SACRED HEART COLLEGE (AUTONOMOUS)

Department of BOTANY

MASTER OF SCIENCE IN BOTANY

Course plan

Academic Year 2018-19

Semester IV

COURSE PLAN

PROGRAMME	MASTERS IN BOTANY	SEMESTER	4
COURSE CODE AND TITLE	16P4BOTT13: BIOTECHNOLOGY & GENETIC ENGINEERING	CREDIT	4
HOURS/WEEK	4	HOURS/SEM	72+36
FACULTY NAME	KIRAN GEORGE KOSHY		

COURSE OBJECTIVES
To explain the fundamental and advanced aspects of recombinant DNA technology, gene cloning strategies
To describe the various aspects of advanced transgenic technology
To explain the social and ethical issues in the field of biotechnology
To describe the scope and relevance of genome editing
To explain the applications of rDNA technology

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	REMARKS
	MODULE I			
1	Isolation and purification of DNA (genomic and plasmid) and RNA.	PPT	video	
2		PPT/Lecture		
3		PPT/Lecture		
4		PPT/Lecture		
	MODULE 2			
5	(a) Vectors – necessary properties of a vector, Construction, important features and specific uses of vectors: plasmid - pBR322, pUC, Lambda phage, M13, artificial chromosomes – YAC, BAC, PAC, HAC. Shuttle vectors, expression vectors. (b) Direct Gene Transfer Methods - microprojectiles, electroporation, microinjection, chemical, lipofection (c) Restriction endonucleases – naming, types and reaction. (d) Ligases – reaction, methods of blunt end joining - linkers and adaptors (e) Topocloning and Gateway cloning	PPT/Lecture	e-resource	
6		PPT/Lecture		
7		Lecture		
8		Lecture		
9		Lecture		
10		Lecture		
11		PPT/Lecture		
	MODULE 3			
12	Creation of recombinant DNA, Introduction of recombinant DNA into host cell – preparation of competent host cells, transformation. Selection of transformed cells, identification of recombinant cells – insertional inactivation. Methods of screening and selection of recombinant cells – selectable markers, reporter systems – Lac Z system, GFP.	PPT/Lecture		
13		PPT/Lecture		
14				
15		PPT/Lecture		
16		Lecture		
17		Lecture		

MODULE 4				
18	(a) Agrobacterium tumefaciens mediated gene transfer in plants - details of vector system based on A. tumefaciens, binary vector and cointegrate vector. Steps involved in Agrobacterium mediated gene transfer to plants. (b) Details of the creation of Bt plants, Golden rice, Flavr Savr Tomato.	Lecture		
19		Lecture		
20		PPT/Lecture		
21		PPT/Lecture		
22		PPT/Lecture		
MODULE 5				
23	Phosphodiester, phosphotriester, and phosphite-triester method of DNA synthesis (Brief study only). Phosphoramidite method, automated DNA synthesis. Artificial genome synthesis.	PPT/Lecture		
24		Lecture		
25		Lecture		
26	CIA-1			
MODULE 6				
27	Applications of protein engineering, protein modification by site-directed mutagenesis, combinatorial methods.	Lecture		
28		Lecture		
29		PPT/Lecture		
30	Design and operation, types. Applications - medical, food and agriculture, industrial, pollution monitoring. GMOs as biosensors.	PPT/Lecture		
31		PPT/Lecture		
32				
33	Inducible expression systems – examples, site-specific recombination for in vivo gene manipulation, gene targeting, gene silencing using antisense RNA and RNAi. In vitro mutagenesis - site-directed mutagenesis.	PPT/Lecture		
34		PPT/Lecture		
35		PPT/Lecture		
36		Lecture	Quiz	
37		Lecture	Q & Ans Session	
38		PPT/Lecture		
MODULE 7				
39	Genomic and cDNA library. Procedure for the construction of a genomic library using phage λ system. Identification of desirable clones from library – hybridization probing, colony and plaque hybridization probing, immunological screening. Locating and isolating a gene - in situ hybridization, positional cloning, chromosome walking and jumping.	PPT/Lecture		
40		PPT/Lecture		
41		PPT/Lecture		
42		Lecture		
43		PPT/Lecture		
44		PPT/Lecture		
45		PPT/Lecture		
46		PPT/Lecture		
MODULE 8				
47	(a) PCR - Procedure and applications, variants of PCR - Real time PCR and its applications. (b) In vitro mutagenesis- Oligonucleotide directed, Error- prone PCR, Cassette Mutagenesis. Applications of In vitro mutagenesis. (c) Blotting techniques - procedure and applications of southern, northern, western, and dot blotting. Microarray (gene chip) technology. (d) Procedure and applications of DNA profiling, Footprinting.	PPT/Lecture		
48		PPT/Lecture		
49		PPT/Lecture		
50		PPT/Lecture		
51		PPT/Lecture		
52		PPT/Lecture	Video	
53		PPT/Lecture		
54		PPT/Lecture		
55				

