SOLAPUR UNIVERSITY, SOLAPUR

NAAC Accredited-2015
'B' Grade (CGPA 2.62)

Faculty of Science

Syllabus of Botany

B.Sc. III (CBCS pattern)

With effect from June 2018

Preamble

Today plant science is a fusion of the traditional components with the modern aspects of biochemistry, molecular biology and biotechnology. Over the years, plant science (Botany) has shown enormous gain in information and applications owing to tremendous inputs from research in all its aspects. With global recognition of the need for conservation, field plant biologists have contributed significantly in assessing plant diversity. Taxonomists have explored newer dimensions for the classification of plants. New insights have been gained in functional and structural aspects of plant development by utilizing novel tools and techniques for botanical research. Challenging areas of teaching and research have emerged in ecology and reproductive biology. Concern for ever increasing pollution and climate change is at its highest than ever before. Keeping these advancements in view, a revision of the curriculum at the undergraduate level is perfectly timed. From the beginning of 2014-15 session, the Botany students across Indian Universities shall have the benefit of a balanced, carefully-crafted course structure taking care of different aspects of plant science, namely plant diversity, physiology, biochemistry, molecular biology, reproduction, anatomy, taxonomy, ecology, economic botany and the impact of environment on the growth and development of plants. All these aspects have been given due weightage over the six semesters. It is essential for the undergraduate students to acquaint themselves with various tools and techniques for exploring the world of plants up to the sub- cellular level. A paper on this aspect is proposed to provide such an opportunity to the students before they engage themselves with the learning of modern tools and techniques in plant science. Keeping the employment entrepreneurship in mind, applied courses have also been introduced. These courses shall provide the botany students hands on experience and professional inputs. On the whole, the curriculum is a source of lot of information and is supported by rich resource materials. It is hoped that a student graduating in Botany with the new curriculum will be a complete botanist at Honours level.

Students should be encouraged to opt for atleast 1 or 2 Generic Electives from other Life Sciences like Zoology/Microbiology/Biochemistry/Biotechnology and Chemistry courses.

Solapur University, Solapur
Faculty of Science
Choice based Credit System (CBCS)
Structure for B.Sc. III (wef 2018-19)

Subject/ Core course	Name and type of paper		No. of papers/practicals	Hrs/week			Total marks per paper	UA	CA	Credits
	Type	Name		L	T	P				
Class:	**B.Sc. III Semester -V**									
	Ability enhancement course (AECC)	English	Paper- III	4			100	70	30	04
	Core	Botany	Paper - IX	3	--	--	100	70	30	03
	Core	Botany	Paper – X	3	--	--	100	70	30	03
	Core	Botany	Paper- XI	3	--	--	100	70	30	03
	DSE-1	Botany	Paper - XII	3	--	--	100	70	30	03
	DSE-2	Botany	Paper- XII	3	--	--	100	70	30	03
Grand Total:				**16**	**--**	**--**	**500**	**350**	**150**	**12**
Class:	**B.Sc. III Semester -VI**									
	Ability enhancement course (AECC)	English	Paper- III	4			100	70	30	04
	Core	Botany	Paper - XIII	3	--	--	100	70	30	03
	Core	Botany	Paper – XIV	3	--	--	100	70	30	03
	Core	Botany	Paper- XV	3	--	--	100	70	30	03
	DSE-1	Botany	Paper - XVI	3	--	--	100	70	30	03
	DSE-2	Botany	Paper- XVI	3	--	--	100	70	30	03
Grand Total:				**16**	**--**	**--**	**500**	**350**	**150**	**12**
B.Sc. III Practicals I to IV										
	Core	Botany	Practical - IV	--	--	5	100	70	30	05
	Core	Botany	Practical-V	--	--	5	100	70	30	05
	Core	Botany	Paper- VI	--	--	5	100	70	30	05
	DSE-1	Botany	Paper - VII	--	--	5	100	70	30	05
Total (Practicals)						**20**	**400**	**280**	**120**	**20**
Grand Total				**16**	**--**	**20**	**900**	**630**	**270**	**44**

Abbreviations: L: lectures, T: Tutorials, P: Practicals; UA: University Assessment by end Semester Examination; CA: College assessment by Internal Continuous Examination; DSE: Discipline Specific elective

UA (University Assessment): University Theory paper shall be of 70 marks for 3.00 hrs duration

CA (College Assessment): The internal examination for theory and practical course.

GENERAL GUIDELINES FOR CHOICE BASED CREDIT SYSTEM (CBCS)

1. The University follows Semester system

2. Each B.Sc. course shall consist of three years i.e. six semesters

3. An academic year shall consist of two semesters.

4. B. Sc. Part-III shall consist of two semesters: Semester V and Semester VI. In semester –V, there will be four theory papers of 100 marks for each. Similarly, in semester –VI there will be four theory paper of 100 marks for each. Paper XII and XVI are Discipline specific elective. Student should select either DSE- 1 or DSE- 2 for each semester. If Student selected DSE 1 for Semester V then student must be select DSE 1 in semester VI. The scheme of evaluation of performance of candidates shall be based on University assessment as well as College internal assessment as given below. For B. Sc. Part III Sem V& VI the internal assessment will be based on Unit tests, Home assignment, viva, practicals etc. as given below. Practical course examination of 400 marks shall be conducted at the end of second semester. Each practical examination of 100 marks shall also consist of 70 marks for University practical assessment and 30 marks for college internal assessment. For University practical examination there will be two external examiners and will be appointed by the University. The internal practical assessment shall be done as per scheme given below.

5. **Scheme of evaluation:**

As per the norms of the grading system of evaluation, out of 100 Marks, the candidate has to appear for College internal assessment of 30 marks and external evaluation (University Assessment) of 70 marks. The respective B.O.S. may decide the nature of College internal assessment after referring to the scheme given below or may be used as it is.

