

UNIVERSITY OF KERALA



THIRUVANANTHAPURAM

FIRST DEGREE PROGRAMME
UNDER
CHOICE BASED CREDIT- SEMESTER SYSTEM

BOTANY & AYURVEDIC PHARMACY

Double Main

Course structure & Syllabus

(w.e.f. 2020 admissions)

First Degree Programme under CBCSS
BSc. Botany and Ayurvedic Pharmacy (Double Main)

Eligibility for admission to First Degree Programme in Botany and Ayurvedic Pharmacy

Candidates shall be admitted to the course provided he / she has passed plus two examinations of the state or central board with biology as one of the subjects.

Aim:

1. Better understanding of plant diversity, natural resources and utilization.
2. Importance of plants and plant derived products in health care systems.
3. Overview of phytodrugs and ayurvedic pharmaceutical industry.

Programme Outcome:

The trained students,

1. Are conscious and aware of natural resources and environment
2. Are equipped to acquire knowledge of plants and related subjects so as to understand and exploit natural phenomena, and environment for the benefit of human beings.
3. Can improve agriculture and allied fields to make the country self reliant and self sufficient.
4. Can appreciate the role of biology in societal issues, like environment, biological resources, biodiversity, ethics, human health and diseases.
5. Aware of the latest developments in the field of Information technology, Biotechnology, Bioinformatics and closely related fields of research and development.
6. Can identify, and collect raw materials and use them in ayurvedic formulations and drugs.
7. Can analyse quality of ayurvedic drugs and effectively manage ayurvedic stores.
8. Ayurvedic drug presentation techniques and are well versed in acts and regulations.

The programme consists of Language courses, foundation courses, Core courses, open Courses and Projects. There are two foundation courses, one is focused on the Indian constitution and fundamental rights to create an awareness in the civic sense of students. The second foundation course is to give a general introduction and awareness in environment, issues and conservation of nature.

Candidates through the program gain proficiency in different fields of Botany and Ayurvedic Pharmacy. The course opens a plethora of opportunity for candidates to pursue after the completion of the program. They can pursue higher education in Botany or can opt for employment related to Botany and Agriculture, as well as in Hospitals and Clinics dealing in Ayurveda, Medical shops, and Pharmaceutical Companies dealing in Ayurvedic products.

Course Structure

The programme consists of Language courses, foundation courses, Core courses, Open Courses and Projects. There are two foundation courses, one focused on the Indian constitution and fundamental rights to create an awareness in the civic sense of students. The second foundation course will provide a general awareness on environment, issues and conservation of nature.

The various courses in the programme are aimed to develop proficiency in theory as well as practical experiments, and common equipments, laboratory, along with the collection interpretation and presentation of scientific data in proper manner. In addition to this, students will be equipped with knowledge in modern areas of Botany and its application in Ayurveda, medical science, agriculture, industry, bioinformatics *etc.* Ayurveda is the field of medicine which is growing in prominence in the scenario of emerging diverse diseases. This course may serve as a platform for candidates to learn in depth about the different medicines and techniques used to cure ailments through Ayurveda. The program is an integrated study of Botany, Ayurveda in combination with basics of Pharmacy.

The first degree programme in Botany and Aurvedic pharmacy consists of a total of 36 courses distributed in seven categories. They are Language courses, Foundation courses, Main courses, an Open course and two Projects. The Course is in double main pattern with projects in both Botany and Ayurvedic Pharmacy. This is compulsory and the students may be assigned a topic for the project in the 5th semester itself and should be completed and submitted during the practical assessment at the end of VI semester. The total credits for the entire programme is 120, and the distribution of credits, contact hours *etc.* for each course in each semester is summarized below. Credit of 1 will be assigned to Social Service/ Extension activity. Total contact hours will be 25 per week. The subject code is BP (Botany & Ayurvedic Pharmacy).

- 1 - Language
- 1.1 - Additional Language
- 2 - Foundation course
- 3 - Main I (Botany)
- 4 - Main II (Ayurvedic Pharmacy)
- 5 - Open Course
- 6 - Project in Main I
- 7 - Project in Main II

Summary of courses

C - Credits

T- Theory

P- Practical

Study Components	No. of courses	Credits /course		Max / Total Credits
1 Languages				
1 English	4	3		12
2 Additional Language	2	3		6
2 Foundation Course	2			
1 Contemporary issues on Constitution / Human rights	1	3		5
2 Environmental Studies	1	2		
3 Main I				
Botany	13	L	P	47
1. Microtechnique, Angiosperm Anatomy, Reproductive Botany & Palynology		4		
2. Methodology of Science & Bioinstrumentation		3		
3. Practical Botany I (Practical of 1 & 2)			4	
4. Phycology, Mycology, Lichenology & Plant Pathology		3		
5. Horticulture, Mushroom Cultivation & Marketing		2		
6. Bryology, Pteridology, Gymnosperms & Paleobotany		3		
7. Cell biology, Plant breeding & Evolutionary biology		3		
8. Practical Botany II (Practical of 4, 5,6 & 7)			4	
9. Economic Botany, Ethnobotany & Forestry		2		
10. Angiosperm Morphology & Systematic Botany		4		
11. Genetics & Biotechnology		4		
12. Plant physiology		3		
13. Practical Botany III (Practical of 9, 10,11 & 12)			4	
4 Main II				
Ayurvedic pharmacy	12			47
1 Introduction to Ayurveda drug Development		4		
2 Biochemistry, Animal physiology & Anatomy		4		
3 Pharmaceutical techniques I (Practical of 1 and 2)			4	
4 Pharmacognosy		4		
5 Pharmaceutical Analysis		3		

6	Pharmaceutical Chemistry and Natural Products		3		
7	Pharmaceutical techniques II (Practical of 4, 5, 6, & 7)			4	
8	Cultivation & Conservation of medicinal plants		3		
9	Pharmaceutical microbiology		3		
10	Industrial Pharmacy. Pharmacy management & Pharmaceutical jurisprudence		3		
11	Formulative Pharmacy		4		
12	Pharmaceutical techniques III(Practical of 9,10,11 &12)			4	
5	Open Course	1	2		2
1	Medicinal plants & Conservation		2		
2	Horticulture		2		
3	Herbal Medicine & First Aid		2		
	Project in Main I	1		4	
	Project in Main II	1		4	
	Social Service / Extension Activity				1
	Total	36			120

Summary of Semester wise hour distribution.

SEMESTER I

Course code	Course Title	Teaching hrs./week		Total Credits	Duration of University Exam hrs	Marks for Evaluation	
		T	P			CE	ESE
EN 1111	English	5		3	3	20	80
1111.1	Additional language	5		3	3	20	80
BP 1121	Contemporary issues on Constitution / Human rights	3		3	3	20	80
BP 1131	Microtechnique, Angiosperm Anatomy, Reproductive Botany & Palynology	4	2	4	3	20	80
BP 1141	Introduction to Ayurveda drug Development	4	2	4	3	20	80
	Total	25					

SEMESTER II

Course code	Course Title	Teaching hrs./week		Total Credits	Duration of University Exam hrs	Marks for Evaluation	
		T	P			CE	ESE
EN1211	English	5		3	3	20	80
1211.1	Additional language	5		3	3	20	80
BP1221	Environmental Studies	2		2	3	20	80
BP1231	Methodology of Science and Bioinstrumentation	4	2	3	3	20	80
BP1232	Practical Botany I (Practical of BP1131 & BP1231)			4	3	20	80
BP1241	Biochemistry, Animal Physiology and Anatomy	4	3	4	3	20	80
BP1242	Ayurvedic Pharmacy –Practical I (Practical of BP1141 & BP1241)			4	3	20	80
	Total	25					

SEMESTER III

<i>Course code</i>	<i>Course Title</i>	<i>Teaching hrs./week</i>		<i>Total Credits</i>	<i>Duration of University</i>	<i>Marks for Evaluation</i>	
		T	P			<i>Exam hrs</i>	<i>CE</i>
EN1311	English	5		3	3	20	80
BP1331	Phycology, Mycology, Lichenology & Plant Pathology	3	2	3	3	20	80
BP1332	Horticulture, Mushroom Cultivation & Marketing	3	2	3	3	20	80
BP1341	Pharmacognosy	3	2	4	3	20	80
BP1342	Pharmaceutical Analysis	3	2	3	3	20	80
	Total	25					

SEMESTER IV

<i>Course code</i>	<i>Course Title</i>	<i>Teaching hrs./week</i>		<i>Total Credits</i>	<i>Duration of University</i>	<i>Marks for Evaluation</i>	
		T	P			<i>Exam hrs.</i>	<i>CE</i>
EN1411	English	5		3	3	20	80
BP1431	Bryology, Pteridology, Gymnosperms & Paleobotany	4	2	3	3	20	80
BP1432	Cell biology, Plant breeding & Evolutionary biology	3	1	3	3	20	80
BP1433	Practical Botany II (Practical of BP1331, BP1332, BP1431 & BP1432)			4	3	20	80
BP1441	Pharmaceutical chemistry & Natural Products	3	2	3	3	20	80
BP1442	Cultivation & Conservation of medicinal plants	3	2	3	3	20	80
BP1443	Ayurvedic Pharmacy- Practical II (Practical of BP1341, BP1342, BP1441 & BP1442)			4	4	20	80
	Total	25					

SEMESTER V

Course code	Course title	Teaching hrs./week		Total Credits	Duration of University Exam	Marks for Evaluation	
		T	P			hrs	CE
BP1531	Economic Botany, Ethnobotany & Forestry	2	1	2	3	20	80
BP1532	Angiosperm Morphology & Systematic Botany	3	2	4	3	20	80
BP1541	Pharmaceutical Microbiology	3	1	3	3	20	80
BP1542	Industrial Pharmacy, Pharmacy management & Pharmaceutical Jurisprudence	4	2	3	3	20	80
BP1551.1	Open course: Medicinal plant conservation	3		2	3	20	80
BP1551.2	Horticulture	3		2	3	20	80
BP1551.3	Herbal Medicine & First Aid	3		2	3	20	80
	Project I		2				
	Project II		2				
	Total	15	10				

SEMESTER VI

Course code	Course Title	Teaching hrs./week		Total Credits	Duration of University Exam	Marks for Evaluation	
		T	P			Exam hrs	CE
BP1631	Genetics & Biotechnology	4	3	3	3	20	80
BP1632	Plant Physiology	4	2	3	3	20	80
BP1633	Practical Botany III (Practical of BP1531, BP1532, BP1631 & BP1632)			4	3	20	80
BP1641	Formulative Pharmacy	4	2	4	3	20	80
BP1642	Ayurvedic Pharmacy- Practical III (BP1541, BP1542, & BP1641)			4	3	20	80
BP1661	Project I		3	4			
BP 1671	Project II		3	4			
	Total	12	13				

Project / Dissertation is compulsory under both main subjects – Botany & Ayurvedic Pharmacy. Students have to begin the project in the 5th semester and submit the project report for valuation at the end of 6th semester. It can be carried out individually or by a group not exceeding five students ensuring active participation of each student. The topic of the project should be innovative and relevant to the field of Botany & Ayurvedic Pharmacy. The topics are either to be allotted by the supervising teacher or be selected by the students in consultation with the supervising teacher. Topics selected once should not be repeated and plagiarising should be avoided. The project report duly attested by the Supervising teacher and certified by the HOD has to be submitted on the day of *Viva voce* examination. *Viva Voce* may be conducted for each student at the time of Project evaluation. The project shall be evaluated by two external examiners. The report (not less than 40 pages) should be prepared in Times New Roman font size 12 with 1.5 spacing as per the format given below.

1. Title page
2. Declaration by the student
3. Certificate (Supervising teacher and HOD)
4. Acknowledgement if any
5. Table of contents
6. Abbreviations if any
7. Introduction & Review of literature
8. Materials & Methods
9. Results & Discussion
10. Summary & Conclusions
11. References.

Field visits and reports:

It is compulsory that every student has to undertake a field visit to local medicinal plant gardens or repositories for observing cultivation & conservation practices & to submit a field report counter signed by the Head of the Department along with the practical Examination of BP 1443.

It is compulsory that every student has to undertake a field study tour of not less than three days for observing plant diversity under the guidance of teachers of the Department during V or VI semesters. Moreover, they have to submit a tour report countersigned by the Head of the department during the practical examination of BP1633. **If a student fails to attend the field study tour he / she will not be permitted to attend the examination.**

Industry or Institute visit: It is compulsory that every student has to undertake an Industry or Institute visit as part of the Ayurvedic Pharmacy curriculum. They have to submit the report of the same, duly certified by the Head of the Department during the practical examination of BP1643.

Semester I
Foundation Course
I
BP 1121: Contemporary issues on
Constitution / Human rights

Credits 3

Contact Hours 54 hrs

***Aim:** To create awareness among the students about the tenets of our Constitution, and the concept of universal human rights and right violations.*

Outcome:

1. Students should be able to understand and analyse objectively issues and problems of constitutional issues and human rights, based on a sound background of our constitution.
2. Violation of human rights and protection of the underprivileged, and their issues should be tackled on a broad social frame work.
3. To develop a better understanding about the principles of Indian constitution regarding human rights.
4. Develop awareness about the Rights of socially excluded people.
5. Understand new Dimensions of Human Rights.

Module: I

Constitution, Human Rights - basic concepts

09 Hrs.

1. Origin and development.
2. Salient features of the Indian Constitution.
3. Preamble.
4. Universal Declaration of Human Rights (1948).

Module: II

Human Rights and the Indian Constitution

18 Hrs.

1. Discussion of the Preamble, Modifications to the Preamble.
2. Fundamental Rights.
3. Fundamental Duties.
4. Need for balance between rights and duties.
5. Directive Principles of State Policy, Fundamental Duties.
6. Protection and Enforcement Agencies - National Human Rights Commission.
7. Women's Commission, Police and Human Rights.

Module: III**Human Rights of Disadvantaged Sections in Kerala****18 Hrs.**

1. Women and Children - Problem of representation, Violence against women - Child labour.
2. Dalits and Adivasis - Right to development and shelter.

Module IV**New Dimensions of Human Rights****09 Hrs.**

1. Right to Development.
2. Media in protecting Human Rights.
3. Globalisation and Human Rights.
4. Civil War and Terrorism - The Right to Peace.

Suggested Reading:

1. Andrew Clapham, Human Rights, Oxford, 2007.
2. Byne, Darren 1, Human Rights, Delhi: Pearson ,2005
3. Pathak, Arunkumar (2005), Human Rights, Delhi; Silvar Line Publications
4. Rao, Bhaskara, Digumarti (2004), Human Rights Education, Delhi: Discovery Publishing House.
5. Das, Asishkumar & Prasantkumar, Mohanty (2007) Human Rights in India, Delhi: Sarup & Sons,
6. Dr. Singh, Subhash Chandra (2006) Social Justice and Human Rights in India, New Delhi, Serials Publications.
7. Sengal B.P.S., (2000) Human Rights in India, Problems and Perspective, New Delhi: Deep and Deep Publications.
8. Jacobson R. (1992) The United Natian and Human Rights: A critical appraisal, Oxford University Press.
9. Khanna, S.K. (1998) Children and Human Rights, New Delhi: Commonwealth Publishers.
10. Mehta, P. L and Neena Varma (1995) Human Rights under the Indian Constitution, ' New Delhi; Deep and Deep Publications.
11. Ujjwal Kumar Singh, Human Rights and Peace, Sage, New Delhi, 2009.
12. Singh, Subhash Chandra. (2006). Social Justice and Human Rights in India. New Delhi: Serials Publications.
13. Sinha, P.C. (2002). Encyclopaedia of Human Rights. New Delhi: Anmol Publishers.
14. Sreekrishna, S. & Samudrala, Anilkumar. (2007). Dalits and Human Rights. New Delhi: Serials Publications.

15. Subhrajit, Chatterjee. (2014). Problems Faced by LGBT People in the Mainstream Society: Some recommendations. International Journal of Interdisciplinary and Multidisciplinary Studies (IJIMS). Vol 1, No.5, pp.317-331. ISSN: 2348 – 0343
16. Suresh, Hosbeth. (2010). All Human Rights are Fundamental Rights: Second Edition. New Delhi: Universal Law Publishing.
17. Tadsad, Kamalaxi G. & Ramaswamy, Harish. (2012). Human Rights and Police Administration. New Delhi: Concept Publishing Company.
18. Welch Jr., Claude E. (2001). NGOs and Human Rights: Promise and Performance. Pennsylvania, University of Pennsylvania Press.

**Semester I
Main I Botany**

BP 1131 Microtechnique, Angiosperm Anatomy, Reproductive Botany and Palynology

Credits 4

Contact Hours 108 (T 72 + P 36)

***Aim:** The course is aimed to bring about the basic concept and understanding about the anatomy of flowering plants and its relationship to the physiology and environmental adaptability of plants.*

Outcome:

1. Students should be able to understand the complexities of cell wall organization, microscopic and sub microscopic structures.
2. Students should distinguish various anatomical features of monocots and dicots with respect to permanent tissues and tissue systems.
3. Identify and differentiate male and female gametophyte development in angiosperms.
4. Distinguish between monocot and dicot embryos and the basic features of pollen grains.

Microtechnique

18 hrs

Module I

1. Introduction - Microscopy - Simple and Compound – Phase contrast; Dark field illumination and Electron microscopes (SEM and TEM).
2. Micrometry, Camera-Lucida
3. Sectioning - Hand and Microtome– Rotary and Sledge
4. Killing and Fixation agents – Carnoy’s formula, Farmers formula, F.A.A.
5. Tissue Dehydration – Reagents.
6. Stains and Staining techniques - Double staining. General account; Stains: Safranin, Haematoxylin, Acetocarmine, Fastgreen.
7. Mounting media – Temporary (Water), Semi permanent(Glycerol jelly) and Permanent (D. P. X and Canada balsam).
8. Whole mounts - Cytological methods: Maceration, Smear and Squash preparation.

Angiosperm Anatomy**18hrs****Module- II**

1. Cell wall organization - Gross structure - Primary and secondary wall - pits-plasmodesmata - microscopic and sub microscopic structures Extra cell wall material.
2. Non-Living inclusions of the cell Reserve food - secretory products and byproducts.
3. Tissues: Meristems, Definition, Classification based on origin, position, growth patterns, functions.
4. Apical meristems & theories on apical organization - Apical cell theory, Histogen theory, Tunica Corpus theory. Organization of root apex in dicots & monocots.
5. Permanent tissues –Definition, classification - simple, complex and secretory.
6. Tissue systems –Epidermal tissue systems-stomata, structure and functions, Ground tissue systems & vascular tissue systems. Different types of vascular arrangements.

Module III**18 hrs**

1. Primary structure- Root, stem and leaf [Dicot & Monocot].
2. Secondary growth - Root and stem - cambium (structure and function), Growth rings, heart wood and sap wood, tyloses, ring porous wood and diffuse porous wood, periderm formation - phellum, phellogen and phelloderm; Lenticels.
3. Anomalous secondary growth - *Bignonia*, *Boerhaavia*, *Dracaena*.
4. Ecological Anatomy- Morphological & Anatomical adaptations of Hydrophytes, Xerophytes, Epiphytes & parasites

Module IV**Reproductive Botany****14 hrs**

1. Introduction to angiosperm embryology
2. Microsporogenesis - structure and functions of wall layers. Development of male gametophyte - Dehiscence of anther.
3. Megasporogenesis - Development of female gametophyte - Embryo sac - Development and types- Monosporic *Polygonum* type, Bisporic - *Allium* type, Tetrasporic *Adoxa* type.
4. Pollination - Germination of pollen grains– Double Fertilization.
5. Structure of Embryo- Dicot [*Capsella*], Monocot [*Sagittaria*] Endosperm types, its development and functions.

Module V**04 hrs**

Palynology: Pollen structure and morphology, viability test for pollen grains (Tetrazolium test and Fluorescein diacetate test). Economic significance of pollen, Pollen allergy.

Practical**36 hrs****Microtechnique**

Preparation and composition of Fixatives (FAA and Carnoy's Fluid), Stains (Acetocarmine, Saffranin, Haematoxylin), Mounting media (Canada balsam, DPX).

Angiosperm Anatomy

1. Non-living inclusions - Cystolith, Raphide, Sphaero-raphide, Aleurone grains. Starch grains (Eccentric, Concentric, Compound).
2. Simple permanent tissue-Parenchyma, Chlorenchyma, Aerenchyma, Collenchyma and Sclerenchyma.
3. Secretory tissue: Resin canal, Lysigenous and Schizogenous cavities. Laticifers– Articulated and non-articulated.

4. Primary structure – Dicot stem: *Hydrocotyle*, *Eupatorium* or any normal type, Bicollateral (*Cephalandra*).
5. Monocot stem: Grass, *Asparagus* or any normal type.
6. Dicot root: Pea, *Limnanthemum (Nymphoides)* or any typical dicot root.
7. Monocot root: *Colocasia* or any typical monocot root.
8. Secondary structure - Stem - *Vernonia* or any normal type.
9. Secondary structure - Root - *Tinospora*, *Carica papaya*, or any normal type.
10. Stomatal types (Anomocytic, Anisocytic, Diacytic and Paracytic)
11. Anomalous secondary thickening - *Bignonia*, *Dracaena*, *Boerhaavia*.
12. Leaf anatomy - Dicot leaf: *Ixora*. Monocot leaf: Grass.
13. Ecological anatomy- Hydrophytes (*Hydrilla*), Xerophytes (*Nerium leaf*), Epiphytes (*Vanda* Velamen root).

Reproductive Botany

Students should be familiar with the structure of anther (mature and young) and embryo (dicot and monocot) using permanent slides.

Estimation of pollen sterility and fertility percentage, Acetocarmine method.

Palynology

Study of pollen morphology of the following plants *Hibiscus*, *Vinca*, *Balsam*, *Ixora*, *Crotalaria*, *Bougainvillea* by microscopic observation.

Suggested Readings

1. Esau K. (1965) - Plant Anatomy – Wiley Eastern, New York.
2. Fahn A. (2000) - Plant Anatomy – Pergamon Press, Oxford.
3. Pijush Roy (2010) Plant anatomy
4. Pandey, B .P. (1997) - Plant Anatomy - S.Chand and co. New Delhi
5. Vashista .P. C (1984) - Plant Anatomy – Pradeep Publications – Jalandhar
6. Prasad and Prasad (1972) Out lines of Botanical Micro technique, Emkay publications, New Delhi.
7. SN Pande and Chadha A. Plant anatomy and Embryology. Vikas Publishing
8. Johri, B. M. 1984. Embryology of Angiosperms. Springer-Verleg, Berlin.
9. Maheswari P. - Embryology of Angiosperms - Vikas Pub:
10. P.K.K. Nair. Palynology of Angiosperms
11. Bhattacharya et. al. 2007. A textbook of Palynology, Central, New Delhi.
12. Bhojwani, S. S. and S. P. Bhatnagar. 2008. The Embryology of Angiosperms (5th Ed.), Vikas Publishing House, Delhi.

Semester II
Foundation Course II
BP 1221: Environmental Studies

Credits 2

Contact Hours 36 hrs

Aim: To inculcate environmental awareness among students and the need for protecting Nature.

Outcome

1. Develop awareness about natural resources, its conservation and importance of sustainable lifestyles.
2. Understand and identify different ecosystems and ecosystem processes.
3. Develop a deep understanding about biodiversity and importance of its conservation.
4. Develop skills to identify polluted sites, major pollutants and recognize the need to mitigate environmental pollution.
5. Awareness about different types of disasters and to adopt strategies to overcome and reduce the impact.
6. Identify the importance of phytogeographical sites in India.

Module I

05 hrs

1. Definition- Scope and relevance to society. Need for public awareness.

Natural Resources

1. Renewable and non-renewable resources.
2. Forest resources: Use and over exploitation. Deforestation.
3. Mineral resources: Use and exploitation, Environmental effects of extracting and using mineral resources.
4. Water resources: Use and over exploitation of surface and ground water, floods, drought.
5. Food resources: Issues related to food production, changes caused by agriculture and over grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging and salinity.
6. Energy resources: Issues related to our growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.
7. Land resources: Land as a resource, land degradation, human induced landslides, soil erosion and desertification.
8. Role of an individual in conservation of natural resources: Understanding resource ecology and life supporting capacity of resources - Economic models: Green building concept- green technology concept.

Module II Ecosystems

09 hrs

1. Ecosystems- Concept of an ecosystem- Structure and Function of an ecosystem.
2. Biotic and abiotic components and energy flow in an ecosystem.
3. Ecological succession - Definition & types.
4. Food chains, food web & ecological pyramids.
5. Types of ecosystem. Characteristic features, structure and function of the following ecosystems (Brief study only).
 - i) Forest ecosystem ii) Grassland ecosystem iii) Desert ecosystem iv) Aquatic ecosystems - Ponds, Streams, Rivers, Oceans & Estuaries.
6. Ecological niche and Habitat. Morphological, anatomical & physiological adaptations of plants to different habitats - Hydrophytes, Xerophytes, Halophytes, Epiphytes, Parasites.

Module III Biodiversity and its conservation

09hrs

1. Definition- Genetic, Species and Ecosystem diversity. Alpha, Beta and Gamma diversity, Ecotypes & Ecological indicators. Introduction to Biodiversity Conservation and The Biodiversity Act.
2. Biodiversity of Kerala- Western Ghats, Shola forests, Mangroves and wet lands in Kerala. Need for protection of mangrove vegetation.
3. Threats to biodiversity: Climate change, habitat loss, Overexploitation, Invasive species poaching of wild life, anthropogenic pressures on wild life. Problems in wildlife protection.
4. Conservation of Biodiversity. *In-situ* conservation: Sanctuaries, Biospheres reserves, National parks, Nature reserves, Preservation plots. *Ex-situ* conservation: Botanical gardens, Zoos, Aquaria, Homestead gardens; *In-vitro* Conservation: Germplasm and GeneBank; Tissue culture: Pollen and Spore bank, DNA bank. National and international programs for biodiversity conservation. Role of WWF, WCU, CITES, TRAFFIC, Forest Rights Act and Participatory forest management, Eco-tourism and Social Forestry. *Ramsar* wetland sites.

Module IV Social issues and the Environment

09hrs

1. Unsustainable to sustainable development. Environment protection Act. Air [Prevention and control of pollution] Act. Water [Prevention and control of pollution] Act. Wildlife Protection Act. Forest conservation Act. Hill preservation Act.

2. Definition causes, effects and control measures of–1. Air pollution 2. Water pollution 3. Soil pollution 4. Marine pollution 5. Noise pollution 6. Thermal pollution.
3. Solid waste Management- (Brief account only): Causes, effects and control measures of urban and industrial wastes.

Module V

04hrs

Natural hazards and disaster management

1. Introduction to Hazards- Hazard classification- Types of Hazards.
2. Natural Hazards: Causes, (Continental drift, Plate tectonics, Sea floor spreading, Isostasy etc.,) Distribution pattern, Consequences and Mitigation: Earthquake, Tsunami, Volcanoes, Cyclone, Flood, Drought, Landslide, Cold and Heat hazards, Forest fire, etc.,- causes, types, distribution adverse effects, etc.
3. Manmade hazards, Bomb threat, explosion, Hazardous material spill, Fire, Terror attacks, Nuclear hazards.
4. Introduction to Disaster Management, Capability, Vulnerability, Risk- Preparedness and Mitigation.
5. Disaster management cycle, Community planning, Education and Engineered structural strengthening techniques- Hazard zonation and mapping, Risk Reduction Measures- Unexpected loss of income, Financial emergency and Insurance.

1. Visit to at least three local polluted sites, analysis, recording and report of the major pollutants.
2. Fire / Disaster alarm and response - Mock drills.

Suggested Reading

1. Ahluwalia V. K. and Sunitha Malhotra. 2009, Environmental science, Ane Books Pvt. Ltd.
2. Ambasht R. S. – Text book of Plant Ecology, Students and Friends & Co., Varanasi.
3. Chandoco S. Weaver and Clements – Plant Ecology, McGraw Hill Publications, New York.
4. Chapman J. L. (2006) Ecology - Principles and Application. Cambridge University Press India Pvt. Ltd.
5. Erach Bharucha – Text book of environmental Studies for undergraduate Courses, Universities Press, University Grants Commission.
6. Kumaresan B. – Plant Ecology & Phytogeography – Rastogi Pub:
7. Misra S.P. and Pandey S. N., 2009, Essential Environmental studies, Ane Books Pvt. Ltd.
8. Odum Eugene P. – Fundamentals of Ecology, Edn. Philladelphia & Saunders, Tokyo, Toppon.
9. Periasamy, K. – Elements of Plant Ecology, (M.K. Publications).
10. Prithipal Singh 2007- An Introduction to Biodiversity. Ane Books Pvt. Ltd

11. Sharma, P.D. – Elements of Ecology (Rastogi's Company Ltd., Publications).
12. The Geography of Flowering Plants - Good
13. Vashista P.C. – Plant Ecology Edu. Vishali Publications.
14. Verma and Agarwal – Principles of Ecology, S. Chand and Co.
15. Verma, P. S. and V. K. Agrawal. 2004. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd., New Delhi.
16. Paritosh Srivastava. 2017. Disaster Management: Disaster Management and Mitigation approaches in India. PHI Learning. ASIN: B0725CQC2D
17. Tyler Miller G., Scott Spoolman. 2018. Environmental Science (16 Edn) Cengage Learning,

Semester II
Main I Botany

BP 1231: Methodology of Science & Bioinstrumentation

Credits 3

Contact hours 108 hrs (T 72+ P36)

***Aim:** The aim is to introduce modern scientific methods & instrumentation used in Science to Students and to equip them to apply statistics and IT in Biological sciences.*

Outcome

1. *Develops skills to interpret scientific data using basic statistical methods.*
2. *Develops an idea about application of IT in biological science in improvement of human life.*
3. *Inculcate research aptitude and training in project writing.*

Module I

Data handling in science and Biostatistics

09 hrs

Significance of statistical methods in biological investigations; classification and tabulation, graphical (Histogram, frequency polygon) and diagrammatic representation (Pie & Bar diagrams), Samples & sampling techniques, Central tendency- Mean, Median, Mode, Standard Deviation, Variance, Standard error. Hypothesis testing (Chi square test).