56	(e) Procedure and applications of ELISA, RIA, Immunoprecipitation, flow cytometry, FISH, GISH.	Lecture	Debate	
MODULE 9				
57	Approaches to gene therapy- somatic cell and germline therapy, vectors used in gene therapy. In vivo and ex vivo therapy. Gene therapy of SCID, Cystic fibrosis, gene augmentation therapy. Problems and fears associated with gene therapy	PPT/Lecture		
58		PPT/Lecture		
59		PPT/Lecture		
60		PPT/Lecture		
61		PPT/Lecture		
MODULE 10				
62	Uses of GM microbes: Bacteria and yeast - producing useful proteins, basic genetic research	PPT/Lecture		
CIA - II				
63	Applications of GM animals: In basic research, producing novel proteins; disease studies, prevention and cure diseases0). Uses of transgenic plants: Herbicide, insect and disease resistance, stress resistance. Genetic engineering for increasing nutritional and other novel qualities in plants.	Lecture	Demo video	
64		Lecture		
65		Lecture	Group discussion	
66		Lecture		
67		PPT/Lecture		
MODULE 11				
68	Need for regulation, regulatory agency in India – GEAE. Patents – issues relating to patenting living organisms, their genes and other bioresources. Potential impact of GMOs on the ecosystem. GM food – effect on health and environment. Ethical problems of rDNA technology. Economic issues. Potential misuse of modern molecular biology tools and techniques, bioweapons, bioterrorism.	PPT/Lecture		
69		PPT/Lecture		
70		PPT/Lecture		
71		PPT/Lecture		
72		PPT/Lecture		
PRACTICALS				
73 - 89	1. Isolation of plant genomic DNA and its quantification. 2. Isolation of plasmids and its purification. 3. Isolation of bacterial genomic DNA and its quantification by using UV spectrophotometer. 4. Separation of DNA by agarose gel electrophoresis. 5. Separation of proteins by PAGE. 6. PCR.	HANDS-ON		

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	12/1/2019	Steps of rDNA Technology
2	18/1/2019	Techniques in rDNA Technology

References

1. James D Watson, Amy A Caudy, Richard M Myers, Jan A Witkowski (2007). *Recombinant DNA* (III Edn). W H Freeman.
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4. T A Brown (2002). *Genomes* (II Edn). Bios.
5. Leland H Hartwell, Leroy Hood, Michael L Goldberg, Ann E Reynolds, Lee M Silver, Ruth C Veres (2004). *Genetics: From genes to genomes* (II Edn). McGraw Hill.
6. Abul K Abbas, Andrew H Lichtmay, Shiv Pillai (2007). *Cellular and molecular immunology* (IV Edn). Elsevier..
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8. Bernard R Glick, Jack J Pasternak, Cheryl L Pattein (2010). *Molecular biotechnology: Principles and applications of recombinant DNA*. ASM press.
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13. printers, Coimbatore.
14. Joseph Sambrook, David W Russell (2001). *Molecular cloning: A laboratory manual*. Cold spring harbor laboratory press.
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17. Desmond S T Nicholl (2010). *An introduction to genetic engineering* (III Edn). Cambridge.
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20. Benjamin A Pierce (2008). *Genetics: A conceptual approach* (IV Edn). W H Freeman and Company
21. Anthony J F Griffiths, Susan R Wesler, Sean B Carroll, John Doebley (2008). *Introduction to genetic analysis* (X Edn). W H Freeman and Company.
22. Benjamin Lewin (2006) *Genes IX*. Jones and Bartlett.
23. William J Thieman, Michael A Palladino (2009*). Introduction to biotechnology* (II Edn). Pearson.
24. Carl Branden, John Tooze (1999). *Introduction to protein structure* (II Edn). Garland Publishing.
25. T A Brown (1995). *Gene cloning: An introduction* (III Edn). Stanley Thomas (Publishers) Ltd.
26. S B Primrose (1999). *Molecular biotechnology* (II Edn). Panima Publishing Corporation.
27. Alan Fersht (1999). *Structure and Mechanism in Protein Science*. W H Freeman and Company.

