UNIVERSITY OF CALICUT

Abstract

General & Academic IV- Scheme & syllabus of Integrated Botany with Computational Biology programme (upto 10 semester) in accordance with Regulations for the Integrated Programmes under Choice Based Credit Semester System (CBCSS) with effect from 2020 admission - Approved-Subject to ratification by the academic council- Implemented - Orders issued.

G & A - IV - J

U.O.No. 15293/2022/Admn Dated, Calicut University.P.O, 08.08.2022

Read:-1. U.O.No. 8389/2021/Admn Dated, 25.08.2021

2. Minutes of the combined meeting of the UG and PG Boards of Studies in Botany, held on 29.06.2022

3. Remarks of the Dean, Faculty of Science, dated 01.08.2022.

4. Orders of the Vice Chancellor in the file of even no. dated 05.08.2022.

ORDER

1. Scheme & syllabus of Integrated Botany with Computational Biology programme (upto 6 semester) in accordance with Regulations for the Integrated Programmes under Choice Based Credit Semester System (CBCSS) with effect from 2020 admission, was implemented, vide paper read (1) above.
2. The combined meeting of the UG and PG Boards of Studies in Botany, held on 29.06.2022, finalised and approved the scheme & syllabus of Integrated Botany with Computational Biology programme (upto 10 semester) in accordance with Regulations for the Integrated Programmes under Choice Based Credit Semester System (CBCSS) with effect from 2020 admission, vide paper read (2) above.
3. The Scheme & syllabus of Integrated Botany with Computational Biology programme (upto 10 semester) in accordance with Regulations for the Integrated Programmes under Choice Based Credit Semester System (CBCSS) with effect from 2020 admission, has been approved by the Dean, Faculty of Science, vide paper read (3) above, and by the Vice Chancellor, vide paper read (4) above, subject to ratification by the Academic Council.
4. Considering the urgency, the Vice Chancellor has accorded sanction to implement the Scheme & syllabus of Integrated Botany with Computational Biology programme in accordance with

Regulations for the Integrated Programmes under Choice Based Credit Semester System (CBCSS) with effect from 2020 admission, subject to ratification by the Academic Council.

5. Orders are issued accordingly. (Syllabus appended)

Ajayakumar T.K

Assistant Registrar

To

The Principals of all Affiliated Colleges

Copy to: PS to VC/PA to PVC/ PA to Registrar/PA to CE/JCE I/JCE IV/DoA/EX and EG Sections/GA I F/CHMK Library/Information Centres/SF/DF/FC

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Section Officer

UNIVERSITY OF CALICUT

SYLLABUS
FOR
INTEGRATED BOTANY
WITH
COMPUTATIONAL BIOLOGY

Effective from 2020 admission

Semester	Course	CREDIT
S-1	Common course: English1	4
	Common course: English II	3
	Common course: Additional Language	4
	Core course1: Plant Anatomy COURSE CODE**: BOT1IB01**	3
	Allied core course: Zoology	2
	Allied core course: Chemistry	2
	Audit course-1	
S-2	Common course: English 1	4
	Common course: English II	3
	Common course: Additional Language	4
	Core course 2: Microbiology, Mycology& Plant Pathology COURSE CODE: **BOT2IB02**	3
	Allied core course: Chemistry	2
	Allied core course: Zoology	2
	Audit course-2	
S-3	Core course 3: Phycology, Lichenology, Bryology& Pteridology COURSE CODE: **BOT3IB03**	4
	Core course 4: Methodology and Perspective in Science. COURSE CODE: **BOT3IB04**	4
	Core course 5: Gymnosperms, Palaeobotany, Phytogeography & Evolution COURSE CODE: **BOT3IB05**	3
	Allied core course: Chemistry	2
	Allied core course: Zoology	2
	Audit course-3	
S-4	Core course 6: Biotechnology and Bioinformatics COURSE CODE: **BOT4IB06**	4
	Core course 7: Tissue Culture, Horticulture, Economic Botany & Ethnobotany COURSE CODE**: BOT4IB07**	3
	Core course 8: Basic mathematics in biological sciences COURSE CODE: **BOT4IB08**	4

	Core course 9: Practical of Semester 1-4 (Paper 1) COURSE CODE: **BOT4IH09**	4
	Allied core course: Chemistry	2
	Allied core course 10: Chemistry Practical	4
	Allied core course: Zoology	2
	Allied core course: Zoology Practical	4
	Audit course-4	
S-5	Core course 10: Angiosperm Morphology and Systematics Part1 COURSE CODE: **BOT5IB10**	3
	Core course 11: Cell biology and Biochemistry COURSE CODE: **BOT5IB11**	3
	Core course 12: Genetics and Plant Breeding COURSE CODE: **BOT5IB12**	3
	Core Course13: Environmental Science COURSE CODE: **BOT5IB13**	3
	Open Course COURSE CODE: **BOT5ID02**	3
S-6	Core course 14: Creativity, Research and Knowledge Management COURSE CODE**: BOT6IB14**	3
	Core course 15: Plant Physiology & Metabolism COURSE CODE: **BOT6IB15**	3
	Core course 16: Molecular Biology, Plant Morphogenesis & Embryology. COURSE CODE: **BOT6IB16**	3
	Core course 17: Genomics COURSE CODE: **BOT6IB17**	3
	Core Course 18: Elective: Genetics and Crop Improvement COURSE CODE**: BOT6IE18**	3
	Core course 19: practical of semester 5 (Paper II) COURSE CODE: **BOT6IH19**	5
	Core course 20: practical of semester 6 (Paper III) COURSE CODE**: BOT6IH20**	5
	Core course 21: Project COURSE CODE: **BOT6IF21**	2
S-7	Core course 22: Proteomics COURSE CODE: **BOT7IB22**	4
	Core course 23: Phycology, Bryology, Pteridology & Gymnosperm Part 2 COURSE CODE: **BOT7IB23**	4
	Core Course 24: Microbiology, Mycology, Plant Anatomy Palynology & Lab Techniques---- Part 2 COURSE CODE: **BOT7IB24**	4
	Core course 25: Practical's of Phycology, Bryology, Pteridology,	4

	Gymnosperm, Microbiology, Mycology, Plant Anatomy, Palynology & Laboratory Techniques COURSE CODE: **BOT7IH25**	
S-8	Core Course 26: Genetics-Part 2, Cytogenetics & Applied Environmental Science COURSE CODE: **BOT8IB26**	4
	Core Course 27: Angiosperm Morphology, Taxonomy, Forest Botany & Plant Resources Part 2 COURSE CODE: **BOT8IB27**	4
	Core Course28: Phylogenetics COURSE CODE: **BOT8IB28**	4
	Core Course 29: Practical's of Genetics, Cytogenetics, Applied Environmental Science, Angiosperm Morphology,Taxonomy, Forest Botany, Plant resources Part 2 & Phylogenetics COURSE CODE: **BOT8IH29**	4
s-9	Core Course 30: Genetic Engineering COURSE CODE: **BOT9IB30**	4
	Core Course 31: Computer Aided Drug Designing COURSE CODE: **BOT9IB31**	4
	Core Course 32: Perl for Biologist COURSE CODE: **BOT9IB32**	4
	Core Course 33: Practical's of Genetic Engineering, Computer Aided Drug Designing, Perl for Biologist COURSE CODE: **BOT9IH33**	4
s-10	Core Course 34: Dissertation COURSE CODE: **BOT10IF34**	4
	Core Course 35: Viva Voice COURSE CODE: **BOT10IG35**	4
	Core Course 36: Elective 1 COURSE CODE: **BOT10IE36**	4
	Core Course 37: Elective 2 COURSE CODE: **BOT10IE37**	4
	Core Course 38: Elective 3 COURSE CODE: **BOT10IE38**	4
	Core Course 39: Practical's of electives COURSE CODE:**BOT10IH39**	4

SEMESTER-1

COURSE CODE: BOT1IB01

COURSE TITLE: PLANT ANATOMY

Theory 36 hrs.

Module – I: Plant Anatomy

1. Introduction: Significance of anatomy.
2. Plant cell- structure.
   A. Structure and composition of cell wall. Middle lamella Primary and Secondary wall thickening, Pits.
   B. Growth of cell wall – apposition, intussusception
   C. Extra cell wall materials – lignin, cutin, suberin, callose, wax.
3. Non-living inclusions: Reserve materials – carbohydrates (starch grains and sugars) proteins (aleurone grains) fats & oils, examples.

Excretory materials; Nitrogenous – alkaloids, Non-nitrogenous- gums, resins, tannins, organic acids, essential oils Mineral crystals- cystolyth, raphides, Druses.

4. Tissues: Definition and Types

A. Meristematic tissues – classification, Theories on apical organisation - apical celltheory, histogen theory, Tunica-Corpus theory.

B. Permanent tissues- definition, Classification- simple complex and secretory.

i. Simple tissues – parenchyma, collenchyma, sclerenchyma, - fibres and sclereids- structure, occurrence and function.

ii. Complex tissues - definition - xylem & phloem structure, function, origin, phylogeny.

iii. Secretory tissues – glands, glandular hairs, nectaries, hydathodes, schizogenous and lysigenous ducts, resin ducts and laticifers.

C. Structure of stomata, classification (Metcalfe & Chalk), cuticIe.

D. Vascular tissue system: vascular bundles - origin and types - conjoint, collateral bicollateral, radial, concentric – amphicribral and amphivasal, protoxylem, metaxylem,

protophloem, metaphloem, cambium, open and closed, endarch and exarch.

E. Primary growth of plant body; Dicot stem, Monocot stem, Dicot root, Monocot root, Dicot leaf and Monocot leaf.

F. Secondary body of the plant.

a. Normal secondary growth in dicot stem and dicot root. Formation of vascular cambial ring, Structure and activity of cambium - storied and non-storied, fusiform and ray initials. Formation of secondary wood, annual rings, ring porous and diffuse porous wood, heart wood and sapwood, tyloses, secondary phloem, vascular rays.
Extra stelar secondary thickening in stem and root - periderm formation. Lenticels - structure & function.

b. Anomalous secondary growth in dicot stem (*Boerhaavia*. *Bignonia)* and monocot stem (*Dracaena*).

PRACTICAL

36 Hrs.

1. Study of primary plant structures – Dicot stem *Centella* and bi-collateral (*Cephalandra*, *Cucurbita*), - Monocot stem-(Bamboo)–Dicot root (aerial *Ficus, Tinospora, Pea*) -Monocot root (*Colocasia,* Musa)-Dicot leaf (*Ixora)* Monocot leaf (Grass)
2. Study of secondary plant structures (dicot stem –(*Vernonia, Polyalthia*) and Dicot root (*Tinospora,*

Papaya) after secondary thickening)

3. Study of anomalous secondary thickening -*Boerhaavia*, *Bignonia*,*Dracaena*
4. Identification of different cell types - tissues, vascular bundles (all types).

REFERENCES

- Cutler, D. F., Botha, T., Stevenson, D. W. 2008. Plant anatomy: an applied approach. Blackwell.

- Cutter, E.G. 1969. Plant Anatomy - Part 1 Cells & Tissue. Edward Arnold.
- Cutter, E.G. 1971. Plant Anatomy, Part 2 Organs. Edward Arnold.
- Eames, A. J. & L H Mac Daniels. 1987. Introduction to Plant Anatomy.Tata-McGraw.
- Esau K. 1985. Plant Anatomy (2nd ed.). Wiley Eastern Ltd. NewDelhi.
- Fahn A.2000. Plant Anatomy. Pergamon Press.
- Pandey B.P. 2001. Plant Anatomy. S. Chand
- &Co.
  Srivastava, S. and Singh S.K. 2009. Anatomy of Angiosperms. Crescent Publishing Corporation.
- Tayal M.S. 2004. Plant Anatomy. Rastogi Publishers,Meerut.
- Vasishta P.C. 1974. Plant Anatomy, PradeepPublication.
- http://www.biologydiscussion.com/plant-anatomy/applications-plant-anatomy/top-7-applicationsof-plant-anatomy-botany/69516
- Beck C. B. 2010. An Introduction to Plant Structure and Development. Cambridge University Press.
- Dickison W. C. 2000. Integrative Plant Anatomy. AcademicPress.
- Pandey S.N. and A. Chadha 2015. Plant Anatomy and Embryology. Vikas PublishingHouse.
- Roy P. 2016. Plant Anatomy. New Central BookAgency.
- Rudall P. 2007. Anatomy of Flowering Plants. Edition 3, Cambridge UniversityPress.

SEMESTER:2

COURSE CODE: BOT2IB02

COURSE TITLE: MICROBIOLOGY, MYCOLOGY, & PLANT PATHOLOGY

Microbiology

1. Introduction to Microbiology (1hr)
2. Bacteria –Classification based on morphology and staining, ultra structure of bacteria; Bacterial growth, Nutrition, Reproduction. (5 hrs)
3. Viruses – Classification, architecture and multiplication; Bacteriophages, TMV, Retroviruses HIV, Viroids, Prions. (3 hrs)
4. Microbial ecology – Rhizosphere and Phyllosphere. (1 hr)
5. Industrial microbiology –alcohol, acids, milk products single cell proteins (1 hr)
6. Economic importance of bacteria, Vaccines: importance, mechanism. (1 hr)

PRACTICAL (MICROBIOLOGY)

1. Simple staining
2. Gram staining – Curd, root-nodules
3. Culture and isolation of bacteria using nutrient agar medium (demonstration only)

REFERENCES:

- Adams, M R & Moss, M.O. Food Microbiology. New Age International Publishing Ltd., NewDelhi.
- Brock, T. D. Biology of Microorganisms. PrenticeHall.
- Campbell, R. Microbiology. ELBS-Edward Arnold,London.
- Carpemter, P.L. Microbiology. W.B. Sunders &Company,Philadelphia.
- Dubey, R.C. & Maheswari, D.K. A text book of Microbiology. S.Chand.
- Desikachary. Cyanophyta-Monograph
- Goodfellow, M. et.al. The Biology of Actinomyçetes. Academicpress.
- Kumar, H.D. & Swati Kumar. Modern Concepts ofMicrobiology.
- Mathew, R.E.F. Plant Virology, Academicpress.
- Pelozar, M.J., Chan, E.C.S. & Krieg, N.R. Microbiology. Tata Mc GrawHill.
- Sharma, P.D. Microbiology & Plant Pathology. Rastogi Publishers,Meerut.

MYCOLOGY

1. General characters and phylogeny of the kingdom Fungi, the concept of anamorph and teleomorph. (2 hrs)
2. General characters, distribution, and biology of the following groups of fungi (8 hrs)

a) Mastigomycotina. Type: *Pythium*

b) Zygomycotina. Type: *Rhizopus*

c) Ascomycotina. Type:, *Xylaria, Aspergillus*

d) Basidiomycotina. Types: *Agaricus, Puccinia*

3. Economic importance of fungi: medicinal, industrial, agricultural. Fungi as model organisms for research. (1 hr)
4. Ecological importance of fungi: different modes of nutrition (pathogenic/parasitic, saprobic, symbiotic) (1 hr)

PRACTICAL (MYCOLOGY)

1. Micropreparation – Lactophenol cotton blue – Slides of the above mentioned types.

REFERENCES (MYCOLOGY)

- Alexopoulos C.J., Mims, C.W. and Blackwell, M. (1996) Introductory Mycology, 4th Edn. John Wiley and Sons, New York.
- Alexopoulos, C.J. and Mims C.W. (1979) Introductory Mycology, 3rd Edition, John Wiley and Sons, New York. 33 3. Jim Deacon (2007) Fungal Biology, 4th edition, Black
- Jim Deacon (2007) Fungal Biology, 4th edition, Blackwell publishing, Ane Books Pvt Ltd
- Mehrotra R.S. and Aneja K.R. (1990) An Introduction to Mycology, Wiley, Eastern Limited, New Delhi.
- Sethi, I.K. and Walia, S.K. (2011) Text book of Fungi and their Allies, Macmillan Publishers India Ltd.

Plant Pathology(12 hr)

1. Principles of Plant Pathology- Causal agents of plant diseases - Biotic causes (fungi, bacteria, virus, mycoplasma, nematodes, angiospermic parasites. Abiotic causes (nutrient and mineral deficiencies, effect of pollution). Koch's postulates. Latrogenic diseases. Seed pathology.
2. Details of different symptoms of plant diseases.
3. Process of infection- mechanical, physiological and enzymatic action. Penetration and entry of pathogens in to host tissue.
4. Host- parasite interaction. Enzymes and toxins in pathogenesis. Defense mechanisms in plants (structural and biochemical).
5. Details of different ways of spread and transmission of plant diseases- wind and water-mediated, seed borne and vector-borne.
6. Plant disease management- exclusion, eradication and protection. Different pesticides and fungicides and their application. Biocides in plant protection.
7. Study of the following diseases with reference to the symptoms, causal organisms, disease cycle and control measures:
8. Bunchy top of banana, Citrus canker, Blast disease of paddy, Mosaic disease of tapioca, Bacterial blight of paddy, Bud rot of coconut, Mahali of Arecanut, Powdery mildew of rubber, Abnormal leaf fall of rubber, tikka disease of Ground nut, Late blight of potato, Blister blight of tea, wheat rust, coffee rust, grey leaf spot of coconut, Quick wilt of pepper, rhizome rot of ginger and turmeric,

angiospermic parasites-*Viscum*, *Dendropthoe*.

PRACTICAL (PLANT PATHOLOGY)

Identification of the disease, pathogen, symptoms and control measures of the following:

(drawing not required)

a. Citrus canker
b. Mahali disease
c. Tapioca mosaic disease
d. Blast of Paddy
e. Quick wilt of pepper
f. Bunchy top of banana
g. Grey leaf spot of coconut

SUBMISSION (PLANT PATHOLOGY)

Students are expected to submit five properly identified Pathology specimens /herbarium during the practical examination of Paper-I held at the end of 4th semester. Diseases mentioned in the syllabus or any locally available common diseases of crop plants can be selected for submission.

REFERENCES

- Agrios, G.N. Plant pathology. 4th Ed., AcademicPress.
- Bilgrami, K.H. & Dube, H C. A Text Book of Modem Plant Pathology. Vikas Publishers, NewDelhi.
- Chaube, H.S. & Ramji Singh . |ntroductory Plant Pathology. lnternational Book Distributing Co.Lucknow.
- Gareth-Jones, D. Plant Pathology: Principles and Practice. Open UniversityPress.
- Horsfall J.G. & Cowling E. B. (Ed.). Plant Disease:An Advanced Treatise. AcademicPress.
- Lucas, J. A.. Plant Pathology and Plant pathogens.Blackwell.
- Manners, J.G. Principles of Plant Pathology. Cambridge UnivPress.
- Mehrotra, R.S. Plant Pathology. Tata Mc GrawHill.
- Pandey, B. P. Plant Pathology -pathogen and plant disease. S. Chand &Co.
- Pathak, V.N., Khatri, N.K. & Pathak, M. Fundamentals of Plant Pathology. Agro-biosIndia.
- Rangaswami, G. Diseases of Crop Plants of lndia. Prentice Halllndia.
- Tarr, S.A. J. The Principles of Plant Patholgy. WinchesterPress.
- Wheeler, H. Plant Pathogenesis. SpringerVerlag.
- Wood, R.K.S. Physiological Plant Pathology.Blackwell

SEMESTER 3

COURSE CODE: BOT3IB03

COURSE TITLE: PHYCOLOGY, LICHENOLOGY, BRYOLOGY& PTERIDOLOGY

1. Introduction, Range of thallus structure, pigments, reproduction (**1**hr.)
2. Life cycle, Classification of Algae proposed by FE Fritsch (1935). (**3**hr.)
3. General Features: Occurrence, thallus structure, reproduction, and life cycle of the types given below: (**18** hrs)

a. Chlorophyceae: *Chlorella*, *Volvox*, *Oedogonium*, *Chara*.
b. Xanthophyceae:*Vaucheria*.
c. Bacillariophyceae:*Pinnularia*.
d. Phaeophyceae:*Sargassum*.
e. Rhodophyceae:*Polysiphonia*.

4. Economic Importance: Algae as food, fodder, green manure, bio-fuels, pollution indicators, research tools, medicinal uses of algae, Commercial Products – carrageenin, agar-agar,alginates, diatomaceous earth. Harmful effects – water bloom, eutrophication, neurotoxins, parasitic algae. (**2** hr.)

PRACTICAL (PHYCOLOGY)

1. Identification of the vegetative and reproductive structures of the types studied.

REFERENCES (PHYCOLOGY)

- Anand, N. (1989) Culturing and cultivation of BGA. Handbook of Blue Green Algae. Bishen Sing Mahendra Pal Sing, Dehradun,Uttarakhand.
- Fritsch, F.E. (1935) The structure and reproduction of the algae. Vol. 1 and II, Cambridge UniversityPress.
- Kanika Sharma (2007) Manual of Microbiology. Tools and Techniques 2nd Edition. Ane BooksIndia.
- Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press,Delhi
- Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4thedition
- Mamatha Rao. (2009) Microbes and Non flowering plants: impact and application.Ane Books Pvt. Ltd., NewDelhi.
- Morris, I. (1967) An Introduction to the algae. Hutchinson and Co.London.
- Papenfuss, G.F. (1955) Classification ofAlgae.
- Prescott, L.M., Harley J.P., Klein D. A. (2005). Microbiology, McGraw Hill, India. 6th edition.
- Rober Edward Lee (2008) Phycology. Cambridge University Press India Pvt. Ltd. Ansari Road, NewDelhi
- Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization.Aravali International, NewDelhi.
- Van Den Hoek, D.G. Mann and H.M. JaHns (2009) Cambridge University Press India Pvt. Ltd. Ansari Road, NewDelhi.

LICHENOLOGY: (1 hr.)

General account and systematics of lichens, thallus structure, reproductive bodies, ecological significance (As Ecological indicators, Pollution indicators, Lichen in Soil formation and pioneers of Xerosere) and economic importance of lichens.

Type of Interaction between the components symbiosis – mutualism.

PRACTICAL (LICHENOLOGY)

1. Identification of different forms of Lichens.
2. *Usnea*: structure of thallus, fruiting body

BRYOLOGY

1. Introduction, general characters and classification by Stotler & Stotler (2008) (**2**hrs)
2. Study the distribution, morphology, anatomy, reproduction, life cycle and affinities of the following types (**6** hrs)

a. *Riccia*(Marchantiophyta)
b. *Anthoceros* (Anthocerotophyta)
c. *Funaria*(Bryophyta)

3. Economic importance of Bryophytes (½hr)
4. Fossil Bryophytes (½hr)

PRACTICAL (BRYOLOGY)

1. *Riccia* – Habit, Anatomy of thallus, V.S. of thallus through antheridium, archegonium and sporophyte.
2. *Anthoceros*- Habit, Anatomy of thallus. V.S. of thallus through antheridium, archegonium and sporophyte.
3. *Bryum* (due to non-availability of *Funaria* at lower altitudes) - Habit, structure ofantheridial cluster, archegonial cluster, L.S. of sporophyte.

REFERENCES (BRYOLOGY)

- AlainVanderpoorten and Bernard Goffinet (2009) Introduction to Bryophytes.Cambridge

UniversityPress.
- Campbell H.D. (1940) The Evolution of land plants (Embryophyta), Univ. Press,Stanford.
- Chopra R.N. and P.K. Kumar, (1988) Biology of Bryophytes. Wiley Eastern Ltd.New Delhi.
- Crandall-Stotler, B. and R. E. Stotler. (2008) In A. J. Shaw and B. Goffinet,Bryophyte Biology, Cambridge University Press (Revisededition).
- Gangulee Das and Dutta. (2007) College Botany Vol.1, Central Book Dept.Kolkatta.
- Gangulee, H.C. and Kar A.K. College Botany Vol. II, New Central BookAgency.
- Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. CentralBook Depot.Allahabad.
- Shaw. J.A. and Goffinet B. (2000) Bryophyte Biology, Cambridge UniversityPress.
- Smith G.M. (1938) Cryptogamic Botany Vol.II. Bryophytes and pteridophytes.McGraw Hill Book Company,London.
- Sporne K.R. (1967) The Morphology of Bryophytes. Hutchinson University Library, London.
- Vasishta B.R. Bryophyta. Revised edition. (2011). S. Chand and Co. NewDelhi.
- Watson E.V. (1971) the structure and life of Bryophytes. Hutchinson UniversityLibrary, London.

PTERIDOLOGY

1. Introduction, general characters and classification (Smith *et al*., 2008 – brief outlineonly). (**2** hrs)

2. Study the distribution, morphology, anatomy, reproduction, life cycle and affinities of the following types (Developmental details are not required) (**12**hrs)

a. *Psilotum*(Psilotopsida)

b. *Selaginella* (Lycopsida).

c. *Equisetum*(Equisetopsida)

d. *Pteris*(Polypodiopsida)

3. Apogamy and apospory in Pteridophytes; Stelar evolution in Pteridophytes; Heterospory and seed habit; Affinities of Pteridophytes; Economic importance of Pteridophytes. (**6** hrs)

PRACTICAL(PTERIDOLOGY)

1. *Psilotum*- habit, T.S. of stem, C.S. of synangium (slides only)
2. *Selaginella* – habit, T.S. of stem, T.S. of rhizophore, L. S. of strobilus
3. *Equisetum* - habit, T.S. of stem, L.S. of strobilus
4. *Pteris* - habit, T.S. of stem, C.S. of sporophyll

REFERENCES (PTERIDOLOGY)

- Bower, F.O. (1935) Primitive Land Plants – Cambridge,London.
- Chandra S. & Srivastava M. (2003) Pteridology in New Millenium, KhuwerAcademic Publishers.
- Eames, A.J. (1979) Morphology of Vascular Plants, Lower Group. Wiley International edition, NewDelhi.
- Parihar, N.S. (1977) Biology and Morphology of Pteridophytes, Central BookDepot, Allhabad.
- Rashid, A. (1976) An Introduction to Pteridopyta, Vikas publ. Co. NewDelhi.
- Ranker, T.A. & Haufler, C.H. (eds.) (2008) Biology and Evolution of Ferns and Lycophytes.Cambridege UniversityPress.
- Mehltreter, K., Walker, L.R. & Sharpe, J.M. (eds.) (2010) Fern Ecology.Cambridge UniversityPress.
- Smith, A.R., Pryer, K.M., Schuttpelz, E. Korall, P., Schnelder, H. and Wolf, P.G. (2006) P

Classification for extant ferns. Taxon 53:705-731.
- Smith, A.R., Pryer, K.M., Schuettpelz, E. (2008) Fern classification.*In*:
- T.A. Ranker and C.H. Haufler (eds.). Biology and Evolution of Ferns and Lycophytes.Cambridge University press,U.K.
- Smith G.M. (1938) Cryptogamic Botany Vol. II. Bryophytes and Pteridophytes. McGraw Hill Book Company,London.
- Sporne, K.R. (1967) Morphology of Pteridophytes – Hutchinson University Library,London.
- Vasishta B.R. (1993) Pteridophyta – S. Chand and Co., NewDelhi.

