

University of Pune

Three Year B. Sc. Degree Course in

BIOTECHNOLOGY

S.Y.B.Sc. BIOTECHNOLOGY

Syllabus

(To be implemented from Academic Year 2014-15)

Course structure: First Year B.Sc. Biotechnology

Course Code and Course Name	Theory/ Practical	Marks	Lecture/ Practical
Bb- 101 Fundamentals of Chemistry	Theory	100	90L
Bb- 102 Fundamentals of Physics	Theory	100	90L
Bb- 103 Basics of plant and animal sciences	Theory	100	90L
Bb- 104 Mathematics & Statistical Methods for Biologists	Theory	100	90L
Bb- 105 Fundamentals of Biological Chemistry	Theory	100	90L
Bb- 106 Biophysics & Instrumentation	Theory	100	90L
Bb- 107 Microbiology	Theory	100	90L
Bb- 108 Computers and application	Theory	100	90L
Bb- 109 Practicals in Chemistry and Biochemistry	Practical	100	30 P
Bb- 110 Practicals in Physics, Biophysics and Instrumentation	Practical	100	30 P
Bb- 111 Practicals in Biosciences	Practical	100	30 P
Bb- 112 Quantitative Methods in Biology	Practical	100	30 P

Course structure: Second Year B.Sc. Biotechnology

Course Code and Course Name	Theory/ Practical	Marks	Lecture/ Practical
Semester I			
Bb- 211 A Genetics & B Immunology	Theory	75 25	45L 15L
Bb- 212 Cell Biology	Theory	100	60L
Bb- 213 Environmental Biology and Biotechnology	Theory	100	60L
Bb- 214 Practicals in Environmental Biotechnology	Practical	100	30P
Bb- 215 Practicals in Cell Biology & Genetics	Practical	100	30P
Semester II			
Bb- 221 Molecular biology	Theory	100	60L
Bb- 222 Animal and Plant development	Theory	100	60
Bb- 223 Scientific writing and communication	Theory	50	30L
Bb- 224 Metabolic Pathways	Theory	50	30L
Bb- 225 Practicals in Molecular biology	Practical	100	30 P
Bb-226 Practicals in Developmental biology	Practical	100	30 P

Course structure: Third Year B.Sc. Biotechnology

Course Code and Course Name	Theory/ Practical	Marks	Lecture/ Practical
Semester I			
Bb-331 Microbial Biotechnology	Theory	100	60L
Bb-332 Plant and animal tissue culture	Theory	100	60L
Bb- 333 Biodiversity & Systematics	Theory	100	60L
Bb-334 Practicals in Tissue culture	Practical	100	30P
Bb- 335 A Practicals in Microbial biotechnology B Practicals in Field studies and report writing	Practical	75 25	30P
Semester II			
Bb-341 Large scale Manufacturing process	Theory	100	60L
Bb- 342 Biochemical and biophysical techniques	Theory	100	60L
Bb- 343 Practicals in Recombinant DNA Technology	Theory	100	60L
Bb -344 Techniques in Genetic Engineering	Practical	100	30P
Bb- 345 A Practicals of large scale manufacturing process B Practicals in biochemical and Biophysical techniques	Practical	50 50	30P

Bb-211 A Genetics (45L)
B Immunology (15L)

Bb-211 A: Genetics (45L)

Sr. No.	Topic	Lectures
1	Mendelian genetics Laws of heredity and modifications of monohybrid interactions (incomplete dominance, co-dominance and over dominance)	3
2	Varieties of gene expression (with at least one example each) Multiple alleles, lethal genes, Gene interactions – dominant and recessive epistasis, duplicate genes, Complementary genes and dominant & recessive interactions	2 3
3	Linkage and linkage maps Complete and incomplete linkage, crossing over, three point cross, genetic mapping, Chromosome interference, analysis of ordered and unordered tetrads	6
4	Pedigree analysis Standard symbols used, penetrance, recessive and dominant inheritance, Probability, sex linked inheritance	2
5	Chromosomal aberrations Variation in chromosome number – types, generation of variation, aneuploidy , dosage compensation and barr bodies (Human) Variation in chromosome structure – types, generation of variation, identification of heterozygotes due to chromosomal variations, consequences	3 3
6	Mutations Classification and types, molecular basis of mutations, mutagens and their action, hot spot mutations	3
7	Bacterial plasmids Types, structure, properties and significance	2
8	Operon concept Inducible and repressible operons, positive and negative regulation, lactose, tryptophan and arabinose operons pertaining to their structure and regulatory mechanisms (both positive and negative regulation in detail)	5

