SOLAPUR UNIVERSITY, SOLAPUR

M.Sc. Part-II Biotechnology

Revised Syllabus (New CBCS Pattern Syllabus)

w. e. f. June 2017-18
## M. Sc. II- BIOTECHNOLOGY CBCS w. e. f. 2017-18 (REVISED ) SEMESTER III

<table>
<thead>
<tr>
<th>SEM-III</th>
<th>Code</th>
<th>Title of the Paper</th>
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## M. Sc. II- BIOTECHNOLOGY CBCS w. e. f. 2017-18 (REVISED) SEMESTER-IV

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<th>SEM-IV</th>
<th>Code</th>
<th>Title of the Paper</th>
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### PRACTICALS/PROJECT WORK

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**M. Sc I year**

| 1250 | 50 |

**M. Sc II year**

| 1250 | 50 |

**Grand Total**

| 2500 | 100 |

** Notes:**
- **L = Lecture**
- **T = Tutorials**
- **P = Practical**
- **IA = Internal Assessment**
- **UA = University Assessment**
- **HCT = Hard core theory**
- **SCT = Soft core theory**
- **HCP = Hard core practical**
- **SCP = Soft core practical**
- **OET = Open elective theory**
- **OEP = Open elective practical**
- **MP = Major project**

**4 Credits of Theory = 4 Hours of teaching per week**

**2 Credits of Practical = 4 hours per week**
M. SC BIOTECHNOLOGY SEMESTER-III
HCT 3.1: INDUSTRIAL AND ENVIRONMENTAL BIOTECHNOLOGY

4 Credits (60L)

UNIT-I: Introduction to bioprocess engineering
Bioreactors, isolation, preservation and maintenance of industrial microorganisms, microbial growth kinetics, media formulation for industrial fermentation, Air and media sterilization. Designing of a fermentor/bioreactor. Types of fermentation process batch, fed batch and continuous, biotransformation, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidized, photo bioreactors etc.) Measurement and control of bioprocess parameters.

UNIT-II: Upstream Process
Industrial production of chemicals: alcohols, acids (citric, acetic and gluconic), solvents (glycerols, acetone, butanol), antibiotics (penicillin, streptomycin, tetracycline) amino acids (lysine, glutamic acid), single cell proteins, single cell oil, dairy products, wine, beer and other alcoholic Beverages.

UNIT-III: Downstream process
Introduction, removal of microbial cells and solid matters, foam separation, filtration, centrifugation, cell disruption, precipitation, liquid-liquid extraction, chromatography, membrane process, drying and crystallization, effluent treatment.

UNIT-IV: Scope of Biotechnology in Environmental protection

UNIT-V: Bioremediation
Biotechnology for clean environment, Biomaterials as substitutes for non-degradable materials, Metal microbe interactions: Heavy Metal Pollution and impact on environment, Microbial Systems for Heavy Metal Accumulation, Biosorption, molecular mechanisms of heavy metal tolerance. Bioindicators and biosensors for detection of pollution, Hazardous Waste Management, Xenobiotics, Biological Detoxification of PAH, Air Pollution Control, Solid Waste Management.

REFERENCE BOOKS:
9. Chattergy : Environmental Biotechnology
10. Varma & Agarwal : Environmental Biology
11. B.K. Sharma : Environmental Chemistry
12. Peavy & Rowe : Environmental Pollution
HCT 3.2: GENETIC ENGINEERING  

4 Credits (60L)

UNIT-I: Tools for Genetic Engineering  
DNA manipulation enzymes- Exonucleases, Restriction endonucleases, Ligase. Gene cloning Vectors- Properties and structure of natural and artificial plasmids, Bacteriophages (λ and M13), Cosmids, animal and plant viruses, Phagmids.

UNIT-II: Expression strategies  
Various expression vectors in bacteria and eukaryotes- Yeast, Baculovirus, Mammalian and Shuttle vectors. Induced expression strategies and protocols. Expression of industrially important products.

UNIT-III: In Vitro construction, screening and Isolation of rDNA Molecules  
Isolation of vector and donor DNA and its purification, assembly of gene of interest and vector DNA, Amplification of Recombinant DNA Molecules. Definition and introduction to genomic library, Construction of Genomic & cDNA library, Preparation of primers and probes, Direct Screening, Indirect Screening, Colony hybridization, Immuno-Screening.

UNIT-IV: Analytical techniques  

UNIT-V: Applications of rDNA technology  
Genetic diseases- Detection and Diagnosis, Gene therapy – ex vivo, in vivo, DNA marker technology in plants, DNA fingerprinting, Genetically engineered biotherapeutics and vaccines and their manufacturing, Transgenic animals and Bio-pharming

REFERENCE BOOKS:

UNIT-I: Plant Physiology and Basic Techniques in Plant Tissue Culture [10]

UNIT-II: Micro propagation [10]

UNIT-III: Protoplast Culture, Anther Culture and Cryopreservation [12]

UNIT-IV: Plant Transformation Technology [14]
Basics of Tumor formation, Hairy root, features of Ti & Ri Plasmid and their uses, Mechanism of DNA transfer role of Virulence gene, Binary vectors, Use of 35s & other promoters, genetic markers, viral vectors & their applications, Multiple gene transfers: vector less or direct DNA transfer, Use of reporter gene, Particle bombardment, electroporation, Microinjection, transformation in monocots, Transgene stability & genesilencing in Plant transformation.

UNIT-V: Applications of Plant Biotechnology [14]

REFERENCE BOOKS:
21th century (Academic press).
SCT 3.2: CANCER GENETICS AND ANIMAL CELL CULTURE

4 Credits (60L)

UNIT-I: Introduction to Cancer Biology
Cancer cell vs. Normal cell; Hallmarks of cancer cell; Cell cycle - Regulation of Cell cycle and pRb tumor suppressor; P53 tumor suppressor; Tumor suppressor genes; Oncogenes and Proto-Oncogenes; Factors activating proto-oncogene to oncogene; Tumor Virus; Physical and Chemical Carcinogenesis; Introduction to Epigenetics, Epigenetics in cancer.

UNIT-II: Cancer Progression
Apoptosis mechanism, Apoptotic Pathways; Metastasis, Clinical significances of invasion, Metastatic cascade, Basement membrane disruption; Theory of invasion, Proteinases and tumour cell invasion; Angiogenesis and its sequence of events in detail.

UNIT-III: Diagnostic and Treatment
Methods of diagnosis - Chemotherapy, Radiation Therapy, Immunotherapy- use of immunotoxins in cancer therapy, Retroviral drugs, Anti-angiogenic Drug; Drugs based on Epigenetics (Acetylation of Histones and Methylation of DNA).

UNIT-IV: Introduction of Animal Tissue Culture
Introduction; Infrastructure of Animal Tissue Culture Laboratory; Characteristics of cells in culture; Media - Natural & Synthetic Media; Primary culture- Cell line (Finite, Infinite, and Continuous); Disaggregation of tissue, Organ culture & its types; Cell culture – initiation, cultivation of animal cell in mass in Bioreactors; Biology of cell culture, evolution of culture dynamics and maintenance of cell lines.

UNIT-V: Viability & Micromanipulation
Viability – measurement of viability and cytotoxicity; Cell cloning – cell synchronization, cell cloning, micromanipulation, Cell Transformation and applications of animal cell culture; In vitro fertilization – embryo transplant techniques and their applications. Commonly used cell line-MCF7, HeLa, CHO & BHK.

REFERENCE BOOKS:
1. The Biology of Cancer, Robert Weinberg, Garland Science; 2 edition;2010
5. Vogel F. Chemical mutagenesis Spinger and Verlag.
OET 3.1: COMPUTATIONAL STRUCTURE BIOLOGY AND DRUG DESIGNING

4 Credits (60L)

UNIT- I: Introduction to Structural and Pathway Databases
[14]
Structural data, exploring the structural databases such as Protein Data Bank (PDB) at RCSB, Catalytic Site Atlas (CSA), Homology Derived Structures of Proteins (HSSP), Protein Data Bank Europe (PDBe), PDBChem, PDBeFold, PDBeMotiff, PDBeNMR, PDBSum, SCOP and CATH. Introduction to biological Pathway Databases.

UNIT- II: Structure Prediction Methods
[10]

UNIT- III: Homology Modeling
[12]
Introduction to homology modeling, Fold recognition and Threading, RNA structure prediction, architectures and topologies of protein and DNA using molecular visualization software, Structure validation

UNIT- IV: Molecular interaction
[10]
Molecular interaction; protein-protein, protein-DNA, Protein-Lipid, Protein- Ligand, Protein- Carbohydrate, DNA-Drug interaction, Metalloproteins, Pi … Pi interactions, C-H…Pi interactions

UNIT-V: Drug Discovery and Drug designing
[14]
Natural products, drugs, principles of drug development, Drug discovery, mutation in drug targets, automated drug design, structure based and ligand based drug design methods, combinatorial chemistry, high throughput screening (HTS), in silico ADMET properties, QSAR, developing lead library, DOCKING; introduction to docking method to generate new structure, tools and molecular docking programs- AUTODOCK, HEX and VLife MD suite, Virtual Screening, Drug metabolism; Cytochrome p450, pharmacodynamics and pharmacokinetics, clinical trials, FDA approval

RECOMMENDED BOOKS:

5. Essential Bioinformatics, Jin Xiong
UNIT-I: Physical pharmaceutics covering the following aspects
Introduction to Advance Pharmaceuticals, Solids: Particle characterization by size, shape and surface of individual particle and for contacted particle. Handling of solids, pharmaceutical granulation, compression and compaction properties of binary mixtures, lubricant sensitivity, characterization of granules and compacts.

UNIT-II: Dissolution

UNIT-III: Surfactant System
Phase behavior of surfactant in binary and ternary systems. Factors affecting phase behavior; Micellization; micelle structure, shape, size factors affecting CMC and micelle size, thermodynamics and kinetics of micelle formation. Pharmaceutical aspects of Solubilization, Solubilization in non-aqueous system, interactions with polymers and oppositely charged species. Hydrotropy in pharmaceuticals, surfactants in emulsions and suspensions. Biological implications of surfactants; Effect on: dissolution of drugs, permeability of membranes, drug absorption, antibacterial activity. Cyclodextrin inclusion complexes and co-solvents.

UNIT-IV: Polymer science
Types and applications of polymers, polymerization reactions, methods of polymerization and characterization of polymers, thermodynamics of polymer solutions.

UNIT-V: Stability studies
Kinetics activation energy calculations, accelerated stability studies, factors responsible for destabilization of pharmaceutical products and techniques to improve, shelf life calculations. Physical testing of solution, suspension, emulsion, aerosol, powder, tablet and sustained release products.

REFERENCE BOOKS:
1. Kitahard and A. Watanabe; Electrical Phenomena at Interfaces; Marcel Dekker.
3. D. M. Parikh; Handbook of Pharmaceutical Granulation Technology; Marcel Dekker.
4. G. Alderborn and C. Nystrom; Pharmaceutical Powder Compaction Technology; Marcel Dekker.
5. H. G. Brittain; Physical Characterization of Pharmaceutical solids; Marcel Dekker.
6. J. T. Cartensen; Drug Stability; Marcel Dekker.
7. James J. Wells; Pharmaceutical Preformulation, Ellis Harwood Ltd.
8. Lieberman, Rieser and Banker; Pharmaceutical Dosage Forms; Disperse system; Marcel Dekker.
11. N. G. Stanley – Wooed; Enlargement and compaction of particle solids; Butterworths.
13. P. J. Tarcha; Polymer for Controlled Drug Delivery, CRC Press.
15. Kitahard and A. Watanabe; Electrical Phenomena at Interfaces; Marcel Dekker.
17. D. M. Parikh; Handbook of Pharmaceutical Granulation Technology; Marcel Dekker.
18. G. Alderborn and C. Nystrom; Pharmaceutical Powder Compaction Technology; Marcel Dekker.
19. H. G. Brittain; Physical Characterization of Pharmaceutical solids; Marcel Dekker.
20. J. T. Cartensen; Drug Stability; Marcel Dekker.
21. James J. Wells; Pharmaceutical Preformulation, Ellis Harwood Ltd.
22. Rieser and Banker; Pharmaceutical Dosage Forms; Disperse system; Marcel Dekker.
25. N. G. Stanley – Wooed; Enlargement and compaction of particle solids; Butterworths.
27. P. J. Tarcha; Polymer for Controlled Drug Delivery, CRC Press.
PRACTICALS

PRACTICAL COURSE HCP 3.1: INDUSTRIAL & ENVIRONMENTAL BIOTECHNOLOGY 2- Credits
2. Alcoholic beverages: Beer/ Wine
3. Fermentative production of Amino Acid: L-glutamic acid/Phenylalanine/ L-lysine & Vitamins: Vitamin B12.
4. To study the BOD & COD levels of different water systems.
5. Bacteriological analysis of water by presumptive, confirmatory and completed tests
6. Isolation of xenobiotic degrading microorganisms

PRACTICAL COURSE HCP 3.2: GENETIC ENGINEERING 2-Credits
1. Isolation of Genomic DNA from bacteria
2. Isolation of plasmid DNA.
3. In vitro DNA ligation
4. Transformation of E. coli
5. Southern blotting and hybridization
6. Restriction Fragment Length Polymorphism (RFLP)
7. DNA amplification by PCR
8. Isolation of Bacteriophage and purification of phage lysate

PRACTICAL COURSE SCP 3.1: PLANT BIOTECHNOLOGY 2-Credits
1. Preparation of Media.
2. Ex-plant Surface Sterilization
3. Callus Culture and Organ Culture
4. In vitro rooting and acclimatization.
5. Protoplast isolation and culture.
6. Anther Culture/ Production of haploids.
7. Synthetic seed preparation

PRACTICAL COURSE SCP 3.2: CANCER GENETICS AND ANIMAL CELL CULTURE 2 Credits
1. DNA amplification by PCR
2. Reporter gene assay (b- Gal)
3. DNA Fingerprinting: Using RAPD techniques
4. Aseptic Transfer technique in animal Cell Culture
5. Preparation of Balanced Salt Solution and Ph standards for animal cell culture.
6. Trypsinization methods in animal cell culture -
7. A.Warm Trypsinization B.Cold Trypsinization
8. Chick Embryo Culture / Lymphocyte Culture.
PRACTICAL COURSE OEP 3.1: COMPUTATIONAL STRUCTURE BIOLOGY AND DRUG DESIGNING  

2 Credits

1. Accessing to Structural Databases and Data retrieval using RCSB PDB, CSA PDBe, PDBeChem, PDBeFold, PDBeMotif, PdbSum.
2. Structural classification using CATH, SCOP resources.
3. Secondary structure prediction using SOPMA and GOR.
4. Homology modeling by SWISSMODEL, and Modeller 9V2 and Model Validation using RAMPAGE or PROCHECK,
5. Prediction of protein-protein, protein-DNA, protein-ligand interactions and
6. Drugbank database and Chembank database
7. Design of ligands using ACD lab and Chemsketch and Development of lead library and high throughput screening using *In silico* ADMET Properties.
8. Docking studies using AUTODOCK and HEX.

PRACTICAL COURSE OEP 3.2 ADVANCED PHARMACEUTICALS  

2-Credits

1. Powder characterization: Microscopy – Particle size analysis, calculation of shape factors. 
   Powder Characterization: Compression and compaction – Huckel plot studies, tensile strength.
2. Solubilization:
   - Effect of dielectric constant on solubility
   - Complexation
   - Ternary phase diagram.
   - Solid dispersion
3. Stability of multiple emulsions
4. Polymer science: Rheological and thermal characterization of polymers. Stability study
6. Accelerated stability studies of a formulation.
7. Dissolution studies of various dosage forms
HCT 4.1: ANIMAL BIOTECHNOLOGY AND STEM CELL TECHNOLOGY

UNIT-I: Introduction, history of animal cell culture and cell culture media [14]
Introduction, importance, history of cell culture development, different tissue culture techniques including primary and secondary culture, continuous cell lines, suspension culture, organ culture, hybridoma technology, culture of lymphocyte, oviductal, epithelial cell culture, stem cell and induced pluripotent stem (iPS) cells. Different type of cell culture media, growth supplements, serum free media, balanced salt solution, other cell culture reagents, culture of different tissues and its application. Bioreactor Design, Mechanochemical Regulation of Cell Behaviour, In vitro and In vivo Synthesis of Tissues and Organs, MicroScale Patterning of Cells and their Environment, Three-Dimensional Scaffolds.

UNIT-II: Characters of cells and behavior [10]
Behavior of cells in culture, division, their growth pattern, metabolism of estimation of cell number. Scaling up the cell culture to large scale/industrial level production.

UNIT-III: Concept of cell line and transgenic animal [10]
Development of cell lines, characterization and maintenance of cell lines, cryopreservation, common cell culture contaminants. Culture of cells for production of various biological, Concepts of transgenic animal technology; strategies for the production of transgenic and knock out animals—significance in biotechnology - stem cell cultures in production of transgenic animals.

UNIT-IV: Stem Cells – Basics, Properties and Classification [12]
Types of Stem cells – Hematopoietic Stem Cells, Mesenchymal Stem Cells, Embryonic Stem Cells, Fetal Stem Cells, Stem cells from adult organs- Characteristics, Isolation, Culture and Characterization protocols Three-Dimensional Cell Culture, Organ Culture, Organotypic Culture. Extra Cellular Matrices Morphogenesis and Tissue Engineering.

UNIT-V: Tissue Engineering and Transplantation Techniques [14]
Immunosolation Techniques, Modes of Cell and Tissue Delivery, Regeneration of Bone and Cartilage Islet Cell transplantation and Bioartificial Pancreas Bioprinting of Organs and Tissues, Stem Cells in Gastrointestinal, Liver, Pancreas, Kidney, Heart, Spinal Cord and Lung Regeneration Stem Cells in Eye Diseases and Disorders

REFERENCE BOOKS:

UNIT-I: Microscopy & Centrifugation [12]
Light microscope, Fluorescence microscope, Phase contrast microscope, Electron microscope, confocal microscopy. Centrifugation: Small bench top centrifuges, large capacity refrigerated centrifuges, High speed refrigerated centrifuges, preparative and analytical ultracentrifuge, Molecular weight determination.

UNIT-II: Chromatographic techniques [10]
Principles of chromatography, size exclusion, ion exchange and affinity chromatography. High performance liquid chromatography (HPLC), Gas liquid chromatography (GLC), Thin layer chromatography (TLC), Paper chromatography, GC-MS, LC-MS, Chromatofocussing.

UNIT-III: Electrophoresis [14]
General principles, factors affecting migrating rates, factors affecting migration of ions, support media, Techniques of electrophoresis: low and high voltage, capillary electrophoresis, electro osmotic flow techniques, instrumentation, zone electrophoresis and applications. Electrophoresis of proteins: SDS-PAGE, Native gels, Gradient gel, Isolelectric focusing, 2-D gel electrophoresis (2-D PAGE), cellulose acetate electrophoresis, continuous flow electrophoresis; Detection, estimation and recovery of proteins, Western blotting. Electrophoresis of nucleic acids: agarose gel electrophoresis of DNA, DNA sequencing gels, Pulse field gel electrophoresis, electrophoresis of RNA, Capillary electrophoresis.

UNIT-IV: Electrochemical technique and Spectroscopy [14]

UNIT-V: Radio isotope techniques [10]
The nature of radioactivity, detection and measurement of radioactivity: detection based on gas ionization- Geiger Muller counter-principle and applications. Detection based on excitation Liquid Scintillation counter-principle and applications. Supply, storage and purity of radiolabelled compounds, specific activity, inherent advantages and restrictions of radio tracer experiments, safety aspects, applications- of radio isotopes in biological sciences.

REFERENCE BOOKS:
4. Instrumental methods of chemical analysis - P.K. Sharma
5. Biophysical chemistry - Upadhyay. Upadhyay and Nath
6. A Biologist's guide to principle and techniques of practical biochemistry - Brigan L. Williams.
HCT 4.3: RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHT (IPR)

UNIT-I: Research [10]

UNIT-II: Sampling Techniques & Parametric Tests [14]

UNIT-III: Thesis and Manuscript writing [14]

UNIT-IV: Introduction to IPR and Patents [12]

UNIT-V: Plant breeder’s right [10]
UPOV, Breeders exemption, Plant variety protection in India. Farmer’s right, advantages and disadvantages of PBR. Technology transfer- Introduction, types of technology transfer and Indian scenario.

REFERENCE BOOKS:

2. Research Methodology, Method and Techniques by C.R. Kothari or by Santosh Gupta.
3. Research Methodology by Gurumani.
SCT 4.1: MEDICAL BIOTECHNOLOGY AND BIO-NANOTECHNOLOGY

4 Credits (60L)

UNIT-I: Medical biotechnology [14]

UNIT-II: Laboratory diagnosis [10]

UNIT-III: Chemotherapy [12]

UNIT IV: Bio-Nanotechnology [10]
Introduction to Nanoworld, Nanoscience and Nanotechnology - nanoparticles, Nanowires, Nanorods, Nanotubes, thin films and multilayer. Applications in nanotechnology viz. Biosensors, separation of cells and cell Organelles, environmental cleaning, drug delivery, gene therapy etc.

UNIT-V: Synthesis of nanostructures [14]

REFERENCE BOOKS:

SCT 4.2: ADVANCED PHARMACOGNOSY

UNIT-I: General Research Methodology [10]
Definition of research, meaning of research objective of research, types of research, Review of literature and sampling techniques.

UNIT-II: Herbal drug Industry [12]
Infrastructure of herbal drug industry involved in production of standardized extracts and various dosage forms. Entrepreneurship Development. Project selection, project report, technical knowledge, plant design, layout and construction. Pilot plant scale–up techniques, case studies of herbal extracts. Formulation production management.

UNIT-III: Herbal drug regulatory affairs [14]
Basic principles of clinical studies, Stability, Safety and toxicology of herbal drugs. Adverse drug reaction in herbal drugs. Effect of herbal medicines on clinical laboratory testing. Regulation and dispensing of herbal drugs.

UNIT-IV: Information Retrieval systems of Herbal Drugs & Literature survey of following therapeutic groups [10]
Immunomodulators: Withaniasomnifera, Centellaasiatica, Embelicaofficinalis, Ocimum sanctum
Antipeptic ulcer: Glyceriza root, Azadirachtaindica,Gingiberofficinalis
Hepatoprotectives:Silibummarianum,Phyllanthusniruri,Picorrhizakurroa, Andrographispaniculata
Anticancer :Taxus species, Camptotheca acuminate
Antifertility : Embelicaribes, Azadirachtaindica, Gossypium species
Nervine Tonic: Centellaasiatica, Acoruscalamus, Valerianawallichi
Anti-AIDS : Areca catechu, Theasinensis

UNIT-V: Volatile oils and Dyes [10]
Volatile oil of commercial significance. Review of Natural sweeteners: Dyes and Pigments, Preservatives.

REFERENCE BOOKS

1. Ayurvedic formulary of India, Govt.of India, 1962.
3. Cultivation and Utilization of aromatic plants: Atal & Kapoor, RRL, Jammu
5. Drug and Cosmatic act, (with latest amendments including Ayurvedic GMP), Govt. of India.
10. Various journals related to medicinal plants.
11. Various journals related to spices, perfumes, food and nutrition.
MP 4.1: PRACTICAL PAPER: PROJECT DISSERTATION AND VIVA VOCE
(200 Marks, Credits-8)

Students have to begin their projects in 3rd Semester and submit the report in 4th Semester.
Solapur University, Solapur
Nature of Theory Question Paper for CBCS Pattern
(CHOICE BASED CREDIT SYSTEM-CBCS)
Faculty of Science
M.Sc. Biotechnology

Time:- 3 hrs Total Marks-70
Note: 1) Section - I Compulsory
2) Answer any four questions from Section – II

SECTION - I

Q. 1 A) Multiple choice questions (07)
   i) .................................................................
      a) b) c) d)
   ii)
   iii)
   iv)
   v)
   vi)
   vii)

B) Define the following terms (07)
   i)
   ii)
   iii)
   iv)
   v)
   vi)
   vii)

SECTION - II

Q. 2) Long answer type question (14)
Q. 3) Long answer type question (14)
Q. 4) Long answer type question (14)

Q. 5) Answer any TWO of the following (14)
   i) Short answer type question
   ii) Short answer type question
   iii) Short answer type question

Q. 6) Write Short notes on any TWO of the following (14)
   i) Short note
   ii) Short note
   iii) Short note

N. B. In Q.5 and 6 the sub-questions (i, ii, and iii) in a given question should be from different topics of the syllabus.