Master of Science - Biochemistry

BIOCHEMISTRY LAB

CourseCode:BCH4105 **Credit Units:02**

Course Objective: To help students learn bioorganic preparations and analysis.

Bioorganic Preparations and Analytical Biochemistry

1. Organic Preparations-
   a) p-nitrophenylacetate
   b) An aromatic alpha- and beta-glucoside starting withglucose
   c) Dinitrophenyl hydrazone of ascorbic acid or any otherketone
   d) Dinitrophenyl derivative of an aminoacid
2. Qualitative and Quantitative Analysis of–
   a) Carbohydrates
   b) Amino acids andproteins
   c) Free and boundphosphate
   d) VitaminC
3. Fats: Acid number, saponification, and iodinevalues
4. Fractionation of egg proteins and itsquantification
5. Isolation of casein from milk and itsquantification

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text/References

- Experimental Biochemistry- R.W. Switzer & L.F. Garrity (W.H.Freeman&Co.)
- Modern Experimental Biochemistry - R. Boyer (PearsonEducation)
- Practical Biochemistry - K. Wilson & J. Walker (Cambridge Univ.Press)
- Laboratory Manual in Biochemistry - J. Jayaraman (Narosa PublishingHouse)
- Practical Biochemistry - D.T. Plummer (TATAMcGraw-Hill)
- Practical Biochemistry - R.C.Gupta& S.Bhargava
- Experimental Physiology and Biochemistry -P.V.Chadha
- Experimental Biochemistry – A Student Companion - B.S. Rao & V.Deshpande,
- I.K. Interational Pvt. Ltd. (N. Delhi, Mumbai, Bangalore)2005.

BIOCHEMICAL ENGINEERING LAB

CourseCode:BCH4107 **Credit Units:02**

Course Objective: To help students learn the laboratory techniques used in the food, feed, and pharmaceutical, biotechnology, and water treatment industries.

Course Content:

Expt. 1: Cheese Production from Milk
Expt. 2: Enzymes in Laundry Detergents
Expt. 3: Digestion of Protein into Amino Acid
Expt. 3: Amino Acid Assay by Ninhydrin Colorimetric Method
Expt. 4: Cellulose Degradation-Glucose Assay by Dinitrosalicylic Colorimetric Method
Expt. 5: Starch Hydrolysis by Amylase
Expt. 6: Enzyme Purification by Salt (Ammonium Sulfate) Precipitation, by Acetone Precipitation and by IsoelectricPrecipitation
Expt. 7 Enzyme Immobilization by Gel Entrapment- Entrapment in Polyacrylamide Gel,Entrapment InAlginate Gel,Enzyme Entrapment In Gelatin Gel
Expt. 8: Aseptic Culture Techniques --- Use of a Steam Autoclave and Petri Dish Preparation.
Expt. 9: Batch Submerged Fermentation of Baker Yeast in a Shaker Flask,Cell DIfferentiation by Gram'sStain,Measurements of Cell Biomass Concentration
Expt. 10: Wine Fermentation

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text/References

- Experimental Biochemistry- R.W. Switzer & L.F. Garrity (W.H.Freeman&Co.)
- Modern Experimental Biochemistry - R. Boyer (PearsonEducation)
- Practical Biochemistry - K. Wilson & J. Walker (Cambridge Univ.Press)
- Laboratory Manual in Biochemistry - J. Jayaraman (Narosa PublishingHouse)
- Practical Biochemistry - D.T. Plummer (TATAMcGraw-Hill)
- Practical Biochemistry - R.C.Gupta& S.Bhargava
- Experimental Physiology and Biochemistry -P.V.Chadha
- Experiments in Microbiology -Gilstrap-Kleyn-Nester
- Experimental Biochemistry – A Student Companion - B.S. Rao & V.Deshpande,
- I.K. Interational Pvt. Ltd. (N. Delhi, Mumbai, Bangalore)2005.

SEMINAR

CourseCode: BCH4108 **Credit Units:01**

Guidelines for Seminar

a) Choosing thetopic
b) Finding relevantmaterials
c) Presentation
d) Response toqueries
e) Submission of the writeup

Presentation of the seminar will be of 30 min maximum (25 min presentation and rest question answer session)

Examination Scheme:

Components	**Weightage**
Content	30
Presentation	40
Response to the queries	20
Write up	10

Syllabus - Second Semester

CLINICAL BIOCHEMISTRY

CourseCode: BCH4204 **Credit Units:03**

Course Objective: The objective of the course is to provide students with a knowledge of the various diseases arising due to disorders in the biochemical processes of cells, involving the hepatobilliary, myocardial and endocrinal systems and the classification and role of antibiotics.