COURSE PLAN

PROGRAMME	M.Sc. BOTANY	SEMESTER	4
COURSE CODE AND TITLE	**16P4BOTT14 TISSUE CULTURE AND MICROBIAL BIOTECHNOLOGY**	CREDIT	4
HOURS/WEEK	4	HOURS/SEM	72
FACULTY NAME	Fr.Jose John, I'ma Neerackal		

COURSE OBJECTIVES
To examine the basic aspects of plant tissue culture in vitro germplasm conservation strategies
To describe the fundamentals of microbial biotechnology
To evaluate the different methods and processes involved in plant tissue culture
To describe the scope and relevance of Bioreactors and fermentation technology
To analyze the somaclonal and ploidy variants

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	REMARKS
MODULE I				
1	Introduction	PPT/ Lecturing		
2	Tissue culture regeneration of plants - Adventitious regeneration: Direct regeneration, indirect regeneration.	PPT/ Lecturing		
3	Tissue culture regeneration of plants - Adventitious regeneration: Direct regeneration, indirect regeneration.	PPT/ Lecturing		
4	Factors affecting adventitious regeneration; genotype, explant – orientation of explant, position on mother plant.	PPT/ Lecturing		
5	Factors affecting adventitious regeneration; genotype, explant – orientation of explant, position on mother plant.	PPT/ Lecturing		
6	Somatic embryogenesis: General aspects	PPT/ Lecturing		
7	Somatic embryogenesis: initiation of embryogenic cultures	PPT/ Lecturing		
8	Somatic embryogenesis: maturation of somatic embryos	PPT/ Lecturing		

9	Somatic embryogenesis: regeneration of plants	PPT/ Lecturing		
10	Somatic embryogenesis: factors regulating somatic embryogenesis	PPT/ Lecturing		
11 - 14	Somatic embryogenesis: differences between somatic and zygotic embryos. Encapsulation of somatic embryos	PPT/ Lecturing		
15 - 18	Somatic embryogenesis: Synthetic seed production; desiccated and hydrated types. Applications and limitations of synthetic seeds.	PPT/ Lecturing		
MODULE II				
19 - 20	Somaclonal Variation: Isolation of somaclonal variants - molecular basis of somaclonal variation.	PPT/ Lecturing		
21	Somaclonal Variation: Origin of somaclonal variation – pre-existing variability, in vitro induced variability	PPT/ Lecturing		
22 - 30	Somaclonal Variation: Reasons – changes in ploidy level, changes in chromosome structure, gene mutations, gene amplifications, changes in extra nuclear genes, activation of transposable elements, DNA methylation.	PPT/ Lecturing		
31	Applications of somaclonal variation.	PPT/ Lecturing		
MODULE III				
32 - 33	Production of Ploidy Variants: Haploids: Androgenesis - pretreatment of anther/pollen grains, media and growth regulators	PPT/ Lecturing		
34	Production of Ploidy Variants: (a) Haploids: Androgenesis - Induction and stage of pollen development, regeneration	PPT/ Lecturing		
35 - 36	Production of Ploidy Variants: (a) Haploids: Androgenesis - androgenic embryos, factors affecting androgenesis.	PPT/ Lecturing		
37	Production of Ploidy Variants: (a) Haploids: Androgenesis -. Microspore culture - protocol, advantages over anther culture.	PPT/ Lecturing		

38	Gynogenesis: Developmental stage at inoculation, in vitro maturation of embryo sacs	PPT/ Lecturing		
39	Gynogenesis: origin of embryos, triggering factors – pretreatment, medium.	PPT/ Lecturing		
40 – 41	Gynogenesis: Uses and limitations of haploid plants.	PPT/ Lecturing		
42	Triploids: importance of triploid plants	PPT/ Lecturing		
43	Triploids: conventional production of triploid plants, endosperm culture - advantages and limitations	PPT/ Lecturing		
44	Triploids: conventional production of triploid plants, endosperm culture - advantages and limitations	PPT/ Lecturing		
MODULE IV				
45	Protoplast Culture - Isolation and purification of protoplasts, culture of protoplasts	PPT/ Lecture		
46	Protoplast Culture - cell division and callus formation, plant regeneration.	PPT/Lecture		
47	Protoplast fusion (somatic hybridization) – chemical, mechanical, electrofusion.	PPT/Lecture		
48	Protoplast fusion (somatic hybridization) – Selection, isolation of heterokaryons, cybrids and their applications. Applications of protoplast culture.	PPT/Lecture		
PRACTICAL				
49	Isolation and fusion of plant protoplasts	Demo/ Lab		
50	Preparation of synthetic seeds.	Demo/ Lab		
51 – 52	Preparation of selective medium for drought or salinity resistance. Preparation of MS soild medium from stock solutions containing auxin and cytokinin, NaCl or PEG, and inoculation.	Demo/ Lab		
53 - 55	Finding out the uninucleate stage of anther and anther culture.	Demo/ Lab		
56 - 58	Dissecting out an embryo from any seed and culturing it on a suitable solid medium.	Demo/ Lab		

59 - 61	Cell plating technique.	Demo/ Lab		
MICROBIAL BIOTECHNOLOGY				
62 - 64	Screening of microbes for metabolite production. Selection of media, sterilization of media.	Presentation/Chalk and Board		
65 - 66	Screening of microbes for metabolite production. Selection of media, sterilization of media.	Presentation/Chalk and Board		
67 - 69	Bioreactors – airlift, stirred tank, bubble column, rotary drum. Fermentation process - batch, fed batch, continuous fermentation. Submerged and solid state fermentation Process control during fermentation- pH, aeration, agitation, temperature, foam control	Presentation/Chalk and Board		
70	Downstream processing.	Presentation/Chalk and Board		
71 - 72	Large scale production of antibiotics - penicillin, streptomycin, industrial chemicals - ethanol, acetone, butanol, lysine. Microbial insecticides. Commercial production of enzymes and their uses - amylase, cellulase, polygalacturonase	Presentation/Chalk and Board		

