U.G. 1st Semester

Paper: BTN101C (Core)
Cell and Molecular Biology

Credits: 5 = 3+1+1 (48 Lectures)

Theory

Unit 1: History of cell biology, cell theory, structural organization of prokaryotes and eukaryotes- cell shape, cell size, cell number, cell types; cell wall, cell coat, endomembrane system and cytoplasmic matrix, symbiont hypothesis, molecular organization of the cell. **3 hours**

Unit 2: Plasma membrane- molecular organization, membrane asymmetry, models of cell membrane, functions of plasma membrane, cell permeability **4 hours**

Unit 3: Nucleus, endoplasmic reticulum, Golgi apparatus, mitochondria, plastids, lysosomes, peroxisome and glyoxysome, vacuole; cytoskeleton and cell motility- microtubules, microfilaments, intermediate filaments- structure and chemical composition; major functions of cytoskeleton; cilia, flagella, basal bodies and centrioles **11 hours**

Unit 4: Cell growth and division- cell cycle, mitosis; meiosis and sexual reproduction, gametogenesis, fertilization; asexual reproduction, parthenogenesis ; cleavage, morulation and gastrulation, organogenesis, differentiation, embryogenesis- frog, mammal **6 hours**

Unit 5: Nucleic acid as genetic material, structure and organization of DNA and RNA, different conformations of double helix, DNA supercoiling, denaturation and renaturation of DNA, cot value and curve; Gene concept- cistron, recon, muton, split genes **7 hours**

Unit 6: DNA replication-in prokaryotes and eukaryotes: semi-conservative, θ mode, semidiscontinuous, unidirectional and bidirectional, models of DNA replication, reverse transcription, DNA recombination - molecular mechanism and models **4 hours**

Unit 7: DNA damage- deamination, missing bases, chemical modification of bases, pyrimidine dimers, strand breaks; DNA repair- direct repair, excision repair, mismatch repair, recombination repair, SOS repair **3 hours**

Unit 8: Expression of gene: mechanism of transcription, RNA polymerases and the transcription cycle- in prokaryotes and eukaryotes, promoter, enhancer, silencer, terminator, transcription factors, activator, repressor **3 hours**

Unit 9: RNA splicing, RNA editing and guide RNA, ribozymes; translation machinerymRNA, structure of tRNA, ribosome- composition and assembly; translation in prokaryotes and eukaryotes- initiation, elongation and termination; modification, folding and transport of released polypeptide **4 hours**

Unit 10: Genetic code-properties of universal genetic code, genetic code dictionary, chain initiation and termination codon, Wobble hypothesis, mitochondrial genetic code **3 hours**

Practical

1. Study of prokaryotic cell
2. Study of eukaryotic cell- preparation of blood smear
3. DNA extraction from bacteria
4. DNA extraction from plant

Suggested Readings

1. Gene XI- Lewin. B. , Jones and Barlett Publishers, 2011.
2. Molecular Biology of the Cell- Alberts. B., Johnson. A., Lewis. J., Morgan. D., Roberts. K. and Walter. P. , Garland Science, 2014.
3. Principles of Biochemistry- Lehninger. A. L., Nelson. D. L., Cox. M. M., CBS Publications, 2001.
4. Cell and Molecular Biology- Karp. G. , John Wiley and Sons, Inc, 2010.
5. Gene Cloning and DNA Analysis- Brown. T. A. , Wiley Blackwell, 2007.
6. The Cell: A Molecular Approach- Cooper. G. M. and Hausman. R. E. Sinauer Associates, Inc, 2013.
7. Essential Developmental Biology- Slack. J.M.W., Wiley-Blackwell, Dec 2012.
8. Developmental Biology- Sastry and Shukal, Rastogi Publication, Meerut, 2014.
9. Molecular Cloning -A Laboratory Manual, Vols 1,2 and 3- Sambrock, J.F. and Russell, D.W., Cold Spring Harbor Laboratory Press, 2001.

Paper: BTN102C (Core)
Microbiology

Credits: 5=3+1+1 (48 Lectures)

Theory:

Unit 1: History and evolution of microbiology; classification of microorganisms based on phylogeny and molecular approaches; diversity of microorganisms- archaea and bacteria, eukarya- algae, fungi, protozoa, *Mycoplasma, Rickettsia, Chlamydia*; structural organization of microorganisms - capsules, slime layers, glycocalyx, pili, fimbriae, cilia, flagella and motility; bacterial endospore; Viruses- structure and classification, viroids, prions **14 hours**

Unit 2: Microscopy - light microscopy: lense and refractive index, magnification, resolution, numerical aperture, compound microscope, staining of specimen **5 hours**

Unit 3: Transformation, transduction and conjugation in bacteria. Viral replication. **4 hours**

Unit 4: Microbial nutrition; culture media: simple, differential, selective, enriched, enrichment, special media; microbial growth- growth curve, generation time; methods of isolation, purification and preservation of microorganisms; control of microorganisms. **8 hours**

Unit 5: Microbial interactions: mutualism, commensalism, parasitism, synergism, antagonism, predation, competition, mycorrhizal and actinorrhizal relationships; microbes in environment- biogeochemical cycling and microbial ecology **9 hours**

