JAI HIND COLLEGE
BASANTSING INSTITUTE OF SCIENCE
&
J.T.LALVANI COLLEGE OF COMMERCE
(AUTONOMOUS)

"A" Road, Churchgate, Mumbai - 400 020, India.

Affiliated to
University of Mumbai

Program : B.Sc.

Proposed Course : Botany

Semester III

Credit Based Semester and Grading System (CBCS) with effect from the academic year 2020 -21

S.Y.B.Sc. Botany Syllabus

Academic year 2020 -2021

Semester III			
Course Code	**Course Title**	**Credits**	**Lectures /Week**
SBOT301	Algae; Fungi and Palaeobotany	2	3
SBOT 302	Instrumentation, Cytology and Molecular Biology	2	3
SBOT303	Pharmacognosy, Forestry & Economic Botany	2	3
SBOT3PR	Practical	2.5	9

Semester III – Theory

<table>
<tr><td>Course code:
SBOT301</td><td colspan="2">ALGAE; FUNGI AND PALAEOBOTANY
(Credits : 2Lectures/Week: 3)</td><td>45 lectures</td></tr>
<tr><td></td><td colspan="3">Learning Objectives:
To learn the morphology, structure and importance of the organisms and differentiate between various groups of Algae & Fungi.
To learn the life cycles of individuals belonging to Xanthophyta, Euglenophyta,Bacillariophyta and Ascomycetes.
To learn the economic importance of each group.
To study the geological time scale and evolution of plants through the same.
To understand the process of fossil formation and how it can be studied.
To study form genera discovered post fossilisation
To understand how knowledge of Palaeobotany can be used in oil and coal exploration.
Learning Outcomes:
Students will be able to
Differentiate and compare between different classes of algae/fungi from their syllabus.
Understand life cycles and systematic position of algae/fungi prescribed in the syllabus
Analyse and comment upon economic importance of algae/fungi with the help of case studies.
Identify the causal organism and give remedial measures for pathological symptoms on plants
Understand the importance and correlation of the different eras in geological time scale.
Understand the evolution of plants and their fossils
Explain different types of fossilisation processes.
Apply the knowledge for coal and oil exploration.</td></tr>
<tr><td>Unit I</td><td colspan="2">ALGAE
Outline of Classification according to G.M. Smith, General characters, mode of nutrition, thallus structure, reproductionof Xanthophyta, Euglenophyta and Bacillariophyta.
Life cycle and systematic position of:
Euglena
Vaucheria
Pinnularia.
Economic importance of Algae with respect toXanthophyta, Euglenophyta and Bacillariophyta
Preservation technique- wet and dry
Case studies for Diatomaceous earth/ coral reef</td><td>15 L</td></tr>
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Unit II	**FUNGI AND PLANT PATHOLOGY** • Outline of Classification according to G. M. Smith, General characters, mode of nutrition, thallus structure, reproduction, economic importance of Ascomycetes • Structure, life cycle and systematic position of: o *Yeast* o *Aspergillus* o *Penicillium* o *Erysiphe* – Powdery mildew o *Claviceps* – Ergot of Rye • Case studies of diseases • Broad review of Mycotoxins from Fungi	**15 L**
Unit III	**PALAEOBOTANY** • Geological time scale, formation and types of fossils. • Study of Form genus (with the help of permanent slides/ photomicrographs): o *Rhynia* o *Calamites* o *Lepidodenron&Lepidocarpon* o *Lyginopteris* o *Pentoxylon* o Importance of Palaeobotany in Coal and Oil exploration	**15 L**

References:

1. Gangulee, H.C., Das K.S., &Datta C., College Botany, Volume I, New Central Book Agency, 2006
2. Vashishta B. R., & Sinha A. K., Botany for degree students Algae, S. Chand, 1st Edition, 2010
3. Vashishta B. R., & Sinha A. K., Botany for degree students Fungi, S. Chand, 1st Edition, 2010
4. Smith G. M., Cryptogamic Botany – Algae and Fungi, Vol. I, McGraw Hill Publications, 1955
5. Agashe S. N., Palaeobotany: Plants of the past, their evolution, Palaeoenvironment and application in exploration of fossil fuels, Science Publishers, 1997
6. Biswas C and Johri BM - The Gymnosperms Springer publication.