Module II

Overview of Information of Technology

18 hrs

Introduction to Computers, Types, Features of modern personal computers and Peripherals, Characteristic of hardware and software, Overview of operating systems and major application software, Introduction to use of IT in teaching and learning- educational software. INFLIBNET, NICNET, BRNET; online learning platforms MOOCS, Swayam, Internet as a knowledge repository- Google scholar, Science direct.

Application of IT in Medicine, Healthcare, Industry, Crime detection, Publishing, Communication, Resource management and Education.

Cyber ethics, Cyber security, Cyber-crime, Security privacy issues.

Module III
Bioinformatics

18 hrs

Introduction, Definition, Brief history, Importance of Bioinformatics, Wet lab and Web lab, Data bases - NCBI, Nucleic acid databases (Gen Bank), Protein sequence databases (SWISS PROT), Model / organism databases, Biodiversity data bases, Protein structure databank - PDB, Sequence analysis and alignment (brief account only), Pair wise sequence alignment, Multiple sequence alignment, Sequence Alignment Tools: BLAST, CLUSTAL X.

Module IV
Research Methodology

09 hrs

Introduction- Need for research, Stages of Research – Definition of the problem, execution of the problem, interpretation of results, characteristics of Research, Types of research- Qualitative & Quantitative.

Experimental design- components of experimental designs - Randomized blocks, completely randomized designs. Preparation of a project report - Data analysis and consolidation of photographs, illustrations, tables and graphs, Title, Introduction, Review of literature, Materials and Methods, Results, Discussion, Summary, References, Acknowledgements; Bibliography – Method of citing and arrangement of references.

Module V
Bioinstrumentation

09hrs

Introduction to Biophysics - Laws of thermodynamics (excluding problems); Mechanism of vision, vision faults and their correction; hearing, generation and reception of sonic vibrations, hearing aids; Fluorescence and Phosphorescence; Isotopes and radioisotopes, radioactive tracer technique, Autoradiography.

Microscopy - Principle of Microscopy, Various types of Microscopy - Simple, Phase contrast, Fluorescence and Electron microscopy (TEM and SEM), Modern developments in Microscopy- Atomic force microscopy, Confocal microscopy.

Module VI
Basic principles and working of instruments

9 hrs

pH meter, Spectrophotometer (UV and Visible) and Colorimeter - Beer-Lambert's law. Brief account on Fluorimetry, IR, NMR, Nephelometry, Turbidimetry, Flame photometry, Atomic Absorption spectrophotometry, Polarimetry, Polarography.

Electrophoresis - Principle of electrophoresis, Components of Polyacrylamide gels, native gel electrophoresis, SDS-PAGE, Immuno electrophoresis.

Practicals**36 hrs**

1. Workout problems on frequency distribution.
2. Represent data using bar diagram and histogram.
3. Measures of central tendencies (Mean, Median, Mode).
4. Workout problems on measures of dispersion (range, mean deviation, variance, standard deviation, coefficient of variation).
5. Workout problems on chi-square test.
6. BLAST Search of NCBI database.
7. Students should access Gene databases, download and take a print out of any one of gene sequences.
8. Students are expected to work with at least any one of the commercial / scientific packages, to explore the WEB and able to find, recognize, download, install and use software in various areas useful to the research in Biology (Demonstration only).

Suggested Readings

1. An Introduction to Biostatistics: A Manual for studies in Health Sciences., P. Sundar Rao, and J. Richard, Prentice Hall .
2. Computers Today, Alexis Leon and Mathews Leon., Leon Vikas.
3. Conceptual Integrated science, Hewitt, Paul G, Suzanne Lyons, ohn A. Suchocki & Jennifer Yeh, Addison-Wesley.2007.
4. Cultural Boundaries of Science, Gieryn, T.F. University of Chicago Press, 1999.
5. Fundamentals of Information Technology, Alexis and Mathew Leon., Leon Vikas
6. Introduction to Information Technology, V. Rajaraman., Prentice Hill.
7. Learning Computer Fundamentals., Ramesh Bangia ., Khanna Book Publishers
8. Methods for Teaching Science as Inquiry, Bass, Joel, E and et. al., Allyn & Bacon, 2009 The truth of science, Newton R.G.,
9. Social issues in Science and Technology: An Encyclopedia, David E. Newton (ABC-CLIO, Santa Barbara), 1999.
10. The Golem: What everyone should know about science, Collins H. and T. Pinch, Cambridge University Press, 1993.
11. Research Methodology For Biological Sciences, MJP Publ. Gurumani N. 2006.
12. Niel C Jones and Pavela Pevzner, (2009). An introduction to Bioinformatics Algorithms. Ane Books India Pvt.Ltd.
13. Selzer P.M., Marhöfer R.J. and Rohwer A. (2008). Applied Bioinformatics: An Introduction, Springer.
14. Selzer PM, Marhofer RJ, Rohwer A (2009) Applied Bioinformatics. Springer- Verlag Berlin Heidelberg, Germany.
15. Teresa Attwood and David Parry-Smith (1999) Introduction to Bioinformatics Prentice Hall
16. A Textbook of Biophysics – R. N. Roy, New central Book Agency Pvt. Ltd, Calcutta.
17. Fundamentals of Biochemistry, Voet, D., Voet, J.G. & Pratt C.W. Jogn Wiley & Sons, Inc.
18. Biophysics- S.Thiruvia Raj, Saras Publications, Tamilnadu.
19. Biophysics, Volkenstein, M.V.
20. Introduction to biophysical chemistry Martin.Willard H. H., J .A. Dean, L. L. Merritt and F. A. Settle.
21. Instrumental methods of analysis CBS Publishers and Distributors Delhi.

22. Blair E. J. (1987) Introduction to chemical instrumentation Mc-Graw Hill Book Company.
23. Casey E. J. (1963) Biophysics – Concepts and Mechanisms Van Nostr and Reinhold Company.
24. Bass, Joel, E et al. (2009). Methods for teaching Science as Inquiry, Allyn & Bacon.
25. Collins H. and T Punch (1993). The Golem. What everyone should know about Science. Cambridge Univ. Press.
26. Gieryn T.F. (1999). Cultural Boundaries of Science, Univer. Chicago Press.
27. Hewitt, Paul G, Suzanne Lyons, John A, Suchocki and Jennifer Yeh (2007). Conceptual Integrated Science, Addison-Wesley.
28. Jeffrey A. Lee (2010). The Scientific Endeavor. Pearson Delhi.
29. Newton RG (2000) The truth of Science, 2nd edition, Harward University Press.
30. Pattabhi V & Gautham N (2011) Biophysics, Narosa publishers.
31. Willard H. H., J .A. Dean, L. L. Merritt and F. A. Settle (2011) Instrumental methods of analysis, CBS Publishers and Distributors N. Delhi.

Semester II

Main I

BP1232: Practical Botany I (Practical of BP1131 & BP1231)

BP1131: Microtechnique, Angiosperm Anatomy, Reproductive Botany and Palynology

Credit 4

Microtechnique

Preparation and composition of Fixatives (FAA and Carnoy's Fluid), Stains (Acetocarmine, Saffranin, Haematoxylin), Mounting media (Canada balsam, DPX).

Angiosperm Anatomy

1. Non-living inclusions - Cystolith, Raphide, Sphaero-raphide, Aleurone grains. Starch grains (Eccentric, Concentric, Compound).
2. Simple permanent tissue- Parenchyma, Chlorenchyma, Aerenchyma, Collenchyma and Sclerenchyma.
3. Secretory tissue: Resin canal, Lysigenous and Schizogenous cavities. Laticifers– Articulated and non-articulated.
4. Primary structure – Dicot stem: *Hydrocotyle*, *Eupatorium* or any normal type, Bicollateral (*Cephalandra*).
5. Monocot stem: Grass, *Asparagus* or any normal type.
6. Dicot root: Pea, *Limnanthemum* (*Nymphoides*) or any typical dicot root.
7. Monocot root: *Colocasia* or any typical monocot root.
8. Secondary structure - Stem - *Vernonia* or any normal type.
9. Secondary structure - Root - *Tinospora*, *Carica papaya*, or any normal type.
10. Stomatal types (Anomocytic, Anisocytic, Diacytic and Paracytic)
11. Anomalous secondary thickening - *Bignonia*, *Dracaena*, *Boerhaavia*.
12. Leaf anatomy - Dicot leaf: *Ixora*. Monocot leaf: Grass.
13. Ecological Anatomy – *Hydrilla*, *Nerium* leaf, *Vanda* Velamen root.

Reproductive Botany

Students should be familiar with the structure of anther (mature and young) and embryo (dicot and monocot) using permanent slides.

Palynology

Study of pollen morphology of the following plants *Hibiscus*, *Vinca*, *Balsam*, *Ixora*, *Crotalaria*, *Bougainvillea* by microscopic observation.

Estimation of pollen sterility and fertility percentage – Acetocarmine method.

BB1231: Methodology of Science & Bioinstrumentation

Practicals

Workout problems on frequency distribution

1. Represent data using bar diagram and histogram.
2. Measures of central tendencies (Mean, Median, Mode).
3. Workout problems on measures of dispersion (range, mean deviation, variance, standard deviation, coefficient of variation).
4. Workout problems on chi-square test.
5. BLAST Search.
6. Students should access Gene databases, download and take a print out of any one of gene sequences
7. Students are expected to work with at least any one of the commercial / scientific packages, to explore the WEB and be able to find, recognize, download, install and use software in various areas useful to research in Biology (Demonstration only).

Semester III
Main IBotany
BP1331 : Phycology, Mycology, Lichenology & Plant pathology

Credit 3**Contact hours 90 (Theory 54+ Practical 36)**

Aim: To impart basic knowledge about lower plant groups the Algae, Fungi, Lichen and diseases caused by these organisms in plants. This will give an account of the life cycle, habitat, anatomy, classification and its involvement in the life cycle of other members of living world.

Outcome

1. The student is equipped to prepare micropreparations and identify the thallus and reproductive structures of lower plant groups like algae, fungi and lichen.
2. An awareness generated among students about various microbes, their structure and economic importance.
3. Students can effectively employ the methodology to isolate and identify bacteria present in curd and root nodules.
4. Can identify various plant diseases, etiology of pathogens and control measures.
5. Able to prepare fungicides like tobacco decoction and Bordeaux mixture.

Module-I**18 hrs****Phycology**

1. Introduction Range of thallus structure Phylogenic trends Pigments Reproduction
 Life cycle Classification based on F. E. Fritsch. – – –
 - a. Salient features of the following major groups with reference to the structure, reproduction and life cycle of the types given below (*Excluding the developmental details*).
 - b. Cyanophyceae– *Nostoc*
 - c. Chlorophyceae - *Chlorella*, *Volvox*, *Oedogonium* and *Chara*
 - d. Xanthophyceae– *Vaucheria*
 - e. Bacillariophyceae– *Pinnularia*
 - f. Phaeophyceae– *Sargassum*
 - g. Rhodophyceae – *Polysiphonia*
2. Economic importance of algae
 - a. Role of algae in soil fertility- Fertilizer – Nitrogen fixation- Symbiosis
 - b. Commercial products of algae – Agar, Alginates, Carrageenin, Diatomaceous earth
 - c. Algae - medicinal aspects, algal blooms and red tides.

Module -II**18 hrs****Mycology**

1. Introduction, structure, reproduction, life cycle and evolutionary trends. Classification based on Ainsworth.
2. Distinguishing characters of different classes of Fungi representing the following genera. (*Excluding Developmental details*).
 - a. Myxomycotina - General characters.
 - b. Zygomycotina – *Rhizopus*

- c. Ascomycotina
 - Hemiascomycetes - *Saccharomyces*
 - Plectomycetes - *Penicillium*
 - Pyrenomycetes - *Xylaria*
 - Discomycetes– *Peziza*
 - d. Basidiomycotina
 - Teliomycetes - *Puccinia*
 - Hymenomycetes - *Agaricus*
 - e. Deuteromycotina - *Cercospora*.
3. Economic importance of Fungi.

Module-III
Lichenology

06 Hrs

Lichens - nature of association classification - habit and habitat - Type- *Usnea* - thallus morphology internal structure reproduction - economic importance.

Module-IV
Plant Pathology

12 Hrs

1. Introduction to plant pathology. Classification of plant diseases on the basis of causative organisms and symptoms–Host parasite interaction, Disease triangle.
2. Study of the following diseases with emphasis on symptoms, disease cycle and control measures of Leaf mosaic of Tapioca, Bunchy top of Banana, Citrus Canker, Blast disease of Paddy, Rhizome rot of Ginger, Root wilt of Coconut.
3. Brief account of the following fungicides- Bordeaux mixture, Lime sulphur, Tobacco decoction, Neem cake & oil.

PRACTICALS
Phycology

36Hrs
18 Hrs

Study of vegetative and reproductive structures of the types mentioned in the syllabus. Identify the algal specimens up to the generic level and make labelled sketches of the specimens observed.

Nostoc, Chlorella, Volvox, Oedogonium, Chara, Vaucheria, Pinnularia, Sargassum, Polysiphonia.

Mycology

14 Hrs

A detailed study of structure and reproductive structures of types given in the syllabus and submission of record.

Rhizopus, Saccharomyces, Penicillium, Xylaria, Peziza. Puccinia. Agaricus and Cercospora.

Lichenology**1 Hr**

Study of vegetative and reproductive parts of *Usnea*. Make sketches of the specimens observed.

Plant Pathology**3 Hr**

1. Identify the Diseases mentioned with respect to causal organism and symptoms.
2. Students should be trained to prepare the fungicide Bordeaux mixture & Tobacco decoction.

Suggested Readings

1. Alain Durieux. 2009, Applied Microbiology, Springer International Edition
2. Alexopoulos, C.J & Mims C.V. 1988. Introductory Mycology, John Wiley & Sons.
3. Chapman, V. J. & Chapman D. J., The Algae, Macmillan.
4. Gunasekharan, G. - Laboratory Manual of Microbiology, -New Age Pub: Fritsch, F. E., 1945, Structure and Reproduction of Algae Vol. I & II. Cambridge University Press.
5. Heritage, L., 2007, Introductory Microbiology, Cambridge University Press India Pvt. Ltd
6. Jim Deacon, 2007, Fungal Biology, 4th edition, Blackwell Publishing, Ane Books Pvt. Ltd.
7. Kanika Sharma, 2009, Manual of Microbiology, Ane Books Pvt. Ltd.
8. Mamatha Rao, 2009, Microbes and Non flowering plants, Impact and applications; Ane Books Pvt. Ltd.
9. R.C .Dubey & D .K .Maheswari - A text Book of Microbiology – Chand & Co.
10. Schlegel ,2008 General Microbiology , Cambridge University Press India Pvt. Ltd.
11. Singh V, Pandey PC and Jam D.K 1998, A Text Book of Botany for Under Graduate Students, Rastogi Publications.
12. Vasishta B.R 1990, Botany for Degree Students, Algae, S.Chand & Co.
13. Webster J 1970, Introduction to Fungi, Cambridge University Press.

**Semester III
Main I
Botany**

BP 1332: Horticulture, Mushroom Cultivation & Marketing

Credits: 3

hours: 90 (T 54+ P36)

Aim : Provide an idea about the application of plant science in business generations and self-employment. This focuses on Horticulture, Mushroom cultivation and its marketing.

Outcome

1. *Identify mushrooms, structure and mode of propagation.*
2. *Understand commercial mushroom cultivation, processing, storage marketing and their nutritional value.*
3. *Students are familiarized in horticulture implements and methods of gardening, commercial horticulture, flower arrangement, cut flowers.*
4. *Can understand about landscaping, fertilizers and Plant protection.*

**Horticulture
Module I**

18 hrs

1. Introduction :

Divisions of horticulture, Importance and scope of horticulture, Principles of garden making, Types of pots and containers, Potting mixture and potting media (soil, sand, peat, *Sphagnum* moss, vermiculite), Soil types, Soil preparation, Irrigation methods, Hydroponics.

2. Propagation methods:

- a). Cuttings – Leaf, Stem and root cutting.
- b). Layering – Air layering, Ground layering (Simple, Trench, Mound and compound).
- c). Budding – T- budding, Patch budding, Chip budding.
- d). Grafting – Approach grafting, Bridge grafting, Whip grafting, Whip and tongue grafting, Wedge grafting, Cleft grafting.

3. Garden tools and implements - Pruning shears, secateurs, spade, trowel, garden rake, hand rake, sprayers / sprayers, shovel and lawn mower.

4. Manures and fertilizers - Farmyard manure, compost, vermicompost and biofertilizers. Chemical fertilizers NPK. Time and application of manures and fertilizers. Foliar sprays.

Module II

09 hrs

5. Components of Garden- Lawns and landscaping, Trees, shrubs and shrubberies, climbers and creepers, Flower beds and borders, ornamental hedges, edges, drives, roads, walks and paths, Carpet beds, topiary, trophy, rockery, Conservatory or green houses, Indoor garden, Roof garden, Bonsai, Terrarium, Vertical garden.

6. **Flower Arrangement**- Containers and requirements for flower arrangements, Free style, Shallow and Mass arrangement, Japanese Ikebana, Bouquet and garland making, Dry flower arrangement.
7. **Harvesting** - Methods, Storage, Marketing of Fruits, vegetables and flowers, Preservation and processing of fruits and vegetables.

Module III**09 hrs**

8. **Growth regulators in horticulture** - Rooting hormones, Growth promoters, Flower induction, Parthenocarpy.
9. **Plant protection:** Common diseases of fruits (Mango, Guava, Papaya, Citrus, Banana, Apple, Grapes) and vegetable crops (Tomato, Capsicum, Potato, Onion, Carrot, Cabbage, Melons).
10. Brief account on Weedicides, Fungicides and Pesticides.

Module IV**12 Hrs****Mushroom Cultivation and Marketing**

11. History and introduction: Edible mushrooms (milky, straw, button) and Poisonous mushrooms.
12. Systematic position, morphology, distribution, structure and life cycle of *Agaricus* and *Pleurotus*. Nutritional value, medicinal value and advantages of mushrooms.
13. **Cultivation:**
14. Paddy straw mushroom cultivation substrate, spawn making. –Methods bed method, polythene bag method, field cultivation.
 - a) Oyster mushroom cultivation Substrate, spawning, pre-treatment of substrate. Maintenance of mushroom.
 - b) Cultivation of white button mushroom Spawn, composting, spawning, harvesting.

Module V**06Hrs**

15. **Diseases** - Common pests, disease prevention and control measures.
16. **Processing**- Blanching, steeping, sun drying, canning, pickling, freeze drying.
17. **Storage** - Short term and long term storage.
Common Indian mushrooms. Production level and economic return.

PRACTICAL.**18 Hrs****Horticulture**

- Propagation methods - Layering, Budding and Grafting.
- Flower arrangement.

Mushroom Cultivation and Marketing**18hrs**

Collection and Identification of Button mushroom, Oyster mushroom and Paddy straw mushroom. Basic training in mushroom cultivation is recommended.

Field Study:

Visit to a Botanical garden and Mushroom cultivating Laboratory/Facility under the guidance of teachers is recommended.

Semester IV
Main I Botany
BP 1431 Bryology, Pteridology, Gymnosperms & Paleobotany

Credit: 3

Contact hours: 108 (Theory 72 + Practical 36)

Aim: Students should be trained in basic botany such as lower plants like Bryophytes, Pteridophytes, Gymnosperms, etc. to get an in-depth knowledge about various plant groups.

Outcome

1. Students are able to make micropreparations of thallus and reproductive structures of as well as better understanding of the life cycle of selected members of Bryophytes, Pteridophytes and Gymnosperms.
2. Can comprehend the economic and ecologic importance of lower groups of plant kingdom.
3. Better understanding of fossilization and importance of Palaeobotany.
4. Identify various parts of fossil plants through micro slides.

Module - I

Bryology

18hrs

1. Introduction and Classification
2. Study of the habit, thallus organization, vegetative and sexual reproduction and alternation of generation of the following types, *Riccia*, *Marchantia*, *Funaria*.
3. Economic Importance of Bryophytes.

Module - II

18hrs

Pteridology

1. Introduction: General characters morphological and classification by Smith.
2. Study of the habitat, habit, internal structure, reproduction and life cycle of the following types *Psilotum*, *Selaginella*, *Equisetum*, *Pteris* and *Marsilea*.
3. General Topics: Stellar evolution in Pteridophytes, heterospory and seed habit, relationships of pteridophytes with bryophytes and gymnosperms, Economic importance of pteridophytes.

Module- III

27 hrs

Gymnosperms

1. Introduction and classification of gymnosperms.
2. Study of the Habit, Anatomy, Reproduction and life cycle of the following types.
(Developmental details not required)
Cycas, *Pinus* and *Gnetum*.
3. Evolutionary trends in gymnosperms - Relationship of gymnosperms with pteridophytes and angiosperms.
4. Economic importance of gymnosperms.

Module-IV
Paleobotany

09 hrs

1. Process of fossilization and types of fossils. Methods of studying fossils.
2. Geological time scale brief account. Fossil Pteridophytes, *Rhynia*, *Lepidodendron*, *Lepidocarpon*. Fossil Gymnosperm - *Lyginopteris*.
3. Applied aspects of Paleobotany - Exploration of fossils fuels.

Suggested Reading

1. Andrews H.N. (1967) - Studies on Paleobotany – C .J. Felix.
2. Arnold C. A (1947) - Introduction to Paleobotany - McGraw Hill Co. New Delhi.
3. Chopra RN and P. K. – Biology of Bryophytes - Wiley Eastern Ltd. New Delhi.
4. Coutler. J. M. - and Chamberlain C. J. (1958) – Morphology of Gymnosperms - Central Book Depot, Allahabad.
5. Gupta V .K. and Varshneya U. D (1967) – An Introduction to Gymnosperms – Kedarnath, Ramnath Meerut.
6. Parihar N .S. – An introduction to Bryophyta - Central Book Depot. Allahabad.
7. Smith G.M. (1955) - Cryptogamic Botany – Vol.II – Mc Graw Hill Co. New Delhi.
8. Sporne K. R. (1966) - Morphology of Pteridophytes - Hutchin University Library, London.
9. Sporne K. R. (1967) - Morphology of Gymnosperms - Hutchin University Library, London.
10. Vashista B. R. (1993) - Pteridophyta – S.Chand and co. New Delhi.
11. Vashista B. R. (1993) Gymnosperms - S. Chand and co. New Delhi.
12. Vasishta B. R. - Bryophyta - S. Chand and Co. New Delhi.

PRACTICAL

36 hrs

Bryology

09 hrs

1. *Riccia* – Habit - Internal structure of thallus – V. S. of thallus through archegonia, antheridia and sporophyte.
2. *Marchantia* –Habit- thallus T.S., thallus with Archegonial receptacle, Antheridial receptacle, Male receptacle V.S., Female receptacle V.S., T.S of thallus through gemma, Sporophyte V.S.
3. *Funaria* - Habit, V. S. of archegonial cluster, V .S. of antheridial cluster, Sporophyte V. S.

Pteridology

18 Hrs

1. *Psilotum* : External features, stem T. S., synangium T. S.
2. *Selaginella* : Habit, rhizophore T. S , stem T. S, axis with strobilus, V.S. of strobilus, Megasporophyll and microsporophyll.
3. *Equisetum* - Habit, rhizome and stem T .S. and V. S. of strobilus.
4. *Pteris* - Habit, petiole T. S., sporophyll T. S., prothallus.
5. *Marsilea* - Habit, Rhizome and petiole T. S., sporocarp T.S, V. S. & R.L .S. (Permanent slides can be used).

Gymnosperms

08 Hrs

1. *Cycas* – seedling, coralloid root and coralloid root T. S., T. S. of leaflet and petiole, micro and mega sporophyll, male cone V. S., micro sporophyll T. S. , entire and V. S. of ovule.
2. *Pinus* - Branch of indefinite growth, spur shoot, T. S of old stem and needle, male and female cone, V .S. of male and female cone.

3. *Gnetum* - Habit, stem young and mature T. S (Permanent slides can be used), leaf T. S, male and female strobilus, V. S. of male and female cone, ovule V. S. and seed.

Paleobotany**1 Hr**

1. Fossil pteridophytes – *Rhynia* Stem, *Lepidodendron*, *Lepidocarpon*.
2. Gymnosperm - *Lyginopteris*.

Semester IV**Main I****Botany****BP1432 Cell Biology, Plant Breeding and Evolutionary Biology****Credits 3****Contact hours: 72 (Theory 54 + Practical 18)**

Aim: This course will provide a basic understanding in cell biology, plant breeding and evolution, which is needed as a student of biology and can supplement in understanding and pursuing studies in Biotechnology

Outcome:

1. Students have a better understanding of cell structure and cell organelles.
2. Can prepare microslides of cell divisions and identify various stages of mitosis and meiosis.
3. Understand evolutionary principles, theories and methods of speciation.
4. Can effectively do plant breeding methods and understands their practical application in betterment of food crops.

Module-I**Cell biology****30 hrs**

1. History and progress of cell biology.
2. Ultra structure and functions of the cell components and organelles (A brief account only); The cell membrane, Endoplasmic reticulum, Ribosomes, Golgi apparatus, Lysosomes, Peroxisomes, Vacuole, Mitochondria, Chloroplast & Nucleus- Nuclear envelope and nuclear pore complex.
3. The chromosomes- Chromosome morphology- Eukaryotic chromosomes and its molecular organization. Chromatin - composition and structure; hetero chromatin and euchromatin; Chemical organization. Nucleoproteins-histones and non-histones. Nucleosome model of DNA organization.
4. Special types of chromosomes- Salivary gland, Lamp brush and B chromosomes.
5. Variation in Chromosome number (Numerical aberrations) - Aneuploidy and Euploidy- haploidy, polyploidy; Significance.
6. Variation in Chromosome structure (Structural aberrations) - deletion, duplication, inversion and translocation; Significance.
7. Mitosis and Meiosis: - Cell cycle, check points and regulation (brief): Significance of mitosis and meiosis.

Module II**14 hrs****Plant breeding**

1. Introduction, objectives in plant breeding.
2. Plant introduction. Agencies of plant introduction in India, Procedure of introduction - Acclimatization - Achievements.
3. Selection - mass selection, pure line selection and clonal selection. Genetic basis of selection methods.
4. Hybridization: Procedure of hybridization, inter generic, inter specific, inter varietal hybridization with examples. Composite and synthetic varieties.
5. Heterosis and its exploitation in plant breeding.
6. Mutation breeding – methods and achievements in India.
7. Breeding for biotic and abiotic resistance.

Module -III**Evolutionary Biology****10 hrs**

1. Progressive and Retrogressive evolution.
2. Parallel and Convergent evolution.
3. Micro and Macro evolution.
4. Theory of Lamarck, Wiesman and De Vries, Darwinism, Neo- Darwinism.
5. Isolation, Mutation, Genetic drift, Speciation.
6. Variation and Evolution – Hybridization and Evolution – Polyploidy and evolution – Mutation and evolution.

Practical**18 Hrs**

1. Make acetocarmine squash preparation of onion root tip and to identify different stages of mitosis.
2. Calculation of Mitotic Index.
3. Make squash preparation of the flower buds of any of the following plants to identify the stages of Meiosis. *Rhoeo*, *Chlorophytum*, *Capsicum*.
4. Hybridization techniques - Emasculation and labeling.
5. Visit to a plant breeding station is desirable.

Suggested Reading

1. Aggarwal S.K. (2009) Foundation Course in Biology, 2nd Edition, Ane Books Pvt. Ltd
2. Allard R.W. (1960) Principles of Plant Breeding. John Willey and Sons. Inc. New York
3. B.D. Singh (2003) Plant Breeding. Kalyani Publishers
4. Cohn, N.S. (1964) Elements of Cytology. Brace and World Inc, New Delhi
5. Lodish, H. et al. (2008) Molecular and Cell biology. Freeman and Company New York.
6. De Robertis, E.D.P and Robertis, E.M.P (1991) Cell and molecular biology. Scientific American books.
7. Dobzhansky, B. (1961) Genetics and origin of species, Columbia University Press New York.
8. Gerald Karp, Janet Iwasa, Wallace Marshall (2015) Cell and molecular biology- Concepts and experiments, 8th edn. Wiley.
9. Lewin, B, Genes IX, Johns and Bartlett Publishers.
10. Lewis, W.H (1980) Polyploidy. Plenum Press, New York.
11. Roy S.C. and Kalyan Kumar De (1997) Cell biology. New central Books, Calcutta.

