

B.Sc., BIOTECHNOLOGY
Course Structure from 2012-2013

Course Duration: 3 Years

Sem	Subject Code	Part	Course	Title of the Paper	Hrs/ Week	Credit	Int. Marks	Ext. Marks	Max. Marks
I	11U1LT1/LA1/LH1/ LU1/LF1	I	Language	Tamil/ Arabic Hindi/Urdu/French	6	3	25	75	100
	11U1LE1	II	English	English	6	3	25	75	100
	12UBT1301	III	Allied -I (a) Theory	Plant Diversity I and II - Theory	3	2	15	45	60
	12UBT1301:P		Allied -I (b) Practical	Plant Diversity I and II - Practical	2	1	10	30	40
	12UBT1401	III	Core I (a) Theory	General Microbiology - Theory	3	3	15	45	60
	12UBT1401:P		Core I (b) Practical	General Microbiology - Practical	3	2	10	30	40
	12UBT1402	III	Core II (a) Theory	Animal Diversity I Invertebrata - Theory	3	2	15	45	60
	12UBT1402:P		Core II (b) Practical	Animal Diversity I Invertebrata - Practical	2	2	10	30	40
	11U19	IV	Environmental Studies	Environmental Studies	2	2	25	75	100
	Total					30	20	150	450
II	11U2LT2/LA2/LH2/ LU2/LF2	I	Language	Tamil/ Arabic Hindi/Urdu/French	6	3	25	75	100
	11U2LE2	II	English	English	6	3	25	75	100
	12UBT2302	III	Allied II (a) Theory	Angiosperms, Plant Anatomy, Embryology , Economic Botany and Plant Pathology - Theory	3	2	15	45	60
	12UBT2302:P		Allied II (b) Practical	Angiosperms, Plant Anatomy, Embryology , Economic Botany and Plant Pathology- Practical	2	1	10	30	40
	12UBT2303	III	Allied III (a) Theory	Animal Diversity II Chordata - Theory	3	2	15	45	60
	12UBT2303:P		Allied III (b) Practical	Animal Diversity II Chordata - Practical	2	2	10	30	40
	12UBT2403	III	Core III (a) - Theory	Biophysics and Biochemistry - Theory	4	2	15	45	60
	12UBT2403:P		Core III (b)- Practical	Biophysics and Biochemistry - Practical	2	2	10	30	40
	12UBT2601	IV	Non Major Elective I	General Chemistry	2	2	25	75	100
	Total					30	19	150	450

Sem	Subject Code	Part	Course	Title of the Paper	Hrs/Week	Credit	Int. Marks	Ext. Marks	Max. Marks
III	11U3LT3/LA3/LH3/LU3/LF3	I	Language	Tamil/ Arabic Hindi/Urdu/French	6	3	25	75	100
	11U3LE3	II	English	English	6	3	25	75	100
	12UBT3304	III	Allied IV (a) -Theory	Plant Physiology and Plant Ecology - Theory	3	2	15	45	60
	12UBT3304:P		Allied IV (b)- Practical	Plant Physiology and Plant Ecology – Practical	2	1	10	30	40
	12UBT3404	III	Core IV (a)- Theory	Cell and Molecular Biology - Theory	3	2	15	45	60
	12UBT3404:P		Core IV (b) - Practical	Cell and Molecular Biology – Practical	2	2	10	30	40
	12UBT3405	III	Core V (a) - Theory	Immunology and Immunotechnology - Theory	2	2	15	45	60
	12UBT3405:P		Core V (b) - Practical	Immunology and Immunotechnology – Practical	2	2	10	30	40
	11U310	IV	Value Education	Value Education	2	2	25	75	100
	12UBT3602	IV	Non Major Elective II	Bioinstrumentation	2	2	25	75	100
Total					30	21	175	525	700
IV	11U4LT4/LA4/LH4/LU4/LF4	I	Language	Tamil/ Arabic Hindi/Urdu/French	6	3	25	75	100
	11U4LE4	II	English	English	6	3	25	75	100
	12UBT4305	III	Allied V (a) - Theory	Animal Physiology - Theory	3	2	15	45	60
	12UBT4305:P		Allied V (b) - Practical	Animal Physiology – Practical	2	1	10	30	40
	12UBT4306	III	Allied VI (a) - Theory	Developmental Biology and Evolution - Theory	3	3	15	45	60
	12UBT4306:P		Allied VI (b) - Practical	Developmental Biology and Evolution – Practical	2	1	10	30	40
	12UBT4406	III	Core VI (a) - Theory	Classical and Molecular Genetics - Theory	2	2	15	45	60
	12UBT4406:P		Core VI (b) - Practical	Classical and Molecular Genetics– Practical	2	2	10	30	40
	11USBE 4701	IV	Skill Based Elective I	Soft Skills	4	4	25	75	100
	12U411	V	Extension	Extension – NCC, NSS etc.,	-	1	-	-	-
	Total					30	22	150	450

Sem	Subject Code	Part	Course	Subject Title	Hrs/ Week	Credit	Int. Marks	Ext. Marks	Total Marks
V	12UBT5407	III	Core VII	Enzymology and Enzyme technology	5	5	25	75	100
	12UBT5408	III	Core VIII	rDNA Technology	5	5	25	75	100
	12UBT5409	III	Core IX	Bioinformatics	5	5	25	75	100
	12UBT5410:P	III	Core X	Enzymology, rDNA technology and Bioinformatics- Practical	6	5	40	60	100
	12UBT5501	III	Major Based Elective I	Environmental Biotechnology	5	5	25	75	100
	12UBT5702	IV	Skill Based Elective II	Biostatistics and Research Methodology	4	4	25	75	100
	Total					30	29	165	435
VI	12UBT6411	III	Core XI	Bioprocess Technology	5	5	25	75	100
	12UBT6412	III	Core XII	Animal Biotechnology	5	5	25	75	100
	12UBT6413:P	III	Core XIII	Bioprocess, Animal and Plant Biotechnology- Practical	6	5	40	60	100
	12UBT6502	III	Major Based Elective II	Plant Biotechnology	5	5	25	75	100
	12UBT6503	III	Major Based Elective III	IPR, Biosafety, Bioethics and Biotechnology Management	4	4	25	75	100
	12UBT6703	IV	Skill Based Elective III	General Pharmacology and Molecular Diagnostics	4	4	25	75	100
	11U612	V	Gender Studies	Gender Studies	1	1	25	75	100
	TOTAL					30	29	190	510
GRAND TOTAL					180	140	950	2850	3800

Syllabus for B.Sc., Biotechnology

2012-13



Since 1951

Department of Biotechnology
Jamal Mohamed College

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Semester I
PLANT DIVERSITY - I & II
ALGAE, FUNGI, BRYOPHYTES, PTERIDOPHYTES AND GYMNOSPERMS

Max. Marks: 60

Int. Marks: 15

Ext. Marks: 45

Allied : I (a) -THEORY
Code : 12 UBT1301
Hours : 3
Credits : 2

UNIT I **ALGAE:** General characteristics of algae, Classification by Fritsch, General characteristics of the various divisions as per Fritsch's system. Thallus organization. Detailed study of the following genera: Oscillatoria, Chlorella, Oedogonium, Caulerpa, Cyclotella, Sargassum and Gracilaria. Economic importance of algae.

UNIT II **FUNGI:** General characteristics of Fungi; Classification according to J. Alexopoulos and G.C. Ainsworth; Detailed study of morphology and reproduction of Plasmodiophora, Albugo, Peziza, Puccinia and Cercospora, Economic importance of Fungi, Lichen – Usnea.

UNIT III **BRYOPHYTES:** General characteristics of Bryophytes, Classification based on Rothmaler (1951), vegetative reproduction methods, a detailed study of the following genera: Marchantia, Anthoceros and Funaria. Economic importance of bryophytes.

UNIT IV **PTERIDOPHYTES:** General characteristics, stelar evolution, economic importance, homosporous, heterosporous and seed habit. Classification (Reimer's System, 1954). General characteristics of major divisions, Psilophyta, Lycophyta, Sphenophyta and Pterophyta. A detailed study of the following genera –Lycopodium, Isoetes, Equisetum, Adiantum and Marsilea (developmental details not required).

UNIT V **GYMNOSPERMS:** General characteristics, distribution, classification (K.R. Sporne.). Salient features of Pteridospermales, Bennettitales, Cycadales, Cordaitales, Coniferales and Gnetales –A detailed study of the following genera: Cycas, Araucaria and Gnetum (developmental details not required)

REFERENCE BOOKS

1. Pandey, BP. 2005. Simplified course in Botany. S. Chand and Company Ltd., New Delhi.
2. Alexopoulos, CJ.1952. Introduction to Mycology, John Wiley & Sons, New York.
3. Gangulee, HC. & Kar, AK.1989. College Botany, Vol-II, Books & Allied Pvt. Ltd. Calcutta.
4. Mehrotra, RS & Aneja, KR. 1999. An introduction to Mycology, 2nd Ed. New Age International Publishers, New Delhi.
5. Sharma, OP. 1989. Text Book of Fungi, Tata Mc Graw Hill, New Delhi.
6. Smith, GM. 1955. Cryptogamic Botany Vol-1&II, Mc Graw Hill, New York
7. Vasishta BR & Sinha AK. 2003. Botany for degree students Fungi. S Chand and Company Ltd., New Delhi.
8. Watson, E.V. The structure and Life of Bryophytes.
9. Prem Puri. 1973. Bryophytes-A broad perspective, Atma Ram & Sons, New Delhi.
10. Vasishta PC, Sinha AK & Anilkumar. 2005. Botany for degree students
11. Sporne, KR.1975. The Morphology of Pteridophytes, Hutchinson & Co., London.
12. Pandey et al., 1998. A text book of Botany Vol. II. S. Chand & Co. Ltd. 1980
13. Bierhorst. Morphology of Vascular Plants.
14. Parihare, N.S. An introduction to Embryohyta, Vol. I.
15. Sporne, KR.1967. The Morphology of Gymnosperms, Hutchinson &Co., London.
16. Gymnosperms. S Chand And Company Ltd., New Delhi.

