M.Sc. GENOMICS

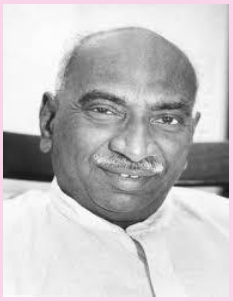
CBCS COURSE STRUCTURE & SYLLABUS

(2020-2022)

SCHOOL OF BIOLOGICAL SCIENCES

MADURAI KAMARAJ UNIVERSITY

MADURAI - 625 021, INDIA



SCHOOL OF BIOLOGICAL SCIENCES
MADURAI KAMARAJ UNIVERSITY
M.Sc. GENOMICS; CHOICE BASED CREDIT SYSTEM (CBCS)
Course structure and Syllabus (2020-2022)

SEMESTER I

S. No	Course Code	Course Title	Credits	Scheme of Examination		
				Int.	Ext.	Total
1	GEN20 11C	Microbiology & Bioprocess Technology	4	25	75	100
2	GEN20 12C	Biochemistry	4	25	75	100
3	GEN20 13C	Molecular Biology and Molecular Genetics	4	25	75	100
4	GEN20 14C	Lab in Microbiology and Biochemistry	4	40	60	100
5	GEN20 15C	Lab in Molecular Biology and Genetics	4	40	60	100
Elective Subjects						
6	GEN20 16E	Biodiversity and Conservation	4	25	75	100
7	GEN20 17E	Biostatistics & Biocomputing	4	25	75	100
SSS Course - 1						
8	GEN20 18S		2	25	75	100

SEMESTER II

S. No	Course Code	Course Title	Credits	Scheme of Examination		
				Int.	Ext.	Total
1	GEN20 21C	Immunology & Immunotechnology	4	25	75	100
2	GEN20 22C	Molecular Cloning & Genome Engineering	4	25	75	100
3	GEN20 23C	Microbial Genomics	4	25	75	100
4	GEN20 24C	Lab in Molecular Cloning & Genome Engineering	4	40	60	100
5	GEN20 25C	Lab in Immunology & Cell Biology	4	40	60	100
Elective Subjects						
6	GEN20 26E	Cell & Developmental Biology	4	25	75	100
7	GEN20 27E	Neuroscience	4	25	75	100
8	GEN20 28E	Tiny Earth: Student sourcing antibiotic discovery	4	25	75	100
SSS Course - 2						
9	GEN20 28S		3	25	75	100

SEMESTER III

S. No	Course Code	Course Title	Credits	Scheme of Examination		
				Int.	Ext.	Total
1	GEN20 31C	Plant Genomics & Plant Biotechnology	4	25	75	100
2	GEN20 32C	Proteomics and Metabolomics	4	25	75	100
3	GEN20 33C	Computational Genomics	4	25	75	100
4	GEN20 34C	Human Genomics	4	25	75	100
5	GEN20 35C	Lab in Genomics, Proteomics & Metabolomics	4	40	60	100
Elective Subjects						
6	GEN20 36E	Lab in Computational Genomics	4	40	60	100
7	GEN20 37E	Stem Cell Therapeutics	4	25	75	100
8	GEN20 38E	AI based Applications in Life Science and Biomedicine	4	25	75	100
SSS Course - 3						
9	GEN20 39S		2	25	75	100

SEMESTER IV

S .No	Course Code	Course Title	Credits	Scheme of Examination		
				Int.	Ext.	Total
1	GEN20 41C	Project work in Genomics Leading to New Knowledge / Technology / Resource	4	25	75	100
2	GEN20 42E	Real-world problem-solution: A practice	4	25	75	100
3	GEN20 43E	Systems Biology	4	25	75	100
SSS Course - 4						
3	GEN20 42S		3	25	75	100

Core subject: 64 Credits Elective: 16 credits SSC: 10 credits Total: 90 credit

SSS course to opt from other Schools

- Bioinstrumentation: Certification training on i) FACS, ii) Mass spec, iii) NGS platforms, and iv) Genomic data Analysis
- NET Training from the I semester onwards
- 75 % Gravity to Hands-on-Sessions

