

**M. SC. BOTANY**  
**Semester III & IV**  
**SYLLABUS**  
**CHOICE BASED CREDIT SYSTEM**  
**(CBCS)**

*(Revised, w.e.f. June 2018)*



**DEPARTMENT OF LIFE SCIENCES**  
**BHAKTA KAVI NARSINH MEHTA UNIVERSITY**  
**Junagadh – 362 640**

## **Department of Life Sciences**

### **1. The Course**

- The course is full time course comprising of four semesters. There will be four theory papers (three core papers and one interdisciplinary / multidisciplinary paper) and one combined practicals in first two semesters. The last two semesters offer choice of courses to the students where two core courses and one elective (to be chosen from three available) courses will be taught. Any elective course will be taught only when prerequisite number of the student enrolls for that course. Students shall be required to submit at the time of practical examination at the end of each semester.
  - The laboratory Journal and diary of field work (Tour report) duly signed by the teachers concerned from time to time.
  - A set of assignments, submissions, preparations or materials illustrating the subject - matter as per syllabus for each semester.

### **2. Eligibility**

- The candidate with B.Sc. degree in Botany with minimum 45% is eligible for admission to M.Sc. Botany course.
- Students, who have cleared B.Sc. with Botany as the second subject in S.Y. B.Sc. will also be considered for admission, provided the seats are available. A total of 20 seats are available in the Botany.
- Students will be admitted as per the reservation policy in effect from time to time, as directed by the University.

### **3. Educational tour**

- The study/ educational tour is compulsory and part of Curriculum to study different ecosystems, botanical, zoological and microbiological places of interest anywhere in the country. Since the tour or tours are part of the curriculum, these can be conducted during any or all of the four semesters. However, in special cases, alternative of the educational tour will be decided and assigned to the student concerned, by the Staff Council of the Department.

### **4. Seminars / Assignments / Submission**

- Regular seminars will be organised on I and II Semesters and it is compulsory. Presentation on relevant topics, mostly from syllabus (oral and / or poster), is

## 5. Attendance

- ## 6. Semester wise distribution of marks

- SEMESTER-II:

**\* 70 external + 30 internal**

- SEMESTER-IV:

3

## M. Sc. Botany

### Semester - III

| Course code             | Paper title                                                | Hours / week | Credits   | Marks    |      |            |
|-------------------------|------------------------------------------------------------|--------------|-----------|----------|------|------------|
|                         |                                                            |              |           | Int.     | Ext. | Total      |
| BOT 313                 | Plant Ecology (Core)                                       | 04           | 04        | 30       | 70   | 100        |
| BOT 314                 | Plant Physiology (Core)                                    | 04           | 04        | 30       | 70   | 100        |
| BOT 315                 | Plant Anatomy, Embryology & Histological Techniques (Core) | 04           | 04        | 30       | 70   | 100        |
| <sup>\$</sup> BOT 316 A | Plant Diversity And Resources (Elective)                   | 04           | 04        | 30       | 70   | 100        |
| <sup>\$</sup> BOT 316 B | Plant Biotechnology (Elective)                             |              |           |          |      |            |
| BOTPRAC 317             | Combined Practicals                                        | 12           | 12        | -        | 200  | 200        |
| *BOT 419                | Dissertation / Project                                     | 09           | 00        | -        |      |            |
|                         | <b>Total</b>                                               | <b>37</b>    | <b>24</b> | <b>-</b> |      | <b>600</b> |

<sup>\$</sup> Out of two elective papers 316 A and 316 B **any one is to be selected**

\* **Dissertation / Project** commences in III Semester but evaluated and Grade Points are to be added in 4th Semester.

### Semester - IV

| Course code   | Paper title                                    | Hours / week | Credits   | Marks    |      |            |
|---------------|------------------------------------------------|--------------|-----------|----------|------|------------|
|               |                                                |              |           | Int.     | Ext. | Total      |
| BOT 418       | Research Methodology, IPR and Biosafety (Core) | 04           | 04        | 30       | 70   | 100        |
| *BOT 419      | Dissertation / Project                         | 16           | 16        | -        | 400  | 400        |
| BOTPRAC 420   | Practicals                                     | 04           | 04        | -        | 50   | 50         |
| BOT 106 + 212 | <sup>#</sup> Seminar course 1 & 2              | -            | 04        |          |      | 50         |
|               | <b>Total</b>                                   | <b>24</b>    | <b>30</b> | <b>-</b> |      | <b>600</b> |

# **Seminar / Tutorial** Courses may be carried out in first two Semesters but evaluated and Grade Points are to be added in the final (4th) Semester only.