12. Sandhya Mitra (1998) Elements of molecular biology. Macmillan, India Ltd.
13. Sharma JR (1994) Principles and Practices of Plant Breeding. Tata McGraw-Hill Pub. Co. New Delhi.
14. Sharma, A.K and Sharma A (1980) Chromosome Technique - Theory and practice, Aditya Books, New York.
15. Swanson, C.P (1957) Cytology and Genetics. Englewood cliffs, New York.
18. Taylor (2008) Biological Sciences. Cambridge University Press India Pvt. Ltd.
19. Twymann, R.M. (1998) Advanced molecular biology Viva books New Delhi.
20. Veer Bala Rastogi (2008), Fundamentals of Molecular Biology Ane Books Pvt. Ltd.
21. The Cell: A Molecular Approach. Geoffrey M. Cooper and Robert E. Hausman. (2013) Sinauer Associates, Inc. Sunderland, Massachusetts.

**Semester IV
Core Course
BP 1433 Practical Botany II**

(Practical of BP1331, BP1332, BP1431 & BP1432)

Credits 4

BP1331 Phycology, Mycology, Lichenology & Plant pathology

Phycology

1. Study of vegetative and reproductive structures of the types mentioned below.
Nostoc, Chlorella, Volvox, Oedogonium, Chara, Vaucheria, Pinnularia, Sargassum, Polysiphonia.
2. Identify the algal specimens up to the generic level and make labelled sketches of the specimens observed.

Mycology

A detailed study of structure and reproductive structures of types given in the syllabus and submission of record.

Rhizopus, Saccharomyces, Penicillium, Xylaria, Peziza. Puccinia. Agaricus and Cercospora.

Lichenology

Make micropreparation of vegetative and reproductive parts of *Usnea*. Make sketches of the specimens observed.

Plant Pathology

Identify the Diseases mentioned with respect to causal organism and symptoms.

Students should be trained to prepare the fungicide Bordeaux mixture & Tobacco decoction.

BP1332 Horticulture, Mushroom Cultivation & Marketing

1. Demonstration of Propagation methods - Layering, Budding and Grafting.
2. Study of various Flower arrangement.
3. Undertake a visit to a Botanical garden under the guidance of the teacher is recommended.
4. Collection and Identification, study of morphology of button mushroom, oyster mushroom, paddy straw Mushrooms.
5. Basic Training in mushroom cultivation is recommended.

BP 1431 Bryology, Pteridology, Gymnosperms & Paleobotany

Bryology

1. *Riccia* - Habit - Internal structure of thallus V. S. of thallus through archegonia, antheridia and sporophyte
2. *Marchantia* - Habit- thallus T. S., thallus with Archegonial receptacle, Antheridial receptacle, Male receptacle V. S., Female receptacle V.S., T.S. of thallus through gemma, Sporophyte V. S.
3. *Funaria* - Habit, V. S. of archegonial cluster, V. S. of antheridial cluster, Sporophyte V. S.

Pteridology

1. *Psilotum* : External features , stem T.S., synangium T.S
2. *Selaginella* : Habit , rhizophore T. S , stem T. S, axis with strobilus, V.S. of strobilus, Megasporophyll and microsporophyll.
3. *Equisetum* - Habit, rhizome and stem T. S. and V. S. of strobilus.
4. *Pteris* - Habit, Petiole T. S., sporophyll T. S. , prothallus.
5. *Marsilea* - Habit, Rhizome and petiole T. S., sporocarp T.S, V. S. & R.L.S.

Gymnosperms

1. *Cycas* - seedling, coralloid root and coralloid root T. S., T. S. of leaflet and petiole, micro and mega sporophyll, male cone V. S., micro sporophyll T. S. , entire and V. S. of ovule.
2. *Pinus* - Branch of indefinite growth, spur shoot, T. S of old stem and needle, male and female cone, V. S. of male and female cone.
3. *Gnetum* - Habit, stem young and mature T. S (Permanent slides can be used), leaf T. S, male and female strobilus, V. S. of male and female cone, ovule V. S. and seed.

Paleobotany

1. Fossil pteridophytes- *Rhynia* Stem, *Lepidodendron*, *Lepidocarpon*.
2. Fossil Gymnosperm – *Lyginopteris*.

BP1432 Cell Biology, Plant Breeding & Evolutionary Biology.

1. Make acetocarmine squash preparation of onion root tip to identify the stages of Mitosis.
2. Calculation of Mitotic Index
3. Make squash preparation of the flower buds of any of the following plants to identify the stages of Meiosis. *Rhoeo*, *Chlorophytum*, *Capsicum*
4. Hybridization techniques - Emasculation and labeling.
5. Visit to a plant breeding station is desirable.

Semester V**Core Course****Botany****BP1531 Economic Botany, Ethnobotany & Forestry****Credit 2****Contact hours 54 (Theory 36 + Practical 18)**

Aim: *This gives awareness about the importance of Medicinal plants and their useful parts, economically important plants in our daily life and also about traditional medicines and herbs, and their relevance in modern times.*

Outcome:

1. *Able to identify economically important plants and products.*
2. *Overview of traditional knowledge on plants and their uses in traditional systems.*
3. *Identification of forest types, Forest products and their utilization.*
4. *Understanding timber yielding plants and methods of identification of timber.*
5. *Get knowledge about Silviculture and Social forestry.*

Module I**14 hrs*****Economic botany***

1. Study of the major crops of Kerala - Coconut and Paddy - with special reference to their methods of cultivation, Botanical description, morphology of the useful part and economic importance.
2. A brief account on the utility of the following plants, specifying the Binomial, family and morphology of the useful parts.

Cereals and millets	-	Wheat and Ragi
Pulses	-	Black gram and Bengal gram
Sugar yielding Plants	-	Sugar cane
Spices	-	Pepper and Cardamom
Beverages	-	Coffee, Tea
Fruits	-	Banana, Jackfruit, Water melon
Vegetables	-	Tomato, Brinjal, Cucumber
Fibre yielding plant	-	Cotton

Dye Yielding plants	-	Henna and <i>Bixa orellana</i>
Resins	-	Asafoetida
Tuber crops	-	Tapioca
Oil yielding Plants	-	Sesame and Coconut
Insecticides	-	Neem

Module II***Ethnobotany*****4 hrs**

1. Definition — importance, scope, categories and significance.
2. Study of various methods to collect Ethno botanical data.
3. Study of common plants used by tribes. *Aegle marmelos*, *Ficus religiosa*, *Cynodon dactylon*, *Ocimum sanctum* and *Trichopus zeylanicus*.
4. Ethnobotanic aspect of conservation and management of plantresources.

Module III**18 hrs*****Forestry***

1. General introduction – types of forests, Natural and Man, Tropical, temperate, evergreen semi-evergreen, deciduous; Monoculture, multipurpose, social and industrial. Forest and gene conservation.
2. Silviculture- concept and scope of study of natural and artificial regeneration of forests. Clear felling, uniform shelter, wood selection, coppice and conservation systems. Silviculture of some of the economically important species in India such as *Azadirachta indica*, *Tectona grandis*, *Eucalyptus indica*, *Mahagoni mahagoni*, *Dalbergia sisso*, *Santalum album*, *Artocarpus heterophyllus*, *Hevea brasiliensis*.
3. Wood: Homogenous and heterogenous- spring and autumn wood- Porous and Non porous wood- Heart and sap wood.
4. Relevance of wood anatomical studies in Kerala- Identification of wood- preparation of key and their uses. Social and agro forestry. Selection of species and role of multipurpose trees. Food, fodder and energy.
5. Forest resources and utilization. Forest products- timber, pulp wood, secondary timbers, non timber forest products (NTFPs).
6. Forest laws- necessity, General principles, Indian forest act 1927 and their amendment.

Practical**18 hrs**

1. Collection and study of economically important plants and morphology of the useful parts.
2. Identify the economic products obtained from the plants mentioned under Economic Botany.
3. Visit a tribal area and collect information on their traditional method of treatment using crude drugs.
4. Familiarize with at least 5 folk medicines.

5. Observe the plants of ethno botanical importance in your area.
6. Students are expected to identify the plants mentioned in the Ethnobotany syllabus.
7. Visit to forest ecosystem and document important forest trees.

Suggested Reading

1. Verma V, 2009 Text Book of Economic Botany; Ane Books Pvt. Ltd.
2. Kapoor LD, 2001 Hand Book of Ayurvedic Medicinal Plants, CRC Press New York,
3. Davis, P. and Haywood, V.H, 1963. Principles of Angiosperm Taxonomy, Oliver and Boyd, London.
4. K. Jain. Glimpses of Ethnobotany. Oxford and IBH Publishing Company, New Delhi.
5. S.K. Jain, 1987. A Manual of Ethno botany. Scientific Publishers, Jodhpur
6. A Hand book of Kerala Timbers- KFRI, Trichur.
7. Anil Kumar Dhiman. (2003). Sacred plants and their medicinal uses. Daya publishing house, NewDelhi
8. B.S. Chundawat and S.K.Gautham. (1996). Text book of Agroforestry. Oxford and IBH Publishing House , NewDelhi
9. Kollmann and Cote (1988). Wood science and Technology. Vol.I& II Springer verlag.
10. Parthiban K T (2016) Forestry, Competition Tutor publishers
11. Tiwari K.M. (1983). Social forestry inIndia
12. T.E Walles. Text book of Pharmacognosy,
13. Rajiv K Sinha. Ethnobotany.

Semester V Core

Course Botany

BP1532 Angiosperm Morphology & Systematic Botany

Credit 4

Contact hrs 90 (Theory 54 + Practical 36)

***Aim:** The course is designed to give a basic awareness in systematic botany and morphology of higher plants and the course should generate interest on students to pursue continuous studies in systematic botany.*

Outcome:

1. Ability to identify different types of inflorescences, flowers and fruits, their arrangement and relative position.
2. Familiarization of basic rules of Angiosperm classification and different types of classification.
3. Preparation and maintenance of Herbarium.
4. Identification of plants to their respective families.

Module I

Morphology

12 hrs

Brief account on the various types of inflorescence including special types (Cyathium, Verticillaster, Hypanthodium, Coenanthium and Thyrsus) with examples; floral morphology- Flower as a modified shoot, Flower parts, their arrangements, relative position, numeric plan, cohesion, adhesion, symmetry of flower, aestivation types, placentation types; floral diagram and floral formula. Fruit types: simple, aggregate and multiple. Seeds: albuminous and exalbuminous.

Module II
Systematic Botany

8 hrs

Definition, scope and significance of Taxonomy. Systems of classification.

1. Artificial- Linnaeus's sexual system.
2. Natural - Bentham and Hooker (Detailed account).
3. Phylogenetic- The Takhtajan system.
4. APG System (recent) of classification.

Module - III

7 hrs

Basic rules of Binomial Nomenclature and International Code of Botanical nomenclature (Brief Account), International Code of Nomenclature for algae, fungi, and plants (ICN). B.S.I Brief history structure and Organisation. Importance of Herbaria, Herbarium techniques and Botanical gardens, with special emphasis on the Major Botanical Gardens in India. Trends in taxonomy; Chemotaxonomy, Numerical Taxonomy, Cytotaxonomy and Molecular taxonomy (Brief account only).

Module -IV

27 hrs

A study of the following families with emphasis on the morphological peculiarities and economic importance of its members (based on Bentham & Hooker's system)

1	Annonaceae	10	Rubiaceae	18	Lamiaceae
2	Nymphaeaceae	11	Asteraceae	19	Amaranthaceae
3	Malvaceae	12	Sapotaceae	20	Euphorbiaceae
4	Rutaceae	13	Apocynaceae	21	Orchidaceae
5	Anacardiaceae	14	Asclepiadiaceae	22	Liliaceae
6	Leguminosae	15	Solanaceae	23	Scitamineae
7	Myrtaceae	16	Acanthaceae	24	Arecaceae
8	Cucurbitaceae	17	Verbenaceae	25	Poaceae
9	Apiaceae				

Practical

36hrs

1. Study on various types of inflorescences with vivid record of practical work.
2. Students must be able to identify and assign the angiosperm members included in the syllabus up to the level of families.
3. Draw labeled diagram of the habit, floral parts, L S of flower, T S of ovary, floral diagram, floral formula and describe the salient features of the member in technical terms.
4. Students must submit practical records, Herbarium sheets (25 Nos:) and Field book at the time of practical examination. There should be sufficient representation of plants collected during field trips.
5. Field trips are to be conducted for four days either as continuous or one day trips.

Suggested Reading

1. Davis, P. I. and Heywood, V. H., 1963. Principles of Angiosperm Taxonomy. Oliver and Royd, London.
2. Heywood, V. H. and Moore D. M. 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
3. Jeffrey, C. 1982. An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge London.
4. Jones, S. B. Jr. and Luchsinger, A. E. 1986. Plant Systematics (2nd edition). McGraw-Hill Book Co., New York.
5. Kapoor LD, 2001 Hand Book of Ayurvedic Medicinal Plants, CRC Press New York, Ane Books Pvt. Ltd
6. Lawrence. G. H. M. 1951. Taxonomy of Vascular Plants. Macmillan, New York.
7. Naik, V. N. 1984. Taxonomy of Angiosperms. Tata McGraw Hill, New York.
8. Nordenstam. B., El-Gazaly, G. and Kassas. M. 2000. Plant Systematics for 21st Century
9. Pandey SN and Misra SP, 2008 Taxonomy of Angiosperms; Ane Books Pvt. Ltd.
10. Radford. A. E. 1986. Fundamentals of Plant Systematics Harper and Row, New York.
11. Singh. G. 1999. Plant Systematics: Theory and practice Oxford & IBH Pvt, Ltd. New Delhi.
12. Stace. C. A. 1989. Plant Taxonomy and Biosystematics. 2nd ed. Edward Arnold, London.
13. Verma V, 2009 Text Book of Economic Botany; Ane Books Pvt. Ltd.
14. Woodland. D. E. 1991. Contemporary Plant Systematics. Prentice Hall, New Jersey.

**Semester VI Core Course
Botany I
BAP :1631 Genetics & Biotechnology**

Credits 3

Contact Hours: 126 (T 72 + P 54)

***Aim:** This course is supposed to supplement the basic knowledge in genetics in general and Mendelian genetics in particular. This is essential to study the various branches of biology like molecular biology and gene technology.*

Outcome:

1. Students should be able to workout problems in classical genetics, modified Mendelian ratios and population genetics.
2. Students should understand about genetic diseases and their inheritance.
3. They are familiarized in biotechnological tools like RFLP, RAPD and PCR techniques.
4. Use of equipment and tools in biotechnology.
5. Better understanding of nanosystems, biosensors and application of nanotechnology in biological systems.

Module: I

Classical Genetics

18 hrs

1. Mendelian Genetics - Mendel and his experiments, Mendel's success, Mendelian principles, Mendelian ratios, monohybrid and dihybrid crosses, back cross and test cross.

2. Genetics after Mendel - Modified Mendelian ratios; Incomplete dominance - Flower color in *Mirabilis*; Interaction of genes - Comb pattern in poultry 9:3:3:1; Recessive epistasis - Coat color in mice. 9:3:4; Dominant epistasis - Fruit colour in summer squash. 12:3:1; Complementary genes - Flower color in *Lathyrus* 9:7; Duplicate gene with cumulative effect - Fruit shape in summer squash. 9:6:1; Duplicate dominant genes in shepherd's purse. 15:1; Inhibitory factor - Leaf color in Paddy. 13:3.
3. Multiple alleles - General account. ABO blood group in man. Rh factor. Self-sterility in *Nicotiana*.
4. Quantitative characters- General characters of quantitative inheritance, polygenic inheritance; Skin color in Man, ear size in Maize.

Module II

18 hrs

Linkage and Crossing over

5. Linkage and crossing over - Linkage and its importance, linkage and independent assortment. Complete and incomplete linkage. Crossing over - a general account, two point and three point test cross. Determination of gene sequence. Interference and coincidence. Mapping of chromosomes.
6. Sex determination - Sex chromosomes, chromosomal basis of sex determination XX-XY, XX-XO mechanism. Sex determination in higher plants (*Melandrium album*). Genic balance theory of sex determination in *Drosophila*. Sex chromosomal abnormalities in man. Klinefelter's syndrome, Turner's syndrome. Sex linked inheritance. Eye color in *Drosophila*, Hemophilia in man. Y- Linked inheritance. Extra nuclear inheritance- General account, maternal influence. Plastid inheritance in *Mirabilis*. Shell coiling in snails, Kappa particles in *Paramecium*.

Module-III

Molecular Genetics

16 hrs

1. DNA as genetic material- Structure of DNA; A, B and Z forms of DNA, satellite and repetitive DNA.
2. Replication of DNA, Circular and helical DNA. Semi conservative model, experimental support, Meselson and Stahl experiment. Enzymology of replication: topoisomerase, helicase, primase, polymerase and ligase. DNA repairing mechanism.
3. RNA structure- Properties and functions of tRNA, mRNA and rRNA. Genetic code.
4. Synthesis of protein: Transcription, translation - Central dogma - reverse transcription. Concept of gene - Units of a gene, cistron, recon, muton; Types of genes- Housekeeping genes (constitutive genes), Luxury genes (non-constitutive genes), interrupted genes (Split genes) - introns, overlapping genes.
5. Transposable genetic elements - General account, Characteristic, Transposons (jumping genes), Cellular oncogenes (general account only). Epigenetics (brief account).

Module IV

2 Hrs

Population Genetics

Hardy Weinberg Law, factors affecting equilibrium- Mutation, migration and selection. Genetic drift, Founder Effect.

Module V
Biotechnology

18 Hrs

Definition and scope of Biotechnology- Isolation and purification of DNA from plant cells- Agarose gel electrophoresis-PCR, RFLP, DNA sequencing.

Plant Tissue Culture – Totipotency, redifferentiation and dedifferentiation, Basic techniques -Plant Tissue Culture Laboratory Organization, , Sterilization Techniques, Surface sterilization of explants, Components of plant tissue culture media- preparation and its functions, use of plant growth regulators. Somatic Embryogenesis and Artificial Seed Production. Plant secondary metabolites production, hairy root cultures.

Genetic engineering of plants-Methods of gene transfer in plants – Agrobacterium mediated gene transfer, electroporation and microinjection method.

Applications of Biotechnology-Transgenic Plants - Insect Resistant Plant- BT Cotton, Herbicide Resistant Plant, nif genes, GMO foods, FLAVR SAVR Tomato and Golden Rice. Biopharming- production of therapeutic proteins in transgenic plants, edible vaccines.

Nanobiotechnology

Introduction to the Nanoworld, classification of nano materials - Carbon Based Materials, Metal Based Materials, Dendrimers and Composites.

Green synthesis of metal based nanoparticles and their application.

Practical

54 hrs

Work out problems in

1. Monohybrid cross (Dominance and incomplete dominance).
2. Dihybrid cross (Dominance and incomplete dominance).
3. Gene interactions (All types of gene interactions mentioned in the syllabus).
 - a. Recessive epistasis 9: 3: 4.
 - b. Dominant epistasis 12: 3: 1
 - c. Complementary genes 9: 7
 - d. Duplicate genes with cumulative effect 9: 6: 1
 - e. Inhibitory genes 13: 3
 - f. Duplicate dominant gene 15: 1
 - g. Comb pattern in poultry 9:3: 3:1
4. Linkage and crossing over
5. Two point and three point crosses
6. Construction of genetic map.
7. Visit to a well equipped biotechnology laboratory to familiar with the use of equipments and glasswares. Petri dishes, conical flasks, culture tubes, Pasteur pipettes, forceps, scalpels, hot air oven, autoclave, platform shaker, pH meter and laminar air flow system.
8. Preparation of media, sterilization, inoculation and callus induction (demonstration only).

Suggested Reading

1. Aggarwal SK (2009) Foundation Course in Biology, 2nd Edition, Ane Books Pvt. Ltd
2. Dobzhansky, B (1961) Genetic and origin of species, Columbia university Press New York
3. Durbin (2007) Biological Sequence Analysis. Cambridge University Press India Pvt. Ltd
4. Gardner, E. J and Snustad, D. P (2006) Principles of Genetics. John Wiley, New York.
5. Gupta P. K. – Genetics (Rastogi publications).
6. Veer Bala Rastogi (2008), Fundamentals of Molecular Biology Ane Books Pvt. Ltd
7. John Ringo (2004) Fundamental Genetics. Cambridge University Press India Pvt. Ltd.
8. Lewin, B, Genes IX, Oxford University Press, New York.
9. Lewis, W.H (1980) Polyploidy. Plenum Press, New York.
10. Nicholl T (2007) An Introduction to Genetic Engineering, Cambridge University Press India Pvt. Ltd.
11. Sharma, A.K and Sharma A (1980) Chromosome technique Theory and practice, Aditya Books, New York.
12. Swanson, C.P (1957) Cytology and Genetics. Englewood cliffs, New York.
13. Taylor (2008) Biological Sciences. Cambridge University Press India Pvt. Ltd.
14. Basics of Biotechnology- A. J. Nair; Laxmi Publications, New Delhi.
15. Modern concept of Biotechnology- H D Kumar; Vikas Publishing House, Pvt. Ltd., New Delhi.
16. Introduction to Genetic Engineering & Biotechnology- Nair, A. J., Jones & Bartlett Publishers, Boston, USA. Biotechnology B D Singh Kalyani Publishers, New Delhi.
17. Introduction to Genetic Engineering & Biotechnology- A. J. Nair; Jones & Bartlett Publishers, Boston, USA.
18. Green metal nanoparticles. Synthesis, Characterization and their applications. Suvadhan Kanchi and Shakeel Ahmed. Wiley Publication.
19. Nanobiotechnology: Concepts, Applications and Perspectives-C.M. Niemeyer and C.A. Mirkin, Wiley, US.

**Semester VI
Main I Botany
BP 1632 Plant Physiology**

Credit 3**Contact Hours 108 (Theory 72 + Practical 36)**

***Aim:** To give basic information on plant physiology and the related biochemical and biophysical aspects to the students of Biotechnology. This course will equip the students to understand the functions of the plant system on biophysical and biochemical approach.*

Outcome:

1. Students must get a clear understanding of the basic concepts of Physiology and Biochemistry.
2. Understand photosynthesis, respiration, plant growth regulators, nitrogen metabolism, and stress physiology.
3. Familiarization of basic physiological practical procedures.

Module I**1 hr**

Introduction to plant physiology - Physiological processes, their significance.

Module II**10 Hrs****Water relations of Plants**

- a. Importance of water to plants- the physical and chemical properties of water.
- b. Organs of absorption - root and root hairs.
- c. Membranes- permeable, differentially permeable and impermeable.
- d. Physical aspects of absorption, imbibition, diffusion and osmosis.
- e. Plant cell as an osmotic system, osmotic pressure, turgor pressure, wall pressure and diffusion pressure deficit, water potential osmotic potential, pressure potential matrix potential Plasmolysis and its significance.
- f. Mechanism of absorption of water - active and passive absorption -root pressure.

Ascent of Sap

Vital theories.

Physical theories - Cohesion tension theory.

Loss of water from plants

- a. Transpiration - cuticular, lenticular and stomatal mechanism.
- b. Factors affecting transpiration
- c. Significance of transpiration.
- d. Guttation.
- e. Water stress and its physiological significance.

Module III
Mineral Nutrition

6 Hrs

Gross chemical analysis of plant - Essential and non-essential elements Criteria of essentiality of elements, Essential elements: major and minor. Role of essential elements their deficiency diseases.

Culture methods: Solution culture, Sand culture, Hydroponics, Aeroponics, Foliar nutrition
 Soil as source of nutrients.

Mechanism of mineral absorption.

- a. Passive absorption - ion exchange - Donnan equilibrium.
- b. Active absorption - Carrier concept.

Module IV
Photosynthesis

12 Hrs

- a. Significance and general equation.
- b. Photosynthetic apparatus and pigment systems.
- c. Raw materials of photosynthesis.
- d. Mechanism

Light reaction

- i) Radiant energy and its effects on chlorophyll pigments.
- ii) Cyclic and non-cyclic photophosphorylation.
- iii) Source of oxygen liberated.
- iv) Hill reaction.

Dark reaction

- v) Path of carbon in photosynthesis.
- vi) Calvin cycle.
- vii) C₃ and C₄ plants. CAM plants.
- viii) Photorespiration.
- ix) Factors affecting photosynthesis. Law of limiting factors.

Module V
Respiration

12 Hrs

- a. Definition and general equation. Significance. Respiratory substrates. Mechanism of Glycolysis, Krebs cycle, Terminal oxidation.
- b. Oxidative pentose phosphate path way.
- c. Factors affecting respiration.

- d. Anaerobic respiration-Alcoholic fermentation and lactic acid fermentation.
- e. Energy relations - aerobic and anaerobic respiration.
- f. Respiratory quotient and its significance.
- g. Oxidation of Fats.

Module VI

9 Hrs

Nitrogen metabolism

- a. Source of nitrogen. Nitrification, Denitrification and Ammonification. The GS-GOGAT pathway. Nitrogenase its significance and mode of action and NiF Genes.
- b. Symbiotic nitrogen fixation.
- c. Rotation of crops.
- d. Nitrogen Cycle.

Module VII

6 Hrs

Translocation of solutes

- a. Pathway of organic solutes. Mechanism of phloem transport. Mass flow hypothesis.
- b. Protoplasm streaming theory

Module VIII

9 Hrs

Growth and Development

- a. Definition.
- b. Dormancy and germination of seeds.
- c. Phases of growth - measurement and factors affecting growth.
- d. Differentiation, morphogenesis and senescence.
- e. Growth Hormones - Auxins, Gibberellins, Cytokinins, Abscissic acid, Ethylene, Brassinosteroids and their practical applications.
- f. Photoperiodism
- g. Vernalization

Module IX

7 Hrs

Plant Movements and Stress Physiology.

- a. Tropic and nastic movements, Circadian rhythm.
- b. General account on stress physiology. Temperature stress, Cold stress, Salinity stress. Methods adopted by plants to overcome them.

Practicals**36 Hrs**

1. Water potential of onion peel, *Rhoeo* peel by plasmolytic method.
2. Thistle funnel experiment.
3. Tissue tension.
4. Root Pressure.
5. Suction force due to transpiration.
6. Foliar transpiration using bell jar.
7. Transpiring surface - Four leaves experiment.
8. Farmer's and Ganong's Potometer.
9. Water balance - Relation between transpiration and absorption.
10. Evolution of oxygen during photosynthesis.
11. Necessity of chlorophyll, CO₂ and light in photosynthesis.
12. Measurement of photosynthesis.
13. Simple respiroscope.
14. Respirometer of R.Q.
15. Anaerobic respiration.
16. Fermentation.
17. Geotropism and phototropism — Klinostat.
18. Hydrotropism.
19. Measurement of growth — Arc or Lever Auxonometer.

Suggested Reading

1. Devlin & Witham – Plant Physiology, C B S publishers.
2. Dieter Hess (1975): Plant physiology.
3. Jain V. K. (1996) Fundamentals of Plant Physiology.
4. Kochhar P. L. & Krishnamoorthy H. N. – Plant Physiology. Atmaram & Sons Delhi, Lucknow.
5. Kumar & Purohit – Plant Physiology - Fundamentals and Applications, Agrobotanical publishers.
6. Malik C. P. & Srivastava A. K. – Text book of Plant Physiology Kalyani Publishers New Delhi.
7. Noggle G R & Fritz G J (1991) Introductory Plant physiology, Prentice Hall of India.
8. Pandey S.N. & Sinha B. K. (1986) – Plant physiology, Vikas publishing House- New Delhi.

9. Salisbury F.B and Ross C.W. (2006): Plant Physiology 4Edn, Wadsworth publishing company.
10. Sundara Rajan S. – College Botany Vol. IV, Himalaya publishing House.
11. William G. Hopkins – Introduction to Plant Physiology John Wiley & Sons, New York.

Semester VI
Core Course
BP1633 Practical Botany III
(Practical of BP1531, BP1532, BP1631, BP1632)

Credit 4

BP1531 Economic Botany, Ethnobotany & Forestry

1. Collection and study of economically important plants and morphology of the useful parts.
2. Identify the economic products obtained from the plants mentioned under Economic Botany.
3. Visit a tribal area and collect information on their traditional method of treatment using crude drugs.
4. Familiarisation of at least 5 folk medicines.
5. Observation and recording the plants of ethno botanical importance in your area.
6. Students are expected to identify the plants mentioned in the Ethnobotany syllabus.
7. Visit to Ayurveda College or other Ayurvedic institution is recommended.

BP1532 Angiosperm Morphology & Systematic Botany

1. Study on various types of inflorescences with vivid record of practical work.
2. Students must be able to identify the angiosperm members included in the following families up to the level of family.

1	Annonaceae	10	Rubiaceae	18	Lamiaceae
2	Nymphaeaceae	11	Asteraceae	19	Amaranthaceae
3	Malvaceae	12	Sapotaceae	20	Euphorbiaceae
4	Rutaceae	13	Apocynaceae	21	Orchidaceae
5	Anacardiaceae	14	Asclepiadiaceae	22	Liliaceae
6	Leguminosae	15	Solanaceae	23	Scitamineae
7	Myrtaceae	16	Acanthaceae	24	Arecaceae
8	Cucurbitaceae	17	Verbenaceae	25	Poaceae
9	Apiaceae				

3. Draw labeled diagram of the habit, floral parts, L S of flower, T S of ovary, floral diagram, floral formula and describe the salient features of the member in technical terms
4. Students must submit practical records, Herbarium sheets (Minimum 25 Nos) and Field book at the time of practical examination. There should be sufficient representation of plants collected during field trips.
5. Field trips are to be conducted for three days either as continuous or one day trips. The report of the same should be submitted during university practical examination of BAP1643.