GEN20 11C: MICROBIOLOGY & BIOPROCESS TECHNOLOGY

Unit I

Introduction and history of Microbiology and scope of Microbiology – microbial world- Prokaryotes and Eukaryotes- Classification and salient features of bacteria - according to Bergey's Manual of Determinative Bacteriology – Haeckel's three kingdom concept, Whittaker's five kingdom concept. Modern method of Bacterial taxonomy – Microbial diversity- various Genomic tools to study diversity-16S rRNA phylogeny (FAME, ARDRA, RISA, RAPD, MLST, REP, ITS) - Salient features of- Virus, Fungi, Algae and protists - An overview about Metagenomics (Unculturable microbes) – SIP, SIGEX, WGA and Microbiome.

Unit II

Microbial stress response- Osmotic stress – Oxidative stress – Nitrate response – Nutrient response – pH stress – Heat shock response – Nutrient stress and starvation stress – Extremophiles. Two components signal transduction – Regulation of nitrogen assimilation- Phosphate transport system – Quorum sensing.

Unit III Human Normal Microflora: Skin, stomach, Small Intestine, Large Intestine, Genitourinary tract, relationship between normal microbiota and the host Principles of Infectious Diseases. Epidemiology : Infectious Disease cycle, Pathogen transmission, control of epidemics, bioterrorism, diseases caused by viruses, fungi and protists -food borne and water borne diseases-Host parasite interaction – Types – Mutualism, commensalism, predation, parasitism, commensalism, competition Host specificity – Virulence factor- Exotoxins Gram +ve and Gram –ve bacterial pathogens – Human pathogens – Antibiotic that affects protein synthesis – Mechanisms of Pathogenesis : toxigenicity – exotoxins and endotoxins, host defence against microbial invasion, microbial mechanism for escaping host defenses.

Unit IV Environmental and Industrial Microbiology- Water pollution, water purification- sewage treatment-major products of industrial microbiology, antibiotics, amino acids, organic acids; special compounds for use in Medicine and Health-Biopolymers, Plant growth hormone production from bacteria and fungi, Biofuel, Biosurfactants and Bioconversion; Biodegradation, Bioremediation-microbial mining- and Bioaugmentation, Microbes as Products-Nanotechnology, Biosensors, Biofertilizers, Biopesticides.

Unit V- Fermentation & bioprocessing**-** Inoculum development for industrial fermentation & Microbial Kinetics: Introduction, Criteria for transfer of inoculum, development of inocula for bacterial processes, yeast processes and mycelial processes. Inoculum development for plant fermenter, aseptic method of inoculation, achievement, and maintenance of aseptic conditions. Fermentation Material and Energy balance, Microbial growth kinetics: Microbial

growth cycle, measurement of growth, Batch culture, continuous culture, fed-batch culture, applications and examples.

References

1. Willey JM, Sherwood LM, and Woolverton CJ. (2016). Prescott, Harley and Klein's Microbiology. 11th edition. McGraw Hill Higher Education.
2. Michael Pelczar, Jr., Microbiology - 2001, McGraw Hill Education
3. Jacquelyn G Black (2008). Microbiology: Principles and Explorations. 7th edition. Prentice Hall.
4. Nester, Anderson, Roberts, Pearsall and Nester. Microbiology: A human perspective. Third Edition (2001). McGraw Hill. ISBN 0-07-231878-1.
5. Madigan MT, and Martinko JM. (2006). Brock Biology of Micro-organisms. 8th edition. Parker J. Prentice Hall International, Inc.
6. Albert G Moat, John W. Foster, Micheal P. Spector. Microbial Physiology 4th Edition (2002), A John Wiley & Sons, Inc., Publication – ISBN 0-471-39483-1
7. Kathleen Park Talaro, Arthur Talaro. Foundations in Microbiology 4th Edition (2002), International Edition. McGraw Hill. ISBN 0-07-112275-3
8. Alcamo: Fundamental s of Microbiology. 8th Edition (2011). Jones and Bartlett Publishers. ISBN 0-7637-1067-9
9. Atlas R.M. 1997. Principles of Microbiology. II ed. WCB, McGraw Hill.
10. Stanier RY, Ingrahm, JI, Wheelis, M L and Painter PR. (1987). General Microbiology. 5th edition. McMillan Press.
11. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.