\* **Dissertation / Project** commences in III Semester but evaluated and Grade Points are to be added in 4th Semester.

# **M.Sc. Botany**

## **DETAILED SYLLABUS**

### **Semester - III**

#### **BOT 313: PLANT ECOLOGY**

##### **Unit – 1. Plant Community and Biodiversity**

- 1.1 Vegetation Organization: Composition and Structure of Plant Community, Qualitative and Quantitative Characteristics, Phytosociological Methods, Ecological Niche.
- 1.2 Vegetation Development: Process of Ecological Succession, Models and Climax Stage, Hydrosere, Xerosere and causes of succession, Vegetation analysis.
- 1.3 Biological Diversity: Concepts and levels; role of biodiversity in ecosystem functions and stability; speciation and extinction; IUCN categories of threat; biodiversity hot spots; ecology of plant invasion ; Invasive species-case studies
- 1.4 Mapping biodiversity, methods of estimating population density of plants and documenting biodiversity by PBR, Role of GSBB, NBA

##### **Unit – 2. Edaphic factors and Ecosystem organization**

- 2.1 definition and composition of soils, origin and formation of soil, soil profile, soil classification, properties of soils, soil erosion.
- 2.2 Biosphere, biotic and abiotic components, ecological balance, food chain, ecological pyramids, energy flow
- 2.3 Types, terrestrial and fresh water ecosystems. Greenhouse gasses (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, CFCs), Ozone hole, consequences of climate change(CO<sub>2</sub> fertilization , global warming, sea level rises, acid rain, UV radiation), Phytoremediation.

##### **Unit – 3. Ecological factors and Environment**

- 3.1 Ecological Factors: Soil, light, water etc, Principles of limiting factors;
- 3.2 Productivity: Population ecology – concept, types, fluctuation, factors regulating size, mortality – natality
- 3.3 Climate Change: Greenhouse gases (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, CFCs; sources, trends and role); ozone layer and ozone hole, consequences of climate change (CO<sub>2</sub> fertilization, global warming, sea level rise, UV radiation).
- 3.4 carrying capacity and population regulation, Species interaction, Ecological Adaptations, sustainable development, EIA

##### **Unit – 4. Desertification and Remote sensing**

- 4.1 Principles, components and types of Remote sensing and GIS

- 4.2 Applications of remote sensing and GIS
- 4.3 Impacts of Desertification and Processes of Desertification
- 4.4 Major Factors Causing Desertification

### **Suggested Readings**

- 1. Basic Ecology – Eugene P. Odum
- 2. Fundamentals of Ecology- P. Odum
- 3. Concept in Indian Ecology and Environmental Science – S. V. S. Rana
- 4. Ecology Theories and Application – Peter Stiling
- 5. Ecology & Environment – P. D. Sharma
- 6. Indian Manual of Plant Ecology – R .Misra & G. S. Puri
- 7. Responses of Plants to environmental stresses, Levitt, J. (1980) Academic Press.
- 8. Ecology, N.S. Subrahmanyam & A.V.S.S. Sambamurthy, Narosa Publishing House

## **BOT 314: PLANT PHYSIOLOGY**

### **Unit – 1. Water and Mineral Nutrition**

- 1.1 Water, water potential, soil water, water absorption and transport, transpiration, water deficit, hormonal and molecular responses to water control in plants.
- 1.2 Mineral nutrition, macronutrients, micronutrients, importance and deficiency symptoms, nutrient uptake by plants
- 1.3 N–P–K in environment, Nitrogen-Phosphorus-Potassium metabolism, N-P-K assimilation
- 1.4 Carbohydrates, Proteins, Lipids-biosynthesis ,Structure and metabolism

