VANITA VISHRAM WOMEN'S UNIVERSITY

SCHOOL OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF BIOTECHNOLOGY

BACHELOR OF SCIENCE (B.Sc.) HONOURS IN BIOTECHNOLOGY

Under Learning Outcomes Based Curriculum Framework (LOCF)

For Undergraduate (UG) Education

SEMESTER - 6

Core Courses (CC)

Syllabus applicable to the students seeking admission in the following Program

B.Sc. Biotechnology under LOCF w.e.f. the Academic Year 2021-2022

BACHELOR OF SCIENCE (B.SC.) BIOTECHNOLOGY HONOURS

SEMESTER VI

CORE COURSE PAPER 13

Clinical Microbiology
Course Objectives: • To enable the students to understand about Epidemiology of infectious diseases of human being and their clinical diagnosis, treatment and prevention. • To familiarize about the prenatal diagnosis techniques and nucleic acid-based diagnosis of infectious diseases and clinical management and metabolic manipulation of Genetic disorders
Course Outcome: Upon completion of the course, the student shall be able to comprehend • At the closing stage of the course, the student will be able to understand the basic concept of Epidemiology of infectious diseases. Further student will also understand about Clinical diagnostic test, antimicrobial susceptibility testing and antimicrobial chemotherapy that can be employed for treatment of infectious disease.

BT11250 - THEORY COURSE CONTENT (4 Credits)		
UNIT 1	**Epidemiology of infectious diseases** Epidemiological terminology, Measuring frequency: The epidemiologist's tools, Infectious disease epidemiology, Recognition of an infectious disease in a population, Recognition of an epidemic, The infectious disease cycle: Story of a disease, Virulence and the mode of transmission, Emerging and reemerging infectious disease and pathogens, Control of epidemic	**15 Lectures**
UNIT 2	**Collection and transport of clinical specimens and their identification** Collection of specimens, Handling of specimens, Transport of specimens Identification of microorganisms from specimens • Morphological: Microscopy • Cultural: Growth • Biochemical characteristics • Rapid method of identification • Molecular	**15 Lectures**
UNIT 3	Hospital infections Quality control in microbiology Laboratory control of antimicrobial therapy Collection of specimens for bacteriological investigations Methods of culture, techniques and organisms encountered in: CSF, blood culture, sputum, pus, urine, stool, UTI, endocarditis, Bone and joint infections	**15 Lectures**
UNIT 4	Bacteriological investigation in: PUO, Tuberculosis, Leprosy, Meningitis, Eye infections Causative agents and investigations in cases of: Food poising, gastro	**15 Lectures**
BT11260 - LAB COURSE CONTENT **(2 Credits)**		

1. Isolation, characterization and identification of pure cultures of bacteria.
2. **Skin/pus /wound pathogens**: Isolation and identification of microbes from skin/pus/wound
3. **Blood pathogens**: Isolation and identification of microorganisms from blood sample
4. **Pathogens in urine**: Isolation and identification of microorganisms from urine sample
5. **Antimicrobial susceptibility testing**: Antimicrobial susceptibility testing by Kirby Bauer disc diffusion method
6. **Determination of MIC and MBC**: Determination of Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC).
7. **Microbial flora of the mouth**: To isolate and identify microbial flora of mouth teeth crevices, Determination of dental caries susceptibility

SUGGESTED READING

1. Murray PR, Baron EJ, Pfaller MA, Tenover PC and Yolken RH (Eds): Manual of Clinical Microbiology 6 th Ed. American Society for Microbiology, Washington, DC 2005.
2. Woods GL, Washington JA: The Clinician and the Microbiology Laboratory, Mandell
3. GL, Bennett JE, Dolin R (Eds): Principles and Practice of Infectious Disease 4th Ed. Churchill Livingstone, New York, 2002.
4. E. Joan Stokes, M.W.D. Wren, G.L.Ridgway, Clinical Microbiology 7th Ed. Hodder Arnold Publishers 7 th Edition.
5. Ananthanarayan & Paniker's Textbook of Microbiology, 8th Ed., Orient Longsman, India; 2009.
6. Bailey and Scott's Diagnostic Microbiology 9th Ed. C V Mosby, St. Louis, 2003.
7. Brooks, Geo F Jawetz Medical Microbiology 22nd Ed. Mc Grew Hill 2001. Prescott Tortora and Funke, Microbiology an Introduction (8th edn) Benjamin-Cummings Publishing Co.
8. Patel R.J (2011) Experimental microbiology Volume 1 (6th edn) Aditya, Ahmedabad, India.
9. Patel R.J (2008) Experimental microbiology Volume 2 (5th edn) Aditya, Ahmedabad, India
10. Ochei J. and Kolhatkar A. (2000) Medical laboratory science theory and practice, McGraw-Hill.
11. Godkar P B. Textbook of Medical Laboratory Technology, 2nd Ed. 2003 Bhalani Publication
12. Mukherjee K.L. (1999), Medical Laboratory Technology, Vol II, 2nd Ed., Tata Mcgraw

