

RANI DURGAVATI VISHWAVIDYALAYA, JABALPUR

**SYLLABUS PRESCRIBED FOR THE DEGREE OF THE MASTER OF SCIENCE IN
BIOCHEMISTRY IN UNIVERSITY TEACHING DEPARTMENT
(Academic Session 2016 – 2017 & Onwards)
[PROGRAMME UNDER CHOICE BASED CREDIT SYSTEM - ORDINANCE 222]**

This brochure of the programme for the M.Sc. degree in Biochemistry consists of three parts, viz., (A) Information from the relevant Ordinance(s) / Statutes, (B) Scheme of examination and (C) Courses of study.

(A) INFORMATION FROM THE RELEVANT ORDINANCE (S)/STATUTES

1. DURATION OF THE COURSE

M.Sc. Biochemistry will be a full time two-year programme to be covered in four semesters, each of six months duration. The first year of the programme will complete the I and II semesters, and the second year will complete the third and fourth semesters. The maximum duration of the programme shall be twice of the minimum duration of the programme, i.e. four years.

2. ADMISSION TO THE COURSE

The number of seats shall be in accordance with the directives by the University. A candidate, who after having secured the B.Sc. degree with at least 50 % marks from a recognized university with a subject of Life Science, shall be eligible for admission to the course. The admission to the course will be on the basis of the merit and according to guidelines from the University and Government of Madhya Pradesh. After the term-end examination at the end of each semester, the student will be provisionally admitted to the next semester.

3. TUITION AND OTHER FEES

The admitted candidate shall pay the course fee in addition to the tuition fee and such other fees as prescribed by the University.

4. PROGRAM OF THE STUDY

The semester will consist of 16-18 weeks of academic work. One credit is equivalent to one hour (60 minutes) of teaching (lecture or tutorial) or two hours (120 minutes) of practical work/field work per week throughout a semester. The credits associated with the courses will be valid credits, while credits associated with comprehensive viva voce will be virtual credits. In the end term examination there will be **three components, namely Core Courses, Elective Courses and Skill Development Course**, except for the 4th semester where every student will carry out and submit a **dissertation**.

The syllabus for the theory and practical examination will be prescribed by the Board of Studies in Biochemistry, R.D. University, Jabalpur.

5. CONTINUOUS EVALUATION

During the semester, a teacher offering the course will do the continuous evaluation of the student at three points of time by conducting three tests of 20 marks each. Of these, two must be written tests and the third may be written test/quiz/seminar/assignment. Marks obtained in two best tests out of three will be awarded to the student.

6. ATTENDANCE

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The student whose attendance is less than 75 % will not be allowed to appear in the end semester examination and he/she will be declared fail in that semester.

7. END SEMESTER EXAMINATION

There shall be end semester examination at the end of first, second & third semester. The semester examination will be held every year normally in December and June or on the dates declared in the academic calendar of the University. A student proceeding to appear in end semester examination will submit through the Head of the Department his / her application on the prescribed form along with required examination fee, etc. to the Registrar of the University. Every student will appear in four respective theory papers and two combined practical examinations in first, second, & third semesters except for the fourth semester. In the fourth semester, every student will be allotted dissertation work in lieu of four theory papers. Allotment of the dissertation will be done by a committee comprising of the Dean of Faculty of Life Science, Head of Department of Biological Science, one Professor and one Associate Professor of the Department by rotation according to seniority. The dissertation may be undertaken in UTD or in any of the National Laboratories/ Institute/ Universities/ Government approved Companies/ Industries. In such cases, there will be two supervisors, one from the parent department and another from the place where the student completes his/her dissertation work.

The dissertation will be evaluated by the external examiner who has expertise in the concerned subject. For the purpose of holding viva-voce, the supervisor will be the internal examiner along with the external examiner who has evaluated the dissertation. The scheme of marks for evaluating the various components of the dissertation will be followed as given in the syllabus.

8. CONDITION FOR A PASS

For each course, each student has to appear in at least two tests and end semester examination, otherwise the student will be awarded “Ab” grade. The total marks obtained in end-semester examination, and best of two tests under continuous evaluation will decide the grade in that course. In addition, student also has to get valid credits for Skill development modules’ courses and Virtual credits and grades for Comprehensive viva-voce. The grading will be made on 10-point scale as follows:

Letter Grade	Grade Points	Description	Range of Marks (%)
O	10	Outstanding	90-100
A+	9	Excellent	80-89
A	8	Very Good	70-79
B+	7	Good	60-69
B	6	Above Average	50-59
C	5	Average	40-49
P	4	Pass	35-39
F	0	Fail	0-34
Ab	0	Absent	Absent

For passing the examination in each semester, a candidate must have secured a minimum of 35% marks (“P” Grade: 4 Grade Points) in the course. If the marks obtained by the student in a course are less than the minimum cut-off percentage of marks, then “F” Grade will be awarded. If a student obtains “F” or “Ab” Grade in any course, he/she will be

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treated to have failed in the course. He/she has to reappear in the examination of the course as and when conducted or arranged by the UTD. Marks obtained earlier in continuous assessment may be carried forward and added to the marks obtained in repeat end semester examination to decide the grade in the repeat course.

The theoretical, practical and skill development courses can be repeated whenever offered or arranged by the UTD but within maximum duration of the programme. He/she can avail multiple repeat attempts to pass the course. The student will be promoted to the next semester if he/she secures at least 12 valid credits in a semester. In case the student secures less than 12 valid credits in any semester, then the student will be asked to repeat entire semester and that semester will be treated as zero semester.

The decision of the teacher regarding the evaluation and the grade shall be final. However, a student submits in writing for review of his Marks/Grade to the Head/Director who will place the case before the board of comprehensive viva voce. The decision of the board will be final. Result of review will be declared by the concerned Head/Director. Review is effective only when grade improves. Review will be allowed only if –

- The prescribed fee is paid.
- The candidate applies within 7 days of the declaration of the grade in that course.

There will be no provision for revaluation. However the candidates can apply for Re-totaling in one course per semester.

9. In matters not covered under this Ordinance, general rules of the University shall be applicable.

10. In case of any dispute/ambiguity, the ruling of the Vice-Chancellor shall be final and binding.

(B) SCHEME OF EXAMINATION: Semester I

(A) Continuous evaluation, Theory, Practical		Credits	Maximum Marks		
			Continuous Evaluation	End Semester Exam	Total
Course Code	Course Title				
I Core courses					
BCC101	General Microbiology	3	40	60	100
BCC102	Cell Biology and Physiology	3	40	60	100
BCC103	Organic and Biophysical Chemistry	3	40	60	100
BCC104	Practical based on BCC101 & BCC102	4	40	60	100
BCC105	Practical based on BCC103 & BCE101/ BCE102	4	40	60	100
II Electives courses (Any one to choose)		3	40	60	100
BCE101	Biomolecules				
BCE102	Bioenergetics and Intermediary Metabolism				
III Skill Development course					
BCS101	Skill Development module 1	2	Grade Point will be provided by Skill Development Centre		
Total valid credits		22			
(B) Comprehensive viva voce (virtual credits)		4	50		

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Semester II

(A) Continuous evaluation, Theory, Practical		Credits	Maximum Marks		
			Continuous Evaluation	End Semester Exam	Total
Course Code	Course Title				
I Core courses					
BCC201	Methods in Molecular Biology	3	40	60	100
BCC202	Advanced Enzymology	3	40	60	100
BCC203	Biostatistics & Computer Application	3	40	60	100
BCC204	Practical based on BCC201 & BCC202	4	40	60	100
BCC205	Practical based on BCC203 & BCE201/ BCE202/ BCE203	4	40	60	100
II Electives courses (Any one to choose)		3	40	60	100
BCE201	Biology of the Immune System				
BCE202	Resource utilization and conservation				
BCE203	Microbial Metabolism				
III Skill Development course					
BCS201	Skill Development module 2	2	Grade Point will be provided by Skill Development Centre		
Total valid credits		22			
(B) Comprehensive viva voce (virtual credits)		4			50

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Semester III

(A) Continuous evaluation, Theory, Practical		Credits	Maximum Marks		
			Continuous Evaluation	End Semester Exam	Total
Course Code	Course Title				
I Core courses					
BCC301	Plant Biochemistry	3	40	60	100
BCC302	Nutritional Biochemistry	3	40	60	100
BCC303	Clinical Biochemistry	3	40	60	100
BCC304	Practical based on BCC301 & BCC302	4	40	60	100
BCC305	Practical based on BCC303 & BCE301/ BCE302/ BCE303/ BCE304	4	40	60	100
II Electives courses (Any one to choose)		3	40	60	100
BCE301	Advanced Molecular Biology				
BCE302	Agricultural Microbiology				
BCE303	Bioprocess Engineering and Technology				
BCE304	Biotechnology				
III Skill Development course					
BCS301	Skill Development module 3	2	Grade Point will be provided by Skill Development Centre		
Total valid credits		22			
(B) Comprehensive viva voce (virtual credits)		4			50

*Both (A – Core courses; One Elective course and Skill Development modules) & (B) are compulsory components of a semester. The grades awarded in the comprehensive Viva-voce shall be shown separately in the Grade Sheet.