Semester I
PLANT DIVERSITY - I & II
ALGAE, FUNGI, BRYOPHYTES, PTERIDOPHYTES AND GYMNOSPERMS- PRACTICAL

Max. Marks: 40

Int. Marks: 10

Ext. Marks: 30

Allied : I (b) - PRACTICAL
Code : 12 UBT1301: P
Hours : 2
Credits : 1

DETAILED STUDY OF THE TYPES MENTIONED IN THE THEORY:

ALGAE: Oscillatoria, Chlorella, Oedogonium, Caulerpa, Cyclotella, Sargassum and Gracilaria.

FUNGI: Plasmodiophora, Albugo, Peziza, Puccinia and Cercospora.

LICHEN: Usnea.

BRYOPHYTES: Marchantia, Anthoceros and Funaria.

PTERIDOPHYTES: Lycopodium, Isoetes, Equisetum, Adiantum and Marsilea.

GYMNOSPERMS: Cycas, Araucaria and Gnetum.

Semester I
GENERAL MICROBIOLOGY

Max. Marks: 60

Int. Marks: 15

Ext. Marks: 45

Core : I (a) - THEORY
Code : 12 UBT1401
Hours : 3
Credits : 3

- UNIT I HISTORY AND DEVELOPMENT OF MICROBIOLOGY. Microscopy- bright field, dark field, Electron microscopy, Phase contrast and Fluorescent microscopy. Sterilization, Control of microorganisms by physical and chemical methods. Bacterial taxonomy and classification according to Bergy's manual of systematic bacteriology.**
- UNIT II MICROBIAL GROWTH -mathematical expression of growth, growth curve, measurement of growth. Synchronous culture and Continuous culture. Factors affecting microbial growth. Culture media and their types. Pure Culture Techniques-Serial dilution methods - spread plate – pour plate – streak plate technique. Culture collection and preservation of microbial cultures.**
- UNIT III NUTRITIONAL REQUIREMENTS and types of microorganisms, uptake of nutrients by microorganisms. Photosynthetic microorganisms. Nitrate and sulfur oxidizing bacteria, nitrate and sulfate reducing bacteria. Nitrogen fixation.**
- UNIT IV HOST – PARASITE RELATIONSHIP, normal microflora. Causative agent, pathogenesis and control measures of typhoid, cholera, tuberculosis, AIDS, hepatitis, malaria and candidiasis. Antimicrobial agents and their mode of action.**
- UNIT V MUTATION AND MUTAGENESIS UV and chemical mutagens; Types of mutation; Methods of genetic analysis – Transformation, Conjugation, Transduction, Recombination. Plasmids and Transposons. Viruses and their genetic system.**

REFERENCES BOOKS

1. **Pelczar MJ, Chan ECS, and Krieg NR, (2006) Microbiology, 5th Edition Tata McGraw Hill Publishing Company.**
2. **Prescott LM, Harley JP and Klein DA (2005) Microbiology, 6th Edition. McGraw Hill.**
3. **Talero KP and Talero A (2002): Foundations in Microbiology. 4th Edition McGraw Hill**
4. **Anantha Narayanan R and Panikar CKJ (2002). 6th Edition. General Microbiology, Orient Longman Pvt. Ltd.**
5. **Benson HJ (1999), Microbiological Applications: A Laboratory manual in General Microbiology. 7th Edition. McGraw Hill.**
6. **Salle AJ, Principles of Bacteriology (1986).7th Edition. Tata McGraw-Hill Publishing Company Ltd. New Delhi.**
7. **Dubey, RC and DK Maheswari. (2005) A text Book of Microbiology. S. Chand & Company Ltd, New Delhi.**
8. **Freifelder D (1995), Microbial Genetics, Narosa Publishing House.**
9. **Maloy SR, Cronan JE and Freifelder D Microbial Genetics, Jones Barlett Publishers.**
10. **Cappuccino JG and Sherman N (1996). Microbiology – Laboratory Manual 5th edition. Editors: Wirth AE and Olsen L.**

Semester I
GENERAL MICROBIOLOGY– Practical

Max. Marks: 40

Int. Marks: 10

Ext. Marks: 30

Core : I (b) - PRACTICAL
Code : 12UBT1401:P
Hours : 3
Credits : 2

MICROBIOLOGY

- 1. Sterilization Techniques & sterilization of Media.**
- 2. Media Preparation (solid & liquid)**
- 3. Isolation & Enumeration of Micro-organism from water, Air, soil**
- 4. Types of culture method-streak plate, pourplate, Stab & slope method.**
- 5. Measurement of Growth rate of bacteria;**
- 6. Staining Techniques – Grain’s staining, Negative staining, flagella staining, spore staining, Lactophend cotton blue staining.**
- 7. Characterization of micro organisms – motility, carbohydrate utilization, MR;VP, citrate utilization, Catalase, Oxidase, H₂S production test.**
- 8. Microscopic slide preparation –Bacteria & fungi.**
- 9. Antibiotic sensitivity Test.**

Semester I
ANIMAL DIVERSITY I - INVERTERBRATA

Max. Marks: 60

Int. Marks: 15

Ext. Marks: 45

Core : II (a) - THEORY
Code : 12UBT1402
Hours : 3
Credits : 2

- UNIT I** **BINOMIAL NOMENCLATURE** – rules of nomenclature, outline classification of invertebrates Protzoa: Classification upto orders, Detailed study of Paramecium. Parasitic Protozoans: Entamoeba, Plasmodium. Porifera: Classification - Detailed study of Leucosolenia. General Topics: Histology of sponges, Canal system and Reproduction in sponges.
- UNIT II** **COELENTERATA:** Classification upto orders. Detailed study of Obelia, and Sea anemone. General Topics: Coral and Coral reefs Polymorphism in hydrozoa. Helminthes: Classification upto orders and their characteristics, Detailed study of Fasciola and Taenia solium.
- UNIT III** **ANNELIDA:** Classification upto orders and their characteristics. Detailed study of Nereis and Leech. General Topics: Modes of life in Polychaetes Nephridia and Coelomoducts in Annelida, Modes of life in polychaeta, Reproduction in Annelids.
- UNIT IV** **ARTHROPODA:** Classification upto orders and their distinguishing characters with suitable Indian examples, Detailed study of Prawn. Detailed study of Scorpion, centipede and Millipede. Crustacean larvae and their significance. Parasitic crustaceans. Mouth parts of insects, Economic importance of Insects.
- UNIT V** **MOLLUSCA:** Classification upto orders and their distinguishing characters. Detailed study of Pila, Freshwater mussel and Sepia. Echinodermata- Classification upto orders and their distinguishing characters, Detailed study of starfish and sea urchins. General Topics: Water vascular system in Echinodermata, larval forms and their significance.

REFERENCE BOOKS

1. Barnes, R.D. 1982, Invertebrate Zoology IV Edn. Holt Saunders International Edn.
2. Barrington, E.J.W, 1979 Invertebrates Structure and function 2nd Edn. ELBS and Nelson.
3. Kotpal, R.L, S.K.Agarwal, R.P.R.Khetarpal 1989 Modern text book of Zoology, Rastogi Publication.
4. Prasad S.N. 1976. Text Book of Invertebrate Zoology Kitab Mahal, Allahabad.
5. Rajesh Karyakarle & Ajit Damle, 2005. Medical Parasitology Books and Allied (P) Ltd. Kolkata.
6. Ekambaranatha Ayyar & T.N. Anantha krishnan 1992 Manual of Zoology Vol - I (Invertebrata)
7. Part I & II Viswanathan Pvt. Ltd. 2. Jordon EL and Verma P.S. (1995), Invertebrate Zoology, S.Chand & Co, New Delhi

Semester I
ANIMAL DIVERSITY I INVERTEBRATA – Practical

Max. Marks: 40

Int. Marks: 10

Ext. Marks: 30

Core : II (b) - PRACTICAL
Code : 12UBT1402:P
Hours : 2
Credits : 2

INVERTEBRATA

Dissections: 1. Earthworm – Nervous systems
2. Cockroach / Prawn – Nervous system

Mountings: 1. Earthworm : Body setae, penial setae
2. Cockroach : Mouthparts
3. Prawn : Appendages

Spotters:

1. Protozoa : Paramecium, Paramecium. Conjugation, Paramecium.
Binary fission, Euglena

2. Porifera : Sponge gemmule, Sponge spicules, Sycon

3. Coelenterata : Obelia entire, Physalia, Porpita, Sea anemone, Aurelia,
Madrepora, Fungia

4. Platyhelminthes: Liverfluke, Tapeworm, Tapeworm scolex, Planaria

5. Nematyhelminthes: Ascaris (Male and female), Filarial worm,
Enterobius

6. Annelida : Nereis, Nereis parabodium, Heteronereis, Cheatopterus,
Sabella, Arenicola Leech, Trocophore larva.

7. Arthropoda : Prawn, Nauplius larva, Zoea Larva, Mysis larva, Balanus, Crab,
Limulus, Bombyx mori, Honey bee, Lac insect, Peripatus, Scolopendra,
Scorpion, Spider.