9	<p>DNA transfer mechanisms</p> <p>Conjugation – F factor, mechanism of conjugation, Hfr strain and its transfer, sexduction</p> <p>Bacterial transformation – concept of transforming principle, mechanism of Transformation in Streptococcus and Haemophilus in detail</p> <p>Transduction – virulent and temperate phages, lytic and lysogenic life cycles, Mechanism of generalised and specialised transduction, abortive transduction, co-transduction.</p>	2 2 3
10	<p>Transposable elements</p> <p>Characteristics, transposable elements in prokaryotes (insertion sequences, Transposons) and eukaryotes (yeast Ty elements, Ac/Ds elements in maize, Copia and P elements in Drosophila, Alu sequences in humans), mechanisms of transposition, excision of transposons</p>	4
11	<p>Population genetics</p> <p>Gene frequencies, allele frequencies, random mating and Hardy –Weinberg principle</p>	2

Bb-211 B: Immunology (15L)

Sr.No.	Topic	Lectures
1	<p>a) History of development of Immunology</p> <p>b) Overview of immune system-cells & organs involved ,T & B cell subsets, effector cells, antigen presentation,</p> <p>c) Innate Immunity & adaptive Immunity, Introduction to Vaccines : Active & Passive immunization Types of Vaccines</p>	5
2	Antigens –Types, factors affecting antigenicity, Structure & functions	2
3	Antibodies –Types, Structure & functions, antibody diversity	4
4	Antigen – Antibody interactions (epitope-paratope), principle & applications	3
5	Hypersensitivity: types, significance	1

Reference books:

For Genetics

1. Genetics, (2006) Strickberger MW - (Prentice Hall, India)
2. Snyder L, Champness W (2007) – Molecular genetics of bacteria (ASM Press, Washington)
3. Hartl DL, Jones EW (2001) – Genentics: analysis of genes and genomes (Jones and Bartlett, Massachusetts)

4. Griffiths AJ, Wessler SR, Carroll SB, Doebley J (2012) – Introduction to genetic analysis (Freeman & Co, New York) tenth edition.

For Immunology

5. Kuby immunology, Judy Owen , Jenni Punt , Sharon Stranford., 7th edition (2012), Freeman and Co., NY
6. Textbook of basic and clinical immunology, 1st edition (2013), Sudha Gangal and Shubhangi Sontakke, University Press, India

Bb-212 Cell Biology (60L)

Sr. No	Topic	Lectures
1	Overview of plant and animal cell structure, cellular diversity	2
2	Mitosis, meiosis in plants and animals	6
3	Cell cycle: Phases of cell cycle, checkpoints of cell cycle, regulation of cell cycle	7
4	Cell wall : Plant cell wall - primary and secondary, glycocalyx Plasma Membrane : Structure, chemistry and receptors Transport- simple diffusion, facilitated diffusion, active transport, membrane potential and synaptic transmission ,exocytosis and endocytosis, pinocytosis and phagocytosis,	10
5	Structure and function of cell organelles Endoplasmic reticulum, Mitochondria, Chloroplast, Golgi body, nucleus, lysosomes, vacuoles, peroxysomes and glyoxysomes	20
6	Protein Targeting	5
7	Cell junctions and cell matrix interactions	5
8	Apoptosis , neoplasia and cell death	5

Reference books:

1. Molecular Cell Biology. 7th Edition, (2012) Lodish H., Berk A, Kaiser C., KReiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., W.H. Freeman and Co., USA
2. Molecular Biology of the Cell, 5th Edition (2007) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Garland Science, USA
3. Cell Biology, 6th edition, (2010) Gerald Karp. John Wiley & Sons., USA
4. The Cell: A Molecular Approach, 6th edition (2013), Geoffrey M. Cooper, Robert E. Hausman, Sinauer Associates, Inc. USA

Bb-213 Environmental Biology and Biotechnology (60L)

Sr. No.	Topic	Lectures
1	Understanding Environment and Ecology	20
1.1	Introduction to Environmental science and Ecology	2
1.2	Environmental Components- Introduction, Atmosphere, Ozone layer, Hydrosphere, Lithosphere, Biosphere.	4
1.3	Ecology and its concepts- Biogeography, Ecosystem and Community with examples, Ecosystem Evolution.	5
1.4	Energy flow- Second law of thermodynamics, Food chain, Trophic Levels, Energy Budget, Nutrient cycles (Nitrogen, Phosphorus, and Carbon).	5
1.5	Factors affecting Ecosystem Natural Factors, Inter & Intra-community Factors, Anthropogenic Factors.	4
2	Threats to Ecosystem/Environment	20
2.1	Pollution- Air, Water, Soil. Pollutants in ecosystems- Terrestrial, Aquatic ecosystems Pesticides/Insecticides, Heavy Metals, Toxins, Radiation.	8
2.2	Environmental Priorities in India- Environmental Impact Assessment (EIA case study), Red data book,	7

	TRAFIC.	
2.3	Microbial Biodegradation of Plastic, Hydrocarbons, pesticides/ insecticides and herbicides, Hazardous Waste.	6
3	Biotechnology in Protection and Restoration of Ecosystem	20
3.1	Protection- Social Awareness, Major Protection acts in India (Forest (conservation) Acts 1980, Wild life Protection Act 1972) and protection efforts in the world (Earth Summit, Agenda 21)	3
3.2	Bioremediation- Importance of bioremediation, Use of microorganisms, Phytoremediation. Bioindicators and detectors	6
3.3	Modern conservation practices- Biotechnology in conservation, <i>Ex situ</i> and <i>In situ</i> conservation practices, In vitro propagation of rare and threatened species, Conservation of genetic resources	6
3.4	Waste and Disaster Management- Waste water treatment-Biological, Biomedical waste management, Integrated waste management, Hazards in environment, Remote Sensing and GIS	5

Reference Books:

1. An Introduction To Geographic Information Technology (2009) Suchandra Choudhury I K International Pvt Ltd., New Delhi
2. Concepts and Techniques of Geographic Information Systems C.P.Lo.Albert K.W.Yeung 2nd edition, Prentice Hall, Inc., New Jersey
3. Ecology and environment (2005) Sharma PD Rastogi Publication, New Delhi
4. Ecology and environmental biology (2011) Saha T K Books & Allied (p) Ltd, Kolkata
5. Ecology science and practice (2001) Faurie et al Oxford & IBH Publ. Co. Pvg. Ltd, New Delhi
6. Ecology: Principles and Applications (1998) J. L. Chapman, M. J. Reiss Cambridge

