



Fergusson College (Autonomous)

Pune

Learning Outcomes-Based Curriculum

F. Y. B. Sc. Botany

With effect from June 2019

Programme Structure

Year	Semester	Course Code	Course Title	Credits
F. Y. B. Sc.	I	BOT1101	Plant Diversity	2
		BOT1102	Phytochemistry	2
		BOT1103	Botany Practical - I	2
	II	BOT1201	Morphology and Anatomy of Angiosperms	2
		BOT1202	Industrial Botany	2
		BOT1203	Botany Practical - II	2
S. Y. B. Sc.	III	BOT2301	Plant Taxonomy and Ecology	3
		BOT2302	Plant Physiology	3
		BOT2303	Practical	2
	IV	BOT2401	Plant Anatomy, Embryology and Palynology	3
		BOT2402	Plant Biotechnology	3
		BOT2403	Practical	2
T. Y. B. Sc.	V	BOT3501	Cryptogamic Botany	3
		BOT3502	Cell Biology	3
		BOT3503	Genetics and Evolution	3
		BOT3504	Spermatophyta and Palaeobotany	3
		BOT3505	Horticulture, Floriculture and Gardening	3
			OR	
		BOT3506	Biofertilizers	3
		BOT3507	Techniques in Plant Sciences and Biostatistics	3
			OR	
		BOT3508	Ethnobotany	3
		BOT3511	Botany Practical - I	2
		BOT3512	Botany Practical - II	2
		BOT3513	Botany Practical - III	2
		VI	BOT3601	Plant Physiology and Biochemistry
	BOT3602		Plant Molecular Biology and Biotechnology	3
	BOT3603		Plant Ecology and Biodiversity	3
	BOT3604		Plant Breeding and Seed Technology	3
	BOT3605		Mycology and Plant Pathology	3
			OR	
	BOT3606		Mushroom Culture Technology	3
	BOT3607		Medicobotany	3
	OR			
BOT3608	Nursery and Gardening		3	
BOT3611	Botany Practical - IV	2		
BOT3612	Botany Practical - V	2		
BOT3613	Botany Practical - VI	2		

Programme Outcomes

PO1	Diversity study - Recognize the diversity of various groups of plant kingdom, to get familiar with the classes and to study relationship between them and their ecological functions.
PO2	Environment conservation and sustainability - To be aware about the role of human activity on nature, significance of importance of sustainable development and its conservation.
PO3	Problem analysis - Identify, formulate research problem and find out its solution for betterment of society
PO4	Techniques - To introduce to appropriate techniques for solving and analyzing problems regarding biological techniques and instrumentation.
PO5	Individual and team work - Developing leadership qualities and Responsible citizen of the society.
PO6	Communication - Developing effective communication skills and its implication in human welfare. Emphasis on innovative project report writing reports and its presentations at various competitions.
PO7	Lifelong Learning - To inculcate moral values and research attitude for economic development of countries.
PO8	Interdisciplinary approach - To highlight interdisciplinary approach for better future development.
PO9	Research - To inspire research attitude based on observation skill, statistical analysis and interpretation.

PAPER CODE: BOT1101
PAPER –I: PLANT DIVERSITY
 [Credit -2: No. of Lectures 36]

Course outcomes	Suggested Pedagogical process
<p>The learner</p> <ul style="list-style-type: none"> • Understands plant diversity & its importance to human welfare. • Understands the importance of diversity conservation. • Recognise the position of different groups of plants in the classification system. • Differentiates between different habits of different group. • Illustrates the life-cycle pattern from each group. • Lists out morphological & anatomical characters of different plants. • Acquires knowledge of industrial applications of various groups. 	<ul style="list-style-type: none"> • Introduce suggesting day to day examples using PPT, Discussion methods & field study. • Use case study as role model. • Visit to college campus & introduce different groups. • Facilitate students to collect specimen from field visit. • Use charts, diagrams & power point presentation. • Use permanent slides to explain vegetative & reproductive anatomy, use of models & Charts. • Discussion method, Power point presentation.

