DEPARTMENT OF BIOCHEMISTRY
PERIYAR UNIVERSITY
PERIYAR PALKALAI NAGAR
SALEM - 636 011

M.Phil. Biochemistry
OBE Syllabus
(For candidates admitted from 2018-2019 onwards)

M.Phil. BIOCHEMISTRY SYLLABUS BASED ON OBE

(For candidates admitted from 2018-2019 onwards)

Full Time

1. Introduction

The Department of Biochemistry was established in the year 2005. The department is known for its commitment to the self development of students into well-molded individuals who can take on leadership role in Industry, Academic or Government organization. The Department aims in developing human resources in Biochemistry and to expand and transfer knowledge in particular to the rural community residing in and around Salem district of Tamil Nadu, India. There is a greater demand globally, for trained manpower in the areas of Biochemistry for Research and Development in multinational companies, public sectors, quality control labs, biopharmaceutical companies, food industries as well as in universities. The Department is inbuilt and established with numerous research facilities such as high speed ultra centrifuges, spectrophotometers, semi autoanalyser, colorimeter, deep freezers, Cold room, sonicator, Gel documentation system, orbital shakers, PCR machines, CO2 incubators, ELISA Reader, centrifuges, incubators, laminar flow, electronic balance, etc.

2. Programme Objectives

PO1: To demonstrate comprehensive knowledge on various areas of biochemistry.
PO2: To acquire skills in current and emerging trends in the areas related to the theoretical and practical aspects of biochemistry.
PO3: To communicate, plan and execute the concepts, experiments, constructs and techniques of the subject learnt in a clear, concise and lucid manner.
PO4: To apply critical thinking, scientific reasoning and mathematical skills in studied areas of Biochemistry.
PO5: To train the students to be able to work independently in a group or individually.
PO6: To make a student life long learner with moral and ethical values

3. Programme outcomes

After successful completion of M.Phil. Programme, the students are expected to have the following:

PO-1	acquire good understanding of major concepts, theoretical principles and experimental findings in Biochemistry.
PO-2	acquire skills in areas related to the current and emerging developments in the field of Biochemistry
PO-3	to solve a wide range of problems associated with Biochemistry by identifying and applying appropriate biochemical principles
PO-4	Learn to communicate the results in a clear and concise manner in writing and oral skills.
PO-5	to plan and execute the experiments and to investigate, analyse and interpret data in a clear and lucid manner
PO-6	have the ability to employ critical thinking, scientific reasoning and efficient problem solving skills
PO-7	ability to acquire generic and competency skills so as to work both independently and in a group
PO-8	To follow moral and ethical practices and by becoming life long learner aimed at personal development and for improving knowledge/skill development to become an entrepreneur in the field of Biochemistry and employed as a researcher / scientist in Research organizations / faculty in academic institutions.

4. Eligibility for admission

- Candidate who have qualified for post graduate degree in Biochemistry or Biological Science of any recognized university shall be eligible to register for the Degree of Master of Philosophy (M.Phil) in Biochemistry.
- For full-time M.Phil registration, candidates shall be required to have obtained a minimum of 55% marks.
- In case of a teacher or other candidates registering for part –time M.Phil candidates belonging to SC/ST community, the minimum percentage of marks for registration is 50%.

5. Duration

The duration of the M.Phil course shall extend over a period of one year from the commencement of the course.

6. Structure of the Course

The course of study for the degree shall consist of Part –I comprising three written papers according to the Syllabus prescribed from time to time. Part I shall consist of Paper I Research Methodology and Paper II Analytical Technique. Paper III shall be the guide paper relating to the proposed Dissertation.

Part	Course	Course code	Name of the Course	Credits	Marks
I	I	18MPBC01	Research Methodology	4	100
	II	18MPBC02	Analytical Techniques	4	100
	III	18MPBCE01	Guide Paper	4	100
II	IV	18MPBCD01	Dissertation and Viva voce	12	200
		Total		24	500

7. Scheme of Examination

Part –I : Written Examination (Papers I, II and III)

The examination of paper I, II and III shall be held at the first six months. The duration for each paper shall be 3 hours.

Paper – III examination will be conducted by the University along with paper I and II.

Part II : Dissertation

The broad area of research shall be intimated within one month after the completion of the written examination. Candidates shall submit the Dissertation to the University through the Supervisor and Head of the Department at the end of the year from the commencement of the course which shall be valued by internal examiner (supervisor) and one external examiner appointed by he

University from a panel of four names sent by the Supervisor through the Head of the Department/ at the time of submitting the Dissertation.

Submission or resubmission of the Dissertation will be allowed twice a year. On receipt of satisfactory evaluation reports, the student shall undergo a Viva-voce Examination.

The allotment of marks for (i) Theory (ii) Dissertation and Viva Voce are as follows:

(i) Theory Papers

Internal	: 25 Marks
External	: 75 Marks
Total	: 100 Marks

(ii) Project Dissertation

Dissertation	: 150 Marks
Viva Voce	: 50 Marks
Total	: 200 Marks

(iii) Internal assessment for course I, II and III

Test	: 10 Marks
Seminar	: 10 Marks
Attendance	: 05 Marks
Total	: 25 Marks

8. Passing Minimum

- A candidate shall be declared to have passed Part-I of the examination if he/she secures not less than 50% of the marks in each paper including Paper-III.
- A candidate shall be declared to have passed Part-II of the examination if his/her scores 50% of the marks in the Dissertation as well as Viva-voce. All other candidates shall be declared to have failed in the examination.

9. Restriction in number of chances

No candidate shall be permitted to reappear for the written examination in any paper on more than two occasions or to resubmit a Dissertation more than once. Candidates shall have to qualify for the degree passing all the written papers and dissertation within a period of two years from the date of commencement of the course. The University may grant extension of time for not more than one year on the recommendation of his/her supervisor for submission of dissertation only.

10. Conferment of Degree

No candidate shall be eligible for conferment of the M. Phil degree unless he/she is declared to have passed both the Part I and Pat II of the examinations as per the regulations.

The Degree and provisional certificate certifying that the Degree has been awarded in accordance with the provisions of 2016 regulations of the UGC.

Paper-I

RESEARCH METHODOLOGY

Course code: ***18MPBC01*** **4 Credits**

Course Objectives:

To improve scientific research through scientific writing, understanding the concept of bioinformatics, biostatistics and to have awareness of various government funding agencies and to follow the ethics in research.

Course Outcomes:

After completing this course, the students will be able :

CO1	To Understand the principles of research methods and instruments. Understand the methods of literature collection and publishing research works. Identify research problems and design
CO2	To Use bioinformatics tool for research analysis.
CO3	To use biostatistics as a research analysis tool.
CO4	To know about the various funding agencies for applying fellowships/scholarships
CO5	To understand and follow the bioethics, IPR and patenting

UNIT I

Scientific Research

Overview of scientific research, improvement through research and applications of research. Choosing a topic and formulation of hypothesis. Designing and investigation techniques to be employed, analysis of results. Use of microorganisms, animals, plants and humans in experimentation.

Scientific writing – logical format for writing thesis and papers – abstract, introduction, review of literature, materials and methods, results – illustration by tables and figures, discussion, and bibliography – Harvard and Vancouver systems.

UNIT II

Bioinformatics

The scope of bioinformatics. The internet. The world wide web. File formats. Biological data bases-sequence and structure-NCBI,PDB. Data retrieval – the Entez system. Searching sequence databases – sequence similarity searches, substitution matrices. Database search-FASTA and BLAST. Protein multiple sequence alignments-CLUSTAL.

UNIT III

Biostatistics

Collection and classification of data – diagrammatic and graphic representation of data – measurement of central tendency, Measures of dispersion, Correlation and Regression analysis, Test of significance based on large samples and small samples, Student t test , Chi square test, ANOVA, DMRT, Normal distribution, Use of SPSS software.

UNIT IV

Safety, general guidelines and funding agencies

Biosafety – Introduction. Levels of Biosafety. General guidelines and practices. Guidelines for DNA research activities. General guidelines for research in transgenic plants, Good laboratory practices. Containments – Types, Basic Laboratory and Maximum Containment Laboratory.

Research bodies & funding agencies – UGC, CSIR, ICMR, DST, DBT,ICAR, DAE, DRDO, DOD, Fellowships – Junior, Senior Research Fellowships and Research associates.

UNIT V

Bioethics and Patenting

Declaration of Bologna, 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 evaluation Ethical Committee (IEC) – Beneral ethical issues. Specific principles for clinical evaluation of drugs, herbal rededies and human genetics. Ethics in food and drug safety. Environmental release of microorganisms and genetically engineered organisms. Ethical issues in human gene therapy, cloning and embryonic stem cel1.

Patenting – definition of patent – different types of intellectual property rights, Case studies of patents (basmati rice, turmeric, neem). Product and process. Patenting multicellular organisms, Patenting and fundamental research.

Reference Books

1. Gupta,S.P. 2011. Statistical Methods, 4th Edition, Sultan Chand & Son Publishers.
2. Lesk, A.M. 2002. Introduction to Bioinformatics, Oxford University Press.
3. Kothari C.R. 2013. Research Methodology : Methods and Techniques, 3rd Edition, New Age Publishers
4. Day.R.A. 1989. How to write and publish a scientific paper. 3rd Edition, Cambridge University Press.
5. CPCSEA Guidelines for Laboratory Animal Facility.
6. Ethical guidelines for Biomedical Research on human subjects. ICMR, New Delhi, 2006.
7. Cooray. P.G. Guide to scientific and technical writing.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	M	H	M	L	H	L
CO2	M	L	H	H	M	H	H	M
CO3	H	M	H	H	H	L	H	L
CO4	H	M	M	H	L	H	H	L
CO5	H	M	L	L	L	M	H	H

H-High; M-Medium; L-Low

Paper-I

ANALYTICAL TECHNIQUES

Course code: ***18MPBC02*** **4 Credits**

Course Objectives:

To improve the applications of various instrumentations and techniques in the field of biochemical research.

Course Outcomes:

After completing this course, the students will be able:

CO1	To Understand the principles of spectroscopy and centrifugation
CO2	To handle chromatography and electrophoresis for research analysis.
CO3	To know about the various principles and application of Radiation and Immunotechniques
CO4	To apply molecular biology techniques in the field of Biochemistry
CO5	To Understand the proper applications of either plant or animal cell cultures techniques in their research endeavors

UNIT I

Spectroscopy and Centrifugation

Principle, instrumentation, and applications of UV-visible spectrophotometry, Vibrational spectroscopy, NMR, ESR, Spectrofluorimetry and luminometery. X-ray diffraction. Atomic spectroscopy – principle and applications of atomic flame and flameless spectrphotometry. Uses of LASER for spectroscopy.

Principle, instrumentation and applications of centrifugation. Preparative ultracentrifugation – differential centrifugation, density gradient centrifugation (rate-zonal & isopycnic). Analytical ultracentrifugation – molecular weight determination.

UNIT II

Chromatography and Electrophoresis

General principles, instrumentation and applications of chromatography – TLC, GLC, HPLC, ion exchange, molecular exclusion, affinity chromatography.

General principles and instrumentation. Electrophoresis of proteins – native gels, gradient gels, SDS Page, Isoelectric focusing, 2-D PAGE, Detection, estimation and recovery of proteins in gels. Western blotting. Electrophoresis of nucleic acids – agarose gel electrophoresis, DNA sequencing gels, pulsed – field gel electrophoresis, capillary electrophoresis.

UNIT III

Radiation and Immunotechniques

Principles and applications of tracer techniques in biology. Radiation hazards, prevention and safety measures. Detection and measurement of radioactivity, immunofluorescence, flow cytometry, phosphoimaging, solid and liquid scintillations counting – Cerenkov radiation. Autoradiography.

Production and applications of antisera and monoclonal antibodies, Antigen – antibody interaction – precipitation reaction, immunodiffusion, immunoelectrophoresis, immunofluorescence. RIA and ELISA – hormonal assay. HLA typing. Lymphocyte isolation and complement fixation. Immunohistochemistry, immunoelectron microscopy.

UNIT IV

Molecular Biology Techniques

Preparation of probes, Sequencing DNA – Maxam and Gilbert method, Sangers method, Next generation sequencing, Blotting techniques

– Southern, Northern and western analysis. DNA finger printing, footprinting. DNA makers

– RFLP and RAPD. PCR – principle and applications – RT PCR, real time PCR In situ hybridization and FISH. DNA and protein arrays.

