hewlett (1999) [Basic Virology](#) Blackwell Science, Inc.
7. Brian W. Mahy, B. W. Mahy (2001) *A Dictionary of Virology* Academic Press.
8. Nigel J. J. Dimmock, K., Leppard, A. Easton, A., Easton, Keith Leppard (2001) [Introduction to Modern Virology](#) Blackwell Science, Inc.
9. Alan J. Cann (2000) / [Virus Culture: A Practical Approach](#) Oxford University Press.
10. Thomas F. Smith, Edwin H. Lennette (1999) [Laboratory Diagnosis of Viral Infections](#) Marcel Dekker.
11. Bernard N. F., David M. K., Peter M. H. (1995) [Fundamental Virology](#) Lippincott-Raven Publishers
12. Brian W.J. M., Hillar O. K. (1996) [Virology Methods Manual](#) Academic Press
13. S. B. Primrose, Dimmock N.J. J. (1995) [Introduction to Modern Virology, Vol. 2](#) Blackwell Science, Inc.
14. Frederick A. Murphy (1995) [Virus Taxonomy: Classification and Nomenclature of Viruses: Sixth Report of the International Committee on](#)

[Taxonomy of Viruses](#) International Committee on Taxonomy of Viruse,
Springer-Verlag New York.

15. Principles of Virology: molecular biology, pathogenesis, and control of animal viruses *by* S. J. Flint, L. W. Enquist, V. R. Racaniello, A. M. Skalka, 2nd Edition, 2003, *published by* American Society for Microbiology, USA
16. Basic Virology *by* E. K. Wagner & M. J. Hewlett 2nd Edition, 2003 *published by* Blackwell Publishers, USA
17. Medical Virology *by* D. E. White & F. J. Fenner, 4th Edition, 1994 *published by* Academic Press, USA
18. Field's Virology *by* B. N. Fields, M. Peter, M. D. Howley, E. Diane, Griffin, A. Roberts, A. Malcolm, M. D. Martin, B. Roizman, E. Stephen, M. D. Straus, M. David, Knipe, CD Edition, 2001, *published by* Lippincott Williams & Wilkins, USA
19. Molecular Virology *by* D. R. Harper, D. R. Harper, P. R. Kinchington, 2nd Edition, 1999, *published by* BIOS Scientific Publishers, USA
20. Matthew's Plant Virology *by* R. Hull, 4th Edition, 2001, *published by* Academic Press, USA
21. Veterinary Virology *by* F. A. Murphy, E. P. J. Gibbs, M. C. Horzinek, M. J. Studdert, 3rd Edition, 1999, *published by* Academic Press, USA

MINI RESEARCH PROJECT

CURRICULUM FOR MS (HONS) SCHEME OF STUDIES

A Sub-Committee meeting for MS Program was held on July 20, 2006 at HEC Regional Center, Lahore. Following attended the meeting: -

- | | | |
|----|---|-----------|
| 1. | Dr. Nusrat Jamil,
Department of Microbiology,
University of Karachi, Karachi. | Convener |
| 2. | Mr. Ahsan Sattar Sheikh,
Assistant Professor,
Institute of Molecular Biology & Biotechnology,
University of Lahore,
1- Km Raiwind Road, Lahore. | Member |
| 3. | Dr. Anjum Nasim Sabri,
Department of Microbiology,
University of the Punjab. Lahore. | Member |
| 4. | Mr. Bashir Ahmed Channar
Sindh University Jamshoro. | Member |
| 5. | Dr. Badaruddin A. Memon,
Department of Microbiology,
Shah Abdul Latif University, Khairpur | |
| 6. | Dr. Abdul Ghaffar,
Foreign Faculty Member,
University of Health Sciences, Lahore. | Secretary |

The MS Program will span over 2 years.

The first year will be composed of 2 semesters and student will carry 15 credit hours during each semester, one course three credit hours (old course) and 3 courses of 4 credit hours each. Proteomics and genomics and instrumentation / analytical techniques will be the core course. Other course will be optional and will vary according to specialization in the following areas:

Agriculture
Cell and Molecular Biology
Food and Dairy
Industry
Medical

Course topics in each area are defined below and the board of studies at each institution will decide contents.

Each student must successfully complete at least 80% of course prior to starting his / her research project. One whole year shall be devoted to research will be novel and regional at the beginning of the research a thesis / research committee consisting of three senior Professor and the supervisor will be appointed and this committee will overseas the research proposal and progress. The conclusion of the research the thesis will be examined by and external examined from outside the university pointed by the board of study

1st Year

Core courses

- | | |
|-------------------------------|---------------|
| 1. Proteomics & Genomics | 3 Credit Hrs. |
| 2. Instrumentation techniques | 3 Credit Hrs. |

CORE COURSES

PROTEOMIC AND GENOMIC

1. Introduction to Proteomics and Genomics
2. Genome Diversity and Evolution
3. Gene to Genome (Comparison of Pro and Eukaryotic Systems)
4. Data base search in genomic, retrieval and analysis
5. Gene to protein
6. Posttranslational modification.
7. Folding and 3D Structures
8. Computer Modeling of Biological Molecular
9. Data Base search in proteomic
10. X-Ray Crystallography, Principle and Interpretations.
11. Principle and Application of Gene and Protein Arrays.