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GEN20 12C: BIOCHEMISTRY

UNIT- I

Bioenergetics, redox potential, biological oxidation – Electron transport system in mitochondria – Components of electron transport system – oxidation phosphorylation. ATP production – chemiosmotic theory. Uncouplers and inhibition of oxidative phosphorylation.

UNIT- II

Chemistry of carbohydrates: Metabolism of carbohydrates: glycolysis, TCA cycle, gluconeogenesis, glycogenesis, glycogenolysis. Pentose phosphate pathway. Hormonal regulation of carbohydrate metabolism – role of cAMP. Fructose, galactose metabolism.

UNIT- III

Chemistry of lipids: Metabolism of lipids: Fatty acid oxidation, ketone bodies, biosynthesis of fatty acids and triglycerides. Metabolism of cholesterol, Regulation of cholesterol biosynthesis.

UNIT- IV

Chemistry of amino acids and Nucleic acids: Metabolism of amino acids: Transamination, deamination, trans-deamination reactions. Urea cycle. Metabolism of aromatic amino acids – inborn errors of metabolism – Metabolism of nucleic acids. Purine, Pyrimidine biosynthesis and regulation.

UNIT- V

Enzymes – Classification - Factors affecting enzyme activity, active site., Enzyme – kinetics, Michaelis – Menten Model – Significance of Km and Vmax – Enzyme inhibition. Allosteric enzymes

References

1. Lehninger, Nelson, and Cox. Principles of Biochemistry .5th Edition. W. H. Freeman and Co. ISBN 0-7167-4339-6
2. The Absolute, Ultimate Guide to Lehninger Principles of Biochemistry – 2017, Marcy Osgood , Karen Ocorr
3. Robert K. Murray David Bender Kathleen M Botham , Peter J. Kennelly Victor W. Rodwell , P. Anthony Weil, , 2018, Harpers Illustrated Biochemistry 31st Edition.
4. Donald Voet, Judith G. Voet, and Charlotte W. Pratt , Voet's Principles of Biochemistry, 2018, Wiley.
5. Smith, Hill, and Lehman. Principles of Biochemistry. 7th Edition, Mc Graw – Hill Publishers.
6. Lubert Stryer, Bery, Jeremy M. John Tymoczkq. Biochemistry.5th Edition. W. H. Freeman and Co
7. Robert Murray, Darryl K Granner, Peter A Mayes Victor and W. Rodwell Harper's Illustrated Biochemistry. 7th Edition. Mc Graw - Hill Publishers
8. Richard A. Harvey, Denise R. Ferrier Lippincott Williams & Wilkins, 2016 Biochemistry.

GEN20 13C: MOLECULAR BIOLOGY AND MOLECULAR GENETICS

UNIT I:

Introduction to Molecular Biology & Genetics – Molecular basis for life – DNA, DNA replication. Origin of spontaneous mutations – Luria and Delbruck's classic experiment – Fluctuation test – inference of function of genes based on isolation of mutations – various types of mutations – missense – nonsense – frameshift, Conditional Lethal etc., - mutagens – physical and chemical agents – Mode of action of important mutagens (5BU, 2AP, NTG, Hydroxylamine, Nitrous acid) – use of mutagenic chemicals in isolation of mutants and their advantages – dominant and recessive nature of mutations with examples – DNA damage and repair.