BP1631 Genetics & Biotechnology

Work out problems in

1. Monohybrid cross (Dominance and incomplete dominance).
2. Dihybrid cross (Dominance and incomplete dominance).
3. Gene interactions (All types of gene interactions mentioned in the syllabus).
 - a) Recessive epistasis 9: 3: 4.
 - b) Dominant epistasis 12: 3: 1.
 - c) Complementary genes 9: 7.
 - d) Duplicate genes with cumulative effect 9: 6: 1.
 - e) Inhibitory genes 13: 3.
 - f) Duplicate dominant gene 15: 1.
 - g) Comb pattern in poultry 9:3: 3:1.
4. Linkage and crossing over.
5. Two point and three point crosses.
6. Construction of genetic map.
7. Visit to a well equipped biotechnology laboratory to familiar with the use of equipments and glasswares. Petri dishes, conical flasks, culture tubes, Pasteur pipettes, forceps, scalpels, hot air oven, autoclave, platform shaker, pH meter and laminar air flow system.
8. Preparation of media, sterilization, inoculation and callus induction (demonstration only).

BP1632 Plant Physiology

1. Water potential of onion peel, *Rhoeo* peel by plasmolytic method.
2. Separation of plant pigments by paper chromatography Demonstration Experiments.
3. Thistle funnel experiment.
4. Tissue tension.
5. Root Pressure.
6. Suction force due to transpiration.
7. Foliar transpiration by using Bell jar.
8. Transpiring surface - 4 leaves experiment.
9. Potometer- Farmer and Ganong's.
10. Water balance- Relation between transpiration and absorption.
11. Evolution of oxygen during photosynthesis.
12. Necessity of chlorophyll, CO₂ and light in photosynthesis.
13. Measurement of photosynthesis.
14. Simple respiroscope.
15. Respirometer experiment.
16. Anaerobic respiration.
17. Fermentation.
18. Geotropism and phototropism — Klinostat.
19. Hydrotropism.
20. Measurement of growth - Arc or Lever Auxonometer.

SYLLABUS MAIN II

AYURVEDIC PHARMACY

Semester I
Main II
Ayurvedic Pharmacy
BP 1141 Introduction to Ayurveda drug Development.

Credits-4

Contact hours- 108(T 72+ P 36)

***Aim:** The course on Introduction to Ayurveda Drug Development is destined to give a thorough and basic understanding in working principle of Ayurveda science, which forms the basis of application of Ayurvedic principles in drug preparation. Students are expected to master the major theoretical and practical skills from this course.*

Outcome:

1. *The students should be aware of the importance of Ayurveda and its principles.*
2. *Understand the Ayurvedic methods for collection and storage of crude drugs.*
3. *Understand the medicinal plant parts and their description.*

Module I

12 hrs

Paribhasha (Terminology)

Ayurveada, Ashtanga of Ayurveda, Swastha, Dosha, Dhatu, Mala, Srothas, Kala, Desa, Agni, Panchabhootha, Tridosha, Vata, Pitta, Kapha, Oushadha, Kalpana.

Brief study of the following

Panchamahabhuta siddhanta, Tridosha siddhanta, Dravya, Dravyaguna sastra, Saptapadārtha of Dravyaguna sastra (seven constituents of Dravya), Rasa, Guna, Veerya, Vipaka, Prabhava, Karma, Panchabouthikatwa of Dravya, Role of dravya in Chikitsa.

Module II

10 hrs

Brief description of Charaka samhitha, Susrutha Samhitha, Ashtanga Hridayam, Sargandhara samhitha, Bhavaprakasa Nighantu. Historical background of Dravyaguna from Vedic era, Samhita and Nighantu period till modern times. Introduction of department of AYUSH, CCIM, CCRAS, RAV, Knowledge on the Ayurvedic Pharmacopoeia of India, The Formulary of India and international pharmacopoeias. Brief knowledge regarding nomenclature, identification of drugs in Ayurveda based on Samhita and in various Nighantu.

Module III

18 hr

Dravya Sangrahana (Drug Collection)

Dravya Sangrahana (collection of dravya)-Ecology-Classification of desha (geographical area) and bhumi (soil), swarupa of sangrahaniya dravya (Nature and quality of drug to be collected). Sangrahana vidhi (Method of collection)-Vegetable and Animal origin drugs according to part used.

Time of collection of drugs, Period of collection according to virya, samrakshana vidhi (preservation of collected dravyas), bshhajagara (Storehouse). Study on different prayojyanga (useful plant parts) and its descriptions. Brief knowledge of Good Agricultural & Collection practice (GACP), Good Harvesting Practice(GHP), and Good Storage Practice (GSP).

Module IV

24 hrs

Drug study

Brief Knowledge of following dravyas with respect to Sanskrit Name, two sanskrit synonyms, local name, Botanical Name, Family, Habit (Samanya Swarupa), Parts Used and Indications.

- 1) Agnimantha 2) Amalaki 3) Apamarga 4) Amalaki 5)Aragvadha6) Ardraka-Shunthi
- 7) Arjuna 8) Arka 9) Ashvagandha 10) Ashoka 11) Ativisha 12) Bakuchi 13)Baladvayam
- 14) Bharangi15) Bhallataka16) Bibhitaka17) Bijaka/Vijayasara 18)Bilva 19)Brahmi
- 20) Bringaraj 21) Brihati 22) Chandandvaya 23) Chitraka 24) Dadima 25) Danti
- 26) Daruharidra 27) Dhanyak 28) Dhatki 29) Draksha 29) Durva 30) Ela 31) Eranda
- 32) Gambhari 33) Gokshura 34) Guduchi 35) Guggulu 36) Haridra 37) Haritaki 38) Hingu
- 39) Jambu 40) Jatamamsi 41) Jatiphal 42) Jeerakdvaya 43) Jyotishmati 44) Kalmegh
- 45) Kampillak 46) Kanchanar 47) Kantakari 48) Kapikacchu 49) Karkatashringi 50) Karpur
- 51) Katuki 52) Khadira 53) Kumari 54) Kupilu 55) Kumkum/Keshara 56) Kushmanda
- 56) Lavang 57) Kutaja 58) Lodhra 59) Madanaphal 60) Manjishtha 61) Marich
- 62) Mushali 63) Musta 64) Nagakeshar 65) Nimba 66) Nirgundi 67) Palasha 68) Palandu
- 69) Pashanabheda 70) Patala 71) Patola 72) Pippali-Pippalimula 73) Punarnava 74) Rasna
- 75) Rasona 76) Saireyaka 78) Saptaparna 79) Sarpagandha 80) Sariva 81) Shalparni
- 82) Shalmali 83) Shatavari 84) Shatapushpa 85) Shigru 86) Shirish 87) Shyonaka 88)
- Tila 89) Tvak 90) Tulsi 91) Ushira 92) Vacha 93) Varun 94) Vasa 95) Vata 96)
- Vatsanabha 97) Vidari 98) Yashtimadhu 99) Nili 100) Durva.

Module V

Purification (Sodhana)

8 hrs

Concept of dravya shodhana, type of sodhana (purification of dravya) with examples Brief knowledge of Apamishran (adulterants), Concept of Abhava pratinidhi dravya (substitutes), concept of Samskara (Processes) and its type, concept of formulation of compound drugs.

Practical**36 hrs**

1. Descriptions of prayojyanga (useful parts of plants) (4 plants each).
 - a) Root/ Rhizomes
 - b) Stem
 - c) Bark
 - d) Wood
 - e) Flower
 - f) Seeds
 - g) Fruits
 - h) Leaves
 - i) Unorganized drugs (Resins, Latex, Juices, gum).

2. Students have to make submissions of 20 crude drugs with critical notes.

Suggested Reading

1. A Textbook of Pharmacognosy T E Wallis, CBS publishers New Delhi.
2. Practical Pharmacognosy – Dr C K Kokate published by M K Jain for Vallabh Prakashan.
3. Introduction to Genetic Engineering & Biotechnology- A. J. Nair; Jones & Bartlett Publishers, Boston, USA.
4. Ayurveda Pharmacopoeia of India Part I Appendix Volumes I, II, III, IV, V published by Govt of India.
5. General guidelines for drug development of ayurvedic formulations Volume I published by central council for research in Ayurvedic sciences ministry of ayush, govt, of India new Delhi.
6. A compendium of 500 species Five Volume, orient longman.
7. Dravyaguna Vijñanam Volume I Dr J L N Sastri , Chaukambha orientalia , Varanasi.
8. Ashtanga Hridayam Sutrasthanam Chowkambha krishnadas Academy.
9. Quality control & standardization of Ayurvedic Medicines Dr Devendra Joshi, Dr Geeta Joshi Published by Chaukambha orientalia Varanasi.

**Semester II
Main II
Ayurvedic Pharmacy**

BP 1241 Biochemistry, Animal Physiology & Anatomy

Credits 4

Contact Hours 120 hrs (T 72+ P54)

***Aim:** This course will impart very fundamental and essential information about the Physiology and anatomy of the various types of cell, tissues and organs in organisms. The students will be able to understand its functioning and to familiarise the biochemical aspects of the living system.*

Outcome:

1. Students should be familiarized with the biochemical processes which control life.
2. Knowledge of physiology of human beings will lead to better understanding of drug action.
3. Basic laboratory and analytical skills is required for analysis of blood, blood groups etc.

Biochemistry

27 hrs

Module-I

9 hrs

Molecules and life: Classification, occurrence, structure and functions of monosaccharides (glucose and fructose), oligosaccharides (sucrose and maltose), polysaccharides (starch and cellulose).

Module-II

9 hrs

Amino acids: Classification based on polarity, Structure, Amphoteric property of amino acids, peptide formation. Amino acid breakdown – Deamination, trans deamination, reductive amination and transamination. Fate of carbon skeleton of aminoacids, Metabolism of Ammonia.

Proteins: Structure (Primary, Secondary, Tertiary and Quaternary), Properties and function.

Module-III

9 hrs

Lipids: Classification, Simple lipids- fats & oils, waxes; Compound lipids- phospholipids, sphingolipids and glycolipids; Derived lipids- Cholesterol and Terpenes; Fatty acids -Alpha-oxidation and Beta-oxidation.

Enzymes: General account - structure, classification and nomenclature (Recommended by Commission on Enzymes); Mechanism of enzyme action - inhibition of enzymes - regulation of enzymes - allosteric inhibition - Isoenzymes, co-enzymes and cofactors.

Animal Physiology & Anatomy

45 hrs

Module IV

9 hrs

Animal cell, Tissues, organs and organ systems. Elementary tissues of the body. i.e epithelial tissue, muscular tissue, connective tissue and nervous tissue.

Nutrition: Nutritional and Vitamin requirements, vitamin deficiencies. Feeding mechanisms, Digestion - types of digestion, basic mechanisms of digestion, Human digestive system. Digestive system and its functioning. Structure and functions of liver, physiology of digestion and absorption.

Module V**15 hrs**

Respiratory system - Respiration, types of respiration, cellular respiration - oxidation of glucose, Human respiratory system, various parts of respiratory system and their functions, pulmonary respiration. Physiology of respiration.

Excretory system: Excretory products of body, excretory organs of invertebrates (Nephridia and Flame cells), Human excretory organs, Nephrons - structure and function, Kidneys - structure and function, Physiology of Urine formation, Pathophysiology of renal diseases and oedema. Accessory excretory organs - skin, its structure and function.

Reproductive system - reproduction, types of reproduction - asexual, sexual and vegetative reproduction Human reproductive system - gametogenesis, spermatogenesis, structure of human sperm, Oogenesis, Menstrual cycle, Human embryogenesis (up to gastrulation).

Endocrine system: Endocrine glands and Hormones. Locations of the glands, their hormones and functions, feedback mechanism. Pituitary, thyroid, Adrenal and Pancreas.

Nervous system: Neurons - structure and function, nervous system of invertebrates (Prawn) and vertebrates (Human Nervous system). Various parts of central nervous system, brain and its parts, functions and reflex action. Anatomy and Physiology of autonomic nervous system.

Module VI**9 hrs**

Structure and function of skeleton. Classification of joints and their function, Joint disorders.

Muscular system – Types of muscles. Ultra structure of striated muscle fibre, mechanism of muscle contraction, sliding filament theory, All or none law.

Structure of skeletal muscle. Physiology of muscle contraction, Names, position, attachments and functions of various skeletal muscles. Physiology of neuromuscular junction.

Module VII**12 hrs**

Composition of blood, functions of blood elements. Blood group and coagulation of blood. Brief information regarding disorders of blood, Antibody-antigen interaction, antigen-antibody reactions, agglutination, ABO blood grouping and Rh incompatibility.

Circulatory system: types of circulation - open and closed circulation, Human circulatory system, Human Heart, Heart beat, “Circulation” cardiac cycle, impulse generation and transmission, electrocardiogram; haemodynamics; capillary circulation; regulation of cardiac output, blood flow and pressure: Tissue fluid, Lymphatic system and Lymph nodes, - comparison of blood and lymph.

Structure and functions of various parts of the heart. Arterial and venous systems with special reference to the names and positions of main arteries and veins. Blood pressure and its recording. Brief information about cardiovascular disorders.

Practicals**54 hrs**

1. Study of the human skeleton.
2. Study with the help of charts and models the following systems and organs:
 - (a) Digestive system.
 - (b) Respiratory system.
 - (c) Cardiovascular system.
 - (d) Urinary system.
 - (e) Reproductive system.
 - (f) Nervous system.
 - (g) Eye.
 - (h) Ear.
3. Microscopic examination of epithelial tissue, cardiac muscle, smooth muscle, skeletal muscle. Connective tissue and nervous tissues.
4. Estimation of haemoglobin in blood. Determination of bleeding time, clotting time, R.B.C. Count, Total leucocyte count, D.L.C. and E.S.R.
5. Recording of body temperature, pulse, heart rate, blood pressure and ECG.
 - (a) Enumeration of RBC.
 - (b) Enumeration of WBC.
6. Blood grouping:-Determination of blood groups and Rh typing.
7. Electrocardiogram - PQRST waves and their significance.
8. Qualitative test for carbohydrates - Molisch's test, Benedict's test (for reducing sugar).
9. Iodine test for starch / Seliwanoff's test.
10. Test for proteins - Biuret test.
11. Estimation of reducing sugar, using DNS reagent.
12. Determination of standard graphs of Protein (BSA) and Sugar.
13. Assay of the enzyme Amylase, and determination of total activity.

Suggested Reading

1. A.C. Guyton & J.E. Hall, Text book of Medical Physiology published in India by Prism Books.Ltd. on arrangement with W.B. Saunders Company, U.S.A., U.S.A., Ninth Edition, 1996.
2. C.A. Keele, E. Neil and N. Joels, Samson Wright's Applied physiology, Thirteenth Edition, published by Oxford University Press, 1982.
3. W.F. Ganong, Review of Medical Physiology, Thirteenth Edition, published by Appleton & Lange, U.S.A., 1987.
4. A.J. Vander, J.H. Sherman and D.S. Luciano, Human Physiology.
5. Gray's Anatomy, edited by P.L. Williams & R. Warwick, 38th Edition, published by Churchill livingstone, 1995.
6. Cunningham's Textbook of Anatomy, edited by G.J. Romanes, Eleventh Edition, published by Oxford University Press.

Semester II Main II
BP1242 Ayurvedic Pharmacy, Practical I
(Practical of BP1141& BP1241)

Credits 4

BP1141 Introduction to Ayurveda Drug Development

1. Descriptions of prajoyyanga (useful parts of plants) (4 plants each).
2. Root/ Rhizomes
3. Stem
4. Bark
5. Wood
6. Flower
7. Seeds
8. Fruits
9. Leaves
10. Unorganized drugs (Resins, Latex, juices, gum).
11. Students have to make submissions of 20 crude drugs with critical notes.

BP 1241 Biochemistry, Animal Physiology & Anatomy

12. Study of the human skeleton.
13. Study with the help of charts and models the following systems and organs:
 - (a) Digestive system.
 - (b) Respiratory system.
 - (c) Cardiovascular system.
 - (d) Urinary system.
 - (e) Reproductive system.
 - (f) Nervous system.
 - (g) Eye.
 - (h) Ear.
14. Microscopic examination of epithelial tissue, cardiac muscle, smooth muscle, skeletal muscle. Connective tissue and nervous tissues.
15. Estimation of haemoglobin in blood. Determination of bleeding time, clotting time, R.B.C. Count, Total leucocyte count, D.L.C. and E.S.R.
16. Recording of body temperature, pulse, heart rate, blood pressure and ECG.
 - (a) Enumeration of RBC.
 - (b) Enumeration of WBC.
17. Blood grouping:-Determination of blood groups and Rh typing.
18. Electrocardiogram - PQRST waves and their significance.
19. Qualitative test for carbohydrates - Molisch's test, Benedict's test (for reducing sugar).
20. Iodine test for starch / Seliwanoff's test.
21. Test for proteins - Biuret test.
22. Estimation of reducing sugar, using DNS reagent.
23. Determination of standard graphs of Protein (BSA) and Sugar.
24. Assay of the enzyme Amylase, and determination of total activity.

Semester III
Main II
Ayurvedic Pharmacy
BP 1341 PHARMACOGNOSY

Credits 4

Contact hours 90 Hr (T 54 Hrs + P 36 Hrs)

***Aim :** To create awareness and skills to identify different drugs of plant and animal used in Ayurvedic medicine.*

Outcome:

1. *Students are expected to develop a better understanding about different sources of Ayurvedic drugs.*
2. *Students will identify important drugs extracted from plants.*
3. *Students need to understand different plant species that are used as source of drugs.*
4. *Develop a deep understanding about different animal products with pharmaceutical importance.*

Module I

Introduction to Ayurvedic Drugs

09 Hrs.

1. Introduction, Definition, History, Scope and Development of Pharmacognosy: Pharmacognosy and modern medicine.
2. Classification of drugs. Plant origin, animal origin and synthetic. Morphological (Organized and unorganized), Taxonomical, Chemical, pharmacological, alphabetical, chemotaxonomical and serotaxonomical.
3. Sources of crude drugs – roots, rhizome, bulb, corm, tubers, leaves, stems, wood, oleo gum resins, flowers, fruits, seeds and whole plant.
4. Adulteration and drug evaluation; significance of Pharmacopoeial standards.

Module II

Plant Drugs

18 Hrs.

Detailed study of the microscopic and macroscopic properties following drugs and binomial and family of source plants,

- | | |
|---------------------------------------|----------------------------------|
| 1. Agnimandha (<i>Arani</i>) | 16. Haridra (<i>Manjal</i>) |
| 2. Aparajita (<i>Sankhapushpam</i>) | 17. Hingu (<i>Kaayam</i>) |
| 3. Aragwadha (<i>Kanikonna</i>) | 18. Jateephala (<i>Jaathi</i>) |
| 4. Arka dwaya (<i>Erikku</i>) | 19. Kaduka (<i>Kadukka</i>) |
| 5. Bilwa (<i>Koovalam</i>) | 20. Karanja (<i>Pongam</i>) |

- | | |
|--|---|
| 6. Brahmi (<i>Brhmi</i>) | 21. Kulatha (<i>Muthira</i>) |
| 7. Chandana (<i>Chandanam</i>) | 22. Kumari (<i>Kattar Vaazha</i>) |
| 8. Dhatura (<i>Ummam</i>) | 23. Madhuka (<i>Elippa</i>) |
| 9. Eranda (<i>Avanakku</i>) | 24. Nagakesara (<i>Nagachempakam</i>) |
| 10. Gudoochi (<i>Amruthu</i>) | 25. Nirgundee (<i>Nochi</i>) |
| 11. Pippli (<i>Vetta</i>) | |
| 12. Satavari (<i>Sathavari</i>) | |
| 13. Tulasi (<i>Krishna tulsi</i>) | |
| 14. Twak patra (<i>Karuvappatta</i>) | |
| 15. Udumbara (<i>Atti</i>) | |

Module III

Evaluation of Drugs

09 Hrs.

Detailed study of organoleptic evaluation, chemical constituents including tests wherever applicable and therapeutic efficacy of following categories of drugs.

- | | | |
|-----------------------------------|---|--|
| 1. Laxatives | : | Castor oil, Senna |
| 2. Cardiotonics | : | Digitalis, Arjuna. |
| 3. Carminatives & G.I. regulators | : | Fennel, Ginger, Black pepper, Asafoetida, Nutmeg, Cinnamon, Clove. |
| 4. Astringents | : | Catechu. |
| 5. Drugs acting on nervous system | : | Belladonna, Aconite, Ashwagandha, Ephedra. |
| 6. Antitumour | : | Vinca. |
| 7. Antidiabetics | : | Pterocarpus, Gymnema. |
| 8. Antiseptics and disinfectants | : | Curcuma. |
| 9. Pharmaceutical aids | : | Honey, Arachis Oil, Starch. |
| 10. Miscellaneous | : | Liquorice, Garlic, Dioscorea. |

Module IV

Study of Medicinal Plants

09 Hrs.

Study of the major medicinal plants in Kerala with special reference to their Botanical description, morphology of the useful part and medicinal properties.

- | | |
|-------------------------------------|--------------------------------------|
| 1. Akshoka (<i>Walnut</i>) | 6. Himsra (<i>Kakkathondi</i>) |
| 2. Amaravalli (<i>Akasavalli</i>) | 7. Musali (<i>Musalli</i>) |
| 3. Amra (<i>Ambazham</i>) | 8. Neeli (<i>Neelayamari</i>) |
| 4. Bimbi (<i>Kova</i>) | 9. Sarja (<i>Kuntirikkappayin</i>) |
| 5. Damanaka (<i>Nilampala</i>) | 10. Vrikshamla (<i>Punampuli</i>) |

Module V

Animal Products

09 Hrs.

Detailed study of the following animal products with special reference to the medicinal properties,

1. Milk
2. Ghee
3. Curd
4. Butter milk
5. Honey
6. Bee Wax

36 Hrs.

Practicals

1. Make micro and macro preparations of the drugs mentioned in the syllabus
2. Microscopic analysis- Types of stomata, stomatal index, palisade Ratio, Vein islets number
3. Nature of trichomes, presence of calcium oxalate crystals, starch grains, stone cells
4. Micrometric measurements of vessels, fibres
5. Physical and chemical tests for evaluation of drugs wherever applicable.
6. Identify the drug with its binomial and morphology of the source plant.
7. Identify the medicinal plants listed under Module III.
8. Students must submit practical records, Herbarium sheets (25 Nos:) and Field book at the time of practical examination.
9. Field trips are to be conducted for three days either as continuous or one day trips.

Suggested Reading

1. Wallis, T.E. (1999). Text book of Pharmacognosy (Fifth Edition). CBS publishers and Distributors, New Delhi.
2. Thomas Easley, and Steven Horne (2016). The Modern Herbal Dispensatory: A Medicine-Making Guide. North Atlantic Books, California.
3. Scripta Rustica (2020). Advanced Herbal Pharmacy: The Practitioner's Guide to Preparation, Formulation and Compounding.
4. Kaushik, P. and Dhiman, A.K. (2020). Medicinal plants and raw drugs of India. Bishen Singh Mahendra Pal Singh, New Delhi.
5. Andrew Chevallier (1996). The Encyclopedia of Medicinal Plants: A Practical Reference Guide to over 550 Key Herbs and Their Medicinal Uses. DK Publishers, UK.
6. Kochar, L. S. 1981. Economic Botany in the Tropics, Macmillan Co. New York.
7. Gamble, J. S. 1935. Flora of Presidency of Madras, London.
8. Sen, S. 1992. Economic Botany, New Central Book Agency, Calcutta.
9. Pharmacognosy of indigenous drugs by K. Raghunathan and Roma Mitra
10. Practical Book on Pharmacognosy, - Kokate et al, 2008, Pragathy Publication.
11. A Text Book of Pharmacognosy.- S.B.Gokhale, C.K.Kokate and A.P. Purohith (Ed).
12. Trease and Evens (1996). Pharmacognosy.
13. Shaw and Quadri (2001). Pharmacognosy.

Semester III**Main II****Ayurvedic Pharmacy****BP 1342 PHARMACEUTICAL ANALYSIS****Credit : 3****Contact hours 90hrs (T54 + P 36hrs)**

Aim : To achieve expertise in identifying and estimating phytochemical constituents present in plant extracts and in using different analytical techniques for the standardisation and evaluation of Ayurvedic drugs.

Outcome

The trained students can,

1. *Understand the apparatus and instruments used for testing and assaying in Ayurveda & basic calculations in pharmaceutical analysis.*
2. *Analyze the heavy metals present in Ayurvedic preparations.*
3. *Determine physico-chemical parameters and phytochemicals present in plant extracts.*

Module I**18hrs**

Introduction – Need and significance for standardization of herbal drugs. Apparatus used for testing and assays – Nessler Cylinders, Sieves, Thermometers, Volumetric Glass wares, Weights and Balances.

Basic calculations in pharmaceutical analysis: Percentage volume / volume (%v/v), percentage weight in volume (%w/v), Dilutions, Preparation of standard stock solutions, percentage weight / weight (%w/w), parts per million calculation (ppm).

Applications of the following analytical techniques in Ayurveda Pharmacy - UV/Visible spectrophotometry, Infrared spectrophotometry, Nuclear Magnetic Resonance spectroscopy, Mass Spectrometry, X -ray Diffraction, Radio immunoassay.

Module II**18hrs**

Tests and Determination.

Determination of different physico-chemical parameters - Foreign matter, Moisture content, Total ash content, Acid insoluble ash, Water soluble ash, Alcohol soluble extractives, Water soluble extractives, Fixed oil content, Determination of saponification value, Unsaponifiable matter, Foaming index, Acid value, Iodine value, Alcohol content, Swelling index, Mineral oil, Rancidity test.

Extraction and estimation of volatile oil content.

Test for Heavy Metals - General introduction of different methods for quantification of heavy metals in Ayurvedic preparation. Permissible limit of heavy metals, Limit test for heavy metals- Lead, Mercury and arsenic, Heavy metal detection by Atomic Absorption Spectrophotometry.

Pesticide Residue – Permissible limit, Test for Pesticides.

Test for Aflatoxins.

Chromatographic & Spectrophotometric methods - Standardization and evaluation of Ayurvedic Drugs.

Module III

6hrs

Extraction and separation techniques- Maceration, Infusion, Percolation, Decoction, Soxhlet extraction, Microwave assisted extraction (MAE), Supercritical fluid extraction (SFE), Ultrasound assisted extraction, Enzyme assisted extraction.

Module IV

12hrs

Phytochemical screening

Qualitative analysis - Steroids, Sugars (Total sugar, Reducing and Nonreducing), Terpenoids, Alkaloids, Phenolics, flavonoids, saponins, tannins, cardiac glycosides and anthraquinones

Quantitative analysis-Determination of total alkaloids, Flavonoids, Phenolics, Saponins, Tannins, and Glycosides.

Estimation of sodium and potassium by flame photometry.

Practical

18hrs

1. Determination of different physico-chemical parameters like foreign matter, moisture content, total ash content, acid insoluble ash
2. Histochemical localization of alkaloids, lipids, protein, starch, flavonoids, phenol
3. Estimation of phenol
4. Determination of swelling index.
5. Qualitative analysis of Steroids, Total sugar, Reducing and Nonreducing sugar, Terpenoids, Alkaloids, Phenolic compounds, Flavonoids, Saponins, Tannins, Cardiac glycosides and Anthraquinones.
6. Estimation of total Alkaloids, Flavonoids, Phenolics, Saponins, Tannins, and Glycosides.
7. Soxhlet extraction of phytoconstituents from plants.
8. Determination of Volatile Oil content.
9. Determination of Pesticide residue in plant extracts.
10. Separation of phytoconstituents present in plant extracts by TLC.

Suggested Reading

1. The Ayurvedic Pharmacopoeia of India, Govt. of India Publication.
2. Protocol for testing ayurvedic, siddha & unani medicines government of India, Dr Lohar.
3. Instrumental methods of analysis- Willard, Merrit, Dean.
4. Practical Pharmaceutical Chemistry – Part-II – Beckett and Stenlake.
5. Pharmaceutical Analysis – Dr. S. Ravishankar.
6. Pharmaceutical Analysis – Dr. A.V. Kasture.
7. Pharmaceutical analysis – David G Watson.

8. Text book of pharmaceutical analysis. K.A.Cannors.
9. Pharmaceutical chemistry, Vol. I & II, L.G.Chatton.
10. Practical pharmaceutical Chemistry, Vol I & II, A.B. Backet & J.B.Stenlake.
11. Quantitative pharmaceutical chemistry, Jenkins et al.
12. Quality control methods for herbal materials. WHO.
13. Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis J. B. Harborne.
14. Practical Pharmacognosy – Dr C K Kokate.

Semester IV
Main II
Ayurvedic Pharmacy

BP 1441 Pharmaceutical Chemistry & Natural Products

Credits : 3

Contact hours : 90 Hrs (T 54 +P 36 Hrs)

Aim : To create awareness about structure, hybridization and different chemical bonding, inorganic and organic components in pharmaceutical drugs, natural products and their pharmaceutical importance.

Outcome:

1. *Students will be expected to develop a better understanding about structure, hybridization and different chemical bonding in nature.*
2. *Identify different inorganic and organic components in pharmaceutical drugs.*
3. *Develop a deep understanding about different natural products with pharmaceutical importance.*

Module I

Inorganic Pharmaceutical Chemistry

18 Hrs.

Structure of an atom. Molecular orbitals and hybridization. Different types of hybridization. Chemical bonding. Different types of bonds. Lewis Dot structure.