University Press, Cambridge

7. Environment Problems & Solutions (2001) Asthana & Asthana S. Chand Limited, New Delhi
8. Environmental Biology (2000) Varma & Agarwal S. Chand Limited, New Delhi
9. Environmental biology and toxicology (2011) Sharma PD Rajpal And Sons Publishing, Delhi
10. Environmental biotechnology(2010) Rana Rastogi Publications, New Delhi
11. Environmental chemistry (2003) A. K. De 5th edition, New Age International Ltd, New Delhi
12. Environmental Chemistry (2007) B.K. Sharma 11th edition, Goel Publishing House, Delhi
13. Environmental pollution and health hazard in India (1987) Ram Kumar Ashish Pub. House, New Delhi
14. Environmental risks and hazards (1994) Susan Cutter Prentice Hall, Inc., New Jersey
15. Environmental Science (2010) G. TyMiller, Jr., Scott Spoolman Brooks and Coel, CengageBrain learning, USA
16. Environmental Science (2011) Santra S.C. New Central Book Agency, Kolkata
17. Fundamentals of Ecology (2005) Eugene Pleasants Odum, Gary W. Barrett Brooks and Coel, USA
18. Fundamentals of Ecology (2009) Dash 3rd edition, Tata McGraw-Hill Education, New Delhi
19. Introduction to Environmental Biotechnology (2007) Chattergy PHI Learning Pvt. Ltd, Delhi
20. Text book of Environmental Engineering (2005) P. Venugopala Rao PHI learning Pvt Ltd, Delhi
21. Textbook of environmental studies for undergraduate courses (2005) Erach Bahrucha Universities Press, Hyderabad
22. The Microbiology of Activated Sludge (2010) R. J. Seviour IWA publication, UK

Bb-214 Practicals in Environmental Biotechnology (30P)

Sr. No.	Practicals	Practicals (Total 30)
1	Identification of different types of Ecosystems (Local Field Visit)	3
2	Community sampling- Quadrat sampling for plants, Relative abundance, Distribution, Girth class distribution. (Local Field Visit)	3
3	Microbial (Bacterial/Algal/Fungal) community estimation	3
4	Estimation of Biomass from Terrestrial/Aquatic Ecosystem.	2
5	Estimation of Physical (Colour, Texture, Water holding capacity, Conductivity) , Chemical(pH, Organic content and Alkalinity), and Biological (microbial load with nitrogen fixers, cellulose degraders) characteristics of polluted and unpolluted soil	6
6	BOD and COD estimation of polluted water	3
7	Genotoxicity and Cytotoxicity assay to estimate water contamination	3
8	Case Study- EIA	2
9	Qualitative and quantitative estimation for Pesticide /Insecticide degradation	2
10	GIS-Remote Sensing (software demo) of local (e.g. college campus, water bodies etc.) area	3

Bb215–Practicals in cell biology and genetics (30P)

Sr. No.	Topic	Practical (30P)
1	Problem sets in Mendelian inheritance, single point & two point crosses, Gene interactions – epistasis, incomplete dominance, co-dominance, multiple alleles, lethal genes Linkage – two and three point crosses Tetrad analysis	1 2 1 1
2	Study of mitosis (onion root tip) and meiosis (grasshopper testis/ <i>Tradescantia</i>)– preparation of slides and identification of different stages	4
3	Study of polytene chromosomes – preparation of slides	2
4	Karyotype analysis	1
5	Hemeagglutination (blood grouping)	1
6	Study of antigen antibody interaction by Ouchterlony method	1
7	Isolation of mutants by replica plate technique	1
8	Microscopy & micrometry – measurement of cell size and nucleus	2
9	Observation of human cheek epithelial cells.	1
10	Staining of mitochondria in human cheek epithelial cells.	1
11	Effect of colchicine on mitosis.	1
12	Isolation of nuclei and mitochondria from chicken/goat liver by Density Gradient Centrifugation	4
13	Counting of nuclei by haemocytometer Confirming mitochondria by succinate dehydrogenase assay	2
14	Methods of Cell lysis	2
15	Study of blood cell types	2

Bb-221 Molecular Biology (60L)