BACHELOR OF SCIENCE (B.SC.) BIOTECHNOLOGY HONOURS

SEMESTER VI

CORE COURSE PAPER 14

Environmental Biotechnology

Course Objectives:

The objective of this course is

- To learn about the about assessment and management of Environmental Pollutions, solid and sewage waste treatment methods and application, Biodegradation and bioremediation and their practical approaches, Applications of Environmental Biotechnology like Bio-resources, Utilization of sewage and Agro-waste, Bioleaching, Biomining, Restoration of land, etc.
- The related experiments will help students to understand how immunologists think and work..

Course Outcome:

Upon completion of the course, the student shall be able to comprehend

- The types of pollutions, their assessment and management through biotechnological approaches and have knowledge to apply these techniques in real life problems.
- The types and various treatment methods for solid and sewage wastes.
- Acquire knowledge about Biodegradation of various compounds like halogenated, pesticides, herbicides, etc. Have knowledge about types of Bioremediation, methods and application as well as phytoremediation approaches will be acquired.
- The information of various Applications in Environmental Biotechnology, which can be useful for practical aspects.

BT11270 - THEORY COURSE CONTENT (4 Credits)		
UNIT 1	**Introduction and Scope of Environmental Biotechnology** • Definition, introduction and scope of environmental biotechnology • Challenges of environmental biotechnology • Pollution monitoring and measurements • Cleaning and cleaner technology in Environmental Biotechnology	**15 Lectures**
UNIT 2	**Liquid and solid waste treatment and disposal** Liquid waste management using living system • Types of liquid waste • Sources and characterization of waste water • Analysis of waste water • Treatment of waste water (Use of Microbial enzymatic techniques) • Waste water treatment at industrial level: Dairy, Sugar and Pharma Solid waste management • Sources and characteristics of sludge • Methods of sludge treatment and disposal: Preliminary operations, Sludge thickening, Stabilization, Conditioning, Disinfection, Dewatering, Heat drying, Ultimate disposal • Septage and septage disposal • Treatment and disposal of solid waste: incineration and landfilling	**15 Lectures**
UNIT 3	**Biodegradation, Bioremediation and Phytoremediation technologies:** Biodegradation of xenobiotic compounds • Characteristics, Types, Hazards and General features of recalcitrant xenobiotic compounds • Degradation of hydrocarbons and halogenated compounds, • Biodegradation of pesticides and herbicides • Bioremediation	**15 Lectures**

	• Definition and types of Bioremediation • Bioaugmentation and Biofiltration • Bioremediation of hydrocarbons Bioremediation of hydrocarbons and xenobiotic compound. Phytoremediation • Definition, Types and mechanisms of phytoremediation • Rhizoremediation - Introduction, Types and Mechanisms • Concept of Phytoextraction and rhizofiltration • Advantages, Disadvantages and applications of phytoremediation	
UNIT 4	**Applications of Environmental Biotechnology** Bioenergy and Bio-resources • Useful features, undesirable features of biofuels and area to focus for future research • Bioremediation (in situ and ex-situ) • Energy crops • Modes of utilization of Biomass • Biogas • Biodiesel Microbial leaching: Bioleaching and Biomining Restoration of degraded lands: biotechnological approaches Utilization of sewage and Agro-waste • SCP production • Mushroom production on agro-waste • Vermicomposting	**15 Lectures**
BT11280 - LAB COURSE CONTENT **(2 Credits)**		