Reactions in Solutions: Mass per cent, Mole fraction, Molarity, Molality, Parts per Million, Normality.

Metals and minerals occurrence properties, reactions and important compounds of Iron, Calcium, Aluminum, Copper, Gold, Silver, Mercury, Arsenic, Sulphur, Magnesium, Zinc, Sodium and Potassium.

Preparation, assay and uses of Ammonium chloride and Borax.

Buffers - their functions in biological systems - Uses of buffers in pharmaceutical research.

Module II**Organic Pharmaceutical Chemistry****27 Hrs.**

General introduction on plant biomolecules of pharmaceutical importance.

Phenolics – Occurrence, general structure and properties, classification, structure and functions; medicinal, of Flavonoids, Anthocyanins, Betalains, Carotenoids.

Terpenes - Occurrence, general structure and properties, classification, structure and functions; medicinal, of Monoterpenoids, Sesquiterpenoids, Diterpenoids, Triterpenoids, Tetraterpenoids.

Glucosinolates- Occurrence, general structure and properties, classification, structure and functions; medicinal.

Alkaloids - Occurrence, general structure and properties, classification based on chemical nucleus, structure and functions; medicinal, of Phenyl amino group (eg:-Tyramine, hordenine), Pyrrolidine group (eg:-Hygrine, Stachydrine), Pyridine group (eg:-Piperine, Ricinine), Pyrrolidine-pyridine(tropane) group (eg:- Nicotine, Hyocyanine), Quinoline group (eg:-Strychnine, Cinchonine), Phenanthrene group (eg:- Morphine, Thebaine).

Steroids - Occurrence, general structure and properties, classification based on chemical nucleus, structure and functions; Stigmasterols.

Vitamins - Occurrence, general structure and properties, classification structure and functions; medicinal, of Vitamin A, Vitamin B1, vitamin B2, B3, Nicotinamide, Vitamin B6, Vitamin B12, vitamin C, Folic acid, Vitamin D, Vitamin K.

Module IV**Natural products****09 Hrs.**

Detailed study of the following natural products with special reference to the source, chemical nature and its medicinal properties.

1. Caffeine
2. Curcumin
3. Quinine
4. Digitalis
5. Vincristine & Vinblastine
6. Aspirin
7. Morphine
8. Digoxin
9. Taxol
10. Lysergic Acid Diethylamide (LSD)

Practicals**36 Hrs.**

1. Estimation of Normality, molarity and molality of different solutions.
2. Preparation of chemical solutions with different Normality and Molarity.
3. Preparation of 1 Molar Phosphate Buffer, with a specific pH.
4. Estimation of pH of given solutions.
5. Qualitative analysis of metals in given material.
6. Identification of simple organic compounds by systematic qualitative analysis based on tests. for elements and functional groups, solubility, melting or boiling point.
7. Qualitative analysis of natural products given in syllabus.

Suggested Reading

1. Peter Sykes (2003). A Guidebook to Mechanism in Organic Chemistry.
2. Michael B. Smith and Jerry March (2006). March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure.
3. Ernest L. Eliel and Samuel H. Wilen (1996). Stereochemistry of Organic Compounds.
4. Caroline Cooper and Rupert Purchase (2017). *Organic Chemist's Desk Reference*. CRC Press, UK.
5. Wallis, T.E. (1999). Text book of Pharmacognosy (Fifth Edition). CBS publishers and Distributors, New Delhi.
6. Thomas Easley, and Steven Horne (2016). The Modern Herbal Dispensatory: A Medicine-Making Guide. North Atlantic Books, California.
7. IJNPR - Indian Journal of Natural Products & Resources, CSIR – NISCAIR.
8. Andrew Chevallier (1996). The Encyclopedia of Medicinal Plants: A Practical Reference Guide to over 550 Key Herbs and Their Medicinal Uses. DK Publishers, UK.
9. IJTK - Indian Journal of Traditional Knowledge, National Institute of Science Communication and Information Resources, Dr K.S. Krishnan Marg, (Near Pusa Gate), New Delhi – 110012.
10. Kochar, L. S. 1981. Economic Botany in the Tropics, Macmillan Co. New York.
11. Gamble, J. S. 1935. Flora of Presidency of Madras, London.
12. Sen, S. 1992. Economic Botany, New Central Book Agency, Calcutta.

Semester IV
Main II
Ayurvedic Pharmacy
BP 1442 Cultivation & Conservation of medicinal plants

Credit 3

Contact hours: 90 hr (T54+ P 36)

Aim: Students should know the ethnobotanical importance of medicinal plants, its cultivation, market demand, and experience of growing medicinal plants, Basics of plant tissue culture, media preparation, and establishment of tissue culture of medicinal plants.

Outcome:

1. *On completion the students would learn the ethnobotanical importance of medicinal plants*
2. *Know the scientific ways to cultivate plants under various modern regimes.*
3. *Gotten exposure to the cultivation and post harvest management of important medicinal plants.*
4. *Gained hands-on experience in growing medicinal plants, their market potential and IP regulations.*
5. *The students would have adequate exposure in plant tissue culture of medicinal plants*
6. *They would be equipped to kindle entrepreneurship among the new generation in the area of cultivation and marketing of medicinal plants.*

Module 1

36 hr

Cultivation and conservation of Ayurvedic and Indigenous medicinal plants- Ethno-botanical and cultural aspects of medicinal plants- Propagation methods of medicinal plants- Soil types for medicinal plant cultivation. Soil analysis- Good agricultural practices in cultivation of medicinal plants- Organic farming, Growing plants under controlled conditions etc.

Pest and Pest management in medicinal plants- Biopesticides / Bioinsecticides / Microbial biofertilizers.

Detailed study on cultivation practices- Post harvest management and uses of any fifteen medicinal plants of high demand (*Asparagus racemosus, Andrographis paniculata, Chlorophytum borivillianum, Piper longum, Bacopa monnieri, Kaempferia galanga, Vetiveria zizanoides, Indigofera tinctoria, Curcuma longa, Alpinia calcarata, Ocimum tenuiflorum, Aloe vera, Adhathoda beddomei, Holostemma adakodiyani, Curculigo orchioides*).

Institutes, National and state agencies for promoting cultivation of medicinal plants (CIMAP, NMPB and SMPBs). Private Ayurvedic pharmaceutical manufacturing companies in Kerala.

Module II

10 hrs

Medicinal plant biotechnology - Plant tissue culture, Historical development of plant tissue culture, types of cultures, Infrastructure for Plant tissue culture facility, Culture media components, growth and their maintenance, Hardening of tissue cultured plants.

Applications of plant tissue culture in pharmacognosy.

Micropropagation- Case studies on large scale production of propagules of medicinal plants through micropropagation - Production of active ingredients through *in vitro* culture.

Module III

8 hrs

Conservation of medicinal plants.

Need for conservation - Worldwide trade of medicinal plants- TRIPS agreement- Intellectual property rights- Indian patent law- Case studies of Turmeric and Neem.

Practicals

36 hrs

1. Collection and cultivation of any 5 medicinal plants studied, in the garden of the department. Students need to take notes on the growth, time duration taken and harvesting of the products.
2. Students may analyse the market potential of the products from the plants they have studied through surveys or enquiries among the end users/market. They can also make an assessment of cost benefit analysis of cultivation of the medicinal plants at reasonably large sized farm.
3. Students need hands on training in tissue culture media preparation. They may initiate tissue cultures, multiply and harden some of the medicinal plants they have studied.
4. Visit to a medicinal plant garden and preparation of a report.

Suggested Reading

1. Sharma D.K. (2008) Horticultural, Medicinal and Aromatic Plants. Book Enclave, Jaipur, India.
2. Trivedi PC (2009) Medicinal plants Utilisation and Conservation. Avishkar publishers, Jaipur, India.
3. Akerele O, Heywood V and Singe H (1991) The Conservation of Medicinal Plants. Cambridge university Press, Cambridge.
4. Chaudhary AB (2007) Endangered medicinal plants. Daya publishing house, Delhi.
5. Geilfus CM (2019) Controlled Environment Horticulture -Improving Quality of Vegetables and Medicinal Plants. Springer-Nature, Switzerland.
6. Mangathayaru K (2013) Pharmacognosy – An Indian perspective. Pearson Education, Chennai.
7. Kar A. (2008) Pharmacognosy and Pharmacobiotechnology. New Age International (P) Ltd. Publishers, New Delhi.
8. Kerala Agricultural University (2011) Package of Practices Recommendations: Crops.14th edition. Kerala Agricultural University, Thrissur, Kerala, India. www.kau.edu/pop.
9. Babu N, Srivastawa SK, Prusty M, Sahoo T (2017) Medicinal and Aromatic Plant Production Technologies a step towards farmwomen prosperity-Technical Bulletin No. 28. ICAR- Central Institute for Women in Agriculture, Bhubaneswar, 751 003 Odisha, INDIA.
10. Rajamani K, Nalina L and Hegde L : Medicinal and Aromatic Crops. <https://www.agrimoon.com/wp-content/uploads/Medicinal-and-Aromatic - Crops.pdf> .
11. Bhatia S, Sharma K, Dahiya R, Bera T (2015) Modern applications of Plant Biotechnology in Pharmaceutical sciences. Elsevier, Amsterdam.

Semester IV
Main II
Ayurvedic Pharmacy,
Practical II
BP 1443 Practical of BP1341, 1342, 1441 & 1442

Credits: 4

BP 1341 Pharmacognosy

1. Make micro and macro preparations of the drugs mentioned in the syllabus
2. Microscopic analysis- Types of stomata, stomatal index, palisade Ratio, Vein islets number
3. Nature of trichomes, presence of calcium oxalate crystals, starch grains, stone cells
4. Micrometric measurements of vessels, fibres
5. Physical and chemical tests for evaluation of drugs wherever applicable.
6. Identify the drug with its binomial and morphology of the source plant.
7. Identify the medicinal plants listed under Module III.
8. Students must submit practical records, Herbarium sheets (25 Nos:) and Field book at the time of practical examination.
9. Field trips are to be conducted for three days either as continuous or one day trips.

BP1342 Pharmaceutical Analysis

11. Determination of different physico-chemical parameters like foreign matter, moisture content, total ash content, acid insoluble ash.
12. Histochemical localization of alkaloids, lipids, protein, starch, flavonoids, phenol
13. Estimation of phenol
14. Determination of swelling index.
15. Qualitative analysis of Steroids, Total sugar, Reducing and Nonreducing sugar, Terpenoids, Alkaloids, Phenolic compounds, Flavonoids, Saponins, Tannins, Cardiac glycosides and Anthraquinones.
16. Estimation of total Alkaloids, Flavonoids, Phenolics, Saponins, Tannins, and Glycosides.
17. Soxhlet extraction of phytoconstituents from plants.
18. Determination of Volatile Oil content.
19. Determination of Pesticide residue in plant extracts.
20. Separation of phytoconstituents present in plant extracts by TLC.

BP1441 Pharmaceutical Chemistry & Natural Products

1. Estimation of Normality, molarity and molality of different solutions.
2. Preparation of chemical solutions with different Normality and Molarity.
3. Preparation of 1 Molar Phosphate Buffer, with a specific pH.
4. Estimation of pH of given solutions.
5. Qualitative analysis of metals in given material.
6. Identification of simple organic compounds by systematic qualitative analysis based on tests. for elements and functional groups, solubility, melting or boiling point.
7. Qualitative analysis of natural products given in syllabus.

BP1442 Cultivation & Conservation of Medicinal Plants

1. Collection and cultivation of any 5 medicinal plants studied, in the garden of the department. Students need to take notes on the growth, time duration taken and harvesting of the products.
 2. Students may analyse the market potential of the products from the plants they have studied through surveys or enquiries among the end users/market. They can also make an assessment of cost benefit analysis of cultivation of the medicinal plants at reasonably large sized farm.
 3. Students need hands on training in tissue culture media preparation. They may initiate tissue cultures, multiply and harden some of the medicinal plants they have studied.
- Visit to a medicinal plant garden and preparation of a report.

Semester V
Main II
Ayurvedic Pharmacy
BP 1541 Pharmaceutical Microbiology

Credits 3

Contact hours: 72hr (T54+ P 18)

***Aim:** This course is designed to get an in-depth knowledge about microbial metabolism, and microbial diseases. This knowledge is very important as far as Modernisation of Ayurveda is concerned. The students are expected to master all microbial related techniques to pursue research in Ayurvedic Pharmacy.*

Outcome:

The students shall be able to,

1. *State the infective microorganisms of the human body and describe the host parasite relationship.*
2. *List pathogenic microorganisms (bacteria, viruses, parasites, fungi) and describe the pathogenesis of the diseases produced by them*
3. *State or indicate the mode of transmission of pathogenic and opportunistic organisms and their sources including insect vectors responsible for transmission of infection*
4. *Describe mechanisms of immunity to infections*
5. *Acquire knowledge on suitable antimicrobial agents for treatment of infections and scope for immunotherapy and different vaccines available for prevention of communicable diseases.*

Module I

09 hrs

General microbiology

Introduction to microbiology - Morphology of bacteria comparison with other microbial forms, Structure of Bacterial cell -Growth, nutrition, culture media and Identification of bacteria.-Antibacterial agents and antibiotic sensitivity test.-Infection-Source and spread of infection-Sterilisation and disinfection Response to microbial infections.

Module II.

10 hrs

Systematic bacteriology

Concept of microbial species, strains, biovars, serovars. Brief introduction to Bergey's Manual.

Gram positive Cocci-Staphylococci, Streptococci, Pneumococci.

Gram negative Cocci-Neisseria.

Gram Positive Bacilli-Corynebacterium, Listeria, Bacillus.

Mycobacteria, Nocardia, Actinomyces.

Clostridia, Nonsporing anaerobes.

Gram negative Bacillus-Haemophilus, Bordetella, Brucella, Enterobacteria / Yersinia.

Pseudomonas, Pasteurella, Acinetobacter.

Vibrio / Campylobacter.

Mycoplasma, Legionella, Rickettsia, Chlamydia.

Spirochetes.

Module III.

09 hrs

Virology

General characteristics of viruses.

1. Virus host interaction
2. Replication of virus
3. Pox virus, Herpes, Adenovirus
4. Papova, Retrovirus
5. Myxoviruses
6. Picorna virus
7. Hepatitis, Miscellaneous
8. Rhabdo virus
9. Arboviruses
10. Oncogenic viruses
11. HIV
12. Bacteriophages

Viral culture.

Module IV.

Immunology

10 hrs

1. Introduction Classification, type and cells involved in immunity.
2. Antigen, Antibodies.

3. Complement in health and diseases.
4. Hypersensitivity .
5. HLA antigens in health and diseases.
6. Immunodeficiency diseases .
7. Serological test in medical practice.
8. Auto immunity.
9. Tumour and transplantation immunology.
10. Immunoprophylaxis and immunotherapy.
11. Immunohaematology.

Module V.

Parasitology

09 hrs

1. Introduction to parasitic diseases.
2. Protozoal infections-Amoebiasis, Plasmodium, Leishmaniasis, Trypanosoma, Giardia, Balantidium, Cryptosporidium, Trichomonas, Toxoplasma, Pneumocystis-laboratory diagnosis of protozoal infection.
3. Helminthus-intestinal nematodes, tissue nematodes, cestodes, trematodes Laboratory diagnosis of helminthic infections.
4. Fungi.

Module VI.

Ayurveda and Microbiology

07 hrs

1. Microbial Evaluation of Herbal drugs.
2. Tests used for assessment of microbial quality of the herbal medicine.
3. Total Aerobic Count for Bacteria and Fungi.
4. Identification of Coliforms, Salmonella spp. and Shigella spp in crude drugs.
5. Bacterial Pathogens in the Herbal Medicines.
6. Fungal Pathogens in the Herbal Medicines.
7. Microbial limit test, Prevention and Control contamination of Ayurvedic preparations.

PRACTICALS**18 hrs**

1. Techniques Simple stain, Gram Stain, Ziehl–Neelsen stain, Fungus: Lactophenol, Cotton blue.
2. Microbial cultures, Preparation of media, Nutrient Broth.
3. Parasitology stool examination.
4. Examination of microbial flora of the skin.
5. Examination of the microbial flora of mouth.
6. Inhibition of microorganisms by antibacterial agents by disc diffusion.

Suggested Reading

1. Textbook of Microbiology by R. Anantha Narayanan and C.K.J. Paniker 7th Edition Orient Longman.
2. A guide to Microbial Infections, Pathogenesis, Immunology, Laborator diagnosis and Control by Greenwood Slack and Penthera.
3. Essentials of Medical Microbiology, Apurba Sankar Sastry, Sandhya Bhatt.K.
4. Textbook of Microbiology and Immunology,Subash Chandra Parija.
5. Textbook of Parasitology by C. K. J. Paniker / Chakraborty /Pareja.
6. Textbook of Parasitology by Chatterjee.
7. Medical Microbiology by Jawetz E, Melnick J L, Adelberg E A.
8. Textbook of Immunology, Kuby.
9. Holt J. S., Krieg N. R., Sneath, P.H.A. and Williams S. T. 1994. Bergey's Manual of Determinative bacteriology. (9th ed).Williams & Wilkins, Baltimore.
10. Brock Biology of Microorganisms (15th Edition). Michael T. Madigan, Kelly S. Bender, Daniel H. Buckley, W. Matthew Sattley, David A. Stahl. NY : Pearson, [2018].
11. Microbiology: An Introduction, 12th Edition, Gerard J. Tortora, Berdell R. Funke, and Christine L. Case. Pearson, [2016].

Semester V**Main II****Ayurvedic Pharmacy****BP 1542 Industrial Pharmacy, Pharmacy Management & Pharmaceutical jurisprudence****Credits 3****Contact Hours 108 (T 72+P 36)**

***Aim:** To equip students for Ayurvedic pharmacy management by creating awareness in pharmaceutical technology, Acts and rules associated with Pharmacy and Drug manufacturing.*

Outcome

1. *The students are expected to gain in depth knowledge in Ayurvedic pharmacy and management.*
2. *Know how to manage a pharmacy and drug manufacturing unit.*
3. *Get awareness about machineries and record keeping of drug manufacturing unit.*
4. *Get knowledge about Acts and rules associated with Pharmacy.*

Module I**10 Hrs**

The Drug Manufacturing Unit, GMP Requirements Based On WHO Guidelines for Ayurvedic Pharmaceutical Industries, Scope, Requirements, Premises, Ancillary areas, Storage areas, Weighing areas, Production areas, Quality control areas. Staff required in Pharmacy, Storage of raw materials, Plan of Modern Pharmacies, plan for construction of pharmacy.

Module II**10hrs**

List of recommended machinery like Pulverizer, Tablet making machine, granulator, disintegrator, sieve and shaker, Mixer and Grinder, Edge runner, End runner, Ballmill Machine, Coating and polishing Pans, Capsule filling Machine, Muffle Furnace, etc for drug manufacturing and Equipments used for quality control like TLC, Refractometer, Tablet disintegration machine etc.

Module III**12 hrs**

Documentation, Batch processing records, Standard operating procedures (SOPs) and records, Good practices in production, Prevention of cross-contamination and bacterial contamination during production, Finished products, Rejected, recovered, reprocessed and reworked materials, Reference samples and standards. Good practices in quality control, Stability studies, Qualification and validation. Hygiene of Workers, Health, Clothing, Sanitation and Medical Services. Labels, Packaging materials, Bar-coding.

Pharmaceutical jurisprudence.

Module IV**12 hrs**

Drug Licensing Authority. Definition and scope of Forensic pharmacy. Pharmacists role in drug treatment and drug usage. Pharmacist as a member of the Health Care scheme. Pharmaceutical Legislation in India. Historical developments of pharmaceutical Education in India. Professional ethics in pharmacy practice. Legal and ethical responsibilities of pharmacists.

Drugs and Cosmetic Act-in relation to Pharmacy,1940 General study of the drugs and Cosmetic Act and rules. Study of the terms “Drugs” and “cosmetics”-Definitions, Provisions applicable to import, sale and manufacture of drugs of Ayurvedic drugs. Qualification, duties and responsibilities of Drug inspectors, sampling procedure, requirements and formalities for establishing manufacturing units, distribution houses, retail shops. Important schedules applicable to their establishment. Study of Schedule X and Y., Pharmacy Act-1948, Drug and magical remedy act. Introduction to consumer protection act (CPA), Introduction to NDP (narcotic drug protection) act. Pharmacovigilance.

Module V**10 hrs**

Detail study of schedules relating to Ayurvedic drugs –Schedule E (1), Schedule T

1. Laws relating to use of alcohol in pharmaceutical preparations with references to Medicinal and Toilet preparations (Excise duties) Act 1955 and rules 1956.
2. Drug dependence, misuse and abuse. Medico legal analysis with special references to Narcotic drugs and psychotropic substances Act 1985.
3. Advertisement of Drugs and Cosmetics – Prohibited and exempted advertisements. Drugs and Magic remedies (objectionable advertisements) Act 1955.

Brief study of the following Acts.

- a. Prevention of Food adulteration Act 1954 and Rules 1955.
- b. Factories Act 1948.
- c. Patent Act 1970.
- d. States shops & Establishment Act 1948.
- e. Minimum Wages Act 1948.

Practical**18 hrs**

1. List out trade names, combinations, banned drugs, newly introduced and out dated drugs, drug tragedies.
2. Study on the effect of particle size on dissolution/ compatibility/flow properties.
3. Testing of drug degradation compounds using TLC.
4. Designing of plant layouts for tablets, liquid orals etc.
5. Dissolution of drugs in different pH media for comparison of performance.

6. Comparative evaluation of marketed sustained release tablets and data treatment.
7. Preparation and evaluation of matrix tablets using natural polymers.
8. Methods for analysis of raw materials and single Ayurvedic drugs.
9. Methodology to study toxicity of Ayurvedic drugs.
10. Concept of microbial contamination in finished and raw material.
11. Study of Acts and Schedules.
12. Industry visit and report (At least one).

Suggested Reading

1. Ahuja A. Textbook of pharmaceutical management. (2005) New Delhi: Birla Publications.
2. Amritpal Singh (2017), Regulatory and Pharmacological Basis of Ayurvedic Formulations, CRC Press.
3. B. S. Kuchekar (2008) Pharmaceutical Jurisprudence Pragati Books Pvt. Ltd.
4. Banker and Rhodes, (1990) Modern Pharmaceutics, Marcel Decker Inc., New York, 2nd Edition.
5. Banker, Rhodes. (2009) Modern pharmaceutics. Vol 121, 4th Ed. New York: Marcel Dekker Inc.
6. Bernd Markert (1996) Instrumental Element and Multi-Element Analysis of Plant Samples: Methods and Applications, Wiley Publishers.
7. Brahmankar Jaiswal (2015) Biopharmacutitics And Pharmacokinetics - A Treatise, Vallabha prakashan publishers.
8. British pharmacopoeia.
9. C. K. Kokate (2008) Pharmacognosy, Nirali publishers.
10. Chiragkumar J. Gohil (2018) Fundamentals Of Pharmacy, IP Innovative Publication Pvt. Ltd.
11. Dharti And Vidhi Kirti (2020) Concise Course In Industrial Pharmacy, S Vikas And Company (Pv).
12. Dharti And Vidhi Kirti (2020) Concise Course In Industrial Pharmacy -Ii S Vikas And Company.
13. EIRI Board Herbal & Ayurvedic Medicines Technology , published by Engineers India Research Institute.
14. Evans, Anderson, Sweeney, Williams. (1984) Applied production and operations management. 3rd Ed. St.paul: West publishing company Ltd.
15. Guarino RA. (2002) New drug approval process. Vol 100. New York: Marcel Dekker Inc.
16. Harold K, Cyril OD, Heinz W. (1986) Essentials of management. New Delhi: McGraw-Hill Book Company.
17. Herbert. (2005) Pharmaceutical dosage form- Tablets, Vol 1,2,3, 2nd Ed. New York: Marcel Dekker Inc.
18. Howard C. Ansel, Nicholas G., Popovid loyd, Allen junior BI. Pharmaceutical dosage forms & drug delivery systems. Waverly pvt, Ltd, New Delhi, Sixth edition.
19. Indian Pharmacopoeia 2010. Volume-I, II & III, Indian Pharmacopoeia Commission. New Delhi.
20. Jai Malik (2018) Pharmacognosy and Phytochemistry, paiging publishers.
21. Jain NK., (2001) Controlled and novel drug delivery, CBS Publishers & Distributors, New delhi.
22. John Wiley and sons, Inc, Encyclopedia of controlled delivery, Editor-Edith Mathiowitz, Published by Wiley Interscience Publication, New York/Chichester/Weinheim.

23. K. Mehta (2006) Ayurvedic Pharmacy Chaukhamba Sanskrit Pratishthan Oriental Publishers & Distributors, IN.
24. KHAR R.K.(2020) Lachman Liebermans The Theory And Practice Of Industrial Pharmacy, CBS publishers.
25. Kohli DPS. (2006) Drug formulation manual. 3rd Ed. New Delhi: Eastern publishers.
26. Lachman L, Liberman HA, Kanig JL. (1986) Theory and practice of industrial pharmacy. 3rd Ed. Bombay: Varghese Publishing House.
27. Leon Lachman, Lieberman, Kanig JL., (1987) Theory and Practice of Industrial Pharmacy, Varghese Publishing House, Bombay, 3rd Edition.
28. Loyd VA, Nicholas GP, Howard CA. (2010) Pharmaceutical dosage forms and drug delivery systems. 9th Ed. New York: Lippincott Williams & Wilkins.
29. M. Ashok Kumar (2008) Intellectual Property Rights, Serials Publications.
30. Martin A. Martin's (2011) Physical pharmacy & pharmaceutical sciences. 6th Ed. New York: Lippincott Williams & Wilkins.
31. Paibag, Satadru, sharma, Shikha (2015) Textbook of Ayurvedic pharmaceuticals, Varanasi.
32. Pandey, Vikas. (2018). Textbook of Industrial Pharmacy- II. paging publishers, New Delhi.
33. Pawar R.A Ahirrao, Patel 92019) Theory Of Pharmacy Practices Vikas And Company (Pv)
34. Peter FD. (1986) Management - task, responsibility and practices. Bangalore: Allied publication.
35. Rawlins EA. (2010) Bentley's textbook of pharmaceuticals. 8th Ed. New Delhi: ELBS Publication.
36. Rehan Uddin (2020) Instrumental Methods of Analysis, IP Innovative Publication Pvt. Ltd.
37. Remington (2006) The Science and practice of pharmacy, Laura Moore Fox. 21st Ed. New York: Lippincott Williams & Wilkins.
38. Robinson JR., Lee VHL. (1992) Controlled drug delivery systems, Marcel Decker, Inc., New York.
39. S. Kuchekar, Mr. A. M. Khadatare, Mr. Sachin Itkar (2006) Forensic Pharmacy, Nirali Prakashan.
40. Sachin Itkar (2008) Pharmaceutical Management, Nirali Prakashan.
41. Shobharani R. Hiremath (2008) Textbook of Industrial Pharmacy: Drug Delivery Systems, and Cosmetic and Herbal Drug Technology, Orient BlackSwan publishers.
42. Shri Prakash (2006) WTO, Intellectual Property Rights and Branding, Har Anand Publications.
43. Sidney H, Willig. (2001) Good manufacturing of pharmaceuticals - A plan for total quality control from manufacturer to consumer. 5th Ed. New York: Marcel Dekker Inc.
44. Smaeer shaikh, Rahul Gaiward, rajeeb Usman, (2019) A text book of Industrial pharmacy, PV Books.
45. Subrahmanyam CVS, Thimmasetty CVS. (2012) Pharmaceutical regulatory affairs. Delhi: Vallabh Prakashan.
46. Subrahmanyam CVS. (2007) Pharmaceutical production and management. Delhi: Vallabh Prakashan.
47. Tomski HW. (1976) A textbook of pharmacy management. London: Kogan Page ltd.
48. Trusha P. Shangrapawar, Mr. Sujit S. Kakade, Mr. Prashant H. Khade (2020) Industrial Pharmacy, Nirali Prakashan.
49. United States Pharmacopoeia, US Publications, US.
50. Vinod Rangari (2019) Practical Pharmacognosy and Phytochemistry Career Publications.
51. Vyas SP., Khar RK., (2002) Controlled drug delivery-concepts and advances, Vallabh Prakashan, New Delhi.
52. World Intellectual Property Organization · 2005, Intellectual Property and Traditional Knowledge, Published by WIPO.
53. Yalkowsky SH. (1981) Techniques of solubilization of drugs. Vol-12. New York: Marcel Dekker Inc.

Semester VI
Main II
Ayurvedic Pharmacy
BP 1641 Formulative Pharmacy

Credit: 4

Contact hours 108 hrs (T 72 + P36)

Aim: The Course enables the student to understand and appreciate the influence of pharmaceutical additives and various pharmaceutical dosage forms, quality control and standardisation of Ayurvedic and Modern Medical formulations.

Outcome

The student shall be able to,

1. *Standardise Ayurvedic formulations and analyse them.*
2. *Analyse and understand development of Modern pharmaceutical dosage forms.*
3. *Evaluate solid, liquid and semisolid formulations for their quality.*

Module- I

09hrs

Introduction to History of Ayurvedic Pharmacy, Evolution, Ayurvedic terminology, Measurements.