COURSE CODE: **BOT3IB04**

COURSE TITLE: METHODOLOGY AND PERSPECTIVES IN SCIENCE.

Module I (15 h) - Scientific methods and patents

1. Steps in scientific methods (2 h)
2. Structure of Research report, Style of citation, Biological Journals, Impact Factor, Sources of reference: Google Scholar, Shodhganga, NCBI, Inflibnet, e-pathshala (5 h)
3. Latest methods of presentation. (2 h)
4. Patents (6 h)

PRACTICALS (SCIENTIFICMETHODS)

1. Bibliography searches using online tools
2. Familiarizing latest methods of ICT based presentations

Module II (15 h) – Micro technique

1. Principles of microscopy and parts of microscopes (1 h.)
2. Types of microscopes: Light microscope, Compound microscope, Phase contrast microscope, Fluorescent microscope, Electron microscope: Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM) (6 h.)
3. Micrometry: Stage micrometer, Ocular micrometer, Calibration and working. (1 h)
4. Illustrations using digital camera and Photomicrography. (1 h)
5. General account of Killing and fixing, agents used for killing and fixing. Common fixatives – Formalin – Acetic – Alcohol, Carnoy's fluids I & II, Chromic acid – Acetic acid – Formation (CRAF) (1 h)
6. Dehydration and infiltration – general account of dehydration (Ethanol, Isopropyl alcohol, Acetone, Glycerine). Ethanol – Xylene series and Tertiary Butyl Alcohol Series. (1 h)
7. Infiltration: paraffin wax method, embedding. (1 h)
8. Free hand sectioning; Microtome (Rotary and sledge) serial sectioning and its significance. (1 h)
9. Staining – General account, Classification: natural dyes, coal-tar dyes. Double staining, Vital staining (1 h)
10. 6. Mounting, whole mounting, maceration and smears (1 h)

Module III (24 h) – Biophysical and biochemical techniques

1. pH and buffer solutions- hydrogen ion concentrations and pH, dissociation of acids and bases. Measurement of pH using organic indicator molecule and potentiometric method. Functions of buffers in a biological system. Use of buffers in biological and biochemical research. pH and life. Henderson and Hassel Balch equation.
2. Chromatography: Principles of chromatography. Types of chromatography.
3. Electrophoresis: Electrophoretic mobility, principles, PAGE, Agarose gel electrophoresis. Separation and detection of macromolecules by electrophoresis. Electrophoretic apparatus, technique and procedure.
4. Centrifugation - Theory of centrifugation. Centrifuge- Types, Methodology of centrifugation, applications.
5. Colorimetry and spectrophotometry: Beer-Lamberts law. Measurement of extinction. Calorimeters and spectrophotometers. Techniques and applications in biological and biochemical research. Comparison

between colorimetry and spectrophotometry.

6. Radiobiology: Autoradiography. Principles, types. Methods and applications in biological research.
7. Immunochemistry: immune response. Antigens- Antibodies. Histo-incompatibility antigens; Structure of IgG. Immunochemical assays-RIA, ELISA.
8. Cryobiology: Freeze drying (lyophilization)-application

REFERENCES

- P.G. Hewitt, J.A. Suchocki ISBN-10 0805 390385, Conceptual integrated science ISBN40139780805390384.
- R.G. Newton (1997) The truth of Science Physical theories and reality. Viva Books, New Delhi, II Edition.
- P.G. Hewitt, J.A. Suchocki ISBN-10 0805 390385, Conceptual integrated scienceISBN40
- 139780805390384.
- R.G. Newton (1997) The truth of Science Physical theories and reality. Viva Books, New Delhi, II Edition.
- Chandal S.R.S. A Handbook of Agricultural Statistics. Achal Prakashan Mandir, Kanpur,India.
- Das M.N. and N.C. Giri. Designs and Analysis of Experiments. Wiley EasternLtd.
- Elhance and Elhance. Fundamentals of Mathematical Statistics. Kithab Mahal, New Delhi,lndia.
- Gupta S.K and V.K. Kapoor. Fundamentals of Mathematical Statistics. Sultan Chand & Sons, New Delhi.
- Gupta C.B. An Introduction to Statistical Methods. Vikas Publishing House Pvt.Ltd.
- Kempthrone,O. An ntroduction to Genetic statistics. John Wiley and Sons lnc. NewYork.
- Mather K. and J.L. Links. Biometrical Genetics. Chapman and Hall,London.
- Panse, V.G and P.. Sukatme. Statistical Methods for Agricultural Workers. ICAR, NewDelhi.
- Rao C.A. Advanced Statistical Methods in Biometrical Research. Wiley and Sons, NewYork.
- Singh P. and S.S. Narayanan. Biometrical Techniques in Plant Breeding. Kalyani Publishers, New Delhi.
- Singh R.K. and Chaudhary B.D. Biometrical Methods in Quantitative Genetic Analysis.Kalyani Publishers,NewDelhi.
- Daniel W.W. Biostatistics- A foundation for Analysis in HealthSciences
- Hoppe, W. (Ed.). Biophysics. SpringerVerlag.
- Rogers,A.W. Techniques of Autoradiography.Elsevier.
- Roy, R.N. A Text Book of Biophysics. New Central Book Agency Pvt. Ltd,Calcutta.
- Sasidharan, A. Selected Topics of Biophysics. Frontier AreaPublishers.
- Slayter, E.M. Optical methods in Biology. WileyIntersciences.
- Wong, C.H. Radiation Tracer Methodology in Biophysical Sciences. PrenticeHall.
- Plummer, D. An introduction to Practical Biochemistry. Tata Mc Graw Hill, NewDelhi

COURSE CODE: **BOT3IB05**

COURSE TITLE: GYMNOSPERMS, PALAEOBOTANY, PHYTOGEOGRAPHY AND EVOLUTION

GYMNOSPERMS

1. Introduction, General characters and classification of Gymnosperms (Sporne, 1965) (**1**hr)
2. Distribution, morphology, anatomy, reproduction, life cycle and affinities of the following types (Developmental details not required): *Cycas, Pinus* and *Gnetum* (**6**hrs)
3. Evolutionary trends in Gymnosperms; Affinities of Gymnosperms with Pteridophytes

and Angiosperms (**1**hr.)

4. Economic importance of Gymnosperms. (**1**hr.)

PRACTICAL (GYMNOSPERMS)

1. *Cycas*- Habit, coralloid root, T.S. of coralloid root, T.S. of leaflet, T.S. of rachis, male cone and L.S. of male cone , microsporophyll, megasporophyll, T.S. of microsporophyll, L.S. of ovule and seed.

2. *Pinus*- branch of unlimited growth, spur shoot, T.S. of stem and needle, male cone and female cone, L.S. of male cone and female cone, seed.

3. *Gnetum*- Habit, stem T.S., leaf T.S., male and female cones, L.S. of ovule, seed.

REFERENCES (GYMNOSPERMS)

- Chamberlain C.J. (1935) Gymnosperms –Structure and Evolution, Chicago UniversityPress.
- Coutler J.M. and C.J. Chamberlain, (1958) Morphology of Gymnosperms. Central Book Depot,Allahabd.
- Sporne K.R. (1967) The Morphology of Gymnosperms, Hutchinson and Co. Ltd.London.
- Sreevastava H.N. (1980) A Text Book of Gymnosperms. S. Chand and Co. Ltd., NewDelhi.
- Vasishta P.C. (1980) Gymnosperms. S. Chand and Co., Ltd., NewDelhi.

PALAEOBOTANY

1. Introduction and objectives (½hr)
2. Fossil formation and types of fossils (**1**hr)
3. Geological time scale- sequence of plants in geological time (**2**hrs)
4. Fossil Pteridophytes- *Rhynia*, *Lepidodendron* and *Calamites* (**2**hrs)
5. Fossil gymnosperms- *Williamsonia* (**1**hr)
6. Important Indian Paleobotanical Institutes. (**1**hr)
7. Indian Palaeobotanists: Birbal Sahni and Savithri Sahni (**1**hr)
8. Applied aspects of Palaeobotany- exploration of fossil fuels (½hr)

PRACTICAL (PALAEOBOTANY)

1 Fossil Pteridophytes - *Rhynia* stem, *Lepidodendron* and *Calamites*

2 Fossil gymnosperms-*Williamsonia*

(Drawings may be replaced by photos with critical notes in the record)

REFERENCES (PALAEOBOTANY)

- Andrews H.N. (1961) Studies in Paleobotany. John Wiley and Sons Inc., NewYork.
- Arnold C.A. (1947) Introduction to Paleobotany, Tata McGraw Hill, NewDelhi.
- Shukla, A.C. & S.P. Misra, (1975) Essential of Palaeobotany, Vikas Publishing House, Pvt. Ltd., Delhi.
- Sreevastava H.N., (1998) Palaeobotany, Pradeep Publishing Company,Jalandhar.
- Taylor, T.N. Paleobotany. An Introduction to Fossil Plant Biology. Mc Graw Hill, NewYork.
- Steward A.C. (1935) Fossil Plants Vol. I to IV. Watson J. An introduction to study of fossil plants. Adams and Charles Black Ltd.London.

PHYTOGEOGRAPHY

1. Definition, concept, scope and significance of phytogeography. (**2**hrs.)

2. Patterns of plant distribution - continuous distribution and discontinuous distribution, vicarism, migration and extinction (**3**hrs.)

3. Continental drift -Evidences and impact. (**3**hrs.)

4. Glaciation: Causes and consequences. (**2**hrs)
5. Theory of land bridges. (**2**hrs)
6. Endemic distribution, theories on endemism, age and area hypothesis. (**3**hrs.)
7. Phytogeographical zones (phytochoria) of India. (**3**hrs.)

PRACTICAL (PHYTOGEOGRAPHY)

1 Mark the phytogeographic zones of India.

REFERENCES (PHYTOGEOGRAPHY)

1. Ronald Good, (1947) The Geography of Flowering Plants. Longmans, Green and Co,New York
2. Armen Takhtajan, (1986) Floristic Regions of the World. (translated by T.J. Crovello & A. Cronquist). University of California Press,Berkeley.
3. P. D. Sharma, (2009) Ecology and Environment, Rastogi Publications,Meerut

EVOLUTION

1. Theories on Origin of Universe, Earth and Origin of life. Condensation and Polymerization; Proteinoids and Prions – Oparin's concept; Miller's experiment. (**3**hrs)
2. Evolution of prokaryotic and eukaryotic cells, archaebacteria, early fossilized cells. (**2** hrs)
3. Theories on origin and evolution of species: Darwinism; Neo-Darwinism and itsobjection; Arguments and support for Darwinism, Modern concept of evolution. (**3**hrs.)
4. Evidences of organic evolution from Morphology, Anatomy, Embryology, Palynology, Genetics and Molecular Biology. (**3**hrs.)
5. Genetic Constancy and Creation of Variability: Cell divisions and genetic constancy; Genetic variability by recombination, Chromosomal variations, Gene mutations, Selection and genetic drift. (**4**hrs.)
6. Speciation: Isolating mechanism, Modes of speciation: sympatric and allopatric (**3**hrs.)

REFERENCES (EVOLUTION)

- Crick F. (1981) Life itself: Its origin and Nature. Simon and Schuster, NewYork.
- Drake J.W. (1970) The molecular basis of mutation. Holden – Day – SanFrancisco.
- Dott R.H. R.L. Batten, (1981) Evolution of the earth 3rd edn. McGraw Hill NewYork.
- Fox S.W. and Dose, K. (1972) Molecular evolution and the origin of life. W.H. Freeman & Co., San Francisco.
- Gould S.J. (1977) Ontogeny and Phylogeny. Harvard Univ. Press,
- Cambridge,Mass. Jardine N., D. Mc Kenzie (1972) Continental drift and the dispersal and evolutionof organisms. Nature, 234.20-24.
- Miller, S.L. (1953) A production of aminoacids under possible primitive earthconditions. Science, 117: 528-529.
- Strickberger, (1990) Evolution, Jones and Bastlett Publishers International,England.

SEMESTER-4

COURSE CODE: **BOT4IB06**

CORE COURSE: BIOTECHNOLOGY AND BIOINFORMATICS

BIOTECHNOLOGY Module –I (11hr.)

1. Introduction, concept, history of biotechnology
2. Plant gene structure and expression; Regulation of structure and expression,
3. Regulation of plant gene expression, Protein coding genes, Translational control, RNA

coding genes.

4. Gene Transfer to plants; Target plant cells for transformation, Transformation approaches, Agrobacterium-mediated genetic transformation of plants, Molecular mechanism of T-DNA transfer, Vector based the Ti plasmid, Protocol for Agrobacterium-mediated genetic transformation of plants.

5. Direct genetic transformation of DNA into protoplasts; Biolistic process (particle Bombardment mediated), Transformation of protoplast by electroporation, microinjection, macroinjection and microprojectiles; Virus vectors for gene transfer to plants)

Module II(8 hr.)

6. Crop improvement through gene transfer technology; Projectiles of transformed plants; Plant variety improvement: addition of useful trait; Genetic mapping and gene cloning.

7. Developing resistance in crops; Herbicide resistance, Insect resistance, Virus resistance, Fungal pathogen resistance, Bacteria resistance, Nematode resistance, Parasite resistance.

8. Engineering the plant cell factory for secondary metabolite production; Oligopeptides and proteins, sugar polymers, alkaloides and phenolics, degradable polymers-.

9. Uses and applications of transgenic plants; New products, Pharmaceuticals, human growth hormone and Forensics - DNA fingerprinting.

10. Plant quality and protection, Edible vaccines, Antiviral proteins(PAP), Antigens antibodies

11. Bio risks of producing transgenic plant; Bio-safety and product labeling, Trade secrecy and material transfer agreements patenting of plant varieties.

12. Environmental Biotechnology: Cleaner technologies- Fermentation, Paper and Plastic industries. Bioremediation. Bio flocculation. Biosensors. Biochips. Bio fertilizers significance. Biological Nitrogen Fixation-*nif* genes- structure, transfer prospects.

Nitrogenase biochemistry, function

13. Medicine - Production of human insulin, Forensics - DNA finger printing

14. Industry- Horticulture and Floriculture Industry, production of vitamins, amino acids and alcohol.

15. Agriculture -Genetically modified crops –Bt crops, Golden rice, Flavr Savr Tomato, Virus, herbicide resistant crops, Edible vaccines

PRACTICAL (BIOTECHNOLOGY)

1. Study of genetic engineering tools and techniques using photographs/diagram (Southern blotting, DNA finger printing, PCR).

BIOINFORMATICS

A. Computer application.(8hr.)

1. Computer in Science with special reference to biology, the scope and prospects.
Information super highway (internet)- Information net works: internet, World Wide Web. Web browsers, HTTP, HTML and URLs. Biological networks.

2. Online publications with special reference to biology, -electronic journals, books, downloading and uploading.)- Open Archive Initiative (www.openarchives.org), biomed central, PubMed central, freedom of scientific information access, e-access debate- concepts and implications, Free Software Movement, Free Software Foundation, GNU/Linux, etc. Online archives, databases, the Public Library of Science (www.publiclibraryofscience.org**).**

REFERENCES

- Online resources freely available at internet sites such
- as www. publiclibraryofscience.org
- www.openarchives.org
- www. pubmedcentral.gov
- www. biomedcentral.com

- www.nature.com/nature/debates/e-ccess/index.html

B. Bioinformatics

Module 1(8hr)

1. Introduction: importance and scope.

2. Biological Databases

a. Nucleic acid databases: EMBL, GenBank- structure of GenBank entries. Specialized genomic resources, UniGene.

b. Protein sequence databases: PIR, SWISS-PROT,

TrEMBL Composite protein databases: NRDB, OWL.

Secondary databases: PROSITE, PRINTS, BLOCKS, IDENTIFY.

Structure classification databases- SCOP, CATH.

Module II(10hr)

3. Database searching

a. Sequence database searching. EST searches. Different approaches to EST analysis. Merck/lMAGE, lncyte, TIGR. EST analytical tools. Sequence similarity, sequence assembly and sequence clustering.

b. Pair wise alignment technique: Comparison of sequences and sub-sequences. Identity and similarity. Substitution matrices, BLOSUM, DOTPLOT and BLAST.

c. Multiple alignment technique: Objective, Manual, simultaneous and progressive methods. Databases of multiple alignments. PSI-BLAST, CLUSTAL-W.

module III (9hr)

4. Protein structure Prediction:

a. Secondary structure prediction. Chou-Fasman, JPred.

b. Tertiary structure prediction: Comparative modelling -Modeller, RasMol.

5. Emerging areas of Bioinformatics: DNA Microarrays, functional genomics, comparative genomics, pharmacogenomics, chemo informatics, Medical informatics**.**

PRACTICALS

1. Acquisition of basic skills in Internet browsing
2. Use of web browsers and search engines.
3. Use of biological and bioinformatics websites Agris, Agricola, BIOSI S, CABWeb.
4. Visit to Bioinformatics websites: NCBI, SWISS PROT, PIR,PDB.

REFERENCES

- Attwood T.K. and D.J. Arry-smith. lntroduction to Bioinformatics. PearsonEducation.
- Sundararajan S. and R. Balaji, introduction to Bioinformatics. Himalaya PublishingHouse

COURSE CODE: **BOT4IB07**

COURSE TITLE: TISSUE CULTURE, HORTICULTURE, ECONOMIC BOTANY &ETHNOBOTANY

TISSUECULTURE

Module-1 (**12** hrs.)

1. Plant tissue culture – Principles and techniques; Cellular totipotency; *in vitro* differentiation – de differentiation and re-differentiation. (**2**hrs.)

2. Tissue culture medium – Basic components in tissue culture medium – Solid andliquid medium; Murashige and Skoog medium – composition and preparation. (**2**hrs.)

3. Aseptic techniques in *in vitro* culture – sterilization – different methods – sterilizationof instruments and glassware, medium, explants; working principle of laminar air flow and autoclave. (**2**hrs)

4. Preparation of explants– surface sterilization, inoculation, incubation, sub culturing. (**2**hrs.)

5. Micro propagation - Different methods – apical, axillary bud proliferation, directand indirect organogenesis and somatic embryogenesis. (**2**hrs.)

6. Different phases of micro propagation – multiple shoot induction, shoot elongation, *in vitro* and *in vivo* rooting hardening, transplantation and field evaluation; advantages and disadvantages of micro propagation, soma clonal variation. (**2**hrs.)

Module – II (8 hrs.)

1. Methods and Applications of tissue culture:

1. Shoot tip and meristem culture.
2. Somatic embryogenesis and synthetic seed production.
3. Embryo culture.
4. Protoplast isolation culture and regeneration: transformation and transgenics
5. Somatic cell hybridization, cybridization.
6. *In vitro* secondary metabolite production: cell immobilization, bioreactors
7. *In vitro* production of haploids – anther and pollen culture
8. *In vitro* preservation of germplasm

PRACTICAL (TISSUE CULTURE)

1. Preparation of nutrient medium – Murashige and Skoog medium using stock solutions.
2. Familiarize the technique of preparation of explants, surface sterilization, inoculation and subculturing.
3. Preparation of synthetic seeds.
4. Demonstration of anther culture.

REFERENCES (TISSUE CULTURE)

- Gamborg, O.L. & G.C. Philips (Eds.) (1995). Plant Cell, Tissue and OrganCulture: Fundamental Methods. Narosa Publishing House, NewDelhi.
- Razdan MK (1995) Introduction to Plant Tissue Culture. Oxford & IBH publishing Co. Pvt.Ltd.
- Reinert & Bajaj. Plant Cell, Tissue and OrganCulture.
- Edwin F. George, Michael A. Hall and Geert-Jan De Klerk. (2008) Plant propagationbytissue culture Volume 1. The Background. Springer, P.O. Box 17, 3300 AADordrecht.
- Madhavi Adhav (2010) Practical book of Biotechnology and Plant Tissue culture, SChand,
- NewDelhi.
- Bhojwani, San Saran, Danu, Prem Kumar (2013) Tissue Culture : An Introductory Text. Springer.

HORTICULTURE

Module - I. **(5 hrs)**

1. Introduction, scope and significance; branches of horticulture. (**1**hr)

2. Soil- components of soil, types of soil. (**1**hr.)

3. Fertilizers – Chemical, organic, bio fertilizer, compost. (**1**hr.)

4. Pots & potting – earthen, fiber, polythene bags, potting mixture, potting, repotting, top dressing. (**1**hr.)

5. Irrigation – Surface, sprinkle, drip and gravity irrigation. (**1**hr.)

Module – II (7 hrs.)

1. Seed propagation –seed quality tests, seed treatment, essential condition for successful propagation: raising of seed beds, transplanting techniques. (**3**hrs.)

2. Vegetative propagation: (**4**hrs.)

1. Cutting (stem, roots)
2. Grafting (approach, cleft)

3. Budding (T-budding, patch)
4. Layering (simple, air).

Module - III.(6 hrs.)

1. Gardening – site selection; propagating structure: green house, poly house, moist chamber, net frame – Garden tools and implements. (**1**hr.)
2. Indoor gardening – selection of indoor plants, care and maintenance of indoor plants, Bonsai – Principle, creating the bonsai. (**1**hr.)
3. Outdoor gardening; landscaping- goals, types. (**1**hr.)
4. Cultivation and post-harvest management of vegetables and ornamental plants. (**1**hr.)
5. Protection of horticultural plants: Precautions to avoid pests and diseases, bio pesticides. (**1** hr.)
6. Mushroom cultivation – Oyster mushroom (**1**hr.)

PRACTICAL (HORTICULTURE)

1. Preparation of nursery bed and polybag filling.
2. Preparation of potting mixture – Potting, repotting.
3. Field work in cutting, grafting, budding, layering **(**drawing not required).
4. Familiarizing gardening tools and implements. (drawing not required)
5. Establishment of vegetable garden/ Visit to a horticulture station.
6. A brief report of item no. 5 may be recorded.

REFERENCES (HORTICULTURE)

- Andiance and Brison. (1971). Propagation HorticulturalPlants.
- Chanda, K.L. and Choudhury, B. Ornamental Horticulture inIndia.
- George Acquaah, (2005) Horticulture: Principles and Practices. Pearson Education, Delhi.
- Hudson, T. Hartmann, Dale K. Kester, Fred T. Davies, Robert L. Geneve,Plant Propagation, Principles andPractices.
- Katyal, S.C., Vegetable growing in India, Oxford, NewYork.
- Kolay, A.K. Basic Concepts of Soil Science. New Age International Publishers,Delhi.
- Naik, K.C., South Indian Fruits and theirCulture.
- Nishi Sinha: Gardening in India, Abhinav Publications, NewDelhi.
- Prakash, R and K. Raj Mohan, Jaivakrishi (Organic farming), State Institute of Languages, Thiruvananthapuram.
- Prasad, S., and U. Kumar. Green house Management for Horticultural Crops, Agrobios, Jodhpur.

ECONOMIC BOTANY

Study the different category of economically important plants their Binomial, Family and Morphology of useful part, products and uses: (**9** hr.)

1. Cereals and Millets – Rice, Wheat, Maize and Ragi
2. Pulses and legumes – Green gram, Bengal gram, Black gram
3. Sugar – Sugarcane
4. Fruits – Apple, Pine Apple, Papaya, Banana, Mango, Guava, Jack, Grapes, Sapota
5. Vegetables – Carrot, Beet Root, Corm, Potato, bitter gourd, Cucumber, Snake gourd, Ladies finger, Cabbage, *Amaranthus*
6. Ornamentals – Rose, *Anthurium*,Jasmine
7. Masticatories – Betel vine, Betel nut, Tobacco
8. Beverages – Coffee, Tea,Cocoa
9. Fibre – Coir, Cotton,Jute
10. Timber – Teak, Rose wood, Jack, *Ailanthus*.
11. Fats and oils – Coconut, Gingelly, Sunflower

12. Latex –Rubber
13. Gums and Resins – Dammar, Gum Arabic, Asafoetida
14. Spices – Pepper, Ginger, Cardamom, Clove, Nutmeg, Allspice, Cinnamon
15. Medicinal – *Adhatoda, Catharanthus, Phyllanthus, Rauvolfia, Aloe*

PRACTICAL (ECONOMIC BOTANY)

1. Students shall be able to identify plants or plant products (raw or processed) studied in theory and shall be able to write Botanical names, Family and morphology of useful parts of source plants.

Students need not make any illustrations but make a table in the record giving the details of the items mentioned in the theory syllabus.

REFERENCES (ECONOMIC BOTANY)

- Bendre Kumar 2000: Economic Botany' Rastogi Publications, Shivaji road, Meerut.
- Jain. S. K. 1981. Glimpses of Indian Economic Botany.Oxford.
- Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4thedition.

ETHNOBOTANY

1. Introduction, scope and significance (**1**hr.)
2. Major tribes of South India. Importance of Traditional Botanical Knowledge, TBGRI model of Benefit Sharing. (**2** hrs.)
3. Ethnobotanical significance of the following: (**6**hrs.)

1. Aegle marmelos
2. Ficus religiosa
3. Curcuma longa
4. Cynadon dactylon
5. Ocimum sanctum
6. Trichopus zeylanicus

PRACTICAL (ETHNOBOTANY)

Students are expected to identify the plants mentioned in the Ethnobotany syllabus and it must be given as a table showing Common name, Binomial, Family and Ethnobotanical significance in the record book. (Drawing not required)

REFERENCES (ETHNOBOTANY)

- Baker. H.G. (1970) Plant and Civilization.
- Jain. S. K. (1995). A Manual of Ethnobotany. Scientific Publishers,Jodhpur.
- Cotton, C.M. (1996) Ethnobotany – Principles and Applications. Wiley andSons

COURSE CODE: **BOT4IB08**

COURSE TITLE: BASIC MATHEMATICS IN BIOLOGICAL SCIENCES

Module I (9 h)

Introductory concepts and Scilab: Review of basic mathematics: Co-ordinate geometry, equations of line, circle and sphere; Trigonometric functions, graphs of functions, types of functions: linear functions, Inverse Functions, Exponentials and logs; Graphical solution of equations of the form f(x) = 0. Scilab, Basic environment, data types, variables, operators, programming, built-in function and user defined function.

