

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY

NAAC A (3.02) State University

PATAN- 384265

Faculty of Science

B. Sc. Microbiology

Syllabus/ scheme

Sem. – 6



Sem./CBCS/Grading pattern

w. e. f. June-2020

TOTAL HOURS: 60

CREDITS: 3

No. of Hours: 20

Unit 1

- A. **Genome organization:** E. coli, Saccharomyces, Tetrahymena
- B. **Mutations and mutagenesis:** Definition and types of Mutations; Physical and chemical mutagens; Molecular basis of mutations; Functional mutants (loss and gain of function mutants); Uses of mutations Reversion and suppression: True revertants; Intra- and inter-genic suppression; Ames test; Mutator genes

No. of Hours: 20

Unit 2

- A. **Plasmids** Types of plasmids – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids, Host range, Plasmid- incompatibility, plasmid amplification, Regulation of copy number, curing of plasmids
- B. **Mechanisms of Genetic Exchange**
Transformation - Discovery, mechanism of natural competence Conjugation -Discovery, mechanism, Hfr and F' strains, Interrupted mating technique and time of entry mapping Transduction - Generalized transduction, specialized transduction, LFT & HFT lysates, Mapping by recombination and co-transduction of markers

No. of Hours: 20

Unit 3

- A. **Phage Genetics** Features of T4 genetics , Genetic basis of lytic *versus* lysogenic switch of phage lambda
- B. **Transposable elements**
Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Mu transposon Eukaryotic transposable elements - Yeast (Ty retrotransposon), Drosophila (P elements), Maize (Ac/Ds) Uses of transposons and transposition.

SUGGESTED READING

1. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings
2. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning
3. Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning
4. Watson JD, Baker TA, Bell SP et al. (2008) Molecular Biology of the Gene, 6th Ed., Benjamin Cummings
5. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India
6. Russell PJ. (2009). *i* Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings
7. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
8. Maloy SR, Cronan JE and Friefelder D(2004) Microbial Genetics 2nd EDITION., Jones and Barlett Publishers

Semester-6

MB-602: INDUSTRIAL MICROBIOLOGY
(THEORY)

TOTAL HOURS: 60

CREDITS: 3

Unit 1

No. of Hours: 20

- A. **Introduction to industrial microbiology** : Brief history and Chronological developments in industrial microbiology. Ranges of Fermentation products.
- B. Isolation of industrially important microbial strains and fermentation media
- C. Sources of industrially important microbes and methods for their isolation, preservation and maintenance of industrial strains, strain improvement, Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates

Unit 2

No. of Hours: 20

- A. **Types of fermentation processes, bio-reactors and measurement of fermentation parameters**
Types of fermentation processes - Solid-state and liquid-state (stationary and submerged) fermentations; batch, fed-batch (eg. baker's yeast) and continuous fermentations Components of a typical bio-reactor, Types of bioreactors-Laboratory, pilot- scale and production fermenters, constantly stirred tank and air-lift fermenters, Measurement and control of fermentation parameters - pH, temperature, dissolved oxygen, foaming and aeration
- B. **Down-stream processing** No. of Hours: 6
Cell disruption, filtration, centrifugation, solvent extraction, precipitation, lyophilization and spray drying

Unit 3

No. of Hours: 20

- A. **Microbial production of industrial products (micro-organisms involved, media, fermentation conditions, downstream processing and uses)**
Citric acid, Ethanol, penicillin, Glutamic acid, Vitamin B12, Amylase, Beer
- B. **Enzyme immobilization**
Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase)

SUGGESTED READINGS

1. Patel A.H. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited
2. Okafor N. (2007). Modern Industrial Microbiology and Biotechnology. 1st edition. Bios Scientific Publishers Limited. USA
3. Waites M.J., Morgan N.L., Rockey J.S. and Higton G. (2001). Industrial Microbiology: An Introduction. 1st edition. Wiley – Blackwell
4. Glaze A.N. and Nikaido H. (1995). Microbial Biotechnology: Fundamentals of Applied Microbiology. 1st edition. W.H. Freeman and Company
5. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
6. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
7. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.

TOTAL HOURS: 60

CREDITS: 3

Unit 1.

A. Normal microflora of the human body and host pathogen interaction

No. of Hours: 20

Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract Host pathogen interaction:

Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections, Transmission of infection, Pathophysiologic effects of LPS

B. Sample collection, transport and diagnosis

Collection, transport and culturing of clinical samples, principles of different diagnostic tests (ELISA, Immunofluorescence, Agglutination based tests, Complement fixation, PCR, DNA probes).

Unit 2.

A. Bacterial diseases

No. of Hours: 20

List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms; mode of transmission, prophylaxis and control Respiratory Diseases: *Streptococcus pyogenes*, *Haemophilus influenzae*, *Mycobacterium tuberculosis* Gastrointestinal Diseases: *Escherichia coli*, *Salmonella typhi*, *Vibrio cholerae*, *Helicobacter pylori* Others: *Staphylococcus aureus*, *Bacillus anthracis*, *Clostridium tetani*, *Treponema pallidum*, *Clostridium difficile*

B. Viral diseases

List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control Polio, Herpes, Hepatitis, Rabies, Dengue, AIDS, Influenza with brief description of swine flu, Ebola, Chikungunya, Japanese Encephalitis

C. Protozoan diseases

List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control Malaria, Kala-azar

Unit 3:

No. of Hours: 20

A. Fungal diseases

Brief description of each of the following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention Cutaneous mycoses: Tinea pedis (Athlete's foot) Systemic mycoses: Histoplasmosis Opportunistic mycoses: Candidiasis