- a. Historical background and development of profession of pharmacy: History of profession of Pharmacy in India in relation to pharmacy education, Industry and organization, Pharmacy as a career, Ayurvedic Formulary, Official compendia, Basic Ayurvedic terminology relating to Choorna, Kvatha, Asava and Arishta, Arka, Avaleha or Leha, Guggulu, Ghrita, Taila, Lepa, Vati /Gutika, Varti, Netrabindu and Anjana. English translations of technical terms used in Ayurvedic pharmacy.
- b. Metrology: Introduction to units of weights and volume in ayurvedic terms, metric systems and imperial systems. Simple calculations involved in preparing solutions of solids in liquids, liquids in liquids.

Module-II

09hrs

Different types of Ayurvedic formulations and their Standardisation

- a. Standardization and quality control of Ayurvedic drugs, Introduction and background.
- b. Parameters included in Ayurvedic Pharmacopoeia of India in Part-I.
- c. Formulation and standardisation of the following compound-formulations.
 (Juice) Swarasa, Kalka (Definition), Choorna, Kvatha, Asava and Arishta, Arka, Avaleha or Leha, Guggulu, Ghrita, Taila, Lepa, Vati /Gutika, Varti, Netrabindu and Anjana.

Module-III

18hrs

Different types of Modern Pharmacological preparations.

Tablets:

- a. Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems.
- b. Tablet coating: Types of coating, coating materials, formulation of coating composition, methods of coating.
- c. Quality control tests: In process and finished product tests.

Capsules:

- a. Hard gelatin capsules: Introduction, Extraction of gelatin and production of hard gelatin capsule shells. Size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules. In process and final product quality control tests for capsules.
- b. Soft gelatin capsules: Nature of shell and capsule content, size of capsules, importance of base adsorption and minimum/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules.

Pellets:

Introduction, formulation requirements, pelletization process.

Module-IV**09 hrs**

Brief knowledge of route of drug administration in Ayurveda and Modern medicine.

Parenteral Products:

- a. Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity.
- b. Production procedure, production facilities and controls.
- c. Formulation of injections, sterile powders, emulsions, suspensions, large volume parenterals and lyophilized products, Sterilization.
- d. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests.

Ophthalmic Preparations:

Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labelling, containers, evaluation of ophthalmic preparations.

Module-V**09 Hours**

Cosmetics:

Formulation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens.

Pharmaceutical Aerosols:

Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies.

Packaging Materials Science:

Materials used for packaging of pharmaceutical products, factors influencing choice of containers, legal and official requirements for containers, stability aspects of packaging materials, quality control tests.

Module- VI**18hrs**

Quality Control and Standardisation Procedures,

Basic tests for drugs – Pharmaceutical substances, Medicinal plants materials and dosage forms. WHO guidelines for quality control of herbal drugs. Evaluation of commercial crude drugs intended for use.

Brief study of quality assurance in herbal drug industry of cGMP, GMP and GLP in traditional system of medicine.

Brief study of WHO Guidelines on current good manufacturing Practices (cGMP) for Herbals.

EU and ICH guidelines for quality control of herbal drugs.

Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines.

Stability testing of herbal medicines.

Practical**36 hrs**

1. Standardization and Evaluation of the following Ayurvedic formulations from standard pharmacies.
 - a. Choorna.
 - b. Kvatha.
 - c. Asava and Arishta.
 - d. Arka.
 - e. Avaleha or Leha.
 - f. Guggulu.
 - g. Ghrita.
 - h. Taila.
 - i. Lepa.
 - j. Vati /Gutika.
 - k. Varti.
 - l. Netrabindu and Anjana.

Suggested Reading:

1. Alfonso R. Gennaro Remington. The Science and Practice of Pharmacy, Lippincott Williams, New Delhi.
2. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, CBS Publications, New Delhi.
3. E.A. Rawlins, Bentley's Text Book of Pharmaceutics, English Language Book Society, Elsevier Health Sciences, USA.
4. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman & J.B.Schwartz
5. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman & Lachman.
6. Pharmaceutical dosage form disperse system VOL-1 by Liberman & Lachman.
7. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition.
8. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Science (RPS).
9. Theory and Practice of Industrial Pharmacy by Liberman & Lachman.
10. Pharmaceutics-The science of dosage form design by M.E.Aulton, Churchill livingstone, Latest edition.
11. Introduction to Pharmaceutical Dosage Forms by H. C. Ansel, Lea & Febiger, Philadelphia, edition, 2005.
12. Drug stability - Principles and practice by Cartensen & C.J. Rhodes, 3rd Edition, Marcel Dekker Series, Vol 107.
13. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy).
14. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.
15. Remington's Pharmaceutical Sciences.
16. Industrial Pharmacy – Lachman and others.
17. Physical Pharmaceutics – Shotton and Ridgway.
18. American pharmacy – Sprowis and Beal.
19. The Ayurvedic Pharmacopoeia of India Part -1.
20. The Ayurvedic Pharmacopoeia of India Part -1. Volume IX.
21. The Ayurvedic Formulary of India, Part-I,II.
22. A handbook of standardisation of Ayurvedic Formulations. Dr. Sudheendra V. Honward, Chaukamba Orientalia, Varanasi.

Semester VI
Main II
Ayurvedic Pharmacy,
Practical III
BP 1642 Practical of BP1541, 1542 & 1641

Credits: 4

BP1541 Pharmaceutical Microbiology

1. Techniques Simple stain, Gram Stain, Ziehl–Neelsen stain, Fungus: Lactophenol, Cotton blue.
2. Microbial cultures, Preparation of media, Nutrient Broth.
3. Parasitology stool examination.
4. Examination of microbial flora of the skin.
5. Examination of the microbial flora of mouth.

Inhibition of microorganisms by antibacterial agents by disc diffusion.

BP1542 Industrial Pharmacy, Pharmacy Management & Pharmaceutical Jurisprudence

1. List out trade names, combinations, banned drugs, newly introduced and out dated drugs, drug tragedies.
2. Study on the effect of particle size on dissolution/ compatibility/flow properties.
3. Testing of drug degradation compounds using TLC.
4. Designing of plant layouts for tablets, liquid orals etc.
5. Dissolution of drugs in different pH media for comparison of performance.
6. Comparative evaluation of marketed sustained release tablets and data treatment.
7. Preparation and evaluation of matrix tablets using natural polymers.
8. Methods for analysis of raw materials and single Ayurvedic drugs.
9. Methodology to study toxicity of Ayurvedic drugs.
10. Concept of microbial contamination in finished and raw material.
11. Study of Acts and Schedules.
12. Industry visit and report (At least one).

BP1641 Formulative Pharmacy

2. Standardization and Evaluation of the following Ayurvedic formulations from standard pharmacies.
 - a. Choorna.
 - b. Kvatha.
 - c. Asava and Arishta.
 - d. Arka.
 - e. Avaleha or Leha.
 - f. Guggulu.

- g. Ghrita.
- h. Taila.
- i. Lepa.
- j. Vati /Gutika.
- k. Varti.
- l. Netrabindu and Anjana.

BSc. Degree Botany & Ayurvedic Pharmacy (Double Main)
Semester V
Open course
BP 1551.1 Medicinal plant Conservation

Credit: 2

Contact hours:54

Aim : Students should know the ethnobotanical importance of medicinal plants, its propagation, cultivation, market demand, large scale cultivation of medicinal plants and marketing.

Outcome:

The students will,

1. *Learn the ethnobotanical importance of medicinal plants.*
2. *Know the scientific ways to cultivate plants under various modern regimes including organic farming.*
3. *Get exposure to post harvest management of important medicinal plants.*
4. *Get hands-on experience in growing medicinal plants.*
5. *Learn their market potential and learn the IP regulations involved in it.*
6. *Kindle entrepreneurship among the new generation in the area of cultivation and marketing of medicinal plants.*

Module I

08 hr

Cultivation and conservation of Ayurvedic and Indigenous medicinal plants- Ethno-botanical and cultural aspects of medicinal plants- History and importance of Ayurvedic medical system.
 Common medicinal plants used in house hold remedies - Medicinal plants used commercially in popular ayurvedic preparations.

Module II

04 hr

Propagation methods of medicinal plants. Seeds and vegetative propagation methods.

Module III

12 hr

Cultivation of medicinal plants- Tools required , Good agricultural practices in cultivation of medicinal plants including Organic farming- Growing plants under controlled conditions- Use microbial biofertilizers- Pest and Pest management in medicinal plants-

Biopesticides/Bioinsecticides.

Module IV

08hr

Detailed study on cultivation practices, post harvest management and uses of any five medicinal plants of high demand (Any five among the following - *Asparagus racemosus*, *Andrographis paniculata*, *Ocimum tenuiflorum*, *Piper longum*, *Bacopa monnieri*).

Module V

06 hrs

Marketing of medicinal plants and the products - Demand and supply of medicinal plants. Issues faced by farmers in the medicinal plants sector- Major end users of the medicinal plants- Ayurvedic tourism (Brief account).

Module VI

06 hrs

Institutes, National and state agencies for promoting cultivation of medicinal plants (CIMAP, NMPB and SMPBs). Private agencies involved in production of ayurvedic formulations in the state of Kerala.

Module VII

10 hrs

Conservation of medicinal plants -Need for conservation of medicinal plants, Worldwide trade of medicinal plants, TRIPS agreement, Intellectual property rights, Indian patent law, Case studies of Turmeric and Neem.

Suggested Reading:

1. Sharma D.K. (2008) Horticultural, Medicinal and Aromatic Plants. Book Enclave, Jaipur, India.
2. Trivedi PC (2009) Medicinal plants Utilisation and Conservation. Avishkar publishers, Jaipur, India.
3. Akerele O, Heywood V and Singe H (1991) The Conservation of Medicinal Plants. Cambridge university Press, Cambridge.
4. Chaudhary AB (2007) Endangered medicinal plants. Daya publishing house, Delhi.
5. Geilfus CM (2019) Controlled Environment Horticulture -Improving Quality of Vegetables and Medicinal Plants. Springer-Nature, Switzerland.
6. Mangathayaru K (2013) Pharmacognosy – An Indian perspective. Pearson Education, Chennai.
7. Kerala Agricultural University (2011) Package of Practices Recommendations: Crops.14th edition. Kerala Agricultural University, Thrissur, Kerala, India. www.kau.edu/pop.
8. Babu N, Srivastawa SK, Prusty M, Sahoo T (2017) Medicinal and Aromatic Plant Production Technologies a step towards farmwomen prosperity-Technical Bulletin No. 28. ICAR- Central Institute for Women in Agriculture, Bhubaneswar, 751 003 Odisha, INDIA.

BSc. Degree Botany & Ayurvedic Pharmacy (Double Main)

Semester V

Open Course

BP1551.2 Horticulture

Credit : 2

Contact hours : 54 hrs

Aim: To develop knowledge about principles of gardening, propagation and flower arrangement.

Outcome:

1. Students are familiarized in horticulture implements and methods of gardening.
2. Better understanding of commercial horticulture, flower arrangement, cut flowers.
3. Can understand about land scaping, fertilizers and Plant protection.

Module-I

10hrs

1. Introduction
2. Divisions of horticulture
3. Importance and scope of horticulture.
4. Principles of garden making
5. Types of pots and containers
6. Potting mixture and potting media – soil, sand, peat, sphagnum moss, vermiculite
7. Soil types, Soil preparation
8. Irrigation methods- drip irrigation and sprinkler irrigation
9. Hydroponics

Module-II

12hrs

Propagation methods,

1. Cuttings- root, stem, leaf.
2. Layering – Air layering, Ground layering (Tip, Trench and Compound).
3. Budding – T-budding.
4. Grafting – Approach grafting, Bridge grafting, whip and tongue grafting.
5. Garden tools and implements.
6. Manures and fertilizers.
7. Farmyard manure, compost, vermicompost and biofertilizers.
8. Chemical fertilizers –NPK.
9. Time and application of manure and fertilizers.
10. Foliar sprays.

Module- III

12hrs

Components of a Garden,

1. Lawns and landscaping Trees, shrubs and shrubberies, climbers and creepers.
2. Flower beds and borders, ornamental hedges, edges, Drives, roads, walks and paths, Carpet beds, topiary, trophy, rockery.

3. Conservatory or green houses, Indoor garden, Roof garden.
4. Bonsai.

Module- IV**12hrs**

Flower Arrangement,

1. Containers and requirements for flower arrangements Free style, Shallow and Mass arrangement.
2. Japanese –Ikebana.
3. Bouquet and garland making.
4. Dry flowerarrangement.
5. Harvesting Methods- Anthurium and Orchid & Storage.
6. Marketing of Fruits, vegetables and flowers.
7. Preservation and processing of fruits and vegetables.

Module- V**08hrs**

Growth regulators in horticulture,

1. Rooting hormones, Growth promoters, Flower induction, Parthenocarpy.
2. Common diseases of Mango and Tomato.
3. Plant protection- Weedicides, Fungicides, Pesticides.

Field Study: Visit to a Botanical garden under the guidance of the teacher is encouraged.

Suggested Reading:

1. Arora J.S (1990). Introductory Ornamental Horticulture, KalyaniPublications.
2. Bailey L.H (1901). The Standard Cyclopaedia of Horticulture Volume 1,2 and 3, Macmillan Publications.
3. Bose T.K and Mukerjee D (1987). Gardening in India, Oxford Book House.
4. Chauhan V.S, (1972). Vegetable Production in India, RamPrasad & Sons.
5. Gupta S N (2010) Instant Horticulture, Jain Brothers publishing.
6. Kumar N (1989). Introduction to Horticulture, RajalakshmiPublications.
7. Manibhushan Rao K (1991). Text Book of Horticulture, Macmillan Publications.
8. Shujnroto, (1982). The Essentials of Bonsai, David & Charles, Newton.
9. Rajesh Kumar, Kaushal Kumar Misra, (2014) Fundamentals of Horticulture, Biotech publishers.
10. Singh J (2017) Fundamentals of Horticulture, Kalyani publishers.

Semester V

Open course

BP 1551.3 Herbal medicine & First Aid

Credit 2

Contact hours: 54 hrs

Aim: *To create an awareness among Botany students about herbal remedies and Ayurvedic first aid.*

Outcome:

1. *Students will identify the medicinal plants for herbal remedies around them.*
2. *Practise the herbal remedies at home, disseminate knowledge about herbal remedies.*
3. *Get awareness about important herbal first aids.*

Module I

8 hrs

Herbal medicine and wilderness medicine,

Herbal medicine and history of herbal medicine, Action of herbal medicine, difference of herbal medicine from pharmaceuticals, Safety aspects of herbal medicines. Healing power of Nature, Nature literacy, Importance of Medicinal plants around us. Wilderness medicine, Preparation of herbal medicines, Advantages and Disadvantages. Herb gardening

Module II

6 hrs

Wounds, infections and immunoboosters,

Herbal medicine for Infection and wound management, Immune supportive herbs for medical emergencies, Herbal medicine :Herbal explanations including use of herbs-, honey, water-based poulticing and plastering techniques, salves and oil-based wound healing, working with burns and blisters, Infections and avoidance of infections, packing of wounds. Importance of Azadirachta, Tulsi, Licorice, Thippali.

Module III

8 hrs

Herbal medicine for gastric problems, respiratory, anxiety disorders

Herbs for gastric problems- Acid reflux- butter milk, asafoetida, turmeric and fenugreek, Indigestion- importance of fasting, Ginger, pepper, garlic, pomegranate juice, lemon, cardamom, triphala, Diarrhoea & Vomiting-Hydration, rock salt & sugar, cumin, dry ginger, pepper, muthanga (Cyprus rotundus), Gynaec problems- asoka, moringa, smilax, achyranthus, Asparagus Tribulus, Respiratory--- adathoda, turmeric, ginger, garlic, lemon, black pepper, tulsi, jaggery and honey -head ache and anxiety - hydration, deep breathing and massaging, Cooling paste, aloe vera, sandal wood, amla, brahmi, oils- clove, eucalyptus.

Module IV**6 hrs**

Burns, Bites and sting management:

Burns- types, venom-pathophysiology of different types of venom in the body, anaphylactic shock, mild to severe venom reactions, immediate first aid, Field first aid for venomous spider bites, signs and symptoms Field first aid and emergency treatment for fire, ant stings, Scorpion stings: treatment and field first aid, tulsi, aloe vera, turmeric, Honey, coconut oil ghee, Sandal wood etc.,

Module V**8 hrs**

First aid and first aid kit:

Importance of First aid, assessing and managing a casualty and an incident (Traffic accidents, Fires, Electrical incidents, Water incidents, Emergency first aid- Action in an emergency, CPR for an adult, CPR for a child, Community emergencies such as fire explosions, earth quakes, flood and famine, Components of first aid kit, Herbal medic - Ayurvedic first aid kit, herbal first aid preparations, Bandaging- bone, wound and burn management.

Suggested Reading:

1. Alagappan R (2017) Medicine For Ayush Students 1st Edition , Athithi books, New Delhi.
2. Bhaswati Bhattacharya (2015) Everyday Ayurveda : Daily Habits That Can Change Your Life, Random House India.
3. Brahmanand Tripathi (2019) Ashtanga Hridayam of Srimadvagbhata, Athithi Books, New Delhi.
4. Chathurbhuj Bhuyan (2016) Ayurvedic first aid, Chaukhambha Orientalia, Varanasi.
5. Clement (2012)Text book on First Aid & Emergency Nursing, First edition, JP brothers.
6. Deepak Yadav (2018) History Of Ayurveda, Athithi Medical books Pvt Ltd, New Delhi.
7. H.K. Bakhru (2020) The Complete Handbook of Nature Cure, Cloud tail India.
8. K. Nishteswar(2017) Text Book Of Dravyaguna, Athithi Medical books Pvt Ltd, New Delhi.
9. Kashinath Pandey Sastry and Dr. Gorakhnath Chaturvedi (2020) Caraka Samhita, Athithi Books, New Delhi.
10. M.S. Krishnamurthy and JV Hebbar (2018) Easy Ayurveda Home Remedies: Based On Authentic, Traditional Ayurveda Practice, Repro Books.
11. Philip Jevon, (2007) Emergency care and First Aid for Nurses, A practical guide, Church & Living Stone.

12. Ravindra Angadi (2017) Classical Compendium Of Ayurvedic Pharmaceutical Science, Athithi Medical books Pvt Ltd, New Delhi.
13. Usha Lad (2010) Ayurvedic Cooking for Self-Healing, Motilal Banarsidass Publishers Pvt. Ltd..
14. Vasant C. Patil (2017) Principles And Practice Of Pancakarma Athithi Medical books Pvt Ltd, New Delhi.
15. Vasant Lad (2017) Ayurveda: The Science of Self Healing - A Practical Guide Motilal Banarsidass Publishers Pvt. Ltd..

MODEL QUESTIONS

B.Sc. DEGREE IN BOTANY & AYURVEDIC PHARMACY
SEMESTER II
FOUNDATION COURSE II
BP 1221 : ENVIRONMENTAL STUDIES

Time : 3 Hours

Max. Marks : 80

SECTION – A

Answer all questions in a word or one or two sentences. Each question carries 1 mark. Draw diagrams only if specified in the question.

1. Give a method for *in-situ* conservation of plants.
2. Mention any two anatomical adaptations in hydrophytes.
3. Define endemism.
4. Cite the names of any two National Parks in Kerala.
5. Give an example for renewable resource.
6. What is meant by endangered species?
7. What are green house gases?
8. Mention the hazards of lead pollution.
9. Comment on Acid rain.
10. What is meant by desertification?

(1 x 10 = 10 marks)

SECTION – B

Answer any 8 questions. Each question carries 2 marks. Answer not to exceed one paragraph

11. Comment on the types of abiotic components of an ecosystem.
12. Briefly describe the causes of biodiversity loss.
13. Point out how epiphytes are adapted to thrive in their habitat?
14. Mention the types of trophic levels in an ecosystem.
15. Differentiate environmental hazard and environmental disaster.
16. Explain the significance of mangrove vegetation.
17. What are the types of Forests in India.
18. Comment on the recent ecological issues in Kasargod.
19. Discuss the causes for global warming.
20. Explain the role of bacteria in ecosystem.
21. Mention any four examples for non-renewable natural resources.
22. Represent a food chain in a grass land ecosystem.

(2 x 8 = 16 marks)

SECTION – C

Answer any six of the following. (Answer not to exceed 120 words). Each question carries 4 marks.

23. Describe diversity and beta diversity.
24. What are hot spots? Mention their significance and give an example from India.
25. Describe the types of ecological pyramids.
26. Mention the stages of succession in a dry habitat.
27. Mention the strategies for conservation of forest resources.
28. Give an account of environmental legislation.
29. Explain briefly on Environmental ethics. Comment on major issues and solutions.
30. Discuss the various options for water management.
31. Explain the role of information technology in environment management.

(4 x 6 = 24 marks)

SECTION – D

Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.

32. Explain the types of vegetation and phytogeographic regions of India.
33. Discuss the concept of sustainable development. Explain with reference to global environmental status.
34. Discuss the impact of solid waste and point out the causes, effects and control measures of urban and industrial wastes.
35. Discuss the role of Forests in environment. Comment on the strategies enforced by Government of India for Forest management.

(15 x 2 = 30 marks)

MODEL QUESTION PAPERS

MAIN I - BOTANY

B. SC. DEGREE BOTANY & AYURVEDIC PHARMACY (DOUBLE MAIN)
SEMESTER I
MAIN I- BOTANY

BP 1131 : Microtechnique, Angiosperm Anatomy, Reproductive Botany & Palynology
Time :3 Hrs **Total Marks: 80**

(Draw diagrams wherever necessary)

SECTION A

I. Answer all questions. Each question carries 1 mark

1. What is middle lamella.
2. In which plant Bulliform cells are present?
3. What is dehydration.
4. Define Exarch condition.
5. What is Conjunctive tissue.
6. Define Cystoliths.
7. What are Tyloses.
8. Amoeboid Tapetum.
9. Comment on orthotropous ovule.
10. Define chalazogamy.

(10 x 1 =10 marks)

SECTION B

II. Answer any **Eight** questions. Each question carries 2 mark

11. Write a note on Bordered pits.
12. Comment on phellogen and its function.
13. Mention different types of Stomata.
14. Give an account of Lacticifers.
15. Differentiate Heart wood and sap wood.
16. Give an account of Quiescent centre.
17. Explain Guttation.
18. Write a note on Canadabalsam.
19. Explain Polyembryony.
20. Draw a neat labeled diagram of Dicot embryo with cellular divisions.
21. Write about Pollen kitt.
22. Explain Korper Kappe theory.

(8 x 2 =16Marks)

SECTION C

III. Answer any **six** questions. Each question carries 4 marks.

23. Write an account on Meristems and their classification.
24. Enumerate Different types of vascular arrangement seen in Angiosperms.
25. Differentiate dicot stem with that of monocot Stem.
26. With the help of diagram describe the internal structure of young anther.
27. Explain different types of Endosperm formation found among Angiosperm.
28. Explain killing and fixing in microtechnique.
29. Briefly describe the theories on apical organization of stem apex.
30. Describe the structure and function of Cambium.
31. Explain about the Non living inclusions of a cell.

(6 x4 =24 Marks)

SECTION D

IV. Answer any **two** questions. Each carries 15 marks.

32. What are permanent tissues? Explain different types.
33. With suitable diagrams describe normal secondary growth in Dicot stem.
34. Write an account on the process of secondary growth in Bignonia stem with diagrams
35. Explain Megasporogenesis and the *Allium* type of Embryosac development with the help of diagrams.

(2x 15=30 Marks)

**B SC. DEGREE IN BOTANY & AYURVEDIC PHARMACY
SEMESTER II
MAIN I BOTANY**

BP1231- METHODOLOGY OF SCIENCE AND BIOINSTRUMENTATION

Time : 3 Hours

Max Marks : 80

SECTION – A

Answer all the questions in a word or one or two sentences. Each question carries one mark

1. Define Beer Lambert's Law
2. What is flourimetry?
3. Name two stains used in microscopy.
4. Define the first law of conservation of energy.
5. Define entropy.
6. What is autoradiography?
7. What is Median.
8. Explain the acronym INFLIBNET.
9. Mention the applications of MOOCS.
10. How is wet lab different from web lab .

(1 x 10 = 10 Marks)

SECTION – B

Answer any 8 questions. Each question carries 2 marks. (Answer not to exceed one paragraph).

11. Explain electron microscopy.
12. Give a note on correction of vision faults.
13. Explain chemi osmotic hypothesis.
14. Give an account of polarimetry.
15. Write a short note on X-ray crystallography.
16. What are the types of molecular interactions? Explain with an example.
17. Principle of flamephotometry.
18. How CLUSTAL becomes an indispensable tool in bioinformatics.
20. Write about fluorescence and phosphorescence.
21. Give an account of SEM.
22. Write notes on SWISS –PROT.

(2 x 8 = 16 Marks)

SECTION – C

Answer any 6 questions. Each question carries 4 marks. (Answer not to exceed 120 words).

23. Write a note on AAS
24. Explain Law of Conservation of energy.
25. Give a detailed account on principle and types of Centrifugation.
26. Brief note on Chi square test
27. Explain the principle and functioning of pH meter.
28. List out the uses of internet
29. Briefly explain phase contrast microscopy.
30. Describe the functioning and uses of spectrophotometer.
31. Give an account of Muffle Furnace

(4 x 6 = 24 Marks)

SECTION – D

Answer any 2 questions. Each question carries 15 marks. (Answer not to exceed three pages).

32. Write in detail about the types and uses of Electron microscopy.
33. Give an account of different biological databases
34. Explain the applications of IT in science
35. Describe electrophoresis. Give a note on types of electrophoresis.

(2x15=30 marks)

**B. SC. DEGREE BOTANY & AYURVEDIC PHARMACY (DOUBLE MAIN)
SEMESTER III
MAIN I- BOTANY
BP1331 : PHYCOLOGY, MYCOLOGY, LICHENOLOGY AND PLANT PATHOLOGY**

Time : 3 Hours

Max. Marks: 80

SECTION – A

Answer all the questions in a word or one to two sentences. Each question carries one Mark. Draw diagrams wherever necessary.

1. What is a coenobium?
2. Mention the types of pigments in Phaeophyceae.
3. What are clamp connections?
4. What are the cell wall constituents present in fungi?
5. Why Lichens are considered as bioindicators?
6. Point out the composition of Bordeaux mixture.
7. Name the diploid stages in the life cycle of *Polysiphonia*.
8. Comment on the type of septum in basidiomycotina.
9. Name a heteroecious fungus.
10. What is a gonidium? **(1 x 10 = 10 marks)**

SECTION – B

Answer any eight questions. Each question carries 2 marks. (Answer not to exceed one paragraph)

11. Mention the mode of branching in *Cladophora*.
12. What are the nodal appendages found in *Chara*?
13. Specify the structure of fruit body in *Xylaria*.
14. Describe the methods of asexual reproduction in *Penicillium*.
15. What are auxospores? Mention their significance.
16. Briefly mention the thallus organization of a Lichen.
17. Mention the name of pathogen, symptoms and control measures of root wilt of pepper.
18. How the zoospores of *Oedogonium* and *Vaucheria* differ from each other?
19. Why *Chlorella* is used in space trips?
20. Differentiate aplanospore and chlamyospore.
21. Write on affinities of bacteria and cyanophyceae.
22. Discuss the economic importance of yeasts. **(2 x 8 = 16 Marks)**

SECTION – C

Answer any six questions. (Answer not to exceed 120 words). Each question carries 4 marks)

23. Describe the mode of reproduction in *Sargassum*.
24. With the help of labeled diagram, explain sexual reproduction in *Rhizopus*.
25. Differentiate macrandrous and nannandrous species of *Oedogonium*.
26. Give an account on economic importance of fungi.
27. Discuss the types of thallus organization in chlorophyceae.
28. Compare Acomycotina and basidiomycotina.
29. Give an account on thallus structure and mode of reproduction in *Nostoc*.
30. Describe the mode of reproduction in *Usnea*.
31. Explain the host-parasite interaction in pathological conditions **(4 x 6 = 24 Marks)**

SECTION – D

Answer any two questions. (Not more than three pages). Each question carries 15 Marks

32. Describe the structure and reproduction of *Polysiphonia*. Write notes on the type of life cycle.
33. With the help of diagrams, explain the life cycle of *Puccinia*.
34. Give an outline of the classification of Fungi by Ainsworth. Briefly mention the evolutionary trends among major groups.
35. What are fungicides? Give an account on the types of fungicides and their mode of action on pathogens.

(2 x 15 = 30 Marks)

B. SC. DEGREE IN BOTANY & AYURVEDIC PHARMACY (DOUBLE MAIN)
SEMESTER III
MAIN I- BOTANY
BP 1332 : Horticulture, Mushroom Cultivation and Marketing

Time : 3 Hours

Max. Marks : 80

SECTION -A

Answer all questions in a word or one or two sentences. Each question carries 1 mark. Draw diagrams only if specified in the question.

1. What is the binomial of Common milky mushroom?
2. Define steeping.
3. What is approach grafting?
4. Expand NPK.
5. What is a bonsai?
6. What is Spawning?
7. What is a trophy?
8. What are foliar sprays?
9. Name a rooting hormone.
10. What is the optimum pH for preparing button mushroom compost?

(1 x 10 = 10 marks)

SECTION - B

Answer any 8 questions. Each question carries 2 marks. Answer not to exceed one paragraph.