Module II (9 h)

Vectors and Matrices: Vectors & Matrices: Scalars & Vectors, addition, subtraction, dot, cross & scalar triple products; Matrices: types, addition, subtraction, multiplication, transpose & inverse (general idea only), determinants, solutions of simultaneous equations using matrices.

Module III (9 h)
Set theory: permutation, combination: Set theory, sets, elements, set operation, finite &countable sets, counting, factorial, permutation, combination, binomial coefficients.

Module IV (18 h) - Biostatistics

- The science of statistics and its applications in biological research.
- Types and collection of data- Census; Sampling- theory and methods.
- Tabulation and presentation of data- diagrammatic and graphic presentation.
- Analysis of data- measures of central tendency: mean, median, mode, geometric mean, harmonic mean, and percentile.
- Measures of dispersion - Range, quartile deviation, mean deviation, standard deviation and standard error. Relative measures of dispersion - coefficient of variation.
- Probability and Statistics: Basic concepts; sample space & events, laws of probability, conditional probability: Baye's theorem, Random variables: probability distribution, binomial, Poisson, normal etc.; Sampling; Markov's processes.
- Tests of significance- formulation and testing of hypothesis- testing the probability of committing type 1 and type 2 errors. z test, t test, chi-square test and ANOVA

Module V (9 h) – Applied Statistics

- Scope of statistical methods
- Analysis of variance- one way classification and two way classification, F test, F value calculation, F table.
- Correlation and Regression analysis- coefficient of correlation- significance testing. Rank correlation.
- Experimental designs- designing an experiment- CRD, RBD, LSD. Factorial experiments.
- Statistical softwares- SPSS, SPAR, MINITAB

REFERENCES:

- Aitken, M., Broadhurst, B., & Hladky, S. (2008). Mathematics for biological scientists. New York [etc.]: Garland Science [etc.].
- Isaev, A. (2006). Introduction to mathematical methods in bioinformatics.Springer.
- Lipschutz, S., & Schiller, J. J. (1998). Schaum's Outline of Theory and Problems of Introduc-tion to probability and statistics.McGraw-Hill.
- Olive, J. (2000). Maths: A Self-study Guide. Cambridge UniversityPress.
- Ramachandran, H., Nair, A.S. (2012). (Scilab: Free Software to Matlab). S. ChandLimited.
- Russell, B. (1903). The principles of mathematics (Vol. 1, p. 173). Cambridge, UP:Cam-bridge.
- Stewart, J. (2008). Calculus Early Transcendentals, 6e. Bob Pirtle, Belmont, CA 94002USA,883-
- 886. Sundar Rao, P. S. S., & Richard, J. (1996). An introduction to biostatistics. New Delhi. Prentice-Hall India, 19,135-52.

SEMESTER 5

COURSE CODE: BOT5IB10

COURSE TITLE:**ANGIOSPERM MORPHOLOGY AND**

SYSTEMATICS PART1

ANGIOSPEM MORPHOLOGY

1. Technical description of a flowering plant (brief) (**2**hr.)

2. Inflorescence: racemose, cymose and specialised (cyathium, hypanthodium, coenanthium, verticillaster, thyrsus) (**3**hr.)

3. Flower: Flower as a modified shoot, detailed structure of flowers, floral parts –their arrangement, relative position, cohesion and adhesion - symmetry of flowers. (**4**hr.)

4. Fruits– simple, aggregate and multiple with examples; Seed structure - dicot and monocot - albuminous and ex-albuminous, aril, caruncle; Dispersal of fruits and seeds - types and adaptations. (**5**hr.)

PRACTICAL (ANGIOSPEM MORPHOLOGY)

1. Identify the types of inflorescence and fruits mentioned in the syllabus.

2. All the types mentioned under inflorescence and fruits must be represented in the photoalbum.(All drawings in records are replaced by photo album submission).

REFERENCES (ANGIOSPEM MORPHOLOGY)

- Gangulee, H.C., J.S. Das & C. Dutta. (1982) College Botany (5th Ed.) New CentralBook
- Agency,Kolkata.
- George, H.M. Lawrence. (1951) Introduction to Plant Taxonomy. Mac Millan comp.Ltd.,
- NewYork.
- Simpson, M. G. (2006) Plant Systematics. Elsevier Academic Press,London
- Sporne, K.R. (1974) Morphology of Angiosperms. Hutchinson University Press,London.

SYSTEMATICS

Module-I (**7**hr.)

1. Components of systematics: identification, description nomenclature and classification; objectives and importance of systematics (**2**hr.)

2. Systems of classification: Artificial– Linnaeus; Natural– Bentham and Hooker; Phylogenetic – Hutchinson; Angiosperm Phylogeny Group system (**4**hr.)

Module – II (**12**hr.)

1. Detailed study (systematic position, distribution, common members, diagnostic features, description from habit to fruit and economic importance of the following families. Annonaceae, Malvaceae, Meliaceae, Fabaceae with sub families, Myrtaceae, Cucurbitaceae, Rubiaceae, Asteraceae, Apocynaceae, Solanaceae, Acanthaceae, Lamiaceae, Euphorbiaceae, Liliaceae, Orchidaceae and Poaceae.

Module- III (**9** hr.)

1. Taxonomic structure: Hierarchy; Concepts of taxa; Species: Biological, Phenetic and Phylogenetic; Genus; Family. (**2**hr.)

2. Taxonomic character – concept, primitive and advanced characters, sources, comparative morphology, vegetative, reproductive, macro and micromorphology; modern trends in taxonomy, cytotaxonomy, chemotaxonomy, numerical taxonomy, molecular taxonomy and phylogenetics. (**4** hr.)

3. Contributions of eminent Taxonomists viz Hendrik van Rheede, William Roxburgh, Robert Wight, J. S. Gamble and EK Janaki Ammal. (**2**hr.)

Module – IV (1**2** hr.)

1. Plant Nomenclature – Limitations of common name, ICN - Principles (introduction only); Typification (holotype, isotype, syntype paratype and lectotype); Priority– merits and demerits; Effective and valid publication; Author citation. (**3**hr.)

2. Plant identification – Keys; indented and bracketed, construction and applications. (**2**hr.)

3. Taxonomic information resources – Herbarium preparation and maintenance, Herbarium types: International- Kew (K); National-Central national herbarium (CAL), MH Coimbatore,Virtual herbarium, Botanic Gardens: RBG, Kew; IGB, Kolkotta; JNTBGRI Thiruvananthapuram and MBGIPS, Kozhikode. (**4** hr.)

4. Taxonomic literature- Floras, e-Flora, Monographs, Revisions, Journals and online resources & Databases. (**3**hr.)

PRACTICAL (SYSEMATICS)

1. Students are expected to work out at least two members of each family mentioned in the syllabus and make suitable diagrams (floral diagram and floral formula not needed). Describe them in technical terms and identify up to species using the Flora. Orchidaceae may be excluded from practical examination scheme.
2. Students shall be able to prepare artificial key to segregate any five given plants.This must be recorded.
3. Familiarization of herbarium techniques (Demonstration only).
4. Mounting of a properly dried and pressed specimen of any common wild plant (rare, endangered or endemic plants should not be collected for the purpose) from any one of the families mentioned in the syllabus, with proper herbarium label (to be submitted in therecord book).
5. Every student shall submit original images of plants, at least one from each family mentioned in the syllabus, duly certified by Head of the department, at the time of examination. The images of plants should be properly identified and they should carry details like systematic position, GPS location, date, name and reg. no. of the student etc. Habitat, Habit,

Inflorescence and single flower should be represented. Web sourced and outsourced images should not be used. The images can be submitted along with the photo album containing images of inflorescence and fruits mentioned under morphology. Individuality should be strictly maintained while preparing the photo album.

6. It is compulsory that every student has to undertake field study trips of 3-5 days to study vegetation of ecologically different areas, under the guidance of teachers. Visits to standard Herbaria, Organizations/ Institutes involved in exploring plant resources, Botanical museums etc. may be conducted as part of study tour. Local habitats like sacred groves, rice fields, wetlands, forests, grasslands etc. also can be selected for field trips. Avoid visit to tourist places with meager plant diversity and of having only entertainment value. Submit a field visit report countersigned by the Head of the department during the practical examination.
7. If a student fails to undergo the study tour he /she may not be permitted to attendthe examination.

REFERENCES (SYSEMATICS)

- Bharati Bhattacharyya (2009) Systematic Botany, Narosa Publishing House Pvt. Ltd.,New Delhi.
- Burkill, I.H. (1965) Chapters on the History of Botany in India,Delhi.
- Clive A. Stace (1991) Plant Taxonomy and Biosystematics, Cambridge UniversityPress.
- Davis, P.H. & V.H. Heywood, (1963) Principles of Angiosperm Taxonomy. Oliver &Boyd Ltd., London.
- Gurucharan Singh (2012) Plant Systematics- Theory and Practice. Oxford & IBH, NewDelhi.
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- Jeffrey, C. (1968) An introduction to Plant Taxonomy, Cambridge University Press,London.
- Mondal A.K. (2009) Advanced Plant Taxonomy, New Central Book agency Pvt. Ltd. Kolkata.
- Nicholas J. Turland *e al*. (2018) International Code of Nomenclature for algae, fungi, and plants- Shenzhen Code (printed/ electronic version) Koeltz BotanicalBooks.
- Pandey, S.N. & S.P. Misra. (2008) Taxonomy of Angiosperms. Ane Books India,New Delhi.
- Radford, A.E. (1986) Fundamentals of Plant Systematics. Harper & Row Publishers, New York.
- Sambamurthy A.S.S. (2005) Taxonomy of Angiosperms, I.K. International Pvt. Ltd, New Delhi.
- Sharma, B.D. *et al*. (Eds.) (1996) Flora of India, Vol. I. Botanical Survey of India,Kolkata.
- Simpson, M.G. (2006) Plant Systematics. Elsevier Academic Press, London
- Sivarajan, V.V. (1991) Introduction to Principles of Plant Taxonomy. Oxford & IBH,New Delhi.
- Stuessy, T.F. (1990) Plant Taxonomy – The systematic evaluation of Comparativedata.

Columbia University Press, NewYork.

COURSE CODE: **BOT5IB11**

COURSE TITLE: CELL BIOLOGY& BIOCHEMISTRY

CELL BIOLOGY

Module I (7 hr.)

1. Architecture of cells. Prokaryotic and Eukaryotic cells.

2. Structure and function of the following: Cell membrane (fluid mosaic model), Endoplasmic reticulum, Golgi complex, mitochondria, chloroplast, Lysosomes Glyoxisomes Ribosomes Cytoskeleton Cytosol Vacuole

3.Interphase nucleus- Nuclear membrane; Nuclear pore complex; organization of interphase Nucleus; Euchromatin and heterochromatin; Nucleolus

4. Chromatin organization- nucleosomes scaffold. Organization of eukaryotic chromosome .Heterochromatin- constitutive, facultative andcondensed. Euchromatin. Satellite DNA. Chromosome banding and its significance. Special types of chromosomes–Polytene chromosomes, lamp-brush chromosomes. Chromosomal changes: structural aberrations: deletion, duplication, inversion, translocation - their meiotic consequences and significance.

Numerical aberration - Definition - Basic chromosome number (Genomic Number) Aneuploidy, Haploidy and Polyploidy - their meiotic behaviour and significance

5. Cell reproduction: Cell cycle-Mitosis, Specific events G1, S, G2 and M phases. Significance of G0. Control of cell cycle. Significance. Gene expression during cell cycle. Mitotic Inducers.

Module II(11hr)

5. Meiosis: types, synaptonemal complex, significance of meiosis. Genetic control and consequences of meiosis. Restriction points and check points. Cell cycle regulation of meiotic events- behaviour of sex chromosomes in meiosis- suppression of DNA replication between Meiosis I and II. Meiotic defects and human diseases.

Module III(9 hr.)

6. Programmed cell death- necessity, classes, signals. Genetic analysis of cell death. Proteins regulating apoptosis.

Pathways leading to cell death- significance. Aging- cellular and extracellular. Cell signaling.

7. Cell interactions-communication, recognition and adhesion. Application.

8.Cellular differentiation and specialization. General characteristics, intrinsic interactions- Nucleo- cytoplasmic. Extrinsic interactions. Molecular mechanisms of cellular differentiations.

Module – IV(7 hr.)

9. Cancer- carcinogenic agents. Phenotype of the transformed cell. Genetic basis of malignant transformation oncogenes.

Tumour suppressor genes. Cancer and cell cycle. Metastasis. Interaction of cancer cells with normal cells.

PRACTICAL

1. Study of Mitosis in root tip cells. Calculation of mitotic index

2. Pre-treatment of root típs with colchicine /hydroxy quinoline /paradichlorobenzene and study of chromosomes in Chlorophytum/ Zea mays/ Crotalaria/ Cyanotis.

3. Isolation of plastids and mitochondria.
4. Chromosome banding

REFERENCES:

1. Cooper Jeffrey M. The Cell- A Molecular Approach. ASM,Washington.
2. Karp Gerald. Cell Biology. JohnWiley andSons.
3. Derobertis. Cell and MolecularBiology.
4. Pollard T.D. and Earn Shaw W.C. Cell Biology.Saunders.

Biochemistry

module– I (3 hr.)

1. The molecular logic of life.

2. The chemical unity of diverse living organisms.

3. Weak interactions in aqueous systems and the fitness of the aqueous environment for living organisms.

Module I I (13hr.)

4. Biomolecules: a- Carbohydrates- Classification, structure and functions of simple sugars and compound carbohydrates. Sugar derivatives of biological importance.

b- Lipids. Classification- storage and structural lipids;
lipids in membranes; the supramolecular architecture of membranes.

c- Amino acids, peptides and proteins.

Amino acids: classification based on polarity; properties. Covalent structure of proteins. Three dimensional structure of proteins. Protein- tertiary and quaternary structures. Native conformation and biological functions of proteins, Denaturation and renaturation. Functions of protein.

d-Nucleotides and nucleic acids. Structure and function of nucleotides and nucleotide derivatives.

Module- I I I (4 hr.)

5. Secondary metabolites: Secondary metabolites, their physiological roles. Significance- ecological and phylogenetic importance

6. Enzymes Classification (IUB), Mechanism of enzyme action, optimization of weak interactions in the transition state. Co-enzymes, inhibition, regulation: allosteric enzymes, covalently modulated enzymes. Isoenzymes.

PRACTICALS

.Qualitative tests for monosaccharides, and reducing non reducing oligosaccharides, starch, amino acids and protein

- Molisch’s test for all carbohydrates
- Benedict’s test for reducing sugars
- Barfoed’s test for monosaccharides
- Seliwanoff’s test for ketoses
- Fearson’s test (methyl amine test) for reducing disaccharides
- Iodine test for starch
- Ninhydrin test for amino acids and protein
- Xanthoproteic test for amino acids with aromatic R-groups
- Millon’s test for tyrosine
- Hopkins- Cole test for tryptophan
- Biuret test for peptide linkage and proteins

Qualitative tests for lipids. Emulsification, saponification, acrolein test, Boundouin'stest.
Quantitative estimation of protein by Biuret / Branford's /Lowry et al method.
Quantitative estimation of DNA and RNA (colorimetric /spectrophotometric)
Quantitative estimation of total phenolics.

REFERENCES:

- Cooper Jeffrey M. The Cell- A Molecular Approach.
- ASM,Washington. Karp Gerald. Cell Biology. JohnWiley andSons.
- Derobertis. Cell and MolecularBiology.
- Pollard T.D. and Earn Shaw W.C. Cell Biology.Saunders.

COURSE CODE: **BOT5IB12**

COURSE TITLE: GENETICS & PLANT BREEDING
GENETICS

Module – I (**23** hrs.)

1. Introduction- Mendel's life history (brief), Mendelian experiments: Monohybrid cross and dihybrid cross, Mendelian ratios, Laws of inheritance; Back cross, test cross. (**5**hrs)
2. Modified Mendelian ratios:

a. Allelic interactions: dominant – recessive, Incomplete dominance – flower color in Mirabilis; Co dominance – Coat colour in cattle, Blood group in human beings; Lethal genes – Sickle cell anemia in Human beings. Modified dihybrid ratios by incomplete dominance of one pair of gene (3:6:3:1:2:1) and both pairs (1:2:1:2:4:2:1:2:1). (**6**hrs)

b. Interaction of genes: Non epistatic - Comb pattern inheritance in poultry (9:3:3:1): Epistasis: dominant - Fruit colour in summer squashes; Recessive epistasis - Coat colorin mice; Complementary gene interaction- flower color in *Lathyrus*. (**6**hrs)

3. Multiple alleles- general account: ABO blood group in man, Self sterility in *Nicotiana*, Coat colour in Rabbits. (**3**hrs.)
4. Quantitative inheritance / polygenic inheritance / continuous variation- Skin colorin human beings, Ear size in maize. (**3**hrs.)

Module –II (**13** hrs.)

1. Linkage and crossing over- importance of linkage, linkage and independent assortment. Complete and incomplete linkage. Crossing over general account, 2 point and 3 –point
2. crossing over, cytological evidence of genetic crossing over. Determination of gene sequences; interference and coincidence; mapping of chromosomes. (**7** hrs)
3. Extra nuclear inheritance- general account- maternal influence- plastid inheritance in *Mirabilis*, Shell coiling in snails. (**3** hrs)
4. Population genetics; Hardy –Weinberg law and equation (**3**hrs)

PRACTICAL (GENETICS)

1. Students are expected to work out problems related to the theory syllabus. One problem each from all the types mentioned should be recorded.

a. Monohybrid cross
b. Dihybrid cross
c. Test cross and backcross
d. Determination of genotypic and phenotypic ratios and genotype of parents
e. Non-epistasis
f. Complementary gene interaction
g. Epistasis: dominant and recessive
h. Polygenic interaction
i. Multiple allelism
j. Chromosome mapping
k. Calculation of Coincidence and interference

REFERENCE (GENETICS)

- Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction toGenetic
- Analysis. W. H. Freeman and Co., U.S.A. 10thedition.
- Gunther, S. Spend & Richard Calender (1986) - Molecular Genetics CBS PublishersDelhi.
- Gupta, P.K. (2018 -19) Genetics. Revised edition. Rastogi Publications,Meerut
- John Ringo (2004) Fundamental Genetics Cambridge UniversityPress.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics.Benjamin
- Cummings. U.S.A. 9thedition.
- Lewin B. (2000) Genes VII Oxford UniversityPress.
- RastogiV.B. (2008) Fundamentals of Molecular Biology, Ane Books,India.
- Sinnot, W.L.C. Dunn & J. Dobzhansky (1996) Principles of Genetics. TataMc
- Graw Hill Publishing Company Ltd., NewDelhi.
- Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5th edition.
- Verma, P.S. & Agarwal (1999) Text book of Genetics. S. Chand & Co., NewDelhi.

PLANT BREEDING

Module-I (**4** hrs.)

1. Definition and objectives of Plant breeding – Organization of ICAR and its role inplant breeding. (**2**hrs.)

2. Plant Genetic Resources - Components of Plant Genetic Resources. (**2**hrs)

Module-II (**14** hrs.)

A. Breeding techniques (**12** hrs.)

1. Plant introduction: Procedure, quarantine regulations, acclimatization- agencies of plant introduction in India, major achievements.

2. Selection -mass selection, pure line selection and clonal selection, genetic basis of selection, significance and achievements.

3. Hybridization – procedure; intergeneric, interspecific and intervarietal hybridization with examples; composite and synthetic varieties.

4. Heterosis breeding - genetics of heterosis and inbreeding depression.

5. Mutation breeding – methods -achievements.

6. Polyploidy breeding

7. Breeding for disease and stress resistance

B. Modern tools for plant breeding: Genetic Engineering and products of genetically modified crops (brief mentioning only). (**2**hrs.)

***PRACTICAL (PLANTBREEDING*)**

1. Techniques of emasculation and hybridization of any bisexual flower.

2. Floral biology of Paddy, any one Pulse and Coconut tree.

3. Visit to a plant breeding station and submission of its report.

REFERENCES (PLANT BREEDING)

- Allard. R.W. (1960). Principles of Plant breeding, John Wiley & Sons, Inc, NewYork.
- Chaudhari. H.K. Elementary Principles of Plant breeding, Oxford & IBHPublishers.
- Singh, B.D. (2005). Plant Breeding: Principles & methods, Kalyani Publishers,
- NewDelhi. Sinha U. & Sunitha Sinha (2000) Cytogenetics, Plant breeding & Evolution,Vikas PublishingHouse.
- 5. Swaminathan, Gupta & Sinha (1983) Cytogenetics of Crop plants Macmillan IndiaLtd.

COURSE CODE: **BOT5IB13**

COURSE TITLE: ENVIRONMENTAL SCIENCE

Module - I

1. Ecosystem: Definition, abiotic and biotic factors, trophic structure, Food chain and food web, Ecological pyramids, Energy flow, Productivity of ecosystems. (**4**hrs.)
2. Biogeochemical cycles (Carbon, Nitrogen, Phosphorous) (**3**hrs.)
3. Plant adaptations: Adaptations in Hydrophytes, Xerophytes, Halophytes, Epiphytes and Parasites. (**3**hrs.)
4. Plant Succession: Definition – Primary and Secondary succession; Autogenic andallogenic succession; Mechanism of plant succession–Xerosere and Hydrosere (**4**hrs.)

Module-II

1 Biodiversity and Conservation: Definition; Biodiversity - Global and Indian Scenario; Megadiversity nations and hotspots: Biosphere reserves; Biodiversity centers in India. (**5** hrs.)

2 Threats to biodiversity; Endangered and endemic plant species, Red data book, Exotic and indigenous plant species, Keystone species, Flagship species, Umbrella species, Indicator species. (**4** hrs.)

3 Conservation strategies *ex situ* and *in situ* methods. Organizations– IUCN, UNEP & WWF; (NBPGR), Kerala state Biodiversity Board (KSBB). (**4**hrs.)

Module-III

1 Pollution: Sources and types of pollution – air, water, soil, thermal and noise ;biodegradableand non-biodegradable pollutants; bio magnification; BOD. (**4** hrs.)

2 Global environmental changes – climatic changes – global warming and greenhouse gases, acid rains, el-nino, efforts of world organizations in the regulation of greenhouse gases emission. (**5**hrs)

3 Management of environmental pollution – conventional and phyto technological approaches – solid wastes management including e-wastes- environmental legislations in India (Prevention and Control of Pollution act, 1981). (**5**hrs.)

Module- IV

1 Major ecosystems of the Biosphere; Sea; Estuarine ecosystem; Lentic ecosystem: lake, Pond; Lotic ecosystem: river; Desert; Forest; Grass land. (**5**hrs.)

2 Techniques in plant community studies – Quadrat and transect methods– species area curve– density, frequency, abundance, dominance of populations– importance value index – construction of phytographs. (**8**hrs.)

PRACTICAL

1. Construct a food web from the given set of data, (Representative of a natural ecosystem). (Drawing not required).
2. Construct ecological pyramids of number, biomass and energy from the given set of data (Representative of a natural ecosystem). (Drawing not required).
3. Study of plant communities: Determination of density, abundance, dominance, frequency by quadrat method.
4. Demonstration of determination of Dissolved Oxygen by Winkler's method.
5. Study of morphological and anatomical characteristics of plant groups: Hydrophytes, Xerophytes, halophytes, epiphytes, parasites. (Drawing not required).

REFERENCES

- Beeby A. & Brennan A.M. (2004) First Ecology. Ecological Principles and Environmental Issues. Oxford UniversityPress.
- Cunninghan W.P. and M.A. Cunningham (2003). Principles of EnvironmentalScience: Inquiry and Applications. Tata McGraw Hill Pub.N.D.
- Dash M.C. (1993). Fundamentals of Ecology. Tata McGraw Hill Publishing Company Ltd. NewDelhi.

- Dix J.H. (1989). Environmental Pollution. Atmosphere, Land, Water and Noise. Wiley Chichester.
- Khitoliya R.K. (2007). Environmental Pollution – Management and Control for Sustainable development S. Chand and Company Ltd., NewDelhi.
- Mishra D.D (2008). Fundamental Concepts in Environmental Studies. S. Chand&Co., New Delhi.
- Mishra S.P. & S.N. Pandey (2008). Essential Environmental Studies. Ane BooksPvt. Ltd.Thiruvananthapuram.
- Odum E.P. (1983). Basics of Ecology. Saunders International UNEdition.
- Shukla R.S. & P.S. Chandel (2005). A Text Book of Plant Ecology S. Chand & Co. Ltd. New Delhi.
- Wise, D.L.(2005) Global Environmental Biotechnology. Ane Books.Thiruvananhapuram.
- Bharucha E. (2005) Text Book of Environmental Studies for UG courses.University Press (India) Private Limited Hyderabad.
- Diamond, J., T.J. Case (1986). Community ecology. Harper & Row, NewYork.
- Futuyma P.J., Slatkin M. (1983) Co-evolution. Sinauer Associates, SunderlandMass.
- Krebs, C.J. (1985). Ecology 3rd edn. Harper & Row NewYork.
- Sharma, P.D. (2008-2009). Ecology and Environment. RastogiPublication.
- Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth SystemsApproach.Oxford University Press.U.S.A.

SEMESTER-6

COURSE CODE: BOT6IB14

COURSE TITLE: CREATIVITY, RESEARCH & KNOWLEDGE MANAGEMENT

Module I:(8 hr.)

Creativity & Thinking Skills: Various views on creativity; creativity & innovation, critical thinking; logical thinking – inductive & deductive logic – common logical fallacies

Module II(9hr.)

Research and it types : Various outlooks on research: pure versus applied, incremental versus innovative, qualitative versus quantitative; Philosophy of science; the scientific method, the research process –creative question – hypothesis – planning and designing of experiments – critical analysis – sources of errors and minimization.

Module III:(12hr.)