Course Contents:

MODULE-I: Errors in metabolism:

Introduction, Metabolic disorders of carbohydrates, galactosemia, glycogen storage disease, deficiency of glucose-6-phosphate dehydrogenase, Hypoglycemia, Diabetes mellitus. Metabolic disorder of lipid: Tay-Sachs disease, Nieman Pick disease. Metabolic disorder of amino acid: phenylketonuria, alkaptonuria, Maple syrup urine disease. Metabolic disorder of nucleotides: gout, Lesch-Nyhan Syndrome.

MODULE-II: Function of liver in health and disease:

Jaundice, Hepatitis; liver function test. Evaluation of organ function test: Assessment and clinical manifestation of renal, hepatic, pancreatic, gastric & intestinal function, enzyme of pancreatic origin and biliary tract, test of myocardial infarction.Enzymes as clinical diagnostic tools. Endocrinal disturbance: protein hormones and hormones of hypothalamus, pituitary, thyroid and steroid hormones. Disorders of blood coagulation,different types of anaemia.

MODULE-III: Antibiotics:

Classification. Primary mode of action of penicillin, streptomycin,chloramphenicol, tetracycline, actinomycin D, mitomycin C, polyenes, mechanism of antibiotics resistance, multiple drug resistance.

MODULE-IV: Cancer:

Oncogenes, different types of malignancy, Hodgkin‟s and non-Hodgkin‟s lymphoma, leukemia, anti cancer drugs, chemotherapy

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Books recommended:

- Notes on clinical chemistry- Whitby-Smith-Beekett-Walker. BalackwellSci,Inc.
- Principle of internal Medicine- Harison T. R. McGrow Hill,NY.
- Antibiotics” Vol. I && II -Gotleib&Shaw.

COMPUTER PROGRAMMING USING C LANGUAGE LAB

CourseCode:BCH4205 **Credit Units:01**

Course Objective:
This course aims to introduce the students with Computer Programming Concepts, taking C language as the medium with examples emphasized from chemistry. The course lays emphasis on foundations & basic principles of Computer Programming. The language is introduced in a structural manner, beginning with the simple constructs and working up to more complex issues, for example, pointers and dynamic data structures, file manipulationsetc

Course Contents:

MODULE-I: Introduction
Introduction to computer, history, von-Neumann architecture, memory system (hierarchy, characteristics and types), H/W concepts (I/O Devices), S/W concepts (System S/W & Application S/W, utilities). Data Representation: Number systems, character representation codes, Binary, octal, hexadecimal and their interconversions. Binary arithmetic, floating point arithmetic, signed and unsigned numbers, Memory storage unit.

MODULE-II: Programming in C
History of C, Introduction of C, Basic structure of C program, Concept of variables, constants and data types in C, Operators and expressions: Introduction, arithmetic, relational, Logical, Assignment, Increment and decrement operator, Conditional, bitwise operators, Expressions, Operator precedence and associativity. Managing Input and output Operation, formatting I/O.

MODULE-III: Fundamental Features in C
C Statements, conditional executing using if, else, nesting of if, switch and break Concepts of loops, example of loops in C using for, while and do-while, continue and break. Storage types (automatic, register etc.), predefined processor, Command Line Argument.

MODULE-IV: Arrays and Functions
One dimensional arrays and example of iterative programs using arrays, 2-D arrays Use in matrix computations. Concept of Sub-programming, functions Example of user defined functions. Function prototype, Return values and their types, calling function, function argument, function with variable number of argument, recursion.

MODULE-V: Advanced Features in C
Pointers, relationship between arrays and pointers Argument passing using pointers, Array of pointers. Passing arrays as arguments.
Strings and C string library.
Structure and Union, Defining C structures, giving values to members, Array of structure, Nested structure, passing strings as arguments. File Handling.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

- Fundamentals of Computer: V. Rajaraman (PrenticeHall)
- "ANSI C" by EBalagurusamy
- YashwantKanetkar, "Let us C", BPB Publications, 2nd Edition,2001.
- Computers in Chemistry: K.V. Raman (Tata McGrawHill)

ADVANCED BIOCHEMISTRY LAB

CourseCode: BCH4206 **Credit Units:02**

Course Objective: To provide students hands-on training in the major instrumentation techniques common to biochemistry.