Genome and proteome analysis – EI – MS, MALDI, SELDI, CI & MALDI

– TOF. DNA protein interaction – yeast two hybrid system, EMSA

UNIT V

Cell and Tissue Culture Plants and Animals

Animal cell and tissue culture – laboratory facilities, culture media and procedures, primary culture and cell lines, pluripotent stem cell lines, organ and embryo culture. 3D cell culture systems.

Plant cell and tissue culture media and cell culture, tissue culture, micropropagation and somoclonal variation, production and uses of haploids, protoplast culture, regeneration and somatic hybridization. Gene transfer methods in plants.

Microscopy – Principles and application of light, phase, contrast fluorescence, scanning and transmission electron microscopy, fixation and staining, Confocal microscopy, super resolution microscopy.

Reference Books

1. Wilson,K. and Walker,J. 2010. Principles and Techniques of Biochemistry and Molecular Biology, 7th Edition, Cambridge University. Press.
2. Upadhyay,A. Upadhyay,K. and Nath,N. 2016. Biophysical Chemistry: Principles and Techniques, 4th Edition, Himalaya Publishing. 11 th Edition.
3. Heldt,H.W. and Piechulla,B. 2016. Plant Biochemistry, 4 th Edition, Academic Press.
4. Lodish *et al*. 2012. Molecular Cell Biology, 7th Edition, W.H. Freeman and Co.
5. Brown,T.A. 2010. Gene cloning and DNA analysis: An introduction, 6 th Edition, Wiley-Blackwell Publishers.
6. Owen,J.A. *et al.,* 2013. Kuby Immunology, 7th Edition, W.H. Freeman and Company.

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CO2	M	H	H	M	L	H	H	L
CO3	H	L	L	M	L	L	H	L
CO4	M	M	M	H	L	H	H	L
CO5	M	M	L	L	L	M	H	L

H-High; M-Medium; L-Low

BIOCATALYST

COURSE CODE : **19 MPBCE01**

MARKS 100

COURSE OBJECTIVES : To understand the classification, kinetics, mechanism of action, regulation and applications of enzymes.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to,

CO1	Understand the isolation, extraction and purification of enzymes
CO2	Understand the concepts of enzyme kinetics and its application in research
CO3	Understand the application of various techniques in enzymology
CO4	Study the different techniques for enzyme immobilization and understand the applications of Enzyme Engineering
CO5	Choose the correct enzymes for application in various industries by realizing their current and future potential

UNIT-I

Isolation, Extraction and Purification of Enzymes

Enzymes general introduction, source of enzymes, isolation of enzymes, extraction of soluble enzymes, membrane bound enzyme, cell disintegration and extraction. Purification of enzymes, Recombinant proteins, membrane protein and purification of antibodies. Development of enzyme assay, quantification of enzyme activity. Mechanism of enzyme catalysis.

UNIT- II

Enzyme Kinetics

Kinetics of enzyme catalyzed reaction kinetics of single substrate enzyme; the Eadie Hofstee, Hanes plot and Dixon plot, rapid reaction kinetics; pre steady state kinetics, relaxation kinetics, King and Altman procedure, multi-substrate enzyme catalyzed reactions; steady state and non steady state methods. Enzyme inhibition; reversible inhibition and Irreversible inhibition. Mixed inhibition, partial inhibition, substrate inhibition, Allosteric inhibition and regulation.

UNIT- III

Techniques of Enzymology

Instrumental techniques: Electrochemical methods, Radio chemical methods and Dry–reagent techniques. Automation in enzymatic analysis: Fixed–time methods fixed concentration methods and methods involving continuous monitoring. Biosensors, Application of biosensors–Analysis- measurement of protein and enzyme activity–UV Absorption, Lowry, Dye binding, Bicinchonic acid. Active site–Investigations of active site structure, Trapping ES complex, Use of substrate analogues, Modification by using chemical

procedures, enzymes modification by treatment with protease, enzyme modification by site directed mutagenesis

UNIT- IV

Immobilization of Enzymes and Enzyme Engineering

Preparation of immobilized enzymes: properties of immobilized enzymes. Application of immobilized enzymes. Bioconversion studies with immobilized enzyme packed-Bed bioreactor. Determination of protein structure: Primary structure and its determination, secondary structure prediction and determination of super secondary structure and domain in protein, quaternary structure, and methods to determine tertiary and quaternary structure, X-ray crystallography, sequencing. Protein database analysis, methods to alter primary structure of protein, examples of engineered protein, protein design, principles and examples.

UNIT- V

Industrial Utilization of Enzymes

Large Scale application of microbial enzymes in food and allied industries. Leather industry, textiles, paper industries, Medical application of enzymes. Enzymes in aqueous biphasic system, Inter esterification of lipids.

REFERENCE BOOKS.

1. Enzymes By Dixon, E.C Webb, CJR Thorne and K.F.Tipton, Longmans, London.
2. Fundamentals of Enzymology 2 ed., (1998) By Nicholas C. Price, Lewis Stevans, Oxford University Press, First Edition (1990).
3. Understanding Enzymes, Trevor Palmer, Ellis Hor wood Limited, Third Edition (1991).
4. Protein Biotechnology, Gary Walsh and Denis Head on, John Wiley and Sons, 1994.
5. Protein Biochemistry and Biotechnology, Gary Walsh and John Wiley and Sons Ltd. 2002.
6. Enzyme kinetics and Mechanism–Paul F. Cook
7. The Chemical kinetics of enzyme action by K.J Laidler and P.S. Bunting
8. Enzymes structure and Mechanism 2nd ed., (1985) by Alan Fersht, W.H. Freeman and company
9. Enzymatic reaction mechanism (1979) by Christopher Walsh Freeman Pub, San Francisco
10. Immobilized enzymes by Ichiro Chibata, Halsted press Book
11. Enzyme structure and function by S. Blackburn (1976) Marcel Dekker, Inc.,NY

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	M	M	M	L	L	H	L
CO2	M	H	H	M	M	H	H	L
CO3	M	L	L	M	L	L	M	L
CO4	M	M	M	H	M	H	H	L
CO5	M	M	L	L	L	M	H	L

H-High; M-Medium; L-Low

PLANT THERAPEUTICS

COURSE CODE : **19 MPBCE02**

MARKS 100

COURSE OBJECTIVES : To provide an core principle and concepts of Indian Traditional system of medicine , clear understanding on the screening and characterization protocols of isolation and purification of secondary metabolites(phytochemicals) Educating and familiarizing the terms and concepts and physiology of kidney and its functions, research concepts and scientific knowledge on kidney markers and molecular aspects and impart knowledge and basics of antioxidants and free radicals.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to,

CO1	Understand the basic knowledge on Indian medicinal practice and overview of secondary metabolites
CO2	ll kniw the structure, function and application of secondary metabolites
CO3	lerstand the screening, isolation and characterization of the secondary metabolites
CO4	liver metabolism and its functions and anatomy and physiological significance of liver and kidney disorders
CO5	uired scientific information and updations on antioxidants and free radicals status

UNIT – I

Overview of secondary metabolites : Definition, types. Classification, Metabolism, Distribution, Significance, Economic importance of secondary metabolism. Clinical applications and as natural remedial source.

UNIT – II

Seconday metabolites: definition, types (alkaloids, steroids, glycosides and flavonoids). Structure chemistry, biosynthesis, metabolism and regulation of secondary metabolites, secondary metabolites as plant therapeutics, economic importance of secondary products.

UNIT – III

Screening of secondary metabolites – Phytochemical analysis, Biochemical methods, quantative and qualitative analysis. Separation procedures, purification and structural elucidation of secondary compounds of ;therapeutic potential- by HPLC & NMR spectroscopy.

UNIT – IV

An overview of liver metabolism and its functions. Anatomy and physiological significance of liver and kidney disorders. Liver toxicity, nephrotoxicity, animal models-basis of liver and kidney studies. Therapeutic options for hepatic and kidney disease, inflammatory diseases. Allopathy and ayurveda.

UNIT – V

Free radicals – Introduction, modern theory of free radical, Oxidative stress, free radical scavengers. Antioxidants – Definition, property and biological significance. Antioxidants –

Enzymes and vitamins. Antioxidants as markers for various disorder diseases. Medicinal plants as a source of Direct and indirect antioxidant activity.

Reference:

1. Handass., Kaul.M.K.,1996. Supplement to cultivation and utilization of medicinal plants. Regional research laboratory . Chapter 1, 2 & 5.
2. Colleen smith, Allan D., Marks. Lieberman., Basic medical biochemistry- a clinical approach. Second edition. 2005. Cippincott Williams and wilkings publishers 439 : 842.
3. Trivedi.P.C. Plant Biotechnology. Recent advances. 2000. Panima publishing corporation. 350
4. Irfen A.Khan. Atiya khanum . Role of Biotechnology in medicinal and Aromatic plants, volume II,First edition 1999. Ukaaz publications. 392.
5. Peter J.Lea. Richard.C.Leegood. Plant biochemistry and molecular biology, 2nd edition, 1999. John wiley and sons publication 2000.
6. Thoma M.Devlin. Textbook of Biochemistry with clinical correlations, 5th edition 2002 wiley – liss publications -480.
7. Geoffrey L. Zubay. Biochemistry. 4th edition,1998. WCB Mc Graw- Hill Publications. Chapter 17.
8. Gajera HP, Patel Sr. Gdakiya BA 2005. Antioxidant properties of some therapeutically active medicinal plants – an overview. Journal of medicinal and aromatic plant sciences. 27.91-100.
9. Seth SD, Bhawana Sharana. Medicinal Plants in India, Indian journal of medical research 120, July 2004,pp 9-11.
10. Buchanan, B.Gruissem. W.Jones.R.L. Biochemistry and Molecular biology of Plants. 1st edition. 2004. I.K. International .Pvt. Ltd. Chapter 24.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	H	L	M	L	M	H	L
CO2	M	L	H	L	M	H	H	L
CO3	H	L	H	M	M	M	M	L
CO4	H	L	M	H	M	H	H	L
CO5	M	M	H	L	L	M	H	L

H-High; M-Medium; L-Low

CLINICAL BIOCHEMISTRY & TOXICOLOGY

COURSE CODE : **19 MPBCE03**

MARKS 100

COURSE OBJECTIVES : to understand the basics of mechanism in health and in disease

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to,

CO1	Grasp the importance of serum enzyme activities in various diseases
CO2	derstand the acute, subacute and chronic toxicity studies
CO3	derstand the basics of cancer biology
CO4	Imbibe the fundamental and applications of cell culture
CO5	mprehend the applications of nanoscience in research

UNIT-1

Serum enzyme activities in diseases

Principle and assay of transaminases, phosphatases, isocitrate dehydrogenase, 5' nucleotidase, streptokinase, asparaginase, α-hydroxybutyrate dehydrogenase, ceruloplasmin, γ-glutamyl transpeptidase, creatine kinase, lactate dehydrogenase, amylase, lipase, choline esterase. Enzyme pattern in disease - Hepatobiliary disease, myocardial infarction.

UNIT-2

Toxicology

Principles of toxicology and treatment of poisoning. Heavy metals antagonists. Non-metallic environmental toxicants. Methods involved in development of new drug. Preclinical toxicological studies. Calculation of LD_{50} ED_{50}. Acute, subacute and chronic toxicity studies. Irwin profile test. Pre-clinical pharmacokinetic and dynamic studies. Lipinski's rule for drug like molecule. High throughput screening (*in-vivo and in-vitro*) for preclinical pharmacokinetic and pharmacodynamic studies.

UNIT-3

Cancer biology

Introduction: Cancer cell - morphology and growth characteristics. Types of growth- hyperplasia, dysplasia, anaplasia and neoplasia. Types and prevalence of cancer. Nomenclature of neoplasms, classification based on origin/organ.

UNIT-4

Animal biotechnology

Animal cell culture: Fundamentals and applications. Organ and tissue slice techniques. Culture media for animal cells, cultured cells - Biology and characterization, primary culture and cell lines, cell viability and cytotoxicity, cell transformation and cell cloning.

UNIT-5

Nano Science

Historical perspective of nano materials - specific features of nano materials classification of nano materials - Reasons for development of nano materials challenges in nano science and technology - Metal structure and bonding - Quantum confinement (Reduction of size). Applications in nano technology.

Reference

1. Devlin, T.M. 2010. 7th Edtion, Text book of Biochemistry with Clinical Correlations.
2. Williams, D.A. et al., 2008. 6th Edition, Foye's Principles of Medical Chemistry.
3. Lodish, Molecular Cell Biology, 5th Edition.
4. Satyanarayana Biotechnology 12th Edition.
5. Wilson. M. 2002, 1st Edition, Nanotechnology: Basic Science & Emerging Technology.

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CO3	H	L	M	M	L	L	L	L
CO4	M	M	M	H	M	H	H	L
CO5	M	M	L	L	L	M	H	L

H-High; M-Medium; L-Low

FUNDAMENDALS OF CANCER BIOLOGY

COURSE CODE : **19 MPBCE04**

MARKS 100

COURSE OBJECTIVES : To understand the mechanisms of cancer development, progression and therapy.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to,

CO1	Understand the basics of cancer and its progression
CO2	Comprehend the factors involved in angiogenesis and epithelial mesenchymal transition
CO3	Grapple the genetics of cancer, its molecular mechanism and different pathways involved in cancer
CO4	Imbibe the interaction of involvement of mitochondria and caner
CO5	t the picture of diagnosis and therapy to counter the cancer

UNIT-I

Introduction: Theories of carcinogenesis, Knudson two hit hypothesis, Agents causing cancer-radiation, viruses, chemicals. Phases of carcinogenesis: Initiation, Promotion, Progression. Stages of cancer, Factors influencing cancer, Cancer cell-morphology and growth characteristics. Classification based on origin and organ.

UNIT-II

Angiogenesis and epithelial mesenchymal transition: Angiogenesis pocess, growth actors, inhibitors, disease arise due to insufficient and excess angiogenesis. Epithelial mesenchymal transition markers, role in invasion and metastasis, genes regulating EMT process.

UNIT-III

Genetics of cancer: Types of genetic mutations, Cell cycle and cancer, Control of cell cycle-cyclins and CDKs. Molecular mechanism of oncogenesis - proto oncogenesis, oncogene, oncoproteins, tumour suppressor genes involved in cancer, Key signaling pathways P13K/Akt/mTOR,Ras/af/MEK and wnt/beta catenin pathway and its pisological process modulation.

UNIT-IV

Mitochondria and cancer: mitochondrial reactive oxygen species, mDNA, mitochondrial metabolism, mutant metabolic enzymes, mitochondrial membrane potential, mitochondria in chemoreistance, inflammation. Apoptotic pathways, role of Bcl2, Bax, caspases, p53. Cellular defense mechanism involved in cancer.

UNIT-V

Diagnosis and Therapy: Principles and methods of cancer diagnosis-Biochemical, genetic, cytotoxic, cell growth and viability tests. Principles of cancer biomarkers and their applications. Immunoediting. Therapy via natural resources - Nanoparticle application in cancer , Nanoparticles preparation and characterization using analytical techniques FTIR, XRD,EDAX,TEM,SEM. Properties of nanopaticles. Advantges and disadvantages of nanoparticles.

Text Books

1. Franks,L.M. and Teich,N.M. 1991. An introduction to Cellular and Molecular Biology of cancer, 2nd Edition, Oxford University Press.
2. Vincent,T. *et al*., 2011. Principles and Practice of Oncology: Primer of the Molecular
   Biology of Cancer, 1st Edition, Lippincott Williams and Wilkins.
3. Weinberg,R.A. 2013. The Biology of Cancer, 2nd Edition, Garland Science.
4. Hesketh,R. 2013. Introduction to Cancer Biology, Cambridge University Press.
5. 5. PDF research articles from google.

Reference Books

1. McKinnell, R.G. *et al*., 2006. The Biological Basis of Cancer, 2nd Edition, Cambridge University Press.
2. Pelengaris,S. and Khan,M. 2002. The Molecular Biology of Cancer, 2nd Edition, Wiley Blackwell.

MAPPING

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
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CO3	M	L	L	M	L	L	M	L
CO4	M	M	M	H	M	H	H	L
CO5	M	M	L	L	L	M	H	L

H-High; M-Medium; L-Low

MICROBIAL FERMENTATION AND MOLECULAR TECHNIQUES

COURSE CODE : **19 MPBCE05**

MARKS 100

COURSE OBJECTIVES : To understand the basics of fermentation technology and to have a basic knowledge in various molecular techniques to be applied in the field of Biotechnology and allied subjects.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to,

CO1	Comprehend the prokaryotic and eukaryotic cell organization and their functions
CO2	Understand the basic concepts of fermentation technology
CO3	Grapple the mode of different types of fermentation and down stream processing
CO4	Imbibe the role of microbes and how its is helpful in environmental management
CO5	Understand the techniques involved in techniques molecular biology

UNIT-1

Prokaryotic and Eukaryotic cell organization, Microbial growth factors, Bacterial growth-Lag phase, Exponential phase, linear phase and continuous phase, Diauxic growth. Bacterial membranes-Gram positive and Gram negative bacteria, structure and biosynthesis of cell wall components.

UNIT-II

Introduction to fermentation technology- Isolation and screening of industrially important microbes, Innoculam preparation. Strain improvement for better yield. Primary and secondary detection of fermentation products.

UNIT-III

Mode of fermentation-Fed Batch, Batch and Continuous culture process and its control. Submerged and solid state fermentation, Fermentation design. Down stream processing-recovery and purification of intracellular and extra cellular products.

UNIT-IV

Microbes and Environment- Microbes in mineral recovery-Bioleaching and Biosorption, Microbial recovery of petroleum, Microbial degradation of xenobiotics, Seawage biodegradation, biodegradation-production of biomass, production of single cell protein and mushroom cultivation.

UNIT-V

Isolation and purification of cellular and plasmid DNA, Agarose gel electrophoresis, Methods for labeling nucleic acids and probes, Methods of DNA sequencing, Analysis of DNA , RNA and Protein by Blotting techniques. PCR techniques and its applications.

Reference books

1. Principles of Fermentation technology. Peter F Stanbury, Allan Whitaker & Stephan Hall. 3rd edition, Elsevier Science & technology.
2. Principles and applications of fermentation technology. Arindam Kuila, Vinay Sharma. Scrievener Publishing.
3. Fermentation Microbiology and Biotechnology. Mansi El Mansi and Charlie Bryce. Taylor and Francis Ltd.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	M	M	M	L	L	H	L
CO2	M	L	L	M	L	L	H	L
CO3	L	L	L	M	L	L	M	L
CO4	M	L	L	H	L	M	H	L
CO5	L	M	L	L	L	M	H	L

H-High; M-Medium; L-Low

19 MPBCG06: NANOTECHNOLOGY IN HEALTH AND MEDICINE

COURSE CODE : **19 MPBCE06**

MARKS 100

COURSE OBJECTIVES : To make the students aware of the applications of nanotechnology in health and medicine

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to,

CO1	Understand the basic concepts of nanotechnology
CO2	mprehend the tools and techniques used in nanotechnology
CO3	derstand the properties, methods of preparation and application of different types of nanomaterials
CO4	Imbibe the role nanotechnology in medicine
CO5	lerstand the ethical issues and limits of nanotechnology

UNIT-I

Introduction to Nanotechnology:- Nanotechnology- Nanometer, Richard Feynman's idea of nanotechnology, General purpose of nanotechnology, History of nanotechnology, uses and future of nanotechnology

UNIT-II

Tools & Techniques:- Basic idea of nanotechnology, Tools and Techniques used in nanotechnology, Electron Microscope- imaging in the TEM, drawbacks of TEM, applications of the TEM, Scanning Electron Microscope (SEM)- functions of SEM, Difference between SEM & TEM. Atomic Force Microscope (AFM)-working and possible imaging modes of AFM, advantages and disadvantages of AFM over SEM.

UNIT-III

Nanomaterials:- Nanomaterials- Properties of nonmaterial, methods to prepare nano materials and applications of nanomaterials. Carbon nanomaterials- different forms, methods to produce carbon nonocones, fullerenes, carbon nanotubes. Properties, industrial applications and toxicity of carbon nanotubes. Nanowires- types, properties, applications, production, structure and uses.

UNIT-IV

Nanotechnology in Medicine:- Nanomedicine- Nanotechnology in medical field, application of nanotechnology in the treatment of cancer, health and environmental impacts of nonmaterial, how nanoparticles behave inside the organism, lab safety guidelines for handling nonmaterials.

UNIT-V

Ethical issues and limits of nanotechnology:- Ethical issues and some limits of nanotechnogy- safety, hazard and public policy issues, information loss, physical limits and nonsense, solution cause problems, change cause problems, clean, decentralized production cause problems, even wealth and leisure cause problems, changing employment cause problems.

Reference books

1. Introduction to nanoscience and nanotechnology. Alain Nouailhat, Gabor L Hornyak, Harry F Tibbals, Joydeep Dutta, John Moore. CRC Press, Taylor and Francies Ltd.
2. Introduction to nanotechnology. Charles P Poole, Frank J Owens. John Wiley and Sons publication.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	M	M	M	L	L	H	L
CO2	M	H	H	M	M	H	H	L
CO3	M	L	L	M	L	L	M	L
CO4	M	M	M	H	M	H	H	L
CO5	M	M	L	L	L	M	H	L

H-High; M-Medium; L-Low

MEDICINAL HERBS & ETHANOMEDICINE

COURSE CODE : **19 MPBCE07**

MARKS 100

COURSE OBJECTIVES : The purpose of this course is to introduce the students to the secondary metabolites in traditional Indian medicine for various its application in various ailments

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to,

CO1	Understand an overview and therapeutic potential medicinal plants
CO2	Understand types , structure, biosynthesis and mechanism of secondary metabolites
CO3	Understand the screening, separation and structure identification of secondary metabolites
CO4	Understand an overview of Liver metabolism
CO5	Imbibe the definition of free radicals and oxidative stress

UNIT- I

Introduction : An overview of Indian Medicine Ayurveda. Traditional medicine /Ethnomedicine. Classification, taxonomy and phytochemistry of Medicinal Plants. Therapeutic potential of Medicinal plants- A global perspective. Recent development of some natural products.

UNIT- II

Secondary Metabolites : Definition, types (Alkaloids, Steroids ,glycosides and flavonoids). Structure, Chemistry, Biosynthesis, Metabolism and Regulation of Secondary Metabolites, Secondary metabolites as plant therapeutics, Economic importance of Secondary products.

UNIT- III

Screening of Secondary Metabolites –Phytochemical analysis, Biochemical methods, qualitative and quantitative analysis –Separation procedures, Purification, and Structural elucidation of secondary compounds of therapeutic potential by HPLC and NMR Spectroscopy .

UNIT- IV

An overview of Liver metabolism and function. Anatomy and Physiological Significance

of Liver and kidney .Liver disease, Kidney disorders, Molecular basis of Liver and Kidney disorders, Liver toxicity, Nephrotoxicity. Animal Models–Basis for clinical studies, Inflammatory disease – Allopathy and Ayurveda.

UNIT- V

Free radicals –Introduction, Modern theory of free radical, Oxidative Stress, Free Radical Scavengers. Antioxidants-Definition ,property and biological significance, Antioxidants – Enzymes and Vitamins. Antioxidants as markers for liver and kidney disease. Medicinal plants as a source of Direct and Indirect antioxidant activity.

REFERENCE BOOKS

1. Supplement to cultivation and utilization of medicinal; plants. Handass ,Kaul.M.K,1996.
2. Basic Medical Biochemistry –A Clinical approach second edition, Collen Smith Allan.D.
3. Plant Biochemistry –Recent Advances by Trivedi .P.C.
4. Role of Biotechnology in Medicinal and Aromatic Plants ,Volume-II, Irfen.A.Khan, Atiya Khanum
5. Plant Biochemistry by Dev and J.B. Harborne
6. Plant biochemistry and Molecular biology,Peter J .Lea, Richard C.Leegood
7. Biochemistry and Molecular Biology of Plants – Buchanan, 2009. Grussem Jones
8. Methods in Plant biochemistry and Molecular biology, William .V.Dashek
9. Introduction to plant Biochemistry, T.W.Goodwin and E.I .Mercer.
10. Biochemistry, Zubay G L.,1988. 4th edition, W M C Brown Publishers.
11. Medicinal plants in India , Indian Journal of Medical Research Seth S.D.Bhavana Sharma .
12. Antioxidants properties of some therapeutically active medicinal plant –an overview Gajera.H.P,Patel Sr .Gdakiya

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	M	M	L	L	H	L
CO2	H	H	H	M	M	L	H	L
CO3	H	L	L	M	L	L	M	L
CO4	H	M	M	M	M	L	H	L
CO5	H	M	L	L	L	M	H	L

H-High; M-Medium; L-Low

METABOLIC DISORDERS AND NATURAL THERAPEUTICS

COURSE CODE : **19 MPBCE08**

MARKS 100

COURSE OBJECTIVES :. To understand different types of metabolic disorders and the availability of tools to identify them.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to,

CO1	Understand the glucose homeostasis and its abnormality
CO2	Understand the basics of diabetes and its metabolism
CO3	Know the causes, types and changes happening in obese patients
CO4	Understand the pathophysiology of obesity
CO5	Understand the biochemical tests and analysis in diabetes and obesity

Unit I

Diabetes: Introduction, Glucose Homeostasis- role of tissues and hormones. Diabetes mellitus - classification (Type I, II and Gestational diabetes). Insulin, Insulin resistance, mechanism of action. Role of natural products in the control of diabetes mellitus.

Unit II

Blood pressure measurement –Tai 1 cuff method, Current therapy in the treatment of diabetes. Streptozotocin and nicotinamide mode of actions. Insulin signaling and glucose metabolism, hypoglycemic agents.

Unit III

Obesity- Epidemiology of Obesity: Global to Local. Obesity - Causes, types, metabolic changes. Therapeutical properties of natural products against obesity.

Unit IV

Pathophysiology of obesity. Roles of leptin and adiponectin. Prevention-adult, pediatric obesity. Treatment- Diet and physical exercise, Medical and Surgical approaches to Obesity.

Unit V

Biochemical analysis: Blood glucose, Plasma Insulin (RIA method), lipids profile,

antioxidants (enzymic and nonenzymic), Primer designing, RT-PCR analysis. Role of antioxidants in diabetes and obesity.

Reference Book

1. Handass ,Kaul.M.K, 1996 Supplement to cultivation and utilization of medicinal; plants.
2. Plant Biochemistry –Recent Advances by Trivedi .P.C.
3. Methods in Plant biochemistry and Molecular biology by William V. Dashek
4. Antioxidants properties of some therapeutically active medicinal plant–an overview Gajera.H.P,Patel Sr .Gdakiya
5. Medicinal plants in India ,Indian Journal of Medical Research Seth S.D, Bhavana Sharma

MAPPING

6.

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	M	M	L	L	H	L
CO2	H	H	H	M	M	H	M	L
CO3	H	M	H	L	L	L	M	L
CO4	H	M	M	H	M	H	M	L
CO5	H	M	L	L	L	M	H	L

H-High; M-Medium; L-Low

19 MPBCG09: PHARMACOGNOSY

COURSE CODE : **19 MPBCE09**

MARKS 100

COURSE OBJECTIVES : To make aware of students the identification, physicochemical characterization, cultivation, extraction, preparation, quality control, and biological assessment of drugs.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to,

CO1	Understand an overview of traditional medicines of india
CO2	Understand the plant secondary metabolites, importance and its metabolism
CO3	Understand the screening of secondary phytoconstitutents
CO4	Understand the free radical generation and oxidative stress
CO5	Understand the applications of few examples of Indian medicinal plants

UNIT I

Introduction: An overview of Indian medicine, Ayurveda. Traditional medicine /Ethnomedicine. Classification, taxonomy and phytochemistry of medicinal plants.

UNIT II

Secondary metabolites: Definition, types (alkaloids, steroids, glycosides and flavonoids).Structure, chemistry, biosynthesis, metabolism and regulation of secondary metabolites. Economic importance of secondary products.

UNIT III

Screening of secondary metabolites-Phytochemical analysis, biochemical methods, qualitative and quantitative analysis-Separation procedures, purification and structural elucidation of secondary compounds of therapeutic potential by HPLC and NMR.

UNIT IV

Free radicals-Introduction, Modern theory of free radicals, oxidative stress, Free radicals scavengers. Antioxidants-Definition, property and biological significance. Enzymes and vitamins as antioxidants. Medicinal plants as a source of direct and indirect antioxidant activity.

UNIT V

Properties, uses and therapeutic applications of medicinal plants - *Azadirachta indica,*

Curcuma longa, Piper nigrum, *Punica granatum.*

REFERENCE BOOKS:

1. Plant Biochemistry by Dey and J.B.Harborne. 1st Edition, Kindle Edition
2. Biochemistry and Molecular biology of plants-Buchanan,Grussem Jones. Academic press.
3. Introduction to Plant Biochemistry by T.W.Goodwin and E.I.Mercer. Second Edition. Pergamon Press.
4. Antioxidants properties of some therapeutically active medicinal plants-An overview by Gajera.H.P,Patel Sr.Gdakiya.
5. Indian Medicinal plants. P.K.Warrier, V.P.K Nambiar and C. Ramankutty. Volume 1, 4.University press.
6. Indian Medicinal plants. Ram P. Rastogi and B.N. Mehrotra. Volume 5, Central Drug Research Institute, Lucknow.

MAPPING

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CO3	H	M	M	L	L	L	M	L
CO4	H	M	M	M	M	H	H	L
CO5	H	M	L	L	L	M	H	L

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CLINICAL DIAGNOSIS AND ENZYMOLOGY

COURSE CODE : **19 MPBCE10**

MARKS 100

COURSE OBJECTIVES : To describe the role of enzymes in health and disease particularly the application of enzymes in diagnosis, prognosis and treatment.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to,

CO1	Understand the definition and basics of clinical Biochemistry and enzymology in health and disease
CO2	Understand and analyze the disorders of amino acid, protein and nucleic Acid Metabolism
CO3	Understand and analyze disorders of carbohydrate and lipid Metabolism
CO4	Understand the basics of liver and kidney disease
CO5	Understand various clinical tests in disease diagnosis and will be able to have the basics of cancer and its mechanism.

Unit I: Basics of Clinical Chemistry and Enzymology

Definition and scope of clinical biochemistry in diagnosis, a brief reviews of units used in expressing clinical values and standard solutions. Quality control. Manual vs automation in clinical laborotary. Clinical enzymology- Definitions of function and non-functional plasma enzymes. Isozymes and diagnostic tests. Enzyme pattern in health and disease special mention of plasma lipase, amylase, cholinesterase, ALP, ACP, SGOT, SGPT, LDH and CPK.

Unit II: Disorder of Amino Acid, Protein and Nucleic Acid Metabolism

Disorder of amino acid metabolism- Pertaining to tyrosine, phenyl alanine, tryptophan and cysteine. **Disorder of protein metabolism**- protein deficiency disease, plasma proteins significance and variation in disease- agammaglobulinemia, multiple myeloma, proteinuria.**Disorder of nucleic acid metabolism-** Gout- primary and secondary.

Unit-III: Disorders of Carbohydrate and Lipid Metabolism

Blood sugar homeostasis: Role of tissues and hormones in the maintenance of blood sugar-modified glucose tolerance test- laboratory diagnosis of early and lateral diabetics, diabetic coma and secondary degenerative damage associated with diabetes mellitus, glycogen storage disease. Galactosemia, Fructosuria. **Disorders in Lipid Metabolism**: Lipid metabolism in liver and adipose tissues, plasma lipoprotein and hypolipoproteinaemia, hyper cholesterolemia, lipidemia associated with ketosis, atherosclerosis and obesity.

Unit IV: Liver and Kidney Diseases

Liver disease – jaundice and types of jaundice, Crigler-Najjar syndrome, cirrhosis, hepatic coma, fatty liver. Liver function test, laboratory findings in jaundice. Kidney and relation to blood pressure, routine qualitative analyses of urine and urinary sediments -renal function test-free water clearance, renal function in acute and chronic glomerularnephritis, acute and chronic renal failure. Laboratory test for peritoneal and haemodialysis, renal calculi. Biochemical findings in recurrence of stones, abnormal constituents of urine diagnostic significance (blood, bilirubin, ketones bodies, bile salts, porphyrin, uric acid and protein)

Unit V: Clinical tests and oncology

Clinical tests in blood (HbA1c test, E.S.R. screening for sickle cell anemia, prothrombin time), body fluids (C-reactive protein test, rheumatoid arthritis (RA), immunologic test for pregnancy); amniotic fluid (Origin, composition, analysis of amniotic fluid); Cerebro spinal fluid (meningitis, convulsive stages, cerebral haemorrhage and thrombosis). Oncology: Cancer cell – morphology and growth characteristics. Biochemical changes in tumor cells. Tumor markers – AFP, CEA and HcG agents causing cancer – radiation, viruses, chemicals. Multistep carcinogenesis – initiation, promotion, progression. Oncogenes and proto oncogenes – mechanisms of protooncogene activation. Tumor suppressor gene – p53. BAX, BCL2.

Books for Reference:

1. Practical Clinical Biochemistry-Herald Varely, 1954
2. Practical Clinical Biochemistry Methods and Interpretations- Chawla, 2003
3. Clinical Chemistry-lawrence A. Kaplan, 2004
4. Medicinal Biochemistry –A. Aroor, 2011
5. Text Book of Clinical Biochemistry- Burtis, 2012
6. Clinical Biochemistry –Tietz, 2015
7. Biochemistry – Devlin, 2016
8. Biochemistry- Chatterjee, 2016
9. Text Book of Medical lab Technology- Praful B. Godkar, 2016

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CO4	H	M	L	M	M	H	H	L
CO5	H	M	L	M	M	M	H	L

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NANOMATERIALS AND NANOSCIENCE

COURSE CODE : **19 MPBCE11**

MARKS 100

COURSE OBJECTIVES : Application of various tools and techniques to understand the different types of nanaomaterial application in health industry.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to,

CO1	Understand the basic concepts of phytochemicals and its characterization using various techniques
CO2	Understand the properties of materials and nanoparticles
CO3	Understand the nanostructured material characterization techniques
CO4	Understand the bottom-up synthesis-Top-down Approach of nanocomposites
CO5	Understand the applications of Bioinformatics tools in research

Unit I:

Phytochemistry:

Phytochemicals: Classification, Qualitative and Quantitative analysis, methods of extraction, isolation, separation. Identification and characterisation of phytochemicals: HPTLC, HPLC, GLC, NMR, IFTR and GC-MS. Primary and secondary metabolism, functions of secondary metabolites. Beneficiary of secondary metabolites in Agriculture, Pharmacy, Medicine and Industry.

Unit II:

Introduction to Nanomaterials:

Properties of materials & nanomaterials, role of size in nanomaterials, nanoparticles, semiconducting nanoparticles, nanowires, nanoclusters, quantum wells, conductivity and enhanced catalytic activity compared to the same materials in the macroscopic state

Unit III:

Nanostructured Materials Characterization Techniques:

X-ray diffraction (XRD), SEM, EDAX, TEM, IR, Elemental mapping, FTIR, UV-Visible spectrophotometer, Laser Raman Spectroscopy, X-ray Photoelectron Spectroscopy (XPS), Electrochemcial Characterization measurements.

Unit IV:

Nanocomposites:

Preparation methods: Bottom-up Synthesis-Top-down Approach, Metal-Metal nanocomposites, Polymer-Metal nanocomposites, Ceramic nanocomposites: Nanoparticles

polymer ensembles; Applications of Nanopolymers in Catalysis. (One example for each type).

Unit-V:

Bioinformatics:

Outline of Bioinformatics, Introduction and Applications of Bioinformatics. The internet. Useful search engines. Classification of biological databases. Structural databases- PDB, SCOP - Structural Classification of Protein, MMDB – Molecular Modeling Database. Comparison of structures by tools – PyMOL, Chimera.

Reference Books:

1. Biochemistry and Molecular Biology of Plants by Bob B.Buchanan, Wilhelm Griuessm and Russel L.Jones,2nd Edn 2007.Published by I K International Pvt Ltd.India
2. Phytochemical techniques By Dr.Raman'2005. Saunders Publication,NewDelhi
3. Introduction to Phytochemicals: Secondary Metabolites from Plants with Active Principles for Pharmacological Importance. byBy Nadia Mendoza and Eleazar M. Escamilla Silva-Open Acess- 2018
4. Phytochemical Methods A Guide to Modern Techniques of Plant Analysis by Harborne, A.J.,1998, Springer Netherlands.
5. NANO: The Essentials, T. Pradeep, McGraw-Hill, 2007.
6. Biomaterials, SV Bhat, Ed. 2, Narosa publishers, 2009
7. Textbook of Nanoscience and Nanotechnology, B S Murty, P Shankar, Baldev Rai, B.B Rath and James Murday, Univ. Press, 2012.
8. Nanotechnology, AIP Press, Springer-Verlag, Gregory Timp, editor, 1999, New York, (ISBN 0-387-98334-1)
9. Trends in Bioinformatics, Shanmughavel, P. 2006. Pointer Publishers, Jaipur, India.

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CO2	H	H	H	L	M	M	M	L
CO3	H	L	L	M	L	L	M	L
CO4	H	L	L	H	L	M	M	L
CO5	H	M	L	L	L	M	H	L

H-High; M-Medium; L-Low