Unit No.	Title and Contents	No. of Lectures
Unit - I	<p>Plant Diversity</p> <p>1.1 Role of plants in human welfare</p> <p>1.2 Direct uses, indirect uses and Ecological services</p> <p>1.3 Magnitude of diversity in plants, loss of diversity, need for conservation</p>	2
Unit - II	<p>Classification:</p> <p>2.1 System of classification</p> <p style="padding-left: 20px;">I. Two Kingdom classification according to Carlous Linnaeus(1758)</p> <p style="padding-left: 20px;">II. Three Kingdom classification according to Earnst Haeckel(1866)</p> <p style="padding-left: 20px;">III. Five Kingdom classification according to Robert H. Whittaker(1969)</p> <p>2.2 General outline of plant kingdom.</p>	3
Unit - III	<p>Algae:</p> <p>3.1 General characters</p> <p>3.2 Pigments in algae</p>	6

	<p>3.3 Food reserves 3.4 Algal flagella 3.5 Range of thallus diversity 3.6 Methods of reproduction 3.7 Outline of classification according to Lee (1980) up to classes with reasons 3.8 Role of algae in industry and agriculture 3.9 Life cycle of <i>Chara</i>.</p>	
Unit - IV	<p>Fungi: 4.1 General characters 4.2 Habit (Types of mycelium) 4.3 Mode of nutrition 4.4 Methods of reproduction 4.5 Outline of classification according to Hibbet et.al (2011) up to classes with reasons. 4.6 Role of fungi in industry, agriculture and health 4.7 Life cycle of <i>Mucor</i>.</p>	5
Unit - V	<p>Lichens: 5.1 General characters of lichens 5.2 Types of Lichens on the basis of thallus morphology. 5.3 Methods of reproduction. 5.4 Economic and ecological significance</p>	2
Unit - VI	<p>Bryophytes: 6.1 General characters 6.2 Methods of reproduction. 6.3 Outline of classification according to recent up to classes with reasons. 6.4 Economic and ecological significance 5.4 Life cycle of <i>Riccia</i>.</p>	5
Unit - VII	<p>Pteridophytes: 7.1 General characters 7.2 Outline of classification according to recent up to classes with reasons 7.3 Economic importance 7.4 Life cycle of <i>Nephrolepis</i>.</p>	5
Unit - VIII	<p>Gymnosperms: 8.1 General characters 8.2 Outline classification according to recent up to classes with reasons. 8.3 Economic importance 7.4 Life cycle of <i>Cycas</i>.</p>	4
Unit - IX	<p>Angiosperms: 9.1 General characters 9.2 Outline classification according to Bentham and Hooker (1883) up to classes with reasons. 9.3 Life cycle pattern in angiosperm.</p>	4

References:

1. Brodie J. and Lewis J- Unravelling the algae: the past, present and future of algal systematics.
2. Bellinger E.G. and Sigeo D.C- Freshwater algae: Identification and use as bioindicators,
3. Cole K.M. and Sheath R.G - Biology of the red algae.
4. Desikachary T.V. - Cyanophyta.
5. Graham L.E. and Wilcox L.W- Algae.
6. Krishnamurthy V- Algae of India and neighboring countries I. Chlorophycota.
7. Lee R.E- Phycology.
8. Misra J.N - Phaeophyceae in India.
9. Prescott G.W- The algae.
10. Smith G.M -The fresh water algae of the United States.
11. Srinivasan K.S -Phycologia India. Vol. I & II .
12. Das Dutta and Gangulee -College Botany Vol I.
13. Vashista B.R, Sinha A.K and Singh V.P. Botany for degree students – Algae.
14. Ainsworth, Sussman and Sparrow -The fungi. Vol IV A & IV B.
15. Alexopolous C.J., Minms C.W. and Blackwell M - Introductory Mycology.
16. Deacon J.W - Fungal Biology .
17. Kendrick B- The fifth kingdom
18. Kirk et al.- Dictionary of fungi.
19. Mehrotra R.S. and Aneja K.R - An introduction to mycology.
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23. Sharma O.P - A text book of fungi.
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26. Chopra R.N. and Kumar P.K - Biology of Bryophytes.
27. Kashyap S.R. - Liverworts of the Western Himalayas and the Punjab Plain. Part 1
28. Kashyap S.R.- Liverworts of the Western Himalayas and the Punjab Plain (illustrated): Part 2.
29. Parihar N. -.Bryophytes: An Introduction to Embryophyta. Vol I.
30. Prem Puri - Bryophytes: Morphology, Growth and Differentiation.
31. Udar R. Bryology in India.
32. Udar R.- Introduction to Bryophytes.
33. Watson E.V - Structure and Life of Bryophytes.
34. Vashista B.R., Sinha A.K., Kumar A -Botany for degree students – Bryophyta.
35. Agashe S.N - Paleobotany.
36. Arnold A.C - An Introduction to Paleobotany.
37. Eames E.J - Morphology of Vascular Plants.