	Topic	Nature of Assignment
1	Protoplast Fusion - Scope and Applications	Written and Seminar Presentation
2	Protoplast Isolation and Purifications	Written and Seminar Presentation
3	Somatic Embryogenesis	Written and Seminar Presentation
4	Gynogenesis	Written and Seminar Presentation
5	Triploid Production in India	Written and Seminar Presentation
6	Androgenesis	Written and Seminar Presentation

REFERENCES

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3. S S Bhojwani, M K Razdan (1996). Plant tissue culture: Theory and Practice. Elsevier.
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7. Edwin F. George, Michael A. Hall, Geert-Jan De Klerk (2008). Plant Propagation by Tissue Culture (Vol I): The Background. Springer.
8. Michael R. Davey, Paul Anthony (2010). Plant Cell Culture: Essential Methods. Wiley-Blackwell A John Wiley & Sons, Ltd.
9. Trevor A. Thorpe and Edward C. Yeung (Eds) (2011). Plant Embryo Culture: Methods and Protocols. Springer, Heidelberg.

COURSE PLAN

PROGRAMME	M. Sc. Botany	SEMESTER	4
COURSE CODE AND TITLE	GENOMICS, PROTEOMICS & BIOINFORMATICS (16P4BOTT15)	CREDIT	4
HOURS/WEEK	6	HOURS/SEM	(Theory 36 + 36 hrs; Practical 0 + 45 hrs)
FACULTY NAME	**Lesly Augustine**		

COURSE OBJECTIVES
To compile and explain the history of genomics and the revolution happened in the field
To distinguish the ancient and modern techniques to understand the structural features of genome
To elaborate the modern principles of functional genomics
To simplify the evolutionary studies using the genomics tools and appraise the social and ethical issues with a scientific temper
To formulate the genomic studies using the fundamentals of bioinformatics

GENOMICS & PROTEOMICS (Theory 36 hrs)

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	REMARKS
Introduction to Course				
	Introduction to the Course	PPT/Lecture	video	
	Genomics: Genome - basis and key concepts.	PPT/Lecture	Seminar	
	Proteomics- basis and key concepts.	PPT/Lecture	Seminar	
	Important findings of the completed genome projects: Human genome project	PPT/Lecture	Seminar	
	Important findings of the completed genome projects: Rice genome project,	PPT/Lecture	Seminar	
	Important findings of the completed genome projects: Arabidopsis genome project	PPT/Lecture	Seminar	
	Important findings of the completed genome projects: E. coli genome project	PPT/Lecture	Seminar	
	Important findings of the completed genome projects: Wheat genome project	PPT/Lecture	Seminar	
	Important findings of the completed genome projects: Tomato genome project.	PPT/Lecture	Seminar	
Module 1: Structural genomics (20 hrs.)				
1	Basic steps in genome sequencing.	PPT/Lecture		
2	Shot gun sequencing of small genomes	PPT/Lecture		
3	Map based sequencing: Hierarchical shot gun sequencing (clone-by-clone approach) - steps involved	PPT/Lecture		
4	Whole genome shot gun approach - steps involved.	PPT/Lecture		
5	Genome mapping	PPT/Lecture		
6	Genetic mapping and physical mapping	PPT/Lecture		
7	Cytogenetic and linkage map	PPT/Lecture		
8	Molecular markers – RFLP	PPT/Lecture		
9	RAPD	PPT/Lecture		
10	AFLP	PPT/Lecture		
11	SSLP	PPT/Lecture		
12	SNP	PPT/Lecture		
13	Construction of linkage maps using molecular markers – E.g., RFLP maps	PPT/Lecture		
14	Physical mapping – restriction mapping,	PPT/Lecture		
15	STS	PPT/Lecture		
16	SNP	PPT/Lecture		
17	EST	PPT/Lecture		
18	Sequence assembly – methods used	PPT/Lecture		
19	Next generation sequencing strategies	PPT/Lecture		
20	Pyrosequencing, 454 GS FLX System	PPT/Lecture		
Module 2: Functional genomics (7 hrs.)				
21	Transcriptome, expression profiling (mRNA	PPT/Lecture	video	