The details are as follows:

Semester – V (Total Marks 400)**:**

University Examination (280 marks) No. of Theory papers (4):

Paper – IX, X, XI, XII	:	UA 70 marks (for each paper)
College Assessment (120 marks)	:	CA 30 Marks (for each paper)
Scheme of Marking (for each paper) CA	:	15 Marks: Unit Test
		15 Marks: Home assignment/Tutorials/Seminars/ Group discussion/ Viva/Field visit/Industry visit.

Semester – VI (Total Marks 400)**:**

University Examination (280) No. of Theory papers (4):

Paper – XIII, XIV, XV, XVI	:	UA 70 marks (for each paper)
College Assessment (120 marks)	:	CA 30 Marks (for each paper)
Scheme of Marking (for each paper) CA	:	15 Marks: Unit Test
		15 Marks: Home assignment/Tutorials/Seminars/ Group discussion/ Viva/Field visit/Industry visit.

Practicals (Total Marks 400):

University Examination (280 Marks**)**	:	No of Practicals: I, II, III, IV
		(U. A. 70 marks for each practical)
College Assessment (120Marks)	:	CA 30 Marks (for each paper)

Scheme of Marking (for each paper) CA : 20 Marks: Internal Test on any two practicals

10 Marks: Lab Journal/viva, attendance, attitude etc.(for each practical)

6. **Passing Standard**

The student has to secure a minimum of 4.0 grade points (Grade C) in each paper. A student who secures less than 4.0 grade point (39% or less marks, Grade FC/FR) will be declared fail in that paper (subject) and shall be required to reappear for respective paper. A student who failed in University Examination (Theory) & passed in internal assessment of a same paper (subject) shall be given FC Grade. Such student will have to appear for University Examination only. A student who fails in Internal Assessment and passed in University examination (Theory) shall be given FR Grade. Such student will have to appear for both University examination as well as internal assessment. In case of year down candidates from the mark scheme the candidates shall appear for the same 70 marks paper of the external examination and his performance shall be scaled to 100 marks.

SOLAPUR UNIVERSITY, SOLAPUR.

Theory syllabus (Semester pattern)

In Botany at B.Sc. III

W.E.F. June 2018

The present syllabus is in continuation with the previous class B.Sc. Part II. This syllabus has been prepared as per UGC curriculum. There will be **four** theory papers for Semester **Vth** and **four** papers for semester **VIth** which will be covered by engaging three lectures per paper per week. Each theory paper will carry **70** Marks. So the total marks for theory will be **280**. There will be **four** practicals per week, each of five periods. At the end of the year (**Sem-VIth**), there will be a practical examination to be conducted on **four** consecutive days for not less than five hours per day. Each practical will be of 70 marks. So the total marks for practicals will be **280.**

SEMESTER V

Paper IX	**:**	Reproductive Biology of Angiosperms	**45 Periods.**
Paper X	**:**	Genetics	**45 Periods.**
Paper XI	**:**	Plant Physiology	**45 Periods.**
Paper XII	**:**	Plant Breeding	**45 Periods.**
Paper XII	**:**	Nursery and Gardening	**45 Periods.**

SEMESTER VI

Paper XIII	**:**	Molecular Biology	**45 Periods.**
Paper XIV	**:**	Plant Biotechnology	**45 Periods.**
Paper XV	**:**	Plant Metabolism	**45 Periods.**
Paper XVI	**:**	Biostatistics	**45 Periods.**
Paper XVI	**:**	Horticultural practices and post harvest technology	

Semester-V

Paper IX: Reproductive Biology of Angiosperms

(Credits: Theory-4, Practical-2)

THEORY (Lectures:45)

Unit1: Reproductive development (04 lectures)

1.1: Induction of flowering.
1.2: Flower as a modified determinate shoot.

Unit 2: Anther and pollen biology (12 lectures)

2.1: Anther wall: Structure and functions.
2.2: Microsporogenesis.
2.3: Callose deposition and its significance.
2.4: Male Gametophyte Development.
2.5: NPC system (in brief).
2.6: Palynology and scope (a brief account of Melisopalynology).

Unit 3: Ovule (10lectures)

3.1: Structure; Types of ovule.
3.2: Megasporogenesis, Female gametophyte (Embryo sac).
3.3: Female gametophyte development - Monosporic, Bisporic and Tetrasporic.

Unit 4: Pollination and fertilization (10 lectures)

4.1: Introduction.
4.2: Pollination types and significance.
4.3: Structure of stigma and style.
4.4: Path of pollen tube in pistil.
4.5: Double fertilization.

Unit 5: Embryo, Endosperm (09 lectures)

5.1: Introduction.
5.2: Structure and types of endosperm.
5.3: Structure of monocot and dicot seed.
5.4. Seed dispersal.

Suggested Readings

1. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5th edition.
2. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd.Delhi.
3. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer,Netherlands.
4. Johri, B.M. l (1984). Embryology of Angiosperms, Springer-Verlag,Netherlands.

PAPER: X: GENETICS

(Credits: Theory-4, Practical-2)

THEORY (Lectures:45)

Unit 1: Sex Determination **(13 Lectures)**

1.1: Autosomes and sex chromosomes.
1.2: Mechanism of sex determination.
1.3: Sex chromosomes in *Drosophila*.
1.4: Sex chromosomes in man.
1.5: Balance concept of sex determination in *Drosophila.*—Bridge's Experiment.
1.6: Sex linked inheritance in man:
a) Colour blindness.
b) Haemophilia.
c) Holandric genes.

Unit 2: Quantitative inheritance **(8 Lectures)**

2.1: Polygene theory.
2.2: Population genetics. Gene pool, Hardy –Weinberg's law.

Unit 3: Extra chromosomal inheritance **(9 Lectures)**

3.1: Mendelian versus extra chromosomal inheritance.
3.2: Examples of maternal inheritance.
a) Mitochondrial inheritance.
b) Plastid inheritance.

Unit 4: Alteration in the genetic make-up and its significance **(8 Lectures)**

4.1: Introduction.
4.2: Numerical and Structural Changes in chromosomes.