8. Mollusca : Pila, Radula, Pearl oyster, Sepia, Chiton, Dentalium, Octopus.

9. Echinodermata : Starfish, Pedicellaria, Sea urchin, Bipinnaria larva, Aristotle's
lantern, Sea urchin, Hiothurian, ophiuroid

**Semester I
ENVIRONMENTAL STUDIES**

Max. Marks: 100

Int. Marks: 25

Ext. Marks: 75

[PART IV]

Code : 11U19

Hours : 2

Credits : 2

Semester II
ANGIOSPERMS, PLANT ANATOMY, EMBRYOLOGY, ECONOMIC BOTANY
AND PLANT PATHOLOGY

Max. Marks: 60

Int. Marks: 15

Ext. Marks: 45

Allied : II (a) - THEORY
Code : 12UBT2302
Hours : 3
Credits : 2

- UNIT I** **ANGIOSPERMS: Taxonomy - Classification – Artificial (Linnaeus system) - Natural (Bentham and Hooker’s system). Binomial Nomenclature-Brief accounts of ICBN- Techniques of Plant specimen preparation and Herbarium management- Various herbaria in India and abroad.**
- UNIT II** **Study of the general characteristics and economic importance of Annonaceae, Tiliaceae, Rutaceae, Myrtaceae, Cucurbitaceae, Apiaceae, Rubiaceae, Sapotaceae, Apocynaceae, Asclepiadaceae, Lamiaceae, Amaranthaceae, Orchidaceae, Amaryllidaceae, Pontederiaceae and Poaceae.**
- UNIT III** **ANATOMY: Anomalous secondary growth in dicots and monocots. Nodal anatomy – unilacunar, trilacunar and multilacunar types. Wood Anatomy – Ultrastructure and basic properties of wood. Chemical composition of wood elements. Commercial wood species of South India.**
- UNIT IV** **EMBRYOLOGY: Structure and development of anther – microsporogenesis – male gametophyte. Structure and development of megasporangium – megasporogenesis – female gametophyte. Fertilization – endosperm types – development of typical dicot (Capsella) and monocot (Najas) embryos. Polyembryony - Apomixis.**
- UNIT V** **ECONOMIC BOTANY AND PLANT PATHOLOGY: Brief study of the following economically important plants and their products-fibres, vegetable oils, cereals and pulses, spices. Plant Pathology: Classification of diseases – general symptoms. penetration and disease development. Morphological and biochemical defense mechanisms in plants. A detailed study of the following plant diseases – Mosaic disease of tobacco, Citrus canker, Late blight of potato, White rust of crucifers, Red rot of sugarcane, Tikka disease of groundnut (causal organisms, symptoms, disease cycle and control measures).**

REFERENCE BOOKS

1. Sambamurty, A.V.V.S & Subrahmanyam, N.S. (1989). A Text Book of Economic Botany. Wiley Eastern Ltd., New Delhi, Bangalore.
2. Bhojwani, S S. & Bhatnagar, SP. 1994. Embryology of Angiosperms, Vikas Publishing House (P) Ltd., New Delhi.
3. Brown et al., 1981. Text book of Wood Technology, Mc Graw Hill Inc. New York.
4. Jeffrey, C. 1982. An Introduction to Plant Taxonomy, Cambridge University Press, UK.
5. Pandey, BP. 1999. Taxonomy of Angiosperms, S. Chand & Co. Ltd., New Delhi.
6. Clive AS.1989. Plant Taxonomy and Biosystematics, Chapman and Hall Inc. New York.
7. Harborne, JB & Turner, BL. 1984. Plant Chemosystematics, Acad. Press, London.
8. Lawrence, GH. 1955. Taxonomy of Vascular Plants, MacMillan Co., USA.
9. Samuel, BJ & Arlene, EL. 1987. Plant Systematics, Mc Graw Hill Inc. New York.
10. Rangaswami G and Mahadevan A (2002). Diseases of crop plants in India. 4th Edition, Printice-Hall of India Pvt. Ltd., New Delhi.

Semester II
ANGIOSPERMS, PLANT ANATOMY, EMBRYOLOGY, ECONOMIC BOTANY
AND PLANT PATHOLOGY– Practical

Max. Marks: 40

Int. Marks: 10

Ext. Marks: 30

Allied : II (b) - PRACTICAL
Code : 12UBT2302:P
Hours : 2
Credits : 1

ANGIOSPERM: Classification and identification (upto genus with the help of flora) of one species from the families covered in theory with reference to local flora, Annonaceae, Tiliaceae, Rutaceae, Cucurbitaceae, Apiaceae, Rubiaceae, Sapotaceae, Apocynaceae, Asclepiadaceae, Lamiaceae, Amaranthaceae, Orchidaceae, and Poaceae.

At least one field trips to be planned to study the flora of various hills and plain. Herbal medicine (Visit to a herbal garden and submission of the report).

ANATOMY: Anomalous secondary thickening in Aristolochia, Bignonia, Boerhaavia, Thunbergia and Dracaena. Nodal anatomy. Preparation of keys to identify any five important timbers of South India on the basis of anatomical characters.

EMBRYOLOGY: TS of young and mature anther, ovule, endosperm types and dissection and isolation of developmental stages of embryos.

ECONOMIC BOTANY: Cotton (*Gossypium*), Jute (*Corchorus spp.*), Cereal Crops: Rice (*Oryza sativa*), Wheat (*Triticum spp.*), Pulses: Red gram (*Cajanus cajan*), Black gram (*Phaseolus mungo*), Vegetable Oils: Coconut (*Cocos nucifera*), Gingelly oil (*Sesamum indicum*), Sugar: Saccharum, Root tubers: Manihot, Medicines: Ocimum, Phyllanthus; Fruits: Syzygium; Gums: Moringa; Arack; Prosopis; Essential oils: Eucalyptus.

PLANT PATHOLOGY: Mosaic disease of tobacco, Citrus canker, Late blight of potato, Red rot of sugarcane, Tikka disease of groundnut.

Semester II
ANIMAL DIVERSITY II- CHORDATA

Max. Marks: 60

Int. Marks: 15

Ext. Marks: 45

Allied : III (a) - THEORY
Code : 12UBT2303
Hours : 3
Credits : 2

UNIT I PROCHORDATA, AGNATHA & PISCES - Characteristics and classification of Prochordata, Agnatha and Pisces up to order level. Prochordata: Amphioxus and Balanoglossus – Organisation & Affinities, Ascidia Retrogressive metamorphosis Agnatha : Structure & Affinities of Cyclostomata Pisces : Scoliodon and Mugil and Dipnoi Organisation.

UNIT II AMPHIBIA: Characteristics and Classification of Amphibia up to order level. Frog: Organization Parental care in Amphibia Gymnophiana: Structure and Biological significance Origin of Amphibia South Indian Amphibians

UNIT III REPTILIA: Characteristics and Classification of Reptilia up to order level. Calotes: Organization Sphenodon: Structure and Affinities, Skulls in Reptiles (Arcades & Fossae), Identification of Poisonous snakes, Snakes of South India, Poison apparatus, biting mechanism and venom

UNIT IV AVES & MAMMALIA Characteristics & Classification of Aves and Mammalia up to order level, Columba livia: Organization Flight adaptations in birds Flightless birds and their distribution, Origin and evolution of birds, Migration in birds, Oryctolagus: Organisation, Prototheria and Methatheria: Structure and Affinities, Dentition in Mammals Aquatic and flying Mammals.

UNIT V GENERAL & COMPARATIVE STUDIES- Origin of Chordates Fate of aortic arches Impact of terrestrialization Origin of tetrapod limbs Jaw suspension in vertebrates Primates and taxonomic position of man

REFERENCE BOOKS

1. Ekambaranatha Ayyar and T.N.Ananthakrishnan, 1995. "A Manual of Zoology". Vol 2 (Part 1 & 2), S. Viswanathan, Chennai
2. Jordan E.L and P.S. Verma, 2000 "Chordate Zoology" S. Chand, New Delhi.
3. Newman. H.H, 1939, "The Phylum Chordata", Mc Millan, New York.
4. De Beer G, 1966, "Vertebrate Zoology", Sedgwick & Jackson, London.
5. Young J.Z, 1950, "The Life of Vertebrates", Oxford University Press, London.

Semester II
ANIMAL DIVERSITY II- CHORDATA- Practical

Max. Marks: 40

Int. Marks: 10

Ext. Marks: 30

Allied : III (b) - PACTICAL
Code : 12UBT2303:P
Hours : 2
Credits : 2

CHORDATA:

Dissections: Rat – Demonstration of Digestive, Arterial, Venous & Reproductive Systems.
Mountings: Placoid scales, Cycloid / ctenoid scales

Spotters:

- 1. Prochordata : Amphioxus, Ascidian Balanoglossus Tornaria larva**
- 2. Pisces : Shark, Ray, Clarius, Echnies, Hippocampus Exocoetus, Gambusia, Crap**
- 3. Amphibian : Alytes, Axolotl larva, Hyla, Salamander, Ichlyophis**
- 4. Reptilia : Naja naja, viper, Draco, Chelone mydas**
- 5. Aves : Pigeon, quill feather**
- 6. Mammalia : Bat, Rabbit**
- 7. Dentition : Rabbit, Dog & Man**
- 8. Osteology : Pigeon - Synsacrum**
Rabbit – pectoral & pelvic girdles, forelimb & hind limb bones
Students be introduced to learning of dissections / anatomy adapting
CDS / Web sources.

Semester II
BIOPHYSICS AND BIOCHEMISTRY

Max. Marks: 60

Int. Marks: 15

Ext. Marks: 45

Core : III (a) - THEORY
Code : 12UBT2403
Hours : 4
Credits : 2

- UNIT I BIOENERGETICS:** Thermodynamics and Molecular basis for evolution - Principles of bioenergetics -free energy functions - ATP as main carrier of free energy. Energy molecules. Biological oxidation - reduction reaction. Biomolecular Interactions - Structure and properties of H₂O. Solute – Solvent Interactions - Bonding; strong and weak interactions – hydrogen bonding – hydrophobic - hydrophilic interactions and ionic interactions.
- UNIT II CARBOHYDRATE METABOLISM:** Glycolysis - citric acid cycle. Oxidative phosphorylation. Photophosphorylation Glyoxalate cycle - Carbohydrate biosynthesis - C₂ - C₃- C₄ cycles. Biochemistry of monosaccharide – disaccharides - polysaccharides.
- UNIT III OVERVIEW OF METABOLIC PATHWAYS:** Lipid metabolism - chemical nature of fatty acids and acylglycerols - sources and storage of fatty acids. Triacylglycerols - cholesterol - Phospholipids - sphingolipids.
- Unit IV AMINO ACID METABOLISM – an over view:** incorporation of nitrogen to amino acids - transport of nitrogen to liver and kidney - urea cycle - synthesis and oxidation of amino acids - de novo synthesis and salvage pathways in nucleotide metabolism, An overview of the Biochemistry of hormones, vitamins.
- UNIT IV UNDERSTANDING STRUCTURE OF NUCLEIC ACIDS:** primary – secondary - tertiary and quaternary - structural components of nucleic acids- DNA supercoiling. RNA structures. DNA-protein interactions. Understanding structure of proteins at different levels – primary – secondary - tertiary and quaternary. Globular and fibrous proteins. Protein stability - protein folding. Ramachandran plot.