	profiling).			
22	Gene expression analysis using dot blotting and microarrays	PPT/Lecture		
23	Fabrication of microarrays – spotted arrays, in situ synthesis.	PPT/Lecture		
24	Chromatin immunoprecipitation (ChIP) and its applications.	PPT/Lecture		
25	Determination of gene functions - knock out and knock down mutants	PPT/Lecture		
26	Antisense RNA and RNAi	PPT/Lecture		
27	Gene over expression	PPT/Lecture		
	Module 3: Comparative genomics (3 hrs)			
28	Orthologs and Paralogs	PPT/Lecture		
29	Gene identification by comparative genomics	PPT/Lecture		
30	Comparative genomics as a tool in evolutionary studies.	PPT/Lecture		
31	Metagenomics.	PPT/Lecture		
Module 4: Proteomics (6 hrs.)				
32	Proteome, proteomics	PPT/Lecture		
33	Separation and identification of cellular proteins by 2D gel electrophoresis	PPT/Lecture	video	
34	Mass spectrometry	PPT/Lecture	video	
35	Protein expression analysis using Protein microarray	PPT/Lecture		
36	Protein localization using GFP,	PPT/Lecture	video	
37	Other applications of GFP	PPT/Lecture	video	

References

- S B Primrose, R M Twyman (2006). Principles of gene manipulation and genomics (VII Edn). Blackwell publishing.
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- S R Pennington, M J Dunn (Edts) (2002). Proteomics: From protein sequence to function. Viva Books Private Limited.
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- Burton E Tropp (2012). Molecular biology: Genes to Proteins (IV Edn). Jones and Bartlett Learning.
- Jocelyn E Krebs, Elliott S Goldstein, Stephen T Kilpatrick (2011). Lewin's Genes X . Jones and Bartlett Publishers

BIOINFORMATICS (Theory 36 hrs; Practical 45 hrs)

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	REMARKS
Introduction to Course				
	Introduction, aim and importance of bioinformatics	PPT/Lecture	video	
	Databases: primary and secondary databases	PPT/Lecture	Seminar	
	DNA sequence databases - Genbank, DNA databank, Nucleotide sequence databank (EMBI Bank). Specialized databases	PPT/Lecture	Seminar	
	Protein databases - SWISS-PROT, PDB	PPT/Lecture	Seminar	
Module: 1 (16 hrs.)				
1	Submission and retrieval of databases	PPT/Lecture	video	
2	BankIt	PPT/Lecture	video	
3	ENTREZ	PPT/Lecture		
4	Sequence analysis – significance	PPT/Lecture		
5	Methods of sequence alignment – paired sequence alignment	PPT/Lecture		
6	Multiple sequence alignment	PPT/Lecture		
7	Scoring matrices	PPT/Lecture		
8	Sequence comparison	PPT/Lecture		
9	Dot matrix method	PPT/Lecture		
10	Dynamic programming for sequence alignment	PPT/Lecture		
11	Global - Needleman Wunch algorithm	PPT/Lecture		
12	Local - Smith Waterman algorithms	PPT/Lecture		
13	Database similarity search – query sequence search	PPT/Lecture		
14	BLAST - different versions	PPT/Lecture		
15	FASTA - different versions	PPT/Lecture		
16	Tools for multiple sequence alignment – CLUSTAL X/W	PPT/Lecture		
Module: 2 (8 hrs.)				
17	Gene prediction strategies	PPT/Lecture		
18	ORF search			
19	RNA secondary structure prediction	PPT/Lecture		
20	Protein structure and function prediction - tools used	PPT/Lecture		
21	Bioinformatics for enzyme and protein design	PPT/Lecture		
22	Protein visualization tool – Rasmol	PPT/Lecture	Videos	
23	Protein visualization tool – Rasmol	PPT/Lecture	Videos	
24	Protein visualization tool – Rasmol	PPT/Lecture	Videos	
	Module: 3 (6 hrs.)			
25	Applications of bioinformatics in evolutionary	PPT/Lecture	Videos	

	studies			
26	Molecular phylogenetics	PPT/Lecture	Videos	
27	Molecular clock	PPT/Lecture	Videos	
28	Construction of phylogenetic trees – MEGA	PPT/Lecture	Videos	
29	Construction of phylogenetic trees – MEGA	PPT/Lecture	Videos	
30	Phylip, Mr.Bayes, RaXML	PPT/Lecture	Videos	
Module: 4 (6 hrs.)				
31	Computer assisted drug design - concept, methods and practical approaches	PPT/Lecture		
32	Computer assisted drug design - concept, methods and practical approaches	PPT/Lecture		
33	Computer assisted drug design - concept, methods and practical approaches	PPT/Lecture		
34	Various computational methods applied to design drugs.	PPT/Lecture		
35	Various computational methods applied to design drugs.	PPT/Lecture		
36	Various computational methods applied to design drugs.	PPT/Lecture	Group discussion	
Practical				
1	Protein visualization using Rasmol	Hands-on Session		
2	Protein visualization using Rasmol,	Hands-on Session		
3	Protein visualization using Pymol	Hands-on Session		
4	Protein visualization using Pymol	Hands-on Session		
5	Protein visualization using Swiss PDB viewer	Hands-on Session		
6	Multiple sequence alignment using CLUSTAL W.	Hands-on Session		
7	Multiple sequence alignment using CLUSTAL W.	Hands-on Session		
8	Multiple sequence alignment using CLUSTAL W.	Hands-on Session		
9	Phylogenetic analysis by Phylip, MEGA.	Hands-on Session		
10	Phylogenetic analysis by Phylip, MEGA.	Hands-on Session		
11	Phylogenetic analysis by Phylip, MEGA.	Hands-on Session		
12	Gene prediction programs – Grail/Exp, GENSCAN, ORF finder.	Hands-on Session		
13	Gene prediction programs – Grail/Exp, GENSCAN, ORF finder.	Hands-on Session		
14	Gene prediction programs – Grail/Exp,	Hands-on		