Research Report Writing: Format of a science research paper – the IMRAD format – objectives of each section reference citing styles; Proof reading & editing; Publishing Science: Authorship; Publication process - Peer review – single/double blind and open; fabrication, falsification and plagiarism – Turnitin; Open Access Publications and other emerging trends in scientific communication; case study of paper writing and peer review; popular journals in Computational Biology & Bioinformatics (brief overview of their scope).

Module IV:(11hr.)

Knowledge Management Skills: Advanced internet search skills – specialized academic search; Google scholar and Scopus; Bibliometrics and webometrics – impact factors –h, h-b and g indices pitfalls in interpreting impact; Reference management tools: diigo, zotero, endnote; Current awareness: RSS feeds, TOC alerts, DB alerts.

Module V: (7hr.)

IPR awareness: Copy lefts, copyrights and patents; IPR of software and life forms; Brief overview of IPR laws in India - Protection of traditional knowledge; Patent amendment of 2005 and its impact; Overview of International treatise – GATT, TRIPS; India as an emerging Knowledge power; Ethics – its role in scientific research and academics, conflict of interests; aca-demia-industry collaborations. Geographical Indication (GI) tag; Benefits of GI tag in agriculture

Module V(6 hrs.)

I (**Flexi module)-** *Only for Internal Assessment. Lecturers may expand and/ or interpret the syllabus to update it or suit the particular cohort in any way)*: Allied Topics: Profile of key Bioinformatics/CB/ pharmaceutical institutions and industries in India& abroad. Overview of Bioinformatics policy of Govt. of India; Job opportunities in CB/BI & skill profiles; Quality – basic concepts – popular certifications; Making effective multi-media and poster presentations; Professional Societies in the field – their role in research and knowledge dissemination.

REFERENCES:

- Day, R., Gastel, B. (2012). How to write and publish a scientific paper. Cambridge UniversityPress.
- Katz, M. J. (2009). From Research to Manuscript: A Guide to Scientific Writing.Springer.
- Lee, J. A. (2000). The scientific endeavor: A primer on scientific principles and practice. Ben-jamin Cummings.
- Lester, J.D.(2005).Research Paper Handbook: Your Complete Guide. Good
- YearBooks. Lowe, P. (1995). Creativity and problem solving.McGraw-Hill.
- Murray, R. (2010). How to Write a Thesis. McGraw-HillEducation.
- Rao, R.A., Rao, B.(2008). Intellectual Property Rights: A Primer. Eastern BookCompany.
- Ruxton, G., & Colegrave, N. (2011). Experimental design for the life sciences. Oxford Univer-sity Press.
- Trochim, P. D. W. M. (2003). Research methods. DreamtechPress.

COURSE CODE: **BOT6IB15**

COURSE TITLE: PLANT PHYSIOLOGY AND METABOLISM

Plant Physiology

Module – I(5hr.)

1. Water and plant cells: Properties of water, hydrogen bonding, polaritv, cohesion and adhesion. Diffusion, osmosis, imbibition, plant cell as an osmotic system, osmotic pressure, osmotic potential, turgor pressure, wall pressure, water potential and its components.
2. Water movements in cells and tissues. Soil-plant atmosphere continuum. Transpiration, stomatal movement, modern theories of stomatal mechanism. Why transpiration? Anti-transpirants.
3. Absorption of water by transpiration pull and cohesion of water molecules. Radial movement of water through root. Soil-plant-atmosphere continuum of water.
4. The ascent of xylem water and the uptake of water by roots. Transpiration pull and cohesion of water molecules. Merits and demerits of cohesion-tension theory.
5. .Absorption of mineral ions- solute absorption.

Module II (7 hr.)

6. Plants and nitrogen: The nitrogen cycle. Biological nitrogen fixation, symbiotic nitrogen fixation in leguminous plants. Biochemistry of nitrogen fixation. Export of fixed nitrogen from nodules. Genetics of nitrogen fixation. Nitrogen assimilation, assimilation of nitrate. Nitrogen nutrition -agricultural and ecological aspects.

Biosynthesis of amino acids- reductive amination and transamination. GDH and GS/ GOGAT pathway.

Module III (10 hr.)

7. Photosynthesis: Absorption and fate of light energy, absorption and action spectra. Photoreceptors- chlorophylls, carotenoids, phycobilins. Bio energetics and the light dependent reactions of photosynthesis. Photosynthetic electron transport and photophosphorylation. The two pigment systems ,Z-scheme, water oxidizing clock. The photosynthetic carbon reduction cycle, C3, C2,C4 and CAM metabolism and ecological significance.

8. Translocation and distribution of photo assimilates. Phloem transport, Sources and sinks, mechanism of translocation. Phloem loading and unloading, distribution of assimilates. Translocation of xenobiotic chemicals.

Module IV(8hr.)

9. Patterns in plant development: Growth, differentiation, and development . Genetic control and hormonal regulation of development. Seed germination- physiology of hormones in plant development- auxins, gibberellins, cytokinins, abscisic acid and ethylene. Role of vitamins and nutrients.

Plant movements- phototropism, gravitropism. nyctinastic and seismonastic movements.

10. Photomorphogenesis: Phytochrome: chemistry and physiological effects. Mechanism of phytochrome and gene action. Cryptochromes and blue light effect

11. Seed dormancy and germination.

12.Stress Physiology: Types of stress- water, temperature, salt, stresses caused by pests andpathogens and pollutants.

PRACTICALS

1. Determination of water potential by tissue weight change method.
2. Extraction of leaf pigments and preparation of absorption spectra of chlorophylls and carotenoids.
3. Demonstration of Hill reaction.
4. Separation of leaf pigments by paper chromatography and column chromatography.
5. Effects of light intensity on photosynthesis by Wilmot's bubbler.
6. Thistle funnel osmoscope
7. Ganong’s photometer
8. Ganong’s light screen
9. Ganong’s respirometer
10. Kunhe’s fermentation vessel
11. Mohle’s half leaf experiment
12. Absorbo-transpirometer
13. Determination of sugars and amino acids in germinating seed by TLC. 14. Extraction of seed proteins based on solubility.
15. Biochemical analyses of leakages from seeds during germination.
16. Analyses of proline in water stressed plants.
17. Testing of seed viability by NBTtest.
18. Changes in the reserve proteins during germination

REFERENCES

- William G. Hopkins. Introduction to Plant Physiology. John Wiley & SonsInc.
- Lincoln Taiz and Eduardo Zeiger. Benjamin/Cumming Publishing Company lnc. NewYork.

Module – I

(4 hr.)

1. Enzymes: General aspect, classification, Michaelis-Menton equation and its significance. Mechanism of enzyme action, co-enzymes, inhibition, regulation, allosteric enzymes, covalently modulated enzymes. Kinetics of enzyme catalysis. Isoenzymes.

Module II (9 hr.)

2. Intermediary metabolism: Anabolism, catabolism, amphibolic pathways and anapleurotic reactions. Link between primary metabolism and secondary metabolism. Bioenergetics and thermodynamics.

3. Catabolism of hexoses: Glycolysis- two phases, overall balance sheet, regulation; fate of pyruvateunder aerobic and anaerobic conditions. Pentose phosphate pathway-multifunctional pathway (significance).

Module III (11 hr.)

4.Tricarboxylic acid cycle: Formation of acetate, reaction of citric acid cycle, anapleurotic reactions of citric acid cycle. Regulation of citric acid cycle. Glyoxylate cycle. Amphibolic nature of TCA cycle.

5.Oxidation of fatty acids. Activation and entry of fatty acids, Beta oxidation of saturated and unsaturated fatty acids. Regulation.

6.Oxidation of amino acids and entry to TCAcycle.

7.Oxidative phosphorylation: Electron transfer reactions in mitochondria. Electron carriers, multienzyme complexes, ATP synthesis. Regulation of oxidative phosphorylation. Shuttle systems- Alternatepathways-Thermogenesis.

8.Carbohydrate biosynthesis: Gluconeogenesis, biosynthesis of starch, glucose and other carbohydrates. Involvement of NDP- sugars. Regulation.

9.Lipid biosynthesis: Biosynthesis of fatty acids. Triacylglycerol's, phospholipids and isoprenoids. Regulation.

10.Biosynthesis of nucleotides: PRPP and its significance. Purine and pyrimidine biosynthesis. Precursors and regulation. Conversion of NMP to NTP. Biosynthesis of deoxyribonucleotides.

11.Secondary metabolism: Main pathways and their relation to primary-metabolism

.**PRACTICALS**

1. Extraction of enzyme: Any enzyme.
2. Effect of substrate on enzyme and determination of its Kmvalue.
3. pH dependent activity profile of enzymes.
4. Ammonium sulphate precipitation of enzymes.
5. Desalting of proteins by gel filtration using Sophadex G25/dialysis
6. Separation of isoenzymes by native PAGE.
7. Determination of enzyme / protein sub units by SDSPAGE.
8. Metabolism of germinating seeds - changes in metabolizable carbohydrates

REFERENCES

- Lehnìnger. Principles of Biochemistry, Macmillan,U.K.
- Geoffrey Zubay. Biochemistry. Macmillan Publishing Company, NewYork.
- Trevor Palmer. Enzymes- Biochemistry, Biotechnology and Clinical Chemistry.Norwood Publishing,Chichester.

COURSE CODE: **BOT6IB16**

COURSE TITLE: MOLECULAR BIOLOGY, PLANT MORPHOGENESIS & EMBYOLOLOGY

Molecular Biology(27 hr)

1. Nucleic acids: DNA– the genetic material; the discovery of DNA as the genetic material; bacterial transformation (Griffith's & Avery's experiments); Hershey and Chase experiment; Structure of DNA, Watson & Crick's Model, Types of DNA- (A,B,Z); Replication: semi conservative replication–Meselson and Stahl's experiment;,
2. Structure of DNA: Repetitive DNA; c-value paradox.
3. Replication of DNA: Enzymology of replication. Molecular mechanism of replication in prokaryotes and eukaryotes. Primosomes and replisomes. Telomerase and its function. RNA- structure, types and properties
4. Gene expression: regulation of gene expression- Operon concept- Gene regulation in prokaryotes and eukaryotes enhancers and silencers.
5. Protein synthesis: Transcription, post-transcriptional events. Introns and their significance. Translation.Post translational events. Role of chaperons.
6. Mutation: Spontaneous and induced. Physical and chemical mutagens. Molecular mechanism of mutation. Mutation and cancer. Mutator and antimutatór genes. DNA repairing mechanisms.
7. Molecular evolution: The origin of genomes. Evolution of new genes. Origin of eukaryotic genomes. Phylogenetics. Application of molecular phylogenetics.

REFERENCES

1. Lewin Benjamin. Genes. Oxford Universitypress.
2. Brown TA. Genomes. John Willey andSons.
3. Snustad, Simmons and Jenkins. Principles of Genetics. John Willey andSons.
4. Weaver and Hendrick. Genetics. Wm. C. BrownPublishers.
5. Hawkins J.D. Gene Structure and Expression. Cambridge UniversityPress.

PRACTICAL

Working out problems from molecular genetics.

1. isolation of nucleic acid and identification of histones bySDS-PAGE.
2. isolation of plant DNA and its quantification by spectrophotometric/ calorimetric method.
3. lmmunological techniques: ELISA and WesternBIot.

SUBMISSION

Visit a research station with Well equipped Biotechnology/ Molecular biology lab and submit a duly certified detailed report of the same during the practical examination.

Plant morphogenesis:(5 hr.)

Basic concepts of plant morphogenesis. Totipotency, symmetry, polarity, differentiation pattern formation. Factors influencing morphogenesis. Organisation of shoot and root apical meristem and the molecular basis of their development. Leaf development. Floral meristems and floral development in Arabidopsis and Antirrhinum

Embryology (22 hr)

1. Introduction to angiosperm embryology - structure of dithecous and monothecous anther.
2. Microsporogenesis: Structure and function of wall layers, role of tapetum in pollen development
3. Male gametophyte: Pollen mitosis, division of generative cells, heterospory.
4. Megasporogenesis: Megaspore triad, dyad, coenomegaspore.
5. Embryo sac - different types- ultra-structure of components- synergid and antipodal. Theories ofthe morphological nature of embryosac
6. Pollination -Artificial pollination - ultra-structural and dis-ultrastructural and histo-chemical sigma.

Significance of pollen - pistil interaction. Role of pollen wall proteins and stigma. In vitro pollination and

fertilization.

7. Fertilization: Role of synergids - filiform apparatus, heterospermy and triple fusion.
8. Structure and development of typical dicot and monocot embryos- structure and function of suspensor.
9. Endosperm: classification and type- ruminate endosperm- mosaic endosperm- endosperm haustoria – physiology and cytology of endosperm.
10. Polyembryony - classification – practical value.
11. Apomixis - general account, genetics of apomixis.
12. Parthenocarpy –seedless fruits
13. Experimental embryology-embryo culture, anther culture, ovule culture.
14. Embryology in relation to taxonomy

PRACTICALS

1. Study of anther development of *Datura*.
2. Preparation of dissected whole mounts of microsporangium.
3. Study of megaspore mother cell, megaspore and embryo sac.
4. .Study of the receptivity of stigma and in situ germination of pollen.
5. Dissection of stages in the development of embryo and endosperm.
6. Pollen germination using hanging drop technique.
7. Demonstration of intra-ovarian pollination

REFERENCES:

- Bouman F. Ovule initiation, ovule development and seed coat astructure in angiosperms. Todayand Tomarrow Publishers, NewDelhi.
- Bhojwani S.S. and Bhatnagar S.S. The embryology of Angiosperms. Vikas Publication, NewDelhi.
- Davis C.L. Systematic embryology of Angiosperms. JohnWiley.
- Eames A.J. Morphology of Angiosperms. Mc GrawHill.
- Johanson D. Plant Embryology. Waltham, Massachusetts.
- John B.D. (Ed.). Embryology of Angiosperms. SpringerVerlag.
- Maheswari P. An introduction to the Embryology of Angiosperms. Mc GrawHill.
- Raghavan V. Experimental embryogenesis in plants. AcademicPress.
- Wardlaw C.W. Embryogenesis in Plants. Methusen,London

COURSE CODE: **BOT6IB17**

C**OURSE TITLE: GENOMICS**

COURSE CONTENT (54 hr.)

Module I: String view of DNA: Composition of DNA-(Chargaff's Rule), Reading frames +1, +2, +3 and -1, - 2, -3, ORFs, Codon usage bias, tandem and inverted repeats, concepts of similarity - homologous, orthologous and paralogous sequences.

Module II: Basic file formats: FASTA, GCG, PIR, Phylip, Nexus file formats etc. Sequence Data Bases, detailed study of GenBank of NCBI- typical Gen Bank (DDBJ+EMBL) for DNA and RNA,

Module III: Sequence Representation & Analysis: Basic gene statistics–base counts, word (n- mer) frequencies, vector contamination analysis, use of Perl scripts in genomics, gene finding, splice site recognition, transcription factor binding site identification, SNPs, microsatellite, minisatellite, sequence profiles, sequence logos, sequence chromatograms.

Module IV: Sequence alignment: Pair-wise sequence alignment, Need of Scoring schemes- Penalizing gaps – Linear and Affine gap penalty; Effect of scoring schemes, Scoring matrices for amino acid sequence alignment, PAM Probability matrix- Log odds matrix(Brief account only); BLOSUM(Brief account only); Dot-plot visualization(Brief account only); Smith –Waterman algorithm for local alignment, Needleman-Wunsch algorithm, Statistics of Sequence alignment score: E-values, bit scores and sensitivity, specificity; BLAST and FASTA.

REFERENCES:

- Bal, H. P. (2005). Bioinformatics: Principles and Applications. TataMcGraw-Hill.
- Bergeron, B. P. (2003). Bioinformatics computing. Prentice HallProfessional.
- Chen, Y. P. P. (Ed.). (2005). Bioinformatics Technologies.Springer.
- Claverie, J. M., & Notredame, C. (2011). Bioinformatics for dummies. John Wiley &Sons.
- Dan. E. Krane, & Raymer, M. L. (2003). Fundamental Concepts of Bioinformatics. PearsonEducation International.
- Deonier, R. C., Tavaré, S., & Waterman, M. (2005). Computational genome analysis: an introduction. Springer.
- Gautham, N. (2006). Bioinformatics: Databases and Algorithms. Alpha Science Int'lLtd.
- Gopal, S., Price, R., Tymann,P., & Haake, A.,(2000). Bioinformatics with Fundamentals of Genomics and Proteomics. Tata McGraw Hill Education Pvt.Ltd.
- Lesk, A. (2013). Introduction to bioinformatics. Oxford UniversityPress.
- Markel, S., & León, D. (2003). Sequence Analysis in a Nutshell: A Guide to Tools: A Guide to Common Tools and Databases. " O'Reilly Media,Inc."
- Mathura, V., & Kangueane, P. (2008). Bioinformatics: a concept-based introduction.Spring-er.
- Mount, D. W. (2004). Sequence and genome analysis. Bioinformatics: Cold SpringHarbour Laboratory Press: Cold Spring Harbour,2.
- Orengo, C., Jones, D. T., & Thornton, J. M. (2003). Bioinformatics: Genes, proteins and com-puters. GarlandScience.
- Pevsner, J. (2009). Bioinformatics and functional genomics. John Wiley &Sons
- Ramsden, J. (2009). Bioinformatics: an introduction (Vol. 10).Springer.
- Rastogi, S. C., Mendiratta, N., & Rastogi, P. (2013). Bioinformatics: Methods And Applica-tions: (Genomics, Proteomics and Drug Discovery). PHI Learning Pvt.Ltd.

- Salemi, M., Lemey, P., & Vandamme, A. M. (Eds.). (2009). The phylogenetic handbook: apractical approach to phylogenetic analysis and hypothesis testing. Cambridge UniversityPress
- Semple, C., & Steel, M. (2003). Phylogenetics. 2003. Oxford Lecture Series in Mathematics andits Applications.
- Setubal, J. C., Meidanis, J., & Setubal-Meidanis. (1997). Introduction to computational mo-lecular biology. PWSPub.
- Xiong, J. (2006). Essential bioinformatics. Cambridge UniversityPress
- Zvelebil, M. J., & Baum, J. O. (2008). Understanding bioinformatics. GarlandScience.

COURSE CODE:**BOT6IE18**

COURSE TITLE: ELECTIVE GENETICS AND CROP IMPROVEMENT

Module -1.

Crop genetics - General account of origin, genetic variability, floral biology, breeding techniques and achievements in: Rice, Coconut, Rubber, Arecanut, Cashew and Pepper. (**11**hrs)

Module –II

1. Plant genetic resources- Definition; Classification of Plant Genetic resources. Activities– exploration, conservation, evaluation, documentation and utilization. (**2**hrs)

2. Agencies involved in plant genetic resources activities – NBPGR and IPGRI (**4**hrs)

3. International institutes for crop improvement – IRRI, ICRISAT, CIMMYT, IITA. Brief account on research activities and achievements of national institutes – IARI, CCMB, IISc, BARC, CPCRI, IISR, RRII, CTCRI, KFRI, JNTBGRI. (**4**hrs)

Module- III

1. Methods of crop Improvement (**4**
hrs) 1.Plant introduction

2.Selection - Principles, Selection of segregating populations, achievements

3. Hybridization – Interspecific hybridization; intergeneric – achievements. Genetics of back crossing, Inbreeding, Inbreeding depression, Heterosis and Heterobeltiosis

Module -IV.

1 Heteroploidy in crop improvement – achievements and future prospects – Significance of haploids and polyploids (**2**hrs)

2 Mutations in crop improvement – achievements and future prospects (**2**hrs)

3 Genetics of nitrogen fixation – Use of biofertilizers in crop improvement (**2** hrs)

4 Genetics of photosynthesis (**1** hr)

Module- V.

1. Breeding for resistance to abiotic stresses – Introduction, importance of abiotic and biotic stresses and its characteristics. (**10** hrs)
2. Breeding for drought resistance: Genetics of drought resistance; Breeding methods and approaches; Difficulties in breeding for drought resistance.
3. Breeding for mineral stress resistance: Introduction, Salt affected soils, Management of salt affected soils: Salinity resistance –general account.
4. Breeding for resistance to biotic stresses. (**12** hrs)
5. Disease resistance – History of breeding for disease resistance; Genetics of pathogenicity – Vertical and horizontal resistance; Mechanism of disease resistance; Genetics of disease resistance – Oligogenic, polygenic and cytoplasmic inheritance – Sources of disease resistance – Methods of breeding for disease resistance.
6. Insect resistance – Introduction, Mechanism, Nature and genetics of insect resistance, Oligogenic, Polygenic and cytoplasmic resistance, sources of insect resistance, breeding methods for insect resistance, Problems in breeding forinsect resistance, Achievements, Breeding for resistance to parasitic weeds.

PRACTICAL

1. Visit a leading breeding station in South India and a detailed report should be included in the practical record. The record duly certified by HoD should be submitted at the time of practical examination of core practical paper III.

2. Make illustrations on the floral biology of Rice, Cashew and *Solanum* spp.

3. Demonstration of hybridization in Rice, Cashew and *Solanum* and describe the procedure.

4. Study the variability under induced stress (salinity and moisture) of seedlings of rice and green gram and record

the observations.

REFERENCES

- Singh, B D. (2000) Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.
- Sharma, J R. (1994) Principles and Practice of Plant Breeding. Tata Mcgraw – Hill Publishing Company, NewDelhi.
- Benjamin Levin. (2007) GenesVIII.
- Allard, R W. (1960) Principles of Plant Breeding. John Wiely & Sons, NewYork.
- Chahal, G S & S S Gosal, (1994) Principles and procedures of Plant Breeding. Narosa Publishing House, NewDelhi.
- 6 Chrispeels M J and Sadava, D E. (1994) Plants, Genes and Agriculture. Jones and Bartlet Publishers, Boston, USA

SEMESTER 7

COURSE CODE:**BOT7IB22**

COURSE TITLE: PROTEOMICS

Module I: Preliminaries: Proteome and proteomics –Proteins as workhorse molecules of life, classification of proteins, Protein separation & analysis; 2D Gel Electrophoresis, Liquid chromatography, Mass spectrometry. Protein structure determination with X-ray Crystallography & NMR spectroscopy.

Module II: Protein Structure: Interatomic forces and protein structure; covalent interaction, hydrogen bonds, hydrophobic and hydrophilic interaction, charge/dipole interaction, Vander Waals forces, steric interaction. Primary structure; 20 amino acids as structural units, peptide bonds, proteins as polypeptides. Secondary structure; Alpha helices, Beta sheets and turns, Ramachandran plot, Backbone flexibility, Φ and ψ- Properties of amino acids- Hydrophobicity, EIIP, Molecular weight, α and β propensities. Tertiary and quaternary structures, protein folding, protein domains.

Module III: Protein databases: UniProtKB/Swiss-Prot, Interpro, PIR, PDB, SCOP & CATH, ProDom, PFAM; Protein visualization tools- Swiss PDB Viewer, Pymol. Expasy proteomic tools: AA CompIdent, MultiDent, Peptide Mass etc. Introduction to software: JPred, 3DPSSM, Modeller, ITASSER, Procheck

Module IV: Protein structure prediction: Chou Fasman method- p(a), p(b) and p(turn) propensities, Garnier Osguthorpe and Robson (GOR) method, Threading, Homology modeling, CASP, *Ab initio* prediction, Molecular dynamics & conformational energy calculation, Prediction of function.

REFERENCES

- Eidhammer, I., Jonassen, I., & Taylor, W. R. (2004). Protein Bioinformatics: An algorithmic approach to sequence and structure analysis (pp. 3-23). J. Wiley & Sons
- Higgins, D., & Taylor, W. (2000). Bioinformatics: sequence, structure, and databanks: a practical approach. Oxford University Press, Inc.
- Jiang, T., Xu, Y., & Zhang, M. Q. (Eds.). (2002). Current topics in computational molecular bi-ology. MIT Press

COURSE CODE:**BOT7IB23**

COURSE TITLE: PHYCOLOGY, BRYOLOGY, PTERIDOLOGY AND GYMNOSPERMS PART 2

(1.5+1+2+1.5 = 6 hours per week)

Phycology

1. Classification of Algae-comparative Survey of important systems - Fritsch-Smith-Round. Criteria for algal Classification-Phylogenetic considerations.
2. Biological importance of Planktons.
3. Algal Cytology-Basic ideas of cell features-Electron microscopic studies of algal cell, cell wall, flagella, chloroplast, pyrenoid, eyespot- their importance in classification.
4. Reproduction-Different types of life cycles in algae.

5. General account of energy sources and pigments in algae.
6. Economic importance of Algae-Roll of algae in soil fertility, algae in industry-Biological importance of phytoplankton's and water blooms.
7. General account of thallus structure, cell ultrastructure, reproduction, relationships and evolutionary trends in the following groups: Chlorophyta, Xanthophyta, Bacillariophyta, Phaeophyta, Rhodophyta.

References:

- Fritsch, F.E. The structure and Reproduction of Algae.
- Smith, G.M. Manual of Phycology
- Round, F.E, The Biology of Algae.
- Pold and Wyane. Introduction of Algae.

Bryology

1. General characters and systems of classifications of Bryophytes
2. General account of the anatomy, reproduction, life history and phylogeny of Sphaerocarpales, Marchantiales, Jungermanniales, Calobryales, Anthocerotales, Sphagnales, Andreales, Funariales and Polytrichales
3. Origin and evolution of Bryophytes- gametophytic and sporophytic.
4. A general account of fossil Bryophytes and their affinities.
5. Economic importance of Bryophytes.