Unit 6: Microbes and human health - *E. coli, Salmonella typhi, Vibrio cholerae, Mycobacterium tuberculosis, Varicella-zoster, Entamoeba histolytica* **8 hours**

Practical

1. Preparation of microbial media, sterilization methods

2. Isolation of bacteria from different sources, pure culture, biochemical characterization-carbohydrate fermentation, IMViC test, catalase test

3. Simple staining, Gram staining, spore staining, negative staining and motility of bacteria; fungal staining

4. Determination of bacterial cell size by micrometry

Suggested Reading

1. Microbiology- Prescott, Harley and Klein; McGraw Hill Publications, 2008.
2. Principles of Microbiology-Atlas, R. M., McMillan Publishing House, 1998.
3. The microbial world- Stainer, R. Y. *et al* , Pearson College Division, 1986.
4. Microbiology: An introduction- Tortora, G.J., Funke, B.R. ,Case, C.L., Pearson Pub., 2015.
5. Microbiology-Pelzer, Chan and Krieg, Tata McGraw Hill New Delhi, 2004.
6. Experiments in microbiology, plant pathology, tissue culture and mushroom cultivation: Aneja, K.R., New Age International, 2003.
7. Microbiology-A laboratory manual- Cappucinno, J. G., Addison Wesley, Longman, USA, 1999.

Paper Code – BTN103M (Modular General Elective)
Biotechnology for Human Welfare

Credits: 4=3+1+0 (32 Lectures)

Unit 1: Historical timeline of biotechnology: emergence of fermentation; chromosome structure and discovery of double helical structure of DNA; era of microbial genetics; era of gene manipulation, emergence of tools and techniques of genetic engineering; Genetically Modified Organisms, Human Genome Project. **3 hours**

Unit 2: Industrial Biotechnology: screening for new microbial products, strain improvement, applications of industrial microbiology- alcohol, enzymes. Fermented foods- advantages; cheese, wine, fermented fish, bamboo shoot. SCP- advantages, types. **8 hours**

Unit 3: Animal Biotechnology: introduction to animal cell culture –scope of animal tissue and cell culture, basic techniques of cell culture- disaggregation of tissue, isolation of tissue, monolayer culture, suspension culture, organ culture, embryo culture, continuous cell lines; subculture, contamination, preservation; culture media -natural media, serum containing and serum free media; semi synthetic and synthetic media. Transgenic animals- objectives, transfection methods, transgenic sheep, transgenic mice. **8 hours**

Unit 4: Medical Biotechnology: Red biotechnology; concept, new diagnostic and therapeutic approach; biotechnology in medicine: production of monoclonal antibodies, antibiotics and vaccines, insulin, interferon, genetic testing, gene therapy. Assisted Reproductive Technology (ART) -IVF, IUI. Stem cell therapy-in treatment of neurological disorders. **10hours**

Unit 5: Agricultural Biotechnology: introduction to plant tissue culture techniques and its application; Transgenic plants for herbicide tolerance and insect tolerance; biotechnology for improvement of crop yield and quality, Golden rice, roundup ready crops, edible vaccines. **8 hours**

Unit 6: Environmental Biotechnology: bioremediation- water and soil contaminated with oil spills, phytoremediation; biofuels- features, energy crops, utilization, biogas, bioethanol, biodiesel, bioleacing. **5 hours**

Unit 7: Biotechnology for Biodiversity: introduction to biodiversity; concept of DNA banks; cryopreservation for biodiversity conservation; molecular markers for biodiversity study and conservation, tools for biodiversity study in plants and animal. **6 hours**

Suggested Readings:

1. Frontiers in Microbial Technology: Bisen P.S. (1994) CBS Publishers
2. A Text of Industrial Microbiology, Creueger W. and Crueger A. (2000) Panima Publishing Corp. New Delhi.
3. Food Microbiology- Adam M.R. and Moss M.O. (1995), New Age International Pvt. Ltd
4. Industrial Microbiology: Prescott and Dum (2005) Agrobios (India) Publishers/ CBS Publishers & Distributors.
5. Biotechnology-Singh, B.D. (1998) Kalyani Publishers.
6. Medical Genetics- Jorde. L. B., Carey, J. C. (2002). White R. L., Mosby Press,
7. Human Molecular Genetics- Strachan. T and Andrew, P. (2001) John Wiley-New York
8. Plant Biotechnology: The genetic manipulation of plants- Slater, A. N. S. and Fowler M. (2008). Oxford University Press, Oxford
9. Plant Biotechnology- Hammond, J. H. , Mcgarvey, P. and Yusibov, V. (2000) Springer Verlag, Heidelberg.
10. Environmental Biotechnology: Theory and Application- Evans, G. M., Judith, C and Furlong. (2008) Wiley
11. Environmental Biotechnology- Bhattacharyya. B. C and Banerjee, R. (2007) Oxford University Press
12. Biodiversity- Wilson. E. O, National Academy Press, Washington, D.C, 1988.
13. A primer of Conservation Genetics- Frankham. R, Ballou.JD and Briscoe.D.A. Cambridge University Press, 2004.
14. Molecular Evolution and Phylogenetics- Nei. M and Kumar. S. Oxford University Press, 2000.