Gene transfer in bacteria – transformation – discovery and its significance – process of transformation – competence development and competent factors – joint transformation and its uses – conjugation – discovery – F^+ , F^- , etc., and F' states of *E.coli*, generation of Hfr Strains, chromosome transfer by Hfr and its uses in genetic mapping –Zygotic induction– generalized transduction – P1 transduction – origin of transducing particles –pre and post Zygotic exclusions, co-transduction and its uses in genetic mapping –ratio test and mutation order- lambda mediated specialized transduction.

UNIT II:

Gene expression – RNA polymerase, sigma factors, and involvement of other factors in the regulation of gene expression, operon model, the molecular basis of regulation of expression of gene expression from well-studied operons – *lac, trp, ara* operons. Translation process, codons – elucidation of genetic code – *T4rII* mutants and their uses in the elucidation of code – translation of in *vitro* synthesized RNA and their uses in elucidation of genetic code – Wobble hypothesis – suppression of missense – nonsense – frameshift mutations – intrageneic and extragenic suppression and their molecular basis.

UNIT III:

EUKARYOTIC GENOME ORGANIZATION AND REPLICATION: Eukaryotic genome organizations - Chromatin structure - Nucleosomes- Heterochromatin repeat sequences – Histone variants produce alternative nucleosomes - DNA structure varies on the nucleosomal surface - Positions of nucleosomes - Nucleosomes are displaced and reassembled during transcription - DNase Sensitivity detects changes in chromatin structure. Introns & Exons – Differences and Patterns of Evolution.

Centromeres: DNA sequences & protein complex – Telomeres: repeating sequences & function in chromosomal ends - End replication problem and consequences - Meiotic chromosome pairing.

Eukaryotic Replication – Topoisomerase & various enzymes - Creating the replication forks at the Origin oriC - Mechanisms to prevent premature reinitiation of replication - Each Eukaryotic chromosome contains many replicons - Coordinating Synthesis of the Lagging and Leading Strands - Recombining meiotic chromosomes and synaptonemal complex Extrachromosomal replicons - Homologius Recombinations.

UNIT IV:

EUKARYOTIC TRANSCRIPTIONAL REGULATION: Eukaryotic RNA Polymerases-subunits, types; Transcription factors-types-general and specific, Domains-DNA binding, oligomerization, transcription regulation, NLS; promoters-core, proximal, distal-enhancers, Silencers, Insulators, Locus control regions (LCR), mechanism of action of activators and repressors; Pre initiation complex formation; Process-Initiation, elongation and termination; Post-transcriptional modification- 5' cap formation, 3' end processing and polyadenylation, RNA splicing-canonical, Alternate, Exonic Intronic, trans, tRNA splicing; RNA editing; RNA modifications; nuclear export of mRNA; RNA degradation-pathways and enzymes; Processing of tRNA and mRNA transcripts; Inhibitors of transcription.

Regulation-chromatin (histone) modification and chromatin remodeling, DNA methylation-imprinting- Yeast GAL genes: A model for activation and repression, Regulation of gene expression by steroid hormones; Riboswitch; Regulatory RNAs- Noncoding RNAs, MicroRNAs, Mechanisms of RNA interference

UNIT V:

Mendelian genetics – Molecular biology of classical Mendelian Traits -Mendelian traits in human – chromosomal basis of inheritance – gene segregation and Meiosis – sex chromosome – sex linkage – sex determination – non- disjunction – extensions of Mendelian genetic principles – multiple alleles – modifications of dominance relationships – gene interactions and epistasis – lethal alleles – gene expression and environment – quantitative genetics – chromosomal aberrations – Structure & function of Centromeres and Telomeres - extrachromosomal inheritance – maternal inheritance – developmental genetics.

Gene mapping in eukaryotes – linkage and crossing over – construction of genetic map – tetrad analysis – mitotic recombination – Molecular Biology of Recombination -mapping human genes – Heterochromatin and Euchromatin: Molecular differences – Repetitive Elements: LINE, SINE & Transposons – Associated Disorders -Regulation of gene expression in eukaryotes – chromatin remodeling- activators and coactivators – gene silencing and genome imprinting – post-transcriptional control – RNA interference – cancer genetics – relationship of cell cycle to cancer – oncogenes – tumor suppressor genes.