References

- Cavers F. The interrelationship of Bryophytes. New Phytologist.
- Watson E.V. The structure and life of Bryophytes. Hutchinson Univ. Press, London.
- Kashyap S.R., 1929-1932. The Liverworts of Western Himalaya and the Punjab Plains, Vol.l&II. Chronica
- Botanica
- Smith G.M. Cryptogamic Botany. McGraw Hill Book Co., N.Y.
- Parihar N.S. An introduction of Embryophyta: Bryophyta. General Book House, Allahabad.
- Verdoon, F.M. Mannual of Bryology. Ashor & Co., Amsterdam.
- Vanderpoorten A. & Goffinet B. 2009. Introduction to Bryophytes, Cambridge University Press
- Shaw, J. and Goffinet, B. (eds.). 2000. (revised 2009) Bryophyte Biology. Cambridge University Press.
- Manju C. Nair, K.P. Rajesh and Madhusoodanan P.V. 2005. Bryophytes of Wayanad in Western Ghats. Malabar Natural History Society, Kozhikode.
- Vasishta, B.R. Bryophyta, S. Chand & Company

Pteridology

1. General characters and life history of Pteridophytes.
2. Cytology of Pteridophytes- Chromosome number and polyploidy.
3. Structure and evolution of stele in Pteridophytes.
4. Origin and evolution of Sporangium.
5. Heterospory and seed habit.
6. Development and evolutionary trends in the Gametophytes of Pteridophytes.
7. Apogamy, Apospory and Parthenogenesis.
8. Classification of Pteridophytes: Holttum, Pichi-Sermolli.
9. Comparative morphology, ecology and phylogeny of the following:

Psilopsida : Rhyniales, Psilophytales and Psilotales, Lycopsida: Lycopodiales and lsoetales, Sphenopsida: Hyeniales, Pseudoborniales, Sphenophyllales, Calamitales and Equisetales, Filicopsida:

10. General account: Primofilicales, Ophioglossales, Marattiales, Osmundales, Schizaeales, Cyatheales, Gleicheniales, Marsileales and Salviniales.
11. Economic importance of Pteridophytes-Medícinal, Horticulture, Biofertilizer, Weeds.
12. General account of the contribution of Indian pteridologists.

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References

- Bierhost, D.W. Morphology of Vascular Plants. Mac Miilan Co., New York.
- Dyer, A.C. The Experimental Biology of Ferns. Academic Press, London.
- Jermy, A.C. (Ed.): The phylogeny and Classification of Ferns.

- Kramer, K.U. and Green, P.S. The Families and Genera of Vascular Plants. Narosa, New Delhi.
- Nampy, S. and Madhusoodanan, P.V. Fern Flora of South India-Taxonomic Revision of Polypodioid Ferns. Daya Publishing House, New Delhi.
- Abdul Hameed C., Rajesh K.P. and Madhusoodanan P.V. Filmy Ferns of South India. Penta Book Publishers & Distributors, Calicut.
- Azeez K., Venugopalakrishna Kurup V. and P.V. Madhusoodanan. Spleenworts (Aspleniaceae) of South lndia. Malabar Natural History Society, Calicut.
- Venugopalakrishna Kurup V., Azeez K. and P.V. Madhusoodanan. Primitive Ferns of South India. 'V'Publishers, Kottayam.

Gymnosperms

1. Geological time scale and correlated predominant Gymnosperm flora.
2. Classification of Gymnosperms- Chamberlain's system.
3. Geological horizons. Distribution, morphology, anatomy, reproduction and interrelationship of the following orders (Study of families and types not required) a) Pteridospermales; b. Glossopteridales; c. Caytoniales; d. Cycadeoidales; e. Pentoxylales; f. Cycadales, g. Ginkgoales; h. Cordaitales; i. Coniferales; j. Taxales; k. Ephedrales; l. Welwitschiales; m. Gnetales
4. Phylogenetic relationship of Gymnosperms.
5. Economic importance of Gymnosperms

References:

- Andrews, H.N. Studies in Paleobotany, Wiley, N.Y.
- Banks, H.P. Evolution and plants of the past. Wadsworth Pub. Co.
- Bierhost, D.W. Morphology of Vascular Plants. Macmíllan.
- Bower, F.O. Primitive Plants. Macmillan.
- Chamberlain, C.J. Gymnosperms- Structure and Evolution. Univ. of Chicago Press.
- Foster, A.S. & E.M. Gifford. Comparative morphology of vascular plants. Freeman.
- Maheshwari, P & V. Vasil. Gnetum. CSIR, New Delhi.
- Ramanujam, C.G.K. Indian Gymnosperms in time and space. Today & Tomorrow, Dehra Dun.
- Sewart, W.N. Paleobotany and the Evolution of Plants. Cambridge Univ. Press.
- Stockey, R.S. Some comments on the origin and evolution of conifers. Canadian J. Bot. 59: 75-82.
- Taylor, T.N. Reproductive biology in early seed plants. Bioscience 32: 23-28.
- Walton. An Introduction to the Study of Fossil plants.

COURSE CODE:**BOT7IB24**

COURSE TITLE: MICROBIOLOGY, MYCOLOGY, PLANT ANATOMY, PALYNOLOGY & LABORATORY TECHNIQUES-PART 2.

Microbiology

1. Introduction - main groups of microorganisms and their characteristics -prions, viroids, viruses, bacteria, mycoplasmas, cyanobacteria and actinomycetes.

2. Bacteria - classification based on Bergey's Manuel. Archaeoacteria and Eubacteria. Morphology, ultra-structure,. nutrition, genetics

3. Plasmids and their characterization..

4. Microbial ecology- Sewage disposal, bioremediation and water purification. Detection of microbes in air and water.

5. Agricultural microbiology - management of agricultural soils, biofertilizers, biopesticides.

6. Food Microbiology -.Food spoilage and preservation methods. Microbiology of fermented food - dairy products, bread and other fermented plant products. Microorganisms as source of food- single cell protein.

7. Industrial Microbiology - Production of alcohol, vinegar, antibiotics, vitamins, steroids, vaccines, organic acids, amino acids.

REFERENCES:

- Adams, M R & Moss, M.O. Food Microbiology. New Age International Publishing Ltd., New Delhi.
- Brock, T. D. Biology of Microorganisms. Prentice Hall.
- Campbell, R. Microbiology. ELBS-Edward Arnold, London.
- Carpemter, P.L. Microbiology. W.B. Sunders &Company, Philadelphia.
- Dubey, R.C. & Maheswari, D.K. A text book of Microbiology. S. Chand.
- Desikachary. Cyanophyta- Monograph Goodfellow, M. et.al. The Biology of Actinomyçetes. Academic press.
- Kumar, H.D. & Swati Kumar. Modern Concepts of Microbiology.
- Mathew, R.E.F. Plant Virology, Academic press.
- Pelozar, M.J., Chan, E.C.S. & Krieg, N.R. Microbiology. Tata Mc Graw Hill.
- Sharma, P.D. Microbiology & Plant Pathology. Rastogi Publishers, Meerut.

Mycology

1. An overview of true fungi and fungal analogues (straminipilan fungi and protistan fungi): biodiversity, significance and phylogenetic relationships.
2. General characteristics of true fungi: thallus organization, hyphal structure; wall composition and construction; hyphal elongation and growth; dimorphism; haustoria; rhizomorphs; sclerotia and stromata; fungal organelles, modes of nutrition, process of extracellular digestion, storage materials reproduction and spores, vegetative incompatibility and sexual compatibility, parasexuality. A brief account of radiotrophic fungi and radiosynthesis.
3. Updated phylum-level classification of true fungi by Tedersoo et al., 2018; current taxonomic concepts regarding straminipilan fungi and protistan fungi. Brief account of DNA barcoding in fungi.
4. General characteristics of the following categories of fungi and fungal analogues: chytridiomycetes, zygomycetes, ascomycetes, basidiomycetes, oomycetes and myxomycetes.
5. Asexual fungi (deuteromycetes): general characteristics, habit and importance of asexual fungi, somatic structures, structures associated with asexual reproduction, conidiomata, conidia and conidium ontogeny, other asexual propagules, teleomorph anamorph connections.
6. Lichens: thallus structure, nutrition, reproduction, mutualistic interaction, ecological and economic significance.

References

- 1. Alerxopoulos C.J., Mims, C.W. & Blackwell, M. lntroductory Mycology. 4th edition. John Wiley & Sons lnc.
- Ainsworth, G.C., Sparrow, K.F.& Susmann, A.S.(Eds.). The Fungi - An Advanced Treatise. Vol 1-4. Academic Press.
- Burnett, J.H. Fundamentals of Mycology. Edward Amolds.
- Cariile, M. J. & Watkinson S.C. The Fungi. Academic Press.
- Deacon, J.W. Introduction to Modem Mycology. Blackwell.
- Dubey, H.C. An lntroduction to Fungi. Vikas Publishers, New Delhi.
- Hale Mason, E. The Biology of Lichens. 3rd Ed. Edward Arnold, London.
- Jennigs, D.H. & Lysek, G. Fungal |Biology. Bios Scientifìc Publishers.
- Mehrotra, R.S. & Aneja, K.R. An lntroductión to Mycology. New Age International Publishers.
- Landecker, Elizabeth Moore. Fundamentals of Fungi. 4th Ed. Prentice Hall.

- Nair, M.C. & Balakrishnan, S. Beneficial fungi and their utilization. Scientific Publishers, Jodhpur.
- Nash, T.H. Lichen Biology. Cambridge University Press.
- Webster, John . lntroduction to Fungi. cambridge University Press.

Plant Anatomy

1. Cell wall and its development. Chemistry of cell wall- cellulose, hemicellulose, polysaccharides, cell wall proteins, water. Organisation of primary wall. Cytokinesis and growth. Plasmodesmata. Secondary wall chemical constituents- lignin, suberin, callose; organisation of secondary wall.
2. Node - nodal patterns: Unilacunar, trilacunar, multilacunar and split lateral. Phylogenetic considerations. Leaf trace and branch trace- origin, departure; effect on stele and pith. Secondary growth in leaf traces.
3. Cambium: Development of vascular cambium and cork cambium in root and stem; cell types in vascular cambium, infected vascular cambia, seasonal variations in cambial activity; role of cambium in wound healing and grafting. Conversion of fusiform initials in to ray initials; cambium in arborescent monocotyledons (Liliflorae).
4. Development and differentiation: The structure of specialized cells. Vascular differentiation (procambium, residual meristem, interfascicular and intrafascicular cambia); acropetal and basipetal differentiation in leaves, stem and roots. Sieve tube differentiation. Control of phloem differentiation. Tracheary elements differentiation. Ultra structure of phloem and xylem, brief account of transfer cells.
5. Secondary wall thickening, cytoplasmic changes and autolysis. Control of differentiation. Genetic aspects- lnduction of vessel elements. lnduction of secondary xylem structure in relation to function in water conduction.
6. Anomalous secondary growth: Concepts; modification of the common type of vascular cambium, unequal activity of the vascular cambium. Successive cambia. Anomalous placement of vascular cambium. Discontinuous, unidirectional and bidirectional activity of cambium. Anomalous secondary growth in storage roots (Beet root, sweet potato).
7. Seedling anatomy: Concepts: anatomy of cotyledons, hypocotyl, seedling root, mesocotyl differentiation
8. Leaf anatomy: Unifacial, bifacial and centric leaf (onion); structure of epidermis, stomatal types; foliar sclerieds; oil cells; crystal idioblasts.
9. Anatomy in relation to taxonomy.
10. Wood anatomy- general account.

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References

- Easu, K. Plant Anatomy - Wiley Eastern Limited.
- Fahn, A. Plant Anatomy. Pergamon Press.
- Cutter, E.G. & Edward, E. Plant Anatomy: Experiment and Interpretations Part I and II.
- Mauseth, J.D. Plant Anatomy - The Nenjamin Cumming Publishing Co.
- Forester, A.S. Practical Plant Anatomy. D. Van Nostrand Company lnc.
- Roberts, L.W. Cytodifferentiation in Plants - Cambridge University Press, Cambridge.

Palynology

1. Introduction- contributions of Erdtman and P K K Nair.
2. Development and structure of pollen wall. Pollen morphology and its application. Pollen evolution
3. Aero palynology- methods of aerospore survey and analysis
4. Melisso palynology- nutritional and medical value of honey- unifloral and multifloral honey.
5. Recent advances in palynological studies- forensic-pollen allergy-oil exploration-paleopalynology.
6. Palynology in relation to taxonomy- eurypalynous and stenopalynous taxa.

REFERENCES:

- Sripad N. Agashe. Palynology and its Application.
- Kahinath Bhattacharya et. al. A Text Book of Palynology.
- P.K.K. Nair, 1966. Essentiales of Palynology

Laboratory Techniques

1. Study of the following instruments - their uses and principles:
2. Microscope: microscopic measurements - Camera lucida, Micrometry.

3. Microtomes- Sledge, Rocking, Rotary.
4. Killing, fixing and staining of plant tissues:
5. Important reagents and chemicals used in the preparation of fixatives and their properties.
6. Fixatives - FAA, Carnoy's fluid, chrome acetic, Nawaschins fluid, Flemings- composition, preparation and
7. specific uses.
8. Dehydrating agents, clearing agents, mounting media. Examples and brief description.
9. Stains - classification, composition and specific uses - safranin, crystal violet, cotton blue, fast green, Orange - G, hematoxylin, carmine.

a.) Brief account of vital staining.
b.) Staining techniques - Double staining.
c.) Saffranin - Fast green
d.) Crystal violet – Orange G

10. Methods of embedding plant materials in paraffin wax - TBA method; embedding for Electron microscopy. Sectioning of embedded paraffin wax materials using Rotary Microtome.- Double staining of microtome serial sections embedding in paraffin wax - Saffranin - fast green; Crystal violet, Orange G / Erythrosin.
11. Whole mounts - general account
12. Maceration, smears
13. Histochemical tests –PAS Test - insoluble polysaccharides. -Sudan black -lipids- Fuelgen reaction - Nucleic Acids.

REFERENCES:

- Peter Gray. Hand book of Basic Microtechnique. Mcgraw – Hill.
- Jensen, W. A. (1962) Botanical Histochemistry. WH Freeman & Company.
- John E. Sass. Botanical Microtechnique, Oxford & IBH Publishing Co.
- John R. Baker. Principles of Biological Microtechnique –A guide book to microscopical methods.
- A. V. Grimstone and R.J. Saker, Cambridge Univ. press.
- K.V. Krishnamurthy. Methods in Plant Histochemistry

COURSE CODE: **BOT7IH25**

COURSE TITLE: PRACTICAL PAPER OF PHYCOLOGY, BRYOLOGY, PTERIDOLOGY, GYMNOSPERMS, MICROBIOLOGY, MYCOLOGY, PLANT ANATOMY, PALYNOLOGY & LAB TECHNIQUES

Phycology

- Collection, preparation and submission of algal herbarium (5 numbers).
- Collection and study of the types mentioned below and their identification up to generic level using algal monographs:

  Chlorophyta: Pediastrum, Scenidesmus, Hydrodyctyon, Ulva, Cladophora, Cephaleuros, Codium, Caulerpa, Halimeda, Desmids (Closterium, Cosmarium), Nitella.
  Xanthophyta: Botrydium.
  Bacillariophyta: Coscinodiscus, Cymbella.
  Phaeophyta: Ectocarpus, Dictyota, Padina
  Rhodophyta: Batrachospermum, Gracilaria

Bryology

- Morphological and structural study of representative members of the following groups using whole mount preparations, dissections and transactions: *Asterella, Targionia, Cyathodium, Lunularia, Pallavicinia, Dumortiera, Porella, Anthoceros, Sphagnum* and *Bryum*.

Pteridology

- Study of vegetative and reproductive features of *Lycopodium, Ophioglossum, Angiopteris, Osmunda, Lygodium, Ceratopteris, Pteris, Asplenium, Blechnum, Cyathea, Gleichenia, Trichomanes, Salvinia* and *Azolla*. Study of the following fossils: *Rhynia, Lepidodendron, Sphenophyllum, Calamites, Calamostachys, Zygopteris* and *Anachoropteris*. Spore germination and development of prothallus in Knop's Agar medium.
- A study of Pteridophytes in their natural habitats.

Gymnosperms

- Identification of petrifications, compressions, impressions: *Lyginopteris, Heterangium, Medullosa, Trignocarpus, Glossopteris, Caytonia, Pentaxylon* and *Cordaites*.

- Study of vegetative and reproductive structures of *Zamia, Ginkgo, Pinus, Cryptomeria, Cupressus, Araucaria, Agathis, Podocarpus, Cephalotaxus, Ephedra* and *Gnetum*.

Microbiology

- Test for the presence of coliform bacteria in contaminated water.
- lsolation of Eubacteria and Cyanobacteria from soil by dilution plate method.
- lsolation of pure bacterial culture by streak plate method.
- Staining of bacteria (negative staining, Gram staining and spore staining).
- Demonstration of bacterial motility by hanging drop method.

Mycology

- Critical study of the following types with the help of fresh/preserved materials by making suitable micro-preparations giving emphasis on systematic position, details of vegetative and reproductive structures:
- *Stemonitis, Saprolegnia, Phytophthora, Albugo, Mucor, Pilobolus, Saccharomyces, Xylaria, Chaetomium, Peziza, Puccinia, Auricularia, Polyporus, Ganoderma, Lycoperdon, Dictyophora, Geastrum, Cyathus, Aspergillus, Curvularia, Alternaria, Fusarium, ColIetotrichum, Parmelia, Usnea*.

Plant anatomy

1. Study of anomalous secondary growth in roots and stems of *Aristolochia, Strychnos,* Amaranthaceae, Nyctaginaceae, Bignoniaceae and Agavaceae.
2. Nodal anatomy of different types.
3. Leaf anatomy: epidermal peels and TS of lamina

Palynology

1. Analysis of honey for microscopic examination of pollen.
2. Calculation of percentage of viable pollen by using Tetrazolium (TZ) test.
3. Study of pollen wall by acetolysis.

Laboratory Techniques

1. Measurement of microscopic objects - Micrometry.
2. Camera lucida drawing - calculation of magnification (demonstration only)
3. Double stained permanent sections - free hand section, Microtome serial sections.
4. Preparation of whole mounts, macerations and smears.
5. Submission of 10 permanent slides - which should include microtome serial sections, free hand sections, macerations, whole mounts and smears.

SEMESTER 8

COURSE CODE:**BOT8IB26**

COURSE TITLE: GENETICS (PART 2), CYTOGENETICS AND APPLIED ENVIRONMENTAL SCIENCE

Cytogenetics

1. Cytogenetics of aneuploids, euploids and structural heterozygotes: Effect of aneuploidy on phenotype. Transmission of monosomics and trisomics and their uses.
2. Breeding behavior and genetics of structural heterozygotes; translocation heterozygotes; Robertsonian translocation; B-A translocation. Karyotype- concepts and its importance. Structural chromosome aberrations- types and significance in evolution. Heteroploidy, A neuploidy, monosoly, trisomy (primary, secondary, tertiary and compensating). Nullisomy. Uses of aneuploidy in cytogenetics. Euploidy- autoploidy, alloploidy and segmental allopolyploid diploidization. Role of aneuploidy and euploidy in evolution.
3. Molecular cytogenetics: Multigenic families and their evolution; *in situ* hybridization- concept. Computer assisted chromosome analysis, chromosome micro-dissection and micro-cloning; flow cytometry.
4. Polytene and Lampbrush chromosomes- cytogenetic importance; Supernumerary chromosomes: *B*-chromosomes

References

- Alberts B., D. Bray, J. Lewis, K. Roberts and J.D.Watson. Molecular Biology of the Cell Gart and Publishing Inc. New York.

- Atherly A.G., J.R. Girton and J.F. McDonald. The Science of Genetics. Saunders College Publishing, Fort Worth, USA.
- Burnharm C.R. Discussions in Cytogenetics. Burgess Publishing Co., Minnesota.
- De Robertis E.D.P. and De Robertis E.M.F. Cell and Molecular Biology ISBN, Hong Kong.
- Dupraw E.J. DNA and Chromosomes. Holt, Rinehart and Winston lnc. New York.
- Hart D.L and E.W. Jones. Genetics: Principles and Analysis. Jones & Bartlett publishers, Massachusetts, USA.
- Khush, G.S. Cytogenetics of Aneuploids. Academic Press.
- Karp G. Celland Molecular Biology: Concepts and Experiments. John Wiley & Sons, Inc. USA.
- Lewin B. Gene. Oxford University Press, New York, USA.
- Lewis R. Human Genetics: Concepts and Applications. WCB Mc Graw Hill, USA.
- Malacinski G.M and D.Freifelder. Essentials of Molecular Biology. Jones and Bastlet Publishers lnc., London
- Rieger R., A.Michaelis and M.M.Green Glossary of Genetics and Cytogenetics -Classical and Molecular.Springer-Verlag, New York.
- Swanson C.P., T. Merz, and J.W.Young. Cytogenetics. Prentice Hall.

Genetics

1. Relevance of Mendelism in modern genetics. A critical evaluation of Mendelism on the basis of modern concept of genes.
2. Linkage and gene mapping. Three- point test cross; linkage map; interference; tetrad analysis and centromere mapping. Linkage in humans. Pedigree analysis. Genetic recombination and mapping of genes in bacteria and bacteriophages.
3. Mobile genetic elements: Transposable elements in Bacteria. lS elements. Tn elements. Composite transposon, P elements in *Drosophila*. Ac-DS and Mu elements in Maize. Retrotransposons- Molecular characteristics and significance in development and evolution.
4. Extranuclear inheritance: Analysis of mitochondrial and chloroplast genomes and their utility. Cytoplasmic male sterility.
5. Biometrical genetics- probability and genetics- prediction of genetic behaviour
6. Statistical tools in genetic analysis
7. Genetics of prokaryotes-genetic organization of bacteria and viruses- bacterial mutants- transformation, conjugation and transduction.
8. Developmental genetics- genetic control of development in plants- genetic control of cell lineages.
9. Behavioural genetics- general account
10. Applied genetics- Eugenics, euphenics and euthenics, Immunogenetics
11. Quantitative genetics: Polygenic inheritance, heritability and its measurements. QTL mapping.
12. Population genetics: systems of mating. The Hardy-Weinberg principle. Estimation of gene frequencies. Factors affecting equilibrium: natural selection, mutation, migration and genetic drift.
13. Human genetics: Human pedigree analysis, Lod score for linkage testing. Karyotype; genetic disorders

References:

- Snustad, Simmons and Jenkins. Principles of Genetics. John Willey and Sons.
- Weaver and Hendrck. Genetics. Wm. C Brown Publishers.
- Goodenough. Genetics. Saunders College Publishing.
- Stansfield. Theory and Problems of Genetics. Mc Grow Hills.
  Strlckberger. Genetics. Macmillan.
- Burnet L.Essential Genetics. Cambridge University Press.
- Friefelder. Microbial Genetics. Narosa Publishing House.
- Gardner, Simmons and Snustad. Principles of Genetics. John Wiley and Sons, New York, USA.
- Singh B.D. Fundamental of Genetics. Kalyani Publishers, New Delhi.

Applied Environmental Science

1. Natural Resources and associated problems; Forests of World/India/Kerala; water resources; Mineral resources; Food resources; Energy sources; Land resources. Ecosystem diversity- Terrestrial and aquatic

Biomes,- Forest, -Grassland, Desert, Tundra, Marine and Fresh water (lentic and lotic) ecosystems- characteristic features, structure and function; Forest types of India, Kerala.

2. Environmental pollution-definition, causes, effects and control, measures of a) air pollution b) water pollution c) land pollution d) marine pollution e) noise pollution f) thermal pollution g) Nuclear (Radio active) pollution; Case studies; Minamata, Love Canal, Bhopal tragedy, Chernobyl, Tsunami 3.
3. Solid waste management- urban and industrial wastes; Role of individual- prevention of pollution.
4. Disaster management.; Environmental Impact Assessment (EIA); Bioremediation, Bioflocculation; Society and Environment- sustainable development –concept.
5. Gia hypothesis- Water conservation- rain water harvesting- water shed management
6. Climatic change- global warming, ozone depletion. Green house effect, Glaciation
7. Environment Protection Act- Air (Pollution and control) Act- Water (Pollution and control) Act- Earth summit (UNCED) Rio+5, Rio+10 (Ramsar conservation, Ramsar sites of India- Kyoto agreement.
8. IPR and Patents.
9. NGO's and conservation movements.

COURSE CODE:**BOT8IB27**

COURSE TITLE: ANGIOSPERM MORPHOLOGY, TAXONOMY, FOREST BOTANY & PLANT REOURCES PART 2(2+2+1+1= 6 hours per week)

Morphology

1. A critical study of the current ideas on the origin of Angiosperms with special reference to their ancestral stock, time and place of origin.
2. The concept of primitive angiosperm flower. Origin and evolution of flower, co-evolution of flowers vis-a-vis pollinators.
3. Origin and evolution of structure and morphology of stamens, nectarines and nectar.
4. Origin and evolution of carpels: different types- concept of foliar origin of carpels; types of ovary; evolution of placentation types- inferior ovary- foliar and axial concepts. Role of floral anatomy in interpreting the origin and evolution of flower and floral parts

REFERENCES:

- Eames, E.J. Morphology of Angiosperms. Mc Graw Hills Book Co. New York.
- Bamard, C. The interpretation of Angiosperm flower. Aust. J. Sci.24:64'72. 1961.
- Manilal, K.S. Vascularization of corolla in Compositae. J. lndian Bot. Soc.59; 189-196
- Meeuse, A.D. J. Some fundamental principles of interpretive floral morphology. International Sci. Publ. Hissar. 1974.
- Melville, R. New theory of Angiosperm flower. Nature 188: 14-18. 1960.
- Puri, V. Inferior ovary. Phytomorpholgy2:122.1952.
- Sporne, K.R. The Morphology of Angiosperms. Hutchinsons Uni. Press, London. 1974.

Taxonomy

1. Principles of Taxonomy- Scope and importance of Taxonomy
2. Conceptual basis of classification- essentialism, nominalism, empiricism, phenetics and cladistics. Phylogenetic and alternative; concept of genus; concept of family; infraspecific categories.
3. Definitions and terms: primitive and advanced; homology and analogy; parallelism and convergence; monophyly and polyphyly.
4. Taxonomic hierarchy- detailed study of salient features and major provisions of the lnternational Code of Botanical Nomenclature (ICBN). Effective and valid publication, rank of taxa, rule of priority and its limitations, typification, author citation, rejection of names and names of hybrids. A brief account of International Code of Nomenclature of Cultivated Plants.
5. Concepts of character: definition, classification of characters- analytical and synthetic, qualitative and quantitative; unit and multiple, good and bad; correlation of characters; character weighting.
6. Modern trends in Taxonomy, biosystematics and numerical taxonomy. Molecular taxonomy- DNA bar coding in plants.
7. History and development of taxonomy in India. Classification of taxonomic literature- general indices, floras, icons, monographs, reviews-and journals; Herbarium- definition, steps involved in the

development of herbarium utility of herbarium and its maintenance- general account of regional and national herbaria with special reference to central National herbarium, Calcutta (CAL) and Madras Herbarium (MH). Botanical survey of India; Botanical gardens- types of gardens and importance of gardens in taxonomic studies- important national and international; Botanical Gardens- Royal Botanical Garden, Kew; Indian Botanical Garden, Calcutta, National Botanical Garden, Lucknow, Tropical Botanic Garden, Trivandrum.