Course Contents:

1. Titration of a weak acid using a pH meter, preparation ofbuffers
2. VerificationofBeer-Lambert‟slawanddeterminationofabsorptioncoefficients
3. Paper chromatography – Separation of amino acids and carbohydrates in amixture
4. Thin layer chromatography of fattyacids
5. Column chromatography – Separation of a mixture of proteins and salt using Sephadexcolumn
6. DNA/Protein GelElectrophoresis

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text/References

- Experimental Biochemistry- R.W. Switzer & L.F. Garrity (W.H.Freeman&Co.)
- Modern Experimental Biochemistry - R. Boyer (PearsonEducation)
- Practical Biochemistry - K. Wilson & J. Walker (Cambridge Univ.Press)
- Laboratory Manual in Biochemistry - J. Jayaraman (Narosa PublishingHouse)
- Practical Biochemistry - D.T. Plummer (TATAMcGraw-Hill)
- Practical Biochemistry - R.C.Gupta& S.Bhargava
- Experimental Physiology and Biochemistry -P.V.Chadha
- Experimental Biochemistry – A Student Companion - B.S. Rao & V.Deshpande,
- I.K. Interational Pvt. Ltd. (N. Delhi, Mumbai, Bangalore)2005.

GENETICS LAB

CourseCode: BCH4207 **Credit Units:01**

Course Objective: To make the students observe the basic cell division processes of cells so that theycan have a clear understanding of the structural details and functions ofchromosomes.

Practicals:

A) Plant/Animal/Human Cytogenetics: Understanding principles of cell culture, aseptic technique, assessing quality and quantity of metaphases, harvesting of mitotic chromosomes, estimation of mitotic index, methodologies of staining and banding in the production of various cytogenetic preparations, clinical relevance of chromosomal abnormalities (heritable / acquired), ideogram preparation, karyotype identification (from photographs) and explaining aspects of chromosome structure / behaviour crucial for interpreting results of chromosomeanalysis.

B) Molecular Genetics: Demonstrate familiarity with databases of information pertaining to genes, markers, maps and diseases such as Online Mendelian Inheritance in Man (OMIM) and Medline; understanding the principles of designing oligonucleotide primers for PCR and utilization of relevant software; PCR applications in assigning genotypes to RFLP / VNTR sequences; screening samples for identifiedmutations.

C) Biochemical /Pharmacogenetics: electrophoretic screening for enzyme polymorphisms; estimation of enzyme deficiency / drugsensitivity.

Examination Scheme:

Components	**A**	**CT**	**S/V/Q**	**HA**	**EE**
Weightage (%)	5	15	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text/References

- Experimental Biochemistry- R.W. Switzer & L.F. Garrity (W.H.Freeman&Co.)
- Modern Experimental Biochemistry - R. Boyer (PearsonEducation)
- Practical Biochemistry - K. Wilson & J. Walker (Cambridge Univ.Press)
- Laboratory Manual in Biochemistry - J. Jayaraman (Narosa PublishingHouse)
- Practical Biochemistry - D.T. Plummer (TATAMcGraw-Hill)
- Practical Biochemistry - R.C.Gupta& S.Bhargava
- Experimental Physiology and Biochemistry -P.V.Chadha
- Experiments in Microbiology -Gilstrap-Kleyn-Nester
- Experimental Biochemistry – A Student Companion - B.S. Rao & V.Deshpande,
- I.K. Interational Pvt. Ltd. (N. Delhi, Mumbai, Bangalore)2005.

CLINICAL BIOCHEMISTRY LAB

CourseCode: BCH4208 **Credit Units:01**

Course Objective: To provide students with hands-on-training in isolation of cell organelles, DNA and RNA from various tissues, serum cholestrol and estimation of the same, qualitative and quantitative analysis of saliva, urea and experiments on blood.

Course Contents:

1. Fractionation of cell organelles from liver and planttissues
2. Preparation of Cytochrome C from goatheart
3. Isolation of NAD from brewer‟syeast
4. Isolation and estimation of RNA and DNA from yeast, liver, andplants
5. Extraction, separation and determination of absorption spectra of plantpigments
6. Isolation and estimation of serumcholesterol
7. Qualitative and quantitative analysisof:

(i) Saliva(α-amylase)
(ii) Urine (urea, uric acid, glucose, proteins, Bence-Jones proteins, Cl-, PO3-3,Ca+2)

8. Experiments onblood

(a) Identification and count of bloodcorpuscles
(b) Estimation ofhaemoglobin
(c) Determination of A/G ratio inserum

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text/References

- Experimental Biochemistry- R.W. Switzer & L.F. Garrity (W.H.Freeman&Co.)
- Modern Experimental Biochemistry - R. Boyer (PearsonEducation)
- Practical Biochemistry - K. Wilson & J. Walker (Cambridge Univ.Press)
- Laboratory Manual in Biochemistry - J. Jayaraman (Narosa PublishingHouse)
- Practical Biochemistry - D.T. Plummer (TATAMcGraw-Hill)
- Practical Biochemistry - R.C.Gupta& S.Bhargava
- Experimental Physiology and Biochemistry -P.V.Chadha
- Experiments in Microbiology -Gilstrap-Kleyn-Nester
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Syllabus - Third Semester

RECOMBINANT DNA TECHNOLOGY

CourseCode: BCH4301 **Credit Units:04**

Course Objective: Recombinant DNA technology deals with genetic manipulation of plants/animals by incorporating DNA sequences from different sources into a single recombinant molecule and finds its application in plant genomics and clinical research. This course will help students in understanding the tools used in gene exploration, creation of genomic library, cloning and expression of proteins, tissue culture and an idea about transgenic plants and animals.

Course Contents:

MODULE-I: BASICS OF RDT
Recombinant DNA technology Restriction endonucleases – types, nomenclature and recognition sequences Vectors , Plasmid, cosmid

MODULE-II:
Chemical synthesis of genes , Gene Libraries Gene Amplification - PCR - apparatus, types, principle and application, emphasis on primer designing , real time , two step and reverse transcriptase PCR. Cloning and expressions of protein, IPTG induction, use of His, GST and Sumo tags.

MODULE-III: PLANT AND ANIMAL TISSUE CULTURE
Plant tissue culture- general techniques, nutrient media, Callus, Cloning and regeneration ,Anther, meristem, ovary and embryo culture Animal tissue culture Hybridoma technology and Monoclonal antibodies, In vitro fertilization and embryo transfer in human

MODULE-IV: MODERN BIOTECHNOLOGY
Somatic hybridization, somaclonal variation, transgenic plants, transgenic animals Cell culture products , DNA finger printing, vaccines

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

References:

- Molecular Biotechnology – Bernard R.Glick and Jack J.Pasternak
- Plant cell, tissue and organ culture – O.N.Gamborg
- Gene Biotechnology - S.N.Jogdanad
- Biotechnology and Genomics - P.K.Gupta
- Plant Tissue Culture -K.G.Ramawat
- Biotechnology - B.D.Singh

INSTRUMENTAL LAB

Course Code: BCH4307 **Credit Units: 01**

Course Objective: To provide training to students in handling of some important instruments in laboratory for performing some biological experiments.

Course Contents:

1. pH meters : Use of pH meter : determination of pKa.
2. Use of pH meter: titration of amino acids.
3. Conductometry: Estimation of Cl- or SO4 by conductometric precipitation titration.
4. Spectrophotometry: Verification of Beer's law, use of least square method for drawing the graph, estimation of molar absorbance, unknown concentrations
5. Absorption spectrum of hemoglobin isolated from whole blood.
6. Dosimetry: measurement of exposure dose- rate due to UV- irradiation by ferrioxalateactinometry.
7. Radioactivity: to draw the characteristic curve of a GM counter and to find out the plateau characteristics
8. To test that the radioactive counts (low) follow Poisson's distribution law.
9. Viscometric study of DNA and protein denaturation.
10. Gel chromatography for separation of a mixture

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

Text/References

- Experimental Biochemistry- R.W. Switzer & L.F. Garrity (W.H.Freeman& Co.)
- Modern Experimental Biochemistry - R. Boyer (Pearson Education)
- Practical Biochemistry - K. Wilson & J. Walker (Cambridge Univ. Press)
- Laboratory Manual in Biochemistry - J. Jayaraman (Narosa Publishing House)
- Practical Biochemistry - D.T. Plummer (TATA McGraw-Hill)
- Practical Biochemistry - R.C.Gupta& S. Bhargava
- Experimental Physiology and Biochemistry - P.V.Chadha
- Experiments in Microbiology - Gilstrap-Kleyn-Nester
- Experimental Biochemistry – A Student Companion - B.S. Rao & V. Deshpande,
- I.K. InterationalPvt. Ltd. (N. Delhi, Mumbai, Bangalore) 2005.