38. Rashid A - An Introduction to Pteridophyta.
39. Sharma O.P - Textbook of Pteridophyta.
40. Smith G.M -Cryptogamic Botany Vol II.
41. Sporne K.R.- The morphology of Pteridophytes.
42. Stewart W.N. and Rothwell G.W - Paleobotany and the Evolution of Plants.
43. Vashista B.R., Sinha A.K., Kumar A- Botany for degree students – Pteridophyta.
44. Gangulee and Kar - College Botany.
45. Sundar Rajan S - Introduction to Pteridophyta.
46. Surange K.R. - Indian Fossil Pteridophytes.
47. Parihar N.S.- Biology and Morphology of Pteridophytes.
48. Pandey. B. P - Plant Anatomy.

PAPER CODE: **BOT1102**
PAPER –II: **PHYTOCHEMISTRY**
[Credit -2: No. of Lectures 36]

Course outcomes	Suggested Pedagogical process
<p>The learner</p> <ul style="list-style-type: none"> • Understand primary & secondary metabolites. • Gets acquainted to basic chemical composition of carbohydrates & its uses. • Gets knowledge of basic chemical composition of protein & its uses. • Recognises the importance of oil & fats. • Understands the importance of glycosides & alkaloids. • Understand the commercial importance of tannin & latex. • Relates to plant resources rich in vitamins & organic acids. 	<ul style="list-style-type: none"> • Use of charts for metabolic pathways. • Demonstration using biochemical tests & plant material containing carbohydrates. • Demonstrate using protein rich plant material. • Discuss the differences in oil & fats with different examples. • Field visit to show plants rich in glycosides & alkaloids. • Use of power point presentation to demonstrate role of tannin & latex. • Demonstration of fruits rich in vitamins.

Unit No.	Title and Contents	No. of Lectures
Unit - I	<p>Plants as organic laboratories</p> <p>1.1 Introduction 1.2 Definition 1.3 Primary and secondary metabolites 1.4 Source and sink relationship 1.5 Plants - The best chemist of the world.</p>	4
Unit - II	<p>Carbohydrates</p> <p>2.1 Introduction 2.2 Plant resources 2.3 Basic chemical composition-sugar, starch, gums and mucilage 2.4 Examples w. r. t. - Botanical source, family, part used, type, uses - Sugarcane, Rice, Gum acacia, Ispaghula.</p>	6
Unit - III	<p>Proteins</p> <p>3.1 Introduction 3.2 Plant resources 3.3 Basic chemical composition</p>	4

	3.4 Examples w. r. t. - Botanical source, family, part used, type, uses - Soyabean Grain <i>Amaranthus</i> (Rajgira), <i>Spirulina</i> , Mushroom.	
Unit - IV	Oils and fats 4.1 Introduction (Properties-Physical and Chemical) 4.2 Plant resources 4.3 Basic chemical composition 4.4 Examples w. r. t. - Botanical source, family, part used, type, uses - Coconut, Safflower, <i>Garcinia</i> , Eucalyptus, lemon grass.	6
Unit - V	Glycosides and Alkaloids 6.1 Introduction 6.2 Plant resources 6.3 Basic chemical composition 6.4 Examples w. r. t. - Botanical source, family, part used, type, uses - <i>Aloe</i> , <i>Asparagus</i> , <i>Catharanthus</i> , Adathoda.	4
Unit - VI	Tannins 7.1 Introduction 7.2 Plant resources 7.3 Basic chemical composition 7.4 Examples w. r. t. - Botanical source, family, part used, type, uses - Tea, Kattha	4
Unit - VII	Latex 8.1 Introduction 8.2 Plant resources 8.3 Basic chemical composition 8.4 Examples w. r. t. - Botanical source, family, part used, type, uses - <i>Hevea</i> rubber, <i>Achras sapota</i> (Chewing gum).	4
Unit - VIII	Vitamins and Organic acids 9.1 Introduction 9.2 Plant resources 9.3 Basic chemical composition 9.4 Examples w. r. t. - Botanical source, family, part used, type, uses - Amla (Vit. C), Carrot (Vit. A), Tamarind (Tartaric acid), Citrus fruits (Citric acid).	4
References: 1. Shah and Quadry's (2005). Pharmacognosy. B. S. Shah Prakashan 2. Daniel – Phytochemical analysis. 3. Kokate C.K. –Pharmacognosy. 4. Sheth A (2005). The herbs of Ayurveda. Vol. I, II, III, IV		