1. Study of sampling technique and sample preservation: Collection of grab and composite sample.
2. Physical analysis of sewage/industrial effluent by measuring: Acidity, Alkalinity, Hardness, Residual chlorine
3. To estimate total solids (TS), total dissolved solids (TDS) and suspended solids (SS) in the given water sample.
4. To estimate dissolved oxygen (DO) content of wastewater.
5. Determination of indices of pollution by measuring BOD & COD of different effluents
6. Bacteriological analysis of water for determination of potability: Standard plate count, Test for coliforms: (presumptive, confirmed and completed tests), Enumeration of coliforms by MPN technique
7. Study of air micro flora by settling plate technique
8. Isolation and enumeration of soil microorganisms
9. Isolation of bacteriophage from sewage
10. To study bioremediation of heavy metal
11. To set up soil ecosystem using a Winogradsky column
12. Visit to Biogas production plant/Biofuel (Ethanol) production plant/Vermicompost site/zero waste technology plant.

SUGGESTED READING

1. Maier, R.M., Pepper, I.L. and Gerba, C.P., 2009. Introduction to environmental microbiology. In Environmental Microbiology (pp. 3-7). Academic Press.
2. Satyanarayana, U., 2013. Biochemistry. Elsevier Health Sciences.
3. Dubey, R.C., 1993. A textbook of Biotechnology. S. Chand Publishing.
4. Dubey, R.C., 2014. Advanced biotechnology. S. Chand Publishing.
5. Gupta, P.K., 1994. Elements of biotechnology. Rastogi Publications.

BACHELOR OF SCIENCE (B.SC.) BIOTECHNOLOGY HONOURS

SEMESTER VI

DISCIPLINE SPECIFIC ELECTIVE PAPER 5

Bacteriology & Parasitology

Course Objectives:

The primary objective of this course is to provide students with a comprehensive understanding of bacteriology and parasitology.

- To intricacies on microbial nutrient acquisition, detailing on bacterial cell division, and mode of communication observed in bacterial population.
- To make them understand about bacterial systematics, classification, and taxonomy.
- To familiarize the students about parasitology and its significance
- To make them understand about unicellular and multicellular parasites like protozoa, helminths, fungi, and arthropods in the context of human health.

Course outcome:

Upon successful completion of the course, students will be able to:

- Understand the fundamental processes observed in bacterial cell i.e., nutrient uptake, cell division and communication.
- Able to differentiate between simple and facilitated diffusion, active transport, group translocation, ABC systems, and secretion systems.
- Explore how bacteria communicate and respond to environmental signals.
- Evaluate taxonomic methods in bacterial systematics, understand bacterial nomenclature and classification, and significance of bacterial group.
- Discuss the importance and classification of protozoa, fungi, helminths, and arthropods in the context of parasitology.

The course gives theoretical knowledge fostering a deeper understanding of some bacterial process and parasitology. Students will gain the analytical skills necessary for further research or application in fields such as microbiology, medicine, and environmental science.

BT14010 - THEORY COURSE CONTENT (4 Credits)		
UNIT 1	Microbial nutrients and Nutrient uptake: Transport of nutrition to the cell - Simple and facilitated diffusion, Active transport, Group translocation, ABC system, Secretion system; Bacterial cell division: Cell cycle, Chromosome replication and segregation, Cell division and Fts proteins, MreB and Cell morphology, Biofilm; Bacterial communication and Signal transduction: Two-component regulatory system, Chemotaxis, Quorum sensing, Stringent response, Other global networks.	**16 Lectures**
UNIT 2	Bacterial Phylogeny and Systematics: Molecular phylogeny, the species concept, Taxonomic methods in systematics; Bacterial Classification and Nomenclature: Criteria for classifying Bacteria, Significance of Bergey's manual, Problems associated with Bacterial taxonomy, Bacterial nomenclature, Bacteria; Domain-Bacteria: The Proteobacteria, The Non-proteobacteria Gram-Negative Bacteria, The Gram-positive bacteria.	**16 Lectures**
UNIT 3	Parasitology and its principles; Protozoa: Introduction, Classification and Lifestyle; Super group Excavata: Leishmania spp, Naegleria spp, Trichomonas spp, Trypanosoma spp; Super group Amoebozoa: Amoebae, Entamoeba spp; Super group Chromalveolata: Paramecium spp, Plasmodium spp, Toxoplasma spp, Babesia spp.	**14 Lectures**
UNIT 4	Helminths: Flatworms - Trematodes (Schistosoma spp) and Cestodes (Taenia spp, Echinococcosis spp), Roundworms - Pinworms, Hookworms, Ascariasis, Filariases spp, Onchocerca spp, Trichinella spp; Fungi: Characteristics, Importance, and Classification of fungi; Arthropods: Characteristics and Classification of Arthropods.	**14 Lectures**