11. List out four poisonous mushrooms with binomial name.
12. Write a short account on Ikebana.
13. What is hydroponics? Mention the advantages.
14. Draw a labelled diagram of the basidiocarp of *Agaricus bisporus*.
15. What is vermicompost?
16. Describe the commercial importance of parthenocarpy.
17. Comment on the medicinal and nutritional value of Oyster mushroom.
18. What are roof gardens? Mention the components.
19. Describe T Budding with diagrams.
20. Describe the polythene bag cultivation method of mushrooms.
21. Comment on Olericulture.
22. Give the details of any two diseases of Mango.

(2 x 8 = 16 marks)

SECTION - C

Answer any six of the following. (Answer not to exceed 120 words). Each question carries 4 marks.

23. Give an account of Paddy straw mushroom substrate preparation methods..
24. Describe the chemical control of insect pests.
25. Differentiate biofertilizers and chemical fertilizers.
26. Describe the various irrigation methods used for gardening.
27. Write notes on spawn making.
28. Give an account on the practical uses of Gibberellins in Horticulture.
29. Describe the methods of preservation of vegetables.
30. Comment on the production level and economic return of mushroom cultivation in India.
31. Write a brief account on garden tools and implements.

(4 x 6 = 24 marks)

SECTION - D

Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.

32. Write an essay on processing and storage of mushrooms.
33. What is layering? With neat labelled diagrams describe the various methods of layering.
34. Write detailed notes on white button mushroom cultivation. Add notes on its harvesting methods.
35. Explain the various methods of landscaping a garden.

(15 x 2 = 30 marks)

**B. SC. DEGREE IN BOTANY & AYURVEDIC PHARMACY (DOUBLE MAIN)
SEMESTER IV
MAIN I- BOTANY
BP 1431 BRYOLOGY, PTERIDOLOGY, GYMNOSPERMS & PALEOBOTANY**

Time : 3 Hours

Max. Marks : 80

SECTION -A

Answer all questions in a word or one or two sentences. Each question carries 1 mark. Draw diagrams only if specified in the question.

1. What is the common name for *Equisetum*?
2. Define Diploxylic condition.
3. Name the class to which *Riccia* belongs.
4. What is meant by heterospory?
5. Give an example for a fossil pteridophyte.
6. What is a synangium?
7. What are sporocarps?
8. What is indusium?
9. What are gemmae?
10. Define plectostele.

(1 x 10 = 10 marks)

SECTION – B

Answer any 8 questions. Each question carries 2 marks. Answer not to exceed one paragraph.

11. Comment on the features of assimilatory zone of *Riccia*.
12. Briefly describe the physiological changes associated with senescence.
13. Describe the anatomical features of *Psilotum* stem.
14. Mention any four morphological features of *Equisetum*.
15. Differentiate perigynium and perichaetium.
16. Explain thallus morphology of *Marchantia*.
17. What are girdle traces?
18. Briefly describe the structure of pollen grain of *Pinus*.
19. Describe the morphology of Rhizophore.
20. Explain the hydrophytic anatomical features of *Marselia* stem.
21. Mention any four affinities of gymnosperms to pteridophytes.
22. Write a brief account on carbon dating technique.

(2 x 8 = 16 marks)

SECTION –C

Answer any six of the following. (Answer not to exceed 120 words). Each question carries 4 marks.

23. Describe the structure of sporophyte of *Marchantia*.
24. Explain the anatomical features of *Funaria* stem.
25. Discuss the mechanism of fossil formation.
26. Mention the structure of *Pteris* sporophyll.
27. Why *Gnetum* is considered as an advanced Gymnosperm?
28. Give an account of the types of steles in species of *Lycopodium*.
29. Explain the anatomical features of *Cycas* leaflet.
30. Discuss the economic importance of Gymnosperms.
31. Explain the structure of *Lyginopteris*. **(4 x 6 = 24 marks)**

SECTION - D

Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.

32. Explain the general characters of Bryophytes and give an outline of the classification of Bryophytes.
33. Describe the life cycle of *Selaginella*. Why is it considered as forerunner of seed plants?
34. Discuss affinities of Gymnosperms to other groups of plants.
35. Discuss the objectives of Paleobotany and give an account of the techniques of fossil study. **(15 x 2 = 30 marks)**

**B. SC. DEGREE IN BOTANY & AYURVEDIC PHARMACY (DOUBLE MAIN)
SEMESTER IV
MAIN I- BOTANY**

BP 1432- Cell Biology, Plant Breeding & Evolutionary Biology

Time : 3 Hours

Max. Marks : 80

SECTION - A

Answer all questions in a word or one or two sentences. Each question carries 1 mark. Draw diagrams only if specified in the question.

1. What are histones?
2. What is meant by euploidy?
3. Why lysosomes are called suicidal bags?
4. What is kinetochore?
5. Mention the names of agencies involved in plant introduction in India.
6. What is meant by composite variety?
7. Define a pureline.
8. Any two examples for inter generic hybrids.
9. What is genetic drift?
10. Who proposed use and disuse theory?

(1 x 10 = 10 marks)

SECTION - B

Answer any 8 questions. Each question carries 2 marks. Answer not to exceed one paragraph.

11. Differentiate heterochromatin and euchromatin.
12. Briefly mention the events during interphase.
13. What is synaptonemal complex? Mention its significance.
14. Differentiate paracentric and pericentric inversion.
15. How autopolyploids differ from allopolyploids?
16. Why deletions are considered as more deleterious than duplications?
17. Discuss the type of mutagens used in plant improvement.
18. What are B chromosomes? How they behave during cell division?
19. Mention the chemical composition of cell membrane.
20. What are peroxisomes? Comment on their functions.
21. Differentiate parallel and convergent evolution.
22. What is meant by quarantine? Point out its significance.

(2 x 8 = 16 marks)

SECTION - C

Answer any six of the following. (Answer not to exceed 120 words).

Each question carries 4 marks

23. Write an account on different phases of cell cycle.
24. How clonal selection differs from other selection methods?
25. Give an account on micro and macro evolution.
26. Explain the types of aneuploids and point out their cytological features.
27. With the help of relevant sketches, outline the events during Prophase I.
28. Explain the types of isolation mechanisms and point out their evolutionary significance.
29. Discuss the steps and principles of resistance breeding.
30. Describe the structure of Lamp brush chromosome. How it differs from a normal chromosome?
31. Explain Neo-Darwinism.

(4 x 6 = 24 marks)

SECTION - D

Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.

32. With the help of diagrams, explain the types of structural aberrations in chromosomes. Point out the evolutionary significance of each.
33. Explain the various forces operating in evolutionary process. Illustrate with examples and evolutionary principles.
34. Explain heterosis and mention how is it exploited by plant breeders?
35. Give an account on ultra structure and functions of cell components and organelles.

(15 x 2 = 30 marks)

**B. SC. DEGREE IN BOTANY & AYURVEDIC PHARMACY(DOUBLE MAIN)
SEMESTER V
MAIN I- BOTANY**

BP 1531- Economic Botany, Ethnobotany & Forestry

Time : 3 Hours

Max. Marks : 80

SECTION - A

Answer all questions in a word or one or two sentences. Each question carries 1 mark. Draw diagrams only if specified in the question.

1. Mention the binomial of cotton.
2. What are gourd vegetables?
3. Point out the binomial of any two plants used by tribes for shelter.
4. What is a totem plant?
5. Mention the binomial of Tapioca.
6. Who coined the term ethnobotany?
7. Why neem is used as insecticide?
8. What are multipurpose trees
9. What is shellac
10. Define sacred plants

(1 x 10 = 10 marks)

SECTION - B

Answer any 8 questions. Each question carries 2 marks. Answer not to exceed one paragraph.

11. Briefly mention the scope of pharmacognosy.
12. Describe in brief the principle of Acupuncture.
13. Mention the types of extraction methods in separation of herbal drugs.
14. What are folk medicines?
15. Comment on the medicinal value of Asoka
16. Point out the crude drugs obtained from corms.
17. Define ethnobotany.
18. Differentiate between homogenous and heterogenous wood
19. Mention the ethnobotanical significance of Aegle.
20. Give the binomial of any two dye yielding plants.
21. What is shifting cultivation?
22. Give the names of any two tribes in Kerala.

(2 x 8 = 16 marks)

SECTION -C

Answer any six of the following. (Answer not to exceed 120 words). Each question carries 4 marks

23. Comment on ethnobotanical significance of *Ficus religiosa*.
24. Why ethnobotany is regarded as interdisciplinary? Illustrate with reasons.
25. Mention the binomial, family and morphology of pepper and cardamom.
26. Differentiate cereals and millets . Give binomials for each.
27. Discuss the significance of sacred groves.
28. What is meant by drug adulteration? Comment on adulterants.
29. Discuss the relevance of wood anatomical studies
30. Explain the importance of evergreen and deciduous forests
31. Give an account of timber forest products

(4 x 6 = 24 marks)

SECTION - D

Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.

32. Explain the methods of cultivation of Paddy.
33. Discuss the various methods of collection of ethnobotanical data. Add a note on significance of ethnobotanical studies.
34. Give an account on the plants used by tribes. Mention the strategies for preservation and management of plant resources by tribes.
35. Describe in detail the common fruits and vegetables of Kerala. Mention their binomial and uses.

(15 x 2 = 30 marks)

**B. SC. DEGREE BOTANY & AYURVEDIC PHARMACY (DOUBLE MAIN)
SEMESTER V
MAIN I- BOTANY**

BP 1532 Angiosperm Morphology & Systematic Botany

Time: 3 Hours

Max. Marks: 80

SECTION - A

Answer all questions in a word or one or two sentences. Each question carries 1 mark. Draw diagrams only if specified in the question.

1. Name the family having lateral style.
2. What are the symbols used in a floral formula?
3. Point out any two contributions of Carolus Linnaeus.
4. What is a labellum?
5. Mention the binomial of any two pulses.
6. Name a family having petaloid staminodia.
7. What is OTU?
8. Differentiate simple raceme and spike.
9. What is resupination?
10. Name the order to which Apocynaceae belongs.

(1 x 10 = 10 marks)

SECTION - B

Answer any 8 questions. Each question carries 2 marks. Answer not to exceed one paragraph.

9. Differentiate hypogyny and epigyny.
10. Describe in brief the type of corolla in Papilionoideae.
11. Mention the types of roots in Orchidaceae.
12. Compare the gynoecium of Solanaceae and Acanthaceae.
13. Why Annonaceae is placed under Ranales?
14. Point out the economic importance of Rutaceae.
15. Discuss the floral characters of Euphorbiaceae.
16. Briefly mention adnation in solanaceae.
17. Comment on APG system of classification.
18. What difference do you notice in the corona of Asclepiadaceae and Apocynaceae?

19. What is a syconus?
20. What is meant by translator mechanism? Point out its significance.

(2 x 8 = 16 marks)

SECTION -C

Answer any six of the following. (Answer not to exceed 120 words). Each question carries 4 marks.

21. Describe the morphology of tendril in Cucurbitaceae.
22. Discuss the features of special types of inflorescence.
23. Evaluate the basic principles of cytotaxonomy.
24. Explain the type of inflorescence and floral characters of Poaceae.
25. Compare and differentiate the subfamilies of Leguminosae.
26. Discuss the basic rules of ICBN.
27. Discuss the types of placentation in angiosperms.
28. Outline the basics of molecular taxonomy.
29. Why Poaceae is regarded as an advanced family?

(4 x 6 = 24 marks)

SECTION - D

Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.

30. Explain the principles and steps in preparation of herbarium. Point out the significance of herbaria.
31. Discuss the various systems of classification. Compare and differentiate natural and phylogenetic systems.
32. Give an outline of the vegetative and floral characters of Lamiaceae. Discuss its advanced features.
33. Write an essay on various types fruits you have studied.

(15 x 2 = 30 marks)

**B. SC. DEGREE BOTANY & AYURVEDIC PHARMACY (DOUBLE MAIN)
SEMESTER VI
MAIN I - BOTANY
BP 1631 GENETICS & BIOTECHNOLOGY**

Time : 3 Hours

Max. Marks : 80

SECTION - A

Answer all questions in a word or one or two sentences. Each question carries 1 mark. Draw diagrams only if specified in the question.

1. What is meant by test cross?
2. Define a pureline.
3. What are allelomorphs?
4. What is meant by split genes?
5. Give an example for sex linked inheritance.
6. What are plasmagones?
7. Define totipotency
8. What are cybrids
9. Give the genotypic and phenotypic ratios in monohybrid incomplete dominance.
10. Mention the first law of Mendel.

(1 x 10 = 10 marks)

SECTION - B

Answer any 8 questions. Each question carries 2 marks. Answer not to exceed one paragraph

11. Comment on non-epistatic interaction.
12. Briefly describe the principle of recessive epistasis.
13. What are the possible blood groups among offsprings of a marriage between O group man and AB group woman.
14. Mention any four characters studied by Mendel in *Pisum sativum*.
15. Differentiate multiple alleles and multiple genes.
16. What is meant by cryopreservation.
17. What are Complementary genes? Mention how it differs from Mendelian dihybrid ratio.
18. Give two examples for sex chromosomal abnormalities in Man.
19. Give an account of somatic embryogenesis.

20. Point out the types of chemical bonds in a DNA molecule.
21. Mention the role of sigma factor.
22. Write a brief account on synthetic seeds.

(2 x 8 = 16 marks)

SECTION - C

Answer any six of the following. (Answer not to exceed 120 words). Each question carries 4 marks.

23. Differentiate complementary gene action from supplementary gene action.
24. Explain suspension culture.
25. Discuss the mechanism of inheritance of skin color in man.
26. Mention the structure of t- RNA. Point out its function.
27. What is meant by linkage? How it influences independent assortment?
28. Give an account of various gene transfer mechanisms in plants.
29. Differentiate quantitative and qualitative characters on basis their pattern of inheritance.
30. Discuss the properties of genetic code.
31. Explain Central dogma and critically evaluate it on basis of Teminism.

(4 x 6 = 24 marks)

SECTION - D

Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.

32. Explain the types of inter allelic genetic interaction.
33. Describe the salient features of jumping genes and point out the mechanism of transposition.
34. Discuss the mechanisms involved in DNA repair.
35. What is PCR ? Discuss basic steps and its application

**B. SC. DEGREE IN BOTANY & AYURVEDIC PHARMACY (DOUBLE MAIN)
SEMESTER VI
MAIN I- BOTANY**

BP 1632 Plant Physiology

Time : 3 Hours

Max. Marks : 80

SECTION - A

Answer all questions in a word or one or two sentences. Each question carries 1 mark. Draw diagrams only if specified in the question.

1. What is Kranz anatomy?
2. Define chemosynthesis.
3. Why cytochrome a_3 is called terminal oxidase?
4. Represent the overall equation of photosynthesis.
5. Cite two examples for C4 plants.
6. What is meant by thigmotropic movement?
7. What is tonicity?
8. Why the rate of photosynthesis decreases beyond 690nm?
9. What is incipient plasmolysis?
10. How the stomata of CAM plants differ from that of C3 plants?

(1 x 10 = 10 marks)

SECTION - B

Answer any 8 questions. Each question carries 2 marks. Answer not to exceed one paragraph.

11. Give an account on raw materials of photosynthesis.
12. Briefly describe the physiological role of Absciscic acid in plants.
13. Differentiate apoplast and symplast.
14. How root pressure influences water movement in plants?
15. Define red drop. How it can be compensated?
16. Explain the physiology of senescence.
17. Discuss the concept of florigen.
18. Briefly describe the relation between OP, TP and WP in plants.
19. Comment on hydroponics.
20. Differentiate absorption spectrum and action spectrum.

21. Why fluorescent radiation has higher wavelength than phosphorescent radiation?
22. Point out the differences between photosynthesis in bacteria and higher plants.

(2 x 8 = 16 marks)

SECTION - C

Answer any six of the following. (Answer not to exceed 120 words). Each question carries 4 marks

23. Describe the vital and physical theories explaining ascent of sap.
24. How the principle of Limiting factors apply in photosynthesis?
25. Give an account on coenzymes and cofactors.
26. Explain how the relative day length influences flowering in plants?
27. Discuss the physiological consequences of water stress in plants.
28. Explain the mechanisms of mineral absorption in plants.
29. How anaerobic respiration differs from aerobic in terms of ATP yield?
30. Discuss the mechanism of photorespiration. Enumerate its advantages and disadvantages
31. Explain biological nitrogen fixation.

(4 x 6 = 24 marks)

SECTION - D

Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.

32. Discuss the various types of stomata and the mechanisms in stomatal movement.
33. Explain dark reaction and compare the photosynthetic mechanisms in C₃ and CAM plants.
34. Discuss various types of movements exhibited by plants.
35. Give an account on structure, classification and nomenclature of enzymes.

(15 x 2 = 30 marks)

Core course: Botany
Model Practical Question Papers

UNIVERSITY OF KERALA
Botany & Ayurvedic pharmacy practical Examination
BP 1232-PRACTICAL BOTANY – I
(Microtechnique, Angiosperm Anatomy, Reproductive botany, Palynology,
Methodology of Science & Bio instrumentation)

Time: 3 hours

Maximum Marks: 80

1. Make a suitable micropreparation of **A** and **B**. Draw a labelled cellular diagram of each. Identify giving reasons. Leave the preparation for valuation.
 (Preparation-3; Identification-1; Reasons-4; Labelled diagram-4) **12x2=24 Marks**

2. Work out the Problem C **10 Marks**

3. Identify the type of stomata in specimen **D**.
 (Identification- 1, Diagram 2, Reason - 2) **5 Marks**

4. Identify the ecological group of specimen **E**. (Ecological group- 1 marks; Adaptations- 3 marks) **4 Marks**

5. write notes on **F and G** **4 Marks**

6. Identify and describe the type of cellular inclusion in specimen **H**
 (Identification- 1, Description-2, Diagram - 2) **5 Marks**

7. Identify **I** and draw a neat labelled diagram
 (Identification- 1, Diagram – 2, Description - 2) **5 Marks**

8. Comment on **J**
 (Major group – 1, Notes – 2) **3 Marks**

RECORD = 20 Marks (Content – 15 Marks; Neatness – 5 Marks)

GRAND TOTAL: 80 Marks

UNIVERSITY OF KERALA
Botany & Ayurvedic Pharmacy practical Examination,
BP 1232-PRACTICAL BOTANY – I
(BP1131 & BP1231)

KEY TO SPECIMENS

- I. **A-** Primary structure of
 Monocot stem (*Grass, Asparagus* or any normal type)
 Monocot root (*Colocasia* or any normal type)
 Dicot Stem – *Hydrocotyle, Eupatorium* or any normal type, Bicollateral (*Cephalandra*)
 Normal Secondary-structure of Dicot Stem *Vernonia* or any normal type.
 Dicot Root *Cariea papaya, Tinospora* or any normal type.

- B.** Anomalous secondary thickening – *Bignonia, Boerhaavia, Dracaena*

2. **C. Problem from Biostatistics.**

3. **D -** Any type of stomata mentioned below (Anamocytic, Anisocytic, Paracytic, Diacytic).

4. **E -** Ecology material – *Hydrilla, Velamen root, Nerium leaf*

5. **F and G- Biophysics Instruments**

6. **H-** Starch grain/Raphide/Cystolith/Aleurone grain etc. mentioned in the syllabus. Permanent slides can be used. Diagrams should be avoided.

7. **I.** Anther T.S./Dicot embryo L.S./Monocot embryo L.S. Permanent slides can be used. Diagrams should be avoided.

8. **J.** Any one of the below. Fixative (FAA and Carnoy's Fluid), Stain (Acetocarmine, Saffranin, Haematoxylin), Mounting medium (Canada balsam, DPX).

Valuation of Records

Students should submit a Practical record duly certified by the Teacher in charge and Head of the Department. (**Content – 15 Marks; Neatness – 5 Marks**)

Record - 20 marks

UNIVERSITY OF KERALA
BOTANY & AYURVEDIC PHARMACY
 Semester III & IV: Main I-Botany Practical Examination,
BP1433 PRACTICAL BOTANY II
(BP1331, BP1332, BP1431 & BP1432)

Time: 3 hours

Maximum Marks: 80

1. Make an acetocarmine squash preparation of material **A**. Identify metaphase or anaphase with diagram and reasons.
Preparation 3, Identification 1, Labelled sketch 2, Reasons 2 **8 Marks**

2. Prepare T.S. of materials **B, C and D**. Identify giving reasons. Draw a labelled diagram and leave the preparation for valuation.
Preparation 2, Identification 1, Labelled sketch 3, Reasons 2 **8x3=24 Marks**

3. Demonstrate T-budding/Air layering/Grafting/Emasculation using material **E**. Submit for Valuation.
Demonstration 3, Protocol 1 **4 Marks**

4. Identify and write notes on **F & G**
Identification 1, Notes 3 **4x2=8 Marks**

5. Identify the disease in plant specimen **H** and give the name of the causative pathogen along with the important symptoms associated with it.
(Disease - 1, Pathogen - 1, Symptoms - 2) **4 Marks**

6. Spot at sight **I, J, K and L**
(Genus name- 1, Part of the plant - 1, Major Group- 1) **4 x 3 = 12 Marks**

TOTAL FOR PRACTICAL EXAM =60 Marks

RECORD =20 Marks (Contents 15; Neatness 5)

GRAND TOTAL 60+20=80 Marks

BOTANY & AYURVEDIC PHARMACY
Semester III & IV: Botany BP 1433
PRACTICAL BOTANY II
(BP1331, 1332, 1431 & 1432)

KEY TO SPECIMENS

1. **A** – Onion root tips to be provided by the centre.
2. **B** - Algae/Fungi (*Sargasum* Stipe, *Xylaria*, *Peziza*, *Puccinia* telial stage, *Agaricus* gill, *Cercospora*).

C - Pteridophytes (*Psilotum* stem, *Selaginella* - Rhizophore and stem, *Equisetum* Stem, *Pteris* - petiole and sporophyll, *Marselia* - Rhizome and Petiole)

D - Bryophytes/Gymnosperms (*Riccia* Thallus, *Marchantia* thallus, *Cycas* - leaflet, Coralloid root and Rachis, *Pinus*- Needle and Old stem).
3. **E**- T- budding/ Air layering/grafting/Emasculation – Required materials to be provided by the centre.
4. **F**- Horticulture- (Material/ Photograph/ Garden tools)

G- Mushroom – (Fresh specimens / Photograph)
5. **H**. Plant pathology
6. **I** -Algae mentioned in the syllabus (Macro or Micro)
J- Fungi/Lichen (Macro or Micro)
K- Bryophyte/Paleobotany
L- Pteridophyte/Gymnosperm

Valuation of Records

Students should submit a practical record duly certified by the Teacher in charge and Head of the Department.

UNIVERSITY OF KERALA
**First Degree Programme under CBCSS BOTANY AND
 AYURVEDIC PHARMACY**
Semester VI
BP 1633: Practical Botany III
(BP1531, BP1532, BP1631 & BP1632)

Time: 3 hours

Max.: 80 marks

1. With a labelled diagram, explain the working of experiment **A**.
 (Aim-1; Working -2; Labelled diagram-2) [5 marks]

2. Describe the specimen **B** in technical terms. Draw labelled diagram of the L.S. of flower.
 Construct a floral diagram and write the floral formula.
 (Description-2; Labelled diagram-2; Floral diagram-2; Floral formula-1) [7 marks]

3. Refer the specimens **C** and **D** to their respective families, pointing out the class, subclass and series with reasons.
 (Reasons up to series-3; Family characters-2; Identification-1) [6x2=12 marks]

4. Work out the problems **E** (3 marks) and **F**.(5 marks) [3+5=8 marks]

5. Write the binomial and family of the given specimens **G** and **H**.
 (Binomial-1; Family-0.5) [1.5 x 2 = 3 marks]

6. Identify the specimen **I** and write notes with labelled diagram.
 (Identification-1; Notes: 1; Labelled diagram-1) [3 marks]

7. Write the binomial, family, morphology of the useful part and uses of the specimens **J** and **K**.
 (Binomial-1; Family - 0.5; Morphology of the useful part- 0.5; Uses-1) [3 x 2 = 6 marks]

8. Spot at sight **L, M, N & O**.
 (Binomial-1; Family-0.5) [1.5 x 4 = 6 marks]

9. Herbarium [7 marks]

10. Field book and Tour report [2+1=3 marks]

11. Record (Content-15; Neatness-5) [20 marks]

Semester VI
BP 1633: Practical Botany III
KEY TO SPECIMENS

- A : Plant physiology experiments mentioned in the syllabus
- B : Flowers and buds from Polypetalae/Gamopetalae
- C : Gamopetalae
- D : Polypetalae/Monochlamydeae
- E : Genetics problem- Monohybrid / Incomplete dominance
- F : Genetics problem- Dihybrid / Gene interactions
- G & H : Herbarium sheets
- I : Morphology (Inflorescence or fruits mentioned in the syllabus)
- J & K : Economic botany
- L & M : Ethnobotany
- N & O : Instruments or glass wares used in Biotechnology

MODEL QUESTIONS

MAIN II

AYURVEDIC PHARMACY

B.Sc. Botany and Ayurveda Pharmacy Examination
SEMESTER I
Main II- Ayurveda Pharmacy
BP 1141: Introduction to Ayurveda Drug Development

Time : 3hrs

Marks : 80

Section A

Answer all. Each question carries 1 mark.

1. Write *Panchahbootha*.
2. Define *Dravya*.
3. Write the *sapthapadartha* of *Dravya*.
4. Define Ayurveda.
5. Full form of CCRAS
6. What is the full form of GACP?
7. Write the useful parts of *Bilva*.
8. Write the Two synonyms of *Yashtimadhu*.
9. Write the Botanical Name & family of *Jatamansi*
10. Write the type of *Desa*.

(10x1=10 marks)

Section B

Answer any eight. Each question carries 2 marks.

11. What is Ayurvedic pharmacopoeia of India?
12. Define *Dravyaguna sastra*.
13. Define *Swastha*.
14. Define *Vipaka*
15. Write the Habit *Bakuchi & Kalmegh*
16. Write the useful parts of *Katuki & Punurnava*
17. Write the Two synonyms of *Danti & Kumari*
18. Write the indication of *Varun*
19. Write the useful parts of *chandana & karpura*
20. Write the botanical name and family of *Hareethakiand Hingu*
21. Write the habit of *jatiphala & Nili*
22. Write the indications of *gulggulu and Haridra*

(8x2=16 marks)

Section C

Each question carries 4 marks. Answer any four.

23. Write short note on *Samskara*
24. Describe *Tridosha sidhantha*.
25. Write short note *Bhavaprakasha nighantu*
26. Briefly describe the nomenclature & identification of drugs in Ayurveda.
27. Describe *Bheshajagara*

28. Write *Panchabouthikatwa of Dravya*
29. Write the concept of drug formulation
30. Write the macroscopic description of plant part, fruit. (6x4=24marks)

Section D

Answer any two of the questions.

31. Describe *Dravya sangrahanavidhi* (collection of crude drug) with respect to GACP guideline.
32. Define *Sodhana*. Describe the types of *Sodhana* with examples
33. Define Adulteration, Describe the types of Adulteration, write the methods of detection of Adulteration
34. Describe the macroscopic description any three plant parts of crude drug with example (15x2=30)

BSc Botany and Ayurvedic Pharmacy Degree Examination**SEMESTER II****Main II Ayurvedic Pharmacy****BP 1241: BIOCHEMISTRY, ANIMAL PHYSIOLOGY and ANATOMY****Time 3 hours****Total Marks 80****SECTION A****Very short answer type. Maximum two sentences. Answer all. (10x1=10 marks)**

1. What are nephrons?
2. What is sanguivory?
3. Define tachycardia?
4. Expand ADH.
5. What do you mean by open circulation?
6. Name the protein present in bones.
7. What are Zwitterions?
8. Name the hormone that promotes absorption of calcium from intestine.
9. What is an O-glycosidic linkage?
10. Comment on sphingolipids?

SECTION B**Short answer questions. Not exceed in one paragraph. Answer any eight. (8x2 = 16 marks)**

11. Write a note on Blood Grouping.
12. What is the role of liver in the metabolism of fats?
13. What are neurotransmitters? Give example.
14. Explain spermatogenesis.
15. Explain ureotelism with one example.
16. Define pulmonary respiration.
17. Define amniocentesis.
18. Describe competitive inhibitor.
19. Explain anomers with examples.
20. What are lacteals? Mention its functions.
21. What is the difference between amylose and amylopectin?
22. What are co-enzymes? Give an example.

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SECTION C

Short essay. Not to exceed 120 words. Answer any six. (6x4=24 marks)

23. With the help of a labelled diagram describe the digestive system.
24. Explain the structure and functions of skin.
25. Explain the various mechanisms involved in the absorption of digested food
26. Mention the hormones of the pituitary glands and their function.
27. What is uterine cycle? Explain. Explain cardiac cycle.
28. Describe the IUB system of classification of enzymes.
29. Explain the classification of carbohydrates with examples.
30. Describe the IUB system of classification of enzymes.

SECTION D

Long essay. Answer any two questions. (2x15=30 marks)

31. Give a detailed structure of human heart. Explain the functioning
32. Write an essay on the mechanism of transmission of nerve impulses.
33. Explain the physiology of urine formation.
34. Write an essay on the four levels of structural organizations in proteins. Add a note on the bonds stabilizing each structure.