REFERENCE BOOKS:

1. **A.L. Lehninger- D.L.Nelson and M.M Cox (2003)- Principles of Biochemisty- Worth publishers- New York.**
2. **L.Stryer- (2002)- Biochemistry- W.H. Freeman & Co.- New York.**
3. **C.Branden J. Tooze. (1999)- Introduction to protein structure- Publishing Inc.**
4. **Thomas Devlin (2002)- Textbook of Biochemistry by John publishers.**
5. **Voet & Voet - Principles of Biochemistry**
6. **Van Holde & Mathew- Principles of Biochemistry**

Semester II
BIOPHYSICS AND BIOCHEMISTRY– Practical

Max. Marks: 40

Int. Marks: 10

Ext. Marks: 30

Core : III (b) - PRACTICAL
Code : 12UBT2403:P
Hours : 2
Credits : 2

BIOPHYSICS

1. Determination of pH using pH meter.
2. Sedimentation of Emulsion of oil
3. Chromatographic methods for macromolecule separation.
4. Agarose Gel Electrophoresis & SDS-PAGE.
5. Isolation & Purification of protein (Dialysis)
6. Estimation of protein – Lowry’s Method, Bradford Method. (Spectrophotometer)
7. Colorimetric Estimation of Creatinine by JAFF’S method.
8. ECG and EEG (Demo)

BIOCHEMISTRY

1. Qualitative Analysis
 - i) Analysis of carbohydrates– Glucose, Fructose, Ribose, Sucrose, Lactose and Starch.
 - ii) Analysis of Amino acids - Tyrosine, Tryptophan, Arginine, Methionine, Cystine & Phenylalanine.
2. Preparation
 - i) Starch from potato
 - ii) Casein from milk
 - iii) Phospholipids from Egg yolk.
3. Quantitative Analysis
 - i) Estimation of Glycine by formal titration method.
 - ii) Estimation of Ascorbic acid by 2,6 dichlorophenol indophenol dye
 - iii) Determination of Acid number
 - iv) Determination of Saponification value
 - v) Estimation of Urea by DAM colorimetric method
 - vi) Estimation of Glucose by Ortho- Toluidine Method
4. Techniques
 - i) Separation of Amino acid & Sugars by Ascending paper chromatography
 - ii) Separation of Lipid by TLC

Semester II
GENERAL CHEMISTRY

Max. Marks: 100

Int. Marks: 25

Ext. Marks: 75

Non Major Elective : I

Code : 12UBT2601

Hours : 2

Credits : 2

UNIT I PERIODIC TABLE: Atomic orbitals and quantum numbers - principle, azimuthal, magnetic and spin. Quantum numbers and their significance. Principles governing the occupancy of electrons in various quantum levels. Pauli's exclusion principle, Hund's rule, Aufbau Principle, (n+/-) rule, stability of half-filled and fully filled orbitals.

Unit II Molecular orbital theory: Periodic table classification as s, p, d & f block elements, variation of atomic volume, atomic and ionic radii, ionisation potential, electron affinity and electronegativity along periods and groups. Variation of metallic characters - Factors influencing the periodic properties. Avogadro's Number.

UNIT III ACIDS, BASES AND ISOMERISM: Arrhenius, Protonic and Lewis Theories of Acids and Bases. Basic concepts of bonding in organic chemistry. Hybridization and geometry of molecules - methane, ethylene, acetylene and benzene. Electron displacements effects - Inductive, inductomeric, electromeric, mesomeric, resonance, hyper conjugation and steric effects.

UNIT IV NOMENCLATURE OF ORGANIC COMPOUNDS: IUPAC recommendations for naming - simple aliphatic, alicyclic and aromatic compounds. Elements of symmetry - symmetry and asymmetry, cause of optical activity, isomerism of tartaric acid - racemization and resolution. Geometrical and isomerism of maleic acid and fumaric acid. Keto-enol tautomerism.

UNIT V AQUEOUS SOLUTIONS AND ACID-BASE CHEMISTRY: Aqueous solutions- Concentration based on volume, Weight, Degree of Saturation, Equilibrium constants, pH of solutions, hydrolysis of salts of weak acids and bases, Handerson-Hasselbalch equation, Buffer concepts, Laboratory Buffers, pH Changes in buffers. Buffer capacity.

REFERENCE BOOKS

1. J.Clayden, N. Greeves, S. Warren, P. Wothers, "Organic chemistry" Oxford University Press, 2001.
2. R.T.Morrison and R.N. Boyd, "Organic Chemistry" ed., prentice Hall of India Pvt Ltd., 2004.
3. I.L Finar, "Organic Chemistry Vol I & II" 5th ed., ELBS, 1975.
4. B.S. Bhal and Arun Bhal, "Text Book of Organic Chemistry", 14th ed., S Chand and Company Ltd., 1997.
5. R.A.Alberty and R.J. Silbey, Physical Chemistry, Jhon Wiley & Sons, Inc., Newyork, 1995.
6. P.W. Atkins, Physical Chemistry, ELBS and Oxford University Press, 1998.
7. G.M. Barrow, Physical Chemistry, Tata McGraw Hill, New Delhi, 1994.
8. James E. Huheey, Eleen A. Keiter, Richard L. Leiter, "Inorganic Chemistry", 4th ed., Pearson Education, Inc., 2002.
9. Irvin H. Segel, Biochemical Calculations, 2nd Edition, John Wiley and Sons., 2004.

Semester III
PLANT PHYSIOLOGY AND PLANT ECOLOGY

Max. Marks: 60

Int. Marks: 15

Ext. Marks: 45

Allied : IV (a) - THEORY
Code : 12UBT3304
Hours : 3
Credits : 2

- UNIT I** **Water:** Water potential – solute potential – and pressure potential. Absorption and transport of water, mineral ion uptake, Transpiration: Types, role, stomatal physiology, factors affecting transpiration. Guttation, Translocation of organic solutes: – source-sink relationship.
- UNIT II** **Photosynthesis:** Photosynthetic apparatus and pigments. Pigment systems, Emerson Effect photochemical reactions –cyclic and noncyclic electron transports, CO₂ fixation cycles (PCR cycles), C₃, C₄ and CAM pathways – factors affecting photosynthesis. Photorespiration, Anaerobic and aerobic respirations. Glycolysis pathway and regulation. TCA cycle.
- UNIT III** **Growth:** Stages of growth, factors affecting vegetative growth. Phytohormone and its physiological significance. Photoperiodism and vernalization, Flowering, plant rhythm, Biological clock and Seed dormancy.
- UNIT IV** **ECOLOGY - Autecology-** Definition, Ecological life history of species. Synecology-Definition, community composition, Raunkier's biological spectrum. Plant environment-climatic, edaphic and biotic factors (Effects of grazing and browsing by animals, Effects of human activities on vegetation).
- UNIT V** **ECOSYSTEM:** Definition, structure of Ecosystem, components of ecosystem, Function of Ecosystem. Energy and its flow in Ecosystem (grassland). Food chain, Food web, Ecological pyramid. Vegetation – Units of vegetation-formation, association, fasciations, Consociation, Migration, Colonization methods of study of vegetation-species area curve, line transect. General trends of succession- migration, colonization. Hydrophytes & Xerophytes.

REFERENCE BOOKS

1. Jain, J.L. 1979. Fundamentals of Biochemistry, Chand & Co. Ltd., New Delhi.
2. Jain, V.K. 2006. Fundamentals of Plant Physiology, S.Chand & Company Ltd., New Delhi
3. Verma, S.K. 2006. A Textbook of Plant Physiology, S.K.Chand & Co., New Delhi
4. Bajjal, B.D & Ravisharma, 1981. A Text book of Plant Physiology, Shiva Lal Agarwal & Co., Agra.
5. Noggle and Fritz, 1976. Introductory Plant Physiology, Prentice Hall, New Delhi.
6. Pandey, S.N & Sinha, B.K. 1989. Plant Physiology, Vikas Publishing House Ltd., New Delhi
7. Robert M. Devlin. 1970. Plant Physiology, East West Press, New Delhi.
8. Salisbury, F.B. & Ross, C.N. 1995. Plant Physiology. CBS Publishers, New Delhi.
9. Dasha, M.C. 1993. Fundamentals of ecology, Tata McGraw Hill.
10. Sharma, P.D. 2000. Ecology and Environment, Rastogi Publications, Meerut, India.
11. Kumar, H.D. 1997. General Ecology, Vikas Publishing House Pvt. Ltd Delhi
12. Shukla, R.S. and P.S Chandel. 2000. Plant ecology and soil science. S.Chand & Company Ltd. Ram Nagar New Delhi.

Semester III
CELL AND MOLECULAR BIOLOGY

Max. Marks: 60

Int. Marks: 15

Ext. Marks: 45

Core : IV (a) - THEORY
Code : 12UBT3404
Hours : 3
Credits : 2

UNIT I Plasma Membrane: Ultrastructure – Chemical composition and functions, Endoplasmic reticulum: Morphology, structure types and functions. Golgi complex: Morphology, Structure, Composition, Functions. Lysosome: Structure, forms, functions and origin. Chloroplast: Structure, forms, functions and origin.

UNIT II Mitochondria: Structure, Chemical composition – Functions – Krebs's cycle – Oxidative phosphorylation Ribosomes: Structure – Chemical composition – Functions and Origin.

UNIT III Nucleus & Nucleolus: Structure and functions Chromosome: Structure Giant chromosomes Cell Cycle: Cell division – Mitosis & Meiosis Cancer Cells – Cell aging.

UNIT IV Introduction to DNA & RNA - as genetic material – properties, structure and function. Prokaryotic and eukaryotic genome organization. Nature of Gene Concept and Chemical Nature of Gene. DNA super coiling. Operon concepts – Lactose – Constitutive - inducible and repressible gene expression.

UNIT V Replication - Enzymes in DNA replication - modes of replication. Prokaryotic and eukaryotic replication Prokaryotic & Transcription - mechanism of transcription - Post Transcriptional modifications; Translation - Genetic code.

REFERENCE BOOKS

1. De Robertis E.D.P. & De Robertis E.M.F. (1988) Cell and Molecular Biology.
2. Verma P.S. & Agarwal V.K. (1991) Cytology. S.Chand & Co, New Delhi
3. Swanson C.P.(1990). The Cell – 8th Edn. Prentice Hall of India Pvt. Ltd. New Delhi.
4. Hans S.S. (1986) Cell Biology – Allen & Unwin.