PAPER CODE: **BOT1103**
PAPER – III: **BOTANY PRACTICAL - I**
[Credit -2: No. of Practical 10]

Course Outcomes

The Learner,

- Examines the specimens and classifies them in different groups
- Develops sectioning, staining and mounting technique
- Identifies and classifies the specimens up to genus level
- Recognises the importance of primary and secondary metabolites in plants.
- Gets acquainted to Qualitative biochemical tests.

Practical No.	Title of Practical
1	Study of <i>Chara</i>
2	a. Study of <i>Mucor</i> b. Types of lichens
3	Study of <i>Riccia</i>
4	Study of <i>Nephrolepis</i>
5	Study of <i>Cycas</i>
6	Study of any one plant resources from Carbohydrates, Proteins, Glycosides and Alkaloids.
7	Study of any one plant resources from Tannins, Latex, Vitamins and Organic acid.
8	Demonstration of extraction of lemon grass oil.
9	Tests for Starch and Protein.
10	Test for Tannin and Alkaloid.

PAPER CODE: BOT1201
PAPER –I: MORPHOLOGY AND ANATOMY OF ANGIOSPERMS
 [Credit -2: No. of Lectures 36]

<p>Course outcomes The learner</p> <ul style="list-style-type: none"> • Gets acquainted with the primary structure of the angiosperms. • Understand the basic concepts of inflorescence. • Can understand & describe the parts of flower & its various modifications with examples. • Gets familiar with the types of fruits and their botanical relevance. • Can grasp the intricacies of plant tissue systems in details. • Can get knowledge of internal structure of monocot & dicot plants & identify their anatomical characters. 	<p>Suggested Pedagogical process</p> <ul style="list-style-type: none"> • Explanation with the help of comparative charts. • Use of power point presentation for explanation of concepts. • Field visit to explore & actually observe the various modifications related to flower. • Use of charts & live specimens. • Use of charts & power point presentation. • Use of comparative charts & power point presentation along with chalk & board method.
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Unit No.	Title and Contents	No. of Lectures
Unit - I	<p>General Organization Of Plant Body</p> <p>1.1 Seed: a capsule of life, fundamental parts of primary and secondary plant body.</p> <p>1.2 Organization Of Plant Body</p> <p style="padding-left: 20px;">I Root system – Characteristics, parts, functions of root, modification of root with examples for storage and adaptations.</p> <p style="padding-left: 20px;">II Shoot system- Characteristics, parts, functions of shoot, modification of root with examples for storage and adaptations.</p> <p style="padding-left: 20px;">III Leaf: Characteristics, parts, functions of leaf and types of leaves: Simple and Compound.</p> <ul style="list-style-type: none"> • Phyllotaxy • Leaf venation. • Modifications of leaf • Functions of leaf 	4
Unit - II	<p>Inflorescence</p> <p>2.1 Definition and characters.</p> <p>2.2 Types</p> <ul style="list-style-type: none"> • Racemose – Characters and subtypes with 	4