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References:

1. Lewin's Genes XII (2017) - Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick. Jones and Bartlett Publishers

2. iGenetics – A Molecular approach, 3rd edition (2016) – Peter J Russell, Pearson Benjamin Cummings, Sanfrancisco, USA

3. Molecular Genetics of Bacteria, 4th Edition – (2013) - Larry Snyder, Joseph E. Peters, Tina M. Henkin, Wendy Champness. ASM press.

4. Molecular Genetics 2nd Edition (2002) – Gunther S Stent and Richard Calender. San Francisco : W. H. Freeman and Co.

5. Microbial Genetics, 2nd Edition (1994) – Stanley R. Maloy, John E. Cronan, David Freifelder. Jones and Bartlett Publishers, Inc.

6. DNA Repair and Mutagenesis, 2006, Errol C. Friedberg, Graham C. Walker, Wolfram Siede, D. Wood Richard, A. Schultz Roger, Ellenberger Tom. ASM Press

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GEN20 14C: LAB IN MICROBIOLOGY AND BIOCHEMISTRY

LAB IN MICROBIOLOGY:

1. Laboratory precautions.
2. Preparation of cleaning solutions.
3. Antiseptics and disinfectants.
4. Principles of aseptic techniques.
5. Methods of sterilization.
6. Serial dilution using various environmental samples.
7. Pure culture techniques - pour plate, spread plate and Streaking.
8. Cultural characteristics of microorganisms-colony morphology on nutrient agar slants, nutrients broth.
9. Enumeration of bacterial cells.
10. Biochemical Analysis- as per the methods of Bergey's Manual of Systematic Bacteriology and API analysis.
11. Staining of microorganisms - Simple, Negative, Gram, Spore and LPCB.
12. Microscopy.
13. Maintenance and preservation of cultures.
14. Genotypic characterization and *in-silico* analysis of the selected strains.
15. Biofilm formation, Quorum sensing.
16. Demonstration of blood culturing system - BACTEC.
17. Observation of representative forms of viruses, fungi and protists
18. Bacterial species identification by rRNA sequencing

LAB IN BIOCHEMISTRY:

1. *Good Laboratory Practices*
2. Importance of Personal Protective Equipment (PPE)
3. Maintenance of Laboratory and workspace
4. Waste management
5. Maintenance and calibration of lab Instruments
   Buffers and Solutions
6. Need and uses of Buffers in laboratory
7. Concepts of pH and pKa
8. Types of buffers and their range of operation
9. Concepts of Molarity, Molality and Normality

10. Mass Percentage (%w/w)
11. Volume percentage (%v/v)
12. Stock solution and standards preparation
13. Preparation of Acid solutions

Basic principles and techniques in Biochemical Estimations

14. Measurement of pH
15. Centrifugation
16. Chromatography
17. *Types of Chromatographic Techniques*
18. Spectrophotometry
    a. Beer Lambert's law
    b. UV-VIS spectrum
    c. Fluorescence Spectroscopy
    d. Luminometer

Extraction and Estimation of Biomolecules

19. Estimation of Carbohydrates
    - Various methods of Estimation
    - Estimation by Anthrone Test
20. Estimation of Proteins and amino acids
    - Various methods of Estimation
    - Estimation by Lowry's method
21. Estimation of Cholesterol
    - Various methods of Estimation
    - Estimation by Zak's method
22. Estimation of molecules of Clinical Value
    - SGOT/SGPT, ALT
    - CK-MB, Lipid Profile

Extraction and Estimation of Nucleic Acids

23. Extraction of DNA from various sources
    - Membrane nature of Eukaryotic cell (Animal tissue/plant tissue) and Prokaryotic cell
    - Reagents used to extract DNA from various sources
    - Quantification of DNA
    - Spectroscopically & Calorimetrically.
    - Visualization of DNA by Electrophoresis
    - How to safely Store & Transport DNA