### **Unit – 2. Major Pathways**

- 2.1 Photosynthesis, photosynthetic apparatus, PS I & PS II, mechanism of electron – proton transport, carbon fixation (C3/ C4/ CAM), evolution of Photosynthesis, factors affecting photosynthesis, photorespiration – C oxidation cycle,
- 2.2 Respiration, Mitochondria, structure, glycolysis, TCA cycle, electron transport, ATP synthesis, different substrates, carbon respiration
- 2.3 Measurement of Photosynthesis, Respiration and Transpiration
- 2.4 Translocation of photosynthetic phloem, source – sink, partitioning and allocation

### **Unit – 3. Growth and Development**

- 3.1 Growth, development, concept, qualitative – quantitative changes, Seed germination, dormancy and method to break dormancy.
- 3.2 Growth regulators, biosynthesis, bioassay, mechanism of action, physiological effects, applications of auxin, cytokinin, gibberellins, ABA, ethylene.
- 3.3 Physiological effects and role of jasmonic acid, polyamines, brassinosteroids, salicylic acid.
- 3.4 Measurement of growth, growth indices-RGR, LWR and NAR, growth correlations.

### **Unit – 4. Plant Responses**

- 4.1 Phytochrome, Pr and Pfr structure, localization, plant responses, plant movement, cellular actions

- 4.2 Flowering, shoot apex modification, floral meristem, photomorphogenesis, photoperiodism, biochemical signaling, vernalization
- 4.3 Stress physiology, water status, deficit, drought, structural and biochemical features to overcome stress, chilling, Heat and salinity stress.
- 4.4 Climate resilience, vulnerability and Tolerance to stress

### **Suggested Readings**

1. Salisbury, F.B. and Ross, C.W. 1992. Plant Physiology (4th edition). Wadsworth Publishing Co. California, USA.
2. Singhal, G.S., Renger, G., Sopory, S.K., Irrgang, K.D. and Govindjee 1999. Concept in Photobiology: Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
3. Taiz, L. and Zeiger, E. 1998. Plant Physiology (2nd edition). Sinauer Associates, Inc., Publishers, Massachusetts, USA.
4. Thomas, B. and Vince-Prue, D. 1997. Photoperiodism in Plants (2nd edition). Academic Press, San Diego, USA.
5. Bewley, J.D. and Black, M. 1994. Seeds: Physiology of Development and Germination. Plenum Press, New York.
6. Bajracharya, D. 1999. Experiments in Plant Physiology: A Laboratory Manual. Narosa Publishing House, New Delhi.
7. Moore, T.C. 1974. Research Experiences in Plant Physiology: A Laboratory Manual. Springer-Verlag, Berlin.
8. Nilesen, E.T. and Orcutt D.M. (1996) The Physiology of Plants under Stress. John Wiley & Sons. Inc New York.
9. Advances in Plant Physiology, vol.10, by D.K.Arora and Seema Gupta, 1996. Anmol Publications Pvt Ltd.
10. Plant Physiology : Fundamentals and Applications, second edition, by Arvind Kumar and S.S.Purohit, 2001, Agrobios.

## **BOT 315: PLANT ANATOMY, EMBRYOLOGY & HISTOLOGICAL TECHNIQUES**

### **Unit-1 : Anatomy**

- 1.1 Root anatomy, RAM, root hairs, root architecture
- 1.2 Stem anatomy, Vascular elements, functional differentiation, proteins. Role of cambium.
- 1.3 Leaf anatomy, Epidermis, stomata, trichomes, types, role, Secretory Ducts and Laticifers, types, development, function. Nodal Anatomy, Nodal types, leaf gaps, branch
- 1.4 Wood anatomy, Wood development and environmental factors, heartwood, softwood and bark, reaction wood

## **Unit-2 : Embryology**

- 2.1 Floral meristem, Intrinsic and extrinsic factors controlling flowering, flower development, ABC model of flower development, flower architecture and mutations.
- 2.2 Structure and development of anther, ovule, male and female gametophytes; Embryo sac ultra structure and its types, nutrition of embryo sac .
- 2.3 Pollination, pollen-pistil interaction, fertilization, sexual incompatibility
- 2.4 Embryo development, types, polyembryony, endosperm, nutrition.