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Semester IV

DISSERTATION	Credits	Maximum Marks
A. Valuation		
(i) Language & Presentation	18	300
(ii) Review of Literature		
(iii) Methodology		
(iv) Analysis & interpretation of Result		
B. Viva-Voce EXTERNAL		100
C. Viva-Voce INTERNAL		
Total		400

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(C) COURSES OF STUDY

FIRST – SEMESTER

Course Code BCC101: GENERAL MICROBIOLOGY (Total Credits = 03)

UNIT I

Types of microorganisms, general characteristics of main groups of microorganisms, criteria used in the classification of microorganisms-cytology, genetics host specialization, serology, and different phases of growth.

UNIT II

Nutrition and growth of microbial cells; gram positive and gram negative organisms; structure and functions of peptidoglycan in gram-positive and gram-negative organisms; functions of polymeric components in outer membrane and acidic polymers in gram-negative organisms.

UNIT III

Special features of bacterial metabolism; food spoilage, fermentation, food-borne infection; role of microorganisms in domestic and industrial sewage.

UNIT IV

Virus structure, virus proteins, virus classification and methods of assay; replications of RNA viruses-negative strand (VSV), positive stand (polio), retroviruses (including all events in the infectious cycle).

UNIT V

Replication of DNA viruses (adenovirus of SV 40); virus-host interaction, vaccines and prevention-smallpox / polio / AIDS.

Books recommended

G. N. Cohen (2011) *Microbial Biochemistry*; Springer.

B.K.P. Singh (2014) *Microbial Biochemistry*.

Manish L. Shrivastava (2008) *Microbial Biochemistry*.

J.R. Quayle (2010) *Microbial Biochemistry*: University Park Press.

Michael J. Pelczar *et al*; (2004) *Microbiology, Tata Mcgraw-Hill New Delhi*

COURSE CODE BCC102: CELL BIOLOGY AND PHYSIOLOGY (Total Credits = 03)

UNIT I

Cell classification: cell variability (size, shape, complexity, function); structural organization of prokaryotic and eukaryotic cells; the ultra structure of nucleus, mitochondria, endoplasmic reticulum- rough and smooth, Golgi apparatus, lysosomes and peroxisomes and their functions; the cytoskeleton-microtubules and microfilaments; type of tissues, epithelium-types, epithelial apices- glycocalyx, microvilli; the basement membrane- structural features and characteristics. The extracellular matrix-collagen, elastin, fibrillin, fibronectin, laminin and proteoglycans. Plant and animals cells: variation in structure and function.

UNIT II

Viruses: structure and classification, life cycle; culture technique to study cell division by mitosis; cell cycle; cell differentiation organogenesis, morphological, functional and biochemical maturation of tissues; Biochemistry of cancer-carcinogenesis, characteristics of cancer cell, agents promoting carcinogenesis.

UNIT III

Blood: composition and function of plasma, erythrocytes including Hb, leucocytes and thrombocytes, plasma protein in health and diseases; blood coagulation- mechanism and regulation; fibrinolysis, transfers of gases- oxygen and carbon dioxide. Bohr effect and chloride shift.

UNIT IV

Hydrogen ion homeostasis-factors regulating blood pH- buffers, respiratory and renal regulation. Acid-base-balance-metabolic and respiratory acidosis and alkalosis. Digestive system: composition, function and regulation of saliva, gastric, pancreatic, intestinal and bile secretions-digestion and absorption of carbohydrates, lipids, proteins.

UNIT V

Excretory system: structure of nephron, formation of urine, glomerular filtration, tubular re-absorption of glucose, water and electrolytes-tubular secretion; regulation of water and electrolytes balance, role of kidneys and hormones in their maintenance; structure of neuron; origin and propagation of nerve impulse, synaptic transmission, neuromuscular junction.

COURSE CODE BCC103: ORGANIC AND BIOPHYSICAL CHEMISTRY
(Total Credits = 03)

UNIT I

Isomerism and Stereochemistry: structural isomerism, stereo- isomerism, geometrical isomerism (E & Z nomenclature), optical isomerism, optical activity, meso- compounds, specific rotation
chirality: chiral center enantiomers, diastereoisomers DL. RS. Threo- erythro-notations, conformation and configuration, dihedral angles, conformational analysis of ethane, n-butane, cyclohexane, mono and di-substituted cyclohexane, monosaccharides, boat and chair forms eclipsed gauche and staggered conformations, axial and equatorial bonds, anomers and mutarotation, epimers, pyranose and furanose.

UNIT II

Biophysical Chemistry: thermodynamics studies in chemistry and biochemistry: open, closed and isolated system; first law of thermodynamics, heat of formation and heat of reaction; second law of thermodynamics, molecular basis of entropy. Helmholtz and Gibbs free energy; third law of thermodynamics in understanding energies in living cells, chemical potentials, equilibrium constant

UNIT III

Water: physical properties and structure of water, hydrogen bonding, ionization of water, pH scale, acid- bases. Henderson– Hasselbalch equation, buffers ionization behavior of amino acids and proteins, titration curve, buffer solutions and their action. Types of electrodes, standard electrode potential and its determination, its relationship with emf, pH electrode, ion-selective electrode, hydrogen electrode, oxygen electrode.

UNIT IV

Radioisotope techniques and centrifugation: nature of radioactivity, decay kinetics, properties of α , β and γ emissions, measurement of radioactivity; molecular weight of bio-molecules, sedimentation of macromolecules, centrifugation techniques and their application; differential centrifugation: density gradient and ultra centrifugation techniques, sub-cellular fractionation

UNIT V

Electrophoresis & Spectroscopy, Gel electrophoresis, isoelectric focusing; UV-Vis, IR and fluorescence spectroscopy, Chromatography: partition, ion-exchange, reverse phase, gel filtration, affinity, gas chromatography, HPLC; Electron Microscopy (scanning and transmission), freeze- fracture technique.

Books Recommended

B.L. Williams and K Wilson (1981) Principles and techniques of Practical Biochemistry
Butler & Tanner Ltd.

V. Pattabhi and N. Gautam (2002) Biophysics Narosa Publishing House

M.M. Cox and D.L. Nelson (2008) Principals of Biochemistry W.H. Freeman & Company

A. Upadhyaya, K. Upadhyaya and N. Nath (2009) Biophysical Chemistry: Principals and Techniques Himalaya Publishing House

K. Wilson and J. Walker (2011) Principals and techniques of Biochemistry and Molecular Biology Cambridge University Press.

S.K. Sawhney and R. Singh (2002) Introductory Practical Biochemistry Narosa Publishing House.

P.S. Kalsi and N. Mahanta (2013) Biophysical Chemistry; *New Academic Science London*.

James P. Allen (2008) Biophysical Chemistry; *Wiley-Blackwell: Hoboken, New Jersey (United States)*.