Extraction and Estimation of RNA from different sources

24. Reagents used to extract RNA
    - Detergents used to disrupt membranes
    - RNA integrity and precautions before isolation
    - Different extraction protocols

- Quantification of RNA
- How to safely Store & Transport DNA

25. Qualitative Estimation of DNA, RNA and protein
26. Southern blotting
    - Preparation of samples
    - Blotting and detection
27. Northern Blotting
    - Preparation of samples
    - Blotting and detection
28. Western Blotting
    - Sample preparation
    - SDS-PAGE
    - Blotting and detection
29. Purification of enzyme proteins by salt precipitation
30. Purification of enzyme proteins by Dialysis
31. Purification of enzyme proteins by Ion exchange / Gel filtration chromatography
32. Determination of soluble constituents in cell system by TLC
33. Determination of soluble constituents in cell system by HPLC

References

1. SBS, MKU, NRCBS Manuals, 2010-2018.
2. Wilson and Walkers, Principles and techniques of biochemistry and molecular biology 8th Ed (2018), Cambridge University Press.
3. Irwin H Segel, Biochemical Calculations, 2nd Ed, 2010, Wiley Publishers.
4. James G. Cappuccino and Natalie Sherman 2004 (6^{th} edition), Microbiology A laboratory Manual- Pearson Education.
5. Beister, L.1996. Microbiology in Pratice (6^{th} edition) Adeland Wesley, Langman, New York.
6. Benson, J.H. 1996. Mocrobiological applications: A laboratory Manual in General Microbiology (8^{th} edition) Wn. C. Brown Publication IOWK USA
7. James G.C and Sharman, N 1996. Microbiology: A laboratory Manual (4^{th} Edition) The Benjamin/ Cummings Publishing Company, International USA.
8. Patrick R. Murray, Ken S. Rosenthal, Micheal A. Pfaller. Medical Microbiology, (5th Edition) (Philadelphia: Elsevier/Mosby, 2005).
9. James G. Cappuccino and Natalie Sherman 2004 (6^{th} edition), Microbiology A laboratory Manual- Pearson Education.
10. Beister, L.1996. Microbiology in Pratice (6^{th} edition) Adeland Wesley, Langman, New York.
11. Benson, J.H. 1996. Mocrobiological applications: A laboratory Manual in General Microbiology (8^{th} edition) Wn. C. Brown Publication IOWK USA

12. James G.C and Sharman, N 1996. Microbiology: A laboratory Manual (4th Edition) The Benjamin/ Cummings Publishing Company, International USA.
13. Patrick R. Murray, Ken S. Rosenthal, Micheal A. Pfaller. Medical Microbiology, (5th Edition) (Philadelphia: Elsevier/Mosby, 2005).

GEN20 15C: LAB IN MOLECULAR BIOLOGY AND GENETICS

MOLECULAR BIOLOGY

1. Isolation and quantitation of genomic DNA from microbial, plant and animal samples
2. Quantitative and Quality analysis of DNA
3. Hyperchromic shift of DNA
4. Isolation and quantitation of genomic RNA from microbial, plant and animal samples
5. Quantitative and Quality analysis of RNA
6. Agarose gel electrophoresis of DNA
7. Agarose gel electrophoresis of RNA
8. Isolation of Protein
9. Quantitation of Protein
10. Western Blot analysis
11. Plasmid DNA extraction by alkali lysis method
12. Plasmid DNA extraction by boiling method
13. Isolation of plasmid using magnetic beads
14. Isolation of RNA from body fluids
15. Determination of molecular weight of plasmid DNA.
16. PCR amplification of desired gene
17. Restriction digestion of DNA
18. Restriction mapping of DNA
19. Isolation of viral genome
20. Mapping of a viral genome
21. Preparation of competent cells and transformation of plasmid DNA in *E. coli.*
22. cDNA synthesis from total RNA
23. RT-PCR amplification of gene of interest
24. Quantitation of Genes by Real time PCR– Optimization of qPCR
25. Absolute quantification, relative quantification, analysis of data
26. Restriction analysis of plasmid DNA and evaluation of restriction sites
27. Primer designing
28. 5 Types of PCRs
29. Genotyping by PCR
30. DNA sequencing
31. Sequence analysis – Coding & non-coding regions, ORF's, translation, aminoacid sequence analysis