## **Unit-3 : Applied Embryology**

- 3.1 Apomixis, Embryology in relation to taxonomy
- 3.2 Cytoskeleton: Ultrastructure and functions of Actin, Myosin, IF and associated proteins
- 3.3 Intracellular Junctions and their functions.  $\text{Ca}^{++}$  dependent homophilic and non-homophilic cell-cell adhesion
- 3.4 Transport across cell membrane: diffusion, active transport and pumps, uniports, symports and antiports

## **Unit-4 : Cellular Communication, Apoptosis and Cancer**

- 4.1 Whole mounts, sections, peels for study of fine surface and internal structures of plants, stains, mounting for temporary preparations.
- 4.2 Killing, fixing ,sectioning and staining for permanent preparations.
- 4.3 Unstained preparations and study of live cells, photographing stained preparations, Pollen pistil interactions through temporary preparation.
- 4.4 Staining for callose, DNA, RNA, Proteins, insoluble polysaccharides

## **Suggested Readings**

1. Bhojwani, S.S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms. [4th revised and enlarged Ed.]. ViKas Publishing House, New Delhi.
2. Fageri, K. and Van der Pijl, L. 1979. The Principles of Pollination Ecology. Pergamon Press, Oxford.
3. Fahn, A.1982. Plant Anatomy. [3th Ed.]. Pergamon Press, Oxford.
4. Proctor, M. and Yeo, P. 1973. The Pollination of Flowers. William Collins Sons., London.
5. Raghavan, V.1997. Molecular Embryology of Flowering Plants. Cambridge University Press, Cambridge.
6. Shivanna, K.R. and Sawhney, V.K. [eds.] 1997. Pollen Biotechnology for Crop Production and Improvement. Cambridge University Press, Cambridge.
7. Shivanna, K.R. and Rangaswamy, N.S. 1992. Pollen Biology: A Laboratory Manual. Springer - Verlag, Berlin.
8. Shivanna, K.R. and Johri, B.M. 1985. The Angiosperm Pollen: Structure and function. Wiley Eastern Ltd., New York.
9. Shivanna, K.R. and Rangaswamy, N.S. 1992. Pollen Biology: A Laboratory Manual. Springer - Verlag, Berlin - Heidelberg (and references therein).

## **BOT 316A: PLANT DIVERSITY AND RESOURCES (ELECTIVE)**

### **Unit -1: Bryophyta & Pteridophyta**

- 1.1 General characters, economic importance and classification of bryophyta and pteridophyta
- 1.2 Morphological patterns in leaf, stem and reproductive organ of bryophyta and pteridophyta
- 1.3 Anatomical patterns in leaf and of bryophyta and pteridophyta
- 1.4 Reproduction and Life-cycles of bryophyta and pteridophyte

### **Unit -2: Gymnosperms & Angiosperms**

- 2.1 General characters, economic importance and classification of gymnosperms and angiosperms
- 2.2 Morphological and anatomical patterns in leaf, stem and reproductive organ of gymnosperms
- 2.3 Classification of family as per Bentham & Hooker classification including merits and demerits
- 2.4 Detailed study: Families of Polypetalae, Gamopetalae and Apetalae; Families of monocotyledons

### **Unit-3 : Agricultural and forest products of India**

- 1.1 Major staple crops: rice, wheat, maize; Minor staple crops: millets, ragi, barley ; Major pulses: oil seeds, fibre crops
- 1.2 Classification of Indian Forests, Silviculture systems, Major and minor forest products of India
- 1.3 Major and minor forest products of India Importance of fodder grasses, forbs and legumes Grassland management
- 1.4 Basic methods and approaches to study traditional knowledge of ethnobotany

### **Unit 4 Intellectual Property Right**

- 4.1 Overview of Intellectual Property Plant variety protection
- 4.2 Farmer's and Breeder's rights
- 4.3 Biodiversity act
- 4.4 Protection of traditional knowledge

### **Suggested Readings**

- 1. College Botany by Das, Datta and Gangulley
- 2. Bryophytes by Puri P.
- 3. Bryophyta by N. S. Parihar
- 4. The morphology of Pteridophyta by Sporne K.K.
- 5. Pteridophyta by N. S. Parihar
- 6. Cryptogamic Botany by Smith
- 7. Angiosperms by R. N. Sutaria

8. Bombay flora by Hook
9. Gymnosperms by Bhatnagar S. P. and Moitra
10. Numerical taxonomy by Cole A. J.
11. Principles of angiosperms taxonomy
12. Plant Biosystematics by Grant W. F.
13. Diversity and classification of flowering plants
14. Economic Botany - SampatNehra
15. Economic Botany - B. P. Pandey
16. Economic Botany: A Profile - AkhilBaruah
17. Economic Botany of Crop Plants - AVSS Sambamurty and NS Subrahmanyam
18. A textbook of Modern Economic Botany - AVSS Sambamurty and NS Subrahmanyam
19. Textbook of Economic Botany - V. Verma
20. Encyclopaedia of Forest Sciences - Evans, Youngguist and Burley
21. Forestry: Principles and Applications - AJ Raj, SB Lal
22. Forestry - Gyan Deep Singh
23. Indian Forestry - K. Manikandan, S. Prabhu
24. Tree and Forest Measurement - P.W. West
25. Forest and Forestry - K.P. Sagreya

## **BOT – 316B: PLANT BIOTECHNOLOGY**

### **Unit - 1. Plant Tissue Culture**

- 1.1 General technique, Laboratory and equipments, aseptic techniques, nutrient medium, plant growth regulators
- 1.2 Callus, induction, transfer – subcultures, growth kinetics, cell suspension, application
- 1.3 Morphogenesis, Plant regeneration, somatic embryogenesis, advantages, synthetic seeds, androgenesis and gynogenesis
- 1.4 Micropropagation, cloning, various stages, applications, pathogen indexing, meristem culture, virus free plants, therapy (chemo/ thermo), advantages

### **Unit – 2. Plant Improvement**

- 2.1 Somatic hybridization, protoplast isolation, culture, fusion, selection of hybrids, advantages.
- 2.2 Somaclonal variation, origin, factors inducing variations, cell selection, advantages
- 2.3 Transgenic plant, gene construct, Ti plasmid, transformation, direct gene transfer methods, advantages
- 2.4 Phytochemicals, large scale cultures, bioreactors, improvement – elicitors, two phase systems, hairy root cultures, bio-transformation, applications

### **Unit – 3. Industrial Applications**

- 3.1 Studies on Primary metabolites
- 3.2 Studies on secondary metabolites
- 3.3 Studies on fine chemicals produced by plants like Shikonine, berberine, geraniol, digoxin, rosmarinic acid and immunologically active polysaccharides from plants
- 3.4 Studies on Plant made Pharmaceuticals (PMP) for human use

#### **Unit – 4. Complementary Techniques**

- 4.1 Germplasm conservation, cryopreservation (freezing – thawing), cryoprotectants, applications
- 4.2 Distant hybridization, in vitro pollination/ fertilization, embryo culture, embryo – rescue, applications.
- 4.3 Commercial outlook, technology, important plants, International and Indian status, issues. Plant tissue culture in India
- 4.4 Molecular markers and DNA finger printing techniques and applications

#### **Suggested Readings**

1. Bhojwani, S.S. 1990. Plant Tissue Culture: Theory and Practical (a revised edition). Elsevier Science Publishers, New York, USA.
2. Bhojwani, S.S. 1996. Plant Tissue Culture: Application and Limitations. Elsevier Science Publishers, New York, USA.
3. Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, the Netherlands.
4. Shantharam, S. and Montgomery, J.F. 1999. Biotechnology, Biosafety and Biodiversity. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
5. Glick, B.R. and Thomson, J. E. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
6. Glover, D. M. and Hames, B. D. (Eds.), 1995. DNA Cloning 1: A Practical Approach; Core Techniques, (2nd edition). PAS, IRL Press at Oxford University Press, Oxford.
7. Hackett, P.B., Fuchs, J.A. and Messing, J. W. 1988. An introduction to Recombinant DNA Techniques: Basic Experiments in Gene Manipulation. The Benjamin / Cummings Publishing Co., Inc Menio Park, California.
8. Shaw, C. H. (Ed.), 1988. Plant Molecular biology: A Practical Approach. IRL Press, Oxford.

#### **PAPER BOTPRAC – 317 :**

#### **Practicals Based on Theory Papers BOT 313, 314, 315 and 316 A / B**

## **Semester – IV**

### **BOT 418: Research Methodology, IPR and Biosafety (Core)**

#### **Unit 1- Basic research methodology**

1. Research problem, Aims & Objectives, Thesis, report, paper writing
2. Hypotheses testing, Mentoring and mentor-mentee responsibility
3. Optimization of protocol, Graphical data analysis, data validation,
4. Multivariate analysis and Plagiarism

#### **Unit 2- Intellectual Property Right**

1. IP: Fundamentals of patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of New GMOs; International framework for the protection of IP.
2. IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies; Introduction to History of GATT, WTO, WIPO and TRIPS.
3. Patent Application: Types of patents, Patent application- forms and guidelines, fee structure, time frames;
4. Types of patent applications: provisional and complete specifications; PCT and convention patent applications; International patenting-requirement, procedures and costs

#### **Unit 3- Scientific writing**

1. Types of scientific research
2. Research scheme and research proposal writing
3. National and international Funding agency and its role
4. Review writing and submission

#### **Unit 4- Biosafety and bioethics**

1. Biosafety fundamentals: Introduction; Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals;
2. Biosafety regulation : Biosafety guidelines-Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture;
3. Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication;
4. Overview of National Regulations and relevant International Agreements including Cartagena Protocol. Transgenic animals and plants

### **Suggested practical**

1. Research and review paper writing
2. Research proposal preparation
3. Multivariate tools and its application
4. Optimization of research methods using various tools
5. Data validation using statistical tools
6. Graphical data analysis
7. Data validation using statistical tools
8. Case study of environmental risk and environmental disaster
9. Biosafety Level-1 and 2 specification and features
10. Preparation of project proposal

### **Suggested Books**

1. IPR, Biosafety and Bioethics, Goel and Parashar, Person
2. A Book on Indian Patenting System and Patent Agent Examination, Sheetal Chopra, Notion Press
3. Fundamentals of Intellectual Property Rights: For Students, Industrialist and Patent Lawyers, Anil Kumar, Ramakrishna, Notion Press
4. Intellectual Property Rights (IPRs): TRIPS Agreement & Indian Laws, E. T. Lokganathan, New Century Publications
5. How to Patent an Idea in India, Prasad Karhad
6. Building Biotechnology: Biotechnology Business, Regulations, Patents, Law, Policy and Science Paperback, Yali Friedman, Logos Press
7. Bioethics and Biosafety M.K. Sateesh, I K International Publishing House
8. Biosafety and Regulation for Genetically Modified Organisms, Xue, Ipha Science International Ltd
9. Kothari, Research Methodology, Methods and Techniques
10. Gurumani, An Introduction to Biostatistics

**Department of Life Sciences**  
**Bhakta Kavi Narsinh Mehta University**  
**Khadiya, Junagadh**

**Question paper Skeleton**

**SECTION-I**

1. Answer the following (Two short Questions)
  - A. Write a short note..... 07
  - B. Explain ..... 07

**OR**

1. Answer the question (One long Question) 14
2. Answer the following (Two short Questions)
  - C. Write a short note..... 07
  - D. Explain ..... 07

**OR**

2. Answer the question (One long Question) 14

**Note:** Question 1 and 2 from the unit-1 and 2 respectively.

3. Do as direct (any seven out of eight questions each of one mark) 07

**Note:** Question 3 from the unit-1 and 2.

**SECTION-II**

1. Answer the question (One long Question) 14
- OR**
1. Answer the following (Two short Questions)
    - A. Write a short note..... 07
    - B. Explain ..... 07

2. Answer the question (One long Question) 14

**OR**

2. Answer the following (Two short Questions)
  - A. Write a short note..... 07
  - B. Explain ..... 07

**Note:** Question 1 and 2 from the unit-3 and 4 respectively

3. Do as direct (any seven out of eight questions each of one marks) 07

**Note:** Question 3 from the unit-3 and 4.