	GENSCAN, ORF finder.	Session		
15	Gene prediction programs – Grail/Exp, GENSCAN, ORF finder.	Hands-on Session		
16	Locate specific sequences like TATA box, promoters, start signals, stop signals etc. in a DNA sequence using computer programmes. Eg. E. coli promoter, human promoter.	Hands-on Session		
17	Locate specific sequences like TATA box, promoters, start signals, stop signals etc. in a DNA sequence using computer programmes. Eg. E. coli promoter, human promoter.	Hands-on Session		
18	Locate specific sequences like TATA box, promoters, start signals, stop signals etc. in a DNA sequence using computer programmes. Eg. E. coli promoter, human promoter.	Hands-on Session		
19	Locate specific sequences like TATA box, promoters, start signals, stop signals etc. in a DNA sequence using computer programmes. Eg. E. coli promoter, human promoter.	Hands-on Session		
20	Locate specific sequences like TATA box, promoters, start signals, stop signals etc. in a DNA sequence using computer programmes. Eg. E. coli promoter, human promoter.	Hands-on Session		
21	Multiple sequence alignment and ontology-based database searches on selected plant cytoskeletal genes to decipher the molecular phylogeny of cytoskeleton genes – record the results	Hands-on Session		
22	Multiple sequence alignment and ontology-based database searches on selected plant cytoskeletal genes to decipher the molecular phylogeny of cytoskeleton genes – record the results	Hands-on Session		
23	Multiple sequence alignment and ontology-based database searches on selected plant cytoskeletal genes to decipher the molecular phylogeny of cytoskeleton genes – record the results	Hands-on Session		
24	Multiple sequence alignment and ontology-based database searches on selected plant cytoskeletal genes to decipher the molecular phylogeny of cytoskeleton genes – record the results	Hands-on Session		

25	Multiple sequence alignment and ontology-based database searches on selected plant cytoskeletal genes to decipher the molecular phylogeny of cytoskeleton genes – record the results	Hands-on Session		
26	Multiple sequence alignment and ontology-based database searches on selected plant cytoskeletal genes to decipher the molecular phylogeny of cytoskeleton genes – record the results	Hands-on Session		
27	Multiple sequence alignment and ontology-based database searches on selected plant cytoskeletal genes to decipher the molecular phylogeny of cytoskeleton genes – record the results	Hands-on Session		
28	Multiple sequence alignment and ontology-based database searches on selected plant cytoskeletal genes to decipher the molecular phylogeny of cytoskeleton genes – record the results	Hands-on Session		
29	Multiple sequence alignment and ontology-based database searches on selected plant cytoskeletal genes to decipher the molecular phylogeny of cytoskeleton genes – record the results	Hands-on Session		
30	Multiple sequence alignment and ontology-based database searches on selected plant cytoskeletal genes to decipher the molecular phylogeny of cytoskeleton genes – record the results	Hands-on Session		
31	Multiple sequence alignment and ontology-based database searches on selected plant cytoskeletal genes to decipher the molecular phylogeny of cytoskeleton genes – record the results	Hands-on Session		
32	BLASTn	Hands-on Session		
33	BLASTn	Hands-on Session		
34	BLASTp	Hands-on Session		
35	BLASTp	Hands-on Session		
36	BLASTx	Hands-on Session		
37	BLASTx	Hands-on Session		
38	tBLASTn	Hands-on Session		
39	tBLASTn	Hands-on		

		Session		
40	Drug Designing: Autodock Vienna and Discovery studio	Hands-on Session		
41	Drug Designing: Autodock Vienna and Discovery studio	Hands-on Session		
42	Drug Designing: Autodock Vienna and Discovery studio	Hands-on Session		
43	Drug Designing: Autodock Vienna and Discovery studio	Hands-on Session		
44	Drug Designing: Autodock Vienna and Discovery studio	Hands-on Session		
45	Drug Designing: Autodock Vienna and Discovery studio	Hands-on Session		

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2. Zhumur Ghosh, Bibekanand Mallik (2008). Bioinformatics: principles and applications. Oxford University press.