References:

- Cronquist A. Evolution and classification of flowering plants. Thomas and Nëlson Co.
- Cronquist. A. An integrated system of classification of flowering plants. New York.
- Graf A.B. Tropica. Roehrs Company Publ. NJ, USA.
- Harborne J.B. & Turner B.L. Plànt chemosystematics. A.P., London.
- Haywood W.H. & Moore D.M. Current concepts in plant taxonomy.
- Rendle A.E. Classification of flowering plants.
- Lawrance. G.H.M. Tãxonomy of Vascular plants. Oxford and IBH.
- Sneeth P.H.A. Numerical taxonomy.W.H.Freeman Co., Sãn Francisco.
- Sporne. K.R. The Morphology of Angiosperms. Hutchinson University Press, London.
- Sivarajan V.V. Introduction to principles of plant taxonomy. Oxford and I
- Smith P.M. The Chemotaxonomy of plants. Edward Arnold, London.
- Stace, C.A. Plant Taxonomy and Biosistematics. Edward Arnord, London.
- Takhtajan, A. L. Diversity and classification of flowering plants. Columbia University Press, New York.
- Woodland, D.W. Contemporary plant systematics. Prentice Hal, New Jersy.
- Simpson M.G. Plant Systematics. Elsevier, Amsterdam.
- Stebbins, G.L. Flowering Plants- Evolution above species level. Edward Arnord, Lond

Forest Botany

1. Forest- Definitions. Study of various types of forests in the world and in India.
2. Forest products-Major and minor with special reference to Kerala.
3. Influence of forests on environment. Consequence of deforestation and industrialization- sustainable utilization of Bioresources

References

- Agarwal A.P. Forests in India. Oxford & IBH.
- Gregorv G.R. Forest products, production, trade and consumption, quantity and value of raw materials requirements. Ford foundation, New-Delhi.
- Puri G.S. Indian Forest Ecology Vol. l& ll. Oxford & IBH.
- Champion G.H. and Seth S.K. A revised survey of the forest types of lndia

Plant Resources

1. A study of history, occurrence, morphology of useful part and overall chemical composition of the following:
    - Cereals & millets: rice, wheat, maize, sorghum, finger millet, pearl millet.
    - Pulses: Bengal gram, cluster bean, common bean, horse gram, cow pea.
    - Sugar yielding plants: sugar cane, beet root.
    - Starch yielding tubers: potato, tapioca, arrow root, yam, taro.
    - Fats & Oils: ground nut, coconut, castor, gingelly, mustard, oil palm.
    - Beverages: tea, coffee, cocoa.
    - Spices and Condiments: pepper, ginger, turmeric, coriander, cumin, fennel, fenu-greek, cardamom, nutmeg, cloves, cinnamon.
    - Fibre yielding plants: cotton, jute, coir.
    - Rubber yielding plants: pararubber.
    - Timber yielding plants: teak, rose wood, Artocarpus, Ailanthes, Xylia.
2. A study of the following medicinãl plants with reference to the chemical and pharmacognosic properties: Neem, Turmeric, *Adhatoda*, *Rauwolfia*, *Catharanthus*, *Bacopa*, *Strycnos* nux-vomica, sweet

flag,

Saraca, wood apple, Indian myrobalans, liquorize

References

- Arora R.K. & Nayar, E,K. Wild relatives of crop plants in India. NBPGR Sci. Monograph No.7.
- Bole, P.V. & Vaghani, Y. Field guide to common Indian trees. Oxford Uni. Press.
- Chandel, K.P.S., Shukla, G. & Sharma, N. Biodiversity in medicial and aromatic plants in lndia- conservâtion and utilization. NBPGR. New Delhi.
- Chripeels, M.J. & Sadava, D. Plants, food and people. W.Freeman & Co. San Francisco.
- Conwqy G. The doubly green revolution: food for all in the 2lst century. Penguin Books. CS1R. The useful plants óf India. Publication and Information directorate, CSIR, New Delhi.
- Kochar S.L. Economic Botany of the Tropics. Macmillon India Ltd.
- Nàir M.N.B. et al. (eds.) Sustainãble management of non wood forest products. Faculty of Forestry, Uni. Putra, Malaysia.
- Padora R.S. and Arora R.K. Plant genetic resources and management. IPGRI Publication, South Asia office, NBPGR, Pusa Campus, New Delhi.
- Indian Science Academy. Plant wealth in India. Special issue of proceedings, 1997.
- Sahni, K.C. The Book of lndian Trees. Oxford Uni. Press, Mumbai.
- Sharma, O.P. Hill's Economic Botany. Tata Mc Graw Hill Co., New Delhi. _
- Swaminathan M.S. & Kochar, S.L..(eds.) . Plants and society. Macmillan Publication, London.
- Thakur, R.S., Puri, H.S. & Husain, A. Major medicinal plants of lndia. Central lnstitute of Medicinal and Aromatic Plants, CSIR, Lucknow.

COURSE CODE:**BOT8IB28**

COURSE TITLE: PHYLOGENETICS

Module I: Background Knowledge: Evolutionary Biology – From atoms to molecules to life, Hy-pothesis of evolution, Darwin's theory of evolution, From taxonomy to molecular phylogenetics –Linnaeus' classification systems- Whittaker's five kingdom system, Carl Woese's three domain sys-tem; Traditional Systematics/phylogeny.

Module II: Tree concept: Molecular data as molecular fossils; Molecular-clock-hypothesis; The terminology of phylogenetics- Trees, Root, branches, Node, Leaf, Clade; lineage sorting, orthology, paralogy, xenology; "basal" lineages, crown vs. stem groups, Phylogram vs. cladogram.

Module III: Molecular phylogeny : Gene phylogeny vs. species phylogeny; Different types of trees- rooted vs. unrooted trees, dichotomy vs. polytomy, monophyletic vs. paraphyletic, ultra-metric vs. unconstrained; Constructing molecular phylogenetic trees-Choice of molecular markers.

Module IV: Phylogenetic Algorithms: Clustering based methods-UPGMA and neighbor joining, Optimality based: Fitch-Margoliash and minimum evolution algorithm; Character based methods-Maximum Parsimony (MP) and Maximum Likelihood (ML) methods; Bayesian inference, Evaluation of phylogenetic trees reliability and significance; Boot strapping; Jackknifing.

Module V: Phylogenetic software & applications: Multiple sequence alignment & Tree building software - ClustalW, Mega, Phylip, Phylodraw, Phyml, RaxML; Case studies- Phylip/Mega.

Module VI: (Flexi module- Only for Internal Assessment. Lecturers may expand and/ or interpret the syllabus to update it or suit the particular cohort in any way) Allied topics: Population genetics. Genetic polymorphism, variations, alleles, Human Y-chromosome haplogroups, Mitochondri-omics: - Mitochondrial haplogroups, rCRS, SNP, Mitochondrial eve, Human mitochondrial molecular clock.

COURSE CODE:**BOT8IH29**

COURSE TITLE: PRACTICALS OF GENETICS, CYTOGENETICS, APPLIED ENVIRONMENTAL SCIENCE, ANGIOSPERM MORPHOLOGY, TAXONOMY, FOREST BOTANY (2), PHYLOGENETICS.

Cytogenetics

1. lnduction of polyploidy using colchicine; different methods of the application of colchicine.

2. Effect of induced and spontaneous polyploidy on plant phenotype, meiosis, pollen and seed fertility and fruit set.
3. Preparation of karyotype and ideogram of plant meristematic cells.
4. Cytological studies in callus tissues.
5. Study of meiosis in translocation heterozygotes (*Rheo discolor*)
6. Study of polytene chromosomes.

Genetics

1. Problems from linkage, tetrad analysis, quantitative genetics and population genetics.

Applied environmental Science

1. Determination of the minimum size of the quadrat suitable for an area using species area curve method.
2. Determination of the Importance Value Index (lVl) of plant species in the community by quadrat, line and belt transect methods.
3. Comparative study of polluted and non polluted aquatic ecosystems.
4. Visit to a meteorological station, national park or wild life sanctuary, sewage treatment unit and major construction site.
5. Estimation of dissolved oxygen content in the water sample by Winkler's method.
6. Determination of primary production in water samples by light and dark bottle method (Winkler's method).
7. Determination of dissolved carbon dioxide content in water samples.
8. Determination of frequency of plant species of an area and heterogeneity of vegetation using transect method.

Angiosperm Morphology

1. Preparation of cleared whole mounts of floral parts to show vasculature.
2. Examination of the following with the help of dissections and hand sections: Transmitting tissues/canals in style and stigma; Different types of ovaries; Different types of placentation, vasculature of androecium and gynoecium in special types of flowers

Taxonomy

1. Familiarization with local flora and construction of keys – use of floras in identification up to species.
2. Study of diagnostic features of the families studied in the theory paper with special reference to their economic aspects.
3. Study of the following families with special reference to morphology of modified parts, economic importance, interrelationships and evolutionary trends: Magnoliaceae, Ranunculaceae, Menispermaceae, Nymphaeace, Polygalaceae, Caryoplyllaceae, Clusiaceae, Sterculiacéae, Meliaceae, Sapindaceae, Rosaceae, Melastomaceae, Rhizophoraceae, Aizoaceae, Rubiaceae, Sapotaceae, Gentianaceae, Boraginaceae, Convolvulaceae, Scrophulariaceae, Pedaliaceae, Verbenaceae, Nyctaginaceae, Euphorbiaceae, Urticaceae, Casuarinaceae, Orchidaceae, Zingiberaceae, Amaryllidaceae, Commelinaceae, Araceae, Cyperaceae and Poaceae.
4. Dissection of at least two members of each family in the laboratory, making suitable sketches, describing them in technical terms and identifying them constructing appropriate floral diagrams.
5. Field study of five days under the guidance and supervision of teachers at an ecologically different locality and submission of a field study report certified by the teacher concerned. The report should contain ecology of flora of the area studied. Each student shall collect plant specimens following the standard means of plant collection for preparation of herbarium. Each student shall submit a minimum of 50 such herbarium specimens along with the field book for the Practical examination.
6. Problems in Bar Coding

Forest Botany

1. Study of the major and minor forest products of Kerala and their uses.

Plant Resources

1. Morphological study of the source plants mentioned in the theory syllabus and identification of the plants and plant products

PHYLOGENETICS

1. Phylogenetic software & applications: Multiple sequence alignment & Tree building software - ClustalW, Mega, Phylip, Phylodraw, Phyml, RaxML; Case studies- Phylip/Mega.

SEMESTER- 9

COURSE CODE:**BOT9IB30**

COURSE TITLE: GENETIC ENGINEERING

Module -I

Introduction to gene cloning (**12** hr.)

1. DNA isolation; DNA isolation solu APPLIED ENVIRONMENTAL SCIENCE tions, isolation buffer pH, concentration and ionic strength, DNase inhibitors, detergents used for isolation, methods for breaking the cells
2. Removal of proteins from cell homogenate; using organic solvents, Kirby method and Marmur method, using CTAB
3. Removal of RNA; using RNase A, RNase T1
4. Concentrating the isolated DNA; precipitating with alcohols, salts added along with alcohol
5. Determination of the concentration and purity of DNA; using UV spectrophotometry
6. Storage of DNA samples
7. Commercially available kits for genomic and plasmid DNA isolation
8. Preparation of genomic DNA from animal cells, plant cells and bacterial cells; protocol for small scale and large scale preparations
9. Isolation of plasmid DNA; protocol for small scale and large scale preparations
10. Isolation and purification of RNA; purification of total RNA, RNAse inhibitors, preparation of cell material, preparation of glass wares, guanidinium hot phenol method, high salt lithium chloride method, isolation of poly A RNA

Module-II

Agarose Gel electrophoresis of DNA and RNA (**15** hr.)

1. Principles of electrophoresis,
2. Buffers used for electrophoresis of nucleic acids,
3. Gel concentration, sample concentration, sample loading solutions,
4. Gel staining,
5. Determination of molecular weight using molecular weight markers, special precautions and treatments required for electrophoresis of RNA, Elution of DNA from agarose gels; electroelution, using low-melting point agarose.
6. Nucleic acid transfer and hybridization; Southern blot transfer, dot-blot transfer, plaque and colony transfer, Southern blot hybridization, Northern blot transfer and
7. hybridization, in situ hybridization
8. Preparation of probes for hybridization, radioactive labeling, digoxigenin labeling, nick translation, preparation of primer using PCR, RNA probes

Module - III

Principle of DNA cloning (**12** hr.)

1. Cloning vectors; essential features of a cloning vector, plasmid derived vectors, bacteriophage derived vectors, hybrid vectors, high capacity cloning vectors; BACs, PACs and YACs, Agrobacterium based vectors, shuttle vectors, expression vectors
2. Enzymes used in recombinant DNA technology; type II restriction endonucleases, ligases, S1

nuclease, alkaline phosphatase, terminal transferase, DNA polymerase I, reverse transcriptase, exonuclease III, bacteriophages λ exonuclease,

3. Finding gene of interest; shot gun cloning followed by screening, construction and use of genomic DNA library and cDNA library, screening DNA libraries, chromosome walking, in silico gene discovery, cloning of the gene of interest, altering the gene of interest through site directed mutagenesis,
4. Preparation of recombinant DNA molecule, blunt ends and sticky ends, using tailing method, using poly linkers
5. Methods to transfer the recombinant DNA molecule into the cloning host; transformation, transfection, transduction, electroporation, microinjection, microprojectiles and DNA gun, Agrobacterium mediated transfer
6. Methods to select the recombinants; antibiotic markers, insertional inactivation, replica plating, blue-white selection, use of reporter genes; GUS, luciferase and GFP genes

Module -IV

Transgenesis; introduction to transgenic organisms and their applications (**15** hr.)

1. Mechanism of gene transfer into eukaryotic cells, transfection methods; using polyethylene glycol, chemical transfection using lithium acetate, calcium phosphate, and DEAE-dextran, lipofection, electroporation, microinjection, DNA gun, fate of DNA transferred to eukaryotic cells, random integration transgenesis – gain of function effects and loss of function effects, gene targeting,
2. Examples of transgenic crop plants and animals
3. Antisense and RNAi technology
4. Production of knock out models and their use
5. Applications of recombinant DNA technology
6. Ethical, Social and legal issues associated with recombinant DNA technology

References

- Recombinant DNA, JD Watson, (1992) Scientific American Books
- Recombinant DNA: genes and genomes – a short course, JD Watson et al., (2006) WH Freeman & Co.
- Recombinant DNA technology and applications, Alex Prokop et al., (1997) McGraw Hill.
- Principles of Gene Manipulation: An Introduction to Genetic Engineering, by R.W. Old and B001H6L956 S.B. Primrose, (2000) Blackwell Scientific

COURSE CODE:**BOT9IB31**

COURSE TITLE: COMPUTER AIDED DRUG DESIGNING

Module -I

Drug Discovery: Review of basic biological concepts- Diseases and their causes-molecular basis of diseases. Immunology- cells and molecules in immune system, antigens & antibodies, immune response, vaccines. Molecular targets, Characteristics of a drug compound, mechanism of drug action, small molecular drugs, peptide drugs. Traditional approaches in drug discovery, serendipity, high throughput screening, and drug discovery in post-genomic era. Drug discovery pipeline, pre-clinical & clinical studies, IP issues in Drug Design, drug licensing in India.

Module II:

(Flexi module- Only for Internal Assessment. Lecturers may expand and/ or interpret the syllabus to update it or suit the particular cohort in any way): Computational approaches in Drug Design: Applications of bioinformatics in target identification & validation, binding site prediction. Lead compound identification: Structure-based & ligand based approaches; Molecular docking- algorithms and scoring functions; Virtual screening- combinatorial chemistry and ligand databases; Design of ligands for known target sites- de novo techniques. Lead optimization.

Pharmacophore ligand based & target based. QSAR - molecular descriptors, bio-activity predictions. ADME Predictions. Introduction to Software: Autodock, Gold etc.

References

- Charifson, P. S. (1997). Practical application of computer-aided drug design. Marcel Dekker, Inc.
- Claverie, J. M., & Notredame, C. (2011). Bioinformatics for dummies. John Wiley & Sons.
- Eidhammer, I., Jonassen, I., & Taylor, W. R. (2004). Protein Bioinformatics: An algorithmic approach to sequence and structure analysis (pp. 3-23). J. Wiley & Sons
- Higgins, D., & Taylor, W. (2000). Bioinformatics: sequence, structure, and databanks: a practical approach. Oxford University Press, Inc.
- Jiang, T., Xu, Y., & Zhang, M. Q. (Eds.). (2002). Current topics in computational molecular bi-ology. MIT Press
- Krane, D. E. (2003). Fundamental concepts of bioinformatics. Pearson Education India.
- Lam, Y. W. F., & Cavallari, L. H. (Eds.). (2013). Pharmacogenomics: Challenges and Opportu-nities in Therapeutic Implementation. Academic Press.
- Propst, C. L., & Perun, T. (1989). Computer-aided drug design: methods and applications. Marcel Dekker, Inc.
- Reddy, M. R., & Erion, M. D. (Eds.). (2001). Free energy calculations in rational drug design. Springer.

COURSE CODE:**BOT9IB32**

COURSE TITLE: PERL FOR BIOLOGIST (Credit-4)

Module I: Perl Basics: Evolution & Environment – Features of Perl; Scalar Data & Operators, Control Structures. Lists & Arrays, Array Functions, Associate Arrays, Arrays & Data Containers, Hash.

Module II: Functions: User defined functions Built in Functions, References, Regular Expressions – Processing Text with R.Es. Strings & Sorting Smart Matching, Perl Modules

Module III: File handling regular expression: File handling and regular expression, File I/O, Di-rectory Operations; Perl & Relational Data bases, Basic operations in regular expression-Match operation, substitute operation, Translate operation

Module IV: Web programming and Perl: Introduction to web programing, Perl and web, CGI & HTML Forms-Perl scripting for CGI, Cookies & sessions

Module V: Principles of Object Orientation, Creating Classes, Instance Methods, Special Methods, Class Variables, Inheritance, Polymorphism, Type Identification, Exceptions- Errors, Run Time Errors, The Exception Model, Exception Hierarchy, Handling Multiple Exceptions, Writing new Exception Classes.

References

- Schwartz, R. L., & Phoenix, T. (2001). Learning Perl. O'Reilly & Associates, Inc.
- Tisdall, J. (2003). Mastering Perl for bioinformatics. "O'Reilly Media, Inc."
- Zamora, M. C. (2013). Programming with Perl.

COURSE CODE**: BOT9IH33**

COURSE TITLE: PRACTICALS OF GENETIC ENGINEERING, COMPUTER AIDED DRUG DESIGNING, PERL FOR BIOLOGIST

Genetic engineering*:*

Students should be given sufficient exposure to the experiments listed below either by visiting nearby biotechnology labs or showing video clippings of the same. Centers selecting this elective are supposed to procure the required facilities in the meantime.

Protocols of the listed experiments should be recorded.

1. chromosome preparation: mitosis –Onion root tip
2. Differential staining of blood, Blood typing.
3. Antibiotic sensitivity test
4. Isolation of genomic DNA from plants and its quantification and purity checking using spectrophotometric method.
5. Agarose gel electrophoresis of the isolated plant genomic DNA, its visualization and photography.
6. Isolation of plasmid DNA from bacterium, and its quantification and purity checking using spectrophotometric method.
7. Agarose gel electrophoresis of the isolated plasmid DNA, its visualization and photography
8. Preparation of competent *E. coli* cells.
9. Preparation of recombinant plasmids, transformation of *E. coli* and selection of transformants.

Record of the practical works done together with the detailed report of the Biotechnology Laboratory visit should be duly certified and submitted for the valuation at the time of practical examination of core practical paper III.

Computer Aided Drug Designing*:*

1. Molecular docking
2. Binding site prediction of enzyme.
3. Design of ligands for non target sites.
4. Introduction to Software: Autodock, Gold
5. Facilitating access from various Bioinformatics databases: NCBI, PDB, SWISS PROT, Pfam etc., and pairwise sequence alignment using BLAST.

Perl For Biologist*:*

1. Perl scripting for CGI, Cookies, sessions
2. Identifying and removing errors from a program – debugging
3. Processing Text with R.Es.
4. Database creation and management using PHP-MySQL, writing programs using python features including functions, string handling as well as object oriented features, Data analysis using R package.

SEMESTER10

ELECTIVES (Credit-4)

COURSE CODE**: BOT10IE36**

Elective1. Plant Physiology

1. **Water and plant cells:** Water in plant's life; properties. Diffusion and facilitated diffusion. Absorption and short distance transport, pressure driven bulk flow and long distance transport. Osmosis driven by water potential gradient. Water absorption by roots via apoplastic, symplastic and transmembrane pathways. Role of aquaporins. Water movement through xylem. Mechanism and theories of transport. Cavitation and embolism. Soil-plant atmosphere continuum. Physiology of stomatal function- blue light effect.
2. **Plants and inorganic nutrition:** Nutrient elements- classification based on biochemical functions. Physiological roles. Nutrient uptake: interaction between roots and microbes. Ion uptake by roots: diffusion, facilitated diffusion and apparent free space. Apoplastic and symplastic pathways. Membrane potential. Passive and active transport. Transport proteins: carriers- Michaelis-Menten kinetics. Channels: Voltage dependent K+ channels, voltage gated channels, Calcium channels, vacuolar malate channels. ATPase ctivity and electrogenic pumps. Patch clamp studies. Application of Nernst equation. Active transport and electrochemical potential gradients.
3. **Assimilation of mineral nutrients:** Nitrogen and bio geocycle nitrate assimilation, reduction, biological nitrogen fixation. Symbiosis: Nitrogenase activity, assimilation of ammonia, pathways and enzymes. Transport of amides and ureides. Sulphur assimilation: Bio geocycle, reduction of sulphates. Importance of

Phosphorus, Iron Magnesium, Calcium and Potassium assimilation. Energetics of nutrient assimilation. Molecular physiology of micronutrient acquisition.

4. **Photosynthesis:** Light absorption and energy conversion. Electron transport system in chloroplast membranes. ATP synthesis in chloroplast. Photosynthetic carbon reduction, carbon oxidation and photorespiratory cycles. C4 and CAM metabolism. Physiological and environmental consideration of photosynthesis. Distribution of photo-assimilates- export. Starch and sucrose synthesis. Allocation and partitioning: Phloem loading and unloading. Concept of osmotically generated pressure flow. Importance of plasmodesmata in symplastic transport.
5. **Respiration:** Glycolytic reactions. Pyruvate entry in to mitochondria and citric acid cycle. Electron transfer system and ATP synthesis. Transporters involved in exchange of substrates and products. ATP synthesis, unique electron transport enzymes of plant mitochondria. Interaction between mitochondrial and other cellular components. Metabolites and specific transporters. Lipid metabolism.
6. **Growth, differentiation and development:** Analysis of plant growth: production of cells, growth velocity profile. Cytological and biochemical events. Differentiation: secondary cell wall formation, multinet growth hypothesis of cell wall. Development: initiation and regulation of development, genes involved in the control of development, role of protein kinases. Types of development: flowering- floral induction, evocation and morphogenesis. Floral organ identity genes. Biochemical signaling: Theories of flowering. Control of flowering phytochrome, cryptochrome and biological clock. Factors affecting flowering: Photoperiodism and thermoperiodism.
7. **Fruit development and ripening:** physiology of ripening- cell wall architecture and softening, enzymes involved in biochemical changes.
8. **Seed development:** deposition of reserves during seed development, desiccation of seeds- hormones involved desiccation tolerance. Classification of seeds. Seed dormancy.
9. **Germination physiology:** Imbibition, germination and reserve mobilization- metabolism of carbohydrates, lipids, proteins and phytins. Physiology of seed dormancy.
10. **Plant growth regulators:** auxins, gibberellins and cytokinins- biosynthesis, physiological roles. Ethylene biosynthesis, mode of action, physiological roles, commercial importance. Abscisic acid- biosynthesis and metabolism, physiological effects, role in dormancy and senescence. Hormonal balance concept.
11. **Photoreceptors:** Phytochromes- photochemical and biochemical properties; functions. Mechanism of of phytochrome regulated differentiation. Signal transduction. Cryptochromes.
12. **Senescence and programmed cell death:** Apotosis and necrosis. Programmed cell death in relation to reproductive development and stress response. Metabolism during senescence.
13. **Stress physiology:** Water deficit and drought resistance. Heat stress and heat shock, chilling and frost. Salinity stress. Stresses due to oxygen deficiency and heavy metal pollution.

Practicals for elective 1

1. Determination of moisture content of plant materials.
2. Separation of plant pigments by paper chromatography and thin layer chromatography and study of their absorption spectra.
3. Quantitative estimation of chlorophyll using spectrophotometry.
4. Study of amylase activity and effect of gibberellic acid in germinating cereal seeds.
5. Estimation of protein by dye binding method.
6. Proline estimation under various levels of abiotic stresses.
7. Estimation of phenol content in plant tissues as affected by biotic stresses.
8. Study of the effect of plant hormones on seedling growth.

References

- Anderson J.W. and Boardall J. Molecular Activation of Plant Cells- An Introduction to Plant Biochemistry. Blackwell Scientific Publishers.
- Beck C.B. An Introduction to Plant Structure and Development. Cambridge University Press.
- Bowley J.D. and Black E. Seeds: Physiology of Development and Germination. Plenum Publishing Corporation.
- Bidwell R.G.S. Plant Physiology. Macmillan Publishing Corporation.
- Buchanan B.B., Gruissem W. and Johns R.L. Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.
- Devlin R.M. and Withan F.H. Plant Physiology. CBS Publishers & Distributers.
- Hopkins W.G. Introduction to Plant Physiology. John Wiley & Sons Inc.