B. Antimicrobial agents: General characteristics and mode of action

Antibacterial agents: Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine Antibiotic resistance, MDR, XDR, MRSA, NDM-1

SUGGESTED READING

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's. Medical Microbiology. 26th edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education
5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition

B.Sc. Microbiology (CBCS PATTERN) - Proposed curriculum
Semester-6

MB-604: RECOMBINANT DNA TECHNOLOGY
(THEORY)

CREDITS: 3

TOTAL HOURS: 60

No. of Hours: 20

Unit 1

A. Introduction to Genetic Engineering : Milestones in genetic engineering and biotechnology

B. Molecular Cloning- Tools and Strategies

Cloning Tools; Restriction modification systems: Types I, II and III. Mode of action, nomenclature, applications of Type II restriction enzymes in genetic engineering DNA modifying enzymes and their applications: DNA polymerases. Terminal deoxynucleotidyl transferase, kinases and phosphatases, and DNA ligases Cloning Vectors: Definition and Properties Plasmid vectors: pBR and pUC series Bacteriophage lambda and M13 based vectors Cosmids, BACs, YACs Use of linkers and adaptors Expression vectors: *E. coli* lac and T7 promoter-based vectors, yeast YIp, YEp and YCp vectors, Baculovirus based vectors, mammalian SV40-based expression vectors

No. of Hours: 20

Unit 2

A. Methods in Molecular Cloning

Transformation of DNA: Chemical method, Electroporation, Gene delivery: Microinjection, electroporation, biolistic method (gene gun), liposome and viral-mediated delivery, *Agrobacterium* - mediated delivery DNA, RNA and Protein analysis: Agarose gel electrophoresis, Southern - and Northern - blotting techniques, dot blot, DNA microarray analysis, SDS-PAGE and Western blotting.

B. DNA Amplification and DNA sequencing

PCR: Basics of PCR, Sanger's method of DNA Sequencing: traditional and automated sequencing Primer walking and shotgun sequencing

No. of Hours: 20

Unit 3

A. Construction and Screening of Genomic and cDNA libraries

Genomic and cDNA libraries: Preparation and uses, Screening of libraries: Colony hybridization and colony PCR, Chromosome walking and chromosome jumping

B. Applications of Recombinant DNA Technology

Products of recombinant DNA technology: Products of human therapeutic interest - insulin, hGH, antisense molecules. Bt transgenic - cotton, brinjal, Gene therapy, recombinant vaccines, protein engineering and site directed mutagenesis

SUGGESTED READING

1. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
2. U.K.
3. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA
4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
5. Sambrook J and Russell D..(2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press
6. Wiley JM, Sherwood LM and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education
7. Brown TA. (2007). Genomes-3. Garland Science Publishers
8. Primrose SB and Twyman RM. (2008). Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K.

MICROBIAL GENETICS

1. Replica Plates & Gradient Plate-Spontaneous mutation
2. Study the effect of UV on bacterial cells – Lac Mutant
3. Study of Petite mutant
4. Study survival curve of bacteria after exposure to ultraviolet (UV) light
5. Isolation of Plasmid DNA from E.coli
6. Demonstration of Bacterial Conjugation
7. Demonstration of bacterial transformation and transduction
8. Demonstration of AMES test

MEDICAL MICROBIOLOGY (

9. Identify bacteria (any three of E. coli, Enterobacter, Proteus, Salmonella, Pseudomonas, Staphylococcus, Bacillus) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests
10. Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS
11. Study of bacterial flora of skin by swab method
12. Perform antibacterial sensitivity by Kirby-Bauer method
13. Determination of minimal inhibitory concentration (MIC) of an antibiotic.
14. Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chicken pox, HPV warts, AIDS (candidiasis), dermatomycoses (ring worms) –Poster Presentation

INDUSTRIAL MICROBIOLOGY

15. Microbial fermentations for the production and estimation (qualitative and quantitative) of: Ethanol & Amylase
16. Sterility testing
17. Antibioqram
18. Bioassay.
19. visit to any educational institute/industry to see an industrial fermenter, and other downstream processing operations. (Submission of visit Report)

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B.Sc. Microbiology (CBCS PATTERN) – Proposed curriculum

Semester-6

MB-ES-601: BIOINFORMATICS

(THEORY)

TOTAL HOURS: 60

CREDITS: 2

Unit 1

No. of Hours: 15

A. Introduction to Bioinformatics, Aim, Tools, & Scope of Bioinformatics, Area of Bioinformatics,

B. Introduction to Bioinformatics and Biological Databases

Biological databases - nucleic acid, genome, protein sequence and structure, gene expression databases, Database of metabolic pathways, Mode of data storage - File formats - FASTA, Genbank and Uniprot, Data submission & retrieval from NCBI, EMBL, DDBJ, Uniprot, PDB

Unit 2

No. of Hours: 15

A. Sequence Alignments,

Local and Global Sequence alignment, pairwise and multiple sequence alignment. phylogenetic analysis using clustalW.

B. Protein Structure Predictions : Hierarchy of protein structure - primary, secondary and tertiary structures, modeling Structural Classes, Motifs, Folds and Domains Protein structure prediction in presence and absence of structure template Energy minimizations and evaluation by Ramachandran plot Protein structure and rational drug design

SUGGESTED READING

1. Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing House
2. Pradeep and Sinha Preeti (2007) Foundations of Computing, 4th ed., BPB Publications
3. Lesk M.A.(2008) Introduction to Bioinformatics . Oxford Publication, 3rd International Student Edition
4. Rastogi S.C., Mendiratta N. and Rastogi P. (2007) Bioinformatics: methods and applications, genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication
5. Primrose and Twyman (2003) Principles of Genome Analysis & Genomics. Blackwell