Unit 5: Gene mutations **(7 Lectures)**

5.1: Introduction.
5.2: Types of mutations; Molecular basis of Mutations.
5.3: Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents).

Reference Books:

1) Cytology and Genetics: Dnyansagar.

2) Fundamentals of Cytology L W. Sharp.

3) Principles of Gene Manipulation. Old R. W. and Primrose, S. B. Blackwell Scientific Publications. Oxford UK.

4) Plant Chromosomes. Laboratory Methods. Fuikui K and Nakayama S., CRC Press. Boca Raton, Florida.

5) Plant Chromosomes: Analysis Manipulation and Engineering. Hawood Sharma A K and Sharma A.1999: Academic Publishing Co. Ausrtalia.

6) Principles of Gene Manipulation. Old R. W. and Primrose, S. B.1989 Blackwell Scientific Publications. Oxford UK.

7) Genetics: M. L. Shrivastav, Shri Publishers and Distributors,, Ansari Road New Delhi,110002.

8) Genetics, P. K. Gupta, Rastogi Publications, Meerut, 250002.

9) Genetics and Evolution, H. S. Bhamrah, Kavita Juneja, Anmol Publications, Pvt. Ltd. New Delhi,110002

10) Study of Genetics and Evolution, R.H lock, Arihant Publisher, Jaipur.

11) Heredity and Genetics, H. V. Bhaskar, Campus Books International. New Delhi.110002.

12) Genetics: M. P. Arora and G. S. Sandhu, Himalaya Publishing House, Nagpur, Bombay, Delhi.

13) An Introduction to Modern Genetics, C. H. Waddington, Vandana Publications, New Delhi.

14) Genetics, A. M. Winchester, Oxford and IBH Publishing Co., New Delhi.110002.

15) Genetics and Developmental Biology, M.S. Ranganathan and P Sharma,Wisdom Press, New Delhi.

Paper XI : Plant Physiology

(Credits: Theory-4, Practical-2)

THEORY (Lectures:45)

Unit1: Plant-water relations: (10 lectures)

1.1: Introduction.
1.2: Water Potential and its components.
1.3: Water absorption- root pressure and guttation.
1.4: Ascent of sap– cohesion-tension theory.
1.5: Transpiration- mechanism and factors affecting on transpiration.

Unit 2: Mineral nutrition: (10 lectures)

2.1: Introduction.
2.2: Macro and Micronutrients.
2.3: Mineral deficiency symptoms and roles of Macro (N, P, K, Ca, Mg) elements.
2.4: Mineral deficiency symptoms and roles of Micro (B, Cu, Mn, Mo) elements.

Unit3: Nutrient Uptake: (07lectures)

3.1: Introduction.
3.2: Soil as a nutrient reservoir.
3.3: Types of Absorption - Passive absorption and Active absorption.

Unit 4: Phloem Transport: (08 lectures)

4.1: Introduction.
4.2: Site of Phloem transport.
4.3: Phloem loading and unloading and its mechanism (Munch Hypothesis).
4.4: Source–sinkrelationship.

Unit 5: Plant growthregulators: (10 lectures)

5.1: Introduction.
5.2: Types of growth regulators.
5.3: Chemical structure.
5.4: Physiological roles and practical applications of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene, CCC.

Suggested Readings

1. Hopkins,W. G. andHuner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U. S. A. 4th edition.
2. Taiz, L., Zeiger, E., Møller, I. M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
3. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.

Paper XII: Plant Breeding (Elective)

(Credits: Theory-4, Practical-2)

THEORY (Lectures: 45)

Unit1: Plant Breeding: (05 lectures)

1.1: Introduction.
1.2: Aim and objectives.
1.3 Scope of plant breeding.

Unit 2: Methods of crop improvement: (20 lectures)

2.1: Introduction.
2.2: Methods of crop improvement.
2.3: Centres of origin and domestication of crop plants.
2.4: Plant genetic resources.
2.5: Introduction and acclimatization.
2.6: Selection methods: Pure line, Mass and Clonal selection.
2.7: Hybridization: Procedure.
2.8: Hybridization in self pollinated crop plants.
2.9: Hybridization in cross pollinated crop plants.

Unit3: Quantitative inheritance: (10lectures)

3.1: Introduction.
3.2: Concept and mechanism.
3.3: Example of inheritance of Kernel colour in wheat.
3.4: Monogenic vs polygenic Inheritance.

Unit 4: Mutation and Plant breeding: (10 lectures)

4.1: Role of mutations.
4.2: Role of Polyploidy.
4.3: Role of biotechnology in crop improvement.
4.4: Distant hybridization.

Suggested Readings

1. Singh, B. D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.
2. Chaudhari, H. K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH. 2nd edition.
3. Acquaah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing.

Paper XII: Nursery and Gardening (Elective)

(Credits Theory 4 practical 2)

Lectures: 45

Unit1: Nursery **(5 lectures)**

1.1: Introduction.
1.2: objectives and scope.

Unit 2: Seed **(10 lectures)**

2.1: Introduction.
2.2: Structure and types.
2.3: Seed dormancy; causes and methods of breaking dormancy.
2.4: Seed storage: Seed banks, factors affecting seed viability, genetic erosion.
2.5: Seed production technology.
2.6: Seed testing and certification.

Unit3: Vegetative propagation **(10lectures)**

3.1: Introduction.
3.2: Types of layering, cutting, budding and grafting.

Unit 4: Gardening **(10 lectures)**

4.1: Introduction.
4.2: Objectives and scope.
4.3: Types of gardening–landscape, home gardening and parks
4.4: Computer applications in land scaping.

Unit 5: Sowing and transplanting **(10 lectures)**

5.1: Introduction.
5.2: Raising of seeds and seedlings.
5.3: Transplanting of seedlings.
5.4:Study cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes and carrots.
5.5: Storage and marketing.