BT14020 - LAB COURSE CONTENT

(2 Credits)

1. Observe bacterial cell division stages under the microscope using stains.
2. Bacterial nucleoid staining by Giemsa stain.
3. Cultivate and detection of biofilm.
4. Study the response of bacteria to environmental stimuli (Chemical stimuli) through chemotaxis experiments.
5. Identify bacteria based on specific criteria such as morphology, colony, and biochemical characteristics.
6. Use Bergey's manual to identify and classify unknown bacterial samples.
7. Investigate specific examples from Super Groups Excavata, Amoebozoa, and Chromalveolata.
8. Blood smear examination of Malarial parasites (i) Thin smear by Leishman's stain, (ii) Thick smear by JB stain.
9. Direct examination of stool by Wet mount and Lugol's iodine.
10. Concentration of stool specimen by flotation and sedimentation method.
11. Study of multicellular parasites by preserve specimen (Helminths, fungi, and arthropod).

SUGGESTED READING

1. Willey J. M., Sherwood L. M., Woolverton C. J., Prescott's Microbiology. Tenth Edition, McGraw Hill Education.
2. Pommerville J. C., Alcamo's Fundamentals of Microbiology. Ninth Edition, Jones and Bartlett Publishers.
3. Nester E. W., Anderson D. G., Roberts Jr C. E., Nester M., Microbiology: A Human Perspective. Seventh Edition, McGraw Hill.
4. Madigan M. T., Bender K. S., Buckley D. H., Sattley W. M., Stahl D. A., Brock Biology of Microorganisms. Fifteenth Edition, Pearson.
5. Baumen R., Microbiology with Diseases by Body System. Fifth Edition. Pearson.
6. Black J. G. and Black L. J., Microbiology: Principles and Explorations. Eighth Edition, Wiley & Sons, Inc.

7. Tortora G. J., Funke B. R., Case C. L., Microbiology: An Introduction. Tenth Edition, Benjamin Cummins.

BACHELOR OF SCIENCE (B.SC.) BIOTECHNOLOGY HONOURS

SEMESTER 1

DISCIPLINE SPECIFIC ELECTIVE PAPER 2

Hematology & Blood Banking

Course Objectives:

- Knowledge on Landmark discoveries in Hematology & immunohematology, information related to blood, blood groups, blood cell production, blood related disorders, immunohematology contains different blood groups, blood typing procedures, blood banking procedures, blood transfusion, transfusion associated disorders etc.

Course Outcome:

At the conclusion of this course the students -

- Have developed a good knowledge of the development of Hematology & immunohematology and the contributions made by prominent scientists in this field.
- Have developed a very good understanding Blood, Blood cells, Blood typing procedures, routine blood banking procedures and basic/advanced tools used in the same.
- Can understand the useful and harmful activities of the blood transfusion and blood related disorders by detecting them.
- Can perform basic experiments to detect disorders related to hematology and immunohematology.

BT14090 - THEORY COURSE CONTENT (4 Credits)		
UNIT 1	Introduction to Hematology: Hematopoietic system, structure & Components of Blood, synthesis of Hemoglobin, collection & processing of blood, types of anticoagulants and their uses, blood coagulation cascade. Hematological disorders: Anemia, Leukemia, Polycythemia vera, and bleeding disorders. Pregnancy & Pediatric hematology.	**18 Lectures**
UNIT 2	Routine Hematological analysis and their clinical significance: Complete blood count (CBC) by manual and automatic method, estimation of hemoglobin, estimation methods for bleeding disorders. Special Hematological test: detection of sickle cell anemia & Beta-thalassemia, bone marrow examination.	**12 Lectures**
UNIT 3	Immunohematology I: Introduction, Human blood group systems, ABO blood group system, Rhesus (Rh) blood group system, Major and Minor blood group systems.	**15 Lectures**
UNIT 4	Immunohematology II: Transfusion immunohematology: criteria for blood donor selection, blood collection, transport and storage of blood, Pre-transfusion testing of donor's blood, preparation of blood components & their clinical significance, compatibility testing between donor & recipient, automation in blood banking, transfusion reactions.	**15 Lectures**