MOLECULAR GENETICS

1. Isolation of single colony: i) Serial dilution & ii) Streaking
2. Determination of mutation rate by fluctuation analysis
3. Survival curve analysis by Physical & Chemical methods

4. Isolation of spontaneous and induced mutations (Physical/ Chemical/ Biological) in *E. coli:* i) Drug resistance & ii) Lac system
5. Isolation of conditional lethal mutants: Temperature sensitive mutations
6. Ampicillin enrichment and isolation of auxotrophs from a mutagenized culture of *E. coli*
7. Preparation of a T7 phage lysate and determination by plaque assay.
8. Preparation of P1 lysate
9. P1 transduction and determination of linkage based on cotransduction
10. Bacterial conjugation-determination of gradient gene transfer in Hfr x F^- cross
11. $CaCl_2$ mediated transformation
12. Transformation: TSS method
13. Analysis of gene expression by induction of *lac* operon using IPTG and determining the efficiency of induction by β–galactosidase.

References

1. A short Course in Bacterial Genetics 1992 – Jeffrey H. Miller.
2. Molecular Cloning, A Laboratory Manual, 3rd Edition – volume I, II, III – Joseph Sambrook, David W. Russell.
3. MKU, SBS, NRCBS Research Manuals, 2010-2017

GEN20 16E: BIODIVERSITY AND CONSERVATION

Unit – I

Biodiversity definition, concept, scope, Levels of biodiversity Genetic, species and ecosystem diversity, Magnitude of biodiversity; Concept of Hot Spots; distribution of hotspots in India and the world; values of biodiversity; Island biogeography theory; Endemic diversity, Measures of biodiversity – alpha, beta and gamma diversity – Diversity indices – dominance and Evenness – methods of studying diversity.

Unit – II

Marine biodiversity – plankton – nekton – benthos – classification – classification of marine environments benthic and pelagic – neritic and oceanic system – littoral and deep sea system – Sea-grass and mangrove communities, Estuaries, Coral reef communities – the Indian examples; Red tide – harmful algal blooms – causes and effects.

Unit – III

Causes and consequences of loss of biodiversity; Impact of exotic species on local biodiversity; extinction of species; Key stone species and their significance. Climate Change mediated Impacts on Biodiversity- El~Nino Southern Oscillation phenomenon (ENSO) and its impacts-sea surface water temperature (SST) elevation and coral reef bleaching, impacts of coral bleaching on coral biodiversity; Red Data Book and its importance.

Unit – IV

Wildlife Conservation and management - need for conservation – *in situ* conservation; Sanctuaries, National parks , biosphere reserves – *ex situ* conservation, Zoological parks, gene banks and cryopreservation – Role of indigenous people in conservation – sacred species, sacred groves; role of remote sensing in biodiversity conservation; Biodiversity conservation – human animal conflicts.

Unit – V

Indigenous knowledge, Bio-prospecting, Bio-piracy, Intellectual property rights and its impact on biodiversity; GATT, WTO, Farmer's and breeder's right. Biodiversity act-Guidelines to release Genetically Modified Organisms-Impact of new technologies biotechnology and genetic engineering on biodiversity

References:

1. Fryxell J. M., Sinclair A. R. E. and Caughley. G. 2014. Wildlife Ecology, Conservation, and Management. John Wiley & Sons Ltd.
2. Gillson, L. 2015. Biodiversity Conservation and Environmental Change, Oxfrd University Press, Oxford.
3. Goldberg W. M. 2013. The Biology of Reefs and Reef Organisms. The University of Chicago Press Ltd., London.