D.N. Singh (2010) Basic Concepts of Organic Chemistry; *Pearson New Delhi*

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COURSE CODE BCC104: Practical based on Course Code BCC101 & Course Code BCC102 (**Total Credits = 04**)

Suggested list of practicals (Course Code BCC101)

1. To identify different kinds of microorganisms in hay infusion.
2. To measure growth of microorganisms.
3. To perform gram staining in bacteria isolated from air.
4. To demonstrate sugar fermentation by bacteria
5. To isolate bacteriophages from sewage.
6. To access catalase activity of bacteria.

Suggested list of practicals (Course Code BCC102)

1. To identify the different types of cells present in the leaf cross section.
2. To prepare permanent slides using the T.S of stem, root, and leaf.
3. To enumerate the number of cells present in the given sample.
4. To measure the cell size using micrometer.
5. To identify the blood typing in humans.
6. To isolate mitochondria.
7. To observe different phases of meiotic cell division.
8. To demonstrate activity of osmosis and diffusion.
9. To prepare the phosphate buffer, pH= 7.
10. To determine the concentration of urea in given sample.

COURSE CODE BCC105: Practical based on Course Code BCC103 & Course Code BCE101 / BCE102 (**Total Credits = 04**)

Suggested list of practicals (Course Code BCC103)

1. To study the pH meter.
2. To prepare a PO_4 buffer of pH-7.
3. To determine the pK_a value of acetic acid by pH-titration method.
4. To determine the pK_a of lysine.
5. To determine the absorption maxima of $\text{K}_2\text{Cr}_2\text{O}_7$.
6. To prove the validity of Beer's law.
7. To estimate the protein in BSA by Folin's reagent.
8. To plot the standard curve of glucose & fructose by DNS method.
9. To separate anion acids by paper chromatography.
10. To separate chlorophyll of spinach by paper chromatography.

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List of Elective Papers

COURSE CODE BCE101: BIOMOLECULES (Total Credits =03)

UNIT I

Structure of water and its solvent properties, Acid- bases, pH and buffer, Bi and polyprotic buffer. Free energy and spontaneity of reactions, ATP and other phosphorylated compound with their free energy of hydrolysis, Phosphoryl group transfer, Biological oxidation reductions reaction, Coupled reaction and oxidative phosphorylation, Inhibitors and uncouplers.

UNIT II

Enzyme classification, Specificity, Active site, Enzyme kinetics, Michealis Menton equation, Determination of kinetic parameters, Bi-substrate reaction and their kinetics, Enzyme inhibition and kinetics, Allosteric enzyme. Kinetics and Allosteric regulation of phosphofructo kinase

UNIT III

Structure and chemistry of macromolecules, Proteins, Carbohydrates and Lipids, Protein folding, Structure and chemistry of biomolecules such as antibiotics, Pigments, Vitamins as coenzymes, Lipid analysis by GLC and Mass Spectrometry, Oligosaccharide and Polysaccharide analysis.

UNIT IV

Biosignaling molecular mechanism of signal transduction, Gated ion channels, Nicotinic acetyl choline receptor, Receptor enzyme, The insulin receptor, G- proteins and cyclic AMP membrane transport, Biomembrane, Nutrient transport across membranes, Active and passive diffusion, Symport, Antiport and uniport, Na^+ K^+ pumps and their metabolic significance.

UNIT V

Chromatographic technique, Paper and TLC , Gel filtration, Ion exchange, Affinity, HPLC, SDS, PAGE, Isoelectric focusing, Western blotting, Protein sequencing, Mass spectrometry, MALDI , TOF, MS.

Books Recommended

J. L., Jain, Sanjay, and Jain Nitin, (1979) Fundamentals of Biochemistry (6th revised Edition). S. Chand & Co. Ltd. New Delhi.

Buchanan . B.B. Gruissem, W. and Jones .R.L. (2000) Biochemistry and Molecular Biology of Plants , American Society of Plant Physiologists, Maryland ,USA.

Albert L. Lehninger, Davis L. Nelson, Michael M. Cox. (2004) Lehninger Principles of Biochemistry.

Lea P.J. and Leegood ,R.C. (1999) Plant Biochemistry and Molecular Biology (2 nd Edition) John Wiley and Sons. Chichester, England

Berg Jeremy, Tymoczko John, Stryer Lubert (2001) Biochemistry 4th Ed, W. H. Freeman, New York.

Conn Eric, Stumpf Paul K., Bruening George, Doi Roy H., (1987) Outlines of Biochemistry 5th Ed , John Wiley and Sons, New Delhi.

Dawes Edwin A. (1972) Quantitative Problems in Biochemistry, Churchill Livingstone, Edinburgh.

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- Hall D. D. and Rao K. K. (1996) Photosynthesis 5th Ed., Cambridge University Press. 5.
- Mandelstam Joel and McQuillen Kenneth (1976) Biochemistry of Bacterial Growth, Blackwell Scientific Publication London.
- Metzler David E. (2001) Biochemistry: The chemical Reactions of Living Cells, Volume 1&2, Academic Press California.
- Moat Albert G. and Foster John W. (1988) Microbial Physiology 2nd Ed. John Wiley and Sons New York.
- Nelson D. L. and Cox M. M. (2005) Lehninger's Principles of Biochemistry, Fourth edition, W. H. Freeman & Co. New York.
- Palmer Trevor (2001) Enzymes: Biochemistry, Biotechnology and Clinical chemistry, Horwood Pub. Co. Chinchester, England.
- Segel Irvin H. (1997) Biochemical Calculations 2nd Ed., John Wiley and Sons, New York.
- Voet Donald and Voet Judith G. (1995) Biochemistry, 2nd Ed.. John Wiley and sons New York.
- White Abraham, Handler Philip, Smith Emil, Hill Rober, Lehman J. (1983) Principles of Biochemistry, Edition 6, Tata Mc-Graw Hill Companies, Inc.
- White David (2000) Physiology and Biochemistry of Prokaryotes. 2nd Ed. Oxford University Press, New York.
- Zubay Geoffrey (1998) Biochemistry, 4th Ed., W. C. Brown, New York.

Suggested list of practicals (Course Code BCE101)

1. To study working of weighing balance.
2. To study the working of pH meter.
3. To determine the pKa value of acetic acid by pH titration method.
4. Preparation of acetate buffer at pH=5.
5. Prepare Phosphate buffer at pH=8.
6. To prepare tris buffer at pH=9.
7. Estimation of protein by Lowry method.
8. Chromatographic separation by paper and thin layer Chromatography.
9. To determine pKa value of glycine.
10. Determine the absorption maxima of Potassium dichromate.
11. To prove the validity of Beer-Lambert's law.
12. Qualitative assessment of carbohydrate.
13. Qualitative assessment of lipids.
14. Qualitative assessment of proteins.
15. To prepare standard curve of glucose by anthrone method.
16. To determine the Km and Vmax of amylase enzymes.
17. To study the effect of substrate concentration on enzyme activity.
18. To study the effect of temperature on enzyme activity.

**COURSE CODE BCE102: BIOENERGETICS AND INTERMEDIARY
METABOLISM (Total Credits = 03)**

UNIT I

Bioenergetics: energy transformation, biological oxidations, oxygenases, hydroxylases, dehydrogenases and energy transducing membranes; free energy changes and redox potentials, phosphate potential, ion and proton electrochemical potentials, membrane potentials, chemo-osmotic theory; ion transport across energy transducing membranes, influx and efflux mechanisms, transport and distribution of cations, anions and ionophores. Uniport, antiport and symport mechanisms, shuttle systems.

UNIT- II

The mitochondrial respiratory chain, order and organization of carriers, proton gradient, iron sulphur proteins, cytochromes and their characterization; the Q cycle and the stoichiometry of proton extrusion and uptake. Oxidative phosphorylation, uncouplers and inhibitors of energy transfer. Fractionation and reconstitution of respiratory chain complexes. ATP synthetase complex, microsomal electron transport.

UNIT- III

Carbohydrates: glycolysis, citric acid cycle- its function in energy generation and biosynthesis of energy rich bonds, pentose phosphate pathway, alternate pathways of carbohydrate metabolism, gluconeogenesis, inter-conversions of sugars, biosynthesis of glycogen, starch and oligosaccharides.