Sr. No.	Topic	Lectures
1	DNA as the genetic material a. Introduction b. Different classical experiments leading to evidence of DNA as genetic material c. Structure of DNA - Watson & Crick model	3
2	Nucleic acids- structure, properties and function a. DNA forms; A, B & Z b. RNA: tRNA, rRNA , mRNA and non-coding RNA (Mi-, SiRNA)	5
3	Concept and Organization of Genomes- Viral, Bacterial, Organelles, human Types of genome sequences including gene families and gene clusters	8
4	Eukaryotic genomes: a. Chromosomal organization and structure. Euchromatin, heterochromatin, centromere, telomere. b. Chromatin structure (nucleosomes)- histone, non-histone proteins	6
5	Definition of gene – introns/exons, Regulatory sequences, promoters, enhancers and suppressors	5
6	Central dogma of Molecular Biology and exceptions to Central Dogma	2
7	DNA replication in prokaryotes and eukaryotes	6
8	DNA damage and repair a. Mutations b. DNA repair mechanisms	4
9	Transcription in Prokaryotes and Eukaryotes a. Mechanism of transcription b. Regulation of transcription	6
10	Genetic Code a. Major scientific contributions to decipher genetic code b. Concept of codon, reading frame, frame shift c. Degeneracy of codon	3
11	Translation: a. in Prokaryotes b. in Eukaryotes c. Inhibitors of translation	6
12	Post-translational modifications a. glycation, glycosylation b. ubiquitination, SUMOylation	3
13	Protein translocation a. Signal peptide b. co- & posttranslational translocation	3

Reference Books :

1. Genes X, 10th edition (2009), Benjamin Lewin, Publisher - Jones and Barlett Publishers Inc. USA
2. Molecular Biology of the Gene, 6th Edition (2008), James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. USA
3. Molecular Biology, 5th Edition (2011), Weaver R., Publisher-McGraw Hill Science. USA
4. Fundamentals of Molecular Biology, (2009), Pal J.K. and Saroj Ghaskadbi, Oxford University Press. India

Bb- 222 Plant & Animal Development

Sr. No.	Topics	Lectures
	Plant Development	
1	Plant as a living system Unique features of plant development Principles of plant development	2
2	Plant development at: Cellular, organ and whole-plant levels Whole plant as an interacting dynamic system	3
3	Major phases of plant development Vegetative development: Zygote to seed embryo to seedling till vegetative maturity Pattern formation in plants- vegetative	3
4	Reproductive development: Shift from vegetative to reproductive phase Induction- perception of inductive stimuli and subsequent changes, Pattern formation in plants- flowering	4
5	Microsporogenesis, development of male gametophyte and male gamete Megaspores, development of female gametophyte and female gamete Double fertilization and triple fusion Development of endosperm	4
6	Concept of competence, determination, commitment, differentiation, de-differentiation and re-differentiation (partial/ terminal) <i>in vivo with one example each</i>	3
7	Model systems to understand plant development, <i>Fucus</i> , and <i>Arabidopsis</i>	2
8	Programmed Cell Death- ageing and senescence	2
9	Molecular regulation of development in <i>Arabidopsis</i>	4
10	<i>In vitro</i> response in-relation-to developmental stage(s) of plants/organs	3
	Animal Development	
1	Gametogenesis: oogenesis and spermatogenesis Fertilization	6
2	Types and patterns of cleavage, blastulation	2
3	Gastrulation in amphioxus, frog and chick up to formation of three germinal layers	7
4	Overview of organogenesis in frog, chick	3
5	Concept of stem cells, Progenitor cells, cell lineages, determination, commitment and differentiation	2
6	Concept of dedifferentiation, redifferentiation, transdifferentiation and	3

	three types of regeneration with one example of each type	
7	Role of gene/s in patterning and development of <i>Drosophila</i> .	4
8	Ageing and apoptosis,	2
9	Abnormal development and teratogenesis in animals	1

Reference Books:

1. Development Biology, 9th edition, (2010), Gilbert S.F.(Sinauer Associates, USA)
2. Principles of Development, 4th edition (2010), Wolpert L and Tickle C, Publisher: Oxford University Press, USA.
3. Bhojwani S.S. and Bhatnagar S.P.(2009) – Embryology of Angiosperms (Vikas Publ House, New Delhi)
4. Burgess J. (1985) An Introduction to Plant Cell Development (Cambridge Univ Press, UK)
5. Taiz L, Zeiger E (2010) – Plant physiology (Sinauer Associates, USA).
6. Sharma HP (2009) – Plant embryology: Classical and experimental (alpha sci)
7. Steeves TA & Sussex IM (2004) – Patterns in plant development. (Cambridge Univ Press, Cambridge, New York)