SUMMER INTERNSHIP EVALUATION+PROJECT

CourseCode:BCH4335 **Credit Units:06**

Methodology:

Practical training is based on the theoretical subjects studied by students. It can be arranged within the college or any in any related industrial unit or in any research lab. The students are to learn various industrial, technical and administrative processes followed in the industry/research. In case of on campus training the students will be given specific tasks of synthesizing /testing/analysis/characterization. On completion of the practical training the students are to present a report covering various aspects learnt by them and give a presentation of the same.

Examination Scheme

Feedback from Industry:	20
Training Report:	40
Viva:	15
Presentation:	25
Total	**100**

MICROBIOLOGY LAB

CourseCode:BCH4311 **Credit Units:02**

Course Contents:

1. Observation of microorganisms using bright field microscope - Bacteria, Protozoa, Moulds and Yeasts, Algae – from naturalhabitat
2. Observation of microorganisms using stainingtechniques:
   a. Monochromestaining
   b. Negative /Relief staining (Capsulestaining)
   c. Gram staining ofbacteria
   d. Sporestaining
3. Observation of motility in bacteriausing:
   a. Hanging drop method and Cragie‟s tubemethod
   b. Swarming growthmethods
4. Enumeration of yeast cells using a countingchamber
5. Cultivation ofmicroorganisms:
   a. Preparation of simple laboratory nutrient media (solid and liquid) and using them to cultivate bacteria.
   b. Observation of the growth of cultures and reporting of colony and cultural characteristics (Nutrient and Mac Conkey‟sagar)
6. Isolation of bacteria by streak platetechnique
7. Enumeration of bacteria from fermented food / soil / waterby:
   a. Spread platemethod
   b. Pour platemethod
8. Aseptic transfer techniques (slant to slant, broth to broth, broth to agar and Agar toAgar)
9. Preservation of cultures on slants, soil and on grain surfaces; revival of these cultures and lyophilized cultures.
10. Checking sterilization efficiency of autoclave using a biological indicator(B.stearothermophilus)
11. Demonstration of checking of efficacy of chemical disinfectant: Phenol Coefficient Rideal Walker method)
12. Preparation of Winogradsky column and observation of different types of microorganisms using bright filedmicroscope.
13. Study of normal flora ofskin:
    a. Cultivating and observing different morphoforms of bacteria fromskin
    b. Studyofeffectofwashingskinwithsoapanddisinfectantonit‟smicroflora
14. a. To study the effect of different parameters on growth of E. coli: pH, temperature, sodium chloride concentration
    b. Study of Oligodynamic action of heavy metal

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

References/Texts

- Experiments in Microbiology -Gilstrap-Kleyn-Nester
- Wilson K. and Walker J.M. (2005) Principles and Techniques of Biochemistryand
- Molecular Biology. 6th Edition. Cambridge UniversityPress.
  David T. Plummer (1993) An Introduction To Practical Biochemistry, 3rd Edition, Tata
- McGraw-Hill Publishing Company Limited, NewDelhi

ADVANCED CELL BIOLOGY AND DEVELOPMENTAL BIOLOGY LAB

CourseCode:BCH4312 **Credit Units:02**

Course Contents:

Advanced Cell Biology

1. Isolation & visualization of cellularproteins.
2. Quantification of cells by Trypan blue exclusiondye.
3. Karyotype analysis following Orcein staining: *Allium cepa/ Allium sativum/ Nigella sativa/Aloevera.*
4. Meiotic chromosome analysis following Carmine staining: *Sagittaria sp./Rhoeo sp./Setcreasea sp./ Alliumsepa*.
5. Study of pollen mitosis: *Allium cepa*, *Rhoeosp*.
6. Adhesion and suspension cell culturetechnique
7. Characterization of haemtaopoietic cells inmice
8. Microtubules in vesicle transport in fishchromatophores.
9. Assessment of proliferation in cultured cells by MTTassay.
10. Observation of DNA fragmentation in apoptoticcells.