	<p>examples: raceme, spike, spadix, umbel, and capitulum.</p> <ul style="list-style-type: none"> • Cymose - Characters and subtypes with examples : solitary, monochasial, dichasial and polychasial. • Special type of inflorescence- Characters with examples : cyathium, hypanthodium <p>2.3 Significance.</p>	
Unit - III	<p>Flower</p> <p>3.1 Definition and parts of typical flower: symmetry</p> <p>3.2 Thalamus forms- anthophore, androphore, gynophore.</p> <p>3.3 Insertion of floral whorls on the thalamus- Hypogynous, perigynous and epigynous.</p> <p>3.4 Calyx modifications- Petaloid, pappus and spurred, aestivation.</p> <p>3.5 Corolla forms- Polypetalous-cruciform, papilionaceous : Gamopetalous- infundibuliform and bilabiate</p> <p>3.6 Perianth-types: Polyphyllous and gamophyllous condition.</p> <p>3.7 Androecium: parts of a typical stamen, arrangement of stamen-tetradynamous, didynamous, heterostemonous; Attachment of anther-basifixed, dorsifixed and versatile. Cohesion- adelphy, syngeny and synandry. Adhesion; epipetalous, epiphyllous and gynandrous.</p> <p>3.8 Gynoecium: parts of a carpel, types- simple (apocarpous) and compound (syncarpous); Placentation - definition and types.</p>	12
Unit - IV	<p>Fruit :</p> <p>4.1 Definition, parts of a fruit.</p> <p>4.2 Types</p> <ul style="list-style-type: none"> • Simple- achene, cypsela, caryopsis, legume, follicle, capsule, drupe, berry and hesperidium. • Aggregate- : Etaerio of berries, achenes and follicles. • Multiple fruits: Syconus and Sorosis. 	5
Unit - V	<p>Types of tissue systems:</p> <p>Definition.</p> <p>5.1 Meristematic tissue system: - Meristem, characters and types based on position.</p> <p>5.2 Simple and complex tissue.</p> <p>5.3 Epidermal tissue system:- Epidermis, structure of</p>	6

	<p>typical stomata, trichomes, motor cells; functions</p> <p>5.4 Mechanical tissue system:- Collenchyma, sclerenchyma and xylem elements , functions.</p> <p>5.5 Vascular tissues:- Components of xylem and phloem, types of vascular bundles, functions.</p>	
Unit - VI	<p>Internal Organization of Primary Plant Body: Comparitive account of primary structure of root,stem and leaf of Dicot Vs Monocot plants.</p>	5

References:

1. Gangulee and Kar - College Botany .
- 2.V N. Naik - Taxonomy of Angiosperms.
3. S. C. Dutta - Systematic Botany
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PAPER CODE: **BOT1202**
PAPER –I: **INDUSTRIAL BOTANY**
[Credit -2: No. of Lectures 36]

Learning outcomes	Suggested Pedagogical process
<p>The learner</p> <ul style="list-style-type: none"> • Acquainted with plant tissue culture techniques. • Understands types of green house and construction. • Describe floriculture methodology. • Relates different aspect of mushroom cultivation. • Recognises the importance of bio-fuel production. • Understands the commercial products used in bio control. • Familiar with genera of fungi and its industrial importance. 	<ul style="list-style-type: none"> • Use of power point presentation to demonstrate various techniques. • Visit to green house. • Use of power point presentation to demonstrate cultivation practices & processing. • Visit to mushroom cultivation unit. • Use of ICT • Demonstration using commercial product preparation. • Demonstration using commercial products.

Unit No.	Title and Contents	No. of Lectures
Unit - I	<p>Plant Tissue Culture</p> <p>1.1 Concept of tissue culture.</p> <p>1.2 Culture techniques: Types of explants, preparation of media, methods of sterilization, inoculation techniques, incubation and hardening.</p> <p>1.3 Commercial significance .</p>	5
Unit - II	<p>Greenhouse technology</p> <p>2.1 Introduction, advantages and limitations</p> <p>2.2 Types of greenhouses</p> <p>2.3 Greenhouse structure, principle- i) Site selection and orientation; ii) Structure materials; iii) Covering materials; iv) Temperature and humidity control.</p>	6
Unit - III	<p>Floriculture Industry</p> <p>3.1 Introduction to floriculture.</p> <p>3.2 Cultivation practices, harvesting and marketing of <i>Rose</i> and <i>Gerbera</i> .</p>	5
Unit - IV	<p>Mushroom Cultivation</p>	5