Bb-223: Scientific writing and communication (30L)

Note: This is a 30 Lectures, Topic nos. 1-6 are to be taught by a teacher of English and Topic nos. 7-16 by a Biology teacher

Sr. No	Topic	Lecture
1	Making oral presentations: Pronunciation, accent, intonation, clarity, speed, fluency, eye contact; Planning and organization.	4
2	Enrichment of vocabulary: Word forms and derivations, prefixes and suffixes, other processes of word formation. Scientific and technical vocabulary, spellings; Frequently confused words.	3
3	Basic grammar: Tenses; Voices; Propositions and conjunctions; Conditional sentences; Count and non-count nouns; Concord; Punctuations.	4
4	Effective written presentation: Order of sentences in a paragraph; Sentence connection, cohesion and coherence; Contradiction, tautology, semantic anomaly, circumlocution	2
5	Using the dictionary and the thesaurus.	1
6	The curriculum vitae.	1
7	Scientific method: Concept, hypothesis, theory, law; Design of experiment; Inductive and deductive reasoning.	2
8	Types of presentation: Oral, poster, written, audio-visual. Aids for presentation	1
9	Preparing the manuscript. Guidelines for authors. The IMRAD format.	1
10	Title, byline; Abstract and Summary; Keywords.	1
11	Introduction: Defining the problem; Literature survey; Justification of study.	1
12	Materials and Methods: Contents, sources, procedures, techniques, reproducibility, Units of measurements, metric system and SI units. Basic statistical techniques, confidence limits, tests, probability, significance.	2
13	Results: Text; How to present data; Tables and illustrations. Writing captions, labels and legends.	2
14	Discussion: Components and sequence. Analysis, comparison and integration of data. Likely sources of errors in Results; Conclusions and significance. Implications for further study.	2
15	Acknowledgements. Literature citation systems. Sources of references: Journals, books, bibliographies, abstracting journals; Databases.	2
16	Preparing and submitting the manuscript. Revising, editing, proofreading.	2

Reference Books:

1. Scientists Must Write. 2nd Edition, (2002), Barrass, R., Routledge, Oxon, UK
2. How to Write and Publish a Scientific Paper. 6th Edition, (2006), Day, R.A. and B. A. Gastgel, Greenwood Press, Westport, CT, USA.
3. Medical Writing: A prescription for clarity. 3rd Edition, (2006), Goodman, N.W. and M.B. Edwards, Cambridge University Press, Cambridge, UK.
4. Planning, Proposing and Presenting Science Effectively, 2nd Edition, (2006), Hailman, J.P. and K. B. Strier, Cambridge University Press, Cambridge, UK.
5. Biomeasurement: Understanding, Analysing and Communicating Data in Biosciences, (2005), Hawkins, D., Oxford University Press, Oxford, UK.
6. AMA Manual of Styles. A Guide for Authors and Editors, 10th Edition, (2007), JAMA and Archives Journals, Oxford University Press, New York.
7. Successful Scientific Writing: A step-by- step guide for the biological and medical sciences, 3rd Edition, (2008), Mathews, J.R. and R.W. Mathews, Cambridge University Press, Cambridge, UK
8. Writing Papers in the Biological Sciences. 4th Edition, (2004),McMillan, V.E., Bedford Books/St Martins.
9. A Short Guide to Writing About Biology. 6th Edition, (2006), Pechenik, J.A., Longman, New York.
10. A Manual for Writers of Research Papers, Theses and Dissertations. Edn. 7, (2007), Turabian K.L., W.C. Booth, G.G. Colomb, J.M. Williams and University of Chicago Press Staff, University of Chicago Press, Chicago, IL, USA.