Semester III
CELL AND MOLECULAR BIOLOGY– Practical

Max. Marks: 40

Int. Marks: 10

Ext. Marks: 30

Core : IV (b) - PRACTICAL
Code : 12UBT3404:P
Hours : 2
Credits : 2

- 1. Microscopes and its parts**
- 2. Micrometry - Stage and Ocular Micrometer.**
- 3. Cell Counting - Haemocytometer**
- 4. Mounting buccal epithelium and observing living cells using vital staining.**
- 5. Mitosis in Onion root tip squash**
- 6. Meiosis in grasshopper testis squash**
- 7. Chironomous - Salivary gland Chromosome squash preparation**
- 8. Staining of macro molecules.**
- 9. Isolation and quantification of Nucleic acids – Bacterial- fungal- animal- plant.**
- 10. Agarose gel electrophoresis- resolution and purification of DNA fragments.**
- 11. SDS – PAGE.**

IMMUNOLOGY AND IMMUNOTECHNOLOGY

Max. Marks: 60

Int. Marks: 15

Ext. Marks: 45

Core : V (a) - THEORY
Code : 12UBT3405
Hours : 2
Credits : 2

UNIT I IMMUNE RESPONSE: Types of immunity, Immune System: Primary Lymphoid Organs, Secondary Lymphoid Organs. Cell of immune system: Mononuclear cells and granulocyte, Antigen presenting cells, lymphocytes and their subsets. Antigens, Heptanes: Factor affecting immunogenicity, Super antigen.

UNIT II MAJOR HISTOCOMPATIBILITY SYSTEMS: Structure of MHC I and II molecules. Organization of MHC complex in mouse and humans. Association of MHC with disease. Recognition of antigens by T and B cells: Antigen processing, T-Cell receptor complex, activation of T –cells, B-cell receptor complex, activation of B-cells, Immunoglobulins: molecular structures, types and function.

UNIT III MOLECULAR MECHANISM OF ANTIBODY DIVERSITY: Organization of genes coding for constant and variable regions of heavy chain and light chain. Mechanism of antibody diversity, Class Switching. Monoclonal antibodies: production, characterization and application in diagnosis, complement system.

UNIT IV CYTOKINES: Structure and functions, cytokine receptors, signal transductions mediated by cytokine receptors, cytokine regulation of immune responses, cytokine related diseases and therapeutic applications of cytokines. Hypersensitivity: definition, IgE mediated hypersensitivity, mechanism of mast cell degranulation, mediators of type I reactions and consequences. Type II reactions, immune complex mediated hypersensitivity and delayed type hypersensitivity.

UNIT V AUTOIMMUNITY: Organ specific diseases, systemic disease, mechanism of autoimmunity. Immunodeficiency Syndrome: Primary Immunodeficiencies and Secondary Immunodeficiencies and their diagnosis and therapeutic approaches. Vaccines: Active and passive immunization, whole organism vaccines, macromolecules as vaccines, Recombinant vector Vaccines, DNA Vaccines, synthetic peptide Vaccines and sub-unit Vaccines.

REFERENCE BOOKS

1. Benjamini E, Coico R and G. Sunskise (2000). Immunology -A short course. IV edn. (Chapters 1-13) .Wiley – Liss publication, NY.
2. Brown, F, Chanock, R. M., Lerner R.A. (Editors) (1986) Vaccines 86: New approaches to Immunization.
3. Fathman, C. G. Fitch, F.W (1982) Isolation, characterization and utilization of T-lymphocytes clones, Academic Press, London.
4. Goding, J. W (1998) Monoclonal antibodies: Principles and practice, Academic Press, London.
5. Goldsby R.A. Kindt T.I and Osborne B.A (2000) Kuby Immunology IV edn WH Freeman &Co, NY.
6. Janeway, C.A. Travers P. Wolport M and Capra J.D (1999) .Immunology IV edn. Current Biology, NY.
7. Kuby, J (1997) immunology, III edn, WH Freeman &Co, NY.
8. Roitt, Male and Brostoff (1998). Immunology 4th edn. Pub. Moby, New York pp 28.14.
9. Roitt, I (2000). Essential Immunology, IV edn. Blackwell Sci NY.
10. Springer T. A (Editor) (1985). Hybridoma technology in Biosciences and Medicine, Plenum Press, New York.

IMMUNOLOGY AND IMMUNOTECHNOLOGY- Practical

Max. Marks: 40

Int. Marks: 10

Ext. Marks: 30

Core : V (b) - PRACTICAL
Code : 12UBT3405:P
Hours : 2
Credits : 2

1. Agglutination- Haem agglutination-ABO blood grouping,
2. Bacterial agglutination
3. WIDAL test,
4. Latex Agglutination- ASO test,
5. Pregnancy test.
6. Precipitation- Raising of Antisera,
7. Immunodiffusion,
8. Double Immunodiffusion,
9. Immuno electrophoresis,
10. Counter Current Immuno electrophoresis.
11. ELISA

**Semester III
VALUE EDUCATION**

Max. Marks: 100

Int. Marks: 25

Ext. Marks: 75

[PART IV]

Code : 11U310
Hours : 2
Credits : 2

**Semester III
BIOINSTRUMENTATION**

Max. Marks: 100

Int. Marks: 25

Ext. Marks: 75

Non Major Elective : II

Code : 12UBT3602

Hours : 2

Credits : 2

UNIT I SPECTROSCOPIC TECHNIQUES: Spectroscopy – Concepts of spectroscopy, Visible and UV spectroscopy, Laws of photometry. Beer-Lambert's law, Principles and applications of colorimetry. Principles of UV-Vis- IR- NMR-spectroscopy.

UNIT II SEPARATION TECHNIQUES: Chromatography – Principles of partition chromatography, paper, thin layer, ion exchange and affinity chromatography, gel permeation chromatography, HPLC. Electrophoretic techniques.

UNIT III CENTRIFUGATION: Principles of centrifugation, concepts of RCF, different types of instruments and rotors, preparative, differential and density gradient centrifugation.

UNIT IV TRACER TECHNIQUES: Radioactive isotope and half life & isotope; Assessing the metabolic pathways. Counting techniques: Liquid scintillation counting- Photomultiplier tubes.

UNIT V MICROSCOPY: Principles of Microscopy - phase contrast- fluorescence- confocal- scanning, Electron microscopy, Bright field microscopy, dark field microscopy. Specimen preparation for Electron Microscopy and scanning electron microscopy.

REFERENCE BOOKS

1. Canter & Canter (1996), Biophysical Chemistry
2. Glick and Pasternack (1994), Molecular Biotechnology by. ASM Press
3. P.L. Soni, Physical chemistry, S. Chand publications
4. Puri & Sharma, Physical chemistry.

**Semester IV
ANIMAL PHYSIOLOGY**

Max. Marks: 60

Int. Marks: 15

Ext. Marks: 45

Allied : V (a) - THEORY
Code : 12UBT4305
Hours : 3
Credits : 2

- UNIT I** **Nutrition – Nutrients – Digestion and absorption of carbohydrates, proteins and lipids, Role of gastro intestinal hormones in digestion. Respiration – Respiratory pigments – Types, Properties and function, Exchange and transport of gases, Respiratory quotient.**
- UNIT II** **Circulation – Composition and Functions of blood, Types of heart, Cardiac cycle, cardiac rhythm, Pace maker, Origin of heart beat and its regulation, ECG, Blood pressure, Theories of blood clotting, Excretion – Classification of animals based on excretory products, Ornithine cycle, mechanism of urine formation and hormonal control.**
- UNIT III** **Osmoregulation – Osmo-iono-regulation in freshwater, marine and migratory fishes, Thermoregulation – Acclimation, Acclimatisation, heat death, cold death, physiology of hibernation and aestivation, Biological rhythm – Types, examples and adaptive significance.**
- UNIT IV** **Nerve Physiology – Types of neuron, conduction of nerve impulse along a nerve fibre, Synapses, Synaptic transmission of impulse, Neurotransmitters, Muscle physiology – Types of Muscles, Ultrastructure and properties, muscle proteins, Theories of muscle contraction Isotonic and Isometric contraction.**
- UNIT V** **Endocrine glands – Structure, secretions and functions of pituitary, thyroid, adrenal, islets of langerhans and gonads, Receptors – Photo and Phono reception in Man.**

REFERENCE BOOKS

1. Verma P.S., Tyagi B.S. and Agarwal V.K. 1995. Animal Physiology, S.Chand & Co, New Delhi
2. Goyal & Sastri "Animal Physiology" Rastogi Publication, Meerut.
3. Nagabhushanam "Animal Physiology" Oxford and IBH Publishing Co.
4. Jain, P.C. Anantharaman, M.S. Animal Physiology and related Biochemistry " Vishal Publications, Jalandhar.
5. Prosser C.L. Comparative Animal Physiology" Prentice Hall.
6. Saradha Subramanian, Madavankutty K. Text book of Human Physiology S.chand and Co. Ltd.
7. Berry A.K. "A text book of Animal Physiology with related Biochemistry" Emkay Publications, New Delhi.
8. Ambika S. Fundamentals of Biochemistry for medical students published by the author.
9. Jain J.L. Fundamentals of Biochemistry S.Chandra & Co., Pvt. Ltd. New Delhi.
10. Murray R.K., Granner, K.D, Maynes P.A. and Rodwell, V.W. "Harper's Biochemistry, 25th Edition. Mac Graw Hill, New York.
11. Debajyoti Das (2005), Biochemistry Academic Publishers, Kolkata. 11. Veerakumari L. 2005 Biochemistry MJP Publishers, Chennai 5.
12. Gurumani N. (2006) Research Methodology for Biological Sciences MJP Publishers, Chennai.

Semester IV
ANIMAL PHYSIOLOGY– Practical

Max. Marks: 40

Int. Marks: 10

Ext. Marks: 30

Allied : V (b) - PRACTICAL
Code : 12UBT4305:P
Hours : 2
Credits : 1

- 1. Observe and compare the inherent rhythmicity of the different parts of the heart.**
- 2. Determine the effects of application of parasympathetic or sympathetic agonists/ antagonists.**
- 3. Assessing physical and chemical modifiers of heart rate in frog.**
- 4. Determine the response of the heart to direct electrical stimulation / vagal stimulation.**
- 5. Effects of drugs and hormones on contraction of smooth muscles.**
- 6. Demonstration of tetany, action current and fatigue in muscle.**
- 7. To study the effect of load on muscle contraction.**
- 8. Concentration / dispersal of pigment in isolated scales of dark / light adapted fish.**
- 9. To examine the relative activity of enzymes in the fore, mid, and hindgut of a typical insect and to correlate the enzyme activity with gut regions.**
- 10. To determine the median threshold concentration of sucrose for housefly population.**

Semester IV
DEVELOPMENTAL BIOLOGY AND EVOLUTION

Max. Marks: 60

Int. Marks: 15

Ext. Marks: 45

Allied : VI (a) - THEORY
Code : 12UBT4306
Hours : 3
Credits : 3

- UNIT I** Theories: Preformation, Epigenetic, Recapitulation and Germplasm – Gametogenesis: Spermatogenesis, Types of Sperm: Oogenesis – Types of eggs and egg membranes – Structure of Spermatozoan and ovum in mammals.
- UNIT II** Fertilization: Structure and functions of Human sperm and ovum. Fertilization process (eg, human, frog and dove). Acrosomal reaction, cortical reaction, Physiological and Biochemical changes, significance – Parthenogenesis. Types and functions of placenta.
- UNIT III** Human reproduction; Puberty, Menstrual cycle – Menopause, pregnancy and related problems – Parturition – lactation.
- UNIT IV** Oparin-Haldane Theory, Evidences for Evolution from comparative Anatomy, Biochemistry and Serology. Lamarckism and Neo- Lamarckism and his concept. Darwinism: Artificial, Natural and Sexual Selection.
- UNIT V** The Geological Records –Geological time - Fossils: Lead and Carbon Method, Living fossils. Genetic Drift – Evolutionary Significance, Evolution of Man, Fossil Record.

REFERENCE BOOKS

1. Verma, S. and Agarwal, V.K., 2000, Chordate Embryology, S.Chand & Co., New Delhi
Books for Reference

1. Balinsky, B.I., 1981, An Introduction to Embryology, Holt Saunders, New York.

2. Berrill, N.J., 1986, Developmental Biology, McGraw Hill, New Delhi.

3. Patten, B.M., 1958, Foundations of Embryology, McGraw Hill, New York.

4. Saunders, J.W., 1982 Developmental Biology – Patterns and Principles, Macmillan, New York.

Semester IV
DEVELOPMENTAL BIOLOGY AND EVOLUTION– Practical

Max. Marks: 40

Int. Marks: 10

Ext. Marks: 30

Allied : VI (b) - PRACTICAL
Code : 12UBT4306:P
Hours : 2
Credits : 1

Developmental Biology

1. Observation of the structure of live spermatozoa of Calotes/Bull.
2. Observation of prepared micro slides to study
 - a. Egg, cleavage, blastula and yolk plug stage in frog.
 - b. Egg, 24 hrs, 36 hrs, 48 hrs, 72 hrs and 96 hrs developmental stages in chick.

Evolution

1. Animals of evolutionary importance: Peripatus, Limulus, Archaeopteryz.
2. Homologous organs: Forelimbs of Frog, Pigeon and Whale.
3. Analogous organs organs: Wings of Insects and Birds.
4. Fossils: Trilobite, Nautilus.
5. Mimicry: Leaf insects, Stick insects, Monarch and Viceroy butterfly.
6. Colouration: Chameleon, Lycodon.

Semester IV

CLASSICAL AND MOLECULAR GENETICS

Max. Marks: 60

Int. Marks: 15

Ext. Marks: 45

Core : VI (a) - THEORY
Code : 12UBT4406
Hours : 2
Credits : 2

- UNIT I** Mendalism – Mendel's experiments and Laws of Mendal-Back or Test cross, Phenotype and Genotype, Dihybrid cross, Tri and Poly hybrid crosses, Incomplete dominance, Interaction of Genes – Complementary factors, supplementary factors, inhibitory and lethal factors, Multiple Alleles, in Drosophila.
- UNIT II** Linkage in Drosophila – Morgan's experiments, theories of linkage, factors affecting linkage, Crossing over, Types, mechanisms, Cytological evidence for crossing over and significance. Chromosome mapping and its significance.
- UNIT III** Mutation and DNA Repair: Mutation – Genetic variability required for evolution. Mutation – basic features of the process – somatic- Germinal-spontaneous- induced random- non – adaptive- reversible nature of mutations. Molecular basis of mutation – physical, chemical and biological.
- UNIT IV** Genetics of Bacteria and virus: Overview of genetic exchange in bacteria – Conjugation, discovery, F⁺ x F⁻ matings, Hfr conjugation, sexduction, Determining linkage from interrupted mating experiments. Transduction – Transformation - the process and competency. Bacterial viruses – discovery, genetic fine structure.
- UNIT V** Transposable Genetic Elements: IS Elements- composite transposons- Tn3- Tn5- Tn 9- Tn10 elements-. Eukaryotes – Ac and Ds elements in maize- P elements in drosophila. Genetic and evolutionary significance of transposable elements. Genetic basis of cancer – malignant - metastatic cancer. Oncogenes and tumour suppressor genes- Ras protein signaling and cancer. Apoptosis.

REFERENCE BOOKS

1. Brown, T.A., 1998, Genetics, A Molecular Approach, Chapman Hall, London.
2. Gardner, E.J., Simmons, M.J., and Snusted D.P., 1991, Principles of Genetics, John Wiley and Sons, New York.
3. Gupta, S.P. 1985, Elementary Statistical Methods, S. Chand and Co., New Delhi.
4. Gurumani, N. 2004, An Introduction to Biostatistics, MJP Publishers, Chennai.
5. Hotter, P, 2002, Textbook of Genetics, IVY Publishing House, New Delhi.
6. Strickberger, M.W., 1996, Genetics, Macmillan publishing Co., New York.
7. Verma, P.S. and Agarwal, V.K. 2003, Genetics, S.Chand & Company Ltd, New Delhi.
8. Weaver, R.F. and Hedrick, P.W., 1997, Genetics, W.M.C. Brown Publishers, London.

Semester IV

CLASSICAL AND MOLECULAR GENETICS – Practical

Max. Marks: 40

Int. Marks: 10

Ext. Marks: 30

Core : VI (b) - PRACTICAL
Code : 12UBT4406:P
Hours : 2
Credits : 2

1. Observation of simple Mendelian traits in man.
2. *Drosophila* – male and female identification, Mutant forms (from pictures), Genetic importance.
3. Human Karyotypes : normal, Down's, Klinefelters and Turner, is syndrome.
4. Recording of Mendelian traits in humans.
5. Experiments with lac operon- induction and assay of beta-galactosidase.
6. Preparation of competent cells and transformation- Transduction- Conjugation

Semester IV

SOFT SKILLS

Max. Marks: 100

Int. Marks: 25

Ext. Marks: 75

Skill Based Elective: I

Code : 11USB 4701

Hours : 4

Credits : 4

EXTENSION

[Part V]

Code : 12U411
Credits : 1

Semester V

ENZYMOLGY AND ENZYME TECHNOLOGY

Max. Marks: 100

Int. Marks: 25

Ext. Marks: 75

Core : VII
Code : 12UBT5407
Hours : 5
Credits : 5

- UNIT I** ENZYME CLASSIFICATION AND NOMENCLATURE: General properties of enzymes like effect of pH- Temperature- Ions etc. Kinetics of enzyme action – Concept of ES complex, active site, specificity, derivation of Michaelis-Menten equation for uni- substrate reactions. Different plots for the determination of K_m & V_{max} and their physiological significances. Significance and evaluation of energy of activation. Collision & transition state theories.
- UNIT II** MULTI SUBSTRATE REACTIONS: Ping Pong, random & ordered Bi-Bi mechanisms. Reversible and irreversible inhibition. Competitive, non-competitive, uncompetitive, linear-mixed type inhibitions. Suicide inhibitor.
- UNIT III** MULTIENZYME SYSTEM: Occurrence, isolation & their properties: Mechanism of action and regulation of pyruvate dehydrogenase & fatty acid synthase complexes. Enzyme-enzyme interaction, multiple forms of enzymes with special reference to lactate dehydrogenase.
- UNIT IV** MECHANISM OF ENZYME ACTION: Acid-base catalysis, covalent catalysis, proximity, orientation effect. Strain & distortion theory. Chemical modification of active site groups. Site directed mutagenesis of enzymes. Mechanism of action of chymotrypsin and lysozyme.
- UNIT V** ENZYME REGULATION: General mechanisms of enzyme regulation, product inhibition. Reversible (phosphorylase) and irreversible (proteases) covalent modifications of enzymes. Allosteric enzymes, qualitative description of “concerted” & “sequential” models for allosteric enzymes. Hill and Scatchard plots. Enzyme Engineering.

REFERENCE BOOKS

1. Glick and Pasternack (1994), Molecular Biotechnology by. ASM Press.
2. Alan Fersht (1995), Enzyme structure and Mechanisms. W.H.Freeman and Company New York.

Semester V
r DNA TECHNOLOGY

Max. Marks: 100

Int. Marks: 25

Ext. Marks: 75

Core : VIII
Code : 12UBT5408
Hours : 5
Credits : 5

Unit I

History and recent developments in rDNA Technology - Enzymes in rDNA – Restriction Endonuclease – Ligases – Alkaline phosphatase – Polynucleotide kinase - Terminal deoxynucleotidyl transferase - S1 nuclease – DNA polymerase - RNases – Ribonuclease – Reverse transcriptase - Taq polymerase .

Unit II

Vectors- Plasmids - Size - Copy Number - Amplification- Types – Plasmid pBR322 - origin – advantage – pUC - Col E1 plasmid – Ti plasmid - F plasmid – R plasmid . Lambda phage vectors, cosmids and phagemid as vectors.

Unit III

Animal and Plant Viruses and their use as vectors, Shuttle vectors, Expression vectors. Screening and selection of recombinant clones.