UNIT- IV

Lipids: fatty acid biosynthesis: acetyl CoA carboxylase, fatty acid synthase; fatty acid oxidation: α , β , oxidation and lipoxidation; lipid biosynthesis: of triacylglycerols, phosphoglycerides and sphingolipids, biosynthetic pathways for terpenes and steroids.

UNIT- V

Amino acids and nucleic acids: biosynthesis and degradation of amino acids and their regulation, specific aspects of amino acid metabolism, urea cycle and its regulation, in-born errors of amino acid metabolism; Nucleic acids: degradation of purines and pyrimidines, regulation of purine and pyrimidine biosynthesis, structure and regulation of ribonucleotide biosynthesis, biosynthesis of ribonucleotides, deoxyribonucleotides and polynucleotides, inhibitors of nucleic acid biosynthesis.

Books recommended

M.M. Cox and D.L. Nelson (2008) Lehninger Principles of Biochemistry W.H. Freeman & Company

Otto Hoffmann-Ostenhof (2008) Intermediary metabolism; *Van Nostrand Reinhold (USA)*.

[P.H. Clarke](#) (1978) Intermediary metabolism; *John Wiley & Sons Ltd Hoboken, New Jersey (United States)*.

[Alexander Lowen](#) (1994) Bioenergetics; *Penguin/Arkana Books USA*.

[David G. Nicholls](#) and [Stuart Ferguson](#) (2013) Bioenergetics; *Academic Press Elsevier United States*.

Suggested list of practicals (Course Code BCE102)

1. To prepare acetate buffer of pH4.7.
2. To perform carbohydrate tests of monosaccharides, polysaccharides, disaccharides.
3. To determine protein of unknown sample by Lowry method.
4. To perform the detection of lipid in the given sample

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**COURSE CODE BCS101: SKILL DEVELOPMENT MODULES 1
(Total Credits = 02)**

**PERSONALITY DEVELOPMENT- MODULE- 1 (Semester-1)
Hrs.-30**

S. No.	Subject	Classroom Activity	Hrs.
01	Orientation , Personality Development	Worksheet	1
02	Role and Impact of Personality	Group Activity	1
03	Pre Self-Assessment (Psychometric Analysis)	PDP Assessment Sheet	2
04	Listening and Caring	Group Activity	1
05	The Art of Communication	Worksheet	1
06	Different level of Effective Communication	Worksheet	1
07	Professional Communication P-A-C	Worksheet	1
08	Rules of Professional Communication	Group Activity	1
09	Body Language - 1	Worksheet	1
10	Language Lab	Worksheet	1
11	Thought Process - 1	Worksheet	1
12	Interpersonal Skills	Worksheet	1
13	Observation & Imagination Power	Group activity	1
14	Creativity	Group Activity	1
15	Extempore - 1	Group activity	1
16	Extempore - 2	Group Activity	1
17	Presentation Skills	Worksheet	2
18	How to Draw the Attention of Audience	Worksheet	1

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19	Steps of Effective Presentation	Worksheet	1
20	Prioritizing Matrix	Worksheet	1
21	Leadership Quality	Group activity	1
22	SWOT Analysis	Worksheet	1
23	Interview Skills	Lecture	2
24	Group Discussion	Group Activity	2
25	Resume Preparation	Group Activity	1

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SECOND – SEMESTER

COURSE CODE BCC201: METHODS IN MOLECULAR BIOLOGY.

(Total Credits = 03)

UNIT I

Extraction, purification, and amplification of nucleic acid: Isolation of DNA, mRNA, rRNA, tRNA, purification of nucleic acid, mRNA enrichment, extraction and purification of plasmid DNA, quantification of nucleic acid, amplification of DNA by PCR, RACE & RT-PCR, RFLP, AFLP & RAPD.

UNIT II

Gel electrophoresis: Agarose, polyacrylamide and pulsed field gel electrophoresis; nucleic acid sequencing (DNA and RNA), radiolabelling of nucleic acid, preparation of oligonucleotide, radiolabelled DNA and RNA probes, nucleic acid hybridization (southern and northern), recovery and purification of DNA from gel, autoradiography; site directed mutagenesis, primer extension, PCR based and unidirectional deletion methods.

UNIT III

Introduction to gene manipulation: Basic techniques used in gene manipulation; enzymes used in molecular cloning: restriction enzymes, polymerases, ligases, kinases, phosphatases, nucleases, DNA binding proteins; vectors: plasmid, bacteriophage λ , cosmid, artificial chromosome (YAC, BAC)

UNIT IV

Methods for introduction of foreign DNA into vectors, transfection/transformation into different hosts: construction of DNA libraries and genomic DNA libraries; selection, screening and analysis of recombinants, isolation of specific genes by marker rescue & transposon tagging techniques.

UNIT V

Plant and animal cell cultures as a tool for genetic engineering. Ti plasmids. *Agrobacterium* transformation; application of molecular biological techniques in agriculture, taxonomy and medical science; gene targeting, gene knockout, transposon tagging; ethical & legal issues associated with transgenic organisms, IPP & IPR.

Books recommended

L.G. Davis M.D. Dibner J.F. Battey (1986) Basic Methods in Molecular Biology: *ELSEVIER Health Reed Elsevier India Pvt.Ltd.14th Phase II, Gurgaon (Haryana) – 122002, India.*

Walker, John (2012) M. Methods in Molecular Biology; *Springer Humana Press New York United States*

COURSE CODE BCC202: ADVANCED ENZYMOLOGY (Total Credits = 03)

UNIT I

Review of uni-substrate enzyme kinetics and factors affecting the rates of enzyme catalyzed reactions, Michaelis pH functions and their significance. Classification of multi-substrate reactions with examples of each class. Kinetics of multi-substrate reactions, derivation of the rate of expression for Ping Pong and ordered Bi reaction mechanism, use of initial velocity, inhibition and exchange studies to differentiate between multi-substrate reaction mechanisms.

UNIT II

Concept of convergent divergent evolution of enzymes, methods of examining enzyme-substrate complexes, flexibility and conformational mobility of enzymes, methods for measuring kinetic and rate constants of enzymic reactions and their magnitudes; enzymes turnover and methods employed to measure turnover of enzymes, significance of enzymes turnover.

UNIT III

Protein: Ligand binding including measurement, analysis of binding isotherms. Cooperatively phenomenon, Hill and Scatchard Plots; allosteric enzymes, sigmoidal kinetics and their physiological significance, symmetric and sequential modes for action of allosteric enzymes and their significance; immobilized enzymes and their industrial applications, metalloenzymes.

UNIT IV

Detailed mechanisms of catalysis of serine proteases, ribonuclease and triose phosphate isomerases; multi-enzyme system: occurrence, isolation and their properties; polygenic nature of multi-enzyme system, mechanisms of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complexes; immobilized multi-enzyme systems and their applications.

UNIT V

Enzyme regulation: General mechanisms of enzyme regulation: Feed back inhibition and feed forward stimulation; enzyme repression, induction and degradation, control of enzymic activity by products and substrates; reversible and irreversible covalent modifications of enzymes; mono-cyclic and multi-cyclic cascade systems with specific examples.

Books recommended

Lehninger ,A.L, Nelson, D.L., and Cox, M.M. (1993) Principles of Biochemistry 2nd Edition. *Worth Publishers, New York.*

Stryer, L (1988) Biochemistry. 3rd Edition. *W.H. Freeman and Co. New York.*

Segel, I.H.(1976). Biochemical Calculations .2nd Edition

Nord,F.F.; Werkman,C.H. Advances In Enzymology And Related Subjects Vol I; *Interscience Publishers Inc. New York*

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COURSE CODE BCC203: BIostatISTICS AND COMPUTER APPLICATION
(Total Credits = 03)

UNIT I

Importance and scope of statistics in experimentation, Measure of central tendency arithmetic, Geometric and harmonic means, Measure of dispersion variance, Standard deviation, Coefficient of variation, Confidence limits of population mean.

UNIT II

Elements of probability, Statistical and Mathematical definitions, Probability distribution function: Normal, Binomial and Poisson distribution.

