MAR ATHANASIUS COLLEGE (AUTONOMOUS) KOTHAMANGALAM, KERALA - 686666

College with Potential for Excellence NAAC Accredited and Reaccredited 'A+ Grade' Institution

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Integrated M.Sc. Programme

in

Basic Sciences - BIOLOGY

PROGRAMME STRUCTURE AND SYLLABUS

(2020 Admission onwards)

Semester	1
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COURSE CODE	COURSE TITLE	COURSE TYPE	HRS / WEEK	TOTAL CREDITS
IBT101	Systematics and diversity of lower life forms and non vascular plants	Theory	2	2
BT102	Systematics and diversity of Invertebrates	Theory	2	2
IBT103	Biophysical chemistry	Theory	2	2
IBT104	English Grammar	Theory	5	4
IBP101	Systematics and diversity of lower life forms and non vascular plants	Practical	2	0
IBP102	Systematics and diversity of Invertebrates	Practical	2	0
IBP103	Biophysical chemistry	Practical	2	0
IBT105	Second language(Malayalam/Hindi)	Theory	5	4
IBT106	Fundamentals in Mathematics	Theory	3	3
		Total	25	17

Semester 2

COURSE CODE	COURSE TITLE	COURSE TYPE	HRS / WEEK	TOTAL CREDITS
IBT201	Systematics and diversity of Vascular Plants	Theory	2	2
IBT202	Systematics and diversity of Vertebrates	Theory	2	2
IBT203	Bio-organic chemistry	Theory	2	2
IBP201	Systematics and diversity of Vascular Plants	Practical	2	2
IBP202	Systematics and diversity of Vertebrates	Practical	2	2
IBP203	Bio-organic chemistry	Practical	2	2
IBT204	Mathematical Biology	Theory	5	4
IBT205	Basics in computing	Theory	2	2
IBP204	Basics in computing	Practical	2	1
IBT206	Introductory Physics	Theory	2	2
IBP205	Introductory Physics	Practical	2	2
		Total	25	23

Semester 3

COURSE CODE	COURSE TITLE	COURSE TYPE	HRS / WEEK	TOTAL CREDITS
IBT301	Plant anatomy & physiology	Theory	3	3
IBT302	Animal anatomy & physiology	Theory	3	3
IBT303	Computer Science	Theory	3	3
IBP301	Computer Science	Practical	2	1
IBP302	Plant anatomy & physiology	Practical	2	0
IBP303	Animal anatomy & physiology	Practical	2	0
IBP304	Inorganic chemistry	Theory	3	3
IBP304	Inorganic chemistry	Practical	2	0
IBP305	Science Education	Theory	5	4
		Total	25	17

Semester 4

COURSE CODE	COURSE TITLE	COURSE TYPE	HRS / WEEK	TOTAL CREDITS
IBT401	Cell biology	Theory	3	3
IBT402	Biophysics	Theory	3	3
IBT403	Green chemistry	Theory	3	3
IBP401	Cell biology	Practical	2	2
IBP402	Biophysics	Practical	2	2
IBP403	Green chemistry	Practical	2	2
IBT404	English	Theory	5	4
IBT405	Instrumentation	Theory	3	3
IBP404	Instrumentation	Practical	2	1
		Total	25	23

Semester 5

COURSE CODE	COURSE TITLE	COURSE TYPE	HRS / WEEK	TOTAL CREDITS
IBT501	Molecular biology	Theory	3	3
IBT502	Evolutionary biology & Ethology	Theory	3	3
IBT503	Biostatistics and Bioinformatics	Theory	3	3
IBT504	Softskill/Professional skill/personality development	Theory	4	3
IBP501	Molecular biology	Practical	2	0
IBP502	Evolutionary biology	Practical	2	0
IBP503	Biostatistics and Bioinformatics	Practical	2	0
IBT505	Environmental Biology and Human Rights	Theory	3	3
IBP505	Environmental Biology and Human Rights	Practical	2	0
IBIP501	Mini Project		1	0
		Total	25	15

Semester 6

COURSE CODE	COURSE TITLE	COURSE TYPE	HRS / WEEK	TOTAL CREDITS
IBT601	Plant reproduction & breeding	Theory	3	3
IBT602	Animal reproduction & breeding	Theory	3	3
IBT603	Genetics	Theory	3	3
IBT604	Research Methodology	Theory	2	1
IBP601	Plant reproduction & breeding	Practical	2	2
IBP602	Animal reproduction & breeding	Practical	2	2
IBP603	Genetics	Practical	2	2
IBIP601	Mini project		3	4
IBT605	Occupational Biology	Theory	3	3
IBP605	Occupational Biology	Practical	2	2
	•	Total	25	25

Semester 7

COURSE CODE	COURSE TITLE	COURSE TYPE	HRS / WEEK	TOTAL CREDITS
IBT701	Pathology	Theory	5	4
IBT702	Biomedical Sciences	Theory	5	4
IBT703	Immunology	Theory	5	4
IBT704	Systems Biology	Theory	4	3
IBP701	Pathology	Practical	2	2
IBP702	Immunology	Practical	2	2
IBP703	Biomedical Sciences and Systems Biology	Practical	2	1
		Total	25	20

Semester 8

COURSE CODE	COURSE TITLE	COURSE TYPE	HRS / WEEK	TOTAL CREDITS
IBT801	Genomics & Proteomics	Theory	5	4
IBT802	Animal Molecular Physiology	Theory	5	4
IBT803	Plant Molecular Physiology	Theory	5	4
IBT804	Genetic Engineering	Theory	4	3
IBP801	Genomics & Proteomics	Practical	2	2
IBP802	Animal Molecular Physiology and Plant Molecular Physiology	Practical	2	2
IBP803	Genetic engineering	Practical	2	1
		Total	25	20

Semester 9

COURSE CODE	COURSE TITLE	COURSE TYPE	HRS / WEEK	TOTAL CREDITS
IBT901	Plant and Animal Biotechnology	Theory	5	4
IBT902	Elective 1	Theory	5	4
IBT903	Elective 2	Theory	5	4
IBT904	Elective 3	Theory	4	3
IBP901	Elective 1	Practical	2	1
IBP902	Elective 2 and Elective 3	Practical	2	2
IBP903	Biotechnology	Practical	2	2
	•	Total	25	20

Semester 10

COURSE CODE	COURSE TITLE	COURSE TYPE	HRS / WEEK	TOTAL CREDITS
IBIP110	Dissertation	Practical		16
IBVVP111	Comprehensive Viva	Practical		4
		Total		20

Mar Athanasius College (Autonomous), Kothamangalam

Programme

Five Year Integrated M.Sc. In Basic Sciences- Biology

RULES & REGULATIONS

1. Name of the Programme: Integrated M.Sc. In Basic Sciences- Biology

- 2. **Duration:**The duration of the Integrated M.Sc. programme shall be 5 years (10 Semesters). At the end of the programme a student shall be awarded the Integrated M.Sc. Degree in the discipline concerned.
- 3. Annual Student Intake: 15 students
- 4. Training levels : There are mainly two levels of training,
 - Foundation Level courses: All 20 students shall be trained in the first six semesters for the foundation level courses which shall be equivalent to the B.Sc. level programmes in their major disciplines.
 - Advanced level courses: All 15 students shall be trained in the final four semesters for the advanced level courses which shall be equivalent to the M.Sc. level programmes in their major disciplines
- 5. **Eligibility for Application:** Students who have passed Plus-Two (+2) in Science stream with minimum 60% marks or equivalent grade with Biology as one of the subjects are eligible for application. Relaxation in minimum marks for reservation categories shall be applicable as per the existing rules and orders issued by Mahatma Gandhi University, Kottayam.
- 6. **Mode of Selection: As per MG University norms**. Reservations and other admission procedure shall be followed as per University rules and orders.
- 7. **Monitoring of the Programme:** Academic activities of the Integrated programme shall be monitored and evaluated by an Institute Programme Advisory Committee (IPAC) which will be constituted by the Principal by including the faculty members of the college.

8. Programme Over view:

- This programme follows 3+2 year pattern with initial six semesters of graduate (B.Sc.)level or Foundation level courses followed by four semesters of Post graduate (M.Sc.) level or Advanced level courses.
- 9. Course structure and highlights:
 - The curricula for first semester are completely common for all disciplines and all courses are mandatory.
 - Second to fourth semesters consists of common/optional courses from the offering disciplines as well as general courses.
 - Mathematics courses are spread across initial four semesters and is mandatory for all in the first semester .
 - Manadatory English language courses form part of first and second semesters, while second language courses (either Malayalam, Hindi, Sanskrit, Arabic or French) are included in the third and fourth semesters.
 - Option to choose an open course from integrated M.A. programme is provided in

third semester.

- Fourth semester also consist of core and elective courses from the major discipline.
- Fifth and sixth semesters exclusively consist of core and elective courses from the opted discipline with a minor research project at end of the sixth semester.
- Seventh to tenth semester consist of advanced level courses in the major dsicpline
- Final (10th) semester is completely set aside for a major research project and followed by Viva- Voce.
- The major research project shall be done under the guidance of a supervising teahcer at the College level or under the guidance of an external supervisor at any national/international institutions of repute approved by the College
- Open course in the nineth semster shall be opted from any other teaching schools of the campus.
- Students shall be allowed to choose elective courses from SWAYAM or similar; instead of the offered electives or as an add on course.
- There shall be flexibility for Board of Studies/Expert Committee/IPAC for updating the content of course(s) and to include new open courses and elective courses depending upon the advancement

of knowledge in various disciplines. However this has to be got approved by the Vice-Chancellor before the commencement of the semester involving the course.

- 10. Credits: The total credit for Integrated M.Sc. programme shall be 200 for 10 semesters in which 120 credits for Foundation level (first six semesters) and 80 credits for Advanced level (last four semesters) courses. These credits shall be spread across core courses, electives, open courses, seminars and minor/major project/dissertation. However there shall be flexibility in the requirement of minimum/maximum credits for core and elective courses per semester as well as for whole programme.
- 11. **Course code:** Each course shall have a unique coding pattern with four abbreviated components including the following;
 - Programme code (IBS)
 - Course type (C-for core, E-for elective, O-for open course),
 - Three digit course number in Arabic numerals in which fitst digit reperesents the semester number except 10th semester for which first two digits designates the semester number.
 - Course description abbreviated with two English capital letters [CH=Chemistry, PH=Physics, LS=Life Sciences, CS=Computer Science, ES=Environmental Sceince, MM=Mathematics, GE=General course, XL= for language courses (where 'X' denotes the first letter of the language concerned; e.g. EL for english), SM=Seminar, VV=Viva-voce, PR= Project, PV=Project and Viva- voce etc]. For elective courses; one more arabic numerals n (n=1,2,3..etc) will be followed after the course description letters, based on the elective(s) chosen.

However, Open Courses (in semster III and IX) shall have a different coding pattern depending upon the Programme/Schools offering that open course.

12. Award of Degrees: After successful completion of 10 semesters; B.Sc. and Integrated M.Sc. Degree in Biology discipline shall be awarded. First three years (Foundation Level) courses will be considered for awarding Bachelor's degree based on the major opted in IV to VI semesters with completion of minimum course credit of **120** and **minimum graduating CGPA of 5**. Fourth and fifth years (Advanced Level) courses will be considered for awarding the Master's degree in the Biology discipline with completion of minimum course credits of **80 and minimum graduating CGPA of 4**. Successful completion of the Major Project and Viva-voce is mandatory requirement for the award of Integrated M.Sc. Degree in Biology

- 13. Faculty: The degree(s) of the programme(s) shall be awarded under the Faculty of Sciences.
- 14. **Evaluation:** The evaluation of the courses shall be done on the basis of continuous internal assessment and end semester examinations. However, lab courses shall be evaluated based on continuous internal assessment only.
- 15. **Grading system:** The grading system shall be as stipulated by CSS regulations of the M.G. University.
- 16. **CGPA and SGPA:** The computation of SGPA and CGPA shall be as stipulated by CSS regulations.
- 17. **Exit option:** Exit option (after UG level courses) is normally not allowed. However students are eligible to get their Under Graduate level degree certificates, after successful completion of six semesters of the programme. This provision shall be availed by students only under special circumstances as convinced by the Institute Programme Advisory Committee and approved by the Vice-Chancellor
- 18. **Re-admission, Condonation and Internal Re-do:** As per M.G. University rules and orders.

19. Reappearance and improvement examination:

a) For the foundation (UG) level courses, students in the 1st to 6th semesters who have secured the minimum letter grade of 'C' or 'P' in the end semester examination can improve their grade by reappearing for all the courses of that semester together with the next immediate batch

provided the student has paid the required fee. In such cases the the student will be awarded a new grade only if there is an improvement, otherwise the student is eligible to retain the (previous) grade.

- b) Students in the 1st to 6th semesters who have secured a letter grade of 'F' or 'Ab' in any of the course(s) can avail two immediate consecutive chances to reappear the examination course wise, provide the student has applied for the same and paid the required fee.
- c) The improvement and reappearance of courses during the 7th to 10th semesters, shall be done based on the CSS regulations of the university. In such cases the 7th to 10th semesters of integrated programmes shall be treated similar to 1st to 4th semesters of conventional PG programmes.
- d) In any case may be; the course requirements for the Foundation (UG) level courses must be completed within 9th semester of the programme and the course requirements for the Advanced (PG) level courses must be completed within a maximum of fourteen semesters.
- 20. **Re-do the project work at the VIth and Xth semesters**: The Project work has to be successfully completed during the stipulated time of the programme. If a student fails to do so on genuine reasons, student shall be allowed to re-do the project work (within the next two years) with the sanction of the Vice-Chancellor.

21. **Fee structure**: The Fees structure for the integrated programme is given below. This shall be revised from time to time based on the rules and orders of the university. In addition to this, examination fees have to be paid in every semester as per M.G. University rules and orders.

Detailed syllabus

SEMESTER 1

Systematics and diversity of lower life forms and non vascular plants

Unit 1

Viruses: General characters and replication of viruses,TMV (RNA Virus) and T4 Phage (DNA Virus) Lytic and Lysogenic cycle. Economic importance of Viruses – a brief account Viriods and Prions – General structure.

Unit 2

Bacteria: General characters, Morphology and Cell structure, Reproduction and Genetic recombination (Conjugation, transformation and transduction) in Bacteria. Economic importance of Bacteria - a brief account.

Cyanobacteria: General characters, Morphological and Structural diversity and Reproduction. Cyanophages – a brief account. Economic importance of Cyanobacteria.

Mycoplasma: General characters, Morphological and Structural diversity and Reproduction. Economic importance Mycoplasma– a brief account.

Unit 3

Fungi: General characters and Classification (Ainsworth, 1971) of Fungi. Morphological and Structural diversity

and Reproduction in Myxomycotina (Stemonites), Mastigomycotina (Saprolegnia), Zygomycotina (Rhizopus), Ascomycotina (Penicillium and Aspergillus), Basidiomycotina (Agaricus and Puccinia) and Deuteromycotina (Cercospora)

Economic importance of Fungi – a brief account. Mycorrhiza – ectomycorrhiza and Endomycorrhizae and their significance.

Unit 4

Algae: General characters and Classification (Fritsch, 1950). Morphological and Structural diversity and Reproduction in Chlorophyceae (Volvox, Hydrodictyon, Spirogyra, Caulerpa and Coleochaete), Charophyceae (Chara), Bacillariophyceae (Diatoms), Xanthophyceae (Botrydium), Phaeophyceae (Ectocarpus and Sargassum), Rhodophyceae (Batrachospermum and Polysiphonia). Cultivation and Economic importance of Algae.

Bryophytes: General characters and Classification (Proskauer,1957). Morphological and Structural diversity, Reproduction in Marchantiaceae (Marchantia), Porellaceae (Porella), Anthocerataceae(Anthoceros), Sphagnaceae(Sphagnum) and Mosses (Funaria). Economic importance of Bryophytes.

Recommended readings:

Alexopoulus C.J. & Mims C.W. 1990. Introductory mycology, 5th edn Wiley Eastern Limited, New Delhi.

Fritsch, F.E. 1961. Structure and reproduction in algae, Vol. I, II. Cambridge University Press, London. Bhatia, K.N. 1984. A treatise on Algae. S. Chand and Company, New Delhi.

Bold, H.C. and Wyhne, M.J. 1978. Introduction to Algae: Structure and reproduction. Prentice Hall, Engle Wood Cliffs, New Jersey.

Chopra, R.N & Kumar, P.K. 1988. Biology of Bryophytes. New Age International Publisher, New Delhi.

Contract, F. H., Kimball, P.C. and Jay, L. 1998. Virology. Prentice Hall, Englewood Cliff, New Jersey. Fritsch, F.E. 1961. Structure and Reproduction in Algae. Vol. I and II. Cambridge University Press.

Cambridge, U.K.

Kumar, H.D. 1990. Introductory Phycology. Affiliated East West Pvt. Ltd. Bangalore.

Pandey, B.P. 1994. Fungi. S. Chand and Company Ltd, New Delhi.

Parihar N.S. 1970. An Introduction to Embryophyta, Vol. I Bryophyta.

Systematics and diversity of Invertebrates

Unit 1

Systematics of Animals: Meaning, Nomenclature, Principles of Classification, Classification of Animal Kingdom. Major branches of invertebrates and their relationships. Diversity and distribution of invertebrates in space and time.

Unit 2

Classification, general characters and diversity of Phylum Protozoa, Porifera, Coelenterata, Ctenophora, Platyhelminthes and Aschelminthes. Life cycle of Plasmodium, Trypanosoma, Obelia, Fasciola hepatica, Taenia solium, Ascaris lumbricoides.

Unit 3

General characteristics and classification of minor phyla

Unit 4

General characteristics, classification and diversity of Phylum Annelida, Arthropoda, Mollusca and Echinodermata. Life cycle of leech, Cockroach, fresh water mussel and star fish.

Unit 5

Social organization in Insects: Honeybee and termites. Coral and coral reefs. Larval forms in Invertebrates

Unit 6

Economic importance of invertebrates and their products and byproducts. Culture and management practice of important invertebrates - Vermiculture, Apiculture, Sericulture, Lac cultivation, prawn culture and mariculture (pearl culture).

Recommended readings:

Bames, R.D. 1968. Invertebrate Zoology, 2nd Edn. Saunders, Philadelphia.

Barrington, E.J.W. 1967. Invertebrate structure and function, Nelson, London.

Hyman, L.H. 1940-67. The invertebrates, Vol. I-VI. McGraw-Hill, New York.

Marshall, A.J. and Williams W.D. (Eds). 1995. Text book of Zoology–Invertebrates Ed., Vol. I, A.I.T.B.S. Publications.

Richard Brusca & Gary J. Brusca 2003. Invertebrates, Sinaver Associates. Inc., Publishers.

A manual of Zoology part 1 non- chordates - Ekambaranatha Ayyar.

BIO-PHYSICAL CHEMISTRY

Unit 1

Introduction to Measurement: SI units-standard units for measurement, Basic units, Prefixes, measurement-Length, mass, time and temperature. Derived units-volume. Significant figures-zero as significant figure.

Unit 2

Atomic structure: Wave particle duality-the de Broglie equation. The Schrodinger wave equation. Quantum numbers. Atomic orbitals and their shapes. Hund's rule

Unit 3

Periodic Classification and Chemical Bonding: Periodic Classification. Trends in the periodic tableatomic and ionic radii, ionization energy, electronegativity and electron affinity. Concept of oxidation number and its computation.

Chemical Bonding: Ionic bond-energetics - Valence bond theory. Hybridization - examples: methane, ammonia, water, ethane and ethylene. Sigma and pi bonds. Concept of resonance. Molecular orbital theory. Properties of covalent molecules- bond length, bond energy and bond angle. Hydrogen bond, inter-and intra-molecular types, importance in biomolecules. Hydrophobic forces.

Unit 4

Radioactivity: Detection of radioactivity. Characteristics of radio elements. Disintegration constant. Half-life. Tracer techniques- production of labeled 14C, 32P and compounds and their applications in biological studies. Biological effects of radiation emitted by isotopes, safety measures. Unit 5

Solutions and Colligative Properties: Concentration units - molarity, molality, normality and mole fraction. Types of solutions - homogenous and heterogeneous. Factors influencing solubility, solubility curves, Henry Law - applications. Osmotic pressure and its measurement by the Berkley-Hartley method. Laws of osmotic pressure. Hypo, hyper and isotonic solutions. Effect of osmotic pressure on living cells. Donnan membrane equilibrium. Relative lowering of vapour pressure. Rault's law. Elevation of boiling point, depression in freezing point and their applications in the determination of molecular weight. Abnormal molecular weights. Vant Hoff factor. Degree of association and dissociation.

Unit

08 hours

Electrolytic Dissociation and Mass Law : Strong and weak electrolytes. Activity and activity coefficient. Relationship between activity coefficient and ionic strength. Common ion effect, solubility product and their applications. Conductance and its

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measurement. Electrochemical cells-Oxidation-reduction reactions, Reversible electrodes and cells. Single electrode potential. Nernst equation. Standard electrodes and their applications. Unit 7

Acids, Bases and Buffers: Modern concepts of acids and bases. Ionisation of acids. Dissociation of water. Ionic product of water. Hydrogen ion concentration.-pH. Determination of pH. Dissociation of weak acids (pKa). Effects of salts on dissociation of acids. Interaction of acids with bases. Dipolar ions - isoelectric pH of amino acids and proteins. Buffers, buffer equation, buffer capacity. Problems on preparation of buffer solutions. Buffers of blood plasma, red blood cells and tissue fluids. Use of buffers. Determination of pH- colorimetric method, based on use of indicators, limitations. Use of buffer solutions and indicators.

Unit8

Biopolymers, Viscosity of liquids and Surface tension: Biopolymers-Classification. polymerization process. Number-average and weight-average molecular weights. Molecular weight determination by osmometry.

Viscosity of liquids: Determination of viscosity of liquids using Oswald's viscometer. Relation of viscosity and shape of molecules with examples.

Surface tension: Definition, determination of surface tension of liquids using Stalagmometer. Effect of surfactants.

Recommended readings:

Casey, E.J. 1969. Biophysics, concept and mechanism, Affiliated East West press.

Bose, S. 1982. Elementary Biophysics. Jyothi Books, New Delhi.

Ackerman, E. 1967. Biophysical Science. Prentice Hall, N.Y.

Narayanan, P. 2000. Essentials of Biophysics. New Age International Publication. New Delhi.

Van Holde, 1998. Principals of physical biochemistry. Prentice Hall, N.Y.

J.D. Lee, 2009. Concise Inoganic chemistry. 4th edition. Wiley India publication.

ENGLISH PAPER -I

Module 1

The Sentence and Its Structure - How to Write Effective Sentences – Phrases -What Are They? - The Noun Clauses - The Adverb Clause - —If All the Trees Were Bread and Cheesel - The Relative Clause - How the Clauses Are Conjoined - Word-Classes and Related Topics - Understanding the Verb - Understanding the Auxiliary Verb - Understanding the Adverbs - Understanding the Pronoun - The Reflexive Pronoun - The Articles I - The Articles II - The Adjective - Phrasal Verbs - Mind Your Prepositions

Module 2

To Err Is Human - Concord - A Political Crisis - Errors, Common and Uncommon - False Witnesses -The Anatomy of Mistakes- A Fault-finder Speaks - A Lecture on AIDS - A Test for You, Reader -Ungrammatical Gossip - Round Circles and Equal Halves: A Look at Tautology - Comparisons are Odious - In Defence Of A Friend - An Invitation Spelling and Pronunciation - Pronunciation: Some Tips - More Tips on Pronunciation – Spelling - An Awesome Mess? - Spelling Part II

Module 3

Singleness of Meaning - Shades of Meaning - Confusing Pairs - What Is the Difference? - Mismatching Mars the Meaning The Tense and Related Topics - _Presentness' and Present Tenses- The _Presentness' of a Past Action - Futurity in English - Passivization Idiomatic Language-_Animal' Expressions - Idiomatic Phrases - _Heady' Expressions - Body Language

Module 4

Interrogatives and Negatives - Negatives- How to Frame Questions -What's What? The Question Tag Conversational English - Polite Expressions - Some Time Expressions - In Conversation - Is John There Please? Miscellaneous and General Topics - On Geese and Mongooses - Pluralisation - On Gender and Sexisms Reading – Kinds of Reading – Recreational Reading – Study-type Reading Survey Reading – The Process of Reading – Readability – The Importance of Reading – Previewing -Skimming

Module 5

The world of words- have a hearty meal- word formation-Use the specific word- word games-the irreplaceable word- Let's play games- body vocabulary Very Good but Totally Incompetent - Long Live the Comma - The Possessive Case- Letter Writing- Academic Assignments

Get your doubts cleared Core Text: Fine-tune Your English by Dr Mathew Joseph. Orient Blackswan and Mahatma Gandhi University

PRACTICALS

SYSTEMATICS AND DIVERSITY OF LOWER LIFE FORMS AND NON-VASCULAR PLANTS

1. Measurement of microscopic structures.

2. Bacterial staining.

3. Study of morphology and Micro-preparation of the following; Phytophthora, Albugo, Rhizopus, Aspergillus, Penicillium, Puccinia, Tikka.