Unit IV

Gene transfer techniques. Molecular mechanism of antisense technology. PCR, RAPD, RFLP, Safety regulations in recombinant DNA.

Unit V

Construction of genomic and cDNA libraries, screening of libraries, Site directed mutagenesis, Ethical issue involving in rDNA Technology. rDNA Technology in solving human problems.

REFERENCE BOOKS:

1. Ernst-L. Winnacker (2003), Genes to Clones- Panima Publishing House- New Delhi.
2. T. A. Brown (2001), Gene Cloning Blackwell Science.
3. Bernard R. Glick and Jack J. Pasternak (2002), Molecular Biotechnology Panima Publishing House New Delhi.
4. S. B. Primrose (2001), Molecular Biotechnolgy, Panima Publishing House- New Delhi.
5. DM. Glover & BD. Hames (1995), DNA cloning I & II by IRL Pres..
6. MA. Innis- DH- Gelfand & DJ Sninsky (1995), PCR strategies by Academic Press.

**Semester V
BIOINFORMATICS**

Max. Marks: 100

Int. Marks: 25

Ext. Marks: 75

Core : IX
Code : 12UBT5409
Hours : 5
Credits : 5

Unit I

Cell structure, Ultra structure of Prokaryotes and Eukaryotes, Cellular organelles.

Unit II

Biomolecules – Carbohydrate, Protein, Lipids and nucleic Acids, Protein confirmation.

Unit III

Prediction of Protein structure – fold recognition, comparative modeling (homology) Basic principles of X-ray diffraction studies, NMR, Mass spectroscopy in identifying protein conformation.

Unit IV

Networking – Network access, Internet, E-mail Servers Use of databases in biology: Sequence databases, structural databases.

Unit V

Sequence Analysis – protein and Nucleic acids, structural comparisons.

Reference Books:

- 1. Molecular databases for protein sequence and structure studies by Sillince, JA and Sillince M (1991) Springer Verlag.**
- 2. Sequence Analysis primer by M.Gribskov, J.Devercux (1989) Stockton Press.**
- 3. Nucleic acid and protein sequence analysis. A practical approach by MJ. Bishop and CJ. Ramslings (1987) IRL press.**
- 4. Information theory and living systems by L.I. Garfield, (1992), Columbia University press.**
- 5. Information to Biostatistics by Sokal and Rohlf (1973) Toppan Company Japan.**

Semester V

ENZYMOLOGY, rDNA TECHNOLOGY AND BIOINFORMATICS– Practical

Max. Marks: 100

Int. Marks: 40

Ext. Marks: 60

Core : X
Code : 12UBT5410:P
Hours : 6
Credits : 5

1. Isolation and visualization of plasmid DNA.
2. Restriction Digestion of Lamda DNA.
3. Ligation of DNA Fragments.
4. Isolation of Antibiotic Resistant Mutants.
5. Bacterial Transformation.
6. Sequence retrieval from any Databanks.
7. Sequence alignment by BLAST.
8. Enzyme kinetics – salivary amylase- acid / alkaline phosphatase-
9. Enzyme Immobilization
10. Enzyme preparation and purification – acid phosphatase –Ammonium Sulphate precipitation

Semester V

ENVIRONMENTAL BIOTECHNOLOGY

Max. Marks: 100

Int. Marks: 25

Ext. Marks: 75

Major Based Elective : I
Code : 12UBT5501
Hours : 5
Credits : 5

- UNIT I** BASIC CONCEPTS AND ISSUES. Environmental pollution. Types of pollution methods for measurement of pollution, methodology of environmental management- the problemsolving approach and its limitations. Global environmental problems- Ozone depletion, Green house effect and Acid rain.
- UNIT II** POLLUTION and its control through biotechnology, bioremediation of soil and water contaminated with oil spills, heavy metals and detergents, Microbiological andbiochemical aspects of waste water treatment process. Various industrial effluent treatment methods
- UNIT III** Biodegradation of xenobiotics in environment: Ecological considerations, decay behaviour and degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants. Biosensors.
- UNIT IV** PHYTOREMEDIATION: Degradation of pesticides and other toxic chemicals by Plants. Degradation aromatic chlorinates petroleum products.
- UNIT V** BIOLEACHING: Leaching of ores by microorganisms (gold, copper and uranium). Environmental significance of genetically modified (GM) microbes, plants and animals. Waste disposal and management, legislation of environmental problems. Microbial association in environment.

REFERENCE BOOKS

1. Environmental Science and Biotechnology: theory and Techniques, A.G.Murugesan and C.Rajakumari,(2005).
2. Encyclopaedia of Environmental Biology, Chhatwal(2005).
3. Environmental Biology, P.D.Sharma(1994) Rastogi Publications.
4. Environmental Biotechnology and cleaner Bioprocesses, Eugenia J.Olguin(2000) Tayloir and Francis.
5. Principle Environmental Science , William P. Conningham and Mary Ann Conningham(2003) Tata McGraw-Hill publishing Company.
6. Environmental Biotechnology, K.V. Agarwall(2005) Nidhi Publishers.
7. Introduction to Environmental Biotechnology, A.K. Chatterji(2002) Prentice-Hall of India.

Semester V

BIOSTATISTICS AND RESEARCH METHODOLOGY

Max. Marks: 100

Int. Marks: 25

Ext. Marks: 75

Skill Based Elective : II
Code : 12UBT5702
Hours : 4
Credits : 4

- UNIT I RESEARCH CONCEPTS AND DATA COLLECTION:** Definition of Research, Qualities of Researcher, Components of Research Problem, Various Steps in Scientific Research, Types of Research; Hypotheses Research Purposes - Research Design.
- UNIT II RESEARCH REPORTS:** Structure and Components of Research Report, Research proposal/ Grant- definition, structure, budget allocation, specific aims, background and significance. Funding agencies in India.
- UNIT III Biostatistics :** Introduction - Definition - Data: Primary & Secondary; Observational & Experimental; Probabilistic & Deterministic; Variable: discrete & continuous - Population & Sample; Random sample. Sampling technique - Judgment Sampling, Random Sampling by Lottery and Random number table methods, stratified random (proportionate and disproportionate) Sampling; Systematic random sampling; Multistage Random Sampling merits and demerits of the above methods.
- Unit IV Classification - Frequency Distribution:** Discrete, Continuous and Cumulative Frequency Distributions - Parts of a statistical Table - Advantages of classification of Data. Presentation of Data - Histogram, Frequency polygon, Frequency curve, Ogive curve, Bar Charts: Simple, Multiple, Subdivided, percentage - Pie diagram.
- Unit V Measures of Location - Measures of Central Value:** Mean, Median, Mode - Measures of dispersion: Range, Mean Deviation, Standard Deviation, coefficient of Variation. Correlation & Regression - Definition - Types - Methods of studying correlation: Probability - Definition - Binomial, Poisson and Normal distributions. Tests of Significance: General procedure - Large sample testing & Small sample testing: t-Test, Chi-square test and F test.

REFERENCE BOOKS

1. Introduction to Mathematics for Life Scientist, E. Batschelet, Springer. 2003
2. Mathematical Modeling, J.N. Kapur, Wiley Eastern Ltd., 1988.
3. Ordinary and Partial Differential Equations, M.D. Raisinghania, R.S. Aggarwal, S. Chand & Company Ltd., 1981.
4. Programming in ANSI C, E. Balaguruswamy, Tata Mc Graw-Hill publishing company Ltd. 2000.
5. Jerrold H. Zar. Biostatistical Analysis (4 th edition).
6. Bose, 1981. Elementary Biophysics, Vijaya Printers, Chennai.
7. Nageswara Rao, G. 1983. Statistics for Agricultural Science Oxford & IBH Publishing company
8. Gupta, S.P. 2008. Elementary Statistical Methods Sultan Chand & Sons, New Delhi.
9. Conn, E. & Stumpf, P.K., 1979. Outline of Biochemistry, Niley Easdtern Ltd., New Delhi.
10. Das Gupta, S.K. 1977. Biochemistry Vol.II, Macmillan & Co., New Delhi.
11. Metz, E.T., 1960. Elements of Biochemistry, V.F & S (P) Ltd., Bombay.
12. Casey, E.J., 1969. Biophysics Concepts and Mechanisms, East & West Press, New Delhi.
13. Renganatha Rao, K., 1986. Text Book of Biochemistry, Prentice-Hall of India (P) Ltd., New Delhi.
14. Saim, A.S., 1994. Text Book of Biochemistry, CBS Publishers, New.

Semester VI
BIOPROCESS TECHNOLOGY

Max. Marks: 100

Int. Marks: 25

Ext. Marks: 75

Core : XI
Code : 12UBT6411
Hours : 5
Credits : 5

- UNIT I INTRODUCTION TO WHITE BIOTECHNOLOGY:** Isolation and screening of industrially important microbes. Strain improvement - mutation and recombination. Preservation of industrially important microorganisms. Media/substrates for industrial fermentation. Media formulation.
- UNIT II TYPES OF BIOREACTORS:** Mechanical - Stirred tank bioreactors, Airlift fermentors, solid state fermentors, animal cell culture reactors and plant cell culture reactors.
- UNIT III BIOREACTOR AND FERMENTATION:** Bioreactor design and operations - basic function, design, components and body construction. Computers in bioprocess control system. Concepts of basic modes of fermentation – Batch, Fed batch and Continuous fermentation.
- UNIT IV DOWNSTREAM PROCESSING:** Objectives and criteria - foam separation - precipitation methods. Filtration devices and filter aids. Centrifugation - industrial scale centrifugation and cell disruption.
- UNIT V BIOPROCESS ECONOMICS AND INDUSTRIAL PRODUCTION:** Production of enzymes-amylases and proteases. Antibiotic production - penicillin and tetracycline. Amino acid - Lysine and glutamic acid. Vitamin production - vitamin B12. Organic acid production - citric acid. SCP production.