UNIT III

Tests of significance, Hypothesis and errors, 't' test, Population mean equals a specified value, Test of the equality of two means (Independent samples & Equal variances), Test of the equality of two means (Paired samples), 'F'- test, One way analysis of variance (Sample sizes, Equal and Unequal).

UNIT IV

Chi-square statistics, Test of goodness of fit and test of independence of factors, Simple correlation coefficient, Significance tests, linear regression equation and diagram regression coefficient, Standard error, Significance tests.

UNIT V

History and development of computers, Hierarchy of computers, Computer hardware components and functional structures, Computers software: system and application software.

Books recommended

G. N. Rao and N. K. Tiwari (2008) Biostatistics and Computer Applications; *PharmaMed Press/BSP Books New Delhi.*

Rajiv Goswami 2009 Biostatistics and Computer Applications; *M D Publications Pvt. Ltd; First edition New Delhi.*

B.L.Agarwal (2009) Basic Statistics

COURSE CODE BCC204: Practical based on Course Code BCC201 & Course Code (Total Credits = 04)

Suggested list of practicals (Course Code BCC201)

1. Isolation and identification of fungi from air.
2. To isolate a pure culture of fungi from mixed culture.
3. To isolate DNA from fungal species by LET's method.
4. Detection of DNA by gel electrophoresis.
5. To demonstrate / perform southern blotting by obtained DNA

Suggested list of practicals (Course Code BCC202)

- 1 To plot the standard curve of glucose and fructose by DNS Dinitrosalicylic acid method
- 2 To study the substrate conc. & cal of K_M by sucrose the enzyme interfase
- 3 To study the effect of temperature on activity of invertase enzyme
- 4 To study the effect of pH on the activity of invertase enzyme

COURSE CODE BCC205: Practical based on Course Code BCC203 & Course Code BCE201 / BCE202 / BCE203 (Total Credits = 04)

Suggested list of practicals (Course CODE BCC203)

1. To calculate the arithmetic mean of mango leaves length
2. To determine the harmonic mean and geometric mean from data of experiment No.1
3. To determine the standard deviation from the data of experiment No. 2
4. Estimate the confidence limit at $\alpha = 0.02$ for the length of mango tree
5. To test the statistical definition of probability
6. To test whether the mean pulse value of M.Sc Biochemistry and M.Sc Microbiology students is statistically equal to 'F2' or not by 'F' test
7. To test that mean pulse value of students is equal to each author by 'F' test

List of Elective Papers

SECOND – SEMESTER
COURSE CODE BCE201: BIOLOGY OF THE IMMUNE SYSTEM (Total Credits =03)

A: Theory

UNIT-I

Introduction: phylogeny of immune system, innate and acquired immunity, clonal nature of immune response; organization and structure of lymphoid organs, nature and biology of antigens and super antigens.

UNIT-II

Antibody structure and function; antigen-antibody interactions, major histocompatibility complex, BCR & TCR, generation of diversity, complement system.

UNIT-III

Cells of the immune system; hematopoiesis and differentiation, lymphocyte trafficking. Blymphocytes, T-lymphocytes, macrophages, dendritic cells, natural killer and lymphokine activated killer cells, eosinophils, neutrophils and mast cells. Regulation of immune response: antigen processing and presentation, generation of humoral and cell mediated immune responses, activation of B-and T-lymphocytes, cytokines and their role in immune regulation; T-cell regulation, MHC restriction, immunological tolerance.

UNIT-IV

Cell- mediated cytotoxicity; mechanism of T cell and NK cell mediated lysis; antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity; hypersensitivity autoimmunity, transplantation.

UNIT- V

Immunity to infectious agents (intracellular parasites, helminthes & viruses); tumor immunology; AIDS and other immunodeficiencies, hybridoma technology and monoclonal antibodies.

Recommended Books:

1. Kuby immunology, 4th Edition, R.A. Goldsby, Thomas J.Kindt, Barbara, A. Osbarne. (Freedom)
2. Immunology-A short Course, 4th Edition- Ell Benjamin, Richard Coico, Geoffrey Sunshine (Wiley-Liss).
3. Fundamentals of immunology, William Paul.
4. Immunology, Roitt and others.

Suggested list of practicals (Course Code BCE201)

1. To perform test for antibiotics sensitivity by disc method.
2. To determine the minimum inhibitory concentration of given antibiotics.
3. Preparation of blood smear.
4. To isolate serum from blood plasma.
5. To perform agglutination reaction to identification of blood group.

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COURSE CODE BCE202: RESOURCE UTILIZATION AND CONSERVATION
(Total Credits = 03)

UNIT – I

Major Biomes of the world, Tropical rain & Seasonal Forests, Temperate rain & Seasonal forests, Boreal forests, Grasslands, Deserts, Aquatic Ecosystems wetlands, Lakes & Ponds Streams & Rivers, Marine & Estuarine habitats.

UNIT – II

Resource utilization, Status & Utilization of Biodiversity, Sustainable development resources from forest, Grassland and aquatic habitats, Food forage, Fodder, Timber & Non-wood forest products, Threats to quality & quantity of Resources due to overexploitation.

UNIT –III

Strategies for conservation of resources: Classifications of resources, Principles of conservation, *In-situ* conservation sanctuaries, National parks, Biosphere reserves for wildlife conservation, Habitat conservation practices of conservation for forests ranges, Soil and water.

UNIT – IV

Air, Water and Soil pollution, Kinds, Sources, Quality parameters, Effects on structure & function of ecosystems, Management of pollution, Bioremediation, Climate changes sources, Trends & role of greenhouse gases, Effect of global warming on climate, Ecosystem processes & Biodiversity, Ozone layer & Ozone hole.

UNIT – V

Resource monitoring, Remote sensing concepts & Tools, Satellite remote sensing basics sensors, Visual & digital interpretation, EMR bands and their applications, Indian remote sensing program, Thematic mapping of resources, Application of remote sensing in Ecology & Forestry.

Books recommended

- Chopra R. N. (1933) Indigenous Drugs of India.
- Hayes W. B. (1953) Fruit Growing in India.
- Atkinson E. T. (1980) Economic Botany of Himalayan Regions.

Suggested list of practical's: COURSE CODE BCE202 (Resource Utilization and Conservation)

1. To find the pH of the various sample of soil by pH meter.
2. To determine the presence of carbonate in different soil mixtures.
3. To determine the presence of phosphate in soil and water sample.
4. To determine the presence of nitrate in mixture sample.
5. To determine the presence of nitrite in mixture sample.
6. To determine frequency, density and abundance of herbaceous species from local garden.
7. To determine the biomass of plant vegetation.
8. To determine leaf area, dry weight and moisture content of few species of plant from grassland.

COURSE CODE BCE203: MICROBIAL METABOLISM (Total credits: 3)

Theory

UNIT-I

Microbial growth: mathematical expression of growth, growth measurement, efficient growth curve, synchronous growth and continuous culture, effect of environmental factors on microbial growth, nutrients diffusion, active transport, group translocation, solutes, temperature, oxygen relations.

UNIT-II

Chemolithotrophy: Sulphur, iron, hydrogen, carbon monoxide, nitrogen oxidations. Methanogenesis, luminescence. Brief account of photosynthetic and accessory pigments chlorophyll, bacteriochlorophyll, carotenoids, oxygenic, anoxygenic photosynthesis. Electron transport- photoautotrophic generation of ATP, fixation of CO₂- Calvin cycle, reverse TCA, carbohydrate anabolism.

UNIT-III

Respiratory metabolism: Embden Mayer Hoff pathway, Entner Doudroff pathway, glyoxalate pathway, Krebs cycle, oxidative and substrate level phosphorylation, Pasteur effect, fermentation of carbohydrates-homo and heterolactic fermentations. Synthesis of polysaccharides- gluconeogenesis and other pathways.

UNIT-IV

Assimilation of nitrogen: Dinitrogen - nitrate nitrogen-ammonia- denitrification, synthesis of major amino-acids, polyamines; peptidoglycan-biopolymers as cell components.

