



శ్రీ వేంకటేశ్వర కళాశాల
श्री वेंकटेश्वर महाविद्यालय
Sri Venkateswara College

(दिल्ली विश्वविद्यालय) (University of Delhi)

NAAC A⁺ Accredited

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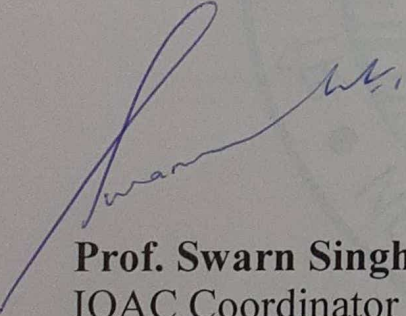
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CRITERIA I

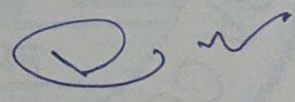
SUPPORTING DOCUMENT

1.3.2 Average Percentage of courses that include experiential learning through project work/field work/internship


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Choice Based Credit System (CBCS)

UNIVERSITY OF DELHI

FACULTY OF INTER-DISCIPLINARY & APPLIED SCIENCES

UNDERGRADUATE PROGRAMME (Courses effective from Academic Year 2015-16)



SYLLABUS OF COURSES TO BE OFFERED

Core Courses, Elective Courses & Ability Enhancement Courses


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Disclaimer: The CBCS syllabus is uploaded as given by the Faculty concerned to the Academic Council. The same has been approved as it is by the Academic Council on 13.7.2015 and Executive Council on 14.7.2015. Any query may kindly be addressed to the concerned Faculty.

Undergraduate Programme Secretariat

Preamble

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters.

The UGC has formulated various regulations and guidelines from time to time to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions (HEIs) in India. The academic reforms recommended by the UGC in the recent past have led to overall improvement in the higher education system. However, due to lot of diversity in the system of higher education, there are multiple approaches followed by universities towards examination, evaluation and grading system. While the HEIs must have the flexibility and freedom in designing the examination and evaluation methods that best fits the curriculum, syllabi and teaching-learning methods, there is a need to devise a sensible system for awarding the grades based on the performance of students. Presently the performance of the students is reported using the conventional system of marks secured in the examinations or grades or both. The conversion from marks to letter grades and the letter grades used vary widely across the HEIs in the country. This creates difficulty for the academia and the employers to understand and infer the performance of the students graduating from different universities and colleges based on grades.

The grading system is considered to be better than the conventional marks system and hence it has been followed in the top institutions in India and abroad. So it is desirable to introduce uniform grading system. This will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students. To bring in the desired uniformity, in grading system and method for computing the cumulative grade point average (CGPA) based on the performance of students in the examinations, the UGC has formulated these guidelines.

CHOICE BASED CREDIT SYSTEM (CBCS):

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed.

Outline of Choice Based Credit System:

1. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.
2. **Elective Course:** Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.
 - 2.1 **Discipline Specific Elective (DSE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).
 - 2.2 **Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.
 - 2.3 **Generic Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.
3. **Ability Enhancement Courses (AEC)/Competency Improvement Courses/Skill Development Courses/Foundation Course:** The Ability Enhancement (AE) Courses may be of two kinds: AE Compulsory Course (AECC) and AE Elective Course (AEEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement. They ((i) Environmental Science, (ii) English/MIL Communication) are mandatory for all disciplines. AEEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.
 - 3.1 AE Compulsory Course (AECC): Environmental Science, English Communication/MIL Communication.
 - 3.2 AE Elective Course (AEEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based instruction.

Project work/Dissertation is considered as a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

Details of courses under B.A (Honors), B.Com (Honors) & B.Sc. (Honors)

Course	*Credits	
	Theory+ Practical	Theory + Tutorial
=====		
<u>I. Core Course</u>		
(14 Papers)	14X4= 56	14X5=70
Core Course Practical / Tutorial*		
(14 Papers)	14X2=28	14X1=14
<u>II. Elective Course</u>		
(8 Papers)		
A.1. Discipline Specific Elective	4X4=16	4X5=20
(4 Papers)		
A.2. Discipline Specific Elective		
Practical/ Tutorial*	4 X 2=8	4X1=4
(4 Papers)		
B.1. Generic Elective/		
Interdisciplinary	4X4=16	4X5=20
(4 Papers)		
B.2. Generic Elective		
Practical/ Tutorial*	4 X 2=8	4X1=4
(4 Papers)		
• Optional Dissertation or project work in place of one Discipline Specific Elective paper (6 credits) in 6th Semester		
<u>III. Ability Enhancement Courses</u>		
1. Ability Enhancement Compulsory		
(2 Papers of 2 credit each)	2 X 2=4	2 X 2=4
Environmental Science		
English/MIL Communication		
2. Ability Enhancement Elective (Skill Based)		
(Minimum 2)	2 X 2=4	2 X 2=4
(2 Papers of 2 credit each)		
Total credit	140	140
Institute should evolve a system/policy about ECA/ General Interest/Hobby/Sports/NCC/NSS/related courses on its own.		

* wherever there is a practical there will be no tutorial and vice-versa

Structure of B.Sc. (Honours) Biochemistry under CBCS

Core Course

BCH C-1:	Molecules of Life
BCH C-2:	Cell Biology
BCH C-3:	Proteins
BCH C-4:	Enzymes
BCH C-5:	Metabolism of Carbohydrates and Lipids
BCH C-6:	Membrane Biology and Bioenergetics
BCH C-7:	Hormone: Biochemistry and Function
BCH C-8:	Human Physiology
BCH C-9:	Gene Organization, Replication and Repair
BCH C-10:	Metabolism of Amino Acids and Nucleotides
BCH C-11:	Concepts in Genetics
BCH C-12:	Gene Expression and Regulation
BCH C-13:	Genetic Engineering and Biotechnology
BCH C-14:	Immunology

Discipline Specific Elective (*Any four*)

BCH DSE-1:	Nutritional Biochemistry
BCH DSE-2:	Research Methodology
BCH DSE-3:	Molecular basis of non-infectious human diseases
BCH DSE-4:	Molecular basis of infectious diseases
BCH DSE-5:	Research Project
BCH DSE-6:	Advanced cell biology
BCH DSE-7:	Plant Biochemistry
BCH DSE-8:	Basic Microbiology

Generic Elective (*Any four*)

BCH GE-1:	Biochemistry of Cell
BCH GE-2:	Proteins and Enzymes
BCH GE-3:	Intermediary Metabolism
BCH GE-4:	Gene Organization, Expression and Regulation
BCH GE-5:	Fundamentals of Cell Biology and Immunology
BCH GE-6:	Fundamentals of Genetic Engineering
BCH GE-7:	Biochemical Correlations in Diseases

Ability Enhancement Compulsory Course

AECC-1:	English communication
AECC-2:	Environmental science

Skill Enhancement Elective Course (*Any two*)

BCH SEC-1:	Tools and Techniques in Biochemistry
BCH SEC-2:	Protein Purification Techniques
BCH SEC-3:	Clinical Biochemistry
BCH SEC-4:	Bioinformatics
BCH SEC-5:	Recombinant DNA Technology

COURSE STRUCTURE of B.Sc. (Honours) Biochemistry under CBCS

SEMESTER I		SEMESTER II	
C1	Molecules of Life	C3	Proteins
C2	Cell Biology	C4	Enzymes
AECC1	English/MIL Communication or EVS	AECC2	English/MIL Communication or EVS
GE1	Generic Elective	GE2	Generic Elective
SEMESTER III		SEMESTER IV	
C5	Metabolism of Carbohydrates and Lipids	C8	Human Physiology
C6	Membrane Biology and Bioenergetics	C9	Gene Organization, Replication and Repair
C7	Hormone: Biochemistry and Function	C10	Metabolism of Amino Acids and Nucleotides
SEC1	Skill Enhancement Course	SEC2	Skill Enhancement Course
GE3	Generic Elective	GE4	Generic Elective
SEMESTER V		SEMESTER VI	
C11	Concepts in Genetics	C13	Genetic Engineering and Biotechnology
C12	Gene Expression and Regulation	C14	Immunology
DSE1	Discipline Specific Elective	DSE3	Discipline Specific Elective
DSE2	Discipline Specific Elective	DSE4	Discipline Specific Elective

C: Core Courses; **GE:** Generic Elective; **AECC:** Ability Enhancement Compulsory Course; **SEC:** Skill Enhancement Courses; **DSE:** Discipline Specific Elective

Generic Elective (any one per semester in semesters I-IV)

- BCH GE-1: Biochemistry of Cell
- BCH GE-2: Proteins and Enzymes
- BCH GE-3: Intermediary Metabolism
- BCH GE-4: Gene Organization, Expression and Regulation
- BCH GE-5: Fundamentals of Cell Biology and Immunology
- BCH GE-6: Fundamentals of Genetic Engineering
- BCH GE-7: Biochemical Correlations in Diseases

Skill Enhancement Course (any one per semester in semesters III-IV)

- BCH SEC-1: Tools and Techniques in Biochemistry
- BCH SEC-2: Protein Purification Techniques
- BCH SEC-3: Clinical Biochemistry
- BCH SEC-4: Bioinformatics
- BCH SEC-5: Recombinant DNA Technology

Discipline Specific Elective (any two per semester in semesters V-VI)

- BCH DSE-1: Nutritional Biochemistry
- BCH DSE-2: Research Methodology
- BCH DSE-3: Molecular basis of non-infectious human diseases
- BCH DSE-4: Molecular basis of infectious diseases
- BCH DSE-5: Research Project
- BCH DSE-6: Advanced cell biology
- BCH DSE-7: Plant Biochemistry
- BCH DSE-8: Basic Microbiology

B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH C-1: MOLECULES OF LIFE (THEORY)
SEMESTER - I

TOTAL HOURS: 60

CREDITS: 4

Unit 1 The foundations of biochemistry

No. of Hours: 2

Cellular and chemical foundations of life

Unit 2 Water

No. of Hours: 4

Unique properties, weak interactions in aqueous systems, ionization of water, buffers, water as a reactant and fitness of the aqueous environment.

Unit 3 Carbohydrates and Glycobiology

No. of Hours: 16

Monosaccharides - structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, structure of biologically important sugar derivatives, oxidation of sugars. Formation of disaccharides, reducing and non-reducing disaccharides. Polysaccharides – homo- and heteropolysaccharides, structural and storage polysaccharides. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides). Carbohydrates as informational molecules, working with carbohydrates

Unit 4 Lipids

No. of Hours: 14

Building blocks of lipids - fatty acids, glycerol, ceramide. Storage lipids - triacyl glycerol and waxes. Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols, structure, distribution and role of membrane lipids. Plant steroids. Lipids as signals, cofactors and pigments

Unit 5 Amino acids

No. of HOURS: 8

Structure and classification, physical, chemical and optical properties of amino acids

Unit 6 Nucleic acids

No. of HOURS: 10

Nucleotides - structure and properties. Nucleic acid structure – Watson-Crick model of DNA. Structure of major species of RNA - mRNA, tRNA and rRNA. Nucleic acid chemistry - UV absorption, effect of acid and alkali on DNA. Other functions of nucleotides - source of energy, component of coenzymes, second messengers.

Unit 7 Vitamins

No. of Hours: 6

Structure and active forms of water soluble and fat soluble vitamins, deficiency diseases and symptoms, hypervitaminosis


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BCH C-1: MOLECULES OF LIFE (PRACTICALS)
SEMESTER - I

TOTAL HOURS: 60

CREDITS: 2

1. Safety measures in laboratories.
2. Preparation of normal and molar solutions.
3. Preparation of buffers.
4. Determination of pKa of acetic acid and glycine.
5. Qualitative tests for carbohydrates, lipids, amino acids, proteins and nucleic acids.
6. Separation of amino acids/ sugars/ bases by thin layer chromatography.
7. Estimation of vitamin C.

SUGGESTED READINGS

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4292-3414-8.
2. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4.


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH C-2: CELL BIOLOGY (THEORY)
SEMESTER - I

TOTAL HOURS: 60

CREDITS: 4

Unit 1 Introduction to cell biology

No. of Hours: 5

Prokaryotic (archaea and eubacteria) and eukaryotic cell (animal and plant cells), cells as experimental models.

Unit 2 Tools of cell biology

No. of Hours: 10

Light microscopy, phase contrast microscopy, fluorescence microscopy, confocal microscopy, electron microscopy, FACS. Centrifugation for subcellular fractionation.

Unit 3 Structure of different cell organelles

No. of Hours: 15

Structure of nuclear envelope, nuclear pore complex. Nuclear protein import and export. ER structure. Targeting proteins to ER, smooth ER. Organization of Golgi. Lysosome. Structure and functions of mitochondria, chloroplasts and peroxisomes. Overview of protein sorting to cell cellular organelles. Endocytosis, Pinocytosis and phagocytosis.

Unit 4 Cytoskeletal proteins

No. of Hours: 10

Introduction to cytoskeletal proteins. Organization of cytoskeletal protein RBC and smooth muscle and skeletal muscles. Structure of cilia and flagella.

Unit 5 Cell wall and extracellular matrix

No. of Hours: 10

Prokaryotic and eukaryotic cell wall, cell matrix proteins. Cell-matrix interactions and cell-cell interactions. Adherence junctions, tight junctions, gap junctions, desmosomes, hemidesmosomes, focal adhesions and plasmodesmata.

Unit 6 Cell cycle, cell death and cell renewal

No. of Hours: 10

Eukaryotic cell cycle, restriction point, and checkpoints. Cell division. Apoptosis and necrosis - brief outline. Salient features of a transformed cell.

BCH C-2: CELL BIOLOGY (PRACTICALS)
SEMESTER - I

TOTAL HOURS: 60

CREDITS: 2

1. Visualization of animal and plant cell by methylene blue.
2. Identification of different stages of mitosis in onion root tip.
3. Identification of different stages of meiosis in grasshopper testis.
4. Micrographs of different cell components (dry lab).
5. Sub-cellular fractionation.
6. Visualization of nuclear fraction by acetocarmine stain.
7. Staining and visualization of mitochondria by Janus green stain.

SUGGESTED READINGS

1. The Cell: A Molecular Approach (2009) 5th ed., Cooper, G.M. and Hausman, R.E., ASM Press & Sunderland (Washington DC), Sinauer Associates, MA, ISBN:978-0-87893-300-6.
2. Molecular Cell Biology (2012) 7th ed., Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell. J., W.H. Freeman & Company (New York), ISBN:13:978-1-4641-0981-2 / ISBN:10: 1-4641-0981-8.
3. Molecular Biology of the Cell (2008) 5th ed., Alberts, B., Johnson, A., Lewis, J., and Enlarge, M., Garland Science (Princeton), ISBN:0-8153-1619-4 / ISBN:0-8153-1620-8.



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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH C-3: PROTEINS (THEORY)
SEMESTER - II

TOTAL HOURS: 60

CREDITS: 4

Unit 1 Introduction to amino acids, peptides and proteins

No. of Hours: 2

Amino acids and their properties - hydrophobic, polar and charged. Biologically important peptides - hormones, antibiotics and growth factors. Multimeric proteins, conjugated proteins and metallo proteins. Diversity of function

Unit 2 Extraction of proteins for downstream processing

No. of Hours: 4

Solubilization of proteins from their cellular and extracellular locations. Use of simple grinding methods, homogenization, ultrasonication, French press and centrifugation.

Unit 3 Separation techniques

No. of Hours: 10

Ammonium sulphate fractionation, solvent fractionation, dialysis and lyophilization. Ion-exchange chromatography, molecular sieve chromatography, hydrophobic interaction/reverse phase chromatography, affinity chromatography, HPLC and FPLC

Unit 4 Characterization of proteins

No. of Hours: 8

Determination of purity, molecular weight, extinction coefficient and sedimentation coefficient, IEF, SDS-PAGE and 2-D electrophoresis.

Unit 5 Covalent structure of proteins

No. of Hours: 12

Organization of protein structure into primary, secondary, tertiary and quaternary structures. N-terminal and C-terminal amino acid analysis. Sequencing techniques - Edman degradation. Generation of overlap peptides using different enzymes and chemical reagents. Disulfide bonds and their location. Mass spectrometric analysis, tandem MS. Solid phase peptide synthesis

Unit 6 Three dimensional structures of proteins

No. of Hours: 6

Nature of stabilizing bonds - covalent and non covalent. Importance of primary structure in folding. The peptide bond - bond lengths and configuration. Dihedral angles psi and phi. Helices, sheets and turns. Ramachandran map. Techniques used in studying 3-D structures - X-ray diffraction and NMR. Motifs and domains. Tertiary and quaternary structures. Structures of myoglobin and haemoglobin

Unit 7 Protein folding and conformational diseases

No. of Hours: 4

Denaturation and renaturation of Ribonuclease A. Introduction to thermodynamics of folding and molten globule. Assisted folding by molecular chaperones, chaperonins and PDI. Defects in protein folding. Diseases –Alzheimer's and Prion based.

Unit 8 Introduction to protein structure databases

No. of Hours: 2

Protein sequence and structure databases (PDB). Use of sequence and domain information. Viewing protein structures using *in silico* tools.

Unit 9 Myoglobin and haemoglobin

No. of Hours: 6

Oxygen binding curves, influence of 2,3-BPG, CO₂ and Cl⁻. Hill plot. Cooperativity between subunits and models to explain the phenomena - concerted and sequential models. Haemoglobin disorders.

Unit 10 Specialized proteins - antibodies and actin-myosin motors **No. of Hours: 4**
Antibody structure and binding to antigens. ATP activated actin - myosin contractions.

Unit 11 Membrane proteins **No. of Hours: 2**
Integral and membrane associated proteins. Hydropathy plots to predict transmembrane domains.
Significance of membrane proteins - bacteriorhodopsin.

BCH C-3: PROTEINS (PRACTICALS)
SEMESTER – II

TOTAL HOURS: 60

CREDITS: 2

1. Estimation of proteins using UV absorbance and Biuret method.
2. Microassay of proteins using Lowry/Bradford method.
3. Isoelectric pH of casein.
4. Ammonium sulphate fractionation of serum proteins.
5. Separation of albumin from serum using anion-exchange chromatography.
6. SDS-PAGE analysis of proteins.

SUGGESTED READINGS

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4292-3414-8.
2. Physical Biochemistry (2009) 2nd ed., Sheehan, D., Wiley-Blackwell (West Sussex), ISBN: 9780470856024 / ISBN: 9780470856031.
3. The Tools of Biochemistry (1977; Reprint 2011) Cooper, T.G., Wiley India Pvt. Ltd. (New Delhi), ISBN: 978-81-265-3016-8.


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH C-4: ENZYMES (THEORY)
SEMESTER – II

TOTAL HOURS: 60

CREDITS: 4

Unit 1 Introduction to enzymes

No. of Hours: 2

Nature of enzymes - protein and non-protein (ribozyme). Cofactor and prosthetic group, apoenzyme, holoenzyme. IUBMB classification of enzymes.

Unit 2 Features of enzyme catalysis

No. of Hours: 6

Factors affecting the rate of chemical reactions, collision theory, activation energy and transition state theory, catalysis, reaction rates and thermodynamics of reaction. Catalytic power and specificity of enzymes (concept of active site), Fischer's lock and key hypothesis, Koshland's induced fit hypothesis.

Unit 3 Enzyme kinetics

No. of Hours: 10

Relationship between initial velocity and substrate concentration, steady state kinetics, equilibrium constant - monosubstrate reactions. Michaelis-Menten equation, Lineweaver-Burk plot, Eadie-Hofstee and Hanes plot. K_m and V_{max} , K_{cat} and turnover number. Effect of pH, temperature and metal ions on the activity of enzyme.

Unit 4 Bisubstrate reactions

No. of Hours: 2

Types of bi bi reactions (sequential – ordered and random, ping pong reactions). Differentiating bi substrate mechanisms (diagnostic plots, isotope exchange).

Unit 5 Enzyme inhibition

No. of Hours: 8

Reversible inhibition (competitive, uncompetitive, non-competitive, mixed and substrate). Mechanism based inhibitors - antibiotics as inhibitors.

Unit 6 Mechanism of action of enzymes

No. of Hours: 8

General features - proximity and orientation, strain and distortion, acid base and covalent catalysis (chymotrypsin, lysozyme). Metal activated enzymes and metalloenzymes, transition state analogues.

Unit 7 Regulation of enzyme activity

No. of Hours: 8

Control of activities of single enzymes (end product inhibition) and metabolic pathways, feedback inhibition (aspartate transcarbamoylase), reversible covalent modification phosphorylation (glycogen phosphorylase). Proteolytic cleavage- zymogen. Multienzyme complex as regulatory enzymes. Occurrence and isolation, phylogenetic distribution and properties (pyruvate dehydrogenase, fatty acyl synthase) Isoenzymes - properties and physiological significance (lactate dehydrogenase).

Unit 8 Involvement of coenzymes in enzyme catalysed reactions

No. of Hours: 6

TPP, FAD, NAD, pyridoxal phosphate, biotin, coenzyme A, tetrahydrofolate, lipoic acid.

Unit 9 Applications of enzymes

No. of Hours: 10

Application of enzymes in diagnostics (SGPT, SGOT, creatine kinase, alkaline and acid phