**THIRUVALLUVAR UNIVERSITY**

**MASTER OF SCIENCE**

(With effect from 2020– 2021)

**M.Sc. (BIO CHEMISTRY)**

**COURSE OUTCOMES:**

1. Be able to design and Contact Scientific experiments and analyzing the resulting data.
2. Able to work as a member of team.
3. Be knowledge in classical laboratory techniques and be able to use modern instrumentation.
4. Knowledgable of ethical practicals in science.
5. Be able to access search and use the chemical literature.

Target suills for lead scientific anticles & critical understanding of the contacts. Spouen & written presentation of scientific tapics & research results.

**PROGRAMME SPECIFIC OUTCOME**

1. Acquire knowledge and skills to undertake a career in research in an academic setup.
2. Apply the knowledge of experimental approaches to save problems of a chemical nature & ability to entered that knowledge to the solution.
3. Drug development and synthesize the knowledge & apply the same for multitude of laboratory applications.
4. Understand and apply the concepts of life Sources, empower the technical knowledge know & practical hands-on braining in the field.
5. Its academic, research, industrial & pharmaceutical applications.

**PROGRAMME OUTCOME**

1. The students achieved for best computational performance in a specific context.
2. They cultivate the highest level of learning and technological key outcomes.
3. We were choose social welfare oriented skill based subject and its applications in biology, helps to the students & social welfare.
4. We were organizing many extension activities live internship programme, industrial visit, hands on training workshop, project oriented instrumentation programmes. It exposes the students for job opportunity and individual talents.
5. These competence of a course possess upon achieved for course specific goals

**The Course of Study and the Scheme of Examination**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Sl.***  ***No.*** | ***Study Components*** | | | ***ins. hrs / week*** | ***Credit*** | ***Title of the Paper*** | ***Maximum Marks*** | | |
| ***Course Title*** | | | ***CIA*** | ***Uni. Exam*** | ***Total*** |
| **SEMESTER I** | | | | | |  |
|  | Core Theory | Paper-1 | | 5 | 4 | Advances in cell biology | 25 | 75 | 100 |
|  | Core Theory | Paper-2 | | 5 | 4 | Chemistry of Biomolecules | 25 | 75 | 100 |
|  | Core Theory | Paper-3 | | 5 | 3 | Human physiology | 25 | 75 | 100 |
|  | Core Practical | Paper-1 | | 4 | - | Isolation and characterization techniques and quantitative analysis. | - | - | - |
|  | Core Practical | Paper-2 | | 5 | - | Molecular biology and microbial techniques | - | - | - |
| **Internal Elective for same major students** | | | | | | | | | |
|  | Core Elective | Paper-1 | | 3 | 3 | **(to choose one out of 3)**  A. Pharmaceutical Biochemistry  B. Plant Biochemistry  C. Cancer Biology | 25 | 75 | 100 |
| **External Elective for other major students (Inter/multi disciplinary papers)** | | | | | | | | | |
|  | Open Elective | Paper-1 | | 3 | 3 | **(to choose one out of 3)**  A. Bioinstrumentation  B. Developmental Biology  C. Nanoscience and Technology | 25 | 75 | 100 |
|  |  |  | | **30** | **17** |  | **125** | **375** | **500** |
|  | | | | | | | | | |
| **SEMESTER II** | | | | | | | ***CIA*** | ***Uni. Exam*** | ***Total*** |
|  | Core Theory | Paper-4 | | 4 | 4 | Analytical Biochemistry | 25 | 75 | 100 |
|  | Core Theory | Paper-5 | | 4 | 4 | Molecular Biology | 25 | 75 | 100 |
|  | Core Theory | Paper-6 | | 4 | 4 | Metabolic Regulation and Disorders | 25 | 75 | 100 |
|  | Core Practical | Paper-1 | | 4 | 3 | Isolation ,Characterization Techniques and Quantitative Analysis, | 25 | 75 | 100 |
|  | Core Practical | Paper-2 | | 4 | 3 | Molecular Biology and Microbiology Practical | 25 | 75 | 100 |
| **Internal Elective For Same Major Students** | | | | | | | | | |
|  | Core Elective | Paper-2 | | 4 | 3 | **(to choose one out of 3)**  A. Microbiology  B. Bioinformatics  C.Biochemical and Environmental Toxicology | 25 | 75 | 100 |
| **External Elective for other major students (Inter/multi disciplinary papers)** | | | | | | | | | |
|  | Open Elective | Paper-2 | | 4 | 3 | **(to choose one out of 3)**  A. Herbal Medicine  B. Herbal Drug Development  C. Organic Farming | 25 | 75 | 100 |
|  | \*Field Study |  | | - | 2 | Summer internship/PG Service learning/Experiential learning/industrial visit | 100 | - | 100 |
|  | Compulsory Paper | | | 2 | 2 | **Human Rights** | 25 | 75 | 100 |
|  |  |  | | **30** | **28** |  | **300** | **600** | **900** |
|  | | | | | | | | | |
| **SEMESTER III** | | | | | | | ***CIA*** | ***Uni. Exam*** | ***Total*** |
|  | Core Theory | Paper-7 | | 5 | 4 | Molecular endocrinology | 25 | 75 | 100 |
|  | Core Theory | Paper-8 | | 5 | 4 | Enzyme technology | 25 | 75 | 100 |
|  | Core Theory | Paper-9 | | 4 | 4 | Biotechnology | 25 | 75 | 100 |
|  | Core Practical | Paper-3 | | 5 | -- | Enzymology and clinical diagnostics | - | - | - |
|  | Core Practical | Paper-4 | | 5 | -- | Haematological methods and urine analysis | - | - | - |
| **Internal Elective for same major students** | | | | | | | | | |
|  | Core Elective | Paper-3 | | 3 | 3 | **(to choose one out of 3)**  A .Phytomedicine  B. Genetic engineering  C. Diagnostic biochemistry | 25 | 75 | 100 |
| **External Elective for other major students (Inter/multi disciplinary papers)** | | | | | | | | | |
|  | Open Elective | Paper-3 | | 3 | 3 | **(to choose one out of 3)**  A. Mushroom cultivation  B. Methods in food preservation  C. Human physiology and nutrition. | 25 | 75 | 100 |
|  | \*\*MOOC Courses |  | | - | - | NPTEL/Spoken tutorial /MSME course | 25 | 75 | 100 |
|  |  |  | | **30** | **20** |  | **150** | **450** | **600** |
|  | | | | | | | | | |
| **SEMESTER IV** | | | | | | | ***CIA*** | ***Uni. Exam*** | ***Total*** |
|  | Core Theory | Paper-10 | | 5 | 4 | Research Methodology | 25 | 75 | 100 |
|  | Core Theory | Paper-11 | | 4 | 4 | Advanced clinical biochemistry | 25 | 75 | 100 |
|  | Core Practical | Paper-3 | | 5 | 3 | Enzymology and clinical diagnostics | 25 | 75 | 100 |
|  | Core Practical | Paper-4 | | 5 | 3 | Haematological methods and urine analysis | 25 | 75 | 100 |
|  | Core | Project | | 5 | 5 | Project with *viva voce (*Compulsory) | 100  (75 Project +25 viva) | | 100 |
| **Internal Elective for same major students** | | | | | | | | | |
|  | Core Elective | | Paper-4 | 3 | 3 | **(to choose one out of 3)**  A. Bioinformatics  B. Nanobiotechnology  C. Stem cell technology | 25 | 75 | 100 |
| External Elective for other major students (Inter/multi disciplinary papers) | | | | | | | | | |
|  | Open Elective | | Paper-4 | 3 | 3 | **(to choose one out of 3)**  A. Evolutionary biology  B. Bioremediation  C.Life science – Disease and prevention. | 25 | 75 | 100 |
|  |  | |  | **30** | **25** |  | **150** | **450** | **700** |
|  |  | |  | **120** | **90** |  |  |  | **2700** |
|  | | | | | | | | | |

**\* Field Study**

There will be field study which is compulsory in the first semester of all PG courses with 2 credits. This field study should be related to the subject concerned with social impact. Field and Topic should be registred by the students in the first semester of their study along with the name of a mentor before the end of the month of August. The report with problem identification and proposed solution should be written in not less than 25 pages in a standard format and it should be submitted at the end of second semester. The period for undergoing the field study is 30 hours beyond the instructional hours of the respective programme. Students shall consult their mentors within campus and experts outside the campus for selecting the field and topic of the field study. The following members may be nominated for confirming the topic and evaluating the field study report.

(i). Head of the respective department

(ii). Mentor

(iii). One faculty from other department

\*\***Mooc Courses**

Inclusion of the Massive Open Online Courses (MOOCs) with zero credits available on SWAYAM, NPTEL and other such portals approved by the University Authorities.

**SEMESTER III**

**PAPER -7**

**MOLECULAR ENDOCRINOLOGY.**

**Course objective**

* To impart knowledge on molecular mechanism and Endocrine system.
* To provide knowledge on hormonal action and metabolic functions.
* To create awareness on hormonal imbalance and regulations.
* To impart basic knowledge on hormone cascade system.
* To develop sound knowledge on steroids and its importance.

**UNIT-I : CLASSIFICATION AND MECHANISM**

Hormones - definition, classification based on receptors, hormone cascade system involving CNS, hypothalamus, anterior pituitary, target gland, feedback mechanisms, classification of hormones (polypeptides, glycoproteins and POMC peptides), genes and formation of polypeptide hormones - POMC peptides and vasopressin, insulin, Parathyroid.

**UNIT-II : AMINO ACID DERIVED HORMONES**

Synthesis of amino acid derived hormones-epinephrine and thyroxine, inactivation and degradation of hormones, signal transduction and second messengers - adenylate cyclase system, cAMP, adrenalin and glycogen degradation. G-protein as cellular transducer, inositol triphosphate and calcium release, glycogen phosphorylase kinase, DAG and protein kinase C-pathway.

**UNIT-III : CYCLIC HORMONAL CASCADE SYSTEM AND PROTEIN KINASES**

Cyclic hormonal cascade system - chronotropic control, melatonin and serotonin - light and dark cycle, ovarian cycle and role of hormones, hormone - receptor interactions, multiple hormone subunits Sactchard analysis, structure beta -adrenergic receptor and insulin receptor, internalization of receptors, intracellular action - protein kinases, insulin receptor - transduction through tyrosine kinase, vasopressin - protein kinase A, GnRH-protein kinase C, atrial natriuretic factor - protein kinase G.

**UNIT-IV : HORMONE RECEPTORS AND REGULATION**

Steroid hormone receptors, intracellular protein receptors, structural organization of receptor protein, hormone binding domain, antigenic domain and DNA binding domain, organizations of functional elements - hormone response elements, positive and negative transcriptional effects of S.R, receptor activation - upregulation and down regulation, apoptosis - steroid hormone action at cell level, multiple endocrine neoplasia - different types.

**UNIT-V : STEROID HORMONES**

Structure, biosynthesis, transport of steroid hormones in blood and metabolic inactivation of steroid hormones, control of synthesis and release of steroid hormones, Hormones that directly stimulate synthesis and release of steroid hormone with reference to the second messengers and the signal pathway (cortisol, aldosterone, testosterone, 17B - estradiol, progesterone and calcitriol)

**Text Books**

* Textbook of biochemistry (with clinical correlation) by Devlin, Wiley-Liss; 6 edition (2005) .
* Wilson and Foster,” *Endocrinology”*, 4th edition, W.B. Saunders Co, 2005.
* Textbook of endocrinology by Wilson and Foster, W.B. Saunders Co.
* Lohar, S.Prakasa, *Endocrinology- Hormones & human health,* MJP Publishers, 2006.

**Reference Books**

* R.K. Murray et al. “*Harper’s Biochemistry”,* 27 edition, McGraw-Hill Medical, 2006.
* Austin and Short,prema Jaypee brothers, “*Mechanism of hormone action”*, 3rd edition, 2005.
* Sembulingam.K and Sembulingam, “*Essential of Medical Physiology”,* 4th Edition, *P*rema Jaypee brothers, Delhi, 2006.

**E- Resources**

* https://www.elsevier.com/books/molecular-endocrinology/bolander/978-0-12-111232-5
* https://www.amazon.in/Molecular-Endocrinology-Franklyn-Bolander-ebook/dp/ B01D4CI1AQ
* https://www.amazon.in/Molecular-Endocrinology-Human-Genetics-ebook/dp /B01E3EUF8U
* https://www.kobo.com/us/en/ebook/molecular-endocrinology-1
* https://www.ebooks.com/en-ao/297039/molecular-endocrinology/franklyn-f-bolander/

**Course outcomes:**

**After studied unit – 1, the student will be able to**

* Familiar with classification of hormone cascade system.
* Well versed with basic hormonal action and classification.
* Knowledgeable on cyclic hormone cascade system.
* Aware of Hormone regulations and Insulin.
* Well versed on pituitary hormones and its roles.

1. **After studied unit – 2, the student will be able to**

* Familiar with thyroid hormones .
* Well versed with signal transduction.
* Knowledgeable on G protein.
* Aware of Hormone regulations.
* Well versed on secondary messengers.

1. **After studied unit – 3, the student will be able to**

* Familiar with cyclic hormone casade system .
* Well versed with ovarian cycle.
* Knowledgeable on Scatchard analysis.
* Aware of protein kinase enzyme regulations.
* Well versed on light and dark cycle.

1. **After studied unit – 4, the student will be able to**

* Familiar with hormone receptor system.
* Well versed with receptor proteins.
* Knowledgeable on up regulation and down regulation.
* Aware of multiple endocrine neoplasia.
* Well versed on hormone response.

1. **After studied unit – 5, the student will be able to**

* Familiar with steroid hormones structure and classification.
* Well versed with signal transduction.
* Knowledgeable on second messengers.
* Aware of steroid Hormone regulations.
* Well versed on synthesis and release of calcitriol.

**PAPER - 8**

**ENZYME TECHNOLOGY**

**Course objective**

* To impart knowledge on classification and active sites of enzymes.
* To provide knowledge on enzyme kinetics.
* To create awareness on role of inhibitors and catalytic enzymes.
* To impart basic knowledge on coenzymes and isoenzymes.
* To develop sound knowledge on Industrial and clinical enzymology.

**UNIT**-**I : CLASSIFICATION, PURIFICATION AND ACTIVE SITE**

Nomenclature and classification of enzymes, isolation and purification of enzymes – enzymeprotein determination by different methods, criteria of purity - specific activity.Enzyme units - Katal, IU. Measurement of enzyme activity - two point assay, kinetic assay, using radiolabelled substrates. Active site - determination of active site amino acids - chemical probe, affinity label, and site-directed mutagenesis, intrinsic and extrinsic regulations.Investigation of 3-D structure of active site.A brief account of nonprotein enzymes - ribozymes and DNA enzymes.

**UNIT-II : ENZYME KINETICS**

Kinetics of single substrate enzyme - catalysed reactions - Michaelis - Menten equation, importance of Vmax, Km, MM equation, and turnover number; Lineweaver - Burk plot, Eadie - Hofstee plot, and Hanes - Woolf plot .

Presteady - state kinetics and relaxation kinetics.Kinetics of Allosteric enzymes - MWC and KNF models Hill’ equation coefficient. Kinetics of multi - substrate enzyme - catalysed reactions - Ping-pong bi-bi, random order and compulsory order mechanism.

**UNIT**-**III : ENZYME CATALYSIS AND INHIBITION**

Mechanism of enzymicaction , mechanism of serine proteases - chymotrypsin, lvsozyme, carboxy peptidase A and ribonuclease.

Reversible inhibition - competitive, uncompetitive, noncompetitive, mixed, substrate and allosteric inhibition.Irreversible inhibition.

**UNIT-IV : COENZYMES AND ISOENZYMES**

Coenzymes - prosthetic group, classification - vitamin and nonvitamin coenzymes, thiamine pyrophosphate - mechanism of oxidative and nonoxidative decarboxylation, transketolase reaction, PALP and PAMP - role of PALP in transamination and decarboxylation reaction, folate coenzymes and vitamin C, metabolite and nonvitamin coenzymes, lipoic acid, coenzyme Q, nucleoside triphosphate and S-adenosyl methionine. Isoenzymes.

**UNIT-V : INDUSTRIAL AND CLINICAL USES OF ENZYMES**

Industrial uses of enzymes - sources of industrial enzymes, thermophilic enzymes, amylases, glucose isomerases, cellulose degrading enzymes, lipases, proteolytic enzymes in meat and leather industry, detergents and cheesed production.

Clinical enzymology - Enzymes as thromblytic agents, anti-inflammatory agents.Immobilization of enzymes and their applications.

**Text books**

* Trevor Palmer, Philip Bonner *Enzymes: Biochemistry, Biotechnology, Clinical Chemistry* 2nd edition, Horwood Publishing Limited, 2007
* Dixon and Webb, *Enzymes*, 3rd edition, Academic Press, New York, 2000.
* Understanding enzymes - Palmer. Prentice Hall; 4 Sub edition, 1995
* Enzymes - Boyer. Academic Press; 3rd edition, November 1983
* Biochemistry - Metzler. Academic Press, 2000.
* Champe P.C and Richard A Harvey, *Lippincotts Biochemistry,* Williams & Wilkins Publishers, 2004

**Reference books**

* E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, *A Text Book of Biochemistry,* 4th edition*,* Oxford and IBH Publishing Co., New Delhi, 2000
* Nicholas C. Price, Lewis Stevens, and Lewis Stevens, *Fundamentals of Enzymology: the Cell and Molecular Biology of Catalytic Proteins*, 3rd edition, Oxford University Press, USA, 2000.
* David L. Nelson Michael M. Cox Lehninger *Principles of Biochemistry*, W. H. Freeman; 4th edition, 2004
* Biochemistry - Stryer. W. H. Freeman; 6 edition, 2006.

**e- Books**

* <https://storeiyta.firebaseapp.com/.../enzymes-biochemistry-biotechnology-clinical-che.>
* <https://quacktradition4ahz.files.wordpress.com/.../fundamentals-of-enzymology-the-ce.>

**Course outcomes:**

1. **After studied unit – 1, the student will be able to**

* Familiar with classification of enzyme system.
* Well versed with isolation of enzymes and criteria of putiry.
* Knowledgeable on 3D structure of active site.
* Aware of non protein enzymes.

1. **After studied unit – 2, the student will be able to**

* Familiar with Enzyme kinetics .
* Well versed with importance of km and Vmax.
* Knowledgeable on presteady state kinetics.
* Aware of multi order reactions.
* Well versed on sigmoidal kinetics.

1. **After studied unit – 3, the student will be able to**

* Familiar with serine proteases.
* Well versed with chymotrypsin.
* Knowledgeable on mode of action of lysozyme.
* Aware of protease carboxy peptidase.
* Well versed on Inhibitors and inhibition.

1. **After studied unit – 4, the student will be able to**

* Familiar with coenzymes.
* Well versed with classification of coenzymes.
* Knowledgeable on non vitamin coenzymes.
* Aware of coenzyme Q.
* Well versed on Isoenzymes.

1. **After studied unit – 5, the student will be able to**

* Familiar with Industrial uses of enzymes.
* Well versed with thermolytic enzymes.
* Knowledgeable on isomerases.
* Aware of proteolytic enzymes.
* Well versed on clinical enzymology

**PAPER - 9**

**BIOTECHNOLOGY**

**Course objective**

* To impart knowledge on basic tools in genetic engineering.
* To provide knowledge on cloning vectors and DNA sequencing.
* To create awareness on gene transfer and its applications.
* To impart basic knowledge on Industrial biotechnology.
* To develop sound knowledge on Bio safety and bio hazards.
* To develop sound knowledge on Bio safety and bio hazards

**UNIT-I : TOOLS OF GENETIC ENGINEERING**

Basic principles - mechanism of natural gene transfer by Agro bacterium, generation of foreign DNA molecules, restriction enzymes, their types and target sites, cutting and joining DNA molecules, linkers, adapters, homo polymers, enzymes used in genetic engineering, cloning vehicles and their properties, natural plasmids, i*nvitro* vectors, cosmids and T-DNA based hybrid vectors.

**UNIT-II : DNA CLONING AND SEQUENCING**

Cloning strategies - cloning with single strand DNA vectors, cDNA cloning and gene libraries, recombinant selection and screening methods, expression of cloned genes, shuttle vectors, DNA sequencing strategies - Sanger’s and Maxam Gilbert’s methods, PCR-types and applications and DNA hybridization, Southern, Northern and Western blotting.

**UNIT-III : GENE TRANSFER METHODS**

Methods of gene recombination - Bacterial Conjugation, Transformation, Transduction. Gene transfer methods - Microinjection, Electroporation, Microprojectile, Shot Gun method, Ultrasonication, Liposome fusion. Competence, identification of transformed colonies/clones – Blue white screening,

**UNIT-IV : INDUSTRIAL BIOTECHNOLOGY**

Applications of biotechnology-industrial biotechnology-fermentors, principle, types product recovery and purification of ethanol, citric acid, vitamin B 12, streptomycin, enzyme biotechnology-production and uses of industrially important enzymes such as protease.

**UNIT – V APPLICATIONS OF GENETIC ENGINEERING 15 Hrs**

Genetic engineering in animals - Production of transgenic mice, Therapeutic products produced by genetic engineering- plasma proteins, human hormones, Genetic engineering in plants: Use of Agrobacterium tumefaciens and A.rhizogenes, Ti plasmids, Strategies for gene transfer to plant cells – Herbicide resistant, Drought tolerant, pest resistant, salt tolerant transgenic plants and related ethical issues

**OUTCOMES:**

**Upon completion of the course, the student**

* Will be familiar with basics of gene cloning tools.
* Will be well versed with cloning technique and various vectors.
* Will be knowledgeable on gene transfer and its applications.
* Will be aware of industrial biotechnology.
* Will be well versed on controversies of gene cloning and human genome project.

**Text books**

* Satyanarayana U, Biotechnology, 2nd edition, Books & Allied (P) Ltd, 2008.
* Bernard R. Glick, Jack J. Pasternak, and Cheryl L. Patten, Molecular biotechnology: Principles and applications of recombinant DNA, 4th edition, By ASM press. 2010
* Singh. K., “Intellectual property rights on Biotechnology”, Springer, 7th edition, 2015
* R.C.Dubey, A text book of Biotechnology, 5th revised edition, S.Chand Publications, 2014
* Basic Biotechnology - Ratledge & Kristianeen, Cambridge University press 2nd ed.
* Srivastava A K, Singh R K, *Animal biotechnology*, Oxford and IBH Publishers, 2005
* John E Smith, *Biotechnology*, Fifth edition, Cambridge university press, 2009

Reference books

* J. Sambrook, E.F. Fritsch and T. Maniatis, Molecular Cloning: a Laboratory Manual, , 3rd edition, Cold Spring Harbor Laboratory Press, New York, 2000
* Brown, T.A, “Gene Cloning and DNA Analysis- An Introduction, 6th edition, John Wiley & Sons, 2010
* Strickberger. M.W., “Genetics”, 3rd edition, Pearson India, 2015.
* Molecular Biotechnology, 2nd ed - Glick & Pasternak, Panima Publications
* Sambamurthy K, Ashoush Kar, *Pharmaceutical Biotechnology , fundamentals and applications*, New Age international publishers, 2016

**Course outcomes:**

1. **After studied unit – 1, the student will be able to**

* Familiar with gene transfer system.
* Well versed with restriction enzymes.
* Knowledgeable on plasmids and cosmids.
* Aware of hybrid vectors in genetic engineering.

1. **After studied unit – 2, the student will be able to**

* Familiar with cloning technique .
* Well versed with gene library.
* Knowledgeable on DNA sequencing methods.
* Aware of PCR and blotting techniques.

1. **After studied unit – 3, the student will be able to**

* Familiar with Explants.
* Well versed with protoplast fusion.
* Knowledgeable on electroporation.
* Well versed on xenografting.
* Aware of GM foods.

1. **After studied unit – 4, the student will be able to**

* Familiar with fermentors.
* Well versed with purification of vitamin B12.
* Knowledgeable on proteases enzymes.
* Well versed on industrial uses of enzymes.

1. **After studied unit – 5, the student will be able to**

* Familiar with Biowepons
* Well versed with food safety measures.
* Knowledgeable on human genome project.
* Aware of IPR.
* Well versed on pattenting.

**CORE ELECTIVE**

**PAPER - 3**

**(to choose one out of 3)**

**A. PHYTOMEDICINE**

**Course objective**

To provide the acquire knowledge on medicinal use of plants and plant extracts for therapeutic purposes.

**UNIT – I : PHARMACOGNOSY**

Definition and history, Indian systems of medicine - Siddha, ayurvedha, and Unani systems. Taxonomy of locally available medicinal plants, their chemical constituents and medicinal uses - Classification of Crude drugs - Chemistry of Drugs - Future of pharmacognosy.

**UNIT – II : CLASSIFICATION OF MEDICINAL PLANTS**

Vernacular name and family - Geographical source, cultivation, collection, and processing for market and commerce in crude drugs. Morphological and histological studies, chemical constituents - Therapeutic and other pharmaceutical uses. Underground stem - ginger, Alpinia - Roots - Rauolfia - Belladona - Aerial parts - Bark - Cinchona.

**UNIT – III : BIOMEDICAL IMPORTANCE OF MEDICINAL PLANTS**

Leaves - Adathoda, Eucalyptus - Flower - Clove fruits seeds - Nux vomica Nutmegs, Gooseberry - unorganized drugs - Gum - Acacia - Resin - Turpentine, fixed oil - castor oil.

**UNIT – IV : HERBAL MEDICINES FOR HUMAN AILMENTS**

Drugs Acting on Cardiac Diseases, Cerebral Diseases, Nasal diseases - Blood pressure Drugs acting on Nervous system – Depressants, Stimulants. Respiration and Drugs - Urogenital system and drugs - Psychoactive plants.

**UNIT – V : PROPAGATION OF MEDICINAL PLANTS**

Micro and macro propagation, conservation of rare medicinal plants, Role of biotechnology in medicinal plant’s banks,cultivation of medicinal and aromatic plants. Drug adulteration - methods of Drug evaluation. Herbal food - Food processing - packaging - Herbal sale and Export of medicinal plants - marketing - Intellectual property rights - Export laws.

**Text Books :**

**Unit 1 to unit 5:**

1. George Edward Trease and W.C. Evans - Pharmacognosy 12th edition, English Language Books Society, Baelliere Tindall.
2. Handa, S.S. and Kapoor, V.K. Pharamcognosy - 2nd Edition, Vallabh Prakashan Publishers, New Delhi.
3. Indian Medicinal plants - Jain, S.K,1980.
4. Kokate, C.K., Durohit, A.P. and Gokhale, S.R., Pharmacognosy - 12th edition - Nirali Prakasham Publishers, Pune.

**References:**

**Unit 1 to unit 5:**

1. An Introduction to Medical Botany and Pharmacognosy - Kumar N.C., 1993.
2. Indian Materia Medica – Nadkarni, 1981.
3. A text book of Pharmacognosy - Shah, S.C. and Qudary, 1990.
4. Text book of pharmacognosy , 5th edition -Wallis, T.E, CBS publishers and distributors, New Delhi.

**Course outcomes:**

1. **After studied unit – 1, the student will be able to**

* Familiar with Indian system of medicine.
* Well versed with plant toxonamy.
* Knowledgeable on medicinal plants.
* Aware of chemistry of drugs.

1. **After studied unit – 2, the student will be able to**

* Familiar with crude drugs.
* Well versed with Therapeutical drugs.
* Knowledgeable on pharmacology.
* Well versed on root plants.

1. **After studied unit – 3, the student will be able to**

* Familiar with roots and flowers.
* Well versed with nutmegs.
* Knowledgeable on castor oil.
* Well versed on unorganised drugs.

1. **After studied unit – 4, the student will be able to**

* Familiar with cardiac diseases.
* Well versed with cerebral diseases.
* Knowledgeable on drugs on nervous systems.
* Well versed on psychoactive drugs.

1. **After studied unit – 5, the student will be able to**

* Familiar with micro and macro propogations
* Well versed with rare medicinal plants.
* Knowledgeable on aromatic plants.
* Aware of drug adulteration.
* Well versed on pattenting.

**CORE ELECTIVE**

**PAPER - 3**

**B. GENETIC ENGINEERING**

**Course objective :**

* To impart knowledge on basics in genetics and intellectual property rights.
* To provide knowledge on cloning vectors and DNA sequencing.
* To create awareness on DNA enzymes and its applications.
* To impart basic knowledge on DNA in biotechnology.
* To develop sound knowledge on blotting techniques.

**UNIT-I**

Introduction to gene cloning: Early development of Genetics - Gene cloning - Specialized tools and techniques - Importance of gene cloning

Intellectual property rights and types, Patenting, Isolation and Purification of DNA; Preparation of total cell DNA, Plasmid DNA, Bacteriophage DNA, Plant cell DNA.

**UNIT-II**

Cloning And Expression Vectors : Plasmids- Bacteriophages (M13 and λ) PUC vectors yeast vectors, agrobacterium, medicated gene transfer, YAC, BAC, Human artificial chromosomes, Ti plasmid, SV40, baculoviruses, adenoviruses, papilloma viruses and retroviruses.

**UNIT-III**

Multipulation of purified DNA: DNA manipulative enzymes – Nucleases, Ligases, polymerases, Topoisomerases, Restriction enzymes performing restriction digests, Ligation- joining DNA molecules together – Random labeling Nick translation and End filling.

**UNIT-IV**

Introduction to DNA into living cells: Biolistics, Electroporation, Microinjection, Liposome – mediated method and Calcium phosphate method.

**UNIT-V**

Construction of libraries – Studying gene and genome structure – Blotting techniques, PCR, Insitu hybridization, DNA Sequencing, Chromosome Walking and Jumping, DNA foot printing, Restriction analysis of DNA, RFLP, RAPD –Principles, Procedures and Applications.

**Text books :**

**Unit 1 to unit 5:**

1. Molecular cloning, vol. I, II, III, II nd edition, Sambrook J, Fritsch E. F. and Maniatis, 1989 Cold spring harbor laboratory press, New York.
2. DNA Cloning : A practical approach D.M. Glover and D.B. Hames, RL Press, Oxford, 1995.
3. Molecular and cellular methods in Biology and Medicine, P.B. Kaufman, W. Wu , D. Kim and L.J. Cseke, CRC Press Florida, 1995.
4. Methods in Enzymology Guide to Molecular Cloning Techniques, Vol. 152 S.L. Berger and A. R. Kimmel, Academic Press Inc, San Diego, 1996.
5. Methods in Enzymology Gene Expression Technology, Vol. 185D. V. Goedel, Academic Press Inc, San Diego, 1990.

**References:**

**Unit 1 to unit 5:**

* 1. DNA Science: A First Course in Recombinant Technology, D. A. Mickloss and G. A Freyer, Cold Spring Harbor Laboratory Press, New York, 1990.
  2. Molecular Biotechnology, 2nd Ed. S. B. Primrose, Blackwell Scientific publishers, Oxford, 1994.
  3. Milestones in Biotechnology, Classic Papers on Genetic Engineering, J. A. Davis and W. S. Reznikoff, Butterworth-Heinemann Boston, 1992.
  4. Route Maps in Gene Technology, M. R. Walker, and R. Rapley, Blakwell Science, Oxford, 1997.
  5. Genetic Engineering: An Introduction to Gene Analysis and Exploitation in Eukaryotes, S. M. Kingsman, Blackwell Scientific Publications, Oxford, 1998.

**Course outcomes:**

1. **After studied unit – 1, the student will be able to**

* Familiar with gene cloning.
* Well versed with tools and techniques.
* Knowledgeable on isolation and purification of enzymes.
* Aware of isolation of plant cell DNA.

1. **After studied unit – 2, the student will be able to**

* Familiar with cloning vectors.
* Well versed with plasmids.
* Knowledgeable on Ti plasmids.
* Well versed on papilloma viruses.

1. **After studied unit – 3, the student will be able to**

* Familiar with DNA manipulative enzymes.
* Well versed with nucleases.
* Knowledgeable on nick translation.
* Well versed on DNA ligation.

1. **After studied unit – 4, the student will be able to**

* Familiar with basic techniques.
* Well versed with biolistics.
* Knowledgeable on electro poration techniques.
* Well versed on liposome mediated transfer.

1. **After studied unit – 5, the student will be able to**

* Familiar with DNA sequencing.
* Well versed with blotting.
* Knowledgeable on chromosome walking and jumping.
* Aware of DNA foot printing.
* Well versed on DNA analysis.

**CORE ELECTIVE**

**PAPER - 3**

**C. DIAGNOSTIC BIOCHEMISTRY**

**Course objective :**

* To impart knowledge on basics in inborn errors.
* To provide knowledge on enzymology.
* To create awareness on heart disease.
* To impart basic knowledge on anaemia.
* To develop sound knowledge on hormones.

**UNIT - I**

Inborn errors of metabolism - Alkaptonuria, Phenyl ketonuria, Cystinuria, Galactosemia, Fanconi’s syndrome and Albinism.

**UNIT - II**

Plasma enzymes in diagnosis - Functional and non functional plasma enzymes - Isoenzymes. Myocardial Infarction, acute pancreatitis, liver diseases and muscle wasting.

**UNIT - III**

Cholesterol - importance, Lipoproteins - Factor affecting blood cholesterol - Atherosclerosis, Risk factor.

**UNIT - IV**

Iron absorption and excretion - Anemia - classification. Sickle cell anemia and Talassemia .

**UNIT - V**

Hormones - Definition and classification- Thyroid hormone- thyroid function test, male sex hormones and female sex hormone.

**Text books :**

**Unit 1 to unit 5:**

1. Clinical chemistry in Diagnosis & Treatment - P.D. Mayne, ELBS/ Arnold, N.Delhi.

2. Clinical chemistry - W.J. Marshall and S.K. Bangert [1995]

3. Textbooks of medicine - K.V. Krishnedas [1996], Jaypee Brothes.

4. Principles of internal medicine [1998] - Harrison, T.R. Fauci, Branuwalad and Isselbaeher, McGraw Hills.

5. Clinical Biochemistry with clinical correlation - Devin, Wiley.

**References:**

**Unit 1 to unit 5:**

1. Practical clinical biochemistry - Harold Varley, CBS, New Delhi.

2. Medical Laboratory technology - kanai L. Mukherjee, Tata McGraw Hill Publication and Co. ltd., vol. I, II, III.

3. Clinical chemistry in diagnosis and treatment, Joan F. ZilvaA, PR Pannall, Llyods - Luke [medical Books ltd., Lon

4. Biochemistry - U.Sathyanarayana & U. Chakrapani, Third edition, Book and Allied (p) ltd.

5. Text book of medical biochemistry - Fourth edition- MN. Chatterjee, Rana Shine, jaypee Publisher.

**Course outcomes:**

1. **After studied unit – 1, the student will be able to**

* Familiar with Inborn errors.
* Well versed with cysteinuria.
* Knowledgeable on falconi sysndrome.
* Aware of albinism.

1. **After studied unit – 2, the student will be able to**

* Familiar with enzymology.
* Well versed with plasma enzymes.
* Knowledgeable on Isoenzymess.
* Well versed on myocardial infractions.

1. **After studied unit – 3, the student will be able to**

* Familiar with atherosclerosis.
* Well versed with lipoproteins.
* Knowledgeable on risk factors of cholesterol.
* Well versed on lipids.

1. **After studied unit – 4, the student will be able to**

* Familiar with iron absorbtion.
* Well versed with anaemia.
* Knowledgeable on sickle cell anaemia.
* Well versed on talasemia.

1. **After studied unit – 5, the student will be able to**

* Familiar with Endocrine system.
* Well versed definition and classification of enzymes.
* Knowledgeable on thyroid hormones.
* Aware of sex hormones.

**OPEN ELECTIVE**

**PAPER - 3**

**(to choose one out of 3)**

**A. MUSHROOM CULTIVATION**

**Course objective:**

* To impart knowledge on types of mushrooms.
* To provide knowledge on cultivation process.
* To create awareness on edible mushrooms.
* To impart basic knowledge on mushroom storage.
* To develop sound knowledge on mushroom nutritive values and recepies.

**UNIT I: EDIBLE AND NONEDIBLE MUSHROOM**History of mushroom cultivation. Morphology of common edible mushroom, nutritional, medicinal value of mushroom, spawn, types of spawn, spawning. Edible and non-edible mushrooms.

**UNIT II : CASING**Casing raw material used for casing, preparation of casing material, important sanitation during various stages of mushroom cultivation. Mushroom bed preparation and factors affecting mushroom bed preparation.

**UNIT III: CULTIVATION OF MUSHROOM**

Cultivation technology : Infrastructure(Mushroom House) ,equipment and substrates in mushroom cultivation. Mass cultivation of *Agaricusbisporous, Volvariellavolvaceae,* Preparation ofsubstrates (compost), casing, harvesting.

**UNIT IV : STORAGE**Methods of storage of mushrooms.Long term short term storage of mushrooms.National and regional level mushroom research centers in india.

**UNIT V: DISEASES AND RECIPES OF MUSHROOM**

Diseases (Bacterial, fungal, viral and pests) and recipes of mushrooms – soup, omlette, samosa, pickles, curry.

**Text books :**

**Unit 1 to unit 5:**

1. Kanniyan, “Handbook of Edible Mushrooms” TNAU Publication, 4th Edition, (2001).
2. Kale Radha, D, Earthworm: Cinderella of organic farming. Prism Books Pvt. Ltd., Bangalore, 4th Edition, (1998).

**References :**

**Unit 1 to unit 5:**

* + - 1. Changs. T. & W.A. Hayanes, “Biology and cultivation of mushrooms” Acad Press, New York, 5th Edition, (1978).

**Course outcomes:**

**1. After studied unit – 1, the student will be able to**

* Familiar with history of mushrooms.
* Well versed with nutritional values.
* Knowledgeable on medicinal values.
* Aware of types of spawn.
  + - 1. **After studied unit – 2, the student will be able to**
* Familiar with casing.
* Well versed with casing methods.
* Knowledgeable on sanitation methods.
* Well versed on mushroom bed preparation methods.

1. **After studied unit – 3, the student will be able to**

* Familiar with mushroom cultivation technology.
* Well versed with mushroom house.
* Knowledgeable on mass cultivation.
* Well versed on harvesting.

1. **After studied unit – 4, the student will be able to**

* Familiar with basic techniques.
* Well versed with methods of storages.
* Knowledgeable on long term storages .
* Well versed on mushroom research in india.

1. **After studied unit – 5, the student will be able to**

* Familiar with mushroom diseases.
* Well versed with infections.
* Knowledgeable on fungal and pest control.
* Aware of mushroom foods.
* Well versed on mushroom cooking.

**OPEN ELECTIVE**

**PAPER - 3**

**B. METHODS IN FOOD PRESERVATION**

**Course objective:**

* To impart knowledge on basics in food processing.
* To provide knowledge on food preservation process.
* To create awareness on preservation techniques.
* To impart basic knowledge on food drying and storage.

**UNIT 1**

Food processing and preservation principles, method of preservation: pasteurization (definition, time-temperature combination and equipments) sterilization (definition, time-temperature combination and equipments), canning , packaging.

**UNIT 2**

Food Freezing and thawing process: Introduction, freezing point and freezing rate, comparison of Freezing and thawing process; freezing methods: Air freezing, plate freezing, liquid immersion freezing and cryogenic freezing. Freezer selection. Advantages and disadvantages of freezing.

**UNIT 3**

Food Drying/Dehydration: Definition, free and bound moisture, factors affecting drying, moisture content , equilibrium moisture content, Drying methods and equipments: sun/solar drying, Cabinet drying, tunnel dryer, spray dryer, freeze dryer, fluidized bed dryer, Nutritional, physico-chemical changes during drying.

**UNIT 4**

Food Concentration: Evaporation- Definition, types of evaporator (single effect, double effect and multiple effect evaporator); Freeze concentration- General principles and applications.

**UNIT 5**

Membrane Processing: General principles and advantages, dead end and cross flow, Classification of membrane system: Reverse Osmosis, Membrane performance, and Limitation of membrane processes.

**Text Books :**

**Unit 1 to unit 5:**

1. Food Processing: Principles and Applications by Ramaswamy H. & Marcotte M. Taylor & Francis.

2. Food Science by Norman N Potter and Joseph H. Hotchkiss, CBS Publishers and Distributors.

**REFERENCES:**

**Unit 1 to unit 5:**

1. Novel Food Processing Technologies by Barbosa-Canovas, Tapia & Cano CRC Press, 2004.

**Course outcomes:**

**1. After studied unit – 1, the student will be able to**

* Familiar with basic food processing techniques.
* Well versed with methods of food preservation.
* Knowledgeable on pasteurisation.
* Aware of types of packaging.

1. **After studied unit – 2, the student will be able to**

* Familiar with food freezing.
* Well versed with freezing methods.
* Knowledgeable on cryogenic freezing methods.
* Well versed on advantages and disadvantages of freezing methods.

1. **After studied unit – 3, the student will be able to**

* Familiar with food drying.
* Well versed with moisture content.
* Knowledgeable on dryer usage.
* Well versed on dryer types.

1. **After studied unit – 4, the student will be able to**

* Familiar with basic techniques.
* Well versed with evaporation methods.
* Knowledgeable on evaporators and its types.
* Well versed on general applications.

1. **After studied unit – 5, the student will be able to**

* Familiar with membrane processing.
* Well versed with reverse osmosis.
* Knowledgeable on basic techniques.
* Aware of membrane performances.

**OPEN ELECTIVE**

**PAPER - 3**

**C. HUMAN PHYSIOLOGY AND NUTRITION**

**Course objective:**

* To impart knowledge on basics human physiology and nutrition.
* To provide knowledge on food digestion and absortion.
* To create awareness on blood groups and anaemia.
* To impart basic knowledge on BMR and trace elements.

**UNIT-I : DIGESTION, ABSORPTION AND EXCRETION**

Digestive secretions - composition, functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions. Digestion and absorption of carbohydrates, lipids and proteins.

Excretory system - structure of nephron. Formation of urine .

**UNIT-II : BLOOD AND CIRCULATION**

Composition and functions of blood and plasma. Blood groups. Blood coagulation - mechanism, Hemoglobin - structure, abnormal types, anemia. E.C.G (elementary knowledge), blood pressure, spleen, lymph.

**UNIT-III : RESPIRATION AND REPRODUCTION**

Structure of lungs, mechanism and regulation of respiration. Transport of blood gases - O2 and CO2. Acid-base balance - role of buffers, erythrocytes, respiratory system and kidneys.

Structure and function of reproductive organs, physiology of pregnancy, parturition and lactation.

**UNIT-IV : NUTRITION**

Basal metabolism, basal metabolic rate, factors affecting BMR, RQ determination of BMR - direct and indirect method, respiratory quotient. Role of fiber in diet, role of essential amino acids and fatty acids.

**UNIT-V : TRACE ELEMENTS**

Trace elements - macro and micro, daily requirements, functions, deficiency manifestations. Nutrition at different stages of life - during infancy, adolescence, pregnancy and old age.

**Text Books :**

**Unit 1 to unit 5:**

1. Review of Medical Physiology - William. F. Ganong. McGraw-Hill Medical; 22 edition, 2005.
2. Human Physiology and Mechanisms of Disease - Guyton. Saunders Publications; 6th edition, 1996.
3. Human physiology - C.C. Chatterjee. 11th edition, 1985.

**References :**

**Unit 1 to unit 5:**

* + - 1. Human Nutrition and Dietetics - Davidson and Passmore. Churchill Livingstone; 8th edition, 1986.
      2. Principles of Nutrition - M.S.Swaminathan
      3. Modern Nutrition and Health Diseases - M.E. Skilis and V.R. Young .

**Course outcomes:**

**1. After studied unit – 1, the student will be able to**

* Familiar with basic food digestions.
* Well versed with salaiva and bile secretions.
* Knowledgeable on carbohydrates, lipids and proteins.
* Aware of excretory system.

**2. After studied unit – 2, the student will be able to**

* Familiar with blood circulation.
* Well versed with blood grouping.
* Knowledgeable on Hb and anemias.
* Well versed on ECG.

**3. After studied unit – 3, the student will be able to**

* Familiar with respiratory system.
* Well versed with transport of gases.
* Knowledgeable on kidney and formation of urine.
* Well versed on physiology of pregnancy.
  + - 1. **After studied unit – 4, the student will be able to**
* Familiar with basal metabolic rate.
* Well versed with BMR and RQ.
* Knowledgeable on essential fattyacids and aminoacids.
* Well versed on fiber content in diet.

* + - 1. **After studied unit – 5, the student will be able to**
* Familiar with Trace elements.
* Well versed with daily requirements.
* Knowledgeable on diet for adolescence and old people.
* Aware of diet for pregnance.

MOOCS COURSES:

SWAYAM, NPTEL, COURSERA, EDX, UDEMY, LEARN DIGITAL.

1. Cell designing.

2. Sustainable management of Biodiversity.

3. Principles of biotechnology.

4. Principles of seed technology.

5. Genetics and genomics.

6. Food law and standards.

7. Certificate course in environmental biology.

8. Analytical techniques.

9. Applied entomology.

10. Biomass characterisation.

**SEMESTER IV**

**PAPER - 10**

**RESEARCH METHODOLOGY**

**COURSE OBJECTIVES:**

* To impart knowledge on research problem and finding scientific articles with Internet.
* To provide knowledge on collection and analysis of data using statistical tools.
* To create awareness on bioinformatics and biological databases.
* To impart basic knowledge on animal experimentation and intellectual property rights.
* To develop sound knowledge on preparation of research reports.

**UNIT- I: INTRODUCTION TO RESEARCH METHODOLOGY**

Identifying a research problem and searching relevant literature. Boolean Searching. Use of Search Engines. Finding Scientific Articles – Google, PubMed, DELNET, INFLIBNET**.**

Role of Computers in Biology. Evolution of Internet. World Wide Web. Internet Addresses, Internet protocols and Web Browsers.Operating Systems and their types.

**UNIT-II : BIOSTATISTICS**

Collection and classification of data - diagrammatic and graphic representation of data-measurement of central tendency - standard deviation - normal distribution - test of significance based on large samples - small samples - Student t test -correlation and regression - Chi square test for independence of attributes - ANOVA.

**UNIT- III :** **BIOINFORMATICS AND BIOLOGICAL DATABASES**

Bioinformatics – Introduction, Objective, Scope and Applications. Biological databases: Sequence databases – Nucleic acid databases (EMBL, GenBank and DDBJ) and Protein (SWISS-PROT, TrEMBL and PIR); Structure databases – Protein (PDB, SCOP and CATH).

Biological sequence analysis: Alignment – Sequence, Global, Local, Pair-wise and Multiple sequence. Database similarity search tools – BLAST and FASTA.

**UNIT-V : BIOETHICS AND PATENTING**

Ethics in animal experimentation. CPCSEA guidelines - Animal care and technical personnel environment, animal husbandry, feed, bedding, water, sanitation and cleanliness, waste disposal, anesthesia and euthanasia.

Composition of (Human) institutional Ethical Committee (IEC) - General ethical issues. Specific principles for chemical evaluation of drugs, herbal remedies and human genetics research, Ethics in food and drug safety. Environmental release of microorganisms and genetically engineered organisms Ethical issues in human gene therapy and human cloning.

Patenting - definition of patent. Product and process patents. Patenting multi cellular organisms. Patenting and fundamental research.

**RESEARCH REPORTS**

Components of a research report - Title, Authors, Abstract, Synopsis, Keywords, Introduction, Materials and Methods, Results, Discussion, Acknowledgement, Summary or Conclusions, References. Plagiarism. Significance of Impact Factor. Preparation of a research proposal for funding. Indian funding agencies for research. Importance of NET examination by CSIR.

Literature Citation: Name-Year System (Harvard System), Citation-Sequence System, Alphabet Number System; Journal Abbreviations. Format and use of Tables and figures in a research report.

**Text books :**

**Unit 1 to unit 5:**

1. Gurumani, N. Research Methodology for Biological Sciences. MJP Publishers, Chennai 2006.
2. CPCSEA Guidelines for Laboratory Animal Facility, CPCSEA, 2003.
3. Lesk, A.M. Introduction to Bioinformatics, 3rd Edition. Oxford University Press. 2009.
4. Day, R.A, Gastel B. How to Write and publish a Scientific Paper. Cambridge University Press, 8th Edition. 2017.
5. Gupta, S.P. Statistical Methods. Sultan.Chand & Sons, 2011.

**References :**

**Unit 1 to unit 5:**

1. Kothari. C.R, Research Methodology, methods and techniques, new age International (P) limited, publishers, 2004.
2. Gurumani, N. An Introduction to Biostatistics. MJP Publishers, Chennai 2011.
3. Rastogi, S.C., Mendiratta, N. and Rastogi, P. Bioinformatics - Methods and Applications, 4th Edition. Prentice Hall of India Private Limited, 2013.
4. R. Panneerselvam., Research methodology, Second Edition, PHI learning Private Ltd, 2014.

**E-Materials:**

1. <https://research.phoenix.edu/blog/how-identify-appropriate-research-problem>
2. <https://www.sciencebuddies.org/science-fair-projects/competitions/finding-and-accessing-scientific-papers>
3. <https://www.geeksforgeeks.org/types-of-operating-systems/>
4. <https://www.researchgate.net/figure/Classification-of-data-collection-methods_fig1_240591073>
5. <https://www.mathsisfun.com/data/standard-deviation.html>
6. <https://en.wikipedia.org/wiki/Analysis_of_variance>
7. <https://www.enago.com/academy/biological-databases-an-overview-and-future-perspectives/>
8. <http://ndbserver.rutgers.edu/>
9. <https://www.ncbi.nlm.nih.gov/books/NBK550342/>
10. <https://www.enago.com/academy/important-ethical-considerations-animal-studies/>
11. <https://www.jli.edu.in/blog/role-of-institutional-ethics-committee-iec-in-clinical-trials/>
12. <https://www.wipo.int/sme/en/ip_business/importance/reasons.htm>
13. <https://myathleticlife.com/components-of-a-research-report/>
14. <https://en.wikipedia.org/wiki/Plagiarism>
15. https://www.aicte-india.org/opportunities/students/research-funds

**COURSE OUTCOMES:**

1. **After studied unit – 1, the student will be able to**

* Identify a research problem by searching relevant literature.
* Write an effective research articles.
* Familiar with search engines.
* Knowledgeable on World Wide Web and internet protocols.
* Well versed with basic approaches to qualitative research.

1. **After studied unit – 2, the student will be able to**

* Well versed with data collection.
* Familiar with analysis of data using statistical tools.
* Knowledgeable on data representation.
* Aware on standard deviation
* Well known on ANOVA.

1. **After studied unit – 3, the student will be able to**

* Familiar with bioinformatics.
* Well versed with different types of database.
* Knowledgeable on biological sequence analysis.
* Aware of BLAST and FASTA.
* Identify the protein structure using bioinformatics tools.

1. **After studied unit – 4, the student will be able to**

* Familiar with ethics in animal experimentation.
* Well versed with CPCSEA guidelines.
* Knowledgeable on instituitional ethical committee.
* Aware of ethics in food and drug safety.
* Well known on patenting and fundamental research.

1. **After studied unit – 5, the student will be able to**

* Familiar with components of research report.
* Well versed with plagarism.
* Knowledgeable on literature citation.
* Aware of writing an effective research proposal.
* Well known on importance of NET examination.

**PAPER - 11**

**ADVANCED CLINICAL BIOCHEMISTRY.**

**COURSE OBJECTIVES:**

* To know the abnormal constituents in urine and CSF, Aminiotic fluid collections.
* To impart knowledge on the disorders of carbohydrate metabolism, nucleic acid metabolism, lipid metabolism and amino acid metabolism.
* To develop an understanding of organ function tests.
* To develop knowledge on the concepts on diagnostic enzymology tests.
* To understand the basic concepts of antioxidants and cancer.

**UNIT-I: SPECIMEN COLLECTION AND ANALYSIS**

Concepts of accuracy, precision, reproducibility, reliability, and other factors in quality control. Normal values. Clinical significance of sugars, proteins, ketone bodies, bilirubin and porphyrins. CSF - collection, composition and analysis. Amniotic fluid - Origin, collection, composition.

**UNIT-II : DISORDERS OF CARBOHYDRATE AND LIPID METABOLISM**

Disorders of carbohydrate metabolism - blood sugar levels, hyper and hypoglycemia, regulation of blood glucose, renal threshold, diabetes mellitus - etiologic classification and diagnostic criteria, glucose tolerance test, metabolic complications - acute and late complications. Hypoglycemic agents. Glycogen storage diseases, galactosemia, fructosuria.

Disorders of lipid metabolism - plasma lipids and lipoprotein abnormalities, lipidosis, Xanthomatoses, hypocholestremic agents, fatty liver. Atherosclerosis. Tay Sach’s disease, Niemann Picks disease, Gaucher’s disease, inherited disorders of familiar hyper and hypolipoproteinemias.

**UNIT-III: DISORDERS OF PROTEIN METABOLISM AND CLINICAL ENZYMOLOGY**

Disorders of protein metabolism - non-protein nitrogenous constituents in blood - urea, uric acid and creatinine. Plasma protein abnormalities - deficiency, agammaglobulinemia, multiple myeloma, proteinuria, glomerulonephritis, nephrotic syndrome. Haemoglobinopathies - sickle cell anaemia and thalassimia. Phenylketonuria, tyrosinosis, alkaptonuria, maple syrup urine disease, Hartnup disease, homocystinuria, albinism.

Serum enzyme activities in diseases - Principle and assay of aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, acid phosphatase, streptokinase, asparaginase, isocitrate dehydrogenase, ceruloplasmin, y -glutamyl transpeptidase, creatine kinase and lactate dehydrogenase.

**UNIT-IV : ORGAN FUNCTION TESTS**

Liver function tests. Liver diseases: Jaundice; Cirrhosis; Alcoholic liver disease; Hepatic tumor; Bilary tract diseases; Gall stones; Crigler-Najjar syndrome; Dubin Johnson syndrome.

Renal function tests. Acute and chronic renal failure; Glomerulonephritis; Nephrotic syndrome; Urinary tract obstruction; Nephrolithiasis. Gastric function tests - Fractional test meal. Pentagastrin test; Insulin stimulation test. Gastritis

**UNIT-V: FREE RADICALS, CANCER AND DISORDERS OF NUCLEIC ACID METABOLISM**

Free radicals in health and disease - Endogenous and exogenous free radicals. Oxidative damages to lipids, proteins and DNA. Role of enzymatic and non-enzymatic antioxidants. Cancer: Morphological and metabolic changes in tumor cells. Tumor markers - AFP, CEA, hCG. Carcinogenic agents.

Inborn errors of nucleic acid metabolism - Lesch Nyhan syndrome, immunodeficiency diseases associated with defects in purine nucleotide metabolism, gout, oratic aciduria, xanthinuria. Serology: C-reactive protein.

**Text books :**

**Unit 1 to unit 5:**

1. T.M. Devlin. Textbook of Biochemistry with clinical correlations, 7th Edition. John Wiley & Sons, 2010.
2. K.V. Krishna Das, Text Book of Medicine - Jaypee Brothers Medical Publishers (P) Ltd, 1996.
3. M.N. Chatterjee and Rana Shinde, Textbook of Medical Biochemistry, 8th Edition. Jaypee Brothers Medical Publishers (P) Ltd., 2012.

**References :**

**Unit 1 to unit 5:**

1. P.D.Mayne., Chemistry in diagnosis and treatment - A Hodder Arnold Publication; 6 Rev Ed edition, 1994.
2. P. Asokan, Enzymes, Chinnaa Publications, 2003.
3. W.J. Marshall and S.K. Bangeit, Clinical biochemistry - Metabolic concepts and clinical aspects, Churchill Livingstone, 1995.

**E-Materials:**

1. <https://www.thoughtco.com/difference-between-accuracy-and-precision-609328>
2. <https://en.wikipedia.org/wiki/Quality_control>
3. <https://www.stanfordchildrens.org/en/topic/default?id=amniocentesis-procedure-92-P07762>
4. <https://www.healthline.com/health/diabetes>
5. <https://en.wikipedia.org/wiki/Glycogen_storage_disease>
6. <https://ghr.nlm.nih.gov/condition/gaucher-disease>
7. <https://en.wikipedia.org/wiki/Non-protein_nitrogen>
8. <https://en.wikipedia.org/wiki/Hemoglobinopathy>
9. <https://www.medicinenet.com/phenylketonuria/article.htm>
10. <https://www.healthline.com/health/liver-function-tests>
11. <https://www.ncbi.nlm.nih.gov/books/NBK507821/>
12. <https://www.webmd.com/digestive-disorders/digestive-diseases-gastritis#1>
13. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3614697/>
14. <https://www.cancer.gov/about-cancer/diagnosis-staging/diagnosis/tumor-markers-fact-sheet>
15. https://rarediseases.info.nih.gov/diseases/7226/lesch-nyhan-syndrome

**COURSE OUTCOMES:**

1. **After studied unit – 1, the student will be able to**

* Well known on accuracy and precision.
* Familiar with normal constitutents present in urine.
* Knowledgeable on Cerebrospinal fluid collection and analysis.
* Well versed with amniotic fluid.
* Aware on abnormal constitutents and its problem related with different organs.

1. **After studied unit – 2, the student will be able to**

* Well known on blood sugar level and its regulation.
* Familiar with glycogen storage diseases.
* Knowledgeable on carbohydrate disorder.
* Well versed with atherosclerosis
* Aware on fatty liver.

1. **After studied unit – 3, the student will be able to**

* Well known on non-protein nitrogenous constituents in blood .
* Familiar with Plasma protein abnormalities.
* Knowledgeable on Haemoglobinopathies.
* Well versed with inborn errors of metabolism.
* Aware on serum enzyme activities in diseases.

1. **After studied unit – 4, the student will be able to**

* Well known on liver diseases.
* Familiar withbilary tract diseases.
* Knowledgeable on glomerulonephritis..
* Well versed with Urinary tract obstruction.
* Aware on Gastric function tests.

1. **After studied unit – 5, the student will be able to**

* Well known on role of free radicals in health and diseases.
* Familiar with enzymatic and non-enzymatic antioxidants.
* Knowledgeable on Cancer.
* Well versed with Inborn errors of nucleic acid metabolism.
* Aware on C-reactive protein.

**CORE ELECTIVE**

**PAPER - 4**

**(to choose one out of 3)**

**A. BIOINFORMATICS**

**COURSE OBJECTIVE:**

1. To provide the strong knowledge on computer peripherals and hardware description.
2. To impart basic knowledge on operating system.
3. To understand about basics in bioinformatics and different types of database.
4. To develop sound knowledge on structural prediction of RNA and protein
5. To understand about 3-D Structural analysis of bio molecules.

**UNIT-I**

Computer peripherals and hardware description: computer system design. Recognition and Structure of Different Components of A Computer System And Their Respective Usage. I/O and Storage Devices with Data Communication with Introduction of Internet. Connections to the internet, internet service requirements and applications – e-mail - World Wide Web, URL, HTML, TCP/IP

**UNIT-II**

Operating systems: system and applications software, evolution of operating systems, layered structure of operating system, CUI and GUI’s DOS internet and external commands, batch files: WIN 95/98: Anatomy of windows and features, multitasking.

Office applications : MS-Office 95/97/2000/2003 including MS-Word, MS-Excel, MS Power point.

Logic developments: generation of programming languages, emulation of common DOS commands using C and C++, data structures in C objects and classes, pointers arravasi one and two dimensional) normal string and file handling in C.

**UNIT-III**

Introduction to bioinformatics – biological data bases- sequence analysis-need and importance-pairwise alignments – dot plot, dynamic programming – global(needle man- wunsch) and local (smith-waterman) alignment algorithms- scoring and substitution matrix – data base searching. Basics of Entrez, BLAST, and FASTA search procedures- multiple alignment. CLUSTAL – Njplot - Phylogenetic trees.

**UNIT-IV**

Secondary structure prediction of RNA and protein – detecting ORFs- restriction maps, algorithm for Tm calculations, primer design and probe synthesis – structural classification of proteins (SCOP and CATH) – structural genomics-functional genomics and proteomics – DNA microarrays – present status and future prospects.

**UNIT-V**

3-D Structural analysis of bio molecules – Molecular Visualization Tools – rasmol, Chime, weblab Viewer, Deep View, ISIS Draw, chemdraw, molmol, etc – computer modeling of proteins. Simulation studies and virtual reality – Simulation Of ES Complex Interaction and stereodynamic concept- structural studies of substrate – Ligand Binding – Drug Designing- introduction to PERL and BIOPERL to facilitate Biological Analysis.

**Text books :**

**Unit 1 to unit 5:**

1. Lesk, A.M. Introduction to Bioinformatics. Oxford, 2002.
2. Baxevanis & Ouellette. Bioinformatics: A practical guide to analysis of genes and proteins. 2nd Edition, Wiley-Inter Sci, 2001.
3. Bergeron BP. Bioinformatics computing, 1st Edition, Printice Hall, 2002.

**References:**

**Unit 1 to unit 5:**

1. Campbell and Heyer. Discovering Genomics, Proteomics and Bioinformatics. Cold Spring Harbour Laboratory Press & Benjamin Cummings, 2002.
2. Gibas and Per Jambeck. Developing Bioinformatics Computer Skills. O’Reilly & Associates, 2001.
3. Krane et al. Fundamental concepts of bioinformatics. Benjamin Cummings, 2002.

**E-Materials:**

1. <https://researcher.watson.ibm.com/researcher/view_group.php?id=6757>
2. <http://oer.nios.ac.in/wiki/index.php/INTERNET_APPLICATION_AND_SERVICES>
3. <https://www.webopedia.com/TERM/O/operating_system.html>
4. <https://docs.microsoft.com/en-us/office365/servicedescriptions/office-applications-service-description/office-applications>
5. <https://www.includehelp.com/basics/generations-of-programming-language.aspx>
6. <https://en.wikipedia.org/wiki/Biological_database>
7. <https://en.wikipedia.org/wiki/BLAST_(biotechnology)>
8. <https://en.wikipedia.org/wiki/FASTA>
9. <https://en.wikipedia.org/wiki/Secondary_structure_prediction>
10. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4011503/>
11. <https://www.ncbi.nlm.nih.gov/books/NBK21841/>
12. <https://www.bioinformatics.org/wiki/Molecular_visualization>
13. <https://bitesizebio.com/38005/computation-protein-modeling/>
14. <https://www.pharmatutor.org/articles/drug-designing-review>
15. https://en.wikipedia.org/wiki/Phylogenetic\_tree.

**COURSE OUTCOMES:**

1. **After studied unit – 1, the student will be able to**

* Well known on computer system design.
* Familiar with components of a computer system and their respective usage.
* Knowledgeable on Storage Devices with Data Communication.
* Well versed with internet.
* Aware on World Wide Web, URL, HTML.

1. **After studied unit – 2, the student will be able to**

* Well known on Operating systems.
* Familiar with MS-Word, MS-Excel, MS Power point.
* Knowledgeable on generation of programming languages.
* Well versed with C and C++.
* Aware on data structures in C objects.

1. **After studied unit – 3, the student will be able to**

* Well known on bioinformatics.
* Familiar with biological data bases.
* Knowledgeable on BLAST, and FASTA.
* Well versed with Phylogenetic trees.
* Aware on pairwise alignments and local alignment algorithms.

1. **After studied unit – 4, the student will be able to**

* Well known on structure prediction of RNA.
* Familiar with structure prediction of protein.
* Knowledgeable on restriction maps.
* Well versed with structural and functional genomics.
* Aware on DNA microarrays.

1. **After studied unit – 5, the student will be able to**

* Well known on molecular visualization tools.
* Familiar with computer modeling of proteins.
* Knowledgeable on simulation Of ES Complex Interaction.
* Well versed with structural studies of substrate – Ligand Binding.
* Aware on drug designing.

**CORE ELECTIVE**

**PAPER - 4**

**B. NANOBIOTECHNOLOGY**

**COURSE OBJECTIVE:**

1. To provide the strong knowledge on nanobiomaterials.
2. To impart basic knowledge on nanobiotechnology.
3. To understand about nanomedicines.
4. To develop sound knowledge on protein microarrays.
5. To understand about nanoparticle synthesis.

**UNIT I: NANOBIOMATERIALS**

Introduction – Biocompatibility - Antibacterial activity- Principles involved - Applications. Biomaterial Nano circuitry: Protein based nano circuity: Neurons for network formation. DNA nanostructures for mechanics and computing and DNA based computation: DNA based nano mechanical devices.

**UNIT II: NANOBIOTECHNOLOGY**

Interaction between Bio molecules and Nano particle surface, Different types of inorganic materials used for the synthesis of Hybrid Nano-bio assemblies, Application of Nano in biology, Nanoprobes for analytical applications- A new methodology in medical diagnostics and biotechnology, Current status of Nano biotechnology, Future perspectives of Nanobiology, Nanosensors.

**UNIT III: NANOMEDICINES**

Developing of Nanomedicines, Nanosystems in use, Protocols for Nanodrug administration, Nanotechnology in Diagnostics applications, Materials used in diagnostics and therapeutic applications - Molecular Nano mechanics, Molecular devices, Nanotribology, Studying Tribology at Nanoscale, Nano tribology applications.

**UNIT IV: MOLECULAR AND CELLULAR BIOLOGY**

Molecular and cellular biology applications, 2-D electrophoresis and mass spectrometry of proteins, Protein Microarrays (Fabrication – Fluorescence detection) - Binding Assays and Immuno sensors- Integrated Nano biotechnology Systems.

**UNIT V: BIOLOGICAL METHODS OF SYNTHESIS**

Use of Bacteria, Fungi, Actinomycetes for Nanoparticle Synthesis, Magnetotactic Bacteria for Natural Synthesis of Magnetic Nanoparticles: Mechanism of Formation: Viruses As Components for the Formation of Nanostructured materials: Synthesis Process and application, Role Of Plants in Nanoparticle Synthesis.

**Text books :**

**Unit 1 to unit 5:**

1. Subbiah Balaji. Nanobiotechnology, MJP Publishers, 2010.
2. Nanomaterials - A.K.Bandyopathy: New Age International Publishers
3. Nano biotechnology: ed - C.M. Niemeyer, C.A.Mirkin.
4. Handbook of Nanostructured Biomaterials and their applications in nanobiotechnology – Harisingh Nalwa

**References:**

**Unit 1 to unit 5:**

1. Nanotechnology - Mark Ratner and Daniel Ratner, Pearson education.
2. Nanobiotechnology: ed. C.M.Niemeyer, C.A.Mirkin.
3. Introduction to Nanoscale Science And Technology (Nanostructure Science And Technology) – Massimiliano Diventra
4. Nanosystems: molecular : Molecular Machinery, Manufacturing And Composition-K.Eric Drexler.

**E-Materials:**

1. <https://link.springer.com/chapter/10.1007/978-1-4020-6829-4_1>
2. <https://en.wikipedia.org/wiki/Nanocircuitry>
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3471994/>
4. <https://en.wikipedia.org/wiki/Nanoparticle%E2%80%93biomolecule_conjugate>
5. <https://jnanobiotechnology.biomedcentral.com/articles/10.1186/1477-3155-2-3>
6. <https://www.azonano.com/article.aspx?ArticleID=1840>
7. <https://www.frontiersin.org/articles/10.3389/fchem.2018.00360/full>
8. <https://www.understandingnano.com/nanotechnology-medical-diagnosis.html>
9. <https://en.wikipedia.org/wiki/Nanotribology>
10. <https://www.futuremedicine.com/doi/full/10.2217/nnm.15.81>
11. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6316038/>
12. <https://www.tsijournals.com/articles/bacterial-synthesis-and-applications-of-nanoparticles-13485.html>
13. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3999464/>
14. <https://copublications.greenfacts.org/en/nanotechnologies/l-2/2-uses.htm>
15. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4126476/

**COURSE OUTCOME:**

1. **After studied unit – 1, the student will be able to**

* Well known on Biocompatibility.
* Familiar with Antibacterial activity.
* Knowledgeable on Protein based nano circuity.
* Well versed with DNA nanostructures.
* Aware on DNA based nano mechanical devices.

1. **After studied unit – 2, the student will be able to**

* Well known on bio molecules and nano particle surface interaction.
* Familiar with synthesis of Hybrid Nano-bio assemblies.
* Knowledgeable on Nanoprobes used for analytical applications.
* Well versed with Current status of Nano biotechnology.
* Aware on Nanosensors.

1. **After studied unit – 3, the student will be able to**

* Well known on nanomedicines.
* Familiar with nanodrug administration.
* Knowledgeable on nanotechnology in diagnostics applications.
* Well versed with molecular nano mechanics.
* Aware on nano tribology applications.

1. **After studied unit – 4, the student will be able to**

* Well known on 2-D electrophoresis and mass spectrometry of proteins.
* Familiar with protein microarrays.
* Knowledgeable on immuno sensors.
* Well versed with integrated nano biotechnology Systems.
* Aware on applications of nanotechnology in molecular level.

1. **After studied unit – , the student will be able to**

* Well known on synthesis of nanoparticles using bacteria.
* Familiar with magnetotactic bacteria for natural synthesis of magnetic nanoparticles.
* Knowledgeable on role Of plants in nanoparticle synthesis.
* Well versed with viruses as a components for the formation of nanostructured materials.
* Aware on different methods used for nanoparticle synthesis.

**CORE ELECTIVE**

**PAPER - 4**

**C. Stem cell technology**

**COURSE OBJECTIVE:**

1. To provide the strong knowledge on stem cells and its types.
2. To impart basic knowledge on in vivo and invitro differentiation of stem cells.
3. To understand about limitations of cloning.
4. To develop sound knowledge on hematopoietic stem cells.
5. To understand about skeletal muscle stem cells.

**UNIT-I**

Stem cells -Introduction, Definition and basics of stem cells. Classification of stem cells-different types of stem cells- Human embryonic stem cells, Adult stem cells. Sources of stem cells - Fetus and various adult tissues – Advantages of stem cells.

Blastocyst culture- Various stages of embryonic development. In vitro fertilization. Xeno-free derivation of stem cells – Alternative feeder cells and feeder free culture. Cryopreservation of stem cells – Conventional slow- freezing method and Vitrification method. Properties of stem cells - self renewel, clonality and plasticity. Pluripotent nature of stem cells - Extrinsic and Intrinsic factors. Characterization of human embryonic stem cells – Expression of cell surface marker, Karyotyping.

**UNIT-II**

Stem Cells and their developmental potentials, Characteristics of stem cells-Transdifferntiation of stem cells. Controlled differentiation of human embryonic stem cells. In vivo and invitro differentiation of stem cells. Application of stem cells.

**UNIT-III**

Therapeutic cloning strategies, derivation and propagation of human embryonic stem cells. Reproductive cloning by SCNT. Use of SCNT. Limitations of cloning – Hurdles to improve the efficiency of therapeutic cloning. Stem cell research and ethics – translational medicine ethics.

**UNIT-IV**

Hematopoietic stem cells (HSC) - Basics, Development and Regulation of HSC. Clinical Application of HSC – Gene Therapy – using haematopoietic stem cells HSC for Leukemia. Mesenchymal stem cells (MSC) - Differentiation and Identification. Characteristics of mesenchymal stem cells. Clinical applications of stem cells. Stem cells and regenerative medicine. Ips –induced pluripotent stem cells.

**UNIT-V**

Skeletal Muscle Stem Cells – Development and functions. Liver stem cells – Organization and functions. Tumor stem cells – Basics differences and Similarities of cancer stem cells and stem cells. Cancer stem cell signaling – NOTCH pathway. Canonical wnt signaling pathways in hematopoietic stem cells. Stem cell therapies in animal models. Use and benefits of stem cell for human beings.

**Text books :**

**Unit 1 to unit 5:**

1. Anthony Atala and Robert Lanza., Handbook of stemcells., 2013.
2. [Yanhong Shi](https://www.amazon.in/s/ref=dp_byline_sr_book_1?ie=UTF8&field-author=Yanhong+Shi&search-alias=stripbooks) and [Dennis O. Clegg](https://www.amazon.in/s/ref=dp_byline_sr_book_2?ie=UTF8&field-author=Dennis+O.+Clegg&search-alias=stripbooks)., Stem cell research and therapeutic., SPRINGER (SIE)., 2009.

**References:**

**Unit 1 to unit 5:**

1. C.S. Potten., Stem cells., Academic Press., 1996.
2. Kursad Turksen., Adult stem cells., 2nd ed., 2014.

**E-Materials:**

1. <https://stemcells.nih.gov/info/basics/1.htm>
2. <https://www.scireslit.com/Pharmacology/AJPT-ID11.php>
3. <https://www.londonwomensclinic.com/fertility-treatments/blastocyst-culture-implantation/>
4. <https://www.nature.com/articles/cr200761>
5. <https://www.nature.com/scitable/topicpage/karyotyping-for-chromosomal-abnormalities-298/>
6. <https://www.ncbi.nlm.nih.gov/pubmed/11177611>
7. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2633984/>
8. <https://www.ncbi.nlm.nih.gov/pubmed/15010323>
9. <https://en.wikipedia.org/wiki/Somatic_cell_nuclear_transfer>
10. <https://www.bbvaopenmind.com/en/science/research/the-limits-of-cloning/>
11. <http://www.aabb.org/aabbcct/therapyfacts/Pages/hsc.aspx>
12. <https://en.wikipedia.org/wiki/Mesenchymal_stem_cell>
13. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC305326/>
14. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3496019/>
15. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3752464/

**COURSE OUTCOME:**

1. **After studied unit – 1, the student will be able to**

* Well known on basics of stem cells.
* Familiar with human embryonic stem cells.
* Knowledgeable on xeno-free derivation of stem cells.
* Well versed with properties of stem cells.
* Aware on karyotyping.

1. **After studied unit – 2, the student will be able to**

* Well known on stem cells and their developmental potentials.
* Familiar with characteristics of stem cells.
* Knowledgeable on transdifferntiation of stem cells.
* Well versed with in vivo and invitro differentiation of stem cells.
* Aware on application of stem cells.

1. **After studied unit –3, the student will be able to**

* Well known on therapeutic cloning strategies.
* Familiar with propagation of human embryonic stem cells.
* Knowledgeable on reproductive cloning by SCNT.
* Well versed with limitations of cloning.
* Aware on stem cell research and ethics.

1. **After studied unit –4, the student will be able to**

* Well known on development and regulation of hematopoietic stem cells.
* Familiar with clinical application of hematopoietic stem cells.
* Knowledgeable on gene therapy using haematopoietic stem cells.
* Well versed with mesenchymal stem cells.
* Aware on –induced pluripotent stem cells.

1. **After studied unit –5, the student will be able to**

* Well known on skeletal muscle stem cells.
* Familiar with liver stem cells.
* Knowledgeable on tumor stem cells.
* Well versed with stem cell therapies in animal models.
* Aware on benefits of stem cell for human beings.

**OPEN ELECTIVE**

**PAPER - 4**

**(to choose one out of 3)**

**A. EVOLUTIONARY BIOLOGY**

**COURSE OBJECTIVE:**

1. To provide the strong knowledge on historical review of evolutionary concept.
2. To impart basic knowledge on Current concept of chemogeny.
3. To understand about Fossils.
4. To develop sound knowledge on plant and fungi evolution.
5. To understand about theories of human migration.

**UNIT I: Historical Review of Evolutionary Concept**

Pre-Darwinian ideas – List of contributors influencing Darwin indicated as a *timeline.*

Lamarckism – Merits and demerits. Darwinism – Merits and demerits, Post-Darwinian era –

Modern synthetic theory; biomathematics and the theory of population genetics leading to

Neo-Darwinism

**UNIT II: Life’s Beginnings**

Chemogeny – An overview of pre-biotic conditions and events; experimental proofs to

abiotic origin of micro- and macro-molecules. Current concept of chemogeny – RNA first

hypothesis. Biogeny – Cellular evolution based on proto-cell models (coacervates and

proteinoid micro-spheres). Origin of photosynthesis – Evolution of oxygen and ozone buildup.

Endosymbiotic theory – Evolution of Eukaryotes from Prokaryotes

**UNIT III: Evidences of Evolution**

Fossils as direct evidences, Types of fossils, Incompleteness of fossil record, Dating of

fossils, Phylogeny of horse as an example, Molecular evidences (Globin gene families as

an example), Molecular clock concept.

**UNIT IV: Evolution of Plants and Fungi**

Origin of land plants – Terrestrial algae and Bryophytes; alternation of generations. Early

vascular plants – Stelar evolution; Sporangium evolution. Angiosperms – Phylogeny of major

groups. Fungi

**UNIT V: Human Ancestry and Phylogeny**

Primate characteristics and unique Hominin characteristics. Primate phylogeny leading to

Hominin line. Human migration – Theories. Brief reference to molecular analysis of human

origin – Mitochondrial DNA and Y-chromosome studies

**Text books :**

**Unit 1 to unit 5:**

1. Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional Evolutionary Approach 7th

Edition , Thomson Books/Cole

1. Campbell & Recce(2005). Biology, Pearson Education, (Singapore) Pvt.Ltd.
2. Smith, T.M.and Smith, R.C. (2006) Elements of Ecology I st editon Pearson Publications
3. Miller,G.T (2006) Environmental Science 11 th edition Brooks/Cole
4. Raven, P.H. et al (2006) biology 7 th edition Tata McGrawIIill Publications, New Delhi.

**References:**

**Unit 1 to unit 5**

1. Ridley, M. (2004). *Evolution*. III Edition. Blackwell Publishing
2. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H., (2007). *Evolution*. Cold Spring, Harbour Laboratory Press.
3. Hall, B. K. and Hallgrimsson, B. (2008). *Evolution*. IV Edition. Jones and Bartlett Publishers.
4. Douglas, J. Futuyma (1997). *Evolutionary Biology*. Sinauer Associates.
5. Minkoff, E. (1983). *Evolutionary Biology*. Addison-Wesley.

E-Materials:

1. <https://plato.stanford.edu/entries/evolution-before-darwin/>
2. <https://en.wikipedia.org/wiki/Lamarckism>
3. <http://www.preservearticles.com/education/what-are-the-merits-and-demerits-of-darwanism/28368>
4. <http://www.yourarticlelibrary.com/biology/origin-of-life-chemical-evolution-formation-of-primitive-life-and-its-evolution-theories/27304>
5. <http://www.yourarticlelibrary.com/biology/origin-of-life-chemical-evolution-formation-of-primitive-life-and-its-evolution-theories/27304>
6. <http://www.plantphysiol.org/content/154/2/434>
7. <https://www.biology.iupui.edu/biocourses/N100/2k2endosymb.html>
8. <https://en.wikipedia.org/wiki/Fossil>
9. <https://sciencing.com/describe-types-fossils-8147260.html>
10. <https://evolution.berkeley.edu/evolibrary/article/molecclocks_01>
11. <https://en.wikipedia.org/wiki/Evolutionary_history_of_plants>
12. <http://www.biologydiscussion.com/plant-tissues/tissue-system/stelar-system-of-plant-definition-and-types-with-diagrams/20313>
13. <https://www.britannica.com/topic/hominin>
14. <https://en.wikipedia.org/wiki/Human_migration>
15. https://en.wikipedia.org/wiki/Molecular\_anthropology

**COURSE OUTCOME:**

1. **After studied unit –I, the student will be able to**

* Well known on Pre-Darwinian ideas.
* Familiar with Lamarckism – Merits and demerits.
* Knowledgeable on Post-Darwinian era.
* Well versed with Modern synthetic theory.
* Aware on Neo-Darwinism

1. **After studied unit –2, the student will be able to**

* Well known on overview of pre-biotic conditions.
* Familiar with experimental proofs to abiotic origin of micro- and macro-molecules.
* Knowledgeable on biogeny.
* Well versed with origin of photosynthesis.
* Aware on endosymbiotic theory.

1. **After studied unit –3, the student will be able to**

* Well known on fossils and its types.
* Familiar with incompleteness of fossil record
* Knowledgeable on dating of fossils.
* Well versed with Phylogeny of horse.
* Aware on Molecular clock concept.

1. **After studied unit –4, the student will be able to**

* Well known on Terrestrial algae and Bryophytes.
* Familiar with Stelar evolution.
* Knowledgeable on Sporangium evolution.
* Well versed with Angiosperms.
* Aware on Fungi.

1. **After studied unit –5, the student will be able to**

* Well known on hominin.
* Familiar with human migration theories
* Knowledgeable on primate phylogeny.
* Well versed with molecular analysis of human origin.
* Aware on primate characterisitics.

**OPEN ELECTIVE**

**PAPER - 4**

**B. BIOREMEDIATION**

**COURSE OBJECTIVE:**

1. To provide the strong knowledge on bioremediation and its types.
2. To impart basic knowledge on xenobiotics.
3. To understand about bioleaching and bio mining.
4. To develop sound knowledge on wastes management.
5. To understand about theories of environmental nanotechnology.

**UNIT - I**

Introduction to Bioremediation, types of Bioremediation, Bioremediation of surface soil and sludges, Bioremediation of subsurface material, In situ technologies, Ex-situ technologies, phytoremediation, Bioaugmentation of naturally occurring microbial activities. Environmental modification. Use of co-substrates, oxygen supplementation (Composting and aerobic bioreactors, in situ aeration).

**UNIT - II**

General microbial strategies for initiating attack on xenobioties – Biodegradation strategies for key classes of compounds – factors affecting biodegradation.

**UNIT- III**

Use of genetically altered microorganisms for field biodegradation of hazardous materials. Bio leaching and Bio mining. Bioremediation technologies to remove heavy metals and radionuclides using iron Fe(III), Sulphate and sulphur reducing bacteria.

**UNIT - IV**

Introduction – Hazardous wastes – biodegradation of Hazardous wastes – biological detoxification of cyanide – market for hazardous wastes management – biotechnology application to hazardous wastes management – source and management safety.

**UNIT - V**

Environmental Nanotechnology Research – Nanotechnology for Bioremediation of Heavy metals – Bioremediation of Petroleum sludge using Bacterial Consortium and Biosurfactant – Biofilms in Porous Media. Mathematical molding and Numerical simulations – Biosensor Technology for Monitoring pollutants.

**Text books :**

**Unit 1 to unit 5:**

1. Environmental biotechnology, 1995 S.N.Jogdand, Himalaya Publishing House, Bombay, delhi, Nagpur.
2. Molecular biology of the gene IV edition Watson, JD. Hopkins, N.H.,Roberts, J.W.,Steritz. J.A.,Weiner, A.M.The Benjamin – cummings Publications company Inc.
3. Crawford R.L.Crawford D.L.Bioremediation. Principles and Applications Cambridge Units, Press, 1996.

**References:**

**Unit 1 to unit 5**

1. Bioremediation 1994 Baker, K.H.and Herson, D.S.McGraw Hill, Inc. New York.
2. Biotechnology biology 1997 P.K.Gupta, rastogi Publications, meerut.
3. Environmental Bioremediation technologies by Shree N.Singh. rudra Tripathi.

**E-Materials:**

1. <https://en.wikipedia.org/wiki/Bioremediation>
2. <https://www.aftermath.com/content/types-of-bioremediation/>
3. <https://en.wikipedia.org/wiki/Bioaugmentation>
4. <https://link.springer.com/chapter/10.1007/978-981-10-8390-7_1>
5. <https://www.intechopen.com/books/biodegradation-life-of-science/biodegradation-involved-microorganisms-and-genetically-engineered-microorganisms>
6. <https://en.wikipedia.org/wiki/Biodegradation>
7. <https://www.azomining.com/Article.aspx?ArticleID=1095>
8. <https://www.americangeosciences.org/critical-issues/faq/what-biomining>
9. <https://www.semanticscholar.org/paper/New-Bioremediation-Technologies-to-Remove-Heavy-and-Bruschi-Goulhen/cc4d5f8a32f75e9f087d2f1f39fcb041a91455f5>
10. <https://www.researchgate.net/publication/15010980_Biodegradation_of_hazardous_wastes>
11. <https://www.ncbi.nlm.nih.gov/pubmed/3073060>
12. <https://en.wikipedia.org/wiki/Waste_management>
13. <https://www.researchgate.net/publication/278715251_Nanotechnology_for_Bioremediation_of_Heavy_Metals>
14. <https://en.wikipedia.org/wiki/Biofilm>
15. https://www.researchgate.net/publication/315829853\_Biosensors\_for\_the\_Detection\_of\_Environmental\_and\_Urban\_Pollutions

**COURSE OUTCOME:**

1. **After studied unit –1, the student will be able to**

* Well known on bioremediation and its types.
* Familiar with phytoremediation
* Knowledgeable on bioaugmentation of naturally occurring microbial activities.
* Well versed with bioremediation of surface soil and sludges.
* Aware on bioremediation of subsurface material.

1. **After studied unit –2, the student will be able to**

* Well known on xenobiotics.
* Familiar with microbial strategies for initiating attack on xenobiotics
* Knowledgeable on factors affecting biodegradation.

1. **After studied unit –3, the student will be able to**

* Well known on biodegradation of hazardous materials.
* Familiar with Bio leaching
* Knowledgeable on Bio mining.
* Well versed with removal of heavy metals using bioremediation technologies.
* Aware on removal of radionuclides using bioremediation technologies

1. **After studied unit –4, the student will be able to**

* Well known on hazardous wastes.
* Familiar with biodegradation of hazardous wastes
* Knowledgeable on biological detoxification of cyanide.
* Well versed with waste management.
* Aware on application to hazardous wastes management.

1. **After studied unit –5, the student will be able to**

* Well known on nanotechnology used for bioremediation of heavy metals.
* Familiar with bioremediation of petroleum sludge using bacterial consortium.
* Knowledgeable on biosurfactant.
* Well versed with mathematical molding and Numerical simulations.
* Aware on biosensor technology for monitoring pollutants.

**OPEN ELECTIVE**

**PAPER - 4**

**C. LIFE STYLE - DISEASE AND PREVENTION.**

**COURSE OBJECTIVE:**

1. To provide the strong knowledge on obesity, cardiac disease and diabetes.
2. To impart basic knowledge on hypertension.
3. To understand about cancer.
4. To develop sound knowledge on age related diseases.
5. To understand about gallstone.

**UNIT – I**

Obesity – prevalence causes, consequences, symptoms – coronary heart disease and type 2 diabetes mellitus – lifestyle and dietary management of obesity.

**UNIT - II**

Hypertension- blood pressure- normal level of blood pressure, dietary management of hypertension, stroke and chronic renal failure due to hypertension Kidney stone – causes, types, symptoms and treatment (only Lithotropy), dietary management for prevention of kidney stones.

**UNIT – III**

Cancer – types of cancer, etiology of breast cancer diagnosis (Self examination, Mammography) and treatment (radiation, chemotherapy, surgery). Cervical cancer causes. Types, symptoms, diagnosis and treatment (radiation, chemotherapy, surgery). Cigarette smoking and symtoms, diagnosis and treatment (chemotherapy).

**UNIT – IV**

Aging – Factors influencing again. Age related diseases – dementia, osteoporosis, Osteo arthritis – causes sign and symptoms, preventive measures of again with special reference to antioxidants.

**UNIT – V**

Gallstones – causes, factors, aetiology of gall stones. Types of gall stones. Symptoms, preventive aspects of gall stone. Drug therapy – ursodeoxy cholic acid, surgical treatment and dietary management – Ulcer – causes and prevention.

**Text books:**

**Unit 1 to unit 5:**

1. Tietz., Fundamentals of Clinical chemistry. A Clinically oriented approach – Churchill. Livingstone Inc., India.
2. M.N.Chatterjee and Rana shinde (2007). Textbook of Biochemistry (7th ed)

**References:**

**Unit 1 to unit 5**

1. Thomas m.Devlin (2014). Textbook of Biochemistry with clinical Correlations   
   (7th ed) John Wiley & Sons.
2. Montgomery R.Conway TW, spector AA (1996) Biochemistry. A Case – Oriented Approach (6th ed), Mosby Publishers, USA.

**E-Materials:**

1. <https://www.mayoclinic.org/diseases-conditions/obesity/symptoms-causes/syc-20375742>
2. <https://www.medicalnewstoday.com/articles/184130>
3. <https://www.webmd.com/diabetes/type-2-diabetes>
4. <https://en.wikipedia.org/wiki/Hypertension>
5. <https://www.webmd.com/hypertension-high-blood-pressure/guide/dash-diet#1>
6. <https://my.clevelandclinic.org/health/articles/13486-eating-well-after-a-stroke>
7. <https://www.healthline.com/health/cancer>
8. <https://www.medicinenet.com/cervical_cancer/article.htm>
9. <https://www.cdc.gov/tobacco/data_statistics/fact_sheets/health_effects/effects_cig_smoking/index.htm>
10. <https://en.wikipedia.org/wiki/Ageing>
11. <https://www.verywellhealth.com/age-related-diseases-2223996>
12. <https://www.healthline.com/health/osteoarthritis>
13. <https://www.healthline.com/health/gallstones>
14. <https://timesofindia.indiatimes.com/life-style/health-fitness/health-news/ulcer-causes-signs-symptoms-prevention/articleshow/61834483.cms>
15. https://en.wikipedia.org/wiki/Ursodeoxycholic\_acid

**COURSE OUTCOME:**

1. **After studied unit –1, the student will be able to**

* Well known on Obesity.
* Familiar with coronary heart Disease.
* Knowledgeable on chronic renal failure due to hypertension.
* Well versed with kidney stone.
* Aware on dietary management for kidney stones prevention

1. **After studied unit –2, the student will be able to**

* Well known on hypertension.
* Familiar with dietary management of hypertension.
* Knowledgeable on stroke.
* Well versed with dietary management of obesity.

1. **After studied unit –3, the student will be able to**

* Well known on Cancer and its types
* Familiar with diagnosis of breast cancer.
* Knowledgeable on Cervical cancer causes.
* Well versed with Cigarette smoking.
* Aware on radiation, chemotherapy, surgery treatment for cancer.

1. **After studied unit –4, the student will be able to**

* Well known on aging.
* Familiar with dementia.
* Knowledgeable on osteoporosis.
* Well versed with Osteo arthritis.
* Aware on factors affecting aging.

1. **After studied unit –5, the student will be able to**

* Well known on gallstones.
* Familiar with types of gall stones.
* Knowledgeable on drug therapy for gallstone.
* Well versed with causes and prevention of ulcer.
* Aware on dietary management of gallstone.

**PRACTICAL – III**

**ENZYMOLOGY AND CLINICAL DIAGNOSTICS** (**BIOCHEMICAL ANALYSIS OF BLOOD)**

**A. ENZYMOLOGY - PURIFICATION AND KINETIC STUDIES**

* 1. a. Purification of acid phosphatase from potato.

b. Effect of activator and inhibitor of acid phosphatase activity by EDTA.

c. Effect of substrate concentration and acid phosphatase activity.

d. Determination of optimum temperature.

e. Determination of optimum pH.

2. Clinical Enzymology :

1. Assay of SGOT.

2. Assay of SGPT.

3. Assay of LDH.

4. Assay of CPK.

5. Assay of Alkaline phosphatase.

6. Assay of Serum acid phosphatase.

**BIOCHEMICAL ANALYSIS OF BLOOD**

1. Estimation of blood glucose by o-toluidine method.
2. Estimation of serum proteins by Bradford’s Method.
3. Estimation of blood urea by DAM method.
4. Estimation of serum uric acid by phosphor tungstate method.
5. Estimation of serum phospholipids.

**References:**

1. J. Jayaraman. Laboratory Manual in Biochemistry. New Delhi : New Age International Publishers, 2nd edition, 2011.

2. H. Varley. Practical Clinical Biochemistry, 4th Edition, CBS Publishers, 2008.

# 3. Practical Biochemistry For Medical Students - [Raghu](http://www.amazon.in/s/ref=dp_byline_sr_book_1?ie=UTF8&field-author=Raghu&search-alias=stripbooks), JAYPEE, 2006

# 4. Practical Clinical BiochemistryHardcover–[Harold Varley](http://www.amazon.in/s/ref=dp_byline_sr_book_1?ie=UTF8&field-author=Harold+Varley&search-alias=stripbooks),Sixth Edition, Alan H Gowenlock.

# 5. An Introduction to Practical Biochemistry - David T. Plummer Third Edition, Tata McGraw Hill

**PRACTICAL – IV**

**HAEMATOLOGICAL METHODS AND URINE ANALYSIS.**

**HAEMATOLOGICAL METHODS**

1. Collection, storage of blood and anticoagulants
2. Total RBC count
3. Total WBC count
4. Total platelet count
5. Differential WBC count
6. Absolute eosinophil count
7. Determination of hemoglobin content
8. Determination of clotting time.
9. Determination of prothrombin time
10. Determination of ESR.
11. Prothrombin time

**B. URINE ANALYSIS**

1. Collection and preservation of urine
2. Qualitative analysis of normal and pathological constituents in urine.
3. Microscopic analysis of urine
4. Estimation of titrable acidity of urine.
5. Estimation of protein in urine by biuret method
6. Analysis of urinary calculi.
7. Estimation Urea in urine
8. Estimation uric acid in urine.
9. Estimation of calcium in urine.

**References:**

1. A. Sadasivam and A. Manickam. Biochemical Techniques, 2nd Edition, New Age International Publishers, 2003.
2. J. Jayaraman. Laboratory Manual in Biochemistry. Wiley Eastern, 1981.
3. H. Varley. Practical Clinical Biochemistry, 4th Edition, CBS Publishers, 2008.

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