Course code: SBOT302	INSTRUMENTATION, CYTOLOGY AND MOLECULAR BIOLOGY (Credits : 2 Lectures/Week: 3)	45 lectures

Learning Objectives:

- To introduce the concept of chromatography to students.
- To teach the technique of centrifugation, essential in biology along with its types and applications.
- To learn chromosomal mutations involving changes in normalchromosomal structure.
- To study the different methods of sex determination seen in plants and animals. They learn about traits specifically present in opposite sexes and yet controlled by either autosomes or sex chromosomes.
- To study inheritance of extra-nuclear genes that follow non-Mendelian inheritance.
- To learn in-depth two main cell organelles- nucleus and vacuole.
- To study the basic structure of eukaryotic chromosome and organization of DNA in prokaryotic and eukaryotic and chromosome.
- To learn about the presence of unique and repetitive sequences DNA present in the genome along with centromeric and telomeric DNA.

Learning Outcomes:

Students will be able to:

- Understand the basic concept & working of light microscope & electron microscope
- Understand and apply the knowledge of chromatography for separation of plant metabolites.
- Understand the principle behind the technique of centrifugation and its applications.
- Relate the association of genetic defects observed in an organism with changes in chromosomal structure. They are also able to guess the consequences of such abnormalities on the offspring due to formation of defective gametes.
- Realise that determination of sex of an organism could be based on either genotypic determination or X chromosome-autosome balance system determination or genic sex determination. Students are able to distinguish between various methods of sex determination as they exists in different organisms.
- Differentiate between sex linked, sex influenced and sex- limited traits. They also realise that secondary sexual characters can also result due to effect of genes present on the autosomes and may not always be on the sex chromosomes.
- Realise that inheritance of extra-nuclear genes follows rules different from those for nuclear genes and is generally maternal or uniparental inheritance.
- Understand the detailed structure and role of important cell

	organelles like nucleus and vacuoles. • Understand the details of organisation of DNA in prokaryotic and eukaryotic chromosomes and also how DNA in the eukaryotic chromosome is compacted by its association of histones in nucleosomes in to chromatin fibres. They will note the presence of unique and repetitive sequences in DNA as well as functions of centromeric and telomeric DNA. • Understand the detail process of DNA Replication both in prokaryotes and eukaryotes and understand the similarities and differences in both the systems.	
Unit I	**INSTRUMENTATION:** • Colorimetry and Spectrophotometry (Visible, UV and IR) - Instrumentation, working, principle and applications • Centrifugation: Principle, working and application of centrifuge, types of centrifuge. • Chromatography- Principles and techniques in paper and thin layer chromatography.	**15 L**
Unit II	**CYTOLOGY:** • Variation in Chromosome structure (Chromosomal Aberrations) Definition, Origin, Cytological and Genetic Effects of thefollowing: Deletions, Duplications, Inversions andTranslocations. • Sex linkedinheritance (eye colour in *Drosophila*, Haemophilia, colour blindness), sex influenced and sex-limited traits, Sex determination- Chromosomal Methods: heterogametic males and heterogametic females. Sex determination in monoecious and dioecious plants. Genic Balance Theory of sex determination in *Drosophila*, Lyon's Hypothesis of X chromosome inactivation. • Extranuclear Genetics Organelle heredity- o Chloroplast determines heredity - Plastid transmission in plants, Streptomycin resistance in *Chlamydomonas*. o Male sterility in maize	**15 L**
Unit III	**MOLECULAR BIOLOGY:** • Ultra-structure and function of nucleus • Ultra-structure and function of vacuole • Structure and function of Eukaryotic Chromosome • DNA replication: Modes of Replication, Messelson and Stahl Experiment • DNA replication in prokaryotes and eukaryotes- enzymes involved and molecular mechanism of replication	**15 L**

References:

1. De Robertis E. D. P., Cell Biology and Molecular Biology, 8th edition, Lea and Febinger, 1987.
2. Russell P. J., iGenetics: A Mendelian Approach, 3rd edition, Pearson Education India, 2009.
3. Buchanan B. B., Biochemistry & Molecular biology of plants, Wiley-Blackwell 2002
4. Lewin B., Gene V, Oxford University Press, 1994
5. Glick, B. R., Pasternak, J. J. & Patten C. L.: Molecular Biotechnology Principles and applications of Recombinant DNA 4th Edition Wiley Publishers 2010
6. Winchester, A. M., Heredity an Introduction to Genetics,
7. Veerakumari, L.,Bio-instrumentation, M. J. P. Publishers, 2011
8. Fletcher, H., Hickey, I., Winter P., Instant Notes – Genetics, Taylor & Francis Publisher, 2006
9. Clive Dennision- A guide to protein isolation: Kluwer Academic Publishers.
10. 10. J. Koolman and K.H. Roehm;- Colour Atlas of Biochemistry; Second edition;Thiem Stuttgart New York.

Course code: SBOT303	PHARMACOGNOSY, FORESTRY & ECONOMIC BOTANY (Credits : 2 Lectures/Week: 3)	45 lectures
	Learning Objectives: • To learn importance of Pharmacopoeia in the world of medicine and to understand differences between different pharmacopoeias from India. • To understand the importance of authentication of crude drugs and the steps involved in achieving the same. • To study Monographs from Ayurvedic pharmacopoeia of India. • To study the different types of natural and artificially created forests and to know the use of forests products for the use of mankind. • To study the different plants used in industry for creating natural products. **Learning Outcomes:** Students will be able to • Differentiate between substitutes and adulterants/ regional and seasonal variations in phytoconstituents. • Understand the importance of proximate analysis/organoleptic evaluation of crude drugs/monographs prescribed in their syllabus. • Differentiate into different types of forests and their relevance to the nature and mankind. • Comment on the economic aspects of the forest products. • Comment on the industrial and economic aspects of different plant basedproducts.	
Unit I	**PHARMACOGNOSY :** o Introduction to pharmacopoeia ➢ Indian pharmacopoeia, Indian Herbal Pharmacopoeia and Ayurvedic Pharmacopoeia o Substitutes; adulterants, regional and seasonal variations in phytoconstituents o Proximate analysis of crude drugs- Total Ash, Acid-insoluble ash, water soluble ash, Extractive values: Polar and non-polar Fluorescence analysis, Moisture content, organoleptic evaluation of crude drugs o Study of Monograph: o *Saracaasoca*(Stem bark) o *Bacopamonnieri* (Entire plant) o *Ocimum sanctum.* (Leaf) o *Emblica officinalis* (Fruit) o *Rubiacordifolia*(Root)	**15 L**

Unit II	**FORESTRY & ECONOMIC BOTANY** • Forestry: o Outline of types of forests in India o Agroforestry, Urban forestry, organic farming and silvi-culture o Case studies • Economic Botany: o Fibre and fibre yielding plants: Botanical source, Method of extraction, characteristics and uses of fibres obtained from: o Jute, Coconut, Sun hemp, Kapok, Linen & Abaca o Spice and condiments:Botanical source, Processing and medicinal uses of: Ginger, Cinnamon, Black pepper, Nutmeg o Beverages: Botanical source & Processing for production of Tea, Coffee, Cocoa	**15 L**
Unit III	**INDUSTRIES BASED ON PLANT PRODUCTS** • Aromatherapy – Introduction, uses with few examples • Nutraceuticals: Source and Nutraceutical values for: o Any 5 currently important plants/plant parts • Enzyme industry: Source, industrial applications and broad overview of Method of extraction/production of the following enzymes: o Cellulase o Papain o Bromelain o Tannase o Lipase o Amylase • Biofuels- Definitions and Typeswith examples. o Firstgeneration: Alcohol (Sugarcane) o Secondgeneration: Jatropha, Karanja o Thirdgeneration: Algae o Fourth generation: Photobiological solar fuels	**15 L**

References:

1. Hill, A. F., .Economic Botany – A textbook of useful plants and plant products, McGraw-Hill Book Company, Incorporated, 1937
2. Ayurvedic Pharmacopoeia of India, AYUSH, Government of India.
3. Kokate C. K., Purohit A. P., Pharmacognosy, NiraliPrakashan, 2011.
4. Khandelwal K.R., Practical Pharmacognosy- techniques and experiments, NiraliPrakashan, 2008.
5. Evans W. C., Trease and Evans Pharmacognosy, 16 th edition, Saunders ltd., 2009.

6. Casida, L.E.J.R., Industrial Microbiology, New age International Publishers, 2007
7. The Amylase Research Society Handbook of Amylases and related enzymes: Their sources, isolation methods, properties and applications. Pergamon Press, 2014.
8. Parameshwaram B Varjani S, Raveendran S. Green Bio-processes: Enzymes in Industrial Food processing. Springer, 2018.
9. Srivastava M, Srivastava N, Ramteke P.W, Mishra P.K. Approaches to Enhance industrial production of Fungal cellulases. Springer, 2019.
10. Konwar B.K. and Sagar K. Lipase: An industrial enzyme through Metagenomics. CRC Press, 2018.
11. Eva-Mari Aro From first generation biofuels to advanced solar biofuels. Ambio 2016, 45(Suppl. 1): S24-S31; DOI 10.1007/s13280-015-0730-0
12. Lehmussaari et al; Process for the extraction of beta amylase from barley grains US4675296AUnited states patent [19]
13. Enzyme Extraction: Beta amylase from barley- ET -8 Enzymology and Enzyme Technology.
14. Margarita M. Andrade-Mahecha, Olga Morales-Rodriguez and Hugo A.Martinez-Correa. Study of extraction process of papain from latex of papaya (*Carica papaya* L.) fruits cv. Maradol; Acta Agronomica 60(3) 2011, pg 217-223.
15. Ketnawa S. Chaiwut P. and Rawdkuen S: Extraction of Bromelain from pineapple peels. Food Science and Technology International 17(4) 395-402; DOI: 10.1177/1082013210387817
16. Rida Arshad, Ayesha Mohyuddin, Shagufta Saeed & Abrar Ul Hassan- Optimized production of tannase and gallic acid from fruit seeds by solid state fermentation: Tropical Journal of Pharmaceutical Research May 2019; 18(5):911-918.

Course Code: SBOT3PR	Practical	Credits: 2.5

Learning Objectives:

- To study the morphological differences and structures of different classes of marine and fresh water algae
- To study the morphological and features of different classes of pathogenic fungi
- To observe the various fossil specimens and slides.
- To learn the method of preparation of various silica or alumina columns to demonstrate adsorption chromatography and use it for separation of plant pigments. They will also learn to prepare and use ion exchange resin columns to demonstrate the separation of amino acids by ion exchange chromatography.
- To observe macroscopic and microscopic structures of parts of different medicinal plants and also perform various chemical tests to identify their active ingredients.
- To learn method of extraction and isolation of some plant based enzymes.

Learning Outcomes:

Students will be able to

- Differentiate and classify the various forms of algae and understand their importance to the environment
- Differentiate and classify the various forms of fungal species, understand life cycles of pathogenic fungi and will also be able to suggest measures to protect the plants from pathogenic fungi.
- Understand the importance of fossil study.
- Apply techniques like chromatography, spectroscopy and electrophoresis for separation and characterisation of plant based compounds
- Understand the use of plants in medicine, their analysis and their applications
- Understand the application of extracted enzymes

	Practical Paper I
1	Study of stages in the life cycle of *Euglena* from fresh/ preserved material and permanent slide
2	Study of stages in the life cycle of *Vaucheria* from fresh/ preserved material and permanent slide
3	Study of stages in the life cycle of *Diatoms* from fresh/ preserved material and permanent slide
4	Economic importance of algae: Pollution indicators, Diatomaceous earth
5	Study of stages in the life cycle of *Yeast* from fresh/ preserved material and permanent slides
6	Study of stages in the life cycle of *Aspergillus* from fresh/ preserved material and permanent slides
7	Study of stages in the life cycle of *Penicillium* from fresh/ preserved material and permanent slides
8	Study of stages in the life cycle of *Erysiphe* from material and permanent slides
9	Study of stages in the life cycle of *Claviceps* from material and permanent slides

10	Economic importance of Fungi – Disease causing fungi, useful fungi
11	Study of form genera*Rhynia*with the help of permanent slides/ photomicrographs
12	Study of form genera*Calamites* with the help of permanent slides/ photomicrographs
13	Study of form genera*Lepidodenron*and*Lepidocarpon* with the help of permanent slides/ photomicrographs
14	Study of form genera*Lyginopteris* with the help of permanent slides/ photomicrographs
15	Study of form genera*Pentoxylon* with the help of permanent slides/ photomicrographs

Practical Paper II	
1	To separate plant pigments using paper chromatography
2	To separate amino acids using paper chromatography
3	To separate plant pigments using thin layer chromatography (TLC)
4	Isolation ofchloroplastusingSucrose density gradient centrifugation.
5	Identification of the chromosomal aberrations
6	Karyotype of Normal Human male and normal human female
7	Study of karyotype for chromosomal aberrations in *Cri-du-chat* syndrome; D-G translocation, Philadelphia syndrome
8	Study of cytoplasmic inheritance pattern with reference to Plastid transmission in plants, Streptomycin resistance in *Chlamydomonas* and Male sterility in maize
9	Study of*Drosophila* – culturing, morphological studies & mutations
10	To extract RNA from the given material
11	Estimation of RNA using orcinol method
12	To extract genomic DNAfrom the given material and determine percentage purity of DNA using UV spectrophotometer.
13	Estimation of DNA by DPA method

Practical Paper III	
1	To determine Total Ash, Acid-insoluble Ash and Water-Soluble Ash from plants mentioned in theory.
2	To determine extractive values from plants mentioned in theory.
3	To perform Fluorescence analysis of given plant material.
4	To determine the moisture content from the given plant material.
5	To study Macroscopic, Microscopic characters and perform the chemical test to study secondary metabolites of the following: o *Saracaasoca* o *Bacopamonnieri* o *Ocimum sanctum* o *Emblica officinalis* o *Rubiacordifolia*
6	Study of different types of forests using cartographic method
7	Fibre and fibre yielding plants: Jute, Coconut, Sun hemp, Kapok, Sisal, Linen, Abaca Spice and condiments: Ginger, Cinnamon, Black pepper, Nutmeg Beverages: Tea, Coffee, Cocoa
8	Extraction of Amylase/ Papain / Bromelain/Cellulase/ Lipase /Tannase from suitable plant or fungal sourcesfollowed by detection/estimation of enzyme activity of extracted protein.
09	To extract and estimate protein content from the given plant material using Lowry's method and biuret method.
10	Use of aromatherapy – bath oils/ scented candles/ incense sticks
11	Identification of Bio-fuel plants
12	To estimate carbohydrates/fats/ vitamin content from the plant material.

Evaluation Scheme:

[A] Evaluation scheme for Theory courses:

I. Continuous Assessment (C.A.) - 40 Marks

(i) C.A.-I: Test/**continuous evaluation in given time frame with Surprise test** – 20 Marks of 40 mins. duration

(ii) C.A.-II: Assignment/project/quiz/ test/ **continuous evaluation in given time frame with Surprise test**

II. Semester End Examination (SEE)- 60 Marks

[B] Evaluation scheme for Practical courses: (SEE – 50 marks)

NOTE:

1. A minimum of TWO field excursions habitat studies are compulsory. Field work of not less than eight hours duration is equivalentto one period per week for a batch of fifteen students.

2. A candidate will be allowed to appear for the practical examinations only if he/she submits a certified journal of SYBSc Botany and the Field Report or a certificate from the Head of theDepartment/Institute to the effect that the candidate has completed the practical course of SYBSc Botany as per the minimum requirements.