REFERENCE BOOKS:

1. Glazer, A N. and Nikaldo, H.1995 Microbial Biotechnology -W H Freeman and company network.
2. Prescott, L M., Harley, J P and Klein, D A.1999. Microbiology 4th edition Mc Graw Hill.
3. Stainer, R Y, Ingrtham, J L., Wheels, M.L and Painter P.R.1987 - General Microbiology. Maomillan.
4. Stanbury P.F., Whitaker A., Hall S.J. (1995) Principles of Fermentation Technology, Butterwoth Heinemann.
5. Casida L.E. (1968) Industrial Microbiology, John Wiley & Sons.
6. Flickinger M.C., Drew S.W. (1999) Encyclopedia of Bioprocess Technology – 5 Volumes, John Wiley & Sons.
7. Arnold L. demain & Julian E. Davis. (2004) Industrial Microbiology & Biotechnology ASM Press.
8. Emt.el - Mansi & CFA. Bryce (2004). Fermentation Microbiology & Biotechnology Taylor & Francis Ltd.
9. P.F. Stanbury - A. Whitaker & S.J. Hall (1997) - Principles of fermentation technology Oxford.
10. Gungalus- I.C. and Stainer. RY. (Eds.) The Bacterial Vol. III Academic press. New York.
11. Sala Teh JR -Bacterial physiology and metabolism Academic press- New York.
12. J.M. Coulson and J.F. Richardson (1984) Chemical Engineering Pergamon Press.

**Semester VI
ANIMAL BIOTECHNOLOGY**

Max. Marks: 100	Int. Marks: 25	Ext. Marks: 75
Core : XII		
Code : 12UBT6412		
Hours : 5		
Credits : 5		

- Unit I** Historical Perspectives, early experiments & Scope of Animal Tissue culture. Requirements for Animal cell culture. Media-Natural, Semi synthetic & Synthetic. Role of ingredients in Animal culture Media. Design & layout of ATC Laboratory.
- Unit II** Basic Techniques of mammalian cell culture; Disaggregation of animal tissue. Primary culture, Evolution of cell line, Organ culture, Stem cell culture, Embryo culture, Embryonic Stem cells and their application. Maintenance of cell culture Embryo culture.
- Unit III** Sericulture, Commercial production of silk, Baculoviruses as animal viral vector. Silkworm as a bioreactor. Aquaculture, Biotechnology of aquaculture
- Unit IV** Embryo Technology & Animal Breeding. In vitro fertilization, Embryo transfer, ICSI, Embryo splitting, Fertility control & regulation, test tube babies. Cell cloning, Transgenic animals-sheep, goat, Mice, fish.
- Unit V** Hybridoma Technology, Production of vaccine, Interferons, Hormones in ATC. Gene therapy. Ethical values in animal biotechnology.

REFERENCE BOOKS:

1. Culture of animal cells – R. Ian Freshney, John Wiley & Sons Publisher.
2. In vitro cultivation of Animal cells – Bulterworth & Heinemann, Tunwich University press.
3. Genetic Engineering of Animal – A. Publer, VCH Publishers.
4. Animal Biotechnology – M. Ranga. Studam publishers, 2006.
5. Animal Biotechnology – Dr. Ramadoss.
6. Animal Biotechnology-R.Sasidhara, MJP Publishers, 2006.
7. Medical biotechnology- S.N Jogdand, Himalaya publishing house, 2004.
8. Biotechnology, Satyanarayana. U, (2008), Books and Allied (p) Ltd

Semester VI
BIOPROCESS, ANIMAL AND PLANT BIOTECHNOLOGY– Practical

Max. Marks: 100

Int. Marks: 40

Ext. Marks: 60

Core	: XIII
Code	: 12UBT6413:P
Hours	: 6
Credits	: 5

1. Plant Tissue culture media preparation
 - a. MS Media
 - b. Nitsch's media
 - c. White's media
2. Callus induction
3. Micro propagation
4. Protoplast isolation
5. Green house visit and maintenance
6. Preparation of Animal cell culture media
7. Culture of chick embryo fibroblast
8. Inoculation virus and observation
9. Cytopathic effect in cell lines
10. Chick embryo – demonstration
11. Process Control of Fermenter – Demonstration (pH, Temp, Foam, Dissolved O₂).

**Semester VI
PLANT BIOTECHNOLOGY**

Max. Marks: 100

Int. Marks: 25

Ext. Marks: 75

Major Based Elective	: II
Code	: 12UBT6502
Hours	: 5
Credits	: 5

- UNIT I** **History of plant tissue culture – laboratory organization – aseptic techniques – nutritional requirements and culture media – Types of cultures – Solid – Liquid.**
- UNIT II** **Micropropagation – mass production of plantlets – hardening and mist chambers – techniques for maintaining plantlets in the field – Callus induction - somatic embryogenesis – induction of multiple shoots – production and exploitation of haploids and triploid – embryo rescue – protoplast culture, Somaclonal variations.**
- UNIT III** **Genetic Engineering in Plants-Molecular biology of Agrobacterium mediated DNA transfer- Ti plasmid Vectors- Technique of hairy root production. Plant viruses as vectors. Physical method of transfer-Biolistics –Electroporation.**
- UNIT IV** **Selectable Markers, reporter genes- Promoters used in Plant vectors genetic engineering for- heat, drought and saline tolerance - Virus resistance - Pest resistance - Herbicide resistance- Herbicide tolerance - Delayed fruit ripening - Fungal and bacterial resistance**
- UNIT V** **Production of therapeutic proteins - antibodies- vaccines - hormones- Golden Rice. Marker free transgenic plants. Secondary metabolite production.**

REFERENCES:

1. R.A Dixon And R.A. Gonzales (2004).Plant cell culture, IRL press.
2. G.W. Lycett and D. grierson (1990) Genetic Engineering of crop plants- (Eds)
3. M.J. Chrispeels and D.F. Sadava (1994) Plants- Genes and Agriculture Jones and Bartlett.
4. Glick and Paster mark (2002) Molecular Biotechnology by Panima.
5. S.S. Bhojwani and M.K. Razdan (2004) Plant Tissue culture: theory and practice a revised edition Elsevier science.
6. F.H.Erbisch and K.M.Maredia (2000). Intellectual property in agricultural Biotechnology, Edited by, University Press.
7. Bernard R.Glick and Jack J.Pasternak (2001). Molecular Biotechnology, Principles and applications of recombinant DNA technology. ASM Press Washington DC.
8. J.Hammond, P.McGarvey and V.Yusibov (eds) (1999). Plant Biotechnology – New products and Applications. By Springer Publication.
9. Kalyankumar De. (2007). An Introduction to Plant Tissue Culture Techniques. New Central Book Agency, Kolkata.

Semester VI
IPR, BIOSAFETY, BIOETHICS AND BIOTECHNOLOGY MANAGEMENT

Max. Marks: 100

Int. Marks: 25

Ext. Marks: 75

Major Based Elective : III
Code : 12UBT6503
Hours : 4
Credits : 4

- UNIT I INTELLECTUAL PROPERTY RIGHTS: TRIP International conventions patents and methods of application of patents - Legal implications Biodiversity and farmer rights.**
- UNIT II PATENTS AND PATENT LAWS: Objectives of the patent system - Basic principles and general requirements of patent law - biotechnological inventions and patent law - Legal development - Patentable subjects and protection in biotechnology - The patentability of microorganisms - IPR and WTO regime.**
- UNIT III BIOTECHNOLOGY MANAGEMENT: Introduction - Designing a manuscript- grant experimental protocols & experimental methods. Selection of a Biotechnology company.**
- UNIT IV SETTING UP OF A LABORATORY: laboratory administration – collaborations - inventories and inspections – personnel – Recruitment hiring – mentoring - promoting and terminating**
- UNIT V GOOD MANUFACTURING PRACTICES ENSURING BIOSAFETY: Biosafety regulations - Good laboratory practices - Good manufacturing practices in industry. Storage and disposal of hazardous wastes: radioactive materials - pathogenic strains. GMO's and their release in environment. Experimental protocol approvals -Levels of containment - Environmental aspects of biotech applications.**

REFERENCE BOOK

1. Beier- F.K.- Crespi- R.S. and Straus- T. Biotechnology and Patent protection-Oxford and IBH Publishing Co. New Delhi.
2. Sasson A- Biotechnologies and Development- UNESCO Publications.
3. Jeffrey M. Gimble- Academia to Biotechnology- Elsevier- Academic Press.

Semester VI

GENERAL PHARMACOLOGY AND MOLECULAR DIAGNOSTICS

Max. Marks: 100

Int. Marks: 25

Ext. Marks: 75

Skilled Based Elective : III
Code : 12UBT6703
Hours : 4
Credits : 4

- UNIT I** Introduction to Pharmacology, Sources of Drugs, Dosage forms and routes of administration and drug delivery system; Mechanism of action, drug receptors and cellular signaling systems ;Combined effect of drugs, Factors modifying drug action, tolerance and dependence; Pharmacogenetics.
- UNIT II** Absorption – Structure of cell membrane, Gastro-intestinal absorption of drugs, Mechanism of drug absorption, Absorption of drug from non-per oral routes. Distribution, Metabolism and Excretion of drugs,
- UNIT III** Immunodiagnostics: Approaches, methods and tools for molecular diagnostics. Antibodies and MHC molecules - allotypes and isotypes. Serodiagnostics: agglutination, immunodiffusion, immunoelectrophoresis and immunoprecipitation. HLA typing. Diagnostic and therapeutic implications of cytokines. Immunoinformatics and vaccine designing.
- UNIT IV** Microbial Diagnostics: Environmental molecular diagnostics – Pathogens of importance in aqua culture (WSSV) and agriculture
- UNIT V** Diagnostics For Human Diseases: Genetic testing - Practice of genetic testing - for carrier detection, predict disorders, presymptomatic testing and disease-susceptibility testing.

References:

1. Rang, M.P., Dale M.M and Reter, J.M – Pharmacology.
2. Pharmacology and Therapeutics – Satoskar
3. Medical Pharmacology by K.D. Tripathi.
4. Benjamin E, Coico R and Sunskise G, (2000). Immunology a short course. IV Edition. Wiley-Liss Publication, New York.
5. Kuby, J (2005). Immunology, III Edition, WH Freeman and Co. New York.

**Semester VI
GENDER STUDIES**

Max. Marks: 100

Int. Marks: 25

Ext. Marks: 75

[Part V]

Code : 11U612
Hours : 1
Credits : 1