Suggested Readings

1. Bose T. K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi.
2. Sandhu, M. K., 1989, Plant Propagation,Wile Eastern Ltd., Bangalore, Madras.
3. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
4. Edmond Musser & Andres, Fundamentals of Horticulture, Mc Graw Hill Book Co., New Delhi.
5. Agrawal, P. K. 1993, Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.
6. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.

SEMESTER VI

Paper XIII: Molecular Biology

THEORY (Credit 4 Practical 2)

Lectures: 45

Unit 1: Nucleic acids **(5 lectures)**

1.1: Introduction.
1.2: Historical perspective.
1.3: DNA as the carrier of genetic information (Griffith's, Hershey & Chase expt).

Unit 2: The Structures of Genetic Material **(10 lectures)**

2.1: Introduction.
2.2: Structure of DNA: Watson and Crick model
2.3: Salient features of double helix.
2.4: Types of DNA.
2.5: Denaturation and renaturation of DNA.
2.6: Organization of DNA in Prokaryotes and Eukaryotes.
2.7: Structure of RNA.
2.8: Types of RNA.

Unit 3: Replication of DNA **(10 lectures)**

3.1: Introduction.
3.2: Synthesis of DNA (Kornberg's discovery).
3.3: Replication of DNA in prokaryotes and eukaryotes.
3.4: Enzymes involved in DNA replication.

Unit 4: Transcription **(10 lectures)**

4.1: Introduction.
4.2: Transcription in prokaryotes and eukaryotes.
4.3: Principles of transcriptional regulation.
4.4: Prokaryotes: Regulation of lactose metabolism in *E.coli*.
4.5: Eukaryotes: transcription factors, heat shock proteins, steroids and peptide hormones.

Unit 5: Translation **(10 lectures)**

5.1: Introduction.
5.2: Structure of Ribosome.
5.3: Assembling of Ribosome and mRNA.
5.4: Charging of tRNA and aminoacyl tRNA synthetases.
5.5: Steps in protein synthesis
5.6: Proteins involved in initiation, elongation and termination of polypeptides.
5.7: Post-translational modifications of proteins.

Suggested Readings

1. Watson J. .D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.
2. Snustad, D. P. and Simmons, M. J. (2010). Principles of Genetics. John Wiley and Sons Inc., U. S. A. 5th edition.
3. Klug, W. S., Cummings, M. R., Spencer, C. A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition.
4. Russell, P. J. (2010). i-Genetics- A Molecular Approach. Benjamin Cummings, U. S. A. 3rd edition.
5. Griffiths, A. J. F., Wessler, S. R., Carroll, S. B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U. S. A. 10th edition.

Paper XIV: Plant Biotechnology

(Credits: Theory-4, Practical-2)

THEORY (Lectures:45)

Unit1: Recombinant DNA Technology (14 lectures)

1.1: Introduction and principles.
1.2: Enzymes involved in recombinant DNA Technology.
1.3: Vectors.
1.4: Southern and northern blotting technique.
1.5: DNA finger printing.
1.6 : PCR.
1.7 : DNA libraries.

Unit 2: Methods of Gene transfer (10 lectures)

2.1: Introduction.
2.2: Marker and Reporter genes.
2.3: Methods of gene delivery-Physical, Chemical and Biological (*Agrobacterium* mediated gene transfer).
2.4: Transgenic plants.
2.5: Achievements in plant Biotechnology.

Unit3: Gene Cloning: (06 lectures)

3.1: Introduction.
3.2: Recombinant DNA.
3.3: Bacterial Transformation and selection of recombinant clones.
3.4: PCR- mediated gene cloning.
3.5:Complementation, colony hybridization.

Unit 4: Plant Tissue culture (10 lectures)

4.1: Introduction.
4.2: Terminology in tissue culture.
4.3:Techniques of tissue culture.
4.4: Micro propagation.
4.4: Anther culture.
4.4 Protoplast isolation and culture.
4.5 Somatic Hybridization.

Unit 5: Applications of Biotechnology: (05 lectures)

5.1: Introduction.
5.2: Pest resistant (Bt-cotton), herbicide resistant plant (Round Up Ready soybean), 5. 3: Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice).

Suggested Readings

1. Bhojwani, S. S. and Razdan, M. K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Glick, B. R., Pasternak, J. J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3. Bhojwani, S. S. and Bhatnagar, S. P. (2011). The Embryology of Angiosperms. Vikas Publication House Pvt. Ltd., New Delhi. 5th edition.
4. Snustad, D. P. and Simmons, M. J. (2010). Principles of Genetics. John Wiley and Sons, U. K. 5th edition.
5. Stewart, C. N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U. S. A.

Paper No. XV: Plant Metabolism

(Credits: Theory-4, Practical-2)

THEORY (Lectures:45)

Unit1: ATP-Synthesis **(10 lectures)**

1.1: Introduction.
1.2: Structure of ATP molecule.
1.3: Mechanism of ATP synthesis.(oxidative and photophosphorylation).
1.4: ATP synthase, Boyers conformational model, Racker's experiment, Jagendorf's experiment.

Unit 2: Carbon Oxidation **(12 lectures)**

2.1:Introduction.
2.2: Glycolysis.
2.3: Pentose phosphate pathway.
2.4: oxidative decarboxylation of pyruvate.
2.5: Regulation of PDH, NADH shuttle.
2.6: TCA cycle.
2.7: Mitochondrial electron transport.
2.8: oxidative phosphorylation.
2.9: cyanide-resistant respiration.

Unit3: Carbohydrate Metabolism **(12lectures)**

3.1: Introduction and broad classification.
3.2 : **Monosaccharides**: Properties and Examples: Trioses, Tetroses, Pentoses and Hexoses.
3.3: **Oligosaccharides:** Properties and Examples: Sucrose, Maltose and Lactose.
3.4 : **Polysaccharides**—Properties and Examples—Starch and Cellulose.
3.5: Isomers, enantiomers and epimers.
3.6 : Biosynthesis of sucrose and starch.
3.7 : Degradation of sucrose and starch.