Developmental Biology

1. Study of life cycle of *Drosophilamelanogaster*.
2. Study of embryogenesis in *Drosophila* and pattern of gene expression in embryogenesis by *insitu* hybridization technique.
3. Immunohistochemical staining to study the expression pattern of gap and pair- rule geneproteins.
4. Dissection and study of larval and prepupal wing, leg and eye antennal imaginal discs of*Drosophila.*
5. Patterning of the adult wing and demonstration of the effect of cell death on the patterning of theadult wing.
6. Study of Homeotic genemutations.
7. Identification of diagnostic features of the early stages of developing Chick embryo (brain, eye, heart andsomites).
8. Preparation of different stages of chick embryo from blastoderm to subsequentchanges.
9. Developing stages of fish embryo-characteristics anddocumentation.
10. Chromosome preparations from rat bone marrow and polytenechromosomes.
11. Karyotyping

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

References/ Texts

- Molecular Cell Biology, Lodishet. al., (2007), W.H. Freeman and Company, New York,USA
- Molecular Biology of the Cell, Alberts et. al., (2008),Garland Science, Taylor & Francis Group, New York,USA.
- Cell Physiology Source Book : A Molecular approach, Sperelakis, (2001), Academic Press, New York,USA.
- Developmental Biology, Gilbert, (8th Ed., 2006) Sinauer Associates Inc., Massachusetts,USA.
- Principles of Development, Wolpert, Beddington, Brockes, Jessell, Lawrence, Meyerowitz, (3rd Ed., 2006), Oxford University Press, NewDelhi.
- Analysis of Biological Development, Kalthoff, (2nd Ed., 2000), McGraw-Hill Science, New Delhi,INDIA.

ECOLOGY LAB

Course Code:BCH4313 **Credit Units:02**

1. Assessment of density, frequency and abundance of plants/animal in a community using various techniques i.e. transect, quadrateetc.
2. Determination of physical and chemical characteristics ofsoil.
3. Assessing influence of light, temperature and moisture on plant germination andgrowth.
4. Assessing influence of soil nutrient status on plant germination andgrowth.
5. Spatial variations of dissolved oxygen concentration in water and percentagesaturation.
6. Dissolved free carbon dioxide dynamics in relation to pH and alkalinity ofwater.
7. Estimation of total hardness. total alkalinity and Salinity ofwater.
8. Estimation of Primary productivity and assessment of nutrient status of waterbodies.
9. Microbial analysis of soil andwater.
10. Study of insect diversity insoil.
10. Productivitydeterminationofdifferentecosystems-Lindeman"sefficiency.
11. Microbial analysis of soil andwater.
12. Evolutionary studies on adaptivecharacters.

Examination Scheme:

Components	**A**	**CT**	**S/V/Q**	**HA**	**EE**
Weightage (%)	5	15	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

References/ Texts:

- Field Sampling: Principles and Practices in Environmental Analysis, Conklin, A.R. Jr.,(2004), CRC Press.
- Practical Methods in Ecology, P.A. Henderson(2003).
- Principles and Standards for Measuring Primary Production, Fahey, T.J. and Knapp, A.K., (2007), Oxford University Press,UK
- Ecological Modeling, Grant, W.E. and Swannack, T.M., (2008),Blackwell.
- Fundamental Processes in Ecology: An Earth system Approach, Wilkinson, D.M., (2007), Oxford University Press,UK

Syllabus - Fourth Semester

ADVANCED ANALYTICAL TECHNIQUES

Course Code: BCH4405 **Credit Units: 03**

Course objective: To give the students an advanced knowledge of analytical techniques, which will provide them enough confidence to start their career in research as well as in industry with ease.

Course Contents:

Module-I: Mass spectrometry

Mass spectrometry - high resolution mass spectrometry, linked scans, MIKES, HV scan, negative ion mass spectrometry, applications of field desorption, plasma desorption, fast atom bombardment, electrospray and tandem mass spectrometry and FTMS. Determination of biomolecules by absorption photometry, fluorimetry, biochemical applications of mass spectrometry. Manometry and respiration measurement, oxygen polarography, BOD estimation, resting cells preparation. Principles of microscopy - light, darkfield, phase contrast, fluorescence and eletron microscope, fixing and preparation of samples.