4. Study of morphology and Micro-preparation of the following; Cyanophyceae:, Oscillatoria, Nostoc, Scytonema. Chlorophyceae: Hydrodictyon, Spirogyra, Caulerpa, Coleochaete. Charaphyceae : Chara. Xanthophyceae: Botrydium. Phaeophyceae: Ectocarpus and Sargassum. Rhodophyceae : Batrachospermum and Polysiphonia.

5. Study of Morphology, Anatomy of Vegetative and Reproductive structures of Marchantia, Porella, Anthoceros, Sphagnum, Funaria.

6. Field visits to study and to collect non-vascular plants.

SYSTEMATICS AND DIVERSITY OF INVERTEBRATES

Identification and Classification of Representatives of Phylum Protozoa – Paramecium, Vorticella, Plasmodium, Euglena, Trypanosoma, Noctiluca, Entamoeba (Amoeba).

Porifera - Leucosolenia, Gemmule, Euspongia (Bath sponge), Euplectella (Venus flower basket), Hyalonema (glass rope sponge).

Coelentarata – Obelia, Aurelia, Sea anemone, Physalia, Porpita, Corals – Fungia, Astrea, Gorgonia, Meandrina (Brain coral), Tubifora (Slag horn coral), Pennantula (Sea pen).

Platyhelminthes-Liver fluke, tape worm, planaria. Aschelminthes- Ascaris, Ancylostoma (Hook worm), Schistosoma (Blood worm) Filarial worm.

Identification and Classification of major representatives of Annelida - Earth worm, Nereis, Aphrodite, leech, Sabella, Tubifex, Arenicola.

Arthropoda- Lepas, Balanus, Centipede, Millipede, Scorpion, Peripatus, Limulus, Prawn, Crab, Lobster, Grass hopper, mouth parts of insects : butterfly, mosquito, honeybee, housefly and cockroach. Mollusca - Sepia, Octopus, chiton, Patella, Dentalium, fresh water mussel, Pila globosa (snail), Nautilus, Murex, Xanchus, Cyprea. Echinodermata - Sea urchin, Starfish, Sea cucumber, Brittle star, Sea lilly.

Demonstration of Dissections – a. Reproductive, Digestive and Nervous system of male and female Cockroach, Silk moth. b. Earth worm – Nervous system (nerve ring) and setae mounting.

Field visits to Museums, Butterfly park and natural habitats of invertebrates

BIOPHYSICAL CHEMISTRY

1. Preparation of Acetate and Phosphate Buffer and checking pH using pH meter-Calculation of pKa. 2. Preparation of standard potassium biphthalate and estimation of alkali (Eg:- NaoH).

- 3. Preparation of standard sodium oxalate and estimation of potassium permanganate.
- 4. Estimation of sulphate as Barium sulphate by Gravimetric method.
- 5. Estimation of Hardness of water using EDTA
- 6. Determination of Density of a liquid.
- 7. Determination of Viscosity of a liquid.
- 8. Determination of Surface tension of a liquid.
- 9. Determination of molecular weight by Walker-Lumsden method.

Linear Algebra and Numerical methods

Module I: System of Equations and Matrices

Liner Equations, Gaussian Elimination, Matrix Operations, Inverse and Algebraic Properties of Matrices, Elementary Matrices and inverse, Diagonal, triangular and Symmetric Matrices .

Module II:Eigen Values and Eigen Vectors

Eigen Values and Eigen Vectors, Diagonalization Orthogonal Matrices Orthogonal Dagonalization Module III: Euclidian Vector Spaces and General Vector Spaces

Vectors in 2- Space, 3- Space, and n- Space, Norm, dot product and distance in Orthogonality. Module IV: General Vector Spaces

Module IV:General Vector Spaces

Real Vector Spaces, Sub spaces Linear Independence and Basis, Dimension .

Module V: Numerical Methods (Use of Non Programmable Scientific Calculator is Permitted) Absolute, relative and percentage errors. A general error formula . Error in a series Approximation. Bisection Method , Methods of false position , Iteration Method , Acceleration of convergence: Aitken's $\Delta 2$ Process, Newton Raphson Method, the quotient – Difference method .

References:

1.Text 1. Howard Anton & Chris Rorres Elementary Linear Algebra with Supplementary Application Wiely Publication .inc 11th Edition

2.Text 2.S.S . Sastry : Introductory methods of Numerical Analysis ,4th edn. (Prentice Hall)

3.Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

4.G. Strang, "Linear Algebra and its Applications", 3rdEdition, Harcourt College Publishers, 1988.

SYSTEMATICS AND DIVERSITY OF VASCULAR PLANTS

Unit 1

Pteridophytes: General characters and classification (Reimers 1954). Morphology, anatomy and reproduction in Psilotaceae (Psilotum), Lycopodiaceae (Lycopodium), Selaginellaceae (Selaginella), Equisetaceae (Equisetum), Ophioglossaceae (Ophioglossum), Marattiaceae (Angiopteris), Osmundaceae (Osmunda), Polypodiaceae (Pteris), Marseliaceae (Marselia).

A brief account on stelar evolution, heterospory and seed habit. Fossil Pteridophytes -Fossilization, Types of fossils Psilophytales (Rhynia), Lepidodendrales (Lepidodendron and Lepidocarpon), Calamitales (Calamites).

Unit 2

Gymnosperms: General characters and classification (Pilger and Melchior (1954) Morphology, Anatomy and Reproduction in Cycadaceae (Zamia and Encephalartos), Pinaceae (Pinus), Podocarpaceae (Podocarpus), Ginkgoaceae (Ginkgo), Taxaceae (Taxus) and Gnetaceae (Gnetum, and Ephedra). A brief account of economic importance, origin and evolution of Gymnosperms Unit 3

Fossil Gymnosperms: A general account on morphology, anatomy and reproductive structures of Pteridospermales(Lyginopteridaceae), Bennetitales (Cycadeiodaceae), Caytoniales (Caytoniaceae), Pentoxylales(Pentoxylaceae), Glassopteridales(Glossopteridaceae) and Cordaitales (Cordaitaceae). Unit 4

4.1 Systematics of Angiosperms: Introduction and a brief account of the history of taxonomy.

4.2 Importance and relevance of character evidence: Phytochemistry, Palynology, Cytology, Molecular taxonomy, Numerical taxonomy. Origin of Angiosperms

Unit 5

Botanical Nomenclature : Principles of Nomenclature, a brief account of ICBN and ICNCP. Unit 6

Botanical literature : Floras, Revisions, Monographs, and Role of computer in taxonomy. Herbarium – Preparation, maintenance and Importance of herbaria; Important herbaria of the world. Botanical garden – a brief account and importance of botanical garden; Important botanical gardens of the world

Unit 7

Classification: Classifications of Bentham and Hooker, Engler and Prantl, Cronquist and APG III system.

Unit 8

Salient features and economic importance of the following families: Dicots: Magnoliaceae, Nymphaeceae, Caryophyllaceae, Malvaceae, Euphorbiaceae, Rubiaceae, Scrophulariaceae, Asclepiadaceae, Asteraceae. Monocots: Alismataceae, Arecaceae, Poaceae, Cyperaceae, Zingberaceae, Liliaceae and Orchidaceae

Recommended Reading

Pteridophytes and Gymnosperm :-

1. Bower F.O. 1884. On the comparative morphology of the vascular cryptogams and gymnosperm. Phil. Trans. Roy. Society. London.

2. Eames A.J. 1936. Morphology of vascular plants (lower groups). Mc. Graw Hill Publications, NewYork

3. Parihar. N.S. 1977. The morphology of Pteridophytes, Central book Dept, Allahabad, India.

4. Andrew. H.N. 1961. Studies in Paleobotany. John Wiley, New York.

5. Bhatnagar and Moitra. A. 1996. Gymnosperms. Poplei. New Age International Ltd. New Delhi. fossilization, fossilization,

6. Chamberlain. C.J. 1986. Gymnosperms, structure and evolution. CBS Publications, New Delhi.

7. Chopra. G.L and Verma. V. 1988. Gymnosperm. Pradeep Publications, Jalandar, India

Angiosperms -: 1. Cronquist. A. 1981. An integrated system of classification of flowering plants. Columbia University Press, New York.

2. Davis. P.H. and Heywood. V.H. 1973. Principles of Angiosperm taxonomy, Robert and E. Kriegen Publications, New York.

3. Heywood. V.H and Moore. D.M. 1984. Current concept in plant taxonomy, Academic Press, London.

4. Sambamurthy. A.V.S.S. 2005. Taxonomy of Angiosperm. IK International Publishers, New Delhi. 5. Lawrence. G.H.M. 1951. Taxonomy of vascular plants, Mac Milan, New York.

SYSTEMATICS AND DIVERSITY OF VERTEBRATES

Unit 1:

Origin, systematic position and characteristics of Vertebrates.

Unit 2: .

Diversity, Salient features and Classification of classes Pisces, Amphibia, Reptilia, Aves and Mammals (up to orders).

External characters of fish (shark), frog and rabbit-Digestive, Respiratory, Circulatory, Excretory, Nervous and Reproductive systems

Unit 3:

Economic importance of vertebrates and their products & by-products

Unit 4:

Adaptations – Aquatic, Terrestrial, Aerial

Unit 5:

Migration in fishes & birds. Parental care in fishes & amphibians. Nesting in birds. Adaptive radiations in Reptiles & mammals.

Unit 6:

Animal Behaviour - Ethogram, Learning, Instincts, Motivation, Cooperation and conflicts, Social organization in Primates.

Recommended readings:

1) Parker, J & W. Haswell, 1995. Textbook of Zoology – Vertebrates. The Macmillan Press Ltd., U.K.

2) Stephen A. Miller & John P. Harley 2001, Zoology. The Animal Kingdom. Wm. C Publishers.

3) Berme, R.N. and Levy MN Principles of Physiology, Mosby Year Book. Inc. 1996.

4) Eckert and Randall. Animal Physiology – Mechanisms and adaptations. CBS Publishers, 2000.

5) Schmidt-Nielsen. Animal Physiology. Cambridge Univ. Press, 2000.

6) D. Jenson. The Principles of Physiology. Appleton-Century-Crofts, 1996.

7) Prosser CL. Comparative Animal Physiology. WB Saunders and Company, 1973.

8) Ekabaranatha Ayyar - A manual of Zoology. Part -2 Books on animal behavior. 9) Marles P & Hamilton W.J. Mechanisms of Animal Behavior, John Wiley & Sons, M.C. N.Y, Land, Tokyo

BIO-ORGANIC CHEMISTRY

Unit 1: Introduction and nomenclature of organic compounds: IUPAC nomenclature of organic compounds including bifunctional ones. Detection and principles of estimation of C, H, N, halogens, S and P in organic compounds. Inductive effect, resonance and hyperconjugation concepts. Reactive intermediates - carbocations, carbanions, carbenes and free radicals.

Unit 2: Hydrocarbons: Mechanism of addition of HCl to propene. Markovnikov's rule. Peroxide effect. Alkenes - ozonolysis and oxidation. Alkynes-formation of acetylides and their importance. Dienes: Types with examples. Conjugate dienes. 1, 3-Butadiene - Stability, Mechanism of addition of HBr. Conformational analysis of ethane and n-butane.

Unit 3: Carbohydrates: Biological importance and classification. Monosaccharides; D and L designation. Glucose- structural elucidation and conformation. Ring structure of fructose, galactose, mannose and ribose. Straight chain structure of sedoheptulose. Epimers and anomers; ascending and descending of monosaccharide series. Derived monosaccharides; structure and biological importance of amino sugars, sugar phosphates, sugar acids and deoxy sugars. Disaccharides; glycosidic linkage. Structure and biological importance of sucrose, maltose, lactose, isomaltose, cellobiose and trehalose, Storage Polysaccharides-starch and glycogen. Structural cellulose and chitin, pectins, glycosaminoglycans, cell wall components- peptidoglycan and teichoic acid.

Unit 4: Cycloalkanes and Arenes: Cycloalkanes : Reactivities and relative stabilities. Baeyer strain theory. Sachse-Mohr theory. Boat and chair forms of cycloalkane. Axial and equatorial bonds. Arenes: Modern concept of the structure of benzene. Aromaticity. 4n+2 rule. Mechanism of electrophilic substitution in benzene. Nitration and Friedel-crafts's alkylation. Electronic interpretation of the orienting influence of substituents in the electrophilic substitution of toluene, chlorobenzene and nitrobenzene. Structures of Naphthalene, anthracene, phenanthrene and diphenyl. Oxidation reactions of naphthalene.

Unit 5: Alkyl halides and Organometallic compounds: SN1 and SN2 mechanisms taking primary, secondary and tertiary alkyl halides as examples. Mechanistic concepts of elimination reactions t-butyl chloride and n-butyl chloride. Organometallic compounds - examples. Preparation and synthetic applications of Grignard reagents.

Unit 6: Stereochemistry: Stereoisomerism: Types. Stereochemical terminology. Optical isomerism: Molecular dissymmetry. Chirality: glyceraldehyde, lactic acid and tartaric acid. Nomenclature of enantiomers - The RS system and DL. Rotation, racemisation and resolution. Fischer projection formulae. Geometrical isomerism: Cis trans isomerism in alkenes and ring compounds. Structure and properties of maleic and fumaric acids. (E) - (Z) system of specifying geometrical isomers. Significance of chirality in the biological world.

Unit 7: Carboxylic Acids and amines: Carboxylic Acids-Meaning and usefulness of pKa values. Acidity of monocarboxylic acids. Effect of substituents on acid strength. Hydroxy acids: Preparation and properties of lactic acid. Structures of tartaric, malic, citric and isocitric acids. Dicarboxylic acids: Saturated dicarboxylic acids - effect of heat on the first five members. Keto acids : Structures of pyruvic, α -ketoglutaric acid and oxaloacetic acids. Properties of pyruvic acid. Amines: Classification. Isomerism. Distinguishing reactions of 10, 20 & 30 amines. pKb values of amines. Effect of substituents on the basic strength of amines. Some biologically important amines.

Unit 8: Heterocyclic Compounds: Structural formula and occurrence of furan, pyran, thiophene, thizole, pyrrole, imidazole, pyridine, pyrimidine, purine, isoalloxazine and indole. Reactions of imidazole and pyridine. Aromaticity of furan, thiophene, pyrrole and pyridine. Terpenes - Isoprene rule. Classification with examples, biological Importance and occurrence of the following: limonene, menthol, santonin, juvenile hormone I, abscisin II, phytol, gibberlic acid, lanosterol, lycopene. Polyphenols - dolichols. Steroids; basic ring system. Structures of cholesterol, steroid hormones (testosterone and estradiol) Structures and importance of β carotene, chlorophyll a, ubiquinone and plastoquinone. Alkaloids - Introduction and general characteristics. General method

of extraction. Structure and medicinal uses of nicotine, atropine and LSD. Phytochemicals-Introduction and uses.

Unit 9: Bioinorganic Chemistry : Metal ions in biological systems. Roles of Iron in myoglobin, hemoglobin and cytochrome C, Copper in haemocyanin, Magnesium in chlorophyll, Cobalt in vitamin B12 and Molybdenum in nitrogenase. Metallo-enzymes.

Unit 10: Antibiotics : Definition: Types. Sources, structures and antimicrobial spectrum of action of penicillin, chloroamphenicol, streptomycin and tetracyclines.

Pesticides : Structures and uses of the following insecticides: DDT, gammexane lindane allethrin and malathion. Herbicides ; 2, 4-D and 2, 4, 5-T. Green chemistry: Atom economy, concept with examples. Wash – production and prevention. Water as a solvent, microwave irradiation and organic synthesis- concept and advantages. Eco friendly pesticides – pyrethroids. Biocatalysis – advantages.

Recommended readings:

1) Lancaster, M. 2002. Green Chemistry: an Introduction. Royal Society of Chemistry, London.

2) Sangi, S and Srivastav, M.M. 2003. Environment friendly alteration. Narosa Publishing House.

3) L. Indira and G.R Chatwal. 2004. College chemistry -1. Himalaya publishing house.

4) K. Peter. C. Vollhardt, Neil. E. Schore. 2002. Organic chemistry structure and function. 4th edition.

5) Clayden, Geeves, Warren and Wothers. Organic chemistry. Oxford publication.

6) Francis. A Carey. Richard. J Sundberg, Advanced organic chemistry. 4th edition.

MATHEMATICAL BIOLOGY

Module – I

The rabbit problem, Fibonacci numbers and types, Lucas numbers and types, Fibonacci and earth, flowers, Fibonacci and sunflower, Fibonacci and bees, Fibonacci and sub sets, Fibonacci and sewage

Module – II

Quadratic equations (Solution of quadratic equations with real roots only), Permutations and combinations – simple applications, Trigonometry- introduction, values of trigonometric ratios of 00, 300, 450, 600 & 900, Heights and distances.

Module – III

The Eucledian algorithm and Lucas formula, exponential series and logarithmic series.

Module – IV

Elementary mensuration – Area and perimeter of polygons, Elementary Algebra, monomial, binomial, polynomial (linear, quadratic & cubic), simple factorization of quadratic and cubic polynomials.

Differential Calculus - Differentiation – Standard results (derivatives), Product rule, Quotient rule and function of function rule (with out proof) and simple problems) Module V Types of numbers, HCF & LCM of integers, Fractions, Simplifications (V BODMAS rule), squares and square roots, ratio and proportion, percentage, profit & loss.

References –

1. M. Tyra, & K. Kundan- CONCEPTS OF ARITHMETIC, BSC PUBLISHING COMPANY PVT.LTD, C – 37, GANESH NAGAR, PANDAV NAGAR COMPLEX DELHI - 110092 2.GRE Math review (pdf)

3.Joseph Edward : Differential Calculus for beginners. Nabu Press (2011)

4.Calculus Volume I, S. Narayanan & T.K. Manikavachagam Pillai – S. Viswanathan (Printers & Publications) Pvt.Ltd

5.S Narayaynan, TK Manikavachagam Pillai : Calculus Volume I, S Viswanathan Printers and publications Pvt. Ltd.

PRACTICALS

SYSTEMATICS AND DIVERSITY OF VASCULAR PLANTS

1.Pteridophytes: Study of morphology, anatomy of vegetative and reproductive structures of Psilotum, Selaginella, Lycopodium, Equisetum, Ophioglossum, Osmunda, Pteris, Marsilia. Fossil pteridophytes subjected to the availability of materials / slides.

2.Gymnosperms: Study of morphology, anatomy of vegetative and reproductive structures of Zamia, Pinus, Podocarpus, Ephedra, Gnetum. Fossil Gymnosperms subjected to the availability of materials/slides.

3. Angiosperms: Herbarium preparation, Description of a taxon using technical terms.

4. Derivation of a taxon to respective family using Floras.

5. Study of local flora and field visits to various Botanical gardens to study the vegetation

SYSTEMATICS AND DIVERSITY OF VERTEBRATES

1. Identification and classification of vertebrates – Shark, Eel, Tetradon, Macropodus, Ophiocephalus, Narcine, Protopterus, Stegostoma, Salamander, Ichthyophis, Calotes, Mabuya, Phrynosoma, Draco, Varanus, Chamaeleon, Naja naja, Viper, Sphenodon, Ostrich, Archaeopteryx, Owl, Vampyrus, Loris, Pangolin, Porcupine.

2. Demonstration of Dissection: Rat nervous, Arterial and venous system, Reproductive system of male and female. (Virtual lab)

3. Life cycle of Frog.

4. Identification of skulls of chordates.

5. Dentition of chordates

6. Visit to Biological National Parks, Zoo, Sanctuaries and report

BIO-ORGANIC CHEMISTRY

1. Systematic qualitative analysis of - alcohol, phenol, carboxylic acid, aldehyde, ketone, ester, amine, amide, nitro compound and halogen compounds

2. Systematic qualitative analysis of monosaccharides-glucose, fructose, pentose, disaccharides and starch.

3. Preparation of acetyl salicylic acid FROM salicyclic acid

COMPUTER ORGANIZATION AND ARCHITECTURE

Module I: Basic Computer Organization and Design

Operational concepts, Instruction codes, Computer Registers, Computer Instructions, Timing & Control, Instruction Cycles, Memory locations and addresses, Memory Reference Instruction, Input - Output & Interrupts, Bus organization, Complete Computer Description & Design of Basic Computer,

Module II:Processor and Control Unit

Hardwired vs. Micro programmed Control Unit, General Register Organization, Stack Organization, Addressing modes, Instruction Classification, Program control.

ModuleIII: Memory Organization

Main Memory, Memory Hierarchy, Processor vs. Memory Speed, High-Speed Memories, Cache Memory, Associative Memory, Interleave, Virtual Memory, Memory Management, Auxiliary memory, Memory mapping Techniques.

Module IV:I/O Systems

Peripheral Devices, I/O Interface, Data Transfer Schemes, Program Control, Interrupt, DMA Transfer, I/O Processor.

Module V: Parallel Architectures

Introduction to parallel processing, Pipeline computers, Multi processing systems, Instruction-level- parallelism, Parallel processing challenges, Flynn's classification , Hardware multithreading, Multicore processors, Pipelining and Vector processing, Array Processors.

References

1.M.Morris Mano, Computer Systems Architecture, Third Edition, Pearson Education

2.Carl Hamacher, Computer Organization, Fifth Edition, Tata McGraw Hill.

3. John P Hayes, Computer Architecture & Organization, Mc Graw Hill.

4.David A. Patterson and John L. Hennessey, Computer Organization and Design, Fifth edition, Morgan Kauffman / Elsevier, 2014.

5.John L. Hennessy, David A. Patterson, Computer Architecture: A Quantitative Approach, 4th Edition.

6.William Stallings, Computer Organization and Architecture, Seventh Edition, Pearson Education 7.Kai Hwang and F A Briggs, Computer Architecture and parallel processing, McGraw Hills.

Internet Technologies Lab

Given the problem statement, students are required to formulate problem, develop code, executeand test it. Students should be given programming assignments on following

User Interface Design: HTML Editors, Image maps in a website, CSS and DHTML, XML and XHTML document construction, Display Alert, Confirm and Prompt Dialog Boxes, Web applications using Java Script, Java Beans API.Interaction with Database: SQL, MySQL, JDBC

□Server side scripting using AJAX and JQUERY and for creating dynamic webpages using HTML5.

Internet Telephony: VoIP, Streaming media, Codec and Plugins, Search Engine and Web Crawler

INTRODUCTORY PHYSICS

Module Development of Physics

An overview on ancient perspectives on the universe - Galileo, and his emphasis on experiments and observations, Kepler's laws, Newton and the deterministic universe, Maxwell and the unification of electricity, magnetism and optics, Fundamental particles and the unification of all forces of nature.

Planck's hypothesis of quantum, Quantum mechanics, Einstein and his theories of relativity, Contributions by the Great Indian Scientists - S. N. Bose, M. N. Saha, C. V. Raman, quantum theory of Raman effect Chandrasekhar's limit (details and derivations not required)

Module II: Units and Measurements of Physical quantities

Fundamental and derived quantities. Units and dimensions, dimensional analysis, order of magnitude, significant figures, errors.

Length measurement – rulers – standard metre – Vernier calipers - micrometers – screw gauges – travelling microscope – laser range finder- sonar, RADAR, GPS. Angle measurement – spectrometer - scale and telescope - measurement of stellar parallaxes.

Module III: Error analysis

Performance characteristics of an instrument – static characteristics – Error in measurement, Types of static error – Gross error, systematic errors, random errors, sources of error.

Statistical analysis: arithmetic mean, deviation from the mean, average deviations, standard deviation, limiting errors, graphical representation of measurements as a distribution.

Module IV: Mathematical Methods in Physics

Vector Analysis: – Vector Operations - Vector Algebra – Component form – How vectors transform, Applications of vectors in Physics. Differential Calculus: – The operator ∇ - Gradient, Divergence, Curl – Physical interpretation - Product rules of ∇ - Second derivatives.