BT14100 - LAB COURSE CONTENT

(2 Credits)

1. ABO & Rh blood grouping by slide & tube technique
2. Estimation of hemoglobin by Cyanmethemoglobin estimation
3. Total RBC, WBC and Platelet count
4. Differential WBC count
5. Determination of reticulocyte count
6. Determination of PCV
7. Determination of erythrocyte indices

8. Determination of erythrocyte sedimentation rate (ESR)
9. Determination of histogram using automated hematological analyzer (demonstration)
10. Detection of sickle cell anemia: Solubility & Sickling test
11. Demonstration of Blood collection and CBC.

SUGGESTED READING

1. Mukherjee, K. L. (1988). Medical Laboratory Technology, Vol 1, 2 & 3, Tata McGraw Hill Publishing.
2. Ochei, J. and Kolhatkar, A. (2000). Medical Laboratory Science-Theory and Practice, Tata McGraw Hill.
3. Godkar, P. B. (2016). Textbook of Medical Laboratory Technology, 3rd Ed., Bhalani Publishing House.
4. Professional guide to diagnostic tests, (2004). 1st Ed., Lippincott Shalliams & Wilkins.
5. Mollison, P.L., Engelfriet, P.L., & Contreras, M. (1997). Blood Transfusion in clinical medicine (10th Eds.), Oxford: Blackwell Science.
6. Dacie JV, Lewis SM (2010). Practical Hematology.10th ed. Philadelphia: Churchill Livingstone.

BACHELOR OF SCIENCE (B.SC.) BIOTECHNOLOGY HONOURS

SEMESTER 6

DISCIPLINE SPECIFIC ELECTIVE PAPER 3

Mycology Phycology

Course Objectives:

- To make students aware about basics of algae and fungi
- To explain the students about mycological media, isolation from natural samples, cultivation and preservation.
- To study of some important fungi- pathogenic and non-pathogenic
- To make students understand about collection, preservation and application of algae.
- To learn them to industrial application of different species of algae and fungi.

Course Outcome:

Students will be able to

- Students would be familiarizing with the structure and characteristics of fungi and algae, study of some of the important fungal and algal genera, useful and harmful activity and their uses.

BT14130 - THEORY COURSE CONTENT (4 Credits)		
UNIT1	**Economic Importance of Fungi:** Phytopathology and important diseases of food crops their control and prevention. Mycorrhizal association, types of mycorrhizal association, Biology of vesicular arbuscular mycorrhizal (VAM) fungi: penetration and colonization inside roots. Recent advances in the field of mycorrhiza. A general account of Phosphate solubilizing fungi (PSF). Overview of lichens and their ecological and industrial importance. Mushroom cultivation- General account, white button, paddy straw, method of cultivation of mushrooms	**12**
UNIT2	**Applied Mycology**: Application of fungi in food industry (F1avour & texture, Fermentation, Baking, Organic acids, Enzymes) Secondary metabolites (Pharmaceutical preparations); Fungi in agriculture (biofertilizer) and remediation of contaminated soils. Mycotoxins; Fungal endophytes of plants and their applications: Endophytic fungi, colonization and adaptation of endophytes. Fungi as biological control agents. Fungi in plant disease control-Selection, production and formulation of fungal biopesticides and commercial use of bio-control agents. Futuristic application of fungi.	**14**
UNIT3	**Economic importance of Phycology**: Use of algae as food, fodder and industrial applications of algae (Alginic acid, Age, Carrageenan), A1ga1 Biofertilizers with special reference to Cyanobacteria. Ecological importance of algae (special reference to marine algae). Algal blooms and Water Pollution, toxic Algae, Algal biofertilizers, Biofouling and Control. Algae in global warming - carbon capture by algae	**14**
UNIT4	**Applied Phycology:** Aquaculture of alg (micro and macro algae cultivation). Mass cultivation of microalgae with special reference to Spirullina and their applications in human welfare, Algal biofuels - algal biodiesel, bio-ethanol	**20**

	(and biological hydrogen production. Importance of algae in production of algal pigments, important constituents for industry from marine algae: agar etc., role of algae in bioremediation, recent developments and future of algal biotechnology. Isolation, Purification and Culture of algae. Cryopreservation.	