Module II: Research based analytical techniques:

Principles of centrifugation - calculation of r.c.f. values, ultracentrifuges, density gradients. Enzyme assays-Biomolecules separation by chromatography, paper, thin layer and column chromatrography, ion exchangers, molecular sieves, affinity columns, Gas chromatography and HPLC. Electrophoresis - theoryPreparations of solutions of different strength and scales (molarity, molality, normality, formality, w/w, v/v ratio calculation exercises) buffers, agarose and polyacrylamide matrices, gel apparatuses, native and SDS -PAGE gels, Isoelectric focussing, Zymograms. Immunochemical methods - immunoassays, immunodiffusion, rocket immunoelectrophoresis. Use of radioisotope tracer techniques in biochemical experiments and their detection.

Module-III: UV & CD spectroscopy

UV-visible spectroscopy - advancements in experimental methods, analysis of mixtures, dissociation constants of acids and bases, study of enzyme catalysis, applications of ORD and CD.

Module-IV: NMR Spectroscopy

experimental aspects, FT NMR, factors influencing sensitivity and resolution, applications of chemical shift and spin-spin coupling, Karplus equation and conformational analysis; NMR of carbon-13, fluorinee-19, phosphorous-31, Nitrogen- 14 and 15 and oxygen 17. EPR Spectroscopy - epr spectra of solutions, frozen solution, especially organic molecules.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text & References:

- Scopes R, Protein purification: Principles and practice, Springer-Verlag NY 1982.
- Plummer D.T., An introduction to practical biochemistry, 3rd edition, Tata McGraw Hill, 1988.
- P.Gerhardt (Ed.), Methods for General Bacteriology, Amer.Soc. Microbiol/ Washington, 1981.
- N.C. Price and L. Stevens, Fundamentals of Enzymology, Oxford University Press, 1989.
- C.N.R. Rao, UV and Visible spectroscopy, Butterworths, 3rd edition, London,1972.

- K. Nakanishi, Infrared absorption spectroscopy - practical, Holden-Day, Inc., San Francisco and Nankodo Company Ltd., Tokyo, 1962.
- J.K.M. Sanders and B.K,. Hunter, Modern NRM Spectroscopy: A Guide for chemists, Oxford University Press, London, 1987.
- W. Kemp, NMR in Chemistry, A Multinuclear Introduction, McMillan, London, 1986.
- W.R. Croasmun and R.M.K. Carlson (Ed), Two-dimensional NMR spectroscopy, Applications for Chemists and Biochemists, VCH, New York, 1987.

RESEARCH PAPER

Course Code:BCH4406 **Credit Units:1**

Objectives

The objective of this course is to judge the understanding as well as application of the knowledge gained by the students. The aim of the term paper is to provide the students with an opportunity to further enhance their knowledge in a sector of their choice by undertaking a significant practical unit of examining and analyzing various aspects of Chemistry & its application at a level commensurate with the learning outcomes of the various courses taken up them in the ongoing semester.

A research paper is primarily a record of intelligent reading in several sources on a particular subject. The students will choose the topic at the beginning of the session in consultation with the faculty assigned.

Guidelines:

1. The research paper will be related to the contemporary research issue and the topic will be given by the supervisors of the department.
2. The research paper has to prepared/communicated before the commencement of Semester examinations.
3. The paper will carry 100 marks that will be marked on the basis of understanding and organization of content based on the literature review. The Bibliography shall form an important part of the paper.
4. Examples of a few broad areas for researchpaper (List is indicative, not exhaustive)
   - Inorganic chemistry
   - Organic chemistry
   - Physical chemistry
   - Green chemistry
   - Agriculture chemistry

Evaluation Scheme:

Organisation and relevance of content	Literature Review	Bibliography	Publication	Total
30	**30**	**20**	**20**	**100**

PROJECT WORK-DISSERTATION

Course Code:BCH4437 **Credit Units:9**

GUIDELINES FOR PROJECT FILE AND PROJECT REPORT

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critically analyzed by the faculty guide and corrected by the student at each stage.

PROJECT FILE

The Project File may be a very useful tool for undertaking an assignment along-with a normal semester, an exploratory study, sponsored projects, a project undertaken during summer period or any other period as per curriculae where the researcher is working with a company/organization. The project/ assignment may also be a part of the bigger research agenda being pursued by a faculty/ institution/department

The Project File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation. This file may be considered in continuous assessment.

In general, the File should be comprehensive and include:

- A short account of the activities that were undertaken as part of theproject;
- A statement about the extent to which the project has achieved its statedobjectives;
- A statement about the outcomes of the evaluation and dissemination processes engaged in as part of theproject;
- Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from theproject;
- Any problems that have arisen and may be useful to document for futurereference.

PROJECT REPORT

The Project Report is the final research report that the student prepares on the project assigned to him. In case of sponsored project the layout of the project could be as prescribed by the sponsoring organization. However, in other cases the following components should be included in the project report:

- **Title or CoverPage**
  The title page should contain Project Title; Students Name; Programme; Year and Semester and Name of the Faculty Guide.
- **Acknowledgement(s)**
  Acknowledgment to any advisory or financial assistance received in the course of work may be given. It is incomplete without students signature.
- **Abstract**
  A good"Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project. It should not exceed more than 1000 words.
- **Table ofContents**
  Titles and subtitles are to correspond exactly with those in the text.

- **Introduction**
  Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.
- **Materials andMethods**
  This section should aim at experimental designs, materials used (wherever applicable). Methodology should be mentioned in details including modifications undertaken, if any. It includes organization site(s), sample, instruments used with its validation, procedures followed and precautions.
- **Results andDiscussion**
  Present results, discuss and compare these with those from other workers, etc. In writing this section, emphasis should be laid on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow.

  Note that in writing the various sections, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary, do not write in "point" form.

  While presenting the results, write at length about the various statistical tools used in the data interpretation. The result interpretation should be simple but full of data and statistical analysis. This data interpretation should be in congruence with the written objectives and the inferences should be drawn on data and not on impression. Avoid writing straight forward conclusion rather, it should lead to generalization of data on the chosen sample.

  Results and its discussion should be supporting/contradicting with the previous research work in the given area. Usually one should not use more than two researches in either case of supporting or contradicting the present case of research.

- **Conclusion(s) &Recommendations**
  A conclusion should be the final section in which the outcome of the work is mentioned briefly.
  Check that your work answers the following questions:
  - Did the research project meet its aims (check back to introduction for statedaims)?
  - What are the main findings of theresearch?
  - Are there anyrecommendations?
  - Do you have any conclusion on the research processitself?

- **Implications for FutureResearch**
  This should bring out further prospects for the study either thrown open by the present work or with the purpose of making it more comprehensive.
- **Appendices**
  The Appendices contain material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.
- **References**
  References should include papers, books etc. referred to in the body of the report. These should be written in the alphabetical order of the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognisedsystem.

Examples:

For research article:

Voravuthikunchai SP, Lortheeranuwat A, Ninrprom T, Popaya W, Pongpaichit S, Supawita T. (2002) Antibacterial activity of Thai medicinal plants against enterohaemorrhagic*Escherichia coli* O157: H7. *ClinMicrobiolInfect* , 8 (suppl 1):116–117.

For book:

Kowalski,M.(1976) Transduction of effectiveness in *Rhizobium meliloti*. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), 7: 63-67

The Layout Guidelines for the Project File & Project Report:

- A4 sizePaper
- Font: Arial (10 points) or Times New Roman (12points)
- Line spacing:1.5
- Top and bottom margins: 1 inch/ 2.5 cm; left and right margins: 1.25 inches/ 3cm

ASSESSMENT OF THE PROJECT FILE AND THE PROJECT REPORT

Essentially, the assessment will be based on the quality of the report, the technical merit of the project and the project execution. Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in. The Project should fulfill the following *assessment objectives:*

- Range of Research Methods used to obtaininformation
- Execution ofResearch
- Data Analysis (Analyze Quantitative/ Qualitativeinformation)
- QualityControl
- Conclusions

Assessment Scheme:

Continuous Evaluation:

40% (Based on punctuality, regularity of work, adherence to plan and methodology, refinements/mid-course corrections etc. as reflected in the Project File.)

Final Evaluation:

60% (Based on the Documentation in the file, Final report layout, analysis and results, achievement of objectives, presentation/ viva)

It is recommended that the Final evaluation should be carried out by a panel of evaluators.