UNIT-V

Microbial development, sporulation and morphogenesis, hyphae vs. yeast forms and their significance. Multicellular organization of selected microbes. Dormancy. Endospore-structure, properties and germination.

List of Recommended Books

1. Doelle H.W. 1969. Bacterial Metabolism. Academic Press.
2. Gottschalk G. 1979. Bacterial Metabolism. Springer Verlag. Moat A.G. 1979. Microbial Physiology. John Wiley & Sons.
3. Sokatch J.R. 1969. Bacterial Physiology and Metabolism. Academic Press.
4. Moat A.G., Foster J.W., Spector M.P. Microbial Physiology, 4th Ed: Wiley India Pvt Ltd 2009.

Suggested list of Practicals (Course Code BCE203: Microbial Metabolism)

1. Determination of Bacterial growth by turbidity measurements (spectrophotometric method).
2. Study of effect of temperature on growth of bacteria.
3. Study of effect of pH on growth of Bacteria.
4. Isolation of rhizobia from root nodules.
5. Slide culture technique for studying morphology and molds.

COURSE CODE BCS201 : SKILL DEVELOPMENT MODULES 2 (Total Credits = 02)**SOFT SKILLS DEVELOPMENT MODULE-2 (Semester- 2) Hrs. 30**

S. No.	Subject	Classroom Activity	Hrs.
01	Orientation , Personality Development	Worksheet/ lecture	02
02	Role and Impact of Personality	Group Activity/ lecture	01
03	Pre Self-Assessment (Psychometric Analysis)	PDP Assessment Sheet	02
04	Importance of characteristics and Traits	lecture/Group Activity	02
05	Empowerment of Internal and external traits	lecture	02
06	Definition of Personality	Lecture	02
07	Power of Self	Lecture	03
08	Path to Improve Personality	lecture/Group Activity	03
09	Body Language - 1	Worksheet	02
10	Grooming Yourself	Lecture	02
11	IQ / EQ / MQ / SQ	lecture	02
12	Disposition of Body in various aspects	Group Activity	03
13	Getting desired output	Group Activity	02
14	Post Assessment of Personality	Group Activity	02

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THIRD SEMESTER

COURSE CODE BCC301: PLANT BIOCHEMISTRY (Total Credits = 03)

UNIT I

Structure and functions of plant cell (including cell wall, plasmodesmata, vacuoles etc.) isolation of cell organelles, mechanism of transport of water, inorganic and organic substances.

UNIT II

Photosynthesis: structure of organelles involved in photosynthesis in plants and bacteria; photo system I and II, their location, mechanism of quantum capture and energy transfer between photosystem, reduction of CO₂, C₃, C₄ and CAM metabolism, regulation of photosynthesis, photorespiration and its significance.

UNIT III

Biological nitrogen fixation, mechanism of nitrate uptake and reduction and ammonia assimilation, sulphate uptake, transport and mechanism.

UNIT IV

Special features of secondary plant metabolism, formation of phenolic acids, lignins, alkaloids, pigments, flavonoids and surface waxes-their biosynthesis and function, defense system in plants.

UNIT V

Plant hormones: mode of action of auxins, gibberellins, cytotoxins, ethylene, abscissic acid in the regulation of seed dormancy, growth and development.

Books recommended

Buchanan. B.B. Gruissem, W and Jones. R.L. (2000) Biochemistry and Molecular Biology of plants. American society of plant physiologists, Maryland USA.

Galston, A.W. (1989) Life processes in plants. Physiology, John wiley and sons Inc new. York USA.

Hopking W.G. (1995) Introduction to plant physiology John wiley and sons Inc. New York USA.

Nobel P.s. (1999) Physiochemical and Environmental plant Physiology.

Taiz .L. and Zeiger, E. (1998) plant physiology (2nd Edn) Sinayer E. Associates Inc. publishers. Massachusetts, USA.

COURSE CODE BCC302: NUTRITIONAL BIOCHEMISTRY (Total Credits = 03)

UNIT I

Basic concepts: composition of human body, energy content of foods, measurement of energy expenditure; direct & indirect calorimetry, definition of BMR and SDA and factors affecting these; thermogenic effect of foods, energy requirements of man and woman and factors affecting energy requirements.

Carbohydrates: dietary requirements and sources of available and unavailable carbohydrates, physico-chemical properties and physiological actions of un-available carbohydrates (dietary fibre).

Proteins: protein reserves of human body. Nitrogen balance studies and factors influencing nitrogen balance, essential amino acids for man and concept of protein quality. Cereal proteins and their limiting amino acids, protein requirement at different stages of development.

UNIT II

Lipids: major classes of dietary lipids, properties and composition of plasma lipo-proteins, dietary needs of lipids, essential fatty acids and their physiological functions.

Electrolytes and water balance: electrolyte concentrations of body fluids, acid base regulation by the human body; concept of metabolic and respiratory acidosis and alkalosis. Minerals: nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper.

UNIT III

Vitamins: Dietary sources, biochemical functions and specific deficiency diseases associated with fat and water soluble vitamins, Hypervitaminosis, symptoms of fat-soluble vitamins, nutritional requirements during pregnancy, lactation and growth of infants and children. Food processing and loss of nutrients during processing and cooking.

Anti-nutrients: Naturally occurring food born toxicants: protease inhibitors, hemagglutinins, hepatotoxins, allergens, oxalates, toxins, from mushrooms, animal food stuffs and sea foods.

UNIT IV

Protein energy malnutrition (PEM): Etiology, clinical features, metabolic disorders and management of Marasmus and Kwashiorkor diseases. Starvation: techniques for the study of starvation, protein metabolism in prolonged fasting, protein sparing treatment during fasting. Basic concept of high protein, low caloric weight reduction diets. Obesity: definition and classification, genetic and environmental factors leading to obesity, obesity related diseases and management of obesity, role of leptin in regulation of body mass.

UNIT V

Clinical nutrition: Role of diet & nutrition in the prevention and treatment of diseases; dental caries, fluorosis, renal failure, hyperlipidemia, atherosclerosis & rheumatic disorders; inherited metabolic disorders: phenyl ketonuria, maple syrup disease, homocystinuria, galactosemia, gout, diabetes insipidus and diabetes mellitus.

Food allergy: definition, role of antigen, host and environment, types of hypersensitivities, diagnosis and management of allergy.

Books recommended

M.M. Burghagen, D. Hadziyev, P. Nelson, S. Jordon and C. Sprinz Food Chemistry Springer

COURSE CODE BCC303: CLINICAL BIOCHEMISTRY (Total Credits = 03)

UNIT I

Introduction to laboratory principles and instrumentation in clinical biochemistry. Automation in the clinical biochemistry; instrumental concepts; chemical reaction phase; measurement approaches; selection of instruments; Quality Assurance: control of pre analytical variables, control of analytical variables, external and internal quality control measurements.

UNIT II

Disorders of carbohydrate metabolism: diabetes mellitus, glycohemoglobins, hypoglycemias, ketone bodies, various types of glucose tolerance tests, glycogen storage diseases, galactosemia; Lipids, lipoproteins and apolipoproteins: physiology of lipids/ lipoproteins, lipidosis; clinical inter relationships of lipids (sphingolipidosis, multiplesclerosis). Lipoproteins and apolipoproteins; diagnostic tests for apolipoproteins HDL-cholesterol, LDL-cholesterol and triglycerides disorders.

UNIT III

Disorders of amino acid metabolism: phenylalaninemia, homocystinuria, tyrosinemia and related disorders, aminoacidurias. Disorders of nucleic acid metabolism: purine metabolism, pyrimidine metabolism, inborn errors of metabolism, electrolytes, blood gases and acid base balance, electrolytes blood gases respiration, acid base balance and acid base disorders. Respiratory and renal mechanism of acid balance disorders. Evaluation of organ function tests: assessment and clinical manifestations of renal, hepatic, pancreatic, gastric and intestinal functions, bilirubin metabolism; clinical presentation and diagnosis of various organ diseases.