BT14140 - LAB COURSE CONTENT

(2 Credits)

1. Study and preparation of Mycological media.
2. Isolation and identification of pathogenic and non-pathogenic fungi.
3. Study of the vegetative and reproductive structures of following genera through temporary
4. and permanent slides: Mucor, Saccharomyces, Penicillium, Agaricus and Alternaria
5. Isolation of common algae from natural samples.
6. Cultivation and preservation of pure cultures of common algae and fungi

SUGGESTED READING

1. Alexopoulus, C.J., Mims, C.W. and Blackwell, M, Introductory Mycology. John Wiley, New York.
2. Mehrotra, R.S. and K.R.Aneja. An Introduction to Mycology. New Age International Press, New Delhi.
3. Bessey E.A. Morphology and Taxonomy of fungi. Vikas Publishing House Pvt. Ltd., New Delhi.
4. John Webster and R W S Weber. Introduction to Fungi. Cambridge University Press 2007.
5. V. S. S. Sambamurty. A Textbook of Algae. I.K. International Publishing House Pvt. Limited, 2010
6. H.D. Kumar and H.N. Singh.A Textbook on Algae (Macmillan international college edition)
7. Kumar, H.D. (1999). Introductory Phycology, 2nd edition. New Delhi, Delhi: Affiliated East-West Press.

BACHELOR OF SCIENCE (B.SC.) BIOTECHNOLOGY HONOURS

SEMESTER 1

DISCIPLINE SPECIFIC ELECTIVE PAPER 4

Bioinformatics
Course Objectives: The objectives of this course are: • to impart fundamental knowledge about computational biology and enhance their skill about in silico analysis which will help to provide ideal prediction in research and analysis. • It acquired adequate knowledge & necessary skills about different computational tools as well as different algorithm which is favourable for sequence as well as structure based learning.
Course Outcome: Students will be able to • Students will gain basic knowledge about sequence and structure based analysis • They will also familiar with importance of in silico analysis and its application in biology as well as biological research. • Course will provide combination of skills for dry lab

BT14150 - THEORY COURSE CONTENT (4 Credits)		
UNIT1	**Introduction of Bioinformatics** • Introduction and history of bioinformatics: Goal, Scope, application, Limitation. • Introduction of NCBI and its application. • Biological databases: Introduction, file format and application of EMBL, DDBJ, Entrez, PubMed, GenBank, OMIM, Swiss Prot, PDB, KEGG database Pitfalls of Biological database.	
UNIT2	**Pairwise Sequence Alignment** • Alignment: Define alignment, Homology, similarity and identity of sequences. • Methods of alignment: Local and global alignment. • Algorithm use for alignment: Dot matrix method, Dynamic programing method: Needleman and wunsch algorithm, Smith waterman algorithm. Database similarity search: Basic Local Alignment Search Tool (BLAST), FASTA	
UNIT3	**Multiple Sequence Alignment** • Define: Multiple sequence alignment (MSA) • Algorithm use for MSA: Exhaustive algorithm, Heuristic algorithm. Profiles, Motif: identification of motif and Domains in Multiple Sequence Alignment. • Phylogenetic: Define: Phylogenetic, Phylogenetic tree construction methods: Distance based methods, character based methods.	
UNIT4	**Structural Bioinformatics** • Protein structure classification • Protein Structure prediction: Secondary structure prediction, tertiary structure prediction	

	• Types of RNA structure, RNA secondary structure prediction methods. protein-protein interaction.	

BT14160 - LAB COURSE CONTENT

(2 Credits)

1. Understand Reverse/forwards strands and reverse complementary strand
2. Construction of phylogenetic tree.
3. Access to Nucleic acid Databases
4. Access to Protein Databases
5. Using BLAST to identify a gene
6. Multiple Sequence Alignment (MSA)
7. Docking
8. Primer designing

SUGGESTED READING

1. Xiong, J., 2006. Essential bioinformatics. Cambridge University Press.
2. Bioinformatics sequence and Genome analysis by Dawid W. Mount
3. Jiang, R., Zhang, X. and Zhang, M.Q. eds., 2013. Basics of bioinformatics: Lecture notes of the graduate summer school on bioinformatics of China. Springer Science & Business Media.