Integral Calculus: – Line integral, surface integral and volume integral - Fundamental theorem of Gradients-Gauss's Divergence Theorem (Statement only)–The fundamental theorem of curl-Stoke's theorem(Statement only).Curvilinear co-ordinates:Spherical polar coordinates – cylindrical coordinates (Basic ideas).

References:-

1. University Physics, Roger A Freedman, Hugh D Young 14th Edition

2.Mathematical Physics :- Charlie Harper

3.Principles of Physics:- Jearl Walker, David Halliday and Robert Resnick

4. The theory of Errors in Physical Measurements- J C Pal- New Central Book Agency- 2010

5.Feynman lectures of Physics

6. Concepts of Modern Physics: ArtherBeisser,

7.Modern Physics: Kenneth Krane

8. Statistical Methods, S.P Gupta, S.Chand &Co.

General Physics Lab

1.Symmetric Compound Pendulum – Determination of acceleration due to gravity (g), radius of gyration(K) and moment of inertia

2.Asymmetric Compound Pendulum – Determination of acceleration due to gravity (g), radius of gyration(K) and moment of inertia (I)

3.Kater's pendulum – Determination of acceleration due to gravity (g)

4. Torsion Pendulum – Determination of rigidity modulus (n) and moment of inertia(I)

5. Torsion Pendulum (Method of equal masses) – Determination of rigidity modulus (n) and moment of inertia (I)

6.Measurement of density of a solid – Sensibility method to find mass using beam balance and screw gauge / venier calipers for dimension measurements

7. Uniform bending - Pin and Microscope - Determination of Young's modulus

8.Non Uniform bending – Pin and Microscope – Determination of Young's modulus

9.Uniform bending - Optic Lever - Determination of Young's modulus

10.Non Uniform bending - Optic Lever - Determination of Young's modulus

Reference books

1.Properties of Matter, D S Mathur

2. Practical Physics, P R Sasikumar Eastern Eco. Ed.

3. Advance level Practical Physics IV Ed., Nelkon and J M Ogborn

4. Advance course in Practical physics, D Chathopathyaya

5.Practical Physics, C L Arora

6.Electronics Lab Manuel, K A Navas

7.Digital fundamentals, Thomas L Floyed

8.A course of experiments with He-Ne Laser, R S Sirohi

9.Laboratory manael for introductory Electronic experiments, L K Maheswari & Nm S Anand

10.Optics, N Subramanyan, Brij Lal 7 Avadhanalu

PLANT ANATOMY AND PHYSIOLOGY

Unit 1

Plant anatomy:

Organization of primary plant body, apical meristems and primary growth, Primary xylem - composition, Primary phloem - composition, the role of auxins in the development of the primary vascular system.

Cell wall

Structure and development of the cell wall (light microscopic and ultramicroscopic structure), composition of the cell wall, Cell wall development, role of cytoskeleton in wall development and genetic control of wall development.

Meristems

Definition, classification of meristem, Apical meristems of Shoot and Root apex, relevant theories pertaining to structure and organization of root apex and shoot apex: Shoot Apex: Apical Cell Theory, Tunica Corpus Theory, Zonation Theory.

Root Apex: Histogenic boundaries; Quiscent center

Formation of leaf primordial, Transitional tissue regions, The primary peripheral thickening meristem of Monocotyledons,

Unit 2

Development of the secondary vascular system of the stem and root. Role of the vascular cambium, the effect of secondary growth on the primary body on leaf and branch traces. Secondary Xylem: Structure and development of secondary xylem, Secondary xylem of gymnosperms and dicotyledons. Patterns of distribution of xylary elements and rays, Tyloses, Genetic control of differentiation of secondary xylem. Evolution in secondary xylem of dicotyledons.

Secondary phloem: Gross and Ultra structure, development of the phloem. Nature and development of the cell wall of sieve elements. Nature of protoplast of sieve elements, Nature and function of P-protein, Distinctive features of phloem of gymnosperms, The nature and function of companion cells and Strasburger cells Unit 3

Nodal anatomy: A general account, Anamalous secondary

growth: Aristolochia, Boerhaavia, Dracaena

Periderm: Structure and development, formation of rhytidome, Lenticels

External secretory structures. Secretary tissues in plants : Internal secretory structures and

Ecological adaptations: Xerophytes, Mesophytes, Hydrophytes, Epiphytes, Parasites and Mangroves.

Unit 4

Water relation of a plant cell: Water potential, osmotic potential, pressure potential, membrane and their permeability mechanism of water absorption, SPAC concept.

Ascent of sap: Vital and physical forces.

Mineral nutrition: Importance of nutrients, major and minor elements, their deficiency disorders and treatments. Passive and active transport of solutes across the membranes, ion transport in roots, mechanism of translocation, sources and sink concept.

Unit 5

Photosynthesis: General concepts and historical backgrounds, photosynthetic apparatus, mechanism of absorption of light, Absorption spectrum, Emersson's enhancement effect, two pigment system-PS-I and PS–II. Non cyclic and cyclic electron transport system. Photophosphorylation, carbon assimilation-the Calvin cycle, C4 cycle and the CAM pathway. Photorespiration and its significance.

Unit 6

Respiration: Types of respiration, mechanism of respiration, Glycolysis, Kreb's Cycle, Electron transport system. Oxidative phosphorylation, Energetics of biological oxidation, respiratory inhibitors.

Unit 7

Growth and metabolism of growth hormones: Definition, Kinetics, growth hormones, biosynthesis, transport and physiological effects of Auxins, Cytokinins, Gibberellins, Abscissic acid and ethylene, mechanism of hormone action.

Unit 8

Nitrogen metabolism: Introduction, nitrogen fixation, biochemistry of nitrogen fixation role of nif genes and Leghaemoglobin.

Recommended readings: Plant Anatomy:

1.Katherine Easn, 1996. Anatomy of seed plants, First Wiley prints, New Delhi.

2.Cutter, D.G. 1971. Plant anatomy- Part-1. Cell and Tissues. Edward Arnold, London.

3.Cutter, D.G. 1971. Plant Anatomy, Part II, Cell and tissues, Edward Arnold, London.

4. Chand, S. 2005. Plant Anatomy, S, Chand and Company Ltd., New Delhi.

5.Metcalf C.R and L. Chalk, 1950, Anatomy of Dicotyledons. Leaves, Stems and wood in

relation to taxonomy with Notes on Economic users II Vols. Clerodendron press, Oxford.

6.Pandey, Plant Anatomy, Chand and Company ltd, New Delhi.

7.Cutler Botha and Stevenson (2007) Plant anatomy an applied approach. Black well publishing, UK.

8.Fahn A.1990, Plant anatomy, 4th edition, Pergamon press, Oxford.

Physiology:

9.Conn, E.E., Stumpf, Bruenning, G. and Doi, R.H. 1987. Outlines of Biochemistry, John Wiley and Sons, New York.

10. Wilkins, M.B. (eds). 1989. Advanced physiology, Pitman publishing Ltd, London.

11.Salisbury and Ross, 2005. Plant physiology, CBS publication, New Delhi.

12.Zeigger, 2006. Plant physiology, Sinaere publisher.

13.Trivedi and Verma, 2007. A text book of physiology, biochemistry and biotechnology, S. Chand and Co., New Delhi.

14. Tiaz & Zeiger, 2010. Plant Physiology, 6th edition, Dincoln Taiz & Eduardo Zugier, Parima Publishing, New Delhi.

15.W.G Hopkins and W.P.A Huner Introduction to plant physiology 4th edition, 2011.

OPERATING SYSTEMS

History and Evolution of OS, Basic OS functions, Resource Abstraction, Types of Operating Systems– Multiprogramming, Batch, Time Sharing Systems; Operating Systems for Personal Computers, Workstations and Hand-held Devices, Real time Systems, Operating System Services.

Module II: Process

Basic Concepts, Processor and User Modes, Kernels, System Calls and System Programs, System View of the Process and Resources, Process Abstraction, Process Hierarchy, Threads, Threading Issues, Thread Libraries; Process Scheduling, Non-Pre-emptive and Pre-emptive Scheduling Algorithms.

Module III: Process Management and Synchronization

Concurrent and Dependent Processes, The Critical Section problem, Semaphores, Methods for Inter- process Communication, Classical Problems of Synchronization, Monitors. Deadlocks: Deadlock Characterization, Methods of handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

Module IV:Memory Management

Physical and Virtual Address Space, Memory Allocation Strategies– Fixed and Variable Partitions, Swapping, Contiguous memory allocation, Paging, Segmentation. Virtual Memory Management- Demand paging, Page Replacement.

Module V: Storage and I/O Management

File Concepts, Access Methods, Directory structure, File System Structure, File Allocation Methods, Free Space Management, Disk Scheduling.

References:

1.A Silberschatz, P.B. Galvin, G. Gagne, Operating Systems Concepts, 8th Edition, John Wiley Publications.

2. William Stallings, Operating Systems, Prentice Hall of India, Pearson

3.William Stallings, Operating Systems: Internals and Design Principles, 7th Ed., Prentice-Hall, 2011.

4.A.S. Tanenbaum, Modern Operating Systems, Pearson Education .

5.M. Milenkovic, Operating Systems- Concepts and design, Tata McGraw Hill

Web Programming Lab

Given the problem statement, students are required to formulate problem, develop code, execute and test it. Students should be given programming assignments on following :

□ Configuring and Installation-Apache and PHP, MySQL, Develop HTMLform with PHP, PHP pages using PHP tags, setting and using Session and Cookie, using File and Directories.

Creating and managing Databases using MySQL, Input, Output and Edit Databases,

Manipulating and Creating Images with PHP, Validation

□ Develop Applications/Projects using PHP5 (LAMP, WAMP may also be used). References

1. Chris Bates, Web Programming Building Internet Applications, Wiley publications.

2.Larry Ullman, PHP and MySQL For Dynamic Web Sites, 4th Edition, Pearson,.

3. Steven M. Schafar, HTML, CSS, Javascript, Perl, Python & PHP, Wiley Publication.

4. ElizebethNaramrore, Jaison Garner, Beginning PHP5, Apache and MySQL.

5.H M Deitel, P J Deitel&A B Goldberg, Internet and Worldwide Web Programming: How to Program, 3/e, Pearson Education.

INORGANIC CHEMISTRY

Module I: Chemistry of Representative Elements

Comparative study of s and p block elements ,diagonal relationships - Inert pair effect. Ionic compounds: BornLande equation (No derivation),Born-Haber cycle and its applications, Lewis acidity of boron halides - Preparation, properties, structure and uses of Diborane, Boric acid, Borazine and Boron nitride . Structures of oxides of N and P, oxy acids of N and P, Structure and acidic strength of oxy and peroxy acids of sulphur, oxy acids of chlorine. Preparation, properties and uses of ammonia, nitric acid, ozone, hydrogen peroxide, sulphuric acid and hydrochloric acid. Chemical properties of the noble gases, chemistry of xenon, structure and bonding of xenon compounds.

Module II: Transition and Inner Transition Elements

Characteristic properties of d- and f- block elements, General group trends with special reference to electronic configuration, colour, and variablevalency, ability to form complexes, magnetic and catalytic properties, non-stoichiometric compounds, complex formation and alloy formation. Chemistry of first transition series in various oxidation states. Explanation of metallic properties of transition metals based on theories of Metallic Bonding- Free electron theory, valence bond theory and band theory

Lanthanides: Occurrence of lanthanides ,Isolation of lanthanides from monazite sand – Separation by ion exchange method. Lanthanide contraction: Causes and consequences. Industrial importance of lanthanides. Actinides: Electronic configuration and general characteristics

Module III: Bioinorganic Chemistry

Metal ions in biological system -Trace and bulk metal ions.General aspects of chemistry of dioxygen Hemoglobin and Myoglobin , Chlorophyll and photosynthesis, Nitrogen fixation and vitamin B12 - Sodium-potassium pump- Biochemistry of Ca, Zn and Co- Toxicity of metal ions (Pb, Hg and As). Anticancer drugs: Cis-platin, oxaliplatin, carboplatin and auranofin - Structure and significance.

Module IV: Chemistry of Non-aqueous Solvents:

Non-aqueous Solvents: Classification – General properties – Self ionization and leveling effect Reactions in non-aqueous solvents with reference to liquid NH3, H2SO4, liquid HF, HSO3F, liquid SO2. N2O4, PC15, BrF3 super acids, ionic liquid: molten salts solvent systems, ionic liquid at ambient temperature; supercritical fluids: properties of supercritical fluids and their uses as solvents,

Module V: Nuclear chemistry

Nuclear forces, Radioactivity: Characteristics of radioactive decay, Decay kinetics, types of decay, α , β , γ - emissions, artificial radioactivity. Nuclear fission and fusion; Nuclear Reactors: Classification of reactors, reactor power, and application of radioactivity,Decay series -group displacement law - Isotopes: Detection - Aston's mass spectrograph -Separation of isotopes -Application of radioactive isotopes -14C dating -Radio diagnosis and radiotherapy, nuclear waste Management

References:

1.Basic Inorganic Chemistry by F. A. Cotton & Wilkinson, John Wiley

2. Inorganic Chemistry by J. E. Huhey, Harpes& Row

3. Comprehensive Co-ordination Chemistry by G. Wilkinson, et.al.Pergamon

4. Concise Inorganic Chemistry by J D Lee.

5.B. R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry

6.D. F. Shriver, P. W. Atkins, Inorganic Chemistry

Chemistry Lab

1.Basic Laboratory Skills- Demonstration & concept:

Awareness of Material Safety Data Sheet (MSDS). Storage and handling of chemicals. Simple first aids: Electric shocks, fire, cut by glass and inhalation of poisonous gases - Accidents due to acids and alkalis - Burns due to phenol and bromine. Disposal of sodium and broken mercury thermometer,

2.Use of calcium chloride and silica gel in desiccators. R & S Phrases (elementary idea only) – Safe laboratory practices – Lab safety signs. Personal Protective Equipment (PPE) Demonstration & concept of good lab practices including chemical/glassware handling and waste management. 3.Calibration and handling of balances, basic principles & experiments related to sample/reagent preparation: practical concept of Molarity, Molality, Normality, equivalence, weight %, vol.%, Preparation of standard solutions, Dilution 0.1 M to 0.001 M solutions.

4.Calibration of Thermometer using 80-82 °C (Naphthalene), 113.5-114 °C (Acetanilide) 132.5-133

°C (Urea), 100 °C (Distilled Water)

5.Determination of Melting Point(any three):Naphthalene 80-82 °C, Benzoic Acid 121.5-122 °C Urea 132.5-133 °C, Succinic Acid 184.5-185 ° C, Cinnamic Acid 132.5-133 °C, Salicylic Acid 157.5-158

°C Acetanilie 113.5-114 °C, m-Dinitrobenzene 90 °C p-Dichlorobenzene 52 °C, Aspirin 135 °C 6.Determination of Boiling Point (any one)a. Ethanol 78 °C, Cyclohexane 81.4 °C, Toluene 110.6 °C

7.Sublimation (Simple and Vacuum):Camphor, Naphtalene, Phthalic Acid and Succinic Acid

8.Volumetric analysis (Acidimetry and alkalimetry only):Titration of Strong acid – strong base, Strong acid – weak base, Weak acid – strong base titrations Estimation of NaHCO3 and Na2CO3 in a mixture, Estimation of NH3 by indirect method.

References:

1. Experiments in General chemistry, C. N. R. Rao and U. C. Agarwal

2.Vogel's Textbook of Practical Organic Chemistry (5th Edition)

3. Vogel's Inorganic Practical Chemistry

ANIMAL ANATOMY AND PHYSIOLOGY

Unit 1

Integument and derivatives: Structure and functions of skin (Mammals), scales, claws, nails, hairs. feathers and horns.

Unit 2

Comparative account of heart (Fish, Frog, Reptile, Bird and Mammals), eyes –compound and camera eye, gills (fish) and lungs (Mammals), skull (rabbit), limbs - fore limbs & hind limbs (mammals).

Unit 3

Histophysiology: Liver, Kidney, Spleen, Testis, Ovary, Pituitary, Pancreas.

Unit 4

Respiration and Circulation: Types of respiration, Respiratory pigments, transport of O2 and CO2, Open and closed circulation, Blood composition and function.

Unit 5

Excitability - Nature of the Nerve Impulse. Origin and propagation of action potential. Propagation of action potential across cell membrane and synaptic junction

Unit 6

Excretory patterns in vertebrates: ammonotelism, ureotelism and uricotelism, Role of kidney in osmoregulation, Counter current mechansim

Unit 7

Contractility: Cytoplasmic Streaming, Ameboid Movement, Ciliary, Flagellar and Muscular movements. Contraction of smooth, cardiac, skeletal muscle fibers. The sliding Filament Mechanism of Muscular Contraction. Mechanism of Contraction – Excitation and Relaxation of Muscle Cell.

Unit 8

Feeding and digestion: Feeding patterns in vertebrates. Chemical and mechanical digestion, Stimulation of gastro-intestinal secretions, Digestion of carbohydrates, lipids and proteins. Nutritive types, vitamins, minerals, energy requirements, nutrition requirements of different ages. Nutritional disorders.

Recommended readings :

1)Parker, J&W. Haswell, 1995. Textbook of Zoology – Vertebrates. The Macmillan Press Ltd., U.K.

2)Stephen A. Miller & John P. Harley 2001, Zoology. The Animal Kingdom. Wm. C Publishers. 3)Berme, R.N. and Levy MN Principles of Physiology, Mosby Year Book. Inc.1996.

4)Eckert and Randall. Animal Physiology – Mechanisms and adaptations. CBS Publishers, 2000. 5)Schmidt-Nielsen. Animal Physiology. Cambridge Univ. Press, 2000.

6)D. Jenson. The Principles of Physiology. Appleton-Century-Crofts, 1996.

7)Prosser CL. Comparative Animal Physiology. WB Saunders and Company, 1973.

PRACTICALS PLANT ANATOMY & PHYSIOLOGY

1.Free hand section of Stem: Helianthus (Normal), Maize(Normal), Triticum, Cucurbita and Peperomia (Special features).

2.Study of anomalous secondary growth of stem: Boerrhavia, Aristolochia , Nyctanthus and Draceana.

3.Study of leaf anatomy of Isobilateral (Nerium) and Dorsiventral leaf (Ficus)

4. Study of stomata: Paracytic, anisocytic, anamocytic, Tetracytic, Diacytic types.

5. Study of root anatomy : Aerial root (Ficus), Orchid root.

6.Study of Ecological adaptation – Xerophyte (Opuntia, Euphorbia), Hydrophyte (Nymphaea, Hydrilla)

7.Wood anatomy-TLS & RLS of Gymnospermous wood (Pinus/Araucaria) & Angiospermous wood (Michelia)

8.Nodal anatomy - Cocculus, Polyscias, Helianthus

8. Plant Microtechnique - Microtomy, Maceration.

9.Determination of water potentials by following drops methods.

10.Hydroponics study of deficiency symptoms (chlorosis, necrosis)

11.Separation of chlorophylls and carotenoids by Ascending paper chromatography

12.Bioassay of Phyto hormones - Auxins, Cytokinins, Gibberllins, Abssisic acid, Ethylene

13.Determination of lipid activity

14.Estimation of Leghaemoglobin in the nodules.

ANIMAL ANATOMY & PHYSIOLOGY

ANATOMY

1.Identification and functions of scales (fishes), claws, nails, hairs, horns, feathers, Hoofs and nests.

2. Field visits to Research institutes, national parks and natural vegetations.

3. Vertebrae – Procoelous (Frog), Amphicoelous (Bird), Amphiplateous (Rabbit).

4.Skulls in vertebrates : Frog, Bird, Mammal, rabbit, dog, man, turtle.

5. Histology sections of Testis, Ovary, Liver, Pancreas, Kidney, Spleen, intestine.

6.Microtomy – Organ fixing, Block making, Sectioning and staining of any one organ (rat)

PHYSIOLOGY

1. Determination of oxygen consumption and metabolic rate in fish.

2.Rate of protein digestion by trypsin.

3. Acetylcholine activity in tissues

4.Determination of ATPase activity in tissues

SCIENCE EDUCATION

Ancient Philosophy, Argumentation analysis, Types-Rhetorical and Dialogue, Positivism, Relativism, Realism ModuleII: The History of Science Ancient civilisation in India, china, Babylon, Egypt, Greece, Rome, Aristotelian views, Archimedes, The Copernican revolution, Contributions of Galileo, Louis Pasteur, Newton, Einstein, Linus Pauling, Development of science, New physics, Newtonian physics, Revolution in Biology, Chemistry, Mathematics, Computer Science ,Need of Environmental Education,Science in twenty first century ModuleIII: Teaching critical thinking Improving reasoning, Critical thinking, Affective strategies, Cognitive strategies, Media role, Science and knowledge, Beliefs, Justification, Maths in Science ModuleIV: Science and society Factors affecting scientific interaction, Positivist perspective, Social perspective, Ethical dilemmas, Proximatevs ultimate causation, Pseudoscience Module V: Scientific ethics Verifyibility and reproducibility, Plagiarism, IPR, Cyberlaws, Internet security Module VI: CurrentTrends in Science Latest developements in variousbranches of science and technology, Nobel Prizes, How science is changing the world, Science in future, Challenges and prospects

References

1. Science in history, 1-4 Volumes ,J D Bernal, MIT Press, Cambridge, 1971.

2. The Story of Civilization,, Will Durant, Simon and Schuster Publishers,, United States, 1975

3. The Scientific Outlook, Bertrand Russell, Routledge Classics

4. Science and Society, John Scales Avery, World scientific

5. The New Physics, C.V. Raman, Literary Licensing LLC, Wisconsin

6.Evolution of the Philosophy of Science-Literary Perspectives, K. Sujatha, and S. Kurien, AneBooks Pvt. Ltd, 2011.

7. One, two, three...infinity ,George Gammow, Dover Publications, INC, NewYork, 1974

CELL BIOLOGY

Unit 1

Methods to study cells, sub-cellular structures and cell membranes: Homogenisation and centrifugation, Light microscopy, tissue fixation and sectioning, Rotary and ultra microtomes, selective staining of cellular components,

Unit 2

Structure and function of endo membrane system - Endoplasmic reticulum, Golgi complex, mitochondria, chloroplast, lysosomes and peroxisomes. Vesicular traffic -exo and endocytosis Unit 3

Nucleus: nuclear envelope, organization and functions of nucleolus. Structure and function of chromatin, organization of nucleosomes, euchromatin, heterochromatin. Mechanism of chromosome condensation. Specialized chromosomes (B-chromosomes, polytene chromosomes, lamp brush chromosome). Cytoplasts and karyoplasts.

Unit 4

Cell cycle and cell division: Mitosis and Meiosis, present concept of chromosomal movement, importance of M phase, cytoskeleton, mechanism of cell division. Amitosis, Endomitosis, c-Mitosis and their significance; Regulation of cell division through cyclins.

Unit 5

Cell Signaling and Apoptosis: General principles of cell signaling (autocrine, paracrine, synaptic, endocrine), classes of cell-surface receptor proteins(ion-channel linked, G protein-linked, enzyme-linked), signaling via GPCRs & enzyme-linked cell-surface receptors, Programmed cell death by intracellular proteolytic cascade, regulation of apoptosis by Bcl-2 family of proteins Unit 6

Stem cells and Cancer cells: Tissue maintenance and renewal, properties of stem cells, classification of stem cells (embryonic vs adult), stem cell niche and its role in stem cell renewal and differentiation, Cancer as a microevolutionary process- different types of cancer, origin of cancerous cell, development of cancer , Metastasis, molecular genetics of cancer (role of p53, oncogenic retrovirus-mediated tumorigenesis, proto-oncogenes and tumor-suppresor genes)

Unit 7

Cell culture: Isolation of cells from tissues and their separation, in-vitro cell culture, primary cells vs cell lines, adherent vs suspension cultures, cell culture medium composition, eukaryotic cell lines, hybridoma culture.

Recommended readings :

1.Cell and Molecular Biology. De Roberts and De Roberts., Saunders College, USA 6th edition. 2.Molecular Cell Biology. Lodish, Berk, Zipursky, Matsudaira, Baltimore & Darnell. Freeman Press, 6th edition.

3.Cell Biology. Karp G., McGraw Hill book comp. New York. 2010 6th edition.