	4.1 Mushroom cultivation: Introduction, nutritional and medicinal value of edible mushrooms. 4.2 Cultivation practices of Oyster mushroom, uses of mushrooms.	
Unit - V	Bio-fuel Technology 5.1 Introduction and advantages. 5.2 Concept of bio-fuel and its need. 5.3 Plants used for bio-fuel production. 5.4 Biodiesel production from Castor.	5
Unit - VI	Bio-control 6.1 Introduction, sources and advantages 6.2 Important commercial products – Source, preparation and uses of Pyrethins, Azadiractin, Trichoderma, Trichogramma	5
Unit - VII	Industrial Mycology 7.1 Introduction 7.2 Important genera of fungi used in various Industries and their products. 7.3 Products and applications of <i>Ganoderma</i> , <i>Penicillium</i> , <i>Aspergillus</i> and Yeast.	5

References

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2. Economic Botany in the Tropics, Kochhar, Macmillan Publisher.
3. Economic Botany: Principles and Practices, Gerald E. Wickens, Springer Publication.
4. Floriculture in India, Gurcharan Singh Randhawa and Amitabha Mukhopadhyay, Allied Publishers.
5. Floriculture Marketing in India, Debashish Sengupta and Raj Kamal, Excel Books.
6. Floriculture Hand Book, Eiri, Engineers India Research in Publication.
7. Nursery Management, John Mason, Landlinks Press Publisher.
8. Plant Nursery Management: How to Start and Operate a Plant Nursery, Ray, P.K., Scientific Publishers.
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10. Plant Cell and Tissue Culture, Indra K. Vasil, (Eds. - Indra K. Vasil, Trevor A. Thorpe), Springer Publication.
11. The Complete Book on Organic Farming and Production of Organic Compost, NPCS Board of Consultants & Engineers, Asia Pacific Business Press Inc.
12. The Organic Farming Manual: A Comprehensive Guide to Starting and Running a Certified Organic Farm, Ann Larkin Hansen, Storey Publications.
13. Hand Book of Mushroom Cultivation, Processing and Packaging, Engineers India Research In Publishers
14. Growing Gourmet and Medicinal Mushrooms, Paul Stamets, Ten Speed Press

Publishers

15. Handbook of Seed Science And Technology: Seed biology, Production, and Technology, Amarjit S. Basra, Food Products Press publishers.
16. Zhiqiang A.N. (2004) Handbook of Industrial Mycology. CRC Press
17. Gary Leatham (1993) Frontiers in Industrial Mycology. Springer

PAPER CODE: **BOT1203**
PAPER –III: **BOTANY PRACTICAL - II**
[Credit -2: No. of Practicals 10]

Course Outcomes

The Learner,

- Describes the variation in reproductive structures of angiospermic plants w.r.t inflorescence, parts of flowers and fruits.
- Develops sectioning, staining and mounting technique of vegetative parts of angiospermic plants.
- Gets acquainted to industrial applications of fungi.
- Gets hands on training on plant tissue culture and mushroom cultivation techniques.

Practical No.	Title of Practical
1	Study of Inflorescence: Racemose: Raceme, Spike, Spadix, Umbel and Capitulum. Cymose: Solitary cyme, Uniparous cyme: Helicoid and Scorpioid, Biparous cyme and Multiparous cyme.
2	Study of flower with respect to Calyx, Corolla and Perianth.
3	Study of flower with respect to Androecium and Gynoecium.
4	Study of fruits with suitable examples Simple fruit: I. Fleshy- Berry and Drupe II. Dry: Achene, Cypsella and Legume Aggregate fruit: Etaerio of follicles and Etaerio of Berries Multiple fruit: Syconus and Sorosis.
5	Study of internal primary structure of dicotyledonous root, stem and leaf.
6	Study of internal primary structure of monocotyledonous root, stem and leaf.
7	Study of plant resources used in biopesticides: (Azadiractin & Trichoderma)
8	Study of industrially important fungi and their products. <i>Ganoderma</i> : Ganoderma tablets, <i>Aspergillus</i> : citric acid; Yeast: Bakery products and <i>Penicillium</i> : Penicillin tablets.
9	Study of plant tissue culture technique: Demonstration of various stages.
10	Cultivation of <i>Oyster</i> mushroom: Demonstration of various stages