3. Orpita Bosu, Simminder Kaur Thukral (2007). Bioinformatics: Databases tools and algorithms. OxfordUniversity press.

4. David W Mount (2001). Bioinformatics: Sequence and genome analysis. CBS publishers & distributors.

5. Jin Xiong (2006). Essential Bioinformatics. Cambridge University Press

COURSE PLAN

PROGRAMME	M.Sc. BOTANY	SEMESTER	4
COURSE CODE AND TITLE	**16P4BOTT16: BIOSTATISTICS, MICROTECHNIQUES & BIOPHYSICS**	CREDIT	4
HOURS/WEEK	4	HOURS/SEM	72
TEACHERS IN CHARGE	**Dr. Giby Kuriakose, Fr. Jose John, Mr. Kiran George Koshy**		

COURSE OBJECTIVES
To explain the tools and techniques available for studying biochemical and biophysical nature of life.
To describe the basics of bio-statistics and experimental design in research
To describe micro-preparation of plant materials for microscopic examination and histo-chemical studies.
To identify various statistical tools and their applications in data analysis processing
To explain principles and working of various types of microscopes and other instruments in biological research
To understand and Apply different bio statistical analytical methods in research, real life and professional fields.

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	REMARKS
MODULE I Killing and Fixing				
1	Introduction, Principles and techniques of killing and fixing	PPT/ Lecturing		
2	Properties of reagents, fixation images; properties and composition of important fixatives - Carnoy's Fluid, FAA, FPA, Chrome acetic acid fluids, Zirkle- Erliki fluid.	PPT/ Lecturing		
MODULE II Dehydration, Clearing, Embedding and Sectioning				
3	Dehydration: Principles of dehydration, properties and uses of important dehydrating and clearing agents - alcohols, acetone, xylol, glycerol, chloroform, dioxan.	PPT/ Lecturing		
4	Dehydration: Principles of dehydration, properties and uses of important dehydrating and clearing agents - alcohols, acetone, xylol, glycerol, chloroform, dioxan.	PPT/ Lecturing		
5	Dehydration Methods: (i) Tertiary-	PPT/ Lecturing		

	butyl alcohol method (ii) Alcohol-xylol method.			
6	Embedding: Paraffin embedding.	PPT/ Lecturing		
7	Sectioning: Free hand sections – Prospects and problems; Sectioning in rotary microtome – sledge microtome and cryotome.	PPT/ Lecturing		
MODULE III Staining				
8	Principles of staining; classification of stains, protocol for preparation of; (i) Natural stains - Haematoxylin and Carmine; (ii) Coal tar dyes – Fast green, Orange G, Safranine, Crystal violet, Cotton Blue and Oil Red O.	PPT/ Lecturing/ Demo		
9	Techniques of staining: (i) Single staining; Staining with Safranine or crystal violet (ii) Double staining; Safranine-Fast green method, Safranine-Crystal violet method (iii) Triple staining; Safranine- Crystal violet-Orange G method.	PPT/ Lecturing/ Demo		
10	Histochemical localization of starch, protein, lipid and lignin.	PPT/ Lecturing		
MODULE IV Specimen Preparation for Transmission Electron Microscopy				
11	Material collection, fixing, dehydration, embedding, sectioning (glass knife preparation, grid preparation, ultra microtome) and staining	PPT/ Lecturing		
12	Material collection, fixing, dehydration, embedding, sectioning (glass knife preparation, grid preparation, ultra microtome) and staining	PPT/ Lecturing		
13	Material collection, fixing, dehydration, embedding, sectioning (glass knife preparation, grid preparation, ultra microtome) and staining	PPT/ Lecturing		
MODULE V Whole Mounts				
14	Principles and techniques of whole mounting, TBA/Hygrobutol method, Glycerine-xylol method.	PPT/ Lecturing		
15	Staining of whole mount materials (haematoxylin, fast green or Safranine-fast green combination).	PPT/ Lecturing		

	Significance of whole mounts			
16	Techniques of smear, squash and maceration.	PPT/ Lecturing		
17	Mounting: Techniques, common mounting media used - DPX, Canada balsam, Glycerine jelly and Lactophenol	PPT/ Lecturing		
18	Cleaning, labeling and storage of slides.	PPT/ Lecturing		
PRACTICAL				
19	Preparation of semi permanent slides.	Lab Work		
20	Preparation of permanent slides.	Lab Work		
21	Preparation of whole mounts	Lab Work		
22	Maceration	Lab Work		
23	Preparation of fixatives (FAA, Carnoys'fluid, Houpt's adhesive).	Lab Work		
24	Preparation of dehydration series (Alcohol, Acetone, TBA).	Lab Work		
25	Preparation of paraffin blocks	Lab Work		
26	Preparation of serial sections	Lab Work		
27	Staining - Free hand sections - single & Double staining	Lab Work		
28	Staining - Serial sections - single & Double staining	Lab Work		