- Mayer and Poljakoff Mayber. The Germination of Seeds. Pergamon Press.
- Moore T.C. Research Experience in Plant Physiology- A Laboratory Manual. Springer Verlag.
- Noggle G.R. and Fritz G.J. Introductory Plant Physiology. Prentice Hall of India Pvt. Ltd.
- Salisbury F.B. and Ross C.W. Plant Physiology. Wordsworth Publishing Corporation.
- Steward F.C. Plant Physiology- A Treatise. Vol. I to X. Academic Press.
- Stumpf P.K. and Conn E.E. The Biochemistry of Plants: A comprehensive Treatise. Academic Press.
- Taiz L. and Zeiger E. Plant Physiology. The Benjamin Cummings Publishing Corporation Inc.
- Wilkins M.B. Advances in Plant Physiology. Longman Scientific & Technical.

COURSE CODE**: BOT10IE37**

Elective.2 Plant Tissue Culture

1. Tissue culture- plant tissue culture- techniques and significances of embryo, endosperm and haploid plant culture. Techniques and significances of cell and protoplast culture.
2. Tissue culture as a biotechnological tool- clonal propagation, somatic embryogenesis, synseed production and exploitation of somaclonal variations.
3. Culture media- liquid, semisolid, raft- MS, WPM, White's, Nitsch & Nitsch, SH- a comparative study. Media for special purposes- modifications, additives- antioxidants, organic supplements, adsorbants.
4. Hormones- role of hormones in phytomorphogenesis *in vitro* and *in vivo*- mode of action of hormones- synergistic action.
5. Commercial clonal propagation- requirements, management- production planning- man power- contamination endophytes as contaminants in tissue cultures- in process quality control.
6. Hardening of TC plants- primary and secondary- green house- poly house- shade house- pots. Media for hardening- management of TC plants.
7. Bioreactor technology for plant micropropagation- photoautotrophic micropropagation.
8. Secondary metabolite production- objectives and achievements.
9. Commercial tissue culture production of trees: Eucalyptus, Teak, Bamboo; crops: Banana, Potato, Papaya; flower crops: Orchids, Anthurium, Gingers.
10. Virus indexing of tissue cultured plants- ELISA, PCR based indexing- methodology and importance.
11. Value addition in TC plants- inoculation of VAM and other endophytes.
12. Certification of TC plants.
13. Farmer's acceptance of TC plants- lab to land awareness.
14. Costing- cost benefit analysis- cost reduction measures and low cost alternatives.
15. Marketing of TC plants.
16. Major tissue culture ventures in India and abroad- success stories.

Practicals of Elective 2.

1. Media preparation- culture initiation- clonal multiplication- rooting- hardening and filed transfer in the case of one plant species.
2. Callus induction and organogenesis in the case of one plant species.
3. Synseed production in the case of one plant species.
4. Suspension culture and its microscopic examination for morphological features and viability in the case of one plant species.
5. Preparation of commercial TC planting material production plan for a crop species.
6. Visit to a commercial TC firm and submission of a report.
7. Preparation of a project report for a commercial TC unit.

References

- Bajaj Y.P.S. (Ed.). High Tech Micropropagation. Springer.
- Biotech Consortium India Ltd. Summary Report on Market Survey on Tissue Cultured Plants.
- DBT, Govt. of India. National Certification System for Tisuue Culture Raised Plants.
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- George E.F., Hall M.A. and Klerk Geert –Jan De. Plant Propagation by Tissue Culture. Springer.
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- IAEA. Low-cost Options for Tissue Culture Technology in Developing Countries.

- Jain S.M. and Ishii K. (Ed.). Micropropagation of Woody Trees and Fruits. Kluwer Academic Publishers.
- Greisen Kay S. Commercial Propagation of Orchids in Tissue Culture: Seed- Flasking Methods.
- Dirr, Michael A. and Heuser Jr., Charles W. The Reference Manual of Woody Plant Propagation- From Seed to Tissue Culture.
- Neumann K.H., Kumar A. and Imani J. Plant Cell and Tissue Culture- A Tool in Biotechnology: Basics and Application. Springer.
- Razdan M.K. Plant Tissue Culture. Science Publishers Inc., U.S.A.
- Trigiano, Robert N. and Gray Dennis J. (Eds.) Plant Tissue Culture, Development and Biotechnology. CRC Press.
- Ziv M., 2000. Bioreactor technology for plant micropropagation. Horticultural Reviews 24: 1-30.

COURSE CODE**: BOT10IE38**

Elective3. Python Programming

Module I: Introduction to Python: Introductory Remarks about Python, Pros & cons, A Brief His-tory of Python, Python Versions, Installing Python, Environment Variables, Executing Python from the Command Line, IDLE, Editing Python Files, Getting Help, Dynamic Types, Python Reserved Words, Naming Conventions, Basic Python Syntax- Comments, String Values, String Operations, The format Method, String Slices, String Operators, Numeric Data Types, Conversions, Simple Input and Output, The print Function **Module II: Language Components:** Control Flow and Syntax, Indenting, The if Statement, Relational Operators, Logical Operators, True or False, Bit Wise Operators, The while Loop, break and continue, The for Loop, Collections- Lists, Tuples, Sets, Dictionaries, Sorting Dictionaries, Copying Collections

Module III: Functions- Defining Your Own Functions, Parameters, Function Documentation, Key-word and Optional Parameters, Passing Collections to a Function, Variable Number of Arguments, Scope, User defined Functions, Mapping Functions in a Dictionary, Lambda, Closures, Modules, Libraries, Iterators, Generators, Text, Binary Handling: iteration protocol, iterable objects, generators and generator expressions, data processing pipelines

Module IV: Classes in Python: Principles of Object Orientation, Creating Classes, Instance Methods, File Organization, Special Methods, Class Variables, Inheritance, Polymorphism, Type Identification, Custom Exception Classes, Class Documentation – pydoc, Exceptions- Errors, Run Time Errors, The Exception Model, Exception Hierarchy, Handling Multiple Exceptions, Writing new Exception Classes, Input and Output- Data Streams, Creating Data Streams, Access Modes, Writing & Reading From/To a File, Using Pipes as Data Streams, Handling IO Exceptions

COURSE CODE**: BOT10IH39**

Practicals of elective 3

1. Class documentation using pydoc.
2. Familarisation of editing in python files.
3. Writing new exceptional classes.

References

- Beazley, D. M. (2009).Python essential reference. Addison-Wesley Professional.
- Barry, P. (2010). Head First Python. "O'Reilly Media, Inc.".
- Punch, W. F., & Enbody, R. (2010). The practice of computing using python. Addison-Wesley Publishing Company.
- Mark, S. (2009). Programming in Python 3. Pearson Education India.
- Lutz, M. (2013). Learning python. "O'Reilly Media, Inc.".
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- Arbuckle, D. (2010). Python Testing: Beginner's Guide. Packt Publishing Ltd.
- Wentworth, P., Elkner, J., Downey, A. B., Meyers, C., & List, C. (2011). How to think like a computer scientist.

MODEL QUESTION PAPER

FIRST SEMESTER B. Sc. INTEGRATED BOTANY WITH COMPUTATIONAL BIOLOGY PROGRAMME

COURSE CODE: BOT1IB01- COURSE TITLE: PLANT ANATOMY

TIME: 2 Hrs **Max. Marks 60**

SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Add a note on palisade mesophyll.
2. Describe the structure of hydathodes.
3. Write a short note about cuticle.
4. Give an account – on apical cell theory.
5. Differentiate between endarch and exarch condition.
6. What is a casparian strip? What is its role?
7. Describe the importance of fusiform initials.
8. Where can you find tyloses? How is it formed?
9. Differentiate between protophloem and metaphloem.
10. Write a short note about lysigenous ducts.
11. What is callose?
12. What is meant by Pits?

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Discuss the specialties and classification of meristematic tissues.
14. Give an account of structure, composition and growth of plant cell wall.
15. With the help of a diagram explain the structure of isobilateral leaf.
16. Give an account of non living inclusions found in plant cells.
17. Describe the structure and classification of stomata.
18. Describe the structure of sclerenenchyma. Where do you find it in a plant body? Add a note on its functions.
19. Give an account of origin and types of vascular bundles found in plants.

SECTION C
(Answer any one question, each question carries 10 marks. 1x10 = 10

Marks)

20. Give a detailed account of complex tissues in angiosperms. Discuss the phylogenetic significance of complex tissues.
21. With suitable diagrams, write an essay on anomalous secondary growth in Dracaena.

MODEL QUESTION PAPER

SECOND SEMESTER B. Sc. INTEGRATED BOTANY WITH COMPUTATIONAL BIOLOGYPROGRAMME

COURSE CODE 2: **BOT2IB02**
COURSE TITLE: MICROBIOLOGY, MYCOLOGY& PLANT PATHOLOGY

TIME: 2 Hrs **Max. Marks 60**

SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Distinguish between viriods and prions.
2. How fimbriae differ from flagella?
3. Distinguish between sporangiospores and conidiospores.
4. What is an ascocarp? Compare the ascocarps of *Xylaria*and *Aspergillus*
5. Differentiate between an obligate parasite and a facultative parasite.
6. Differentiate between uredospores and teleutospores.
7. What is bacterial transformation?
8. Differentiate between RNA virus and retrovirus?
9. What is epidemic disease? Give examples.
10. Distinguish between smut and rust.
11. Differentiate between an ascus and a basidium.
12. What is a prophage?

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Describe the structure of a typical bacteriophage with the help of a labelled sketch
14. Describe the ultrastructure of bacteria.
15. Distinguish between Gram+ve and Gram –ve bacteria.
16. Explain different asexual spores in fungi.
17. Point out how Ascomycetes are different from Basidiomycetes
18. Describe the different stages of *Puccinia* on wheat plant.
19. Explain the various symptoms of plant diseases.

SECTION C

(Answer any one question, each question carries 10 marks. 1x10 = 10 Marks)

20. Describe the life cycle of *Rhizopus.*
21. Describe various symptoms and control measures of plant diseases.

MODEL QUESTION PAPER

THIRD SEMESTER B. Sc. INTEGRATED BOTANY WITH COMPUTATIONAL BIOLOGYPROGRAMME

COURSE CODE: **BOT3IB03**

COURSE TITLE: PHYCOLOGY, LICHENOLOGY, BRYOLOGY& PTERIDOLOGY

TIME: Two and half Hrs **Max. Marks 80**

SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Differentiate between conceptacles and receptacles in *Sargassum*
2. What are akinetes?
3. Differentiate between protostele and siphonostele.
4. Explain the structure of the sporophytes of *Riccia*
5. Explain the xerophytic features of *Equisetum*
6. Write notes on sex organs in *Oedogonium*
7. Write a note on the photosynthetic pigments seen in algae
8. Write a note on fossil bryophytes
9. Describe the fruiting bodies in lichens.
10. Differentiate between crustose and foliose lichens.
11. Why *Selaginella* is called resurrection plants?
12. Distinguish lateral and scalariform conjugation in *Spirogyra*

SECTION B
(Answer any eight questions, each question carries 5 marks. Ceiling: 40 Marks)

13. Give an outline of algal classification by Fritsch
14. Write a note on economic importance of Bryophytes
15. Explain the sexual reproduction in *Vaucheria*
16. Describe different thallus types of lichens.
17. Comment on the sporophyte of *Funaria*

18. Write notes on Aplanospore, Zoospore and Synzoospore
19. Write an account of Apogamy and Apospory in pteridophytes.
20. Enumerate the economic importance of lichens.
21. Give an outline of algal classification.
22. Explain heterospory and seed habit in pteridophytes.

SECTION C
(Answer any two question, each question carries 10 marks. 2x10 = 20Marks)

23. Write an essay on stelar evolution in pteridophytes.
24. With the help of diagrams explain the sexual reproduction in *Funaria*.
25. Explain the lifecycle of algae.

THIRD SEMESTER B. Sc. INTEGRATED BOTANY WITH COMPUTATIONAL BIOLOGYPROGRAMME

COURSE CODE: **BOT3IB04**

COURSE TITLE: METHODOLOGY AND PERSPECTIVE IN SCIENCE
TIME: Two and half Hrs **Max. Marks 80**

SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Define Shodhganga and elaborate its importance.
2. What does an Impact Factor indicate?
3. Differentiate between Central tendency and Dispersion.
4. How is a Chi-square test used in biological experiments?
5. What are Ogives?
6. Is pH of any solution relevant? Why?
7. What is molecular sieving?
8. What are the different kinds of centrifuges?
9. What is ‘ppm’, why is it commonly used in preparation of solutions?
10. Differentiate TEM from SEM in their principles.
11. Why are vital stains important?
12. Describe the importance of maceration.

SECTION B

(Answer any eight questions, each question carries 5 marks. Ceiling: 40 Marks)

13. Elaborate the steps involved in Scientific methods and preparation of scientific reports
14. Describe the various data collection methods
15. Explain the importance of Correlation and Regression
16. Describe the principle and applications of different photometric methods
17. Write a short note on the importance of buffers in biological experiments
18. Explain the principle of phase contrast microscopy
19. Describe the various killing and fixing agents used in preservation of specimens

20.What do you mean by lyophilisation?Writedown its applications.

21.Differentiate between colorimetry & spectrophotometry.

22.What are antigens? Illustrate the structure of antibody.

SECTION C

(Answer any TWO question, each question carries 10 marks. 2x10 = 20 Marks)

23. Explain the prospects and limitations of Biostatistics, emphasizing on the different tools used for statistical analysis.
24. Describe the principles and different types of chromatography.

25.Give a detailed account on electrophoresis.

THIRD SEMESTER B. Sc. INTEGRATED BOTANY WITH COMPUTATIONAL BIOLOGYPROGRAMME

COURSE CODE: **BOT3IB05**

COURSE TITLE: GYMNOSPERMS, PALAEOBOTANY, PHYTOGEOGRAPHY & EVOLUTION

TIME: 2 Hrs **Max. Marks 60**

SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. What is an ovuliferous scale?
2. Describe the features of manoxylic wood. Give an example.
3. What is Amber?
4. Comment on Palaeobotanical Institute in India.
5. Describe the features of the male gametophytes of Pinus?
6. Describe on ‘age of fern’
7. What is genetic drift?
8. What is Miller’s experiment and mention its significance?

9. Enlist the phytogeographic zones of India?
10. Write down the impacts of Continental drift theory.
11. What is extinction? What are the causes of extinction?
12. Explain Neo-Darwinism.

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Explain the economic importance of Gymnosperm
14. Describe Geological time scale
15. Enumerate the contribution of Birbal Sahni and SavithriSahni
16. Comment on the evolutionary position of Gymnosperms.
17. Mention xerophytic characters of Pinus leaflet
18. What are the postulates of Lamarckism? Bring out the drawbacks of this theory.
19. What is glaciation? Explain the causes and consequences.

SECTION C
(Answer any one question, each question carries 10 marks. 1x10 = 10 Marks)

20. Compare the anatomy of Cycas leaflet and Pinus needle with suitable diagrams. Add a note on the special types of tissues found in these.
21. Explain the various theories on origin and evolution of species.

MODEL QUESTION PAPER

FOURTH SEMESTER B. Sc. INTEGRATED BOTANY WITH COMPUTATIONAL BIOLOGYPROGRAMME

COURSE CODE: **BOT4IB06**
COURSE TITLE: BIOTECHNOLOGY AND BIOINFORMATICS

TIME: Two and half hours Hrs **Max. Marks 80**

SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Give a brief account on bioremediation.
2. Comment on pBR322.
3. Which are the methods used for indirect/ vector mediated gene transfer. Mention the steps included.

4. What are genetically modified crops?
5. Enumerate on sequence alignment search tool
6. Comment on DNA finger printing.
7. Write a brief note on one gene one enzyme hypothesis.
8. What are composite databases?
9. What is the role of DNA ligase in biotechnology?
10. Comment on DNA microarray
11. What are the properties of Genetic material?
12. What is internet?

SECTION B

(Answer any eight questions, each question carries 5 marks. Ceiling: 40 Marks)

13. Explain different methods for direct gene transfer.
14. Give an account on industrial application of biotechnology.
15. Describe on biosensors
16. Explain on online publications
17. Enumerate on free softwares
18. Explain on biosafety and product labeling
19. Which are the types of cloning vectors? Give a note on each.
20. Explain Secondary databases
21. Tools using for Tertiary structure prediction
22. Multiple alignment technique

SECTION C

(Answer any one question, each question carries 10 marks. 2x10 = 20 Marks)

23. Describe the agricultural application of biotechnology
24. Discuss on types of biological database
25. Uses and applications of transgenic plants

FOURTH SEMESTER B. Sc. INTEGRATED BOTANY WITH COMPUTATIONAL BIOLOGYPROGRAMME

COURSE CODE: **BOT4IB07**

COURSETITLE: TISSUE CULTURE, HORTICULTURE, ECONOMIC BOTANY & ETHNOBOTANY

TIME: 2 Hrs **Max. Marks 60**

SECTION A

(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Why Plant cell considered as totipotent?

2. Distinguish among redifferentiation and dedifferentiation?
3. Give a note on Mound layering?
4. Binomial and useful part of Apple
5. Give an outline of drip irrigation
6. Explain the approach of Grafting
7. Give two characteristics of Laminar Airflow Chamber
8. Define Somatic Embryogenesis
9. Enlist the ethnobotanical importance of *Trichopuszeylanicus*
10. Differentiate between organic fertilizers and chemical fertilizers
11. How seed beds are prepared?
12. Mention the binomial and family of asafoetida and dammar

SECTION B

(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Give an outline of post harvest managements of vegetables
14. Give binomial and family name of Rose and Antirrhinum
15. What are the components of soil?
16. What is somatic embryogenesis? Discuss its advantages and disadvantages
17. Discuss the sterilization methods in Tissue Culture?
18. Write a brief notes on media components and culture conditions required for plant tissue culture?
19. What is the significance of landscaping?

SECTION C

(Answer any one question, each question carries 10 marks. 1x10 = 10 Marks)

20. Discuss the process involved in Micropropagation and mention its advantages

Explain different methods of irrigation with their advantages and disadvantages.

FOURTH SEMESTER B. Sc. INTEGRATED BOTANY WITH COMPUTATIONAL BIOLOGYPROGRAMME

COURSE CODE:BOT4IB08

COURSE TITLE: BASIC MATHEMATICS IN BIOLOGICAL SCIENCES

TIME: Two and half Hrs **Max. Marks 80**

SECTION A

(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Add a note on Scilab.

2. Define Census.
3. Write a short note about Set theory.
4. Give an account on coefficient of variation.
5. Differentiate between harmonic mean and geometric mean.
6. What is random variables?
7. Describe F test.
8. What sample space and events?
9. Differentiate between binomial and Poisson distribution.
10. Write a short note about ANOVA.
11. What is RBD?
12. What is meant by SPSS?

SECTION B

(Answer any eight questions, each question carries 5 marks. Ceiling: 40 Marks)

13. Discuss diagrammatic and graphic presentation.
14. Give an account of measures of dispersion.
15. Describe the laws of probability.
16. Give an account of sampling.
17. Differentiate t test and chi-square test.
18. Describe Experimental designs
19. Give an account of correlation and regression analysis.
20. Give an account of permutation, combination
21. Binomial coefficients
22. Explain Set theory

SECTION C

(Answer any two question, each question carries 10 marks. 2x10 = 20 Marks)

23. Give a detailed account of measures of central tendency
24. write an essay on scope of statistical methods
25. Describe Tests of significance.

FIFTH SEMESTER B. Sc. INTEGRATED BOTANY WITH COMPUTATIONAL BIOLOGYPROGRAMME

COURSE CODE: **BOT5IB10**

COURSE TITLE: ANGIOSPERM MORPHOLOGY AND SYSTEMATICS PART1

TIME: 2 Hrs **Max. Marks 60**

SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Define Simple leaf and compound leaf?
2. Explain Didynamous condition with suitable example.
3. Define holotype and lectotype?
4. Define RBG, TBGRI, and IGB?
5. Define artificial system of classification?
6. Homonyms and tautonyms?
7. Diagnostic features of *papilionaceae*
8. Define monographs and revisions.
9. Phyllode and pitcher and cladodes.
10. Define chemotaxonamy
11. List out economically importance plants of *malvaceae*
12. Describe on cyathium type of infloresence

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Aestivation and list out with examples with schematic representation
14. Floral characters of *Euphorbiaceae*
15. Differentiate between intended key and bracketed key with suitable example.
16. Discuss on placentation with suitable representation and examples.
17. Explain the rules of ICN.
18. Write a short note on stem modification with suitable examples
19. Short note on simple dry fruits.

SECTION C
(Answer any one question, each question carries 10 marks. 1x10 = 10 Marks)

20. Bentham and hooker system of classification
21. Different types ofracemose inflorescence and cymose inflorescence with suitable schematic diagrams and examples

MODEL QUESTION PAPER

FIFTH SEMESTER B. Sc. INTEGRATED BOTANY WITH COMPUTATIONAL BIOLOGYPROGRAMME

COURSE CODE: **BOT5IB11**
COURSE TITLE: CELL BIOLOGY AND BIOCHEMISTRY

TIME: 2 Hrs **Max**

Marks 60

SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. What are the two types of endoplasmic reticulum?
2. Describe the function of nucleolus?
3. What is crossing over explain its significance?
4. What are co enzymes? Give examples?
5. Mention any four biological roles of glucose?
6. What is duplication?
7. What is optical isomerism?
8. What is peptide bond?
9. What is Amitosis?
10. What is G1 phase?
11. Significance of cell cycle?
12. What is histones?

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Differentiate between euchromatin and heterochromatin
14. Explain the structure and function of ATP
15. Differentiate between prokaryotic and eukaryotic cell
16. Explain different levels of protein structure?
17. Sketch the Classification of carbohydrates with examples
18. Explain the process of inversion with types
19. Explain major difference between Mitosis and Meiosis?

SECTION C
(Answer any one question, each question carries 10 marks. 1x10 = 10 Marks)

20. Give an account of numerical aberration of chromosomes and its significance
21. What are secondary metabolites? Explain the classification of secondary plant metabolites in brief with examples

SIXTH SEMESTER B. Sc. INTEGRATED BOTANY WITH COMPUTATIONAL BIOLOGYPROGRAMME

COURSE CODE: **BOT5IB12**

COURSE TITLE: GENETICS AND PLANT BREEDING

TIME: 2 Hrs **Max. Marks 60**

SECTION A

(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Define Mendelian law of inheritance
2. Give comment on plant introduction
3. What is heredity and variation?
4. Give three postulates of the chromosome theory of linkage.
5. What is CO Value? Give equation
6. What is criscross inheritance
7. What is multiple allelism with example
8. Name two important plant introduction organizations and their location.
9. What is independent assortment?
10. What is mass selection and its demerits
11. What is cytoplasmic inheritance with one example?
12. What is induced mutation? Give two example for chemical mutagens

SECTION B

(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Explain the quantitative inheritance
14. Explain complementary gene inter action with example
15. Explain techniques involved in hybridization.
16. What are the main objectives of plant breeding?
17. Write a note on pue line selection and its advantages.
18. Differentiate cytoplasmic inheritance from chromosomal inheritance.
19. Explain achievements in mutation breeding

SECTION C

(Answer any one question, each question carries 10 marks. 1x10 = 10 Marks)

20. What is linkage? Explain it with regards to crossing over in organism. Mention four features linkage
21. What is extra nuclear inheritance? Explain it with chloroplast inheritance?

MODEL QUESTION PAPER

FIFTH SEMESTER B. Sc. INTEGRATED BOTANY WITH COMPUTATIONAL BIOLOGYPROGRAMME

COURSE CODE: **BOT5IB13**
COURSE TITLE: ENVIRONMENTAL SCIENCE

TIME: 2 Hrs **Max. Marks 60**

SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Explain abiotic and biotic components of ecosystem with examples
2. Write two examples of gaseous cycle
3. Explain food web
4. What are the major activities of NBPGR?
5. What is BOD?
6. Explain primary and secondary succession
7. Explain on biodegradable and non-biodegradable pollutants
8. Name any two water pollutants
9. Enumerate biosphere reserves in India
10. Name an agency involved in conservation of biodiversity
11. Explain different stages of hydrosere
12. What are the categories of threatened species by IUCN?,

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Differentiate between grazing and detritus food chain with examples
14. What are ecological growth pyramids and explain on types of ecological pyramids.
15. What are endemic species? Explain the kinds of endemic species
16. Explain on terrestrial carbon cycle with flow chart
17. What is biodiversity? Explain the causes for the loss of biodiversity.
18. Explain the stages of mechanisms of succession.
19. Explain the main causes for natural extinction?

SECTION C
(Answer any one question, each question carries 10 marks. 1x10 = 10 Marks)

20. Explain in detail on nitrogen cycle with flow chart
21. Explain In-situ and Ex-situ strategies of biodiversity conservation

MODEL QUESTION PAPER

FIFTH SEMESTER B. Sc. INTEGRATED BOTANY WITH COMPUTATIONAL BIOLOGYPROGRAMME

COURSE CODE : **BOT5ID02**

OPEN COURSE: APPLIED BOTANY

TIME: 2 Hrs **Max. Marks 60**

SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Describe on Green house?
2. Explain on plant propagation by cuttings
3. Enumerate on potting mixture
4. Give brief on organic manure
5. Brief on fiber yielding plant
6. Economic uses of Coffee
7. Explain on soil texture
8. What are pulses
9. Morphology of useful part of pepper
10. What is vermicompost?
11. Types of seed germination
12. Discuss on anthurium cultivation

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Define Bonsai
14. Merits of organic manures
15. Brief note on timber yielding plants
16. Olericulture
17. What are biofertilizers.
18. Vegetative propagation methods.

19. Mechanical control measures adopted to avoid pests and diseses.

SECTION C
(Answer any one question, each question carries 10 marks. 1x10 = 10 Marks)

20. Define irrigation? What are the methods of irrigation?
21. Write an account on mushroom cultivation

MODEL QUESTION PAPER

SIXTH SEMESTER B. Sc. INTEGRATED BOTANY WITH COMPUTATIONAL BIOLOGY PROGRAMME

COURSE CODE: BOT6IB14
COURSE TITLE: CREATIVITY, RESEARCH & KNOWLEDGE MANAGEMENT
TIME: 2 Hrs **Max. Marks 60**

SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Differentiate between critical & logical thinking.
2. Write any 2 popular journals in Computational biology & Bioinformatics.
3. What is GI?
4. Explain the term copyright.
5. Define plagiarism.
6. What is authorship?
7. Differentiate bibliometrics and webometrics.
8. Write any 2 objectives of reference citing styles.
9. What is hypothesis in research?
10. Explain proofreading & editing.
11. Differentiate pure and applied research.
12. What are the TOC alerts and DB alerts?