4. The Cell : A molecular approach. Cooper, G.M. ASM Press, USA 2009, 5th edition.

5. Chromatin structure and function. Wolfe, A., Academic press, New York 1995.

6.Cell Biology. Pollard. J.P. and Earnshow, W.C. Saunders, 2002.

7. The Cell – A molecular approach. Cooper, G.M. Princeton Publishers, NY, 2000.

8.Molecular Cell Biology. Lodin, H., Berk, A., Zipursky, S.L., Matsudain, P., Baltimore, D. and Darneil, T. Will Freeman company, NY, 6th edition.

9Molecular biology of the cell. Albert, B., Johnson, A., Raff, M., Robert, K., Walter, P. Garland Sciences, NY, 5th edition.

INSTRUMENTATION

Unit 1

Microscopy and Microscopic techniques: Mechanism, application of light, inverted phase contrast, electron microscope (SEM & TEM), confocal microscope, scanning tunneling microscope,. Micrometry and flow cytometry. Fluorescence microscopy, Phase-contrast microscopy, Confocal scanning microscopy, SEM & TEM, Cryo-electron microscopy

Unit 2

pH meter and its applications, Cell disruption techniques – Physical and chemical methods, PCR, RT-PCR, nano-drop, DNA analyzer,

Centrifugation – basic principles of sedimentation, types of centrifuges and rotors, ultracentrifugation, differential centrifugation, density gradient and analytical ultracentrifugation and its application. Unit 3

Chromatography – General principles and definition, Partition, absorption, gas-liquid chromatography, paper chromatography and TLC. Principles of Gel filtration, affinity chromatography, HPLC and ion-exchange chromatography.

Electrophoresis - PAGE, SDS-PAGE, isoelectric focusing, 2D electrophoresis, agarose gel electrophoresis, recovery of DNA from agarose gels, Pulse-field gel electrophoresis.

Unit 5

Immunochemical techniques - antibodies and their specificity, antigen - antibody interactions, immunoassay, western blotting, ELISA, immune electrophoresis. Radioisotopes and dosimetry, radiation counters, Radio isotopes and safety. Labelling of Antibodies. Principle and application of UVvisible spectrophotometer, fluorescence spectroscopy.

Recommended readings:

1. The Principles and practices of electron microscopy. Watt IM, Cambridge Univ. press, London, 1989. 2. Gordon M.H and Macrae, M. Instrumental analysis in biological sciences, Blackie and sons Ltd. London, 1998.

3.Principles of physical biochemistry. Vanholdem W.C. and Johnson, P.S. Printice Hall, 1998. 4.Principles & techniques in practical biochemistry. Wilson, K and Walker, J.M. Foundation books, New Delhi, 1994

BIOPHYSICS

Foundations of Biophysics-Matter and energy – Photo electric effect, quantum theory of light, de Broglie wave equation, wave function, atomic models, Bohr's atomic energy levels.

Biomolecular interactions-Water-properties and interactions of water, association of macromolecules, supramolecular interactions, protein-protein interactions, protein nucleic acid interactions, lipid/membrane-protein interactions

Thermodynamics: Laws of Thermodynamics, Gibbs free energy, Entropy and enthalpy and its relationship, Relation between standard free energy change and equilibrium constant, Redox reactions and a brief account on photo and chemo- bioenergetics.

Protein Structure analysis : Alpha helix and Beta sheet structure of proteins (fibroin structure), conformation of protein – Ramachadran plot, Tertiary conformation

Protein thermodynamics: Free energy and entropic forces, solvent interactions and solvent entropy, polypeptide chains in water, the folding process, folding pathways, simulations and predictions, experimental studies on folding, Excitement and relaxation of protein structure, equilibrium fluctuations, kinetics of proteins, proteins as complex systems.

Spectroscopy : Instrumentation and application of UV - visible spectrophotometer, fluorescence spectroscopy, NMR, Mass spectroscopy, IR, Raman. X-ray diffraction in determining molecular structure of proteins.

Radiation biophysics: Special characteristics of atmosphere long wave and short wave radiation, radiation fluxes in natural environment, the ultraviolet region absorption and scattering, alpha, beta, gamma and x-radiation, cosmic radiation, absorption of electromagnetic radiation and interaction with matter, comparison of different ionizing radiations, radiation as environmental pollutant, radioisotopes, detection and measurement of radiation, effect of radiation at cellular levels-structural and functional changes, interaction with biological macromolecules, interaction of carcinogens/anti-cancer agents with DNA, RNA and nucleoproteins.

Biological effects of light: Importance of Light, Radiant energy, Light interaction with biological materials, Effect on growth patterns in plants-Phytochrome system, Photochemical mechanism, Phototrophism, Photoperiodism, Solarization, Photodynamic action, UV light on living system, Photoreactivation, Lethal effects on animals and plants.

Recommended readings:

1. Casey, E.J. 1969. Biophysics, Concept and Machanics. Affiliated East West Press.

2.Dr. R. N. Roy, 2007.A Text book of Biophysics. New Central Book Agency (P) Ltd.

3. Ackerman, E. 1967. Biophysical Sciences. Prentice Hall, NY.

4. Narayan, P. 2000. Essentials of biophysics. New Age Int. Pub. New Delhi.

5.Cantor R. and Schimmel P.R, W.H. Freeman. Biophysical chemistry

6.David Freifelder, W H Freeman and company. Physical Biochemistry

7.A.L. Stanford, Academic Press. Foundations of Biophysics

COMMUNICATIVE ENGLISH-1

Unit -1 Speech Sounds

Phonemic symbols - Vowels - Consonants - Syllables - Word stress - Stress in polysyllabic words – Stress in words used as different parts of speech - Sentence stress – Weak forms and strong forms – Intonation – Awareness of different accents: American, British and Indian – Influence of the mother tongue

Unit – 2 Listening

Active listening – Barriers to listening – Listening and note taking– Listening to announcements – Listening to news on the radio and television

Unit-3 Speaking

Word stress and rhythm - Pauses and sense groups - Falling and rising tones -

Fluency and pace of delivery – Art of small talk – Participating in conversations –

Making a short formal speech – Describing people, place, events and things – Group discussion skills and telephone skills. Common errors in communication and how to avoid them. Some Notions—Conventional and idiomatic expressions

Unit 4– Reading

Reading: theory and Practice – Scanning - Surveying a textbook using an index - reading with a purpose – making predictions – Understanding text structure – Locating main points – Making inferences - Reading graphics - reading critically – Reading for research

Unit 5.- Applying for jobs—Preparing Resumes—Writing Cover letters, Preparing for interviews—Taking Interviews—Post-Interview follow-up-Promotion, interviews—Group Discussions

Unit 6

Human relationships in academic and professional life,Front Office Management and Keeping public relations (Telephone Skills),Soft Skills for Team Building. Keeping the Job—Professional Ethics, Managing Multiple Roles- Healthy Balancing of family and career.

Recommened Reading

1.Samson et al. English for Life - 4. New Delhi: Cambridge UP.

2. Vasudev, Murthy. Effective Proposal Writing. New Delhi: Response, 2006.

3. Towards Academic English: Developing Effective Writing Skills. New Delhi: Cambridge UP, 2007.

4.Oxford Guide to Effective Writing and Speaking. OUP, 2007.

5.Bhatnagar, R. P. English for Competitive Examinations. New Delhi: Macmillan, 2009.

6.English for Careers. Pearson.

7.ABC of Common Grammatical Errors. Macmillan, 2009

8.Kaul, Asha. The Effective Presentation. New Delhi: Response

9.Shepherd, Kerry. Presentations at Conferences, Seminars and Meetings. New Delhi: Response.

10.Vilanilam, J. V. More Effective Communication: a Manuel for Professionals. Response 2008 11.English for Career Development. Orient Longman, 2006.

Core Text

V.Sasikumar, P Kiranmai Dutt and Geetha Rajeevan, . Communication Skills in English. Cambridge University Press and Mahatma Gandhi University

BIOCHEMISTRY

ModuleI:Chemistry of Biomolecules and Natural Products

Basic aspects(structure, chemistry and bonding),carbohydrates, amino acids and proteins, nucleic acids,terpenoids,alkaloids, fatty acids,steroids, plant pigments, lipids, and vitamins. Nomenclature of prostaglandins.Methods for primary structure determination of peptides, proteins and nucleicacids. ModuleII: Reactions And Concepts in Protein Chemistry.

Concept of supramolecular assembliesbased on structural aspects-example proteins (enzymes) and biomembrane assemblies.

ModuleIII: Biocatalysis

with respect to conformations and structure and function relationship, enzymecatalysis, vitamins as cofactors, enzyme kinetics, graphical evaluation of KM and Vmax, enzymeinhibition, mechanisms regulatory aspects.

ModuleIV: Metabolism

overview and selected individual and important oxidative pathways.Glycolysis, TCA cycle-pentose phosphate pathway. Citric acid cycle: energetic and amphibolicnature. Regulatory aspects of TCA cycle and glycolysis. Photosynthetic electron transport andphosphorylation and CO2 fixation. ModuleV:Transfer of Genetic Information

Chemistry of nucleic acids, nucleotide, nucleoside, cyclicAMP, assembly of DNA, types of RNA. Replication of DNA, flow of genetic information, protein biosynthesis,transcription and translation, Genetic code, regulation of gene expression, DNAsequencing. The Human Genome Project. DNA profiling and the PolymeraseChain Reaction (PCR).Repair ofDNA and recombinant DNA concept. References

1. A. Lehninger, Principles of Biochemistry, CBS Publishers, 1990.

- 2. R.W. McGilvery, G.W. Goldstein, Biochemistry: a Functional Approach, 3rd Edn., Saunders, 1983.
- 3. G. Zubay, Biochemistry, 2nd Edn., MacGraw Hill Ryerson, 1999.
- 4. P.S. Kalsi, Chemistry of Natural Products, Kalyani Publishers, 2001.
- 5. S.V. Bhat, B.A. Nagasampagi, M. Sivakumar, Chemistry of Natural Products, Springer, 2005
- 6. D.E. Metzler, Biochemistry: The Chemical Reactions of Living Cells, Academic Press, 2001.

PRACTICALS CELL BIOLOGY

1. Isolation and separation of sub cellular organelles.

2. Vital staining of mitochondria

3. Squash and smear preparation of mitotic and meiotic chromosomes -

- Allium cepa, Poecilocerus picta.
- 4. Determination of chromosome number from mitotic and meiotic preparations.
- 5. Preparation of Polytene chromosome- D.melanogaster /Chironomous
- 5.Cytological technique, preparation of semi-permanent and permanent slides.

6.Identification of B-chromosomes, sex chromosomes and chromosomal abnormalities.

7. Counting of cells using haemocytometer

8. Tissue culture techniques – Passage, maintenance, cryo-preservation– Adherent & Suspension cell types

INSTRUMENTATION

1. Separation and identification of amino acids by paper chromatography.

- 2. Separation and identification of sugars and lipids by TLC.
- 3. Separation of proteins by ion exchange chromatography
- 4.Separation of proteins by gel filtration.
- 5.Dialysis.
- 6. Isolation of mitochondria by differential centrifugation.
- 7.Separation of proteins by SDS-PAGE
- 8. Amplification of gene by PCR.

BIOPHYSICS and BIOCHEMISTRY

1. Absorption spectra of amino acids, proteins and nucleic acids by Spectrophotometer.

- 2. Verification of Beer-Lambert law.
- 3. Analysis of IR spectra of a diatomic molecule / simple biomolecules.
4.Denaturation and Renaturation of Protein by spectroscopic method.5.Experiment with GM counter.6.Experiment to demonstrate photo-electric effect

MOLECULAR BIOLOGY

Unit 1: Introduction to molecular biology: History of molecular biology, prokaryotic and eukaryotic cell composition, organization of chromosomes in prokaryotic and eukaryotic cells, model organisms in the study of molecular biology (E. coli, Sachharomyces, Arabidopsis, C. elegans, Drosophila, Mus musculus, Homo sapiens)

Unit 2: Nucleic acids: Structure and function of DNA (DNA as a storehouse of information; genes are mutable units; DNA is the genetic material; topology of nucleic acids; isolating the gene), the structure of eukaryotic chromosomes (chromatin and nucleosomal organization, DNA packing in several layers, interphase chromosomal architecture, nucleosomal remodeling allows access to DNA). Structure, function and biogenesis of different types of DNA.

Unit3: Replication, repair and recombination: The replicon- unit of replication (mapping of origin of replication, replicon in bacterial vs eukaryotic genomes, rolling circle model of DNA replication, bacterial replication and cell cycle, plasmid propagation and plasmid incompatibility), Primosomes and Replisomes (apparatus for DNA replication, DNA polymerases, Okazaki fragments, Leading and Lagging strand synthesis, common events in priming replication at origin, methylation regulating initiation at origin), DNA repair mechanisms, recombination (breakage and reunion involves heteroduplex DNA, Holliday junction)

Unit 4: Transcription and post-transcriptional modifications: Transcription complex (promoters, factors, RNA polymerases), initiation-elongation-termination of transcription, mono-cistronic and poly-cistronic RNAs, Transcription factors and their functions (zinc-fingers, helix-loop-helix, leucine zippers, homeo domains, steroid receptors), inhibitors of transcription, Post transcriptional modifications of m-RNA, t-RNA and r-RNA, apparatus for nuclear splicing (spliceosome and lariat formation, alternative splicing, self-splicing by group I introns).

Unit 5: Translation: Genetic code- General features of Genetic code. Mechanism of protein synthesis: initiation, elongation and termination in Prokaryotes and eukaryotes. Inhibitors of protein synthesis Post-translational modifications. Protein sorting and targeting. Signal hypothesis – signal sequences, signal recognition particle.

Unit 5: Gene regulation in prokaryotes, eukaryotes and phages: Transcriptional and post-transcriptional control of gene expression in prokaryotes and eukaryotes: control at initiation (RNA polymerase-promoter

interactions), a panoply of operons(Lactose and Tryptophan operon), control of RNA structure (termination and anti-termination), Phage strategies (lytic cascade and lysogenic repression).

Recommended reading:

1)Cell and Molecular Biology. De Roberts and De Roberts., Saunders College, USA 6th edition. 2)Molecular Biology. Lodish, Berk, Zipursky, Matsudaira, Baltimore & Darnell. Freeman Press, 6th edition.

3)Cell Biology. Karp G., McGraw Hill book comp. New York. 2010 6th edition.

4) The Cell : A molecular approach. Cooper, G.M. ASM Press, USA 2009, 5th edition.

5)Genes V: Benjamin Lewin. Oxford University Press, 1995

6)Cell Biology. Pollard. J.P. and Earnshow, W.C. Saunders, 2002.

7)Molecular biology of the cell. Albert, B., Johnson, A., Raff, M., Robert, K., Walter, P. Garland Sciences, NY, 5th edition.

8)The Cell –A molecular approach. Cooper, G.M. Princeton Publishers, NY, 2000. 9)Molecular Cell Biology. Lodin, H., Berk, A., Zipursky, S.L., Matsudain, P., Baltimore, D. and Darneil, T. Will Freeman company, NY, 6th edition.

EVOLUIONARY BIOLOGY AND ETHOLOGY

Unit 1: Introduction to Evolution:

Molecules to Organisms: The first ten billion years (universe and earth arise, the atmosphere, rocks and continents), Origin of life (origin of the molecules of life-molecules, membranes, protocells, the first cells, eukaryotic organelles and organisms)

Theories of Evolution: Voyages of discovery, Theories of Evolution (Lamarckism, Darwinism, Mendel's theory of heredity, Neo-Darwininan Synthesis). Evidences for evolution.

Unit 2: Natural selection: Survival of the fittest, Types of Natural selection (Stabilizing, Directional, Disruptive, Sexual, Group selection, frequency dependent and density dependent selectors), Selection in relation to constraint, changing environments and plasticity, fitness, and balanced polymorphism. Unit 3: Evolutionary genetics: Basic population genetics: Hardy-Weinberg genetic equilibrium; basic one-locus models of mutation, migration and selection; genetic polymorphism; average effect of an allele, breeding value for fitness; breeding value; random genetic drift and inbreeding.

Unit 4: Speciation and molecular evolution: Species concepts; reproductive isolation mechanisms and patterns; different models of speciation; phyletic gradualism, punctuated equilibrium; neutral theory of molecular evolution; molecular clocks, phylogeny construction.

Unit 5: Population biology: Population growth, biological interactions within populations, competition, niche segregation, predation, symbiosis; Coevolution: Parasitism and viral pathogens, insects and host plants, plant evolution

Unit 6: Human Origins & cultural evolution: Primate evolution, Chimpanzees and Humans, Earliest Hominids, Australopithecines: the southern apes of Africa, Bipedalism and brain size, origins of Homo, Out of Africa, Humans as hunter-gatherers; Cultural and Social evolution: Instincts and learned behaviour, Learning, society and culture, cultural evolution dominating phenotypic evolution, Social Darwinism, inheritance of social behaviour.

1.Brown, Genomes, Bios, 1999.

2.Strickberger, Evolution, Jones and Barlett, 2000.

3. Jobling et al, Human Evolutionary Genetics, Garland, 2004.

4. Daniel Hartal and Andrew Clark. Population genetics, 3rdedition.

5. Ridley, M. (2004) Evolution. III Ed. Blackwell.

6.Futuyma, D. (1998) Evolutionary Biology. III Edn. Sinauer Assoc. Inc.

DEVELOPMENTAL BIOLOGY

Unit 1: Introduction to developmental biology; Early development- Fertilization, Types & mechanisms of cleavage. Gastrulation: Cell movement and formation of germ layers in frog & chick and mouse, Concept of cell type determination, competence and differentiation, Creation of specific organs (organogenesis – chick)

Unit 2: Organizer concept: Primary organizer, embryonic stem cell, development of vertebrate nervous system (chick) Formation of neural tube, regions of brain.

Unit 3: Genetics of pattern formation: Coenorhabditis – Vulva formation, Drosophila – Maternal gene and formation of body axes, Homeotic gene function, Imaginal disc development, Axes formation in vertebrate, Hox genes.

Unit 4: Post embryonic development:

Metamorphosis- endocrine control of metamorphosis in insects and amphibian.

Regeneration – Cellular processes in regeneration, Sources, determination of polarity, regulation of regeneration.

Unit 5: Gametogenesis in plants:

Microsporogenesis & male gametophyte :- Anther wall Structure and development- Endothecium, Middle layers, Tapetum, Nuclear behaviour in tapetal cells and Sporogenous tissue; Formation of vegetative and generative cells, Formation of sperms, pollen wall – Structure and development and abnormal pollen grains.

Megasporogenesis & female gametophyte :- Structure and development of ovules, Types and parts of ovules. Structure and development of female gametophyte, Types of female gametophytes, Structure of mature embryo sac, embryo sac haustoria

6: Fertilization and embryogeny: Structure of style and stigma, Pollen germination and pollen tube growth. Path of pollen tube, pollen tube discharge, Double fertilization: triple fusion and syngamy. Central cell as the second gamete of the flowering plant. Structure and types of endosperm, Physiology and cytology of endosperm and functions of endosperm and endosperm haustoria. Classification of Embryogeny, early embryogenesis and mature embryo of Dicotyledons – Capsella bursa pastoris and mature embryo of monocotyledons- Najus lacerata and Grass.

Recommended reading

1. Alberts et al, Molecular Biology of The Cell. Garland, 2002.

2.Scott F. Gilbert, Developmental Biology, Sinauer, 2003.

3.Kalthoff, Analysis of Biological Development, McGraw Hill, 1996.

4.Lewin, Genes VIII, Pearson, 2004.

5. Monk, Mammalian Development – A Practical Approach, IRL, 1987.

6.O'Rahilly and Muller, Human Embryology and Teratology, Wiley, 1992.

7.Rana, Human Embryology Made Easy, Harwood, 1998.

8. Wolpert, Principles of Development, Oxford, 2002.

9.Singh, P. 2001. Essentials of Plant Breeding, Kalyani Publishers, Hyderabad.

10.Allard, R. W. 1999. Principles of Plant Breeding. John Willey & Sons. New York.

11.Dana, S. 2001. Plant Breeding. Naya Udyog. Calcatta.

12.Singh. B. D. 1995. Plant Breeding – Principles and Methods. Kalyani Publishers, New Delhi.

BIOSTATISTICS

Unit 1 Basics of Biostatistics

Scope and Significance of Biostatistics. Steps in Statistical Investigation, Data and Variable (Collection, Types, Sources). Statistical Analysis Tools - Parametric and Non-Parametric; Bivariate and Multivariate Analysis. Interpretation and Forecasting.

Descriptive Statistics: Basic statistical concepts. Reduction of data frequency distribution. Graphical representation of frequency distribution-histogram, frequency curve, cumulative frequency curve. Measures of central tendency and dispersion. Relative dispersion and coefficient of variation.

Sampling techniques: Random sampling. Simple random sampling and stratified random sampling. Use of random number tables, sample size determination

Unit 2 Measures of Dispersion

Introduction, Characteristics. Quartiles and Percentiles. Merits and Demerits of Range, Quartile Deviation, Mean Deviation and Standard Deviation. Relative Measures of Dispersion.

Calculations/Problems for frequency table. Standard error. Skewness and Kurtosis

Unit 3 Correlation Analysis

Correlation - types and methods of correlation analysis, Problems for Karl Pearson's correlation coefficient and Spearman's rank correlation.

Unit 4 Regression Analysis

Regression and Line of Best Fit, Types and methods of regression analysis. Graphic Methods (Scatter method, Curve fitting). Algebraic method (Fitting of strait line through regression equation).

Comparing correlation and regression. Probit Analysis Scatter diagram. Product moment correlation coefficient and its properties. Rank correlation coefficient. Simple linear regression. Method of least squares. Curve fitting. Exponential and power curves. Coefficient of determination.

Unit 5 Theory of Probability

Probability and Distributions: Simple space. Events. Probability and conditional probability. Addition and multiplication theorems of probability. Probability distributions. Binomial, Poisson and normal distributions. Illustrations.

Unit 6 Testing of Hypothesis

Hypothesis and types, Confidence Interval, Methods and Errors. Tests of significance (For large and small samples – Critical Ratio and P value). Z Test (Problem for small samples), Chi- Square Test – test of independence and goodness of fit (Problem for 2×2 table only). Student"s "t" test (Problem for small samples comparing mean of two variable). F-test, Analysis of Variance (ANOVA - One way), Kruskal Wallis test . Mc Nemar and Mann Whitney U test Test of Significance: Statistical hypothesis. Type–1 and Type–2 errors, level of significance, size and power of a test. Definition of Chi-square, t and F distributions. Central limit theorem. Tests for the mean, equality of two means, variance (for large and small samples). Large samples tests for proportions. Chi-square test for goodness of fit and for independence of attributes in contingency tables. Confidence interval.

Recommended reading

1. Cambell. R.C, Statistics for Biologists, Cambridge University Press, UK, 1967.

2.Fry J.C., Biological data analysis, a practical approach, IRL Press, Oxford, U.K, 1993.

3.Snedecor P.S., Statistical Methods, Affiliated East-West press, New Delhi, 2000.

4.Primer of Biostatistics, 7th edition (2011), Stanton Glantz, McGraw-Hill Medical. ISBN- 13: 978-0071781503.

5.Biostatistics: A Foundation for Analysis in the Health Sciences, 10th edition (2013), Wayne W Daniel and Chad L. Cross, Wiley. ISBN-13: 978-1118302798.

6.Biostatistical Analysis, 5th edition (2009), Jerrold H. Zar, Pearson. ISBN-13: 978-0131008465.

BIOINFORMATICS

Unit 1:

Introduction to Bioinformatics and Computational biology: Branches of Bioinformatics, Applications of Bioinformatics. Biological databases: Introduction, Classification of Biological databases, Biological data retrieval systems

Unit 2:

Sequence Comparison and Database Search:

Introduction, Pair wise alignment, global alignment, local alignment, multiple sequence alignment, scoring a multiple alignment, multiple sequence alignment methods

Unit 3:

Dynamic programming approach, Progressive alignment, iterative refinement methods, pattern matching in DNA and protein sequences, PAM matrices, BLAST, FAST and FASTA

Unit 4:

Molecular phylogenetics: Introduction, application of phylogenetic trees, basic terminology- taxa, taxanomy, root, leaf, node, tree, branch, clade, dendogram, cladogram, rooted tree, unrooted tree, scaled tree.

Unit 5: Molecular Clocks:

Introduction, basic steps of phylogenetic tree construction, methods of phylogeny, Distance based methods-UPGMA, NJ algorithm, Character based methods- Maximum parisomy method, maximum likelihood method, validating phylogenetic methods-bootstrapping and jackknifing, study of Phylip, NJ plot, Clustal X, and other popular softwares.

Recommened reading

1.Zhumur Ghosh and Bibekanand Mallick, Bioinformatics, Principles and Applications, Oxford University Press, New Delhi, 2008

2. Teresa Attwood, et.al, Introduction to Bioinformatics, Pearson Education, Singapore, 2006 3. Joao Carlos Setubal et. al., Introduction to Computational Molecular Biology, PWS publishing company, Boston.

4.David W. Mount, Bioinformatics, Sequence and Genome analysis, CBS Publishing House 5.Balagurusamy, Computing Fundamentals And C Programming, McGraw-Hill Education (India) Pvt Ltd, 2008.

6.Arthur M. Lesk, Introduction to Bioinformatics, University of Cambridge, 2002.

7.O'Reilly & Associates, Beginning Perl for Bioinformatics, 1st edition, Sebastopol, CA, 2001.

Principles of Management

Module I: Evolution of Management, Management-Meaning, Nature & Significance-Combination of Art

& Science, Management as a Profession, Management Vs Administration, Levels of Management Elements of managerial processes-Styles & Roles of Managers in Organizations. Contributions of Taylor

and Fayol, Human Relations & Behavioural Schools-Hawthorne Studies.

Module II: .Planning-Nature, Process of Planning, Planning and Environmental Uncertainties, Types of Planning, Advantages and Limitations of Planning-Decision Making-Stages in Decision Making. ModuleIII: Nature & Significance of Organization, Authority & Responsibility Relationships-Span of Control, Process of Delegations-Barriers to Delegation, Centralization & Decentralization. Concept of Line & Staff-Overcoming Line-staff conflict, Committees, Co ordination, Organization Structures, Types, Advantages & Disadvantages.

Module IV: Staffing, Motivation & Leadership. Scope of Staffing Functions, Theories of Motivation.

Theory X, Theory Y, Theory Z. Maslows need hierarchy. Leadership Styles.

Module V: Communications of Control, Process of Communication. Verbal & Non Verbal, Barriers to communication, Types, Process, Tools of control, Characteristics of Effective Control System, Human Reaction to control system.

References:

- 1. Drucker, F. Peter Management-Tasks, Responsibilities & Practices.
- 2. Koontz "O" Donnel Weihrich Elements of Management.
- 3. Koontz H, "O" Donnel C Management-A Book of Reading.
- 4. Drucker, F. Peter The Practice of Management.
- 5. Terry and Franklin Principles of Management
- 6. Stoner Principles of Management
- 7. L. M. Prasad; Principles of Management; Sultan Chand and Sons, 6th Edition

ENVIRONMENTAL BIOLOGY AND HUMAN RIGHTS

MODULE 1 ECOSYSTEM

Basic concepts of ecosystem Components of ecosystem: Abiotic (Sunlight, temperature, soil, water, atmosphere) and Biotic components (Producers, consumers, decomposers), Ecological pyramid-number, biomass, energy, Functions of ecosystem: Productivity-Food chain-Food web?Energy flow-Laws of Thermodynamics.Types of Ecosystem: Terrestrial-Forest-Grassland-Desert, Aquatic-Marine-Fresh water, Wetland &Biome Concept of limiting factors: Liebig's and Shelford's

Aquatic-Marine-Fresh water, wetland &Biome Concept of limiting factors: Liebig's and Shelford's laws of limiting factors. Biogeochemical cycles: Concept, gaseous and sedimentary cycles, Carbon cycle, Nitrogen cycle. Renewable resources (solar,wind, hydroelectric, biomass and geothermal) and Non renewable resources (mineral and metal ore, fossil fuels)

MODULE 2

CONCEPTS OF POPULATION AND COMMUNITY

Concept of population: Population attributes- Population growth forms, Basic concepts of growth rates, density, natality, mortality, growth curves

Animal interactions: Positive- Commensalism- Mutualism-Protocooperation,

Negative-Predation?Parasitism-Competition-Antibiosis Characteristics of a community: Species diversity- richness, eveness, stratification, dominance,

ecological indicators, Ecotone and Edge effect, Keystone species, Concepts of Ecological Niche and Guild, Ecological succession, community evolution- climax.

MODULE 3

BIODIVERSITY AND ENVIRONMENTAL ISSUES

Introduction to Biodiversity: Types of biodiversity- Alpha, Beta and Gamma diversity. Concept and importance of Biodiversity: Levels of Biodiversity-Species diversity, Genetic diversity, Microbial, Ecosystem diversity, India as a mega-diversity nation, Biodiversity hotspots Global Environmental Issues: Ozone depletion, Greenhouse effect, Global warming, Climate change, Carbon trading, carbon credit; Carbon sequestration, Acid rain, Oil spills, Nuclear accidents, IPCC/UNFCC.

National Environmental issues: Deforestation, forest fire, pollution(air, water, soil, noise thermal, nuclear- brief account only) solid waste management, sewage, drinking water crisis and water logging, Toxic products and disaster: Types of toxic substances – degradable, non degradable, Impact on human – case studies: Endosulphan tragedy, Bhopal disaster Flood, drought, cyclone, earthquake and landslide (Management and mitigation) local Environmental issues: Landscape alteration, sand mining, quarrying, changing crop pattern, conversion of paddy lands,

Threats to water resources of Kerala: Degrading Mangrove and wetland ecosystems of Kerala, RAMSAR sites, Marine ecosystem crisis- pollution, overfishing etc. Impact of tourism on Environment.

MODULE 4

CONSERVATION OF BIODIVERSITY

Protected area concept – Sanctuary, National Park, Biosphere reserve, Core Zone, Buffer Zone, Corridor concept. Conservation reserves Concept of threatened fauna – IUCN categories - extinct, extinct in the wild, critically endangered, endangered, vulnerable, near threatened, least concern and data deficient. Red and

Green Data Books. Man–animal conflict (Tiger, Elephant, Dog, Monkey) – causes and concern Water conservation- rainwater harvestiong, watershed management

Environment education Environmental laws (Brief account only): The Water (Prevention and Control of Pollution) Act, 1974, The Air (Prevention and Control of Pollution) Act, 1981, Indian Forests Act (Revised) 1982.

The Environment (Protection) Act, 1986, Hazardous Wastes (Management and Handling) Rules, 1989, The Forest (Conservation) Act, 1980, The Wildlife Protection Act, 1972, Biodiversity Act, 2002.

MODULE 5

HUMAN RIGHTS

Introduction, main concepts associated with Human Rights, Different types of human rights, Manifestations & phenomena, Role of agencies in promoting human rights, Mechanisms for checking violations of human rights, National human right commission, Constitutional provisions related to Human rights.

References

- 1.Erach Bharucha 2008 (UGC). Text Book of Environmental Studies of Undergraduate course. University Press.
- 2.J.B Sharma (2009), Environmental studies' 3
- rdEd. University science Press
- 3. Misra S.P., Pandy S.N. 2009Essential Environmental Students, Ane books Pvt. Ltd.
- 4.P.D Sharma (2012), Ecology and Environment' 11th Ed. Rastogi Publications
- 5.R.B Singh & Suresh Mishra PaulamiMaiti (1996), Biodiversity Perception, Peril and
- Preservation' PHI Learning, Environmental Law in India: Issues and Responses

6.Rajagopalan, R. 2005.Environmental Studies from Crisis to Cure. Oxford University Press, New Delhi.

- 7.Paul R.C., 2000.Situations of Human Rights in India. Efficient offset printers. ·
- 8. Arun kumar Palai(1999) National Human Rights Commission of India, Atlantic publishers
- 9.Sharma P.D. (2005)Environmental biology and Toxicology, Rastogi publication
- 10. Meera Asthana and Astana D.K.1990 Environmental pollution and Toxicology Alka printers.
- 11. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders College Publishing, Philadelphia
- 12. Alan Beeby, 2006 Anne Maria Brennan First Ecology, Ecological principles and Environmental issues . International students edition Sec. edition Oxford University Press.
- 13. Robert Ricklefs (2001). The Ecology of Nature. Fifth Edition. W.H. Freeman and Company.
- 14. Stiling Peter (2002). Ecology: Theories and applications. Prentice Hall of India pvt.Ltd. New Delhi.
- 15. Landis, Wayne and Hing-hoYu, Baca Raton, 1995. Introduction to Environmental Toxicology: Impacts of chemicals upon Ecological systems: Lewis Publishers.

PRACTICAL

ENVIRONMENTAL BIOLOGY & TOXICOLOGY

- 1. Estimation of dissolved Oxygen
- 2. Estimation of carbon di oxide
- 3. Estimation of soil organic carbon (Demonstration only)
- 4. Identification of marine/ fresh water planktons
- 5. Counting of plankton using plankton counting chamber
- 6. Study of equipments Sechi disc, Plankton net
- 7. Study of sandy shore fauna, rocky shore fauna.
- 8. Study of animal Association

9. Visit to any two important areas of bio diversity: 1. Forest, 2.Sea shore, 3. Mangrove, 3.

Wet lands, 4. Bird sanctuary, 5. Wild life sanctuary, 6. Sacred groves

Field study (compulsory)

PRACTICAL

MOLECULAR BIOLOGY

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1. Isolation of nucleic acids from plant (young leaves, Allium cepa) and animal (butterfly or silkworm larva, adult Uzi fly, Drosophila larva) by CTAB and SDS-Proteinase K method

- 2. Isolation of plasmid DNA from bacterial culture using DNA extraction kit
- 3.Extraction of total RNA from bacterial culture using RNA isolation kit
- 4.Estimation of DNA content by Diphenylamine(DPA) method

5.Estimation of RNA by Orcinol method

- 6.Estimation of protein by Bradford method
- 7.Separation of nucleotide bases by paper chromatography
- 8.Agarose gel electrophoresis of DNA and RNA

9.Polyacrylamide gel electrophories of proteins

EVOLUTION AND ETHOLOGY

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

Evidences of fossils

1.Study of types of fossils (e.g. trails, casts and moulds and others) and Index fossils of Palaeozoic era 2.Connecting links/transitional forms - Eg. Euglena, Neopilina, Balanoglossus, Chimaera, Tiktaalik, Archaeopteryx, Ornithorhynchus

3. Living fossils - Eg. Limulus, Peripatus , Latimeria, Sphaenodon

4. Vestigial, Analogous and Homologous organs using photographs, models or specimen

Variations

5.Sampling of human height, weight and BMI for continuous variation

6.Sampling for discrete characteristics (dominant vs. recessive) for discontinuous variations e.g. hitch-hiker's thumb, dexterity, tongue rolling, ear lobe (data categorization into 16 groups based on the combination of 4 traits; assigning each subject to the respective group)

Selection Exemplifying Adaptive strategies

7.Coloration, Mimetic form, Co-adaptation and co-evolution; Adaptations to aquatic, fossorial and arboreal modes of life) using specimens

Neo-Darwinian Studies

8. Calculations of genotypic, phenotypic and allelic frequencies from the data provided

9.Simulation experiments using coloured beads/playing cards to understand the effects of selection and Genetic drift on gene frequencies

Phylogeny

10.Digit reduction in horse phylogeny (study from chart),

11.Study of horse skull to illustrate key features in equine evolution

12.Study of monkey and human skull - A comparison to illustrate common primate and unique Hominine features

DEVELOPMENTAL BIOLOGY

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1. Study of whole mounts of frog and chick- early developmental stages

2.Study of chick development from live eggs (window viewing) & permanent embryo mounting

3.Study of section of chick embryo through selective developmental stages

4.Dissection and mounting of imaginal discs of Drosophila / silk worm

4. Videos showing selective embryonic events like cleavage; gastrulation

5.Study of gene expression during development with Lac Z reporter gene

6.Measurement of animal/plant cell size using ocular and stage micrometer.

7.Study of microsporangium development, microsporogenesis, male gamete development (subject to availability)-slides only

8.Study of types of megasporangium, Structure of the megasporagium, development of megaspore,

types of embryo sacs (subject to availability)

9. Mounting of endosperm – Cucumis sp.

10.Mounting of embryo – Cyamopsis / Tridax sp.

BIOSTATISTICS AND BIO INFORMATICS

Biostatistics

1.Calculation of corrected mean, and standard deviation (Problems can be solved using scientific calculator).

2.Derive regression equation for protein, cholesterol and creatine using Optical density and Concentration

3.Drawing best line of fit for protein, cholesterol and creatine (Problems can be solved using scientific calculator).

4. Calculation of Pearson correlation coefficient.

5.Calculation of regression coefficient and regression equation ("x" on "y" only)

6.Calculation of Chi -square value (2x2 table only)

7.Calculation of "t" value (for small sample comparing two samples)

8.MS Excel: Preparation of graphs (bar, histogram, frequency polygon, frequency curve, pie diagram and ogives)

9.MS Excel/PH Stat/SPSS: Basic statistics (mean, median, mode, standard deviation), Correlation Analysis, Regression analysis, Test of significance (T test between two sample or sample and population), Chi-square test, Problems using one way ANOVA

1. Searching bibliographic databases for relevant information;

2.Sequence retrieval from nucleic acid and protein databases;

3. Restriction mapping; Sequence (FASTA and BLAST) searches;

4.Pair wise comparison of sequences; Multiple alignment of sequences; Evolutionary studies / Phylogenetic analysis;

5. Identification of genes in genomes; RNA folding; Primer Design;

6. Protein databank retrieval and visualization;

PLANT REPRODUCTION & BREEDING

Unit 1: Introduction to Plant reproduction:

Angiosperm flower: Calyx, Corolla, Androecium, Gynoecium, Transition of shoot apex to flowering apex, Specification of floral organs, ABC – Model- Arabidopsis thaliana, Homeotic mutants, Pollination: Structural adaptations of pollen dispersals, pollen viability, storage and germination, pollen-pistil interaction – Genetic control of pollen – pistil interaction and pollen allelopathy, Pollen sterility: Genetic and cytoplasmic male sterility, chemical induction of male sterility, utilization of male sterility in hybrid seed production.

Unit 2:

Incompatibility:- Types of Incompatibility, methods to overcome Incompatibility, Delayed pollination, bud pollination, Intra-ovarian pollination, test tube fertilization, somatic hybridization, egg transformation, ovary and embryo culture.

Apomixis and Polyembrony:- Types of Apomixis, Embryology of gametophytic-apomicts, apomixis and plant breeding, Polyembrony- A brief account

Unit 3: Introduction to Plant breeding: Concept and scope of plant breeding, a brief historical account of plant breeding, objectives, significance, problems of plant breeding. National and International institutes, location, aims, achievements, prospects of plant breeding.

Unit 4 Methods of Plant breeding: Plant introduction and acclimatisation, germplasm

maintenance, Selection (pure line, mass, pedigree analysis, single seed descent, clonal selection).

Unit 5 Hybridisation : Definition, methods of hybridization (self pollinated crops – rice and wheat, cross pollinated crops – maize, asexually propagated crops- sugarcane, potato) Polyploidazation and breeding- its significance.,

Unit 6 Mutation breeding: Methods of mutation breeding (chemical and physical), merits and demerits of mutation breeding, significance. Heterosis: definition, types, theories of Heterosis, heterosis in self and cross pollinating plants and its application, Inbreeding depression: Hybrid vigour and inbreeding depression, genetical basis of inbreeding depression, degree of inbreeding depression, out breeding and significance of inbreeding and out breeding. Back cross breeding: Methods, merit and demerits, markers assisted breeding.

Unit 7: Plant genetic resources: Definition, classification, genetic diversity, significance of genetic diversity, erosion of genetic diversity, dangers of erosion, concepts of asexual seeds, Seed certification and quarantine.

Recommended reading

1.Bhojwani S.S. & Bhatnagar, S.P. The embryology of Angiosperms. Kalyani Publishers, NewDelhi.2001

2.Johri B.M. Ambegaokar, K.B. and Srivastava P.S. Comparative Embryology of Angiosperms, Vol. I& II, Springer Verlag.

3.Chahal, G.S. & Gosal S.S. Principles & Procedures of Plant Breeding Biotechnological and Conventional Approaches, Narosa Publishing House, New Delhi.

4.Singh, P. 2001. Essentials of Plant Breeding, Kalyani Publishers, Hyderabad.

5. Allard, R. W. 1999. Principles of Plant Breeding. John Willey & Sons, New York.

6.Dana, S. 2001. Plant Breeding. Naya Udyog. Calcatta.

7.Singh. B. D. 1995. Plant Breeding – Principles and Methods. Kalyani Publishers, New Delhi.

ANIMAL REPRODUCTION & BREEDING

UNI 1 Introduction:Invertebrates: Reproduction in Coelenterates, Annelida and Arthropoda with special reference to insects, male and female reproductive systems, hormones, pheromones and their role in sex differentiation and gonadal activity. Mollusca and Echinodermata: Male and female reproductive systems, Gamete diversity, comparative embryonic development.

Vertebrates: Reproduction in vertebrates: Fishes, Amphibians, Reptiles and Birds: Male and female reproductive systems, Reproductive patterns - Ovipary, Ovo-vivipary and vivipary.

Unit 2: The Female Reproductive System in mammals: Comparative anatomy and physiology of the mammalian and sub-mammalian ovary and ductal system. Follicular growth, Ovarian hormones, two cell theory of Estrogen biosynthes. Autocrine, Paracrine, Endocrine regulation of Ovarian functions.

Unit 3: The Male Reproductive System in mammals: Comparative anatomy and physiology of the Mammalian and sub-mammalian testis and sex accessory glands: Function and organisation of Testis, Spermatogenic cycle, Testicular androgens, Autocrine, Paracrine, Endocrine regulation of Testicular function, semen and its biochemical nature.

Unit 4: Fertilization in Mammals: Pre-fertilization events, bio-chemistry of fertilization and post-fertilization events. Implantation and its hormonal regulation, delayed implantation. Placenta as an endocrine tissue; foeto- placental unit. Gestation and its hormonal regulation.

Unit 5: Regulation of mammalian reproduction: The Pituitary gland: Functional cytology, adenohypophyseal hormones, their chemistry and physiology. The hypothalamus and its neuro secretory centres: structure of Neurosecretory cells, the hypothalamic, principles: synthesis, storage, release and

chemistry. The phenomenon of neuro-endocrine integration and the hypothalamo hypophyseal gonadal axis, mammary gland, endocrinology of lactation.

Unit 6: Animal Breeding: Concepts, development and applications breeds and breed structure, basic breeding methods; Silkworm, sheep and poultry and cattle; genetic principles in animal breeding, heredity and environment, Heritability, repeatability, methods of their estimations; genotypic, phenotypic and environmental correlations. Traits for selection, breeding efficiency and inbreeding, out breeding, top crossing, grading, cross breeding, criss- crossing, triple crossing system. Artificial insemination, infertility and assisted reproduction.

1.Balinsky, B.I. 1981. An Introduction to Embryology, 5th ed. W. B. Sunders Co. West Washington Square, Philadelphia.

2.Bodemer, C.W.1968. Modern Embryology, Holt, Reinhart Winston Inc. NY. Chicago.

3.Enerjee, G.C.1987.A text Book of Animal Husbandry, 6th ed. Oxford and IBH Pub. Co. NY. Delhi, Calcutta & Mumbai.

4.Dalton, D. C. 1987. An Introduction to Practical Animal Breeding. English Language Book Society Collins.

5.Gordon I (1983) Controlled Breeding in Farm Animals. Paragon Press, Oxford, NY & Sydney

6.Hafez, E.S.E. (1987).Reproduction in Farm Animals, 5th ed. Lea & Febigar, Philadelphia.

GENETICS

Unit 1: Introduction to Genetics: Mendelism – Mendel's Law of segregation, Law of Independent Assortment. Chi-square test & its applications, Chromosomal basis of segregation & Independent assortment.

Unit 2: Extension of Mendelian principles: Codominance, Incomplete dominance, Gene interactions, Pleotrophy, Genomic imprinting, Penetrance and expressivity, Phenocopy. Concept of gene – Allele, Multiple alleles, Pseudoalleles, Complementation test.

Unit 3: Non-Mendelian inheritance & linkage studies: Linkage and crossing over, Linkage maps and interference and Coincidence, Intragenic recombination, Polygenic inheritance, Sex determination in animals and plants. X Chromosome inactivation in mammals, X linked inheritance, Sex limited and sex influenced characters. Cytoplasmic inheritance – maternal effects.

Unit 4: Bacterial and Viral genetics: Genetics of Bacteria and their viruses, Bacterial Conjugation, Bacterial Transformation, Transduction, Lytic and Lysogenic cycle, Bacteriophage genetics.

Unit 5: Human Genetics – Pedigree analysis, Karyotype, Genetic disorders (syndromes)

Unit 6: Mutations: Mutations – Types of Mutations, Chemical mutagens, Radiation mutagenesis, Detection of mutations. Structural rearrangements of chromosomes: Deletion, Duplication, Translocation, Inversion; Numerical variation in Chromosomes – Aneuploidy, Euploidy.

1.Genetics (2012) 6th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2.

2.Genetics - A Conceptual Approach (2012), 6th ed., Pierce, B.A., W.H. Freeman & Co.(New York), ISBN:13:978-1-4292-7606-1 / ISBN:10:1-4292-7606-1.

3.An Introduction to Genetic Analysis (2010), 10th ed., Griffiths, A.J.F, Wessler, S. R, Carroll, S. B. and Doebley, J., W.H. Freeman & Company (New York), ISBN:10: 1-4292-2943-8.

RESEARCH METHODOLOGY

Unit 1: Research methodology: Nature of Research: Concept, Meaning and Definition. Introduction to research methods, concepts of research – basic v/s applied research, Historical and Descriptive/ Analytical Research, Conceptual and Experimental/Empirical Research.

Unit 2: Research processes: Research design, identification of research gaps, Research problems: Identification, selection and formulation of hypothesis, conceptualization of research problems, data tools and techniques.

Unit 3: Sources of data: Primary and secondary data: Survey – Sampling techniques, systematic random sampling, multiple random sampling and positive random sampling.

Unit 4: Designing of Experiments: Questionnaires and interview methods, data processing and data analysis: Presentation and prediction of research findings, Statistical tools

Unit 5: Review of literature: Identification of sources of literature, Types of literature, Collection and Review of research literature, and their evaluation. Necessity and importance of review of literature.

Unit 6: Presentation of Research findings

Report/ thesis writing/ research correspondence, General strategies for preparation of Research Proposal, Data representation in Technical Reports, Poster presentation in Scientific conferences and Workshops. Preparation of manuscripts for national and international journals. Yardsticks employed in evaluation of manuscripts for publication. Citation index & impact factor of journals.

Recommended reading

1.Louis Cohen, Research Methods in Education (6th Edition), Lawrence Manion, and Keith Morrison, Paperback Publications, 2007.

2.Robert K. Yin, Case Study Research: Design and Methods: (Applied Social Research Methods), Paperback Publications, 2003.

3.Jane Ritchie and Jane Lewis, Qualitative Research Practice: A Guide for Social Science Students and Researchers, Paperback, 2003.

4.Stephen F. Davis, Handbook of Research Methods in Experimental Psychology, Black Well Publications, Lonodn, 2005.

OCCUPATIONAL BIOLOGY.

Module 1. APICULTURE

Definition, Different species of honey bees, Organization of honey bee colony, Social life and adaptation of honey bees. Communication among honey bees. Bee keeping methods and equipments, Management and maintenance of an apiary, Growth period, honey flow period and dearth period Division of the colony, uniting two colonies, , replacing old queen with new queen, swarming management, monsoon management. Enemies of bees. Diseases of bees, Bee pasturage. Uses of honey bees, By-products of honey bees, Honey and wax composition. Testing the quality of honey.Extraction of wax, Uses of honey and wax.Royal jelly, Propolis. Apitherapy, Agencies supporting apiculture.

MODULE: 2. VERMICULTURE

Introduction, Ecological classification of earth worms. Species of earth worms used for vermicultre, Reproduction & life cycle, Role of earth worm in solid waste management, in agriculture, in medicine etc. Preparation of vermibed, Maintenance & monitoring, Preparation of vermicompost, Preparation of vermiwash.

MODULE: 3.QUAIL FARMING (Coturnix coturnix)

Introduction, care of quail chicks, care of adult quails, care of breeding quails, ration for quail, care of hatching eggs, health care, use of quail egg and meat.Sources of quality chicks. MODULE: 4. AQUACULTURE.

Advantages and salient features of aquaculture, Types of Aquaculture, Biotic and abiotic features of water, Importance of algae in aquaculture, Common cultivable fishes of Kerala, Fish diseases, Composite fish culture, Integrated fish culture, Carp culture, Prawn culture Mussel culture Pearl culture. Processing & Preservation.

Aquarium management - Setting up of an aquarium, Biological filter & Aeration, Breeding of gold fish, gourami (Osphronemus), fighter and Guppy (live bearer). Nutrition and types of feed for aquarium fishes, Establishment of commercial ornamental fish culture unit. Fish Transportation - Live fish packing and transport Common diseases of aquarium fishes and their management. Aquaponics (a brief introduction only).

References

NPCS Board, The complete book on Bee keeping and honey processing, NIIR Project consultancy services, 106E, Kamala nagar, Delhi- 110007.
Shukla G.S, & Updhyay V.B, Economic zoology ,Rastogi Publ. Meerut.
Pradip.V.Jabde , Text book of applied zoology, 2005
Applied Zoology, Study Material Zoological Society of Kerala , CMS college Campus Clive. A Edwards, Norman. Q. & Rhonda. 2011. Vermitechnology: earthworms, organic waste & environmental management.
Chauhan, H.V.S. Poultry, Disease, diagnosis and treatment, Wiley eastern Ltd Delhi.
Otieno.F.O 2014. Quail farming: markets & market strategies
Pillai T.V.R., Aquaculture, principles and practices.
Ronald j. Roberts (1978) Fish pathology , Cassel Ltd London.
Cowey C. B. et. al. (1985) Nutrition and feeding in fishes, academy press.
Farm made aquafeeds. FAO fisheries Technical paper, 343.
Harisankar J. Alappat& A. Bijukumar, Aquarium Fishes. B. R. Publ. Corporation, Delhi.
MPEDA, A hand Book on AquafarmingOrnamentalfishes, MPEDA, Kochi.

Amber Richards. 2014. Aquaponics at home.
Pradip.V.Jabde. 1993. Text book of applied zoology
Venkitaraman, P.R,1983, Text book of Economic zoology(SudharsanaPuubl. Kochi)
Addison Webb, Bee Keepingfor profit and pleasure, Agrobios Ltd.
Edwards.C.A.&Lafty, J.R.1972 Biology of earthworms(Chapman & Hall Led.London)
Applied Zoology, Study Material Zoological Society of Kerala , CMS college Campus
George cust& Peter Bird, Tropical Fresh water Aquaria, Hamlyn London.
Verreth J. Fish larval nutrition, Chapman & Hall Publ.
Bone Packer. 2014. Aquaponic system

PRACTICAL

OCCUPATIONAL BIOLOGY

1. General Identification, Economic importance, Morphology, scientific names and common names of the following

a) Economic important and morphology of culturable fishes (Catla, Rohu, Grass

carp, Common carp, Silver carp, Etroplus suratensis, Oreochromis /Tilapia,

Mugil cephalus and Anabas Testudineus)

b) Identification and morphology of ornamental fishes (gold fish, fighter, Gourami,

Angel fish, Guppy

c) Two species of earthworms used in Vermiculture

d) Four species of honey bees

e) Economic importance and morphology of shell fishes (Any three species of

prawn, two marine mussels, two oysters one rock oyster - Crasostria and pearl

oyster - Pinctada fucata and freshwater mussel - Lamellidens marginalis).

2. Castes of bees

3. Principle & uses of - Aquarium filters, Aquarium aerator, Aquarium plants, Oven, Pelletiser, Screw Press, die plate

4. Identification and study of fish parasites and diseases (five numbers each) using slides/pictures

5. Bee keeping equipments, Beehive, Smoker, honey extractor, Queen Cage,

- 6. Bees wax, Honey, Vermicompost (Identification-Uses)
- 7. Formulation of artificial feed for aquarium fishes demonstration
- 8. Tests for determining the adulteration in honey.
- 9. Mounting of pollen basket
- 10. Mounting of mouth parts of honey bee
- 11. Separation of cocoon from worm castings.

PRACTICALS

PLANT REPRODUCTION & BREEDING

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1. Morphology of the reproductive parts of flower

2. Tests for Pollen Viability – In vitro pollen germination, Tetrazolium test.

3. Study of effect of Sucrose, Boron and Calcium on pollen germination.

4. Vegetative reproduction- Artificial methods- Grafting, Cutting, Gootee, and Layering.

5.Breeding by emasculation, bagging and artificial cross pollination

ANIMAL REPRODUCTION & BREEDING

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1. Reproduction in animals with models of vertebrates and invertebrates

2. Identification of sperms in insects, annelids, amphibians, and mammalian (slides)

3.Sperm counting, studies on process of fertilization (slides/Rat)

4. Visit to breeding research station/ and institutes- GKVK, IISC, Animal house etc. and report writing

GENETICS

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1. Study of Linkage, recombination, gene mapping using marker based data from Drosophila.

2.Study of sexual dimorphism in Drosophila.

3.Study of mutants in D. melanogaster.

4.Study of inheritance pattern of mono and dihybrid crosses, sex-linked inheritance & multiple allelism (ABO and MN blood group typing)

5.PTC testing in a population and calculation of allele and genotype frequencies.

6.Study of abnormal human karyotype and pedigree analysis (dry lab).

7.Determination of chiasma frequency and terminalization coefficient in Allium cepa & Poekilocerus picta.

8.Restriction enzyme digestion plasmid DNA & estimation of size of a DNA fragment after electrophoresis using DNA markers.

9. Construction of Restriction digestion maps from data provided.

10. Demonstration of DNA fingerprinting.

PATHOLOGY

Plant pathology:

Unit 1: Introduction to plant pathology: Importance of plant diseases, disease concept, disease description and diagnosis, disease cycle terminology, life-cycle strategies of plant pathogens, host-pathogen interactions and co-evolution.

Unit 2: Plant fungal pathogens: Study of Oomycetes, Ascomycetes, Basidiomycetes as disease causing agents; disease cycle, host resistance, gene for gene concept, disease management with special emphasis on biological control.

Unit 3: Bacterial, Viral and Nematode pathogens of plants: Life cycle of selected pathogens affecting agricultural crops (Beans, tomato, rice, grapes, citrus, groundnuts, Ladies finger, tobacco), integrated management by cultural, chemical, biological and host resistance method, importance of plant quarantine in disease management.

Animal pathology

Unit 4: Introduction to animal pathology: History of pathology, principles of animal pathology including etiology, course and termination of disease.

Unit 5: Study of animal pathogenesis: Various degenerations, infiltration, necrosis, endogenous and exogenous pigmentations associated with animal pathology, circulatory and growth disturbances, reversible and irreversible cell injuries, different types of inflammation with special emphasis on chemical mediators.

Unit 6: Fungal, viral and bacterial diseases of animals including disease management: Foot & mouth diseases of cattle, bird flu, mastitis in cattle, Grasserie, Flacherie, Muscardine, Pebrine (in silkworm and economically important insects), cocciodiosis, scrapie, brucellosis, Q fever, marine white spot disease.

Recommended reading

1.George N. Agrios, Plant pathology, 5th edition, Elsevier academic press, 2000

2.R.S.Singh, Plant pathogens, Oxford and IBH publishing co., 1994

3.G.L.Schumann & C.J. D'Arcy, Essential Plant Pathology, 2nd edition, 2009

4.K. Starr Chester, Nature and prevention of plant diseases, 2006

5.JD Smyth, An Introduction to Animal Parasitology, 3rd edition, CUP, 1994

6.S.H. Gillespie & P.M. Hawkey ed. Medical Parasitology – A Practical Approach, OUP,1995

7.F.E.G. Cox ed., Modern Parasitology, Blackwell Publishing, 1993.

SYSTEMS BIOLOGY

Unit 1: Introduction:

Systems biology as a new perspective, scope and application of systems biology. Systems structure – Biological systems, metabolic systems, signal transduction systems, neural networking systems, pathways, dynamics, response to perturbation, stress response, Heat shock response.

Unit 2: Control of enzyme activity & metabolic pathways:

Introduction, control of activities of the single enzymes, controlling the activity by change in covalent structure of enzymes, models account for the behavior and regulation of enzymes, significance of allosteric and cooperative behavior of enzymes. Metabolic pathways - general consideration, amplification of signals, formulation of theories for control of metabolic pathways, examples Regulation of glycolysis, gluconeogenesis and glycogen metabolism.

Unit 3: Enzymes in organized systems:

Models of multi-enzyme complexes, Pyruvate dehydrogenase from E.coli and mammalian Tissues. Tryptophan synthase.

Unit 4: Gene expression: Introduction, analysis of gene expression, different tools available for analysis of gene expression, measurement of gene expression by Micro arrays, RNAi types of micro arrays, analysis of micro array gene expression data, Relating Expression data to other biological information – Predicting binding sites of proteins to DNA, Predicting protein-protein interactions and protein functions, Predicting functionally conserved modules, Reverse-engineering of gene regulatory networks.

Unit 5: Introduction to proteomics and genomics: Genomics and Proteomics as a foundation for Systems Biology, Strategies relating to In-silico Modeling of biological processes, Metabolic Networks, Signal Transduction Pathways, Gene Expression Patterns. Applications of Systems Biology Markup language (SBML), E-cell and V- cell Simulations and Applications; Synthetic genomics – Methods and applications

Unit 6: Bioinformatics in Drug and Vaccine Design: Introduction, The drug discovery process, techniques in drug designing.

1. Jonathan Pevsner, "Bioinformatics and Functional Genomics" 2003 John Wiley & Sons, Inc.

2.ICRF handbook of genome analysis, by NK Spurr, BD Young, SP Bryant. Volumes I & II. - Blackwell science publishers.

3.ICRF handbook of genome analysis, by NK Spurr, BD Young, SP Bryant. Volumes I & II. - Blackwell science publishers

4.Daniel P. Berrar, Werner Dubitzky, Martin Granzow, "A Practical Approach To Microarray Data Analysis" 2003 Kluwer Academic Publishers ISBN: 1-4020-7260-0

5. Molecular Modeling Principles and Applications, Andrew R. Leach, II ed. 2001. Prentice Hall

6.Murphy K.P. (ed.) Protein structure, stability, and folding (Humana Press, 2001)

7. Current Protocols in Protein Science, Wiley Publishers, 2005

IMMUNOLOGY

Unit 1: Introduction to Immunology: Historical account; Cells and organs of immune system; Lymphocytes, their origin and differentiation (B-Lymphocytes and T-Lymphocytes); antigens, types and classification; complement system and its biological functions; types of immune responses; mechanism of immune response.

Unit 2: Types of Immunity: Innate and acquired, humoral and cellular;

Humoral immunity - B-lymphocytes and their activation; structure and function of immunoglobulins; immunoglobulin classes and subclasses, genetic control of antibody production, monoclonal antibodies and diagnosis, idiotypes and idiotypic antibodies

Cellular immunity - Major histocompatibility complex. Thymus derived lymphocytes (T cells) their classification, antigen presenting cells (APC) - macrophages, dendritic cells, langerhans cells, their origin and functions; mechanisms of phagocytosis; identification of cell types of immune system; immunosuppression, immune tolerance.

Unit 3: Immune hypersensitivity: Mechanisms of T cell activation, cytokines and their role in immune response; Leukocyte migration and inflammation; hypersensitivity of macrophage activation and granuloma formation, immune regulations, immune response to infectious organisms, Vaccines.

Unit 4: Immunotechniques and their applications: Immunodiffusion, immunoblot, immunofluorescence, immunoaffinity, ELISA, agglutination, immunoprecipitation, immunoelectrophoresis, cross-linking.

Unit 5: Transplantation and Grafting: Graft rejection, evidence and mechanism of graft rejection, prevention of graft rejection, immunosuppressive drugs, HLA and disease, mechanisms of immunity to tumor antigens.

Unit 6: Autoimmunity: Auto-antibodies in humans, pathogenic mechanisms, experimental models of auto immune diseases, treatment of auto immune disorders.

RECOMMENDED READING

1.Roitt's Essential Immunology, by Delves, Martin, Burton & Roitt, 12th edition, Wiley-Blackwell, , 2011.

2.Kuby Immunology. Owen, Punt, Stranford, 7th edition, Macmillan, 2013.

3.Cellular & Molecular Immunology, Abbas et al., 7th edition, Elsevier, 2011.

BIOMEDICAL SCIENCES

Unit 1: Stem Cells: Definition and characteristics, classification of stem cells (Embryonic stem cells and adult stem cells), stem cell niche, stem cell division and its control, induced pluripotent stem cell generation & application, hemopoietic stem cell disorders: classification and manifestations, principle and procedure of bone marrow transplantation.

Unit 2: Human Cytogenetics: Human Chromosomes and karyotypes, sex determination, X and Y chromosomes, evolution of human chromosomes, Fragile sites mutagenesis studies, causes of chromosome breakage, SCE/MN, In-situ Hybridization, chromosome and cancer, studies of prenatal chromosomes, Somatic cell hybrids in gene mapping, chromosomal disorders/ syndromes.

Unit 3: Cancer Biology: Different types of tumors, factors and mechanism involved in tumor formation, oncogenes, tumor suppressor genes, methods of detection of cancer, tumor markers, treatment-chemotherapy, radio therapy, immunotherapy and gene therapy for cancer.

Unit 4: Human Microbial diseases: Mode of infection, symptoms, epidemiology and control of AIDS, Hepatitis B, Rabies, Tetanus, Typhoid, STD, TB, Cholera, Aspergillosis, Histoplasmosis, Cryptococcosis, Leprosy, H5N1 and H1N1; Arboviral diseases: Yellow fever, Dengue, Japanese Encephalitis, Chickungunia, Kyasanur forest disease- epidemiology and management. Unit 5: Haematology and transfusion science: Structure, function and production of blood cells, platelet structure and function haemostasis, fibrinolysis, thrombosis. Types of anaemias, haemoglobinopathies and thalassaemias, Haematological malignancy. Transfusion science, Genetics, inheritance, structure and role of red cell antigens, The preparation, storage and use of blood components, the selection of appropriate blood components for transfusion and possible adverse effects, immune mediated destruction of blood cells, health and safety aspects of handling blood.

Unit 6: Disease diagnostics: Nervous system, perspective and behaviour, Neural disorders and repair.

DNA finger printing in Forensic science and Disease diagnosis. Enzymes in diagnosis of human diseases and Health care. Acetylcholinesterase, angiotensin converting enzyme (ACE), Pseudocholinesterase, 5'- nucleotidase (5NT), Glucose-6-phosphate dehydrogenase (GPD) and other red cell enzymes; CK isoforms, Immunoreactive trypsinogen (IRT) and Chymotrypsin; Amylase isoenzymes, Macroamylases, Isoenzymes (CK, LD, ALP). SGOT and SGPT. Diagnosis of Diabetes mellitus and Glucosurea.

Recommened Reading

1.Enzyme Technologies for pharmaceutical and biotechnological applications by Herbert A Kirst, Wu-Kuang Yeh, Milton J.

2. Developmental Biology, 6th Edition, by Scott F. Gilbert

3.Hematology, by William J. Williams, Ernest Beutler, Allan JU. Erslev, Marshall A. Lichtman Molecular Biology of the Cell, 3rd Edition, Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, James D. Watson

4.Caul .E (1992) Immuno-flouresent–antigen detection techniques in diagnostic microbiology, Pub ,Health Lab services

5. Cruick shank et.all Medical microbiology

6.Goding, M.J.W Monoclonal Antibodies: principles and practice – (1983) Academic press.

7.Kuby.J (1992) Immunology 4th Edn. Richard A. Goldsby Kindt &Oshome Eds W.H.Feeman &Co .NY

8.Zaiko, G.E (2004) Biotechnology and agriculture & Food industry, Nova publishers

9.A. V. Hoffbrand, P. A. H. Moss, J. E. Pettit, Essential haematology- Medical - 2006

10. Atul B. Mehta, A. V. Hoffbrand, Haematology at a glance- Medical - 2005

PRACTICALS

PATHOLOGY

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1Methods of studying plant and animal diseases- Scoring, Collection and preservation of samples

2Culturing of Nematodes - Isolation and pathogenesis

3.Identification of disease pathology in plants: Tikka of ground nuts, Blast of rice, Mosaic of bhindi, Powdery mildew of grapes, Leaf spot of bean, Citrus canker.

Animals: Grasserie, Flacherie, Muscardine, Pebrine, Foot and mouth diseases, Mastitis in cattle, coccidiosis, Scrapie, Brucellosis, Bird flu, Q Fever, Marine White Spot Disease in fishes.

4. Identification of insect pests of agricultural crops – Leaf roller, mealy bugs, stem borers, sap suckers.

5.Field Visit to study crop diseases and animal disease

IMMUNOLOGY:

- 1.Separation of serum from blood samples
- 2. Isolation and enumeration of lymphocytes using haemocytometer
- 3. Isolation and enumeration of spleen cells

4. Purification of IgG from serum by ammonium sulphate fractionation method - Dialysis

5.ABO Blood group typing

6.VDRL/ WIDAL test

7.Immunodiffusion tests: Ouchterlony double immunodiffusion method (DID) and Single Radial immunodiffusion (SRID, Mancini method)

8.Demonstration of ELISA

9.Immunoelectrophoresis: Countercurrent IEP & Rocket IEP

10.Isolation and enumeration of lymphocytes using haemocytometer

11.Survey of structural plant defences: viz. cuticle, wax, lignin, bark, thorns, prickles, trichomes, armour in different plants species including thigmonasty, camouflage, mimicry.

12.Survey: Quantitative and qualitative secondary metabolites in plants: alkaloids, glycosides, glycosinolates, terpinoids, phenolics, gammosis etc. in healthy and diseased plant/plant organs

BIOMEDICAL SCIENCES & SYSTEM BIOLOGY

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

- 1.Estimation of SGOT in blood samples by standard curve method
- 2. Estimation of SGPT in blood samples by standard curve method
- 3. Estimation of LDH in blood samples by standard curve method
- 4. Estimation of Creatinine in blood samples by standard curve method
- 5. Estimation of Cholesterol hypercholesteremia samples
- 6.Estimation of Bilirubin
- 7. Estimation of blood glucose by glucose oxidase method
- 8.Immunoassay for detection of typhoid (kit method)
- 9.STD detection by agglutination method (kit method)
- 10.Chromosomal analysis, bright field technique, GTG and CBC banding
- 11.NOR staining and sex chromosome identification
- 12.Identification of organelles by marker enzymes: SDH, LDH, acid phosphatase
- 13.Fluorescence technique, Q & C banding, FISH
- 14.Labelling of DNA-probes by Nick -translation filter test. .
- 15.Karyotyping- normal karyotyping, Aneuploidy, Aberrations.
- 16.Gene expression measurement through DNA microarrays and SAGE.

GENOMICS & PROTEOMICS

Unit 1: Genomics and the Human Genome project: History, organization and goals of human genome project, Mapping strategies, current status of various maps; DNA segment nomenclature, Human genome diversity, Organization of human genome, Mitochondrial genome, Gross base composition of nuclear genome, Gene density, CpG islands, RNA-encoding genes, Functionally identical/similar genes, Diversity in size and organization of genes. General aspects of the structure of E. coli, Arabidopsis, rice, yeast, Drosophila, C. elegans and mouse genome

Unit 2: Gene families: Multigene families – Classical gene families, families with large conserved domains, families with small conserved domains, Gene super families, Gene families in clusters, Pseudogenes, Repetitive DNA and transposable elements, Origin of gene families (Haemoglobin, Myoglobin as examples).

Unit 3: Comparative Genomics: Whole genome analysis, Genome sequence, micro assay, molecular phylogeny, Overview of prokaryotic and eukaryotic genomes, C-value, number of genes and complexity of genomes, Conservation and diversity of genomes, Comparative genomics as an aid to gene mapping and study of human disease genes. Comparative genomics of mitochondria and chloroplast genomes.

Unit 4: Genome wide analysis: Global study of Genome activity, Transcriptome and its analysis, Proteomics, Synthetic genomics

Unit 5: Protein characterization: Amino acids; proteins as polypeptides- classification of proteins, Backbone flexibility- Φ and ψ - Properties of amino acids-Hydrophobicity, EIIP, Molecular weight, α and β propensities etc. Proteome and Proteomics Proteins as workhorse molecules of life, -protein separation & analysis using 2D Gel Electrophoresis, protein arrays; Liquid chromatography, Mass spectrometry- Protein-protein interaction; Detection of functional linkages.

Unit 6: Protein structure analysis: Structure prediction of primary, secondary and tertiary structure of proteins- SCOP, DALIDD, CATH classification. Interatomic forces and protein structure, covalent interaction, hydrogen bonds, hydrophobic and hydrophilic interaction, charge/dipole interaction, Vander waals forces, steric interaction, Determining protein structure, Homology modeling, CASP, Ab initio prediction, Molecular dynamics & conformational energy calculation, Prediction of function.

Recommended Reading

1. T.A. Brown, Genomes, Bios, 2002.

2Coleman and Tsongalis, Molecular Diagnosis, Humana, 1997.

- 3.Dale & Schartz, From Genes to Genomes, Wiley, 2003.
- 4. Hawley and Mori, The Human Genome, Academic, 1999.
- 5.Lewis, Human Genetics, WCB, 1999.
- 6.Liebler, Introduction to Proteomics, Humana, 2002.
- 7. Pasternak, An Introduction to Molecular Human Genetics, Fritzgerald, 2000.
- 8. Primrose & Twyman, Principles of Genome Analysis & Genomics, Blackwell, 2003.
- 9. Strachan and Read, Human Molecular Genetics, Wiley, 1999.
- 10.Sudbery, Human Molecular Genetics, Prentice Hall, 2002.

ANIMAL MOLECULAR PHYSIOLOGY

Unit 1: Introduction to mammalian physiology: Basic body plan in mammals, location of organs, concept of homeostasis.

Unit 2: Circulatory & Respiratory system – Composition of blood, cells, homeostasis, mechanism of blood clotting, organization of neuro cardiovascular reflexes, neuro-hormonal control of arterial pressure, integrated cardiovascular responses.

Mechanical properties of respiratory system. Tissue gas exchange, control of breathing. Distribution of ventilation and perfusion.

Unit 3: Excretory System – Renal hemodynamics. Glomerular filtration. Formation of urine, acid – base balance. Control of body fluid volume and osmolytes.

Unit 4: Nervous System & sensory organs – Synapses, NMJ, Cholinergic and Adrenergic systems, inhibitory neuro transmitters, structure and function of acetyl choline receptor. Mechanism of vision, taste, olfaction and auditory responses.

Unit 5: Muscular system- Muscle proteins, molecular mechanism of muscle contraction. Cardiac action potential, pacemaker, contractile machinery and mitochondria and energy supply. Cardiac performance (ECG).

Unit 6: Gastrointestinal System – Mechanism of gastric acid, pepsin and bicarbonate secretion, features of motor activity of gut, sphincters, specific patterns of mortor activity, pattern of contraction. Digestion and absorption in gut.

Unit 7: Biomembranes – Physicochemical properties of biological membranes – membranes as permeability barriers. Special transporters on absortive and secretary epithelium, types and role of ATPases, Ion channels including aquaporin and TRIP.

Recommended Reading

1.Bullock N, Boyle S, Wang M.B, Physiology, Lippincott Williams, New York, 2001.

2.Astrand P.P, Rodahl, Stromme, Text Book of Physiology, Kinetic Inc. New York, 2005.

3.William P. Stone G, Johnston I., Environmental Physiology of Animals, Blackwell Publishers, London, 2001.

4.Gerald Karp, Cell and Molecular Biology, Cell and Molecular Biology- Concepts and Experiments, John Wiley & Sons, New York, 1996.

5.Schimidt, Animal Physiology: Adaptation and Environment, 5th edition, Cambridge University Press, London, 1997.

6. Roberts M.B.V, Nelson Thrones, Biology: A Fundamental approach, Bristol, 2003.

PLANT MOLECULAR PHYSIOLOGY

Unit 1: Photobiology and Signal Transduction: Signal transduction in stomatal opening and phototropism, Red/Far Red, Green and Blue light stimulated stomatal opening. (Role of Photoreceptors- Phototropins, Phytochromes, Cryptochromes and Zeaxanthin) on the Photosynthesis & Stomatal movements).

Unit 2: Cellular and Molecular mechanism of Phytochrome : Phytochrome - the Red/ Far-Red photoreceptor, structure, photo reversibility, properties, phytochrome induced whole plant responses- VLFRS, LFR & HIR and phytochrome induced Gene expression.

Unit 3: Floral stimulus and biochemical signaling involved in flowering: Circadian rhythms, molecular mechanism of photo-periodism and vernalization.

Unit 4: Biochemical signaling in plants: Role of cyclic nucleotides, calcium calmodulin cascade, protein kinases, phosphatase and specific signaling mechanism (Membrane based receptors & nuclear based receptors).

Unit 5: Defense mechanisms in plants: Genetic basis of Plant-pathogen interactions, R genes and R-gene mediated Disease resistance. Multiple types of defense reactions activated by pathogen attack, Hypersensitive reactions, Role of Reactive oxygen species in plant resistance response, Nitric oxide signaling, Role of salicyclic acid and jasmonic acid in defense reactions, role of PR proteins and other defense other defense related proteins in signal transduction cascades.

Unit 6: Secondary metabolites: Types, chemical nature, mode of action of phenolics, terpenes and nitrogen containing compounds like alkaloids, cyanogenic glycosides and non-protein amino acids.

Unit 7: Stress Physiology: Molecular, biochemical and physiological aspects of plant responses and adaptations to water stress, Role of solutes in cell osmotic adjustment, Role of Seed proteins, Freezing stress, chilling stress, Heat stress, salinity stress & oxygen deficiency and Oxidative stress in plants (free radicals, scavenging enzymes- superoxide dismutase, peroxides and catalase).

Recommended reading

1. Gerald Karp, Cell and Molecular Biology, Cell and Molecular Biology- Concepts and Experiments, John Wiley & Sons, New York, 1996, 2014.

2.Buchanan B.B, Gruissem W and Jones R.L. Biochemistry and Molecular Biology of Plants, I.K. International Pvt. Ltd., 2004, 2007.

3. Dey and Harborne J.B. Plant Biochemistry, Aca. Press, 1977.

4. Hall D.O and Rao KK, Photosynthesis, Cambridge Press, 1999.

5.Harborne TC, Phytochemical methods- A guide to modern techniques of plant analysis, Chapmen and Hall, 1981.

6. Moore TC, Biochemistry and Physiology of Plant Hormones, Springer, 1989.

7. Moore TC, Research experiences in Plant Physiology, Springer, 1974.

8. Taiz L. and Zeiger, E. Plant Physiology, Panima Publishing Co-operation, 2008

GENETIC ENGINEERING

Unit 1: Introduction to Recombinant DNA technology: An overview of structure and function of nucleic acids, role of enzymes used in Genetic Engineering (endo- & exonucleases, RNase, DNase, restriction endonucleases) DNA methylation, RNA modification, role of kinases, phosphatases, bacteriophage polynucleotide kinase, Ligases. Vectors employed in recombinant DNA technology, – cloning plasmids (pBR322, pUC19/18, Ti) cosmids, phagemids, shuttle vectors, ARS, mini chromosomes, BACs, PACs, YACs, Expression vectors used for expression of proteins in bacteria, yeast, plants and animal cell lines.

Unit 2: Gene cloning and expression: Various techniques and strategies used in gene cloning in prokaryotes (E. coli) and eukaryotes (S. cerevisiae, Pichia pastoris), gene transfer methods: Physical, Chemical and Biological. Transformation into bacteria and yeast, transfection into plant and animal cells, selection of recombinant cells, expression of recombinant proteins.

Unit 3: Gene Screening and Isolation: Isolation and purification of nucleic acids,

Construction of genomic and cDNA libraries, Selection of probes and labeling,Blotting of DNA / RNA and hybridization, Colony, plaque screening and hybridization.

Unit 4: DNA sequencing: Dideoxy and chemical methods, sequence assembly, automated sequencing, and applications of DNA sequencing (synthetic oligonucleotides), Next Generation Sequencing (NGS).

Unit 5: Application of recombinant DNA technology: Overview of transgenic plants and GMO (Bt cotton, golden rice, tomato, corn, brinjal, cow, sheep, poultry, fish). Gene therapy: rationale, types of gene therapy (additive, replacement), gene therapy vectors (viral, non-viral), gene therapy drawbacks, gene therapy clinical trials and outcome, integration of gene and cell therapy.

Unit 6: Bioethics and IPR

Introduction to ethics: deontology & consequentialism, ethics codes, relationship to law; Human subject research: history and standards; federal regulation of research, protection; Genetics & ethics: privacy and confidentiality, discrimination & commercialization; Introduction to IPR, Patents-Gene Patenting, Trademarks, Copyrights, Industrial Designs, Geographical Indications, Future Developments of Intellectual Property Rights.

Unit 9: Bioprocess engineering

Screening and selection of industrial microorganisms, Bioreactors – types, basic functions, design and components, construction, temperature control, aeration, agitation systems, sterilization of fermenters, air supply and medium, aseptic inoculation and sampling methods.

Recommended Reading

1. Introduction to Genetic Engineering by Nicholl. Cambridge Low Price Edition.

2.Principles of gene manipulation - An introduction to genetic engineering, Old R.W., Primrose S.B., Blackwell Scientific Publications, 1993.

- 3.Genes VIII by Benjamin Lewis. Oxford University & Cell Press
- 4.Bacterial Plasmids by P. Broda.
- 5.Genetic Engineering Vol. 1-4 (Williamson Edition)
- 6.Recombinant DNA by Watson et al., 1983.
- 7. Vectors by Rodriguer and Denhardt, 1987.

8.Molecular cloning Volumes I, II and III. Sambrook J et al (1989, 2000). Cold Spring Harbor laboratory Press, New York, USA.

9.Furrow et al., Bioethics (6th ed. 2008).

10. Intellectual property rights: innovation, governance and the institutional, Birgitte Andersen, ${\rm Law}-2006$

PRACTICALS

Genomics & Proteomics:

1.Restriction mapping of plasmid DNA

2.RAPD analysis

3.RFLP analysis

4.DNA fingerprinting analysis: Parentage detection

5.Demonstration of EST/ STS/ Microarray analysis

6.Homogenization, fractionation and separation of enzymes/ proteins in plants and animals

7.2D-PAGE separation of proteins

8. Superposition of structures; Secondary structure prediction of proteins;

9.Identification of membrane proteins;

10.Pattern searching in proteins (PROSITE);

11.Pattern searching in nucleic acids; Validation of 3D structures

ANIMAL MOLECULAR PHYSIOLOGY & PLANT MOLECULAR PHYSIOLOGY

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1.Effect of isotonic, hypotonic and hypertonic salines on erythrocytes

2.Estimation of RBC count and total WBC count using haemocytometer

3.Oxygen consumption in aquatic animals by Winkler titrimetry and dipping Oxygen electrode.

4.Measurement of heart beat rate in Invertebrates. Influence of excitatory and inhibitory neurotransmitter on the rate.

5.Effect of ACh and DOPA on Skeletal muscle contraction (Using Kymograph)

6.Estimation and separation of amino acids from various tissues including blood

7.Estimation of alkaloids in the given plant.

8. Estimation of Flavonoids in the given plant.

9. Estimation of total Phenolics in the leaf tissue.

- 10.Estimation of Proline in the leaf tissue.
- 11.Extraction and Estimation of total chlorophylls, carotenoids and total

proteins in Normal (unstressed) and stressed plants.

12...Estimation of antioxidant activity in a given plant.

GENETIC ENGINEERING

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

- 1.Callus Induction Techniques
- 2.Artificial seed production
- 3. Production of haploid plants by anther and pollen culture
- 4. Agrobacterium mediated transformation
- 5. Isolation and purification of plasmid DNA from E. coli
- 6.Fibroblast culture from chick embryo
- 7.Cell disruption techniques

PLANT AND ANIMAL BIOTECHNOLOGY

Plant Biotechnology

Unit 1: Introduction to plant tissue culture: Scope and importance of plant tissue culture – media composition and types, hormones and growth regulators, explants for organogenesis, somaclonal variation and cell line selection, production of haploid plants and homozygous cell lines. Micropropagation, somatic embryogenesis, protoplast culture and somatic hybridization, selection and maintenance of cell lines, cryopreservation, germplasm collection and conservation, plant tissue culture certification.

Unit 2: Metabolic engineering of plants: Plant cell culture for production of useful chemicals and secondary metabolites (hairy root culture, biotransformation, elicitation)- pigments, flavanoids, alkaloids, mechanism and manipulation of shikimate pathway. Production of industrial enzymes, biodegradable plastics, therapeutic proteins, edible vaccines and antibiotics using transgenic technology.

Unit 3: Transformation techniques & GM technology: Ti and Ri plasmids as vectors, role of virulence genes, design of expression vectors (35S promoter, genetic markers, reporter genes). Direct gene transfer methods – particle bombardment, electroporation and microinjection. Transgene stability & gene silencing. Crop improvement, productivity, performance and fortification of agricultural products. Strategies for engineering stress tolerance plants. Current status of transgenic plants in India and other countries. Importance of terminator gene technology. Environmental impact of herbicide resistance crops and super-weeds.

Animal Biotechnology

Unit 4: Introduction to animal cell culture: Cell culture laboratory design, layout and maintenance. Methods of sterilization, types of culture media, composition, preparation and metabolic functions. Role of CO2, serum, supplements, growth factors (EGF, PDGF,NGF, Gap-43). Serum and protein-free defined media. Culture and maintenance of primary and established cell lines. Biology of cultured cells – culture environment, cell adhesion, cell proliferation and differentiation. Characterization of cultured cells, viability, cytotoxicity, growth parameters, cell death and apoptosis. Expression of culture efficiency.

Unit 5: Transgenic animals: Methods involved in the production of transgenic animals. Gene knock-out and mice models of human diseases. Methods of animal cloning and their importance with reference to domestic animals. Improvement of biomass, disease resistance, recombinant vaccines for poultry. Pharmaceutical products produced by mammalian cells – plasminogen activator, erythropoietin, blood clotting factors, glycoprotein hormones, interleukins, interferons, cell culture based vaccines.

Unit 6: Biosafety: The Cartagena protocol on biosafety. Biosafety management: environmentally responsible use of biotechnology, ethical implications of biotechnological products and techniques. Social and ethical implications of biological weapons. National and international guidelines with regards to rDNA technology, transgenics andGM crops. Good manufacturing practice (GMP) and Good laboratory practices (GLP).

Recommended readings:

1.Ballinic C.A. et al., Animal Biotechnology, PErgamon press, New York 1989.

2.Glick B.R. and Pasternak J.J., Molecular Biotechnology, ASM Press, Washington DC, 2003.

3.Ratlege C. and Kristiansen B., Basic biotechnology, CUP, London 2001.

4.Shantharam D. et al., Biotechnology, Biosafety & Biodiversity: Scientific & Ethical issues for sustainable development, 1999.

5. John Davis, Animal cell culture: Essential methods (1st ed), Wiley-Blackwell & Sons, 2011.

6.Kirakosyan A., and Kaufman P.B., Recent advances in Plant Biotechnology (1st edition ed.), Springer publishers, 2009.

7.Nickoloff J.A., Plant cell electroporation and electrofusion protocols- Methods in molecular biology, Humans Press, NJ, USA, 1995.

8.Heldt, Plant biochemistry and Molecular biology, Oxford and IBH Publishing Co., Delhi 1997.

PRACTICAL

BIOTECHNOLOGY

Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos / virtual labs etc.

1.Solid-liquid separation methods: Sedimentation.

- 2.Solid-liquid separation methods: Filtration.
- 3. Solid-liquid separation methods: Centrifugation.
- 4.Estimation of percentage of ethanol from fermented broth
- 5. Estimation of Lactic acid from fermented broth.
- 6. Production, isolation and purification of biopharmaceuticals/ antibiotics, Pencillium notatum.
- 7.Production of wine using yeast
- 8. Micro injection and transformation
- 9.RDNA technology

ELECTIVE 1 : ENVIRONMENTAL SCIENCE

Concepts of Environmental science- Biodiversity, conservation and microbial ecology

Module I. Introduction to Environmental Science

Definition, Principle and Scope of environmental science- its relation to other sciences. Subdivisions of ecology- autecology, synecology, paleoecology, genecology, ecosystem ecology,chemical ecology, physiological ecology, evolutionary ecology, taxonomic ecology

Module II. Models and Principles in ecology

Fundamental concepts, structure of natural systems, natural succession, self sustaining systems in ecosystem, factors contributing to homeostasis, resilience, environmentalism Prerequisite: Basic concept of ecosystem, abiotic and biotic factors

Module III. Biodiversity

Biodiversity-concepts and patterns. Types of biodiversity-wild biodiversity, agro-biodiversity, domesticated biodiversity. Values of biodiversity, ecosystem functions and biodiversity, mobile links and valuating ecosystem services.

Module IV. Threats to Biodiversity

Causes of biodiversity loss. Tools and techniques for biodiversity estimation-biodiversity indices, relative abundance, Species diversity and genetic diversity
Module IV. Strategies for biodiversity conservation

In-situ conservation: sanctuaries, biospheres reserves, national parks, nature reserves, preservation plots. Ex-situ conservation: botanical gardens, zoos, aquaria, homestead garden; herbarium; In-vitro Conservation: germplasm and gene bank; tissue culture: pollen and spore bank, DNA bank. GEF-World Bank initiatives. Biodiversity hotspots and their characteristics, global distribution.

CBD, IPRs, National and international programmes for biodiversity conservation. CITES and TRAFFIC. Indian Biodiversity Act 2002 and laws, National Board of Biodiversity, State Board of Biodiversity. Ecosystem people and traditional conservation strategies; People's participation in conservation-PFM, community reserve and People's Biodiversity Register (PBR). Biodiversity Management Committee (BMC). Wildlife values and eco-tourism, wildlife distribution in India, problems in wildlife protection-Policies and programmes. Threatened animals of India.

Module V. Biological Invasions

Introduction Elton's hypothesis – Invasion patterns and process biological attributes for invasion: Reproductive potential, Allelopathy Phenotypic plasticity, fitness to the new environment. Hypotheses for invasion success: Natural enemy hypothesis evolution of invasiveness hypothesis, empty niche hypothesis, novel weapon hypothesis, disturbance hypothesis and Propagule pressure hypothesis. Invasive alien species of India (plants and animals). Databases of biological invasions. Impacts and management of invasions: impacts of exotics on biodiversity, productivity, nutrient cycling.

Management: Bio-control programmes, mechanical and chemical control Positive utilization Quarantine and EIA of biological invasion.

Module VI. Microbial Ecology

Bacteria of air, water and soil. Microbes in extreme environments-exteremophiles; acidophile, alkaliphile, endolith, halophile, piezophile, psychrophile, thermophile, xerophile. Environmental significance of microbes

Prerequisite- Symbiosis, commensalism. Mutualism, Cooperation, competition, predation, antagonism. Parasitism

Module VII. Role of microbes in biosphere

Biogeochemical cycles and microorganisms-Nitrogen cycle, carbon cycle, sulphur cycle and phosphorus cycle. Microorganisms and organic matter decomposition-humus, mineralization, degradation of cellulose, lignin, starch. Syntrophism in soil

Module VIII. Microbes and mankind

Role of microbes in soil formation and soil fertility, agricultural microbiology-microbes and crop production, microbial pesticides, biofertilizers, agricultural pathogens.

Food microbiology-fermentative role, SCP, microbes in dairy products, food spoilage

Aquatic microbiology-microbes in sea, domestic water, microbes in sewage and waste water treatment.

Industrial microbiology-bioactive products, enzymes, organic acids, biofuel, aroma compounds antibiotics, industrial waste water treatment.

Module IX. Conservation and Sustainable Development

Anthropocene - agricultural society, industrial society, industrial revolution and resource utilization, environmental consequences. Modern agriculture and green Revolution- environmental impacts. Tragedy of the commons. Basic needs-Imperatives relating to sustainable development. Johannesberg Conference 2002 and follow up Conference on sustainable development. The earth charter; Securing Sustainable futures, Millennium Development Goals and Strategies (MDG), Sustainable Development Goals (SDGs); need and scope for evolving participatory, community based environmental management strategies. Education for sustainability. Building sustainable societies and lifestyles. Ecological Foot Print analysis and its significance. Environmental concerns in traditional societies, Gandhian environmentalism.

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ENVIRONMENTAL POLLUTION AND TOXICOLOGY

Module I. Introduction

Brief history of human civilization, industrialization and urbanization. Definition of pollution. Different types of pollution- Air, Water and soil and their local, regional and global aspects.

Module II. Air Pollution

Sources and classification of air pollution ; particulates and gaseous pollutants in the atmosphere. Primary and secondary pollutants. Effects of air pollutants on human health, animals, vegetation, materials and structures.

Air pollution monitoring - methods, air quality standards; ISI, EPA.

Sampling and measurement of particulate matters (SPM) - gaseous pollutants, C02, CO, NO2, S02, H2S, oxidants, ozone and hydrogen fluoride.

Control of gaseous emission: adsorption by liquids, adsorption by solids, combustion and condensation. Control of S02, NOx, CO, CO2 and hydrocarbons. Pre requisites: GHGs, climate change, carbon foot print and carbon trade

Module III. Water Pollution

Sources of water pollution-Domestic (municipal sewage), industrial and agricultural. Health effects of water pollution. Water borne and water related diseases. Effects of water pollution on aquatic system. Water quality standard for potability - Pollution parameters, BOD, COD, Coliform bacteria.

Treatment of water for potable purpose (mixing, sedimentation, coagulation, filtration and disinfection) Primary and secondary treatment. Sludge disposal. Biological treatment: Kinetics of Biological growth - activated sludge treatment - trickling filters - anaerobic digestion, combined aerobic and anaerobic treatment process, aerobic process.

Advanced waste water treatment - removal of dissolved organics and inorganic - precipitation, iron exchange, reverse osmosis, electro dialysis, adsorption and oxidation.

Removal of nutrients. Removal of heavy metals - overall waste water treatment for sewage water. Water pollution treatment using constructed wetlands Bioremediation; traditional water purification techniques.

Module IV. Soil Pollution

Sources of soil pollution; - agricultural, industrial and domestic. Hazardous waste compounds, formulations and classes of substances, chemical classification of hazardous waste.

Soil factors affected by pollution – physico-chemical and biological impacts. Case studies on soil pollution in wetland and Highland soils in Kerala. Control of soil pollution. Soil quality parameters and test method.

Module V. Noise, Thermal and Oil Pollution

Properties of sound and noise. Effects of noise on People and ecosystem. Basic principles of noise control. National and International Standards. Assessment and measurement of sound. Thermal Pollution-causes and consequences Oil pollution – causes and consequences (any two case studies).

Module VI. Radiation Pollution

Radiation pollution- Definition, Radioactivity, Radionuclide, Radiation emissions, sources, Radioactive decay and buildup. Biological effects of radiation. Radioactive pollution impacts on ecosystem. Nuclear reactor disasters (Any two case studies), safety standards.

Module VII. Toxicology

Definition, scope and history of toxicology, Acute and chronic toxicity, selective toxicity, dose, synergism and antagonism.

Dose – Response relationships – Graded response, quantal response, Time action curves, Threshold Limit value (TLV); LC50; Margin of safety; Toxicity curves; Cumulative toxicity and LD50 and CTF. Toxic chemicals in the Environment – Biochemical aspects of As, Cd, Pb, Hg, Cu, O3, PAN, pesticides, MIC and other carcinogens. Bio accumulation and biomagnification.

Occupational toxicology- hazardous chemicals, disorders from chemical exposure at work, assessment of occupational hazards.

Toxicity testing; Bioassay – Definition, purpose, criteria for selection of test organism, methodology, estimation of LC50, Limitation and importance of bioassay, acute toxicity (single); sub acute toxicity; chronic toxicity; teratogenicity, carcinogenicity and mutagenicity.

Bio-monitoring of toxic chemicals - objectives, programs and parameters, concepts of bio indicators. Bio-transformation of Xenobiotics (Selective Toxicity).

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ENVIRONMENTAL MANAGEMENT AND CLIMATOLOGY

Module 1. The Physical Environment

Lithosphere - Weathering and soil formation, - soil colloids, adsorption and exchange of anions and cations, role of microbes in soil, types of soil, soil profile, classification of rocks, folds, faults and dykes and other geological formations and their environmental significance. Geomorphological

processes-plate tectonics, sea floor spreading, mountain building, evolution of continents and structural deformation.

Atmosphere -Physico-chemical characteristics, divisions, composition and significance of atmospheric components.

Hydrosphere -Visible and invisible hydrosphere, Range of aquatic habitats, water cycles between earth and the atmosphere, Global water balance, ice sheets, origin and composition of sea water, sea level changes, River basins and watershed. Physico-chemical characteristics of water- diffusion of oxygen from the atmosphere to surface waters. Influence of pH, turbidity and light on aquatic life. Prerequisite: Physical and chemical properties of soil, Biomes and distribution of life on earth.

Module II. Environmental Management

Basic principles: Management of physical, social, and economic environment. Concepts and scope of environmental planning, regional planning and management. Cost-benefit analysis and Resource economics. Environmental modeling- simulation modeling, input-output modeling, Linear programming, Software and resource management.

Tool box for environmental management – An over view of Ecological foot prints, SEA, Ecological Economics, conflict resolution strategies. Eco funds.

Environmental auditing and standards Eco labeling and certification, accreditation – need, objectives and benefits; Corporate social responsibility and Corporate environmental responsibility, ISO standards for environmental management systems (EMS) ISO 14000, 14001 and 26001; OHSAS 18001.

Module III. Ecosystem Management

An overview Population, Resources and ecosystem management Exponential growth in human numbers and the implications.

Major management concepts and methodologies The five basic laws of Ecology and their relevance for ecosystems management; paradigm shifts in the management of Ecosystems- influence of economics in ecology.

Management practices for various ecosystems: grasslands, forests, mountains, wetlands and coastal areas. Environmental planning and management of – waste lands, reclaimed lands, mining areas, human settlements, industrial lands and agricultural lands.

Eco restoration/remediation; local knowledge and management systems;

Module VII. Solid Waste Management

Municipal solid wastes (MSW) - quantities and characteristics, waste collection and transport, waste processing and resources recovery and recycling. Aerobic and anaerobic systems- composting, vermicomposting; Biodigesters (Biogas plants); incineration, pyrolysis, plasma pyrolysis; sanitary land fills and open dumping yards. Management of plastic and e-waste. Better management strategies (any two model case studies). Treatment process for unsegregated waste, fixation of hazardous solid waste prior to disposal, hazardous waste in land fill.

Hazardous waste (Management and Handling) Rules 1989 - the Manufacture Storage and Import of Hazardous Chemicals Rules 1989 - Biomedical Waste (Management and Handling) Rules 1998 - Plastic Act 1999. Extended producer responsibility. Recent amendments

Module IV. Environmental Impact Assessment (EIA)

Introduction- Definition, history, Aim, principles, concept and scope. Baseline data collection, Methods and steps - Adhoc method, checklist method, matrices, Map overlays method, network method, index method.

Impact assessment and impact evaluation-EIA Processes, Stages, EIA Statement Environment management plan- Risk assessment and disaster management programme. Life Cycle Assessment (LCA) and its significance.

Module V. Weather and Climate

Definitions and scope of climatology, weather and climate, components of climate system, earth's thermal environment, earth intercepts solar radiation, seasonal variation in intercepted solar radiation, air temperature in relation to altitude, global circulation of air masses, wind and earth's rotation on ocean currents, climatic types and zones.

Global climatic phenomena-El Nino and La Nina, causes and factors of climate change. Effect of climate change on ecosystems. Organisms and microclimate.

Module VI. Climate of India

Climatic regions of India, tropical monsoon climate-onset, rain bearing systems, break in the monsoon, retreat of monsoon. Monsoon in Kerala, oceanic and continental influence.

Module VII. Impact of Climatic Change on Environment

Global climatic change, - floods, tsunami, drought, avalanche, earthquakes, lightening. Effects of global warming on – environment, land use pattern, ocean, biodiversity, agriculture, human health. Natural disaster management. Measures to reduce climatic change- Afforestation, resoration of traditional agricultural practices, sequestering CO2, UNFCCC.

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(with CD ROM and Info Trac). 7th Edition., Thomson/Brooks Cole, USA

UN General Assembly.2010. Keeping the promise: a forward-looking review to promote an agreed action agenda to achieve the Millennium Development Goals by 2015. Report of the Secretary General.

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Web Resources

www.moef.gov.in (of Ministry of Environment and Forests, Govt. of India) www.millenniumassesment.org. (for Millennium Ecosystem Assessment Synthesis Reports) www.unep.org

ENVIRONMENTAL SCIENCE: PRACTICAL –I

Soil texture using micrometry from two different sites. Determination of moisture content. Determination of Potassium and Sodium using Flame photometer

Determination of soil pH from at least three different locations and correlate it with the soil type. Determination of Chloride, Calcium, Magnesium, Potassium and Phosphorous.

Determination of Calcium Carbonate in Egg shell- (Three different types of egg; calculate the mean value and the standard deviation, and compare it with the standard values).

Identification of trophic levels from gut analysis (Fish)

Study of biodiversity in Forest/Grass land and Pond/River and report the species richness, abundance and animal interactions. Calculate frequency, abundance, eveness and diversity indices (This can be done as part of the three / four day field study compulsory for this elective).

MZY4EBP21G ENVIRONMENMTAL SCIENCE PRACTICAL-II

Water Quality Analysis:

a.Determination pH, Electrical conductivity, Alkalinity, Salinity, Hardness, Nitrate, Phosphate and Silica

b.Determination of total dissolved salts (TDS)

Toxicity Analysis of Water: For Chlorine, Ammonia, Copper and Chromium Estimation of BOD and COD of polluted water

Isolation and Enumeration of microorganisms in soil (TBC or TMC). Bacteriological quality testing of water and wastewater.

- (a). Presumptive coliform test
- (b). Confirmatory coliform test

Prepare a report on faunal diversity of a stipulated area during a month and submit

Field Study Report: (Three /four days)

Visit to Institutions engaged in environment /conservation research; a sanctuary/national park and an industrial /polluted area. Report the study conducted and submit a 10 page write up/ print out giving the dates, daywise itinerary, methodology, results and references. Include photographs of the activity. Group and individual assignments shall be preferred.

(The activity suggested in Practical -1 can be clubbed with this field study).

ELECTIVE 2. ENTOMOLOGY

MORPHOLOGY AND TAXONOMY

Module I. Introduction

Scope and importance of insects, Origin and evolution of insects (including theories), Fossil insects.

Module II. Insect Morphology

Segmentation and division of the body: General morphology of head (Opisthognathus, Prognathus, Hypognathus). Head segmentation; Head skeleton; Tentorium; Modifications in head capsule; Cephalic appendages; Antennae – Structure functions and types, Mouth parts –various modifications, feeding mechanisms.

General morphology of thorax (thoracic segmentation, thoracic skeleton and thoracic appendages); Wings

- Structure, Venation, Wing articulation, Wing coupling apparatus, Wing modifications.

Legs-structure and adaptive radiation of legs, Locomotion; Morphology of abdomen and its appendages. External genitalia-structure and diversity of male and female genitalia. eg. Grasshopper, Drosophila, Cockroach ,Dragonfly.

Sense Organs – Structure and classification of sense organs (Hair organs, Plate organs, Campaniform organs, Compound eyes and vision.); Light and Sound Producing Organs – Structure of light producing organs, Production of light, Stridulatory organs in various insects.

Module III. Insect Classification

Methods of Insect collection and preservation, Use of keys, kinds of keys, their merits and demerits. Classification of insects up to families; General characters, Biology and habits of different orders of insects (special emphasis on economically important insects). Vectors of human diseases (Diptera, Anoplura and Siphonoptera).

Module IV. Social Organisation and Behaviour

Social organisation and behaviour with reference to Termites, Ants and Honey Bees; Study of Gall forming insects (features, Gall formation, Types of Galls – open and Closed, Common Gall pests, adaptations for Gall making habits. Economic importance); Leaf mining insects – features forms of leaf mines, feeding habits. Ecological aspects of leaf mining; Communication – Acoustic, Visual, Tactile and chemical methods; Adaptations of parasitic and predatory insects; Study of aquatic insects (factors influencing the aquatic life, food capture – modifications, anchorage, locomotion, respiration, oviposition and adaptations of swimming forms.

Module V. Insect Development

Egg, structure and adaptations; General pattern of embryonic development; Polyembryony; Parthenogenesis; Paedogenesis; Metamorphosis; Diapause.

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ANATOMY AND PHYSIOLOGY

Module I. Integumentary System Anatomy and histology, Moulting and sclerotisation, Role of hormones. Module II. Digestive System Anatomy and histology of gut. Modifications of gut (filter chamber). Physiology of digestion of wood, keratin,wax and silk. Extra intestinal digestion.Role of microbe in digestion. Assimilation.

Module III. Circulatory System

Anatomy and histology of dorsal vessel, dorsal and ventral diaphragms and accessory pulsatile organs.Composition and cellular elements in haemolymph; functions. Course of circulation and control of heart beat.

Module IV. Respiratory System Anatomy and histology of trachea, trachiole, spiracles and air- sacs. Modifications of respiratory system-cutaneous respiration, diffusion, ventilation, control of ventilation, cyclic release of CO2, respiratory pigments. Module V. Muscular System Histo-morphology of muscles, skeletal muscles and visceral muscles. Neuromuscular junctions. Excitations of muscle fibres, role of fast and slow axons. Module VI. Fat Body and Intermediary Metabolism

Structure of fat body, Role of fat body in storage of reserves.

Intermediary metabolism-Glycolysis, Glycerol phosphate shuttle, Trehalose-biosynthesis

Module VII. Excretory System

Anatomy and histology of Malpighian tubules (Hemiptera, Coleoptera, Lepidoptera). Nephro-rectal complex

and labial glands. Physiology of excretion.

Absorption of water and ions, reabsorption of essential materials. Synthesis of uric acid, formation of excreta.

Module VIII. Nervous System

Anatomy and histology of brain, ganglia and nerves. Physiology-reception and transmission of stimuli, production and conduction of nerve impulses.

Anatomy and histology of mechanoreceptors, photoreceptors and chemoreceptors. Sound production and light production.

Module IX. Endocrine System.

Histomorhology of neurosecretory cells and endocrine glands (corpora cardiaca,corpora allata and prothoracic glands). Hormones and their functions.

Types of pheromones and behavioural patterns.Pheromonal communications-allelochemicals; allomones, kairomones and synomones.

Module X. Reproductive System .

Reproductive system in male insects, Reproductive system in female insects.

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APPLIED ENTOMOLOGY Module I. Insect Pests

Kinds of pests (major and minor) – Key pests, sporadic pests, endemic pests, exotic pests, epidemic and pandemic pests, seasonal pests, occasional pests, regular pests, persistent pests. Causes of pest outbreak. Pest resurgence and replacement (secondary pest outbreak). Causes and management of resurgence and replacement. Forecasting pest outbreaks and surveillance (Short term and long term forecasting); forecasting based on observations – climatic and empirical factors.

Types of damage caused by insect pest to crops (Injury by chewing, piercing, sucking insects, internal feeders, subterranean insects, to stored products and indirect effect of feeding).

Module II. Insect Pests of Crops

Life history, nature of damage and control measures of major pests of paddy, coconut, cotton, sugar cane, mango, cashew, pulses, coffee, tea, banana, pepper, cardamom, turmeric and ginger, tapioca, rubber, vegetables, stored products; Locusts –life history and migration, damage and methods of control; Termites– life history, damage and control measures.

Module III. Basic Principles of Insect Control

Prophylactic methods. Curative methods- Cultural methods; Mechanical methods; Physical methods; Legal methods.

Biological control- History, ecological basis and agents of biological control – Parasites, Parasitoids, Predators; The practice of biological control (Conservation and enhancement, importation and colonisation, mass culture and release of natural enemies); Economic dimensions of biological control; merits and demerits; Important biological control projects undertaken in India against insect pests and weeds. Autocidal control

- Sterile male technique and other methods, Chemo sterilants, methods of sterilisation, application advantages and disadvantages. Examples; Pheromonal control – Mode of application, pest management with pheromones. Advantages and disadvantages. Examples;

Insect growth regulators (IGRS), Insect growth hormones and mimics (brief account).

Insect repellents – Definition, features of good repellents, types, applications in pest management, advantages and disadvantages, examples. Insect antifeedants – definition, applications, advantages, disadvantages, examples.

Microbial control of crop pests by employing bacteria virus and fungi. Mode of action, applications and examples; Insect attractants – definition, types, application in pest management. Advantages and disadvantages and examples.

Pest management – concepts, definition, characteristics, pest management strategies and techniques Integrated pest management – definition, IPM in agro ecosystem, Preventive practice, therapeutic practice, guidelines for developing IPM. IPM of rice; Ecological backlash and its management (resistance of population to pest management tactics, Pest population resurgence and replacement, genetic physical and biochemical mechanisms, microbial and environmental degradation of pesticides.

Module IV. Chemical Control

Insecticide formulations, Insecticide appliances and applications; Classification of insecticides – based on mode of entry, mode of action, chemical nature, toxicity.

Chemistry and mode of action of insecticides; Inorganic compounds as insecticides - Arsenic, fluoride and sulphur compounds; Synthetic organic insecticides - Organochlorine compounds (DDT, BHC, Endosulfan–heptachlor, dieldrin).

Organo phosphorous insecticides – monocrotophos, tetra ethyl pyrophosphate, parathion, carbamates – carbaryl, carbofuran.

Botanical insecticides – chemical properties, mode of action and toxicity. (nicotine, rotenone, pyrethrum and neem; Ethnobotanical traditions. Synthetic pyrethroids – definition, uses as insecticides, mode of action (pyrethrin, allethrin).

Fumigants – definition, examples, methods of fumigation, hazards, precautions, advantages; Insecticide synergists – definition, types of synergism, mode of action and examples; Pesticide impact on wildlife and human health.

Module V. Vectors of Domestic Animals and Man

Insect vectors of human diseases belonging to diptera, anoplura, Syphonoptera (self study systematic and biology); Identification, nature of attack, and control measures of insect pest of domestic animals – cattle, sheep and goat, fowl, dog.Acarina – Morphology, biology and control measures.

Module VI. Mode of Transmission and Epidemiology of Vector Borne Diseases

Malaria, Filariasis, Yellow Fever, Dengu Fever, West Nile Disease, Chickungunia, Encephalitis, Kala-azar, Plague, Typhus, Kyasanur Forest Disease, Scabies – control of vectors.Vector control measures.

Module VII. Beneficial Insects

Biology and rearing of Honey bees, Silk worm, lac insect; Insects of forensic importance – crime detection using entomological science. Examples of forensically important insects; DNA techniques in forensic entomology.

Module VIII. Insect Host Interactions

Selection of hosts (plants and animals); Evolution of phytophagy and haematophagy in insects; Insect host resistance; Insect pollinator – plant interaction. Modern findings.

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Thacker, J.R.M. 2002. An Introduction to Arthropod Pest Control. Cambridge University Press, UK Wall, Richard and Sheares, David.1998. Veterinary Entomology. Chapman and Hall.

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Pradhan, S.1969. Insect Pests of Crops. National Book Trust of India, New Delhi.

PRACTICAL - I MORPHOLOGY, ANATOMY AND TAXONOMY

Study of mouthparts in insects (Grasshopper,plantbug,mosquito,honeybee, house fly) Study of different types of antennae, genitalia and legs.

Sting apparatus –honeybee

Wings and wing venation in insects of 5 orders. Study of sexual dimorphism in insects

Preparation of dichotomous keys with reference to various insect orders

Dissection of alimentary canal and associated glands of different insects (plant bug,honey bee,oryctes, grasshopper.

Dissection of nervous system in different insects (plantbug,honeybee,oryctes, grasshopper) Dissection of reproductive system in insects (cockroach,oryctes ,grasshopper, Plant bug) Dissection of stomatogastric nervous system –cockroach

Collection and preservation of insects (students are required to submit an insect collection belonging to 50 families-dry collection, wet collection, whole mounts and slides) at the time of practical examination.

Field Study Report:

Visit to two institutions engaged in entomology research and different ecological niches other than local area for collection of insects. The field study is for 3-4 days. Report the study conducted and submit a 10 page write up/ print out giving the dates, daywise itinerary, methodology, results and references. Include photgraphs of the activities. Group and individual assignments shall be preferred.

PRACTICAL - II INSECT PHYSIOLOGY AND APPLIED ENTOMOLOGY

Survey of digestive enzymes -amylase, invertase, protease and lipase in different parts of the gut in cockroach, grasshopper, dragonfly

Dye transport by Malpighian tubule using dyes

Identification of free aminoacids (at least 3) in haemolymph by paper chromatography. Haemocytes – staining and identification.

Collection and identification of insect pests of different crop plants, fruit trees, vegetables and stored products

Collection and identification of insect vectors of man and domestic animals.

Collection and preservation of economically important insects, their life stages, products, damaged parts.

Collection and identification of insect damages to crop plants. Insecticide appliances.

Determination of LC50 using probit analysis.

Collection – Students are expected to submit a collection consisting of insect pest of different crops, stored products, domestic animals and man. Useful insects, their life stages and products, parasites and predators

ELECTIVE 3: MEDICAL MICROBIOLOGY

GENERAL MICROBIOLOGY AND PARASITOLOGY

Module 1. Historical Introduction to Microbiology History, scope, relevance and future of microbiology.

Module II . Nomenclature and Identification of Bacteria . Identification and nomenclature of bacteria - common biochemical tests for the identification.

Serological identification. Classification of bacteria and salient features according to Bergey's manual of determinative Bacteriology. Microbial diversity in different ecosystems (halophiles, mesophiles,

thermophiles, acidophiles, alkalophiles, barophiles and other extremophiles). Identification and classification using molecular techniques.

Module III. Sterilization and Control of Microbial Growth

Control of microorganisms by physical methods: heat, filtration and radiation; Sterilization equipments: Hot air oven and Pasteurization, Tyndallization.

Autoclaves- principles, precautions and applications; Filtration- types and methods Sterilization by radiation.

Chemical methods: phenolics, alcohols, halogens, heavy metals, quartenary ammonium compounds, aldehydes and sterilizing gases; Disinfectants and their mechanisms of action.

Evaluation of antimicrobial agent effectiveness. Antibiotics- types, mechanism of action. Determination of MIC and MBC

Antibiotic sensitivity tests, antibiogram. Antimicrobial agents (bacterial, viral and fungal).

Module IV. Microbial Growth and Cultivation of Bacteria

Growth and nutritional requirements of bacteria. Autotrophs, heterotrophs - enrichment culture - growth curve - Kinetics of Growth - Mathematical expression of exponential growth phase; Measurement of growth and growth yields - Culture media, culture methods; Batch Culture - Synchronous growth - Techniques of pure culture.

Module V. Study of Morphology of Bacteria Microscopy, different types of microscopy.

Morphology and arrangement of bacteria, ultrastucture of bacteria. Cellular components of bacteria - sporulation and its mechanics.

Staining: Principle and Methods. Simple Staining and Differential staining, Common differential staining - Gram staining, Acid –fast staining (Ziehl-Neilson Method), Staining of Specific Structures, Spore staining (Schaeffer-Fulton Method), Capsule staining, staining of volutin granules, Negative staining.

Examination of bacterial motility.

Epidemiology of bacterial infections, Guidelines for the collection, Transport, Processing analysis, isolation of bacterial pathogens and reporting of cultures from specimens for bacterial infections.

Module VI. Microbiology of Water, Milk and Food Substances

Microbial contamination of water- types, sources, threats. Microbial contamination of milk. Food poisoning. Major food borne diseases. Methods of detection of mirobial contamination of food, water and milk. Microbial standards of drinking water.

Module VII. Parasites and Vectors

Study of Parasites- parasitism, types, origin and theories.

Structure and life cycle of the following parasites and pathogenesis of diseases caused: Also study their laboratory diagnosis, treatment and prevention, antiparasitic agents and susceptibility test (of each). Protozoan parasites-Entamoeba histolytica, Plasmodium sp., Lieshmania, Trypanosoma, Trichomonas, Giardia.

Taenia; Trematodes: Schistosoma; Paragonimus;

Helminthes – Ascaris lumbricoides, Hook Worm, Pin worm, Filarial Parasites.

Arthropod vectors of medical importance: defenition, types, importance. Major vector borne diseases and their pathogens.

A brief study of the following insects, the major diseases they transmit, epidemiology of such diseases, control and preventive measures:

Mosquito, Sand fly, House fly, Tse-Tse fly, Fleas, Louse, Bed bug, Ticks, Mites

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Ross, N.E. and J.D.Mclaren (eds). 1986. Pathophysiological Responses to Parasites. British Society for parasitology, London.

BACTERIOLOGY, VIROLOGY AND MYCOLOGY Module I. Pathogenesis Mechanism of pathogenesis- bacterial and viral. Prophylaxis of communicable diseases.

Module II. Pathogenic Bacteria Study of important properties, pathogenicity and laboratory identification of: Staphylococci, Streptococci,

Pneumococcus, Corynebacterium diphtheriae, Bacillus anthracis, Clostridium Neisseria, E.coli,

Proteus, Klebsiella, Shigella and Salmonella. Vibrio, Pseudomonas, Haemophilus, Brucella.

Study of important properties, pathogenicity and laboratory identification of: Mycobacterium, Treponema, Leptospira, Yersinia, Bordetella, Mycoplasma, Actinomycetes, Rickettsiae and Chlamydiae A brief study of bacteria viz. Borrelia, Listeria, Campylobacter, Helicobacter and Legionella.

Module III. Bacterial Infections of Human Body

Bacterial infections of respiratory tract, Bacterial infections of gastro intestinal tract and food poisoning, Bacterial urinary tract infections, Bacterial infections of genital tract and reproductive organs, Bacterial infections of central nervous system, Skin and soft tissue infections, Bone and joint infections, Eye ear and sinus infections, Cardiovascular infections, Tissue samples for culture, Anaerobic infections, Zoonotic infections.

Infections associated with immunodeficiency and immune suppression, Pyrexia of unknown origin.

Module IV. Virology

Study of properties of viruses viz., Alpha virus, Pox, Herpes Virus, Adeno, Orthomyxo virus, Paramyxo virus and Papova. Pathogenesis and laboratory diagnosis of diseases caused by these viruses.

Sudy of properties of viruses viz. Polio, Influenza, Rabies, and Rubella viruses, Hepatitis viruses, HIV and AIDS.

Pathogenesis of these viral diseases

Oncogenic viruses, Slow viruses and Prion diseases Immunology of viral infections

Module V. Control of Viruses and Emerging Viruses

Control of viral infections through vaccines, interferons and chemotherapeutic agents.

Structure, genomic organization, pathogenesis and control of Human immunodeficiency virus.

Emerging viruses

Module VI. Bacteriophages Structure and life cycle patterns of T-even phages; one step growth curve and burst size; Bacteriophage typing; Structure of Cyanophages, Mycophages. General principles of phage-bacterium interaction and growth cycle studies of RNA and DNA phages. The biochemistry of phages infected bacterium. Phage genetics.

Module VII. Mycology

Introduction, Classification of fungi, General techniques used in mycology. Cultivation of fungi, Staining of fungi.

Mycosis in man-Classification, pathogenesis and clinical findings in various superficial, cutaneous and systemic fungal infections. Oppurtunistic mycoses;Immuno compromised situation and mycological infections; emerging diseases. Antifungal agents (specific to disease to included in course) and their susceptibility test.

REFERENCES

Ananthanarayan and Jayaram Panicker. 2002. Text Book of Microbiology. Orient Longman. Belsche, R.B., 1991. Text Book of Human Virology (2nd edn.). Mosby, St.Louis.

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Szaniszlo, P.J. (edn) 1985. Fungal Dimorphism; with Emphasis on Fungi Pathogenic for Humans.

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Topley W.W.C. and G. Wilson. 2002. Principles of Bacteriology, Virology and Immunity. Systematic Bacteriology: (8th edn.). BWW Publishers.

White, D.C. and F.J. Fenner. 2004. Medical Virology. (4rdedn.) Academic Press, New York.

CLINICAL MICROBIOLOGY

Module I. Introduction

History of development of Medical Microbiology, Contributions made by eminent scientists. Safety in Clinical Microbiology laboratory. Good laboratory practices. Microbiological safety cabinets-Types. WHO safe code of practice for a clinical microbiology laboratory.

Module II. Epidemiology

Factors predisposing to microbial pathogenicity Infections. Sources of infections. Mode of transmission of infections, nosocomial infections, opportunistic infections, Normal microflora of human body. Identification of pathogens- cultural, biochemical, serological and molecular methods. Module III. Laboratory Procedures for Microbiology

Collection, transport, processing and microbiological examination of Blood, Sputum, stool, urine, Cerebrospinal fluid, genital specimens, throat and mouth specimens, nasopharyngeal swabs and aspirates, ear discharges, eye specimens, pus from wounds, abcesses, burns and sinuses, and effusions.

Module IV. Diagnosis of Viral Diseases

Laboratory Diagnosis of Viral diseases

Specimens for viral diagnosis, Viral isolation and growth, Cell culture for viral detection

Detection of viral proteins, Detection of viral genetic material, Viral serology

Module V. Diagnosis of Fungal Diseases

Laboratory diagnosis of fungal diseases.

Diagnostic procedures, Superficial, Cutaneous and Systemic mycosis.

Module VI. Laboratory Studies of Parasites

Laboratory methods for diagnosis of parasitic infections.

Identification of animal parasites, Collection of specimens for the detection of parasites

Intestinal protozoans, Blood protozoans, intestinal helminthes, blood helminthes

Module VII. Handling of Laboratory Animals

Care and management of laboratory animals. Legal requirements for animal experiments. General aspects of organization of animal experiments- Preparation of animals, common experimental procedures, Humane methods of killing animals. Handling of common laboratory animals: Rabbit, guinea-pig, mouse and rat.

REFERENCES

Baron E.J, L.R.Peterson and S.M. Finegold.1994. Bailey and Scott's Diagnostic Microbiology.ASM, Washington,DC

Cowan, S.T. and K.J.Steel.1985. Manual for the Identification of Medical Bacteria. Cambridge University Press, London.

D.C. Kloss, W.E., and T.L. Bannermann.1995. ..Manual of Clinical Microbiology (6th edn.), American Society for Microbiology, Washington,USA

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Mackie and Mccartney, 2008. Practical Medical Microbiology (14th edn). Churchill Livingstone, UK.

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P.R.Murray, E.J.Baron, M, Patrick R. M, K.S.Rosenthal, G.S. Koayashi and M.A.Ptaller, 1997. Medical

Microbiology.

Sherris Jc., 1990. Medical Microbiology, An Introduction to Infectious Diseases. Ed.2. New York.

PRACTICAL I - GENERAL MICROBIOLOGY,

PARASITOLOGY AND MYCOLOGY

Preparation of stains and various staining methods

Simple Staining, gram's staining, Acid fast staining, Albert's staining Sterilization-various Techniques: Autoclave, Hot air oven; Laminar flow chamber

Disposalof contaminated materials and Laboratory refuse. Preparation of Antibiotic disc

Antibiotic sensitivity test-Kirby Bauer test and Tube dilution Method Estimation of MIC

Test for Beta Lactamase. Testing of disinfectants

Bacteriological test for water, air and food. Examination of faces for: Amoeba and cyst Eggs,larva and adult helminthes

Examination of blood for plasmodium and Filariasis. Collection of Specimen for Fungi Preparation of special medium.

Inoculation, Incubation and Identification of Fungi-Candida albicans. Slide culture Techniques.

PRACTICAL 2 - BACTERIOLOGY, VIROLOGY AND

CLINICAL MICROBIOLOGY

Study of Morphological, cultural and Biochemical reactions of following organisms.

Staphylococcus aureus, Streptococcus Species, E.coli, Klebsiella, Proteus, Salmonella Schigella, Pseudomonas.

Slide agglutination

Anaerobic culture methods; Mcintosh Method

Slide Identification

Neisseria gonoerrhoea, Mycobacterium, Tuberculosis, Mycobacterium leprae, Clostridium botulinum, C.tetani.

Viral Haemagglutination

Heamagglutination Inhibition test

Precipitation of serum and preservation for short and long term.

Widal test.

Immonodiffusion.

Various antigen-antibody reactions

Agglutination, Precipitation, Complement fixation, Passive Haemagglutination- latex agglutination test

(RA,ASO,CRP AND TRUST ANTIGEN)

ELISA

Field Study Report: (Three to four days)

1. Visit to Institutions engaged in microbiology/virology research (e.g., Vector Control Research Institute, Cherthala/ Virology Institute, Alapuzha/ Sree Chithra Institute, Thiruvananthapuram) ; 2. hospital with Pathology laboratory (e.g., Government Medical College Hospital), 3. Visit a polluted area and document microbial diversity. Report the study conducted and submit a 10 page write up/ print out giving the dates, daywise itinerary, methodology, results and references. Include photgraphs of the activity.

Group and individual assignments shall be preferred.