BIOSTATISTICS

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	REMARKS
	Module -VI Introduction to Biostatistics			
29	Basic principles of Biostatistics: Methods of collection and classification of data	Lecture/PPT		
30	Primary and secondary data, qualitative and quantitative data.	Lecture/PPT		
31	Frequency distribution, graphical representation.	Lecture/PPT		
32	Measures of central tendency (a) Mean, (b) Median and (c) Mode	Lecture/PPT		
33	Measures of dispersion: Mean deviation, Standard deviation, variance, standard error, co-efficient of variation.	Lecture/PPT		

	Module-VII Correlation and Regression			
34	Introduction to Regression and Correlation	Lecture/PPT		
35	Liniar Regression	Lecture/PPT		
36	Simple Liniar regression	Lecture/PPT		
37	Multiple Linear Regression	Lecture/PPT		
38	Correlation and Correlation coefficient	Lecture/PPT		
39	Problem solving	Practical/Hands on		
	Module VIII: Probability			
40	Introduction to Probability	Lecture/PPT		
41	Definition, mutually exclusive events – sum rule,	Lecture/PPT		
42	Independent events – product rule.	Lecture/PPT		
43	Probability of unordered combination of events.	Lecture/PPT		
44	Binomial, Normal and Poisson distribution - 1	Lecture/PPT		
45	Problem Solving	Practical/Hands on		
	Module IX: Design of experiments			
46	Experimental designs: Principles - replication and randomization.	Lecture/PPT		
47	Common designs in biological experiments	Lecture/PPT		
48	Completely randomized design,	Lecture/PPT		
49	Randomized block design,	Lecture/PPT		
50	Latin square design	Lecture/PPT		
51	Factorial design	Lecture/PPT		
52	Duncan's Multiple Range Test.	Lecture/PPT		
53	Problem solving	Practical/Hands on		
	Module X: Tests of significance			
54	Statistical inference – estimation	Lecture/PPT		
55	testing of hypothesis	Lecture/PPT		
56	t-test	Lecture/PPT		
57	Chi square test - goodness of fit	Lecture/PPT		

58	Chi square test-independence or	Lecture/PPT		
59	Chi square test -association	Lecture/PPT		
60	Chi square test - detection of linkages	Lecture/PPT		
61	F-test	Lecture/PPT		
62	ANOVA.	Lecture/PPT		
63	Problem Solving	Practical/Hands on		
BIOPHYSICS				
SESSION	**TOPIC**	**LEARNING RESOURCES**	**VALUE ADDITIONS**	**REMARKS**
	Module XI: Microscopy			
64	Parts of microscope, principles of microscopy.	Lecture/PPT		
65	Types of microscopes - simple and compound; Stereo microscope,	Lecture/PPT		
66	Phase contrast microscope, Fluorescence microscope, Polarization microscope,	Lecture/PPT		
67	Confocal microscope and electron microscope (TEM, SEM and E-SEM).	Lecture/PPT		
68	Micrometry, Photomicrography and microphotography	Lecture/PPT		
	Module XII: Principles and applications of instruments			
69	Basic principles and applications of; (i) pH meter (ii) UV-visible spectrophotometers.	Lecture/PPT		
70	Centrifuges: Basic Principle, Table top centrifuge and ultra-centrifuge. Centrifugation techniques-. Zonal	Lecture/PPT		
71	Centrifugation, Equilibrium density gradient centrifugation.	Lecture/PPT		
72	Chromatography: Principles and application; paper, TLC, Column chromatography, GC, HPLC.	Lecture/PPT		
73	Immunoassay systems, ELISA - ELISA reader.	Lecture/PPT		
74	Electrophoresis: SDS PAGE, AGE and PFGE.	Lecture/PPT		

75	X-ray crystallography.	Lecture/PPT		
76	Haemocytometer.	Lecture/PPT		
77	Mass Spectrometry	Lecture/PPT		

Sl No	Topic	Nature of Assignment
1	Specimen Preparation for Electron Microscopy - SEM	Written and Seminar Presentation
2	Stains and Staining Techniques	Written and Seminar Presentation
3	Dehydration and Staining	Written and Seminar Presentation
4	Whole mounts and Mounting techniques	Written and Seminar Presentation
5	Significances and Applications of Biostatistics	Written and Seminar Presentation
6	Role of testing hypothesis in research	Written and Seminar Presentation
7	Application of probability	Written and Seminar Presentation
8	Experimental design	Written and Seminar Presentation
9	Electron Microscopy - SEM	Written and Seminar Presentation
10	Micrometry	Written and Seminar Presentation
11	Advancement of Biophysics	Written and Seminar Presentation
12	Applications of Biophysics	Written and Seminar Presentation

TEXT BOOKS AND REFERENCES

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2. Johanson D A (1940). *Plant microtechnique*. McGraw Hill co.
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