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Write note on reference management tools.
14. Comment on the advantages & disadvantages of patent.
15. Write down the steps in research process.

16. What is ethics? Describe its role in scientific research and academics.
17. Explain the various indices of impact factor.
18. Enumerate the benefits of GI tag in agriculture.
19. Write a short note on open access publication and other emerging trends in scientific communication.

SECTION C
(Answer any one question, each question carries 10 marks. 1x10 = 10 Marks)

20. Give a detailed account on format of a science research paper.
21. Write note on IPR. What are the IPR laws in India?

MODEL QUESTION PAPER

SIXTH SEMESTER B. Sc. INTEGRATED BOTANY WITH COMPUTATIONAL BIOLOGYPROGRAMME

COURSE CODE: **BOT6IB15**
COURSE TITLE: PLANT PHYSIOLOGY & METABOLISM
TIME: 2 Hrs **Max. Marks 60**

SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. What is RUBISCO explain its importance
2. What is Light harvesting complex?
3. Explain the components of Water potential?
4. Why transpiration called as a necessary evil?
5. Represent the overall process of photosynthesis by equation?
6. What is guttation?
7. What is Kranz anatomy?
8. What is quantasomes?
9. What are the reaction centres?
10. Differentiate among amphibolic and anapleurotic reactions.
11. Mention the fate of pyruvic acid under the presence and absence of oxygen
12. Brief out the energy harvesting phase in Glycolysis pathway.

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Explain the light reaction of photosynthesis with diagrams?
14. Differentiate cyclic and Non- cyclic photophosphorylation
15. Explain the theories of stomatal movement

16. Explain CAM pathways with merits and demerits
17. What are the factors affecting photosynthesis
18. Brief out the importance of TCA Cycle
19. What if β-Oxidation of Fatty Acid?.

SECTION C

(Answer any one question, each question carries 10 marks. 1x10 = 10 Marks)

20. Explain dark reaction of photosynthesis for CO2 fixation in terms of C3 and C2 cycles with neat diagrams
21. Explain the steps involved in TCA Cycle with mentioning the enzymatic reactions.

MODEL QUESTION PAPER

SIXTH SEMESTER B. Sc. INTEGRATED BOTANY WITH COMPUTATIONAL BIOLOGY PROGRAMME

COURSE CODE: BOT6IB16

COURSE TITLE: MOLECULAR BIOLOGY, PLANT MORPHOGENESIS & EMBRYOLOGY

TIME: 2 Hrs **Max. Marks 60**

SECTION A

(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Write a note on totipotency.
2. Differentiate between dithecous&monothecous anther.
3. What is c value paradox?
4. Explain triple fusion.
5. Enumerate factors influencing morphogenesis.
6. What is the significance of introns?
7. Define heterospory.
8. Differentiate between primosomes and replisomes.
9. What are different types of embryosac?
10. What is the role of synergids?
11. Write any 2 chemical mutagen with example.

SECTION B

(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

12. Differentiate parthenocarpy and apomixis.
13. Write a note on lac operon.
14. What is the difference between the structures of dicot and monocot embryo.
15. Explain floral development in Arabidopsis.
16. Describe polyembryony.
17. Briefly explain the process of transcription in prokaryotes.
18. Give an account on endosperm.

SECTION C
(Answer any one question, each question carries 10 marks. 1x10 = 10 Marks)

19. Give a detailed account on DNA replication. How eukaryotic replication differ from prokaryotes?
20. With suitable diagrams, write an essay on microsporogenesis.

MODEL QUESTION PAPER

SIXTH SEMESTER B. Sc. INTEGRATED BOTANY WITH COMPUTATIONAL BIOLOGY PROGRAMME

COURSE CODE: BOT6IB17 COURSE TITLE: GENOMICS

TIME: 2 Hrs **Max. Marks 60**

SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Differentiate between tandem and inverted repeats.
2. What is E - values?
3. Write a short note on SNPs.
4. Explain Chargaff's rule.
5. What is sequence chromatograms?
6. Briefly describe about reading frames.
7. What is PAM?
8. Enumerate the basic file formats.
9. What is codon usage bias?
10. What is the difference between linear and affine gap penalty?

11. Comment on bit scores and sensitivity.
12. What are sequence logos?

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Write a note on the concept of similarity.
14. Differentiate between microsatellite and minisatellite.
15. What is the effect of scoring schemes?
16. Give a brief account on BLOSUM.
17. Explain the use of Pearl scripts in genomics.
18. Write a short note on FASTA.
19. Give an account of Dot - plot visualization.

SECTION C
(Answer any one question, each question carries 10 marks. 1x10 = 10 Marks)

20. Give a detailed account of GenBank of NCBI.
21. Explain scoring matrices for aminoacid sequence allignment.

MODEL QUESTION PAPER

SIXTH SEMESTER B. Sc. INTEGRATED BOTANY WITH COMPUTATIONAL BIOLOGYPROGRAMME

COURSE CODE: **BOT6IE18**
ELECTIVE: GENETICS AND CROP IMPROVEMENT

TIME: 2 Hrs **Max. Marks 60**

SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. What is Plant breeding? Comment on Objectives of Plant breeding?
2. Explain activities of KFRI
3. What is Mutation and Types of mutagens?

4. What is emasculation?
5. Expand ICRISAT
6. Comment on Centre of origin of Pepper
7. Define Domestication?
8. Describe floral biology of cashew
9. Comment on propagation methods of Rubber
10. Describe on Ploidy breeding
11. Explain Plant introduction
12. What is hybrid vigour?

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Explain the floral biology and breeding techniques in Coconut.
14. Describe on importance of plant selection?
15. Comment on conservation strategies of plant resources
16. Explain major activities of TBGRI
17. Explain quarantine? Its benefits in plant introduction.
18. Describe on mutation breeding and its significance?
19. Enumerate on achievements of CPCRI

SECTION C
(Answer any one question, each question carries 10 marks. 1x10 = 10 Marks)

20. What is hybridization? With examples, enumerate the different types and explain the steps involved in the process.
21. Brief account on major research activities and achievements of plant breeding institute in Kerala.

MODEL QUESTION PAPER

SEVENTH SEMESTER INTEGRATED M. Sc. BOTANY WITH COMPUTATIONAL BIOLOGY PROGRAMME

COURSE CODE:BOT7IB22

PROTEOMICS

Time: 3 Hours Maximum : 80 Marks

PART A

Answer any two of the following each answer not exceeding 500 words.

1.Give a detailed account on protein databases.

2.. Explain the mechanism of protein structure determination with X-ray Crystallography.

3. Give a detailed account on primary and secondary structure of protein.

(2x10 = 20 marks)

PART B

Answer any eight of the following each answer not exceeding 250 words.

4. Write a note on NMR spectroscopy.
5. Give an account on classification of proteins.
6. Write down the features of tertiary and quaternary structures of protein.
7. Give a short note on Homology modeling.
8. Write a short note on Ramachandran plot.
9. Describe Chou Fasman method.
10. Write a note on protein visualization tools.
11. Describe protein isolation
12. Explain the principle of 2D Gel Electrophoresis.
13. What are the interactions that stabilizes the protein structure?

(8x5 =40 marks)

PART C

Answer any ten of the following each answer not exceeding 100 words

14. Write a note on Swiss-Prot
15. What do you mean by propensity?
16. Expand CASP,SCOP and CATH.
17. What do you mean by peptide bond? List out its features.
18. Give a short note on Expasy.
19. Comment on Alpha helices structure of protein
20. Describe the term Proteome.
21. Define dihedral angles.
22. Which are the polar aminoacids?
23. Describe protein folding.
24. What is the use of modeler?
25. Explain GOR method.

(10x2 =20 marks)

MODEL QUESTION PAPER

SEVENTH SEMESTER INTEGRATED M. Sc. BOTANY WITH COMPUTATIONAL BIOLOGY PROGRAMME

BOT7IB23 -Phycology, Bryology, Pteridology & Gymnosperm Part 2

Time: 3 Hours Maximum : 80 Marks

PART A

Answer any two of the following each answer not exceeding 500 words

1. Give a detailed account of the stellar evolution in Pteridophytes with diagrams.

2. Explain the origin and evolution of bryophytes with respect to gametophytic and sporophytic characters.
3. Explain the thallus variation in algae with the help of suitable diagrams and examples.

(2x10 = 20 marks)

PART B

Answer any eight of the following each answer not exceeding 250 words

4. Enumerate on economic importance of Gymnosperms
5. Describe the general account of energy sources and pigments in Algae
6. Explain the fossil bryophytes and why they are not suited for fossilization?
7. Economic importance of Algae.
8. Outline the Chamberlain system of classification of Gymnosperms
9. Comment on economic importance of pteridophytes
10. Write a note on Geological time scale
11. Enumerate on spore development and evolution in pteridophytes
12. Describe heterospory in pteridophytes.
13. Brief the general characters of Marchantiales.

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(8x5 =40 marks)

PART C

Answer any ten of the following each answer not exceeding 100 words

14. Comment on Biological importance of Planktons
15. Enumerate any five fossil bryophyes.
16. Describe the types of flagella with citing examples in Algae
17. Differentiate between apogamy and apospory?
18. What is parthenogenesis?Explain.
19. Write down the importance of pyrenoids?
20. Enumerate economic importance of bryophytes
21. Explain seed habit in Pteridophytes
22. Write a short note on contributions of Indian pteridologists
23. Explain Chamberlain system of classification of gymnosperms.
24. Differentiate Cycadales and Welwitsciales
25. What do you mean by algal bloom?
26. Define apogamy and apospory?

(10x2 =20 marks)

MODEL QUESTION PAPER

SEVENTH SEMESTER INTEGRATED M. Sc. BOTANY WITH COMPUTATIONAL BIOLOGY PROGRAMME

COURSE CODE: **BOT7IB24**

MICROBIOLOGY, MYCOLOGY, PLANT ANATOMY PALYNOLOGY & LAB TECHNIQUES PART 2

Time: 3 Hours Maximum : 80 Marks

PART A

Answer any two of the following each answer not exceeding 500 words

1. Discuss on different methods of tissue processing in anatomical studies
2. Explain the classification of fungus by Ainsworth and describe the characters of main groups.
3. What are main general characters cyanobacteria. Give an account on their economic importance.

(2x10 = 20 marks)

PART B

Answer any eight of the following each answer not exceeding 250 words

4. Write a note on fungal symbiosis.
5. Give features of plasmids.
6. Give a short note on microbial role in food –diary products
7. Write a short note on evolution of fungi.
8. Describe the anatomical features in relation to taxonomy
9. Explain the tools used in deducing microscopic measurement
10. Give an account on a) sclerotia b) hyphae c) pseudoparenchyma
11. Enumerate working of Rotary microtome. Mention the advantages
12. Illustrate ultra-structure of bacterial cell wall
13. Write a short note on mycorrhiza

(8x5 =40 marks)

PART C

Answer any ten of the following each answer not exceeding 100 words

14. Distinguish among prions and viroids
15. Explain vascular differentiation.
16. Give general characters of Zygomycota.
17. Give an account on mounting media
18. Give a short note on components of cytoskeleton of fungi.
19. Explain the process of maceration
20. Differentiate between dicot and monocot leaf
21. What is melittopalynology?
22. What are pyrenoids?
23. Differentiate between lytic and lysogenic cycle of virus
24. Distinguish between eurypalynous and stenopalynoustaxa
25. What are coprophilous fungi?

(10x2 =20 marks)

MODEL QUESTION PAPER

EIGTH SEMESTER INTEGRATED M. Sc. BOTANY WITH COMPUTATIONAL BIOLOGY PROGRAMME

COURSE CODE: **BOT8IB26**

GENETICS-PART 2, CYTOGENETICS & APPLIED ENVIRONMENTAL SCIENCE

Time: 3 Hours Maximum : 80 Marks

PART A

Answer any two of the following each answer not exceeding 500 words

1. Describe the different types of transposable elements

2. Discuss on environmental pollution with related to climate change
3. Brief on chromosome aberrations types and significance in evolution

(2x10 = 20 marks)

PART B

Answer any eight of the following each answer not exceeding 250 words

4. Enumerate on forest types of India
5. What are lampbrush chromosomes? Give its significance?
6. Enumerate on Gia hypothesis
7. Statement on Hardy-Weinberg principle and its application.
8. Explain flow cytometry
9. Discuss on bioremediation
10. Transposable elements in Drosophila
11. Describe on Environmental protection act
12. How to determine Importance Value Index (lVl)?
13. Enumerate on karyotype and ideogram

(8x5 =40 marks)

PART C

Answer any ten of the following each answer not exceeding 100 words

14. What is B-A translocation
15. Discuss on cytoplasmic inheritance with example?
16. Define dissolved oxygen
17. Explain Minamata
18. Describe on Pedigree analysis
19. Explain Lod score for linkage
20. Comment on major national park in India
21. What is QTL mapping
22. Comment on tetrad analysis
23. Describe EIA
24. Distinguish among polytene chromosome and lambrush chromosome
25. What is Bioflocculation?

(10x2 =20 marks)

MODEL QUESTION PAPER

EIGHTH SEMESTER INTEGRATED M. Sc. BOTANY WITH COMPUTATIONAL BIOLOGY PROGRAMME

COURSE CODE: **BOT8IB27**

ANGIOSPERM MORPHOLOGY, TAXONOMY, FOREST BOTANY& PLANT RESOURCES PART-2

Time: 3 Hours Maximum : 80 Marks

PART A

Answer any two of the following each answer not exceeding 500 words

1. Describe the techniques involved in Herbarium preparation.
2. Briefly explain the origin and evolution of structure and morphology of Stamens in Angiosperm.
3. Briefly describe the significance of APG system in comparison with the natural system of classification.

(2x10 = 20 marks)

PART B

Answer any eight of the following each answer not exceeding 250 words

4. Write a note on NBRI.
5. Briefly describe the types of placentation and their evolution.
6. Distinguish between binomial and polynomial nomenclature.
7. Give a brief account on International code of nomenclature of cultivated plants.
8. Write a note on typification.
9. Describe the functions of BSI.
10. What are identification keys?Give the method of preparing such keys.
11. Explain the significance of molecular data in Taxonomy.
12. Describe the diagnostic features of the family Lamiaceae.
13. Briefly describe the medicinal uses of Catharanthes,Adhatoda and Saraca.

(8x5 =40 marks)

PART C

Answer any ten of the following each answer not exceeding 100 words

14. What is cladogram ?
15. Write a note on cytotaxonomy.
16. List out the top two botanical gardens in the world.
17. Give the floral features of Poaceae.
18. Explain DNA bar coding in plants.
19. Types of forest in India
20. Describe any two situations for rejection of plant names.
21. Mention the inflorescence in Asteraceae.
22. Write down the significance of ICBN.
23. Distinguish between aggregate fruit and multiple fruit.
24. What do you mean by biosystematics? What is its significance.
25. What are the demerits of Bentham & Hooker's system of classification?

(10x2=20 marks)

MODEL QUESTION PAPER

EIGHTH SEMESTER INTEGRATED M. Sc. BOTANY WITH COMPUTATIONAL BIOLOGY PROGRAMME

COURSE CODE: **BOT8IB28**

PHYLOGENETICS

Time: 3 Hours Maximum : 80 Marks

PART A

Answer any two of the following each answer not exceeding 500 words

1. Describe the various methods for the evaluation of phylogenetic trees.
2. Give a detailed account on phylogenetic software and its applications.
3. Explain different types of phylogenetic trees.

(2x10 = 20 marks)

PART B

Answer any eight of the following each answer not exceeding 250 words

4.What is species phylogeny?
5.Differentiate phylogram and cladogram.
6.Statement on Hardy-Weinberg principle and It's application.
7.Explain Character based methods.
8.Discuss major tools in Multiple sequence alignment.
9. Describe UPGMA.
10.Explain lineage sorting.
11.Write a note phylogenetic algorithms.
12.Explain the significance of phylogenetic tree.
13.List out and explain the major terminologies used in phylogenetics.

(8x5 =40 marks)

PART C

Answer any ten of the following each answer not exceeding 100 words

14.What is Clustal W?
15.Discuss Whittaker's five kingdom system
16.Explain Carl Woese's three domain system
17.Describe Bayesian inference
18.Explain Boot strapping
19.Explain Phyml and RaxML
20.Describe Jackknifing.
21.What is molecular clock hypothesis?
22.Distinguish between gene phylogeny and species phylogeny.
23.What do you mean by boot strapping?
24.What is population genetics?
25.State Darwin's theory of evolution.

(10x2 =20 marks)

MODEL QUESTION PAPER

NINETH SEMESTER INTEGRATED M. Sc. BOTANY WITH COMPUTATIONAL BIOLOGY PROGRAMME

COURSE CODE: **BOT9IB30**

GENETIC ENGINEERING

Time: 3 Hours Maximum : 80 Marks

PART A

Answer any two of the following each answer not exceeding 500 words

1. Write a detailed account on applications of recombinant DNA technology.
2. Explain the mechanism of gene transfer into eukaryotic cell

3. Write an essay on hybridisation techniques.

(2x10 = 20 marks)

PART B

Answer any eight of the following each answer not exceeding 250 words

4.Explain the principles of electrophoresis.
5. Differentiate between genomic DNA library and cDNA library.
6.Briefly describe the blue white selection mehod.
7. Give a brief account on antisense RNA technology.
8. Write a short note on enzymes used in rDNA technology.
9. Describe the steps involved in DNA isolation.
10. Differentiate Kirbi method and Marmur method
11.What is a vector? Explain various types of vectors with suitable example.
12.Write a note on guanidium hot phenol method.
13.Give a brief account on gene knockout and its uses.

(8x5 =40 marks)

PART C

Answer any ten of the following each answer not exceeding 100 words

14. What is gel staining?
15. Distinguish between blunt end and sticky end.
16. List out the RNase inhibitors.
17. What is a probe?
18. What are transgenic crop. Give suitable examples.
19. Explain the term elution.
20.Write a note on how to store DNA samples.
21.List out the features of a vector.
22.What are reporter genes?
23.Differentiate between microinjection and gene gun.
24.What do you mean by chromosome walking.
25.Distinguish between GUS gene and GFP gene.

(10x2 =20 marks)

MODEL QUESTION PAPER

NINETH SEMESTER INTEGRATED M. Sc. BOTANY WITH COMPUTATIONAL BIOLOGY PROGRAMME

COURSE CODE: **BOT9IB31**

CORE COURSE 31: COMPUTER AIDED DRUG DESIGNING

Time: 3 Hours Maximum : 80 Marks

PART A

Answer any two of the following each answer not exceeding 500 words.

1. Write a note on diseases and their causes.What is the molecular basis of disease?
2. Give a detailed account on drugs.

3. Write an essay on cells and molecules involved in immune system and immune responses.

(2x10 = 20 marks)

PART B

Answer any eight of the following each answer not exceeding 250 words

4. Write a note on vaccines.
5. Mention the applications of bioinformatics in drug design.
6. What are the IP issues in drug design?
7. Give a brief account on drug discovery in post- genomic era.
8. What are the drug discovery pipeline? Explain.
9. Briefly explain the different approaches of drug designing.
10. Differentiate between small molecular drugs and peptide drugs.
11. Describe the structure of antibody with the help of suitable diagram.
12. Briefly describe the de novo techniques involved in design of ligands.
13. What are the traditional approaches in drug discovery?

(8x5 =40 marks)

PART C

Answer any ten of the following each answer not exceeding 100 words

14. Define serendipity.
15. What is an antigen? Give examples.
16. Mention any four charaterestics of a drug compound.
17. Differentiate between pre clinical and clinical studies of drug disvovery.
18. Explain molecular docking.
19. Write a short note on drug licencing in India.
20. Mention the softwares involved in drug design.
21. What are the different types of immunoglobulin?
22. Define binding site prediction.
23. Distinguish between structure based and ligand based approaches in drug design.
24. QSAR stand for ----------
25. What do you mean by ADME prediction?

(10x2 =20 marks)

MODEL QUESTION PAPER

NINTH SEMESTER INTEGRATED M. Sc. BOTANY WITH COMPUTATIONAL BIOLOGY PROGRAMME

COURSE CODE: **BOT9IB32**

PERL FOR BIOLOGISTS

Time: 3 Hours Maximum : 80 Marks

PART A

Answer any two of the following each answer not exceeding 500 words.

1. Write a detailed account on file handling and regular expression
2. Explain the web programming.
3. Elaborate the functions used in perl language.

(2x10 = 20 marks)

PART B

Answer any eight of the following each answer not exceeding 250 words.

4. Write a note on features of Perl.
5. Briefly describe the types of operations.
6. Distinguish between CGI and HTML.
7. Give a brief account on type identification.
8. What do you mean by polymorphism? What is its importance?
9. Describe the Perl modules.
10. Write a short note on writing new exception classes.
11. Write a short note on CGI
12. Describe basic operations
13. Give a brief account on errors

(8x5 =40 marks)

PART C

Answer any ten of the following each answer not exceeding 100 words

14. What is CGI?
15. Distinguish between Perl & web.
16. List out the functions of array.
17. What is cookies and sessions?
18. Explain the exception model.
19. Differentiate lists and arrays.
20. What is scalar data?.
21. Explain array function
22. Importance of Autodock
23. Pharmacophore
24. Describe binding site prediction
25. What is string?

(10x2 =20 marks)

MODEL QUESTION PAPER

TENTH SEMESTER INTEGRATED M. Sc. BOTANY WITH COMPUTATIONAL BIOLOGY PROGRAMME

COURSE CODE: **IBC10B36IE**

PLANT PHYSIOLOGY-ELECTIVE1

Time: 3 Hours Maximum : 80 Marks

PART A

Answer any two of the following each answer not exceeding 500 words

1. Explain Lipid metabolism
2. What are main stress tolerance mechanisms in plants?

3. Give the detailed account on biosynthesis and physiological roles of phytohormones

(2x10 = 20 marks)

PART B

Answer any eight of the following each answer not exceeding 250 words

4. Write a note on C4 and CAM metabolism.
5. Give features of electron transport chain of plant mitochondria.
6. Give a short note on Floral organ identity genes
7. Write a short note on Phloem loading and unloading.
8. Describe the role of microbes in nutrients uptake
9. Explain physiology of fruit ripening
10. Give an account on classification of Nutrient elements
11. Write a short note on facilitated diffusion
12. Explain stomatal opening
13. Write a note on ETC

(8x5 =40 marks)

PART C

Answer any ten of the following each answer not exceeding 100 words

14. ETC
15. Brief apoplastic and symplastic movement of water
16. Explain major roles of aquaporins
17. What is phytochrome
18. Give a short note on seed dormancy.
19. Comment on programmed cell death
20. Describe Michaelis-Menten kinetics
21. What are applications of Nernst equation?
22. Photorespiration
23. Give a short note on cryptochrome
24. Explain heavy metal pollution
25. Apoposis

(10x2=20 marks)

MODEL QUESTION PAPER

SEVENTH SEMESTER INTEGRATED M. Sc. BOTANY WITH COMPUTATIONAL BIOLOGY PROGRAMME

COURSE CODE: **IBC10B37IE**

ELECTIVE 2: PLANT TISSUE CULTURE

Time: 3 Hours Maximum : 80 Marks

PART A

Answer any two of the following each answer not exceeding 500 words

1. Discuss on media components and culture conditions required for plant Tissue culture

2. Discuss the process involved in Micropropagation and mention its advantages
3. Briefly describe the farmer's acceptance of tissue culture plants and its significance.

(2x10 = 20 marks)

PART B

Answer any eight of the following each answer not exceeding 250 words

4. Briefly explain the aseptic methods in Tissue Culture?
5. Write a short note on hardening of tissue culture plants
6. Briefly describe the ELISA techniques for TC plants
7. Distinguish between Somatic embryogenesis and Somaclonal variation
8. Give a brief account on commercial production of Anthurium
9. Enumerate on the role of hormones in tissue culture
10. Describe the Bioreactor technology for plant micropropagation
11. What are the advantages of secondary metabolite production by tissue culture?
12. Enumerate on haploid plant culture and its significance?
13. Discuss on commercial tissue culture on orchid

(8x5 =40 marks)

PART C

Answer any ten of the following each answer not exceeding 100 words

14. What is Somatic embryogenesis?
15. Distinguish among redifferentiation and dedifferentiation?
16. List out the organic supplements used for culture media.
17. Write down the significance of VAM in tissue cultue
18. Explain Synseed production.
19. Major tissue culture ventures in India.
20. Describe on protoplast culture
21. Comment on certification of tissue culture plants
22. Principles of plant tissue culture
23. Comment on hairy root culture
24. Differentiate between liquid, semisolid media for tissue culture
25. What is clonal propagation?

(10x2 =20 marks)

MODEL QUESTION PAPER

TENTH SEMESTER INTEGRATED M. Sc. BOTANY WITH COMPUTATIONAL BIOLOGY PROGRAMME

COURSE CODE: **IBC10B38IE**

ELECTIVE 3 : PYTHON PROGRAMMING

Time: 3 Hours Maximum : 80 Marks

PART A

Answer any two of the following each answer not exceeding 500 words

1. Write a detailed account on language component.
2. Explain the functions of python programming
3. Describe the general account of python programming.

(2x10 = 20 marks)

PART B

Answer any eight of the following each answer not exceeding 250 words

4. Write a note on brief history of python.
5. What are generators? List out the generator expressions.
6. Give a short note on pydoc.
7. Write a short note on iteration protocol.
8. Describe the exception model.
9. Explain the format method.
10. Give an account on a) syntax b) tuples c) iterators
11. Explain data streams.
12. Write a short note on executing Python from the Command Line.
13. Write down the pros and cones of python.

(8x5 =40 marks)

PART C

Answer any ten of the following each answer not exceeding 100 words

14. Distinguish among input and output.
15. What are the python versions?
16. What is IDLE?
17. What are the parametres in python programming?
18. How to handle multiple exceptions?
19. Write a short note on creating classes.
20. Describe data processing pipeline.
21. What are IO exceptions?
22. What is a keyword?
23. How to edit python files?
24. What is the use of if statement?
25. Define string value.

(10x2 =20 marks)