UNIT IV

Diagnostic enzymes: principles of diagnostic enzymology, clinical significance of: aspartate aminotransferase, alanine aminotransferase, creatine kinase, aldolase, lactate dehydrogenase, enzyme tests in determination of myocardial infarction; enzymes of pancreatic origin, biliary tract. Hormonal disturbances: protein hormones, anterior pituitary hormones, posterior pituitary hormones, steroid hormones, adrenocortical steroids, reproductive endocrinology, thyroid function

UNIT V

Disorders of mineral metabolism: hypercalcemia, hypocalcemia, normocalcemia, hypophosphatemia, hyperphosphatemia. Biochemical Aspects of Hematology: disorders of erythrocyte metabolism, hemoglobinopathies, thalassemias, and anaemias. Blood clotting: homeostasis and thrombosis, extrinsic and intrinsic pathways of blood clotting, laboratory test to measure coagulation and thrombolysis. Detoxification Mechanism in the body: enzymes of detoxification polymorphism in drug metabolizing enzymes; detection of toxic substances by specific procedures. Disorders of vitamins and trace elements.

Books recommended

Chatterjee, M.N. and R. Shinde (2007) Textbook of Medical Biochemistry Jaypee Brothers Medical Publishers

Darshan P. Godkar Praful B. Godkar (2014) Textbook of Medical Laboratory Technology Vol 1 & 2 Bhalani Publishing House

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COURSE CODE BCC304 : Practical based on Course **Code BCC301** & **Code BCC302**
(Total Credits = 04)

Suggested list of practicals (Course code BCC301)

1. Extraction of chloroplast pigments from leaves and preparation of the absorption spectrum of chlorophyll.
2. To determine the chlorophyll a and chlorophyll b ratio in C₃, C₄ plants.
3. Principles of colorimetry & spectrophotometry.
4. Desalting of proteins by gel filtration chromatography employing sephadex G 25.
5. Preparation of the standard curve of protein and estimation of the protein content in extracts of plant material by Lowry's or Bradford's method.

Suggested list of practicals (Course code BCC302)

1. Estimation of total lipids in groundnut by Falsh's method.
2. Estimation of free fatty acids in olive oil.
3. Qualitative analysis of milk.
4. To test albumin protein in egg white.
5. To test starch in potatoes.
6. To determine the saponification value of mustard oil.
7. Isolation of casein from milk.
8. To determine the amount of lycopene present in tomato samples.

COURSE CODE BCC305: Practical based on Course **code BCC303** & **code BCE301** /
BCE302 / **BCE303** / **BCE304** **(Total Credits = 04)**

Suggested list of practicals (Course code BCC303)

1. To determine the presence of glucose in given sample by benedicts qualitative test.
2. Determination of the presence of ketone bodies in the given sample by Rothera's nitroprusside test.
3. Quantitative estimation of glucose in serum/plasma by glucose oxidase method (GOD POD).
4. Quantitative estimation of urea in serum/plasma by DAM method.
5. Quantitative estimation of cholesterol in given serum sample.
6. Quantitative estimation of high density lipoprotein (HDL) cholesterol in serum sample (PTA method).
7. Quantitative estimation of urea in urine.

List of Elective Papers

THIRD SEMESTER

COURSE CODE BCE301: ADVANCED MOLECULAR BIOLOGY (Total Credits = 03)

UNIT I

Recombinant DNA technology I: methods of creating recombinant DNA molecule, properties of restriction endonucleases and their mode of action, selection screening construction of DNA library.

UNIT II

Recombinant DNA Technology II: Use of cloned gene, sub-cloning; recombinant proteins production in bacteria, site-directed mutagenesis, RFLP, PCR, DNA-fingerprinting, antisense-RNA technology, chromosomal walking.

UNIT III

Hybridoma technology: monoclonal antibodies mycelium cell infusion selection of hybridomas, protoplast fusion and HAT-medium screening assay purification and application of monoclonal antibodies.

UNIT IV

Cell and tissue culture: micropropagation, somatic cell culture, somoclonal variations, somatic cell hybridization, protoplast isolation, protoplast fusion, protoplast culture, genetic transformation, various methods of gene transfer (all vector and methods), production of transgenic plant and animal; production of secondary metabolites, primary and transferred cell culture, differentiated cells in culture application.

UNIT V

Fermentation technology: continuous and batch type culture techniques, principle types of Fermenters, general design of fermentors. Fermentation processes, brewing manufacture of antibiotics, production of single cell protein. Application of genetic and molecular biology procedures in strain improvement.

Books recommended

1. Molecular cloning : A Laboratory Manual , J. Sambrook ; Fritsch and T. Maniatis Cold Spring Harbor Laboratory Press, New York, 2000.
2. Introduction to practical molecular biology P.D. Dabre, John Wiley & sons Ltd. N York 1988
3. Molecular Biology LabFax, T.A. Brown (Ed) Bios Scientific Publishers Ltd. Oxford, 1991
4. Molecular Biology of the Gene (4th edition), J.D. Watson N.H. Hopkins, J.W. Roberts J.A. Steitz and A.M. Weiner, The Benjamin/ Cummings Publ Co. Inc. California, 1987.
5. Molecular Cell Biology (2nd Edition) J. Darnell, H. Lodish and D. Baltimore, Scientist American Books, Inc., USA, 1994.
6. Molecular Biology of the Cell (2nd Edition) B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts, and J. D. Watson, Garland Publishing, Inc., New York, 1994.
7. Gene VI (6th Edition) Benjamin Lewin, Oxford University press, U.K., 1998.
8. Molecular Biology and biotechnology; a comprehensive desk reference, R.A. Meyers (Ed.) VCH Publishers, Inc, New York, 1995
9. Genomes, T.S. Brown

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Suggested list of practicals (Course Code BCE301)

1. To isolate genomic DNA from fungi by LETS methods.
2. To determine the quantity and quality of the isolated fungal DNA.
3. To determine the agarose gel electrophoresis of the isolated fungal DNA.
4. To isolate plasmid DNA from bacteria by quick method.
5. To purify the DNA from agarose gel.
6. To study the Thermal cycler.
7. To study the gel documentation system.

COURSE CODE BCE302: AGRICULTURAL MICROBIOLOGY (Course credit: 3)

Theory

UNIT – I

History, scope and development of agricultural microbiology, rhizosphere and phyllosphere: concept, importance, factors affecting microbial diversity.

UNIT – II

Soil health: crop residues, humus, mineralization, immobilization, soil-sickness, composting, vermicomposting, green manure. Effect of crop residues on plant growth; biodegradation of pesticides and pollutants; biodegradation fate, bioavailability, acceleration, bioremediation. Biofertilizers: types, production, formulation and constraints.

UNIT – III

General idea about major agricultural pests: Plant diseases- late blight potato. downy mildew of pea, stem gall of coriander, powdery mildew / rust / smut, rust of linseed, Ergot of bajara, Anthracnose of soybean, Tikka disease of groundnut, wilt of arhar, bacterial blight of paddy, citrus canker, leaf curl of papaya, little leaf of brinjal. Insects: gram, soybean. Weeds: parthenium, xanthium, waterhyacinth, cyperus, phalaris

UNIT – IV

Post harvest losses of agricultural products: causes, problems and management recent trends in pest management: strategies, mass production, formulation and application technology, achievements, constraints

UNIT – V

Biotechnology in agriculture: the new green revolution, transgenic crops, gene protection technology, frost control technology, resistant varieties. Bioconversion futurology: exploitation of agricultural wastes for food / feed and fuel.

List of Recommended Books

1. Soil microbiology by Subba Rao
2. Soil and microbes by Waksman and Starkey.
3. Plant pathology by Mehrotra.
4. Alexander, M. Introduction to Soil Microbiology, 3rd Edition. Wiley Eastern Ltd., New Delhi
5. Microbiology by S.S. Purohit.

Suggested list of Practicals (Course Code BCE302: Agricultural Microbiology)

1. Isolation and Enumeration of the microorganism from soil by serial dilution agar plate method.
2. Isolation of fungi from soil by warcup's method.
3. Isolation of azotobacter species from soil.
4. Isolation of microorganism from rhizosphere.
5. Isolation of microorganism from phyllosphere (phyloplane) by serial dilution, agar plate method or leaf impression method.
6. Plant diseases – leaf curl of papaya, rust of wheat, citrus canker, red rot of sugarcane. Study of weeds- Parthenium, water hyacinth.