Unit 4: Lipid Metabolism **(11 lectures)**

4.1: Introduction and classification.
4.2 : Saturated fatty acids—properties and examples—Stearic and palmitic acids.
4.3 : Unsaturated fatty acids—Properties and Examples—Linoleic and linolenic acids.
4.4 : General outline of fatty acid biosynthesis.
4.5 : Beta oxidation of fatty acids.
4.6 : Gluconeogenesis of fatty acids during germination.
4.7 : Properties and significance of lipids.

Suggested Readings

1. Hopkins,W. G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U. S. A. 4th edition.
2. Taiz, L., Zeiger, E., Møller, I. M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. U. S. A. 6th edition.
3. Harborne, J. B. (1973). Phytochemical Methods. John Wiley & Sons. NewYork.

Paper XVI: Biostatistics (Elective)

(Credits: Theory-4, Practical-2)

THEORY

Lectures:45

Unit1: Introduction **(12 lectures)**

1.1: Definition.
1.2: Basic principles.
1.3: Statistical methods.
1.4: Variables - measurements, functions, limitations and uses of statistics.

Unit 2: Collection of primary and secondary data **(12 lectures)**

2.1: Introduction.
2.2: Types of data.
2.3: Methods of data collection.
2.4: Merits and demerits.
2.5: Classification of data.
2.6:Tabulation and presentation of data.
2.7: sampling methods.

Unit3: Measures of central tendency **(11lectures)**

3.1: Introduction.
3.2: Mean, median and mode, merits & demerits.
3.3: Measures of dispersion- range, standard deviation and mean deviation, merits &demerits.
3.4: Co- efficient of variations.

Unit 4: Probability **(05 lectures)**

4.1:Introduction.
4.2: Basic Concepts.
4.3: Kinds of Probabilities.
4.4: Measures of Probability.

Unit 5: Statistical inference **(10 lectures)**

4.1:Introduction.
4.2: Hypothesis - Student 't' test and chi square test and its significance.

Suggested Readings

1. Biostatistic, Danniel, W.W., 1987. New York, John Wiley Sons.
2. An introduction to Biostatistics, 3rd edition, Sundarrao, P. S. S and Richards, J. Christian Medical College, Vellore.
3. Statistical Analysis of epidemiological data, Selvin, S., 1991. New York University Press. 4. Statistics for Biology, Boston, Bishop, O. N. Houghton, Mifflin.
4. The Principles of scientific research, Freedman, P. New York, Pergamon Press.
5. Statistics for Biologists, Campbell, R. C., 1998.Cambridge University Press.

Paper XVI: Horticultural Practices and Post-Harvest Technology (Elective)

(Credits: Theory-4,Practical-2)

THEORY (Lectures:45)

Unit1: Introduction **(05 lectures)**

1.1:Scope and importance.
1.2: Branches of horticulture.

Unit 2: Ornamental plants **(08 lectures)**

2.1: Introduction.
2.2: Types and classification (annuals, perennials, climbers and trees).
2.3: Ornamental flowering trees (Indian laburnum, gulmohar, *Jacaranda*, *Lagerstroemia*, fishtail and areca palms, semul and coral tree).

Unit3: Fruit and vegetable crops **(10 lectures)**

3.1: Introduction.
3.2: Origin and distribution.
3.3: Description of plants and their economic products.
3.4: Management and marketing of vegetable and fruit crops.
3.5: Identification of some fruits and vegetable varieties (Pomogranate, mango, and cucurbits).

Unit 4: Horticultural techniques **(09 lectures)**

4.1: Introduction.
4.2: Application of manure, fertilizers, nutrients and PGRs.
4.3: Weed control, Biofertilizers and biopesticides.
4.4: Hydroponics.

Unit 5: Floriculture **(06 lectures)**

5.1: Introduction.
5.2: Cut flowers.
5.3: Bonsai, commerce (market demand and supply).
5.4:Importance of flower shows and exhibitions.

Unit 6: Disease control and management **(07 lectures)**

6.1: Introduction.
6.2: Field and post-harvest diseases.
6.3:Identification of deficiency symptoms; remedial measures and nutritional management practices.
6.4: Crop sanitation.
6.5: IPM strategies.

Suggested Readings

1. Singh, D. & Manivannan, S. (2009). Genetic Resources of Horticultural Crops. Ridhi International, Delhi, India.
2. Swaminathan, M. S. and Kochhar, S. L. (2007). Groves of Beauty and Plenty: An Atlas of Major Flowering Trees in India. Macmillan Publishers, India.
3. NIIR Board (2005). Cultivation of Fruits, Vegetables and Floriculture. National Institute of Industrial Research Board, Delhi.
4. Kader, A. A. (2002). Post-Harvest Technology of Horticultural Crops. UCANR Publications, U. S. A.
5. Capon, B. (2010). Botany for Gardeners. 3rd Edition. Timber Press, Portland,Oregon.

Practical IV: Reproductive Biology of Angiosperms and Molecular Biology

1. Study of anther wall and tapetum (through slides / micrographs).
2. Pollen grains: Fresh or acetolyzed showing ornamentation and aperture, pollinia (slides / photographs, fresh material).
3. Pollen viability test, calculation of germination percentage.
4. Diversity of style and stigma.
5. Study of Ovule: Types - anatropous, orthotropous, amphitropous, campylotropous, circinotropous.
6. Study of unitegmic, bitegmic ovule, tenuinucellate and crassinucellate; (permanentslides / specimens / photographs).
7. Female gametophyte through permanent slides / photographs.
8. Intra-ovarian pollination; Test tube pollination through photographs.
9. Endosperm: Dissections of developing seeds for endosperm with free-nuclear haustoria.
10. Embryogenesis: Study of development of dicot embryo through permanent slides.
11. Identification of genus and species with the help of flora.
12. Herbarium techniques.
13. Tour Report-Industrial / Research Institute / Field visit (Submit separate Report).
14. Microtomy / Micrograph.
15. Preparation of LB medium and raising E.Coli.
16. Isolation of genomic DNA from E.Coli.
17. DNA isolation from cauliflower head.
18. Qualitative and Quantitative estimation of DNA by diphenylamine reagent.
19. Qualitative and Quantitative estimation of RNA by Orcinol reagent.