Recommended Books

1. Barnes, M.R. and Gray, I.C., 2005. Bioinformatics for Geneticists John Wiley & Sons limited.
2. Barnes, M.R. and Gray, I.C., 2005. Bioinformatics for Geneticists John Wiley & Sons limited.
3. Campbell, A.M., and Heyer, L.J., 2002. Genomics, Proteomics and Bioinformatics. Benjamin Cumming,
4. Dardel, F., Képès, F. and Hardy, N., 2006. (Bioinformatics: Genomics and Post-Genomics. John Wiley & Sons limited.
5. Dardel, F., Képès, F. and Hardy, N., 2006. (Bioinformatics: Genomics and Post-Genomics. John Wiley & Sons limited.

6. Kinter ,M., and Sherman , N.E., 2000. [Protein Sequencing and Identification Using Tandem Mass Spectrometry](#). John Wiley and Sons Limited.
7. Liebler, D.C., 2001. Introduction to Proteomics, Tools for the New Biology. Humana Press.
8. Meksem, K., and Kahl, G., 2005. [The Handbook of Plant Genome Mapping: Genetic and Physical Mapping](#). John Wiley and Sons Limited.
9. Mount, D.W., 2001. Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press.
10. Mount, D.W., 2001. Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press.
11. Nakamura, H., and Arisaka, F., 2005. Architecture and Physical Properties of Proteins, Biophysical Society of Japan.
12. Nakamura, H., and Arisaka, F., 2005. Architecture and Physical Properties of Proteins, Biophysical Society of Japan.
13. Nelson, P., 2003. [Biological Physics: Energy, Information, Life](#), W. H. Freeman.
14. Nelson, P., 2003. [Biological Physics: Energy, Information, Life](#), W. H. Freeman.
15. Pannington, S. and Dunn, M.J., 2001. Proteomics: From protein sequence to function Springer- Verlag.
16. Schomburg, D., and Lessel, U., 1995. Bioinformatics: From Nucleic Acids and Proteins to Cell Metabolism. Wiley. John & Sons.
17. Schomburg, D., and Lessel, U., 1995. Bioinformatics: From Nucleic Acids and Proteins to Cell Metabolism. Wiley. John & Sons.
18. Sensen, C.W., 2005. Handbook of Genome Research: Genomics, Proteomics, Metabolomics, Bioinformatics, Ethical and Legal Issues, John Wiley and Sons Limited.

INSTRUMENTATION AND ANALYTICAL TECHNIQUES

Principles and Applications of various techniques in Biology

Confocal Microscopy

Ultracentrifugation

Spectroscopy

Isoelectric Focusing

Chromatography (TLC, GC, CLS, HPLC, Affinity and Ion Exchange)

Photographic techniques (simple and microphotography)

Amplification of DNA

Use of computer for genetic analysis

DNA and Amino acid sequencing

Kinetics of molecular Hybridization

Southern, Western, Northern blotting and FISH

Labeling Techniques of Probes (Isotopes, Fluorescence, Chemiluminescence, and other Chromogenic substances)

Tests for Chemical Carcinogens

Microarray Chips

Recommended Books

1. Louise, O'C., 2006. [Diagnostic Bacteriology Protocols, Second Edition](#), Humana Press, Inc. Scientific and Medical Publishers, 999 Riverview Dr, Ste 208, Totowa, NJ 07512
2. Hydar, A. and Haribabu, B., 2006. [Transmembrane Signaling Protocols, Second Edition](#), Humana Press Inc. Scientific and Medical Publishers. 999 Riverview Dr, Ste 208 Totowa, NJ 07512
3. Vaughn, P. 2000. DNA Repair Protocols: Prokaryotic Systems, Methods in Molecular Biology, Volume 152, Clifton, New Jersey.
4. Stanley. R.,1990. Experimental Techniques in Bacterial Genetics, Jones and Bartlett series in Biology, Jones and Bartlett, Boston.
5. Griffin, H G., and Griffin, A. M., 2000. DNA Sequencing Protocols Methods in Molecular Biology, Volume 23, Humana Press, Inc. Scientific and Medical Publishers, 999 Riverview Dr, Ste 208 Totowa, NJ 07512.
6. Isaac, P. G., 1994. Protocols for Nucleic Acid Analysis by Nonradioactive Probes, Methods in Molecular Biology, Number 28, Humana Press, Inc. Scientific and Medical Publishers, 999 Riverview Dr, Ste 208 Totowa, NJ 07512.

OPTIONAL COURSES

Following area of specialization are recommended student would take six courses in any area of specialization four credit Hors each course.

1. Health & Medical Microbiology

- a. Molecular Pathogenesis
- b. Epidemiology: Analytical & expedited Approaches.
- c. Molecular Virology.
- d. Molecular Cancer Biology
- e. Gene and Gene Activity
- f. Advance Molecular Diagnostic
- g. Molecular Mechanism of Anti microbial drugs.

2. Agriculture

- a. Microbial Techniques in Horticulture
- b. Plant viral Diseases
- c. Pathogenic of Plant Diseases
- d. Microbiology of Soil and Bioremediation
- e. Current development in Diagnosis of Plant Diseases.
- f. Advance Veterinary Microbiology
- g. Control of Plant Microbial Disease.

3. Industry

- a. Fermentations and its industrial application
- b. Microbial Strain development for Industry
- c. Bioreactors & Biosensors

- d. Microbial Enzyme Technology
- e. Vaccine Development
- f. Biopolymers & Microbial Pharmaceutics
- g. Microbial Pollution and Waste Management.

4. Food and Dairy

- a. Food Borne Diseases
- b. Pathogens of Aquatic Animals
- c. Advances in Dairy Microbiology
- d. Microbes & Poultry
- e. Current Advances in Food Preservation and Packaging
- f. Innovations in Microbial Fermentation Technology.

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.