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**COURSE CODE BCE303: BIOPROCESS ENGINEERING AND TECHNOLOGY
(Total Credits =03)**

A: Theory

UNIT-I

Biofermentation: designing and application, principles of biofermentation, monitoring and control of parameters (pH, oxygen, agitation, temperature, foam etc.), batch & continuous; production medium, raw materials, isolations; maintenance, preservation & improvement of industrial strains, computer control of fermentation processes.

UNIT-II

Downstream processing: Filtration of fermentation broths, ultra-centrifugation, recovery of biological products by distillation, superficial fluid extraction.

UNIT-III

Industrial production of solvents: Ethyl alcohol, citric and acetic acids; enzymes; amylases, proteases, cellulases; vitamins: vitamin B12, vitamin C, antibiotics (penicillin, streptomycin, tetracycline and griseofulvin). Microbes in petroleum industry (oil recovery); immobilized cells & enzymes.

UNIT-IV

Microbiology of food: sources and types of microorganisms in food, food borne pathogens, microbiological examination of food, spoilage of food, food preservation, fermented foods, microbial proteins.

UNIT-V

Dairy microbiology: sources and types of microorganisms in milk, microbial examination of milk, pasteurization and phosphatase test, sterilization of milk, grades of milk, dairy products, fermented milk, butter & cheese.

Recommended Books:

1. Biochemical Engineering, Aiba, S., Humphrey, A.E. and Millis, N.F. Univ of Tokyo Press, Tokyo.
2. Biochemical Reactors, Atkinson, B: Pion Ltd. London.
3. Biochemical Engineering Fundamentals, Baily, J.E. and Ollis, D.F. McGraw-Hill Book Co. New York.
4. Bioprocess Technology: Fundamental and Application, KTH, Stockholm.
5. Process Engineering in Biotechnology, Jackson, A.T., Prentice Hall, Engelwood Cliffs.
6. Bioprocess Engineering: Basic Concepts, Shuler, M.L. and Kargi, F., Prentice Hall, Engelwood Cliffs.
7. Principles of Fermentation Technology, Stanbury, P.F. and Whitaker, A. Pergamon Press, Oxford.
8. Bioreaction Engineering principles, Nielson, J. and Billadsen, J. Plenum Press.
9. Chemical Engineering Problems in Biotechnology, Shuler, M.L. (Ed.) AICHE.
10. Biochemical Engineering, Lee, J.M. Prentice Hall Inc.
11. Bioprocess Engineering-kinetics, Mass Transport, Reactors and Gene Expression, Viet; W.F., John Wiley & Sons, Inc.

Suggested list of Practicals (Course Code BCE303)

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1. Isolation of micro-organism from canned food.
2. Isolation of bacteria and fungi from spoiled bread.
3. Quantitative test of milk by resazurin test.
4. Quantitative estimation of Amylase production.
5. Isolation of lipase producing bacteria from soil.
- 6.** Isolation of phosphate solubilizing/producing bacteria from soil.
7. Estimation of antibiotic property of bacteria.

COURSE CODE BCE304: BIOTECHNOLOGY (Total Credits = 03)

UNIT I

Biotechnology an Overview, Definition, Perspective and scope of biotechnological processes and products, Biotechnology and Ethics, Introduction, Medical and chemical Biotechnology, Agriculture and Food, Energy and environment and human, Bioethics, Facing problem and finding solutions, Regulating the use of biotechnology, Patenting biotechnology inventions.

UNIT II

Genetic Engineering and gene cloning, Introduction of genetic engineering procedure, restriction endonuclease, cloning vehicle, Vectors for animals and plants, Insertion of DNA molecule in to a vector, Direct transformation, Isolation and cloning, Transformation and growth of cells, Selection and screening of particular recombinants, Genomic library, sequencing of DNA, Gene identification and mapping, Analysis of expression of cloned genes, Polymerase chain reaction, Monoclonal Antibodies.

UNIT III

Plant cell and tissue cultures, Culture techniques, Protoplast fusion, Direct gene transfer, Microinjections, Nuclear transplantation, Plastid and mitochondrial genes, production of secondary metabolites by immobilized plant cell, Development of disease resistant, herbicide resistant, Salt & drought resistant plant varieties, Microbial Toxins, Introduction, Toxins gene isolation, Genetic engineering of *B. thuringiensis* strains, *Baculovirus* as biocontrol agents.

UNIT IV

Culturing microorganisms for the production of biomass, Production of microbial (Bacterial, Cyanobacterial and Fungal) products, Batch culture, Continuous culture, Fed-batch culture, Mass culture, Use of culture system for the production of microbial products, Production of cyanobacterial biomass for food, Feed and health care products, Improvement of microbial strains for industry, Agriculture, Immobilization of microbial cells and enzyme and its applications.

UNIT V

Strain improvement, bioreactor design, Reactor types, Application of immobilized cells and enzyme, improvement in bioreactor to control environment of process organism. use of microorganisms in pollution control, Waste treatment, Bioremediation, Biological removal of eutrophic nutrients, Heavy metals, Toxic chemicals (Herbicide, Insecticide and Fungicide and Other Toxicants) from waste water and industrial effluents, Utilization of waste water for the production of food and feed, Biodegradation, Bioleaching of metals, Application of microorganisms from environment

Books recommended

- Haekett P. B., Fuchs J. A. and Mesing J. W. (1988) An Introduction to Recombinant DNA techniques – basic experiments in gene manipulation.
- Glck B. R. and Thompson J. E. (1993) Methods in Plant Molecular Biology and Biotechnology.
- Bjorn Kristiansen, (2012) Basic Biotechnology third Edition.

Suggested list of practicals (Course Code BCE304)

1. Demonstration:-

PCR
Spectrophotometer
pH meter

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Centrifuse

Photomicrographic Camera

2. To prepare the media for plant tissue culture.
3. Isolation of pathogenic fungi from infected plants/Disease plants (Leaf/ Stem/ root)
4. Identification of unknown microorganism from given plates.
5. Preparation of tissue culture media.

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COURSE BCS301: SKILL DEVELOPMENT MODULES 3 (Total Credits = 02)

ENTREPRENEURSHIP DEVELOPMENT PROGRAMME AGENDA (Semester-3)

TIME - 30 Hrs

- 1. ORIENTATION PROGRAM FOR ENTREPRENEURSHIP**
- 2. WHAT IS ENTREPRENEURSHIP**
 - Definition of Entrepreneurship**
 - Be a Successful Entrepreneurship**
- 3. TYPE OF ENTREPRENEURSHIP**
 - Manufacturing**
 - Trading**
 - Service Provider**
- 4. NEED TO BE SUCCESSFUL ENTREPRENEURSHIP**
 - Knowledge - About work and Concern**
 - Information - About sources/ market/ Customer's**
 - Assets - About Technology, Place, Man power and money**
- 5. CHOOSING A BUSINESS -**

Micro Scale Unit	Small Scale Unit
Large Scale Unit	Mega Scale Unit
- 6. MARKETING and DISTRIBUTION**
 - Definition and Type of Marketing**
 - About Sales and Marketing**
 - Distribution channels**
- 7. PRODUCT DESIGNING / BRANDING / MERCHANDIZING**
 - Research and Development**
- 8. FINANCIAL FLUENCY, PLANNING AND LEGAL ASPECTS**
 - Taxation**
 - Rules and norms of the Govt. to run a business**
- 9. GOVERNMENT SCHEMES AND ASSISTENCE**
 - About financial loan / Place/ Training / Subsidy.....etc**
- 10. INDUSTRY VISITS.**

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FOURTH- SEMESTER (TOTAL CREDITS = 18)

DISSERTATION

A. Valuation

1. Language & Presentation
2. Review of Literature
3. Methodology
4. Analysis & Interpretation of Results

B. Viva –Voce

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