20-22 Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication).

23. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs.
24. Photographs establishing nucleic acid as genetic material (Griffith’s experiments).
25. Demonstration of dialysis of starch and simple sugar.

Practical V: Genetics and Plant Biotechnology

1. Examples based on polygene inheritance.
2. Examples based on Population Genetics (Hardy-Weinberg Law).
3. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
4. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes.(Photograph).
5. Induction of polyploidy in plants using colchicine. Different methods of application of colchicine. (Demo.).
6. Detection of meiotic anomalies in chromosomes in *Rhoeo.*
7. Study of human genetic traits: Sickle cell anemia, Colour blindness by photographs.
8. To study effect of mutagen on genetic material by scoring the chromosomal aberrations.
10. To study polytene chromosomes in *Drosophila* larvae.
11. To study the karyotype and prepare ideogram of any two plant species by photograph.
12. To solve the given problem on population genetics (at least three).
13. Tools and techniques used in biotechnology.
15. Study of recombinant vectors with the help of photographs.
16. Tissue culture techniques.

17-18 Preparation of MS media.

19. Demonstration of *in vitro* sterilization and inoculation methods using leaf and explants.
20. Study of anther, embryo and endosperm culture, micropropagation.
21. Isolation of protoplasts.
22. Construction of restriction map of circular and linear DNA from the data provided.
23. Study of methods of gene transfer through photographs / video (ICT): *Agrobacterium*-mediated, direct gene transfer by electroporation, microinjection and microproctile bombardment.
24. Study of steps in genetic engineering for production of Bt cotton and Golden rice.
25. Isolation of plasmid genomic DNA and confirm by DPA.

Practical VI: Plant Physiology and Plant Metabolism

1.	Determination of osmotic potential of plant cell sap by plasmolytic method.
2.	Determination of water potential of given tissue (potato tuber) by weight method.
3.	Study of the effect of light on the rate of transpiration.
4, 5& 6	Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte and xerophyte.
7.	To study the mineral deficiency symptoms and roles of Macro (N, P, K, Ca, Mg) elements.
8.	To study the mineral deficiency symptoms and roles of Micro (B, Cu, Mn, Mo) elements.
9.	To study the phenomenon of seed germination (effect oflight).
10.	To study the effect of different concentrations of IAA, on seed germination.
11.	To study the effect of different concentrations of GA, on seed germination.
12.	To study the induction of amylase activity in germinating seeds.
13.	Fruit ripening by hormonal treatment.
14.	Rooting from cuttings by hormonal treatment.
15& 16	To compare the rate of respiration in different parts of plant.
17.	Qualitative tests for sugars in plant material.
18.	Qualitative tests for starch and cellulose in plant material.
19.	Determination of Carbohydrate by Anthrone Method.
20.	To measure the sugar percentage by hand refrectometer
21.	Qualitative tests for lipids in plant material.
22.	Determination of fatty acid value of oil sample.
23.	To study the activity of lipases in germinating oilseeds and demonstrate mobilization of lipids during germination.
24.	Demonstration of fluorescence by isolated chlorophyll pigments.
25.	Visit to research centre.

Practical VII (Elective): Plant Breeding and Biostatistics

1. To study floral biology in self pollinated crop plants.
2. To study floral biology in cross pollinated crop plants.
3. To study pollen viability.
4. Calibration of ocular micrometer and estimate the size of pollen grain.
5. To study hybridization techniques in Malvaceae.
6. To study hybridization techniques in Fabaceae.
7. To study hybridization techniques in Brassicaceae.
8. To study hybridization techniques in Poaceae.
9. Study of male sterility in sorghum in field or in laboratory by staining the pollen grain.
10. Studies on Learning the precautions on handling of different mutagenic agents: Physical and chemical mutagens.
11. Methods of estimation of Heterosis (i) Mid- Parent Heterosis (ii) Better parent Heterosis (iii) Standard Heterosis (Demo).
12. Determination of interspecific variation in chromosome number in *Allium.*

13-15 Collection of Data and tabulation.

16-17 Methods of sampling.

18. Presentation of Data.
19. Measures of central tendency (Mean, mode and median) of given plant material.
20. Calculation of Standard Deviation.
21. Examples based on probability.
22. Calculation of ‘t’ test.

23-24 Calculation of chi square test

25. Visit to breeding stations.

Practical VII (Elective): Nursery and Gardening and Horticultural practices and post harvest technology

1. Garden implements and their uses.
2. Different types of pots and potting medium. Potting and Repotting.

3-5 Propagation practices by seed, vegetative propagation, cutting, budding, layring and grafting.

6. **Identification of:**

   Fertilizers: Identification by physical and Chemical methods- Urea, Ammonium sulphate, Pottasium sulphate and Super phosphate.

   Manures: Identification of plants as green manures- *Glyricidia, Crotolaria,* and *Leucaena*.

   Biofertilizers: Identification (material as slides) VAM, *Nostoc* and *Rhizobium*.

7-9 Soil pH, use of soil testing kit, electrical conductivity, pH of water and liquid fertilizers.

10. Method of preparing Bonsai, Bottle garden/Terrarium, Hanging Baskets, Dish Garden.
11. Diseases and Pests:
12. Fungal- Powdery mildew, Rust, Wilt, Blight and Smut.

    Bacterial- Canker and Wilt.

    Viral- Leaf Curl and Yellow vein mosaic.

    Insects- Sucking, Biting, Chewing, Borers and Ants.

    Non-Insects Pests- Nematodes and Rodents.