MODEL QUESTION PAPER
THIRD SEMESTER B. Sc. DEGREE (CBCSS) EXAMINATION
SEMESTER III
Main II : Botany and Ayurvedic Pharmacy
BP 1341- Pharmacognosy

Time : 03 Hours

Max. Marks :80

SECTION A

I. Answer all questions in one word or one sentence. Each question carries one Mark.

1. Name two drugs extracted from root.
2. Give the taxonomical family of “Kumari”
3. State the pharmacological importance of *Senna*
4. Give the morphology of *Nirgundee*
5. Define adulteration.
6. Name binomial of Brahmi.
7. Name two synthetic drugs.
8. Give one oleo gum resin used as Ayurvedic drug.
9. What is the ecologic significance of *Chandana*.
10. State the binomial of an anticancerous drug.

(10 X 01 = 10)

SECTION B

II. Answer any eight questions, not to exceed a paragraph. Each question carries two marks.

11. Describe antiseptic properties of *Curcuma*.
12. Evaluate medicinal properties of Ghee.
13. Give pharmaceutical significance of Starch.
14. State three milk products that have pharmaceutical properties.
15. Give binomial and taxonomic family of Neeli.
16. Evaluate castor oil as an ayurvedic drug.
17. Give binomial, family and morphology of Nirgundee’s source plant.
18. State difference between Clove and Nutmeg.
19. Differentiate between organized and unorganized drugs.
20. Give the significance of tubers as drug.
21. Give morphological characters of Haridra.
22. State *Gymnema* as an antidiabetic drug.

(08 X 02 = 16)

SECTION C**III. Answer any six questions, not to exceed 120 words. Each question carries four marks.**

23. Describe two drugs acting on nervous system.
24. Evaluate medicinal properties of bee wax.
25. Give significance of Pharmacopoeial standards.
26. Evaluate the significance of chemotaxonomy in pharmacognosy.
27. Describe medicinal properties of Honey and Bee wax.
28. Describe botanical description of Amaravalli.
29. What is Digitalis and Arjuna.
30. Evaluate microscopic and macroscopic properties of Twak patra.

(04 X 06 = 24)**SECTION D****IV. Write essay on any two of the following, not more than three pages. Each question carries 15 marks.**

31. Explain the classification of drugs.
32. Evaluate the history, evolution and significance of Ayurvedic pharmacology in India.
33. Explain organoleptic evaluation, chemical constituents and therapeutic efficacy of different Carminatives & G.I. regulators.
34. Give a detailed comparative account of “Musali”, “Akshota” and “Vrikshamla” special reference to their Botanical description, morphology of the useful part and medicinal properties.

(02 X 15 = 30)

B.Sc. Botany and Ayurveda Pharmacy Degree Examination**SEMESTER III****Main II Ayurvedic Pharmacy****BP1342 PHARMACEUTICAL ANALYSIS****Time : 3 Hours****Max Marks : 80****SECTION A****Answer all the questions in a word or one or two sentences. Each question carries one mark.**

1. Name the chemical used for testing fixed oil in a specimen.
2. Expand ppm.
3. What are Sieves?
4. Define the term foreign matter, in a preparation?
5. What is Rf Value?
6. What is microbial limit test?
7. What is unsaponifiable matter?
8. Define the term, "rancidity"?
9. Define the term RIA.
10. What are aflatoxins?

(1 x 10 = 10 Marks)**SECTION B****Answer any 8 questions.****(Answer not to exceed one paragraph).**

11. Write short note on moisture content analysis.
12. Write a note on Nessler cylinders.
13. What are the benefits of using supercritical fluid extraction method?
14. Is high iodine value good or bad. Substantiate your answer.
15. Write a note on tests for cardiac glycosides.
16. Write notes on maceration of tissues.
17. Explain the difference between volatile oils and fixed oils?
18. Write the names of any two spraying agents used in TLC for identification of phyto constituents?
19. Differentiate fluorescence from phosphorescence?
20. Describe the method of preparation of standard stock solutions.
21. Write a note on microwave assisted extraction.
22. What are pesticide residues? How are they determined?

(2 x 8 = 16 Marks)

SECTION C**Answer any 6 questions.****(Answer not to exceed 120 words).**

23. Describe the methods used for the analysis of stem in crude drug formulations.
24. What are saponins? How is foaming index detected in herbal extracts?
25. Explain the extraction of volatile oils from plants?
26. Define and classify the term extractive value.
27. What are the different chromatographic techniques adopted for the standardization of herbal drugs?
28. Explain the applications of X-ray diffraction ?
29. What is swelling index? How is it detected in herbal material?
30. Differentiate between infusion and decoction.
31. Explain the estimation of sodium by flame photometry.

(4 x 6 = 24 Marks)**SECTION D****Answer any 2 questions.****(Answer not to exceed three pages).**

32. Explain the estimation of total alkaloids, flavonoids, phenolics, saponins and tannins in plant extracts?
33. Describe the process of heavy metal detection by Atomic Absorption Spectrophotometry.
34. Explain different chromatographic techniques used for the standardisation of herbal drugs.
35. Define limit test. Explain the principle and procedure involved in the limit test of arsenic and lead.

(2 x 15 = 30 Marks)

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SEMESTER IV B. SC. DEGREE (CBCSS) EXAMINATION
SEMESTER IV
Main II : Ayurvedic Pharmacy
BP 1441- Pharmaceutical chemistry and Natural Products

Time : 03 Hours

Max. Marks :80

SECTION A

V. Answer all questions in one word or one sentence. Each question carries one Mark.

11. What is LSD.
12. Define buffer.
13. Give the source of Morphine.
14. Give four heavy metals present in plant drugs.
15. Give the binomial of turmeric.
16. Define Mol per cent.
17. What is a coordination bond?
18. Give a natural terpene.
19. Expand PPM.
20. Give functions of Aspirin

(10 X 01 = 10)

SECTION B

VI. Answer any eight questions, not to exceed a paragraph. Each question carries two marks.

23. Differentiate between Molarity and Molality.
24. Evaluate the biological significance of buffers.
25. Give general structure of Glucosinolates.
26. State significance of ionic bonds .
27. Give chemical nature of Caffeine.
28. Give pharmaceutical importance of Betalains.
29. Evaluate chemical nature of Aspirin.
30. Give two medicinal properties of Carotenoids.
31. Explain Lewis Dot structure.
32. Write four functions of hordenine.
33. Differentiate between covalent and hydrogen bonds.
34. Evaluate medicinal properties of Folic acid.

(08 X 02 = 16)

SECTION C

VII. Answer any six questions, not to exceed 120 words. Each question carries four marks.

31. Give general structure of Steroids.
32. Evaluate the medicinal properties of Stigmasterols.

33. Give source, chemical properties and medicinal properties of Vincristine & Vinblastine.
34. Differentiate between Cinchonine and Hyocymine.
35. State classification of Terpenes.
36. Evaluate medicinal properties of Digoxin and Taxol.
37. Evaluate the chemical nature of Gold and Magnesium.
38. Give the classification of Alkaloids based on chemical nature.

(04 X 06 = 24)

SECTION D

VIII. Write essay on any two of the following, not more than three pages. Each question carries 15 marks.

35. Explain different types of hybridization in molecules.
36. Evaluate general structure, properties, classification, structure and functions of Vitamins.
37. Describe the preparation, assay and uses of Ammonium chloride and Borax.
38. Explain structure and significance of phenolics.

(02 X 15 = 30)

B.Sc. Botany and Ayurveda Pharmacy Degree Examination
SEMESTER IV
Main II Ayurvedic Pharmacy
BP1442 Cultivation and conservation of medicinal plants

Time :3Hours

Max. Marks :80

SECTION –A

Answer all questions in a word or one or two sentences. Each question carries 1mark. Draw diagrams only if specified in the question.

1. Mention the binomial of Tulsi.
2. What do meant by totipotency?
3. Define Callus.
4. Role of sucrose in tissue culture media?
5. CIMAP.
6. TRIPS
7. Name a plant that can be used as biopesticide
8. Give the binomial of Sarpagandha
9. What is NMPB?
10. What do you meant by red data book?

(1 x 10 = 10 marks)

SECTION - B

Answer any 8 questions. Each question carries 2 marks. Answer not to exceed one paragraph

11. What do you meant by “protected cropping”?
12. What is explants? What are the commonly used explants for establishment of cultures?
13. Mention propagation methods of four medicinal plants.
14. What are folkmedicines?
15. Comment on the medicinal value of Asoka.
16. Can you patent a newly discovered medicinal plant? Give explanation.
17. What is the soil conditions in which Aonla grows well?
18. Explain organic farming?
19. How microbial biofertilizers are beneficial to medicinal plant cultivation?
20. What is use of media sterilization?
21. What is the function of a Laminar Air flow hood?
22. What is the role of Herbaria in medicinal plant conservation.

(2 x 8 = 16 marks)

SECTION - C

Answer any six of the following. (Answer not to exceed 120 words). Each question carries 4 marks

23. Name four medicinal plants which are having consumption of more than 1000 tonnes per year.
24. Why medicinal plants are considered as part and parcel of culture and rituals of Kerala and India? Explain with sufficient examples.
25. What are the minimum requirements of a plant tissue culture laboratory?
26. What is the need to hardening of tissue cultured plants?
27. How micropropagation could be beneficial to pharmacology?
28. Why shoot tip/axillary bud culture is preferred to multiply plants than callus cultures?
29. Discuss the agencies and their role in cultivation of medicinal plants
30. What are difficulties faced by farmers with growing and marketing of medicinal plants?
31. What is the importance of medicinal plant conservation for Kerala being a state traversed by western Ghats?

(4 x 6 = 24 marks)

SECTION - D

Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.

32. Explain the post harvest processing and marketing of three medicinal plants. Mention the end users of these products.
33. Explain the controversies involved with regard to patenting of our indigenous plant – Turmeric.
34. Write an account on the mineral composition of MS media. Describe the procedure of media preparation.
35. Describe in detail the cultivation of 3 medicinal plants of importance to Ayurveda. Mention their binomial and uses.

(15 x 2 = 30 marks)

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B.Sc. Botany and Ayurveda Pharmacy Degree Examination
SEMESTER IV
Main II Ayurvedic Pharmacy
BP 1541 : PHARMACEUTICAL MICROBIOLOGY

Time : 3 hrs

Max Marks : 80

SECTION A

Answer all the questions in a word or one or two sentences. Each question carries one mark.

1. What is Cold Sterilization?
2. Define symbiosis.
3. Name two anaerobic culture methods.
4. Name the scientist who first discovered penicillin.
5. Define DPT.
6. What is a vaccine?
7. Name the causative organism of Typhoid.
8. What is an autoclave?
9. What is meant by transduction?
10. What is an alkalophile?

(1 x 10 = 10 Marks)

SECTION B

Answer any 8 questions. Each question carries 2 marks.

(Answer not to exceed one paragraph).

11. What is Nutrient Broth?
12. What is the use of an inspissator?
13. Give an account on Protozoal infections.
14. Explain stages of Bacterial Growth curve.
15. Write a short note on bacteriophage.
16. What is a CFU?
17. Define Sexduction.
18. List out and describe any two physical sterilization methods.
19. What is McIntosh Filde Jar used for?
20. What are auxotrophs?
21. Define Downstream Processing. What is the importance of this technique?
22. Give the nutritional classification of bacteria.

(2 x 8 = 16 Marks)

SECTION C

Answer any 6 questions. Each question carries 4 marks.

(Answer not to exceed 120 words).

23. Differentiate Gram positive and Gram negative Cell wall.
24. Summarize the Tests used for assessment of microbial quality of the herbal medicine.
25. Give a detailed account on Inclusion bodies found in bacterial cell.
26. Explain the Lysogenic life cycle of virus.
27. Define fermentation. Explain the process of acetic acid fermentation.
28. Explain types of bacterial mutations.
29. Write a note on Identification of Coliforms, Salmonella spp. and Shigella spp.
30. Describe the features of any two Gram negative Bacilli.
31. Compare and contrast on sterilization and disinfection.

(4 x 6 = 24 Marks)

SECTION D

Answer any 2 questions. Each question carries 15 marks.

(Answer not to exceed three pages).

32. Describe the structural components of a bacterial cell.
33. Explain bacterial growth curve. What are the factors affecting growth of bacteria?
34. Explain in detail about anaerobic culture methods.
35. Elaborate on Classification, type and cells involved in immunity.

(2 x 15 = 30 Marks)

B.Sc. Botany and Ayurveda Pharmacy Degree Examination
SEMESTER V
Main II Ayurvedic Pharmacy

BAP 1542: Industrial Pharmacy, Pharmacy Management and Pharmaceutical jurisprudence

Time : 3 Hours

Max. Marks : 80

SECTION -A

Answer **all** questions in **a word** or **one or two sentences**. Each question carries **1** mark.

1. Point importance of Pharmacovigilence
2. Write about types of storage materials for liquid drugs
3. What is a granulator?
4. How can we prevent drug adulteration?
5. Define cosmetics
6. Differentiate Cosmetics and drugs
7. What is reference sample?
8. What is drug dependence?
9. What is TLC?
10. Mention functions of ancillary rooms.

(1 x 10 = 10 marks)

SECTION - B

Answer any **8** questions. **Each** question carries **2** marks. Answer **not** to exceed **one** paragraph

11. Explain consumer protection Act.
12. Explain importance of pharmaceutical education.
13. Write about quality control areas in drug industry.
14. Write about defective syrups.
15. Mention importance of hygiene of workers in pharmacy.
16. Explain about natural moisturizer.
17. Write about Prohibited advertisements.
18. Mention importance of proper documentation in pharmacy.
19. Explain importance of Schedule X.

20. Write about capsule filling machine. Explain different types of packaging materials in pharmaceutical industry.
21. Write about storage of raw materials.

(2 x 8 = 16 marks)

SECTION - C

Answer any **six** of the following. (Answer **not** to exceed **120** words). Each question carries **4** marks

23. Explain Patent Act 1970.
24. Define Forensic pharmacy and mention its scope.
25. Explain Rejected and recovered materials in Ayurvedic drugs.
26. Write about Laws relating to use of alcohol in pharmaceutical preparations.
27. Explain the Qualification, duties and responsibilities of Drug inspector.
28. Write an account on Labeling, Packaging, Bar-coding of drugs.
29. Write about Pharmaceutical Legislation in India.
30. Write a note on ayurvedic cosmetic formulations and related laws.
31. Explain the measures needed for quality control.

(4 x 6 = 24 marks)

SECTION - D

Answer any **2** questions. (**Not** more than **three** pages). Each question carries 15 marks.

32. Explain the role of pharmacists in ayurvedic drug usage and treatment. Write a note on legal and ethical responsibilities of pharmacists.
33. Write an account on drug manufacturing unit and WHO guidelines for Ayurvedic pharmaceutical industry.
34. Write about Drugs and Cosmetics Act, Schedule X and Y.
35. Explain important machines in an Ayurvedic drug production unit.

(15 x 2 = 30 marks)

**B.Sc. Botany and Ayurveda Pharmacy Degree Examination
SEMESTER VI
Main II Ayurvedic Pharmacy**

BP 1641: Formulative Pharmacy

Time : 3 Hours

Max. Marks = 80

SECTION A.

1x10=10marks

Answer all the questions in one or two sentences.

1. Define the term GLP, with respect to Ayurvedic formulations.
2. What are Parenteral medications, give two examples.
3. List out the different types of coatings used in capsules.
4. Define the term Swarasa, how is it different from other liquid formulations used in Ayurveda.
5. Convert 100 Palams into Tulam and the equivalent metric units.
6. Differentiate Emulsions from Suspensions.
7. Define the term Sterilisation, with respect to Ayurvedic formulary.
8. Define the term "Drona" as used in classical units.
9. List various propellants used in aerosol preparations.
10. Name any two Ayurvedic compendia.

SECTION B.

2x8=16 marks

Answer any 8 questions. (Answer not to exceed one paragraph).

11. List out the important components of a label to be affixed to an Ayurvedic drug container.
12. List out any four points in the WHO guidelines, relating to quality control of herbal drugs.
13. "The nature of the product to be packaged determines the type of packaging to be used", discuss the statement.
14. List out any four points relating to waste disposal, in GMP.
15. Define the term "Monograph", with respect to ayurvedic formulation.
16. Define the term, "Foreign Matter".
17. Explain the term "Cross-contamination", and methods to prevent it.
18. Define the term "Validation"? What is the need for validation as a part of GMP?
19. Explain the term "Quality", with respect to ayurvedic formulations?
20. List out six parameters, which are analysed for standardizing an "Arishta".
21. Convert the following classical units into their metric equivalents,
a. 2 Gunjas into g, b. 2 Karsas into mg, c. 10 Sukthis into g, d. 5 Kudavas into mg.

SECTION C.

4x6=24 marks

22. Define Quality control as per WHO-GMP guidelines. Describe it in brief.
23. Differentiate between Q.C. & Q.A.
24. Bring out the Pharmacopoeial parameters for Avaleha and Paka.
25. Discuss importance of documentation in GLP.
26. Discuss the Importance of S.O.P. in formulation practices.

27. The Health, sanitation and hygiene of workers has a major role in GMP, Discuss.
28. What are Parenteral products?, Discuss the parameters involved in various parenteral formulations.
29. Discuss the process of making a hard gelatin capsule ?
30. Discuss the process of making a pellet ?

SECTION D.

15x2=30 marks

31. What is a Pharmacopoeia? Enumerate parameters included in Ayurvedic pharmacopoeia of India. Explain any four in detail.
32. Describe Quality control measures for preparing a Churna preparation. Which parameters are required to be established for a fine Churna formulation ?
33. How will you standardise the primary packaging materials for different formulations of Ayurveda? Explain with suitable examples.
34. Explain the process standardisation of any one Churna formulation with suitable details.

Core course 2: Ayurvedic Pharmacy
Model Practical Question Papers

BSc. Degree in Botany & Ayurvedic Pharmacy (Double Main)**Main II Ayurvedic Pharmacy-Practical I****BP 1242 : (BP1141 & BP1241)****Time 3 hrs****Marks 80**

1. Assay the amount of Amylase in the given sample **A**.
(Principle & Procedure – 5, Demonstration -2 Calculation -2 Result -2) **10 marks**
2. Make a smear of the blood sample **B** and identify two leucocytes with suitable diagrams
(Procedure-2, slide-2, identification-2 Labelled diagram -1) **7 marks**
3. Enumerate RBC of the human blood sample **C**. Give procedure & calculation
(Procedure-2, Slide Preparation- 1, calculation -1, Result-1) **5 marks**
4. Detect presence of protein/reducing sugar/starch in the given sample **D**
(Conduct of Experiment-2, Procedure—2, Identification -1) **5 marks**
5. Estimation of sugar in the given sample **E**
(Conduct of Experiment- 3, Procedure- 2, Calculation & Result – 1) **6 marks**
6. Identify the crude drug with botanical name, useful part and uses **E, F, G, H**,
(Botanical name-1, Family- 1, Uses- 2) **(4x4)** **16 marks**
7. Write critical notes on **I, J, K**, **(2x3)** **6 marks**

Total - 55 marks**Record 20 marks (Content -15, Neatness – 5) Submission -5**

BP 1242 : Ayurvedic Pharmacy
Practical I

Key To Specimens

- A- Sample for amylase
 B- Sample for smear
 C- Sample for RBC count
 D- Protein/ Reducing sugar/ starch Solution
 E,F, G, H Crude drug sample
 I,J, K, Crude drug sample/ Photographs/ models of human systems

BSc. Degree in Botany & Ayurvedic Pharmacy (Double Main)

Main II Ayurvedic Pharmacy-Practical II

BP 1443 : (BP1341, BP1342, BP1441 &BP1442)

Time 3 hrs

Marks 80

- | | | |
|--------------|--|-----------------|
| 1. | Demonstration of inoculation in tissue culture of material A
(Demonstration – 5 , Procedure – 2) | 7 mark |
| 2. | Identify the medicinal plants B & C
(Description – 3 , Family- 1) 4x2 | 8 mark |
| 3. | Identify the plant product with botanical name & uses of D, E, F
(botanical name- 1, uses-2) 3x3 | 9 mark |
| 4. | Identify the animal product and its uses in Ayurveda G , H
(uses-2, identification- ½) 2 ½x2 | 5 mark |
| 5. | Estimate the phenol/alkaloid/tannin/flavonoid content in the given sample I
(Principle& Procedure- 3, Demonstration -2, Calculation & result- 2) | 7 marks |
| 6. | Identify the stomatal type & calculate the stomatal index of K
(Preparation – 1, identification & calculation – 1) | 2 marks |
| 7. | Prepare a normal solution with the given stock solution L
(Procedure & calculation – 3) | 3 mark |
| 8. | Write critical notes on the instruments M, N, O 3x3 | 9 marks |
| Total | | 50 marks |

Record 20 marks (Content -15, Neatness -5) Herbarium & field Book 10

BP 1443 : Ayurvedic Pharmacy
Practical II

KEY TO SPECIMENS

- A** Tissue culture Explant
- B, C** Medicinal plants mentioned in the syllabus
- D, E, F** Crude drug
- G, H** Any animal product mentioned in the syllabus
- I** Sample for phenol estimation
- J** Leaf sample
- K** Stock solution
- L, M, N** Instruments used in analysis/ photographs

BSc. Degree in Botany & Ayurvedic Pharmacy (Double Main)**Main II Ayurvedic Pharmacy-Practical III****BP 1642 : (BP1541, BP1542 & BP1641)****Time 3 hrs****Marks 80**

1. Demonstrate Streak plate method for isolation of colony from given sample **A**.
(Principle- 3, Procedure – 2) **5 mark**
2. Determine the morphology of the given bacterial sample **B**.
(Principle- 3, Procedure- 6, Slide Preparation -4, Result- 2) **15 marks**
3. Evaluate the given formulation C and asses its quality.
(Methodology- 3, Procedure-5, Requirements-3, Analysis and Result-4) **15 marks**
4. Give an account of D, E, F (Description- 4, Identification – 1) **5x3 15 marks**

Record- 20 (content 15, neatness 5)**Industrial Visit Report - 10**

BP 1643 : Ayurvedic Pharmacy
Practical III

Key to Specimens

A- Bacteria

B- Curd/root nodule

C- Any standard commercial formulation from among, Choorna, Kvatha, Asava and Arishta, Arka, Avaleha or Leha, Guggulu, Ghrita, Taila, Lepa, Vati /Gutika, Varti, Netrabindu and Anjana.

D- D & E photograph/instrument / major machinery used in Ayurvedic industry.

E- F Any Ayurvedic formulation.

MODEL QUESTION PAPERS
OPEN COURSE

First CBCSS Degree Programme in B.Sc. Botany and Ayurveda Pharmacy Examination
Open Course
SEMESTER V
BP 1551.1 Medicinal Plant Conservation

Time : 3 Hours

Max. Marks : 80

SECTION –A

Answer all questions in a word or one or two sentences. Each question carries 1mark.
Draw diagrams only if specified in the question.

1. Mention the binomial of Tulsi.
2. Name a major ingredient of Chyavanaprash?
3. What is morphologically useful part of Satavari?.
4. Botanical name of Brahmi?
5. CIMAP.
6. TRIPS
7. Name a plant that can be used as biopesticide
8. Give the binomial of Sarpagandha
9. What is NMPB?
10. What do you meant by red data book?

(1 x 10 = 10 marks)

SECTION - B

Answer any 8 questions. Each question carries 2 marks. Answer not to exceed one paragraph

11. What do you meant by “protected cropping”?
12. Name two plants used as hair tonic?
13. Mention propagation methods of four medicinal plants.
14. What are folkmedicines?
15. Comment on the medicinal value of Asoka
16. Can you patent a newly discovered medicinal plant? Give explanation.
17. What is the soil conditions in which Aonla grows well?
18. Explain organic farming?
19. How microbial biofertilizers are beneficial to medicinal plant cultivation?
20. Soil preparation for growing Brahmi.

21. What are the horticultural tools for cultivation of medicinal plants?
22. What is the role of Herbaria in medicinal plant conservation.

(2 x 8 = 16 marks)

SECTION - C

Answer any six of the following. (Answer not to exceed 120 words). Each question carries 4 marks.

23. Name four medicinal plants which are having consumption of more than 1000 tonnes per year.
24. Why medicinal plants are considered as part and parcel of culture and rituals of Kerala and India?. Explain with sufficient examples.
25. Name four plants which are considered as weeds, but is having high medicinal value?.
26. Name five medicinal plants which you consider to have good untapped commercial potential?
27. Kerala is considered as the Land of Ayurveda? Explain
28. Explain the discovery, uses and product name of Aarogyapacha?
29. Discuss the agencies and their role in cultivation of medicinal plants
30. What are difficulties faced by farmers with growing and marketing of medicinal plants?
31. What is the importance of medicinal plant conservation for Kerala being a state traversed by western Ghats?

(4 x 6 = 24 marks)

SECTION - D

Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.

32. Explain the post harvest processing and marketing of three medicinal plants. Mention the end users of these products.
33. Explain the controversies involved with regard to patenting of Turmeric.
34. What are the activities promotional programmes taken up by government agencies to promote medicinal plant cultivation? What are the main motives behind it?
35. Describe in detail the cultivation of 3 medicinal plants of importance to Ayurveda. Mention their binomial and uses.

(15 x 2 = 30 marks)

First CBCSS Degree Programme in B.Sc. Botany and Ayurveda Pharmacy Examination

SEMESTER V

Open Course II

BP1551.2 :HORTICULTURE

Time. 3 Hrs

Total Marks: 80

(Draw diagrams wherever necessary)

SECTION –A

I. Answer **all** questions in one word or two sentences. Each question carries **one** mark.

- 1) What is Air layering?
- 2) Define Hydroponics
- 3) What are the uses of Weedicides
- 4) Define Parthenocarpy
- 5) Write two examples for rooting hormone
- 6) What are Fertilizers?
- 7) Write common uses of Vermiculite
- 8) What are foliar sprays?
- 9) Explain NPK?
- 10) Define Pomology

(10x1=10 Marks)

SECTION –B

II. Answer **any eight** of the following; not to exceed one paragraph.Each question carries **twomarks**

- 11) Write four principles of garden making?
- 12) Explain approach grafting
- 13) Write two examples of garden tools and its uses?
- 14) What are the advantages of Vermicompost
- 15) Explain potting mixture
- 16) What is carpet beds?.
- 17) What is sphagnum moss?
18. Write four uses indoor garden
19. What is Bouquet?
20. What is the purpose of storage of flowers?
21. Write uses and examples of fungicide
22. Briefly explain different types cutting

(8x2=16 Marks)

SECTION –C

III. Answer any six of the following; not to exceed 120 words; Each question carries fourmarks

23. Explain flower arrangements
24. What is the relevance of conservatory and green house in a garden?
25. Explain different types of layering
26. Briefly explain different types of soil
27. Describe different types of irrigation methods
28. What are the components of a garden?
29. Write an account on Bonsai
30. Explain T-budding
31. Explain Methods of Dry flower arrangements

(6x4=24 Marks)

SECTION –D

IV. Write an essay on any two of the following; Each question carries fifteenmarks

32. Write an essay on common diseases of fruits and vegetable crops
33. Explain various types of grafting methods
34. Briefly explain different types processing and preservation of fruits and vegetables
35. Give an account of Manures and fertilizers

(2x15=30 marks)

BSc Botany and Ayurvedic Pharmacy Degree Examination**SEMESTER V****Open Course****BP 1551.3 Herbal Medicine & First Aid****Time : 3 Hours****Max. Marks : 80****SECTION -A**

Answer **all** questions in **a word** or **one or two sentences**. Each question carries **1** mark.

22. Write about triphala
23. Point out importance of hydration of body
24. Mention uses of garlic
25. Point out uses of sandal wood
26. Write about aromatherapy
27. Name two herbs commonly used as immunobooster
28. Write about medicinal uses of adhatoda
29. Mention a natural cure for common cold
30. Mention medicinal properties of Amla
31. Point out significance of licorice

(1 x 10 = 10 marks)

SECTION - B

Answer any **8** questions. **Each** question carries **2** marks. Answer **not** to exceed **one** paragraph

32. Write about a herbal cure for acid reflux
33. Mention herbal uses of Tulsi
34. Explain importance of curcumin and pepper in health care
35. Write a note on healing power of nature
36. Point out use of herbs for indigestion
37. Write about importance of herbal gardening
38. Explain advantages and disadvantages of herbal medicine
39. Write about different types of burns
40. Write a note on herbs for packing of wounds
41. Explain CPR

42. Explain emergency step for an electrical accident
43. Write about wilderness medicine

(2 x 8 = 16 marks)

SECTION -C

Answer any six of the following. (Answer not to exceed 120 words). Each question carries 4 marks

23. Mention importance of honey in health care
24. Write about ayurvedic first aid kit
25. Explain herbal first aid for scorpion and ant sting
26. Write a note on home remedies for respiratory problems
27. Write about broken bone and burn management in an emergency
28. Explain importance of training in community emergencies
29. Give explanations for use of herbal remedies for wound healing
30. Explain pathophysiology of different types of venom in the body
31. Write about signs symptoms and first aid for venomous spider bites

(4 x 6 = 24 marks)

SECTION - D

Answer any 2 questions. (Not more than three pages). Each question carries 15 marks.

32. Describe the importance of first aid. Mention herbal first aid preparations and components of first aid kit
33. Explain the importance of herbal medicine, its mode of action and safety aspects
34. Write an account on herbal medicines to prevent infection
35. Write an account on herbal medicine for gastric problems

(15 x 2 = 30 marks)