4. Goulletquer P., Boeuf P. G. G. and Weber. J. 2014. Biodiversity in the Marine Environment. Springer, New York, London.
5. Krishnamoorthy K. V. 2009. An Advanced Text Book on Biodiversity: Principles and Practice. Oxford & IBH Publishing Company Pvt. Ltd., New Delhi.
6. Schulze,E., Beck,E., & Muller-Hohenstein, 2005. Plant Ecology**,** Springer, Berlin-Heidelberg.
7. Singh R. L. 2017. Principles and Applications of Environmental Biotechnology for a Sustainable Future. Springer, Singapore.
8. Sodhi, N. S. and Ehrlich P. R. 2010. Conservation Biology for All. Oxford University Press Inc., New York.

GEN20 17E: BIOSTATISTICS & BIOCOMPUTING

UNIT I :

Definition, scope, and role of statistical methods in biological research. Basic principles of experimental designs- principle of replication, randomization and local control. Informal and formal experimental designs- completely randomized design, randomized block design, Latin square design and factorial designs.

Statistical population, sampling from population –simple random sampling and complex random sampling. Parameters and statistics. Data collection – types of biological data; data processing, classification, and categorization- simple and complex tables, pictorial presentation, graphic presentation of data.

UNIT II:

Basic statistics: measures of central tendencies- mean (arithmetic, harmonic and geometric) median and mode; frequency of distribution; measures of dispersion- range, quartiles, standard deviation, coefficient of variation and standard error. Concept of probability – Probability distributions- binomial, Poisson and normal distribution.

UNIT III:

Tests of statistical significance – Hypothesis testing Student 't'test one tailed and two tailed one sample and two sample ; multi-sample One way analysis of variance, two – way analysis of variance and multivariate analysis of variance. Multiple comparisons-the Tukey test, The Newman-Keuls test and Duncans multiple range test.

UNIT IV :

Regression and correlation – scatter diagram, simple linear regression, correlation and correlation coefficient; Karl Pearson's correlation coefficient ; Spearman's rank correlation. Chi-square test. Use of computer resources (Excel, available statistical softwares and other web resources) in data processing, statistical analysis and presentation.

UNIT V:

Introduction to R package; Installation in windows/Mac/Linux environment - Basics of R Programming for Data Science - Use of commands like read.table, read.csv, write.table to read/write data in R console -Essentials of R Programming - Data Types and Objects in R - Control Structures (Functions) in R - Useful R Packages.

Graphical Representation of Variables, Basic statistics (Mean, standard deviation, correlation coefficient and p-value) in R -Operators and assignments in R, Use of loops - Exercises in Looping concept - Generating simple plots on screen or/and in pdf/png/jpg files.

R based data handling with specific examples for i) Summary statistics, ii) Distribution (discrete & continuous), iii) Negative binomial experiments with coin and die, iv) Parametric statistical testing(t-test), v) ANOVA test, vi) X2 test and Fisher's test, vii)Non-parametric test (Wilcoxon signed-rank test and Mann-Whitney test), viii) Machine learning in R (Naïve Bayes and Decision Tree), ix) Linear and multiple linear regression, Logistic regression, x) Clustering (k-means and hierarchical clustering) -Bioconductor in R; Bioconductor packages.

References:

1. Zar, J.K. (2014). Biostatistical Analysis, 5th edition, Prentice-Hall, International, INC, Englewood cliffs, New Jersey.
2. Daniel WW (2013). Biostatistics, 10th edition, John Wiley and Sons, NewYork, USA.
3. Kothari,C.R (2013). Second Edition Research Methodology : methods & techniques. 2nd edition New Age International (P) ltd., Publishers, New Delhi. 459p.
4. Sharma,A.K. (2005).Textbook of Biostatistics, I. Discovery Pub., New Delhi. 459 p.
5. Rastogi,V.B. (2011).Fundamentals of Biostatistics. Ane's Books. New Delhi. 438p.