13. Preparation of Natural Insecticides- Neem arka, Dashaparniarka, Seetaphal Powder, Tobacco extracts.
14. Project-Each students should individually present a project to any topic related to nursery Development. It should be duly certified presented at the practical examination (Compulsory).
15. Preparation of garden layout.
16. List of plants suitable for garden locations- 2 to 3 plants for each location.
17. Identification of important horticultural plants- herbs(Foliage and flowering), shrubs.
18. (Foliage and flowering), trees (Foliage and flowering), climbers, Lianas, Epiphytes, Creepers, Trailers, Aquatic plants, Succulents, Weeds (from all types any two plants).
19. Flower Arrangements- Indian (Gajara, Veni, Garland, Bouquet, Hand torch, Japanese and
20. western all type.

21. Preparation of Jam, Jellies, Squashes, Syrups, Pickle, Sauces with Organoleptic Chart.
22. Green house plants- Information regarding soil, temperature, irrigation and fertilizer.
23. requirements and propagation methods for *Anthurium*, *Gerbera*, Orchids, Tuberose, Carnation, Roses and *Capsicum*.
24- **Visits:** To garden /Parks /Nurseries /Exhibition / Horticulture industries / Research Station.
25 and record should be duly certified and presented at practical examination.

Equivalent Subject for Old Syllabus

Sr. No.	Name of the Old Paper	Paper No.	Name of the New Paper	
1)	Biology of Cryptogams	IX	Reproductive Biology of Angiosperms	Core
2)	Gymnosperms and palaeobotany.	X	Genetics	Core
3)	Genetics	XI	Plant Physiology	Core
4)	Plant Biochemistry	XII	Plant Breeding	Elective
		XII	Nursery and Gardening	Elective
5)	Microbiology and Plant Pathology	XIII	Molecular Biology	Core
6)	Systematics of Angiosperms	XIV	Plant Biotechnology	Core
7)	Microbial Genetics, Plant Breeding and Biostatistics	XV	Plant Metabolism	Core
8)	Molecular Biology and Biotechnology	XVI	Biostatistics	Elective
		XVI	Horticultural practices and post harvest technology	Elective

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Nature of Question Paper for CBCS pattern

B. Sc. III

• Faculty of Science •

(w.e.f. June 2018)

Time: - 2 ½ hrs. **Total Marks- 70**

Q1. Multiple choice questions. (1x14) =14

Q2. Answer **any seven** of the followings. (7x2) = 14

i)

ii)

iii)

iv)

v)

vi)

vii)

viii)

ix)

Q3. A) Attempt **any two** of the followings. (2x5) =10

i)

ii)

iii)

Q3. B) (1X4) =04

Q4. Attempt **any two** of the followings. (2x7) = 14

i)

ii)

iii)

Q5. Answer **any two** of the followings. (2x7) =14

i)

ii)

iii)

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PRACTICALS IN BOTANY at B. Sc.III

W.E.F. June 2018

Practical - IV	**: (Based on Paper- IX and XIII)**	**=70 Marks**
Practical- V	**: (Based on Paper X and XIV)**	**=70 Marks**
Practical- VI	**: (Based on Paper XI and XV)**	**=70 Marks**
Practical- VII	**: (Based on Paper XII and XVI)**	**=70 Marks**

Scheme of Marking for Internal assessment (30 marks) for each practical	**:**	**20 Marks**	**Internal Test on any two practicals**
		10 Marks	**Lab Journal/viva, attendance, attitude etc. (for each practical)**

PRACTICAL EXAMINATION B Sc. Part III (BOTANY)

Each candidate must produce a certificate from Head of the Department stating that He/She has completed the practical course in a satisfactory manner, on the lines laid down from time to time by the Academic Council on the recommendations of the Board of Studies and that the Laboratory Journal has been properly maintained. The candidate must have recorded his /her observations directly in his/her laboratory journal and written their report of each exercise performed. Every journal shall be checked and signed periodically by concerned teacher and certified by the head of the Botany Dept. at the end of academic year.

Candidate shall present the followings at the time of Examination.

1) Certified Laboratory Journal/s, with tour report and fieldwork report.

2) At least 10 herbarium specimens well mounted on sheets, 10 preserved specimens, 10 permanent slides (5 microtomy). The candidates shall be orally examined (Viva-voce) for their submission. The student will not be allowed to appear for the practical examination unless he/she submits the Journal, submission report and Excursion report duly certified by Head of the Botany Dept.

Fieldwork and Tour report:

In addition to the number of practicals prescribed, the students are required to undertake field excursions to the places of botanical interests, Research centres / Industrial places under the guidance of teachers. There shall be frequent study tours in local areas. One of excursions shall be to an area having different botanical characters for not more than 12 days. There shall be one teacher in- charge for a batch of student up to 12 and one additional lady teacher is allowed

whenever there are female candidates and T.A and D.A be paid to the teachers, peon and field collector as per University rules.

XThe record of fieldwork, visit report and report of the excursion have to be written in the journal or separately which will be duly signed by the teacher in-charge and certified by the Head of Botany Department. Collection of rare flowering and non flowering plants such as **Orchids, *Ceropegia, Gnetum, Isoetes, Ophioglossum, Equisetum, Osmunda*** etc. should be avoided during the excursion. Avoid massive collection of plants. Collection of common weed plants should be preferred. Certified journal and excursion report will be considered for assessment by the examiners. There are 70 marks for each practical.Disrtibution of marks for each practical is as follows.

Distribution of Marks for Practicals B. Sc. III –Botany (UA)

Practical: IV (Based on Paper IX and XIII) Total Marks: 70

Reproductive Biology of Angiosperms	25 Marks
Molecular Biology	25 Marks
Submission	10 Marks
Journal	10 Marks

Practical:-V (Based on Paper X and XIV) Total Marks: 70

Genetics	25 Marks
Plant Biotechnology	25 Marks
Submission	10 Marks
Journal	10 Marks

Practical: - VI (Based on Paper XI and XV) Total Marks: 70

Plant Physiology	25 Marks
Plant Metabolism	25 Marks
Submission	10 Marks
Journal	10 Marks

Practical: - VII (Based on Paper XII and XVI) (Elective) Total Marks: 70.

Plant Breeding	25 Marks
Biostatistics	25 Marks
Submission	10 Marks

Journal	10 Marks

Practical: - VII (Based on Paper XII and XVI) (Elective) Total Marks: 70.

Nursery and Gardening	25 Marks
Horticultural practices and post harvest technology	25 Marks
Submission	10 Marks
Journal	10 Marks

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(Practical Question paper)

B.Sc. Part-III/Practical Examination in Botany, Mar/.Apr.2019

Practical –IV (Based on paper IX and XIII)

Time:-11 a.m. onwards Marks: 70

Date: Centre-

N.B. I) Do not write about points of theoretical information unless asked specifically.

II) Draw neat and labeled diagrams wherever necessary.

Q-1 **(24)**

Q-2 **(6)**

Q-2 **(6)**

Q-3 **(8)**

Q-4 **(8)**

Q-5 Identifications **(12)**

a) **(6)**

b) (6)

Q-6 a) Submission **(10)**

b) Journal **(10)**

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(Practical Question paper)

B.Sc. Part-III/Practical Examination in Botany, Mar/.Apr.2019

Practical –V (Based on paper X and XIV)

Time:-11 a.m. onwards Marks: 70

Date: Centre

N.B. I) Do not write about points of theoretical information unless asked specifically.

II) Use of Angiosperm key is allowed

III) Draw neat and labeled diagrams wherever necessary

Q-1 **(12)**

Q-2

Q-3 **(10)**

Q-4

Q-4

Q-5 Identifications **(6)**

a)

b) **(5)**

c)

d) **(5)**

Q-6 a) Tour report (10)

b) **Herbaria submission** **(10)**

c) Journal (10)

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(Practical Question paper)

B.Sc. Part-III/Practical Examination in Botany, Mar/.Apr.2019

Practical –VI (Based on paper XI and XV)

Time:-11 a.m. onwards Marks: 70

Date: Centre

N.B. I) Do not write about points of theoretical information unless asked specifically.

II) Draw neat and labeled diagrams wherever necessary.

Q-1 **(8)**

Q-2

Q-3 **(8)**

Q-4

Q-5 Identifications **(10)**

a)

b) **(8)**

Q-6 a) Submission (10)

b) Journal (10)

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(Practical Question paper)

B.Sc. Part-III/Practical Examination in Botany, Mar/.Apr.19

Practical –VII (Elective) (Based on paper XII and XVI)

Time:-11 a.m. onwards Marks: 70

Date: Centre

N.B. I) Do not write about points of theoretical information unless asked specifically.

II) Chart for biochemical tests is allowed.

Q-1 **(12)**

Q-2 **(10)**

Q-2 **(10)**

Q-3 **(10)**

Q-3 **(10)**

Q-4 **(12)**

Q-5 Identifications **(10)**

a) **(5)**

b) **(5)**

Q-6 a) Submission **(10)**

b) Journal **(10)**

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(Practical Question paper)

B.Sc. Part-III/Practical Examination in Botany, Mar/.Apr.19

Practical –VII (Elective) (Based on paper XII and XVI)

Time:-11 a.m. onwards Marks: 70

Date: Centre

N.B. I) Do not write about points of theoretical information unless asked specifically.

II) Chart for biochemical tests is allowed.

Q-1 **(12)**

Q-2 **(10)**

Q-2 **(10)**

Q-3 **(10)**

Q-3 **(10)**

Q-4 **(12)**

Q-5 Identifications **(10)**

a) **(5)**

b) **(5)**

Q-6 a) Submission **(10)**

b) Journal **(10)**

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B.Sc. Part –III- Botany

Practical no -V

(Based on Paper No- X and XIV)

Examples on Polygene Inheritance

1) Assuming the height in a particular plant to be determined by two pairs of unlinked Polygenes. Each effective (contributing) allele contributing 5 cm to the base height of 5cm. The cross AABB x aabb is made.
   a) What height is to be expected in the F1 plants, if there is no environmental factor?

   b) What is the expected phenotypic ratio in F2?

2) In a corn, the length of ear (cob) is controlled by two independent polygenes say- A & B. The black Mexican corn with the genotype AABB having ear length 17 cm is crossed with a Tomthum pop corn variety with the genotype aabb having ear length 7 cm.
   i) What will be the ear length of F1?

   ii) What will be the result of F2?

   iii) Give the ear length of F2?

   iv) What is the contribution of each allele in the length of ear?

3) Two races of corn averaging ‘28’ inches & ‘72’ inches in height respectively are crossed. The F1 is quite uniform, averaging ‘60’ inches in height. Out of the 500 plants of F2, two are as short as ‘28’ inches parent and two are as tall as ‘72’ inches parent.
   a) What is the no. of polygenes involved?

   b) How much does each effective allele contribute to the height?

4) In human beings, the eye colour is being controlled by the four polygenes say-A, B, C and D (no. of alleles =8).The eye colour and the no. of alleles for a particular eye colour is shown in the table below

Sr. No.	Eye colour (Phenotype)	No. of alleles	Genotypes
1	Dark brown	8	AA,BB,CC,DD
2	Medium brown	7	AA,BB,CC,Dd
1	Light brown	6	AA,BB,CC,dd
2	Hazel	5	AA,BB,Cc,dd
5	Green	2	AA,BB,cc,dd
6	Grey	1	AA,Bb,cc,dd
7	Dark blue	2	AA,bb,cc,dd
8	Medium blue	1	Aa,bb,cc,dd
9	Light blue	0	aa,bb,cc,dd

Mr. A has dark brown eyes and his wife Mrs. –B has light blue eye. Based on the hypothesis that 2 pairs of polygenes are responsible for brown eye colour. Give the genotype of Mr. and Mrs. and their child.

© Pascle's triangle may be provided for Polygene inheritance Examples.