Bb- 224 Metabolic Pathways (60L)

Sr. No.	Topic	Lecture
1	Bioenergetics: Bioenergetics, Source of free energy for cells. Free energy change during reaction, important types of reaction in metabolism, oxidation- reduction reaction , biological oxidation reduction reaction, types of electron transfer, redox potential, phosphoryl group transfer and ATP.	1
2	Enzymes: Definition, advantages over chemical catalyst, classification with examples, how enzymes work, specificity. Enzyme activity, specific activity, turnover number. Enzyme kinetics: substrate concentration, Presteady state, steady state assumption , Michaelis Menten equation, initial velocity , V_{max} , K. Lineweaver Burke's Plot. Inhibition: Reversible, irreversible, competitive, non- competitive, uncompetitive, Regulation : Allosteric enzymes and regulation, feedback inhibition.	3
3	Metabolism: Introduction to anabolism and catabolism.	1
4	Carbohydrate Metabolism: Glycolysis, fates of pyruvate: cori cycle fermentation, ED pathway, TCA cycle, Anapleurotic reactions, gluconeogenesis, glycogen breakdown and glycogen synthesis, Glyoxylate pathway, pentose phosphate pathway. Regulation of pathways	10
5	Electron transport System and Photosynthesis, light and dark reaction. C3 and C4 pathways	5
6	Overview of Lipid metabolism: Action of lipases, Beta oxidation of Fatty acids (Even No.) ketone bodies, synthesis of fatty acids, overview of cholesterol synthesis. And phospholipid synthesis.	5
7	Overview of Protein metabolism: Metabolic fates of amino acids, transamination , transfer of amino group by glutamate, urea cycle, Nitrogen fixation by nitrogenase, incorporation of ammonia into biomolecules through glutamate and glutamine, Amino Acid Biosynthetic Families, Grouped by Metabolic Precursor	5

Reference books:

1. Outlines of Biochemistry: 5th Edition, Erice Conn & Paul Stumpf ; John Wiley and Sons, USA
2. Fundamentals of Biochemistry. 3rd Edition, Donald Voet & Judith Voet , John Wiley and Sons, Inc. USA
3. Biochemistry: 7th Edition (2006) , Jeremy Berg, Lubert Stryer, W.H. Freeman and company, NY
4. Lehninger, Principles of Biochemistry. 5th Edition (2008), David Nelson & Michael Cox, W.H. Freeman and company, NY. Biochemistry. 4th Edition(2008), Reginald Garrett and Charles Grisham, Brook/Cole, Cengage Learning, Boston, USA.

Bb-225 Practicals in Molecular Biology

Sr. No.	Topic	Practical (Total 30)
1.	Importance of clean handling, sterility, cleanliness	2
2.	Reagent preparation	3
3.	Absorption spectra and quantitation of DNA, RNA and proteins	4
4.	DNA isolation and determination of purity - a) Bacterial DNA: alkaline lysis/ lysozyme method, b) Eukaryotic DNA cTAB/ SDS/ homogenization	6
5.	Analysis of DNA by Agarose gel electrophoresis	2
6.	Comparative protein estimation by Biuret, Lowry and Bradford's method	6
7.	SDS-PAGE separation of proteins	4
8.	Staining and destaining of protein gels	2

Bb-226 Practicals in Developmental biology (30P)

Sr. No.	Topic	Practical (Total 30)
	Plant development	
1	Methods of studying plant development a) Dissection b) Sectioning c) Maceration d) Staining e) Mounting	5
2	Study of apices and meristem- RAM, SAM, florally induced meristem Microsporogenesis- anther squash technique Development of male and female gametophytes Developmental stages during plant embryogenesis in dicots and monocots Dissection of seed and excision of young embryo and endosperm (one dicotyledon and one monocotyledon)	4 2 3 2 4
	Animal development	
1	Study of different types of eggs	1
2	Study of frog development, observation of frog embryos, different development stages, life cycle	1
3	Study of amphioxus development, observation of embryos, different development stages	1
4	Study of staging & staining of Chick embryos (18h, 24 h, 48h, 72 h)	4
5	Chick embryo culturing	4
6	Effect of teratogen on development of chick embryo by window technique	3
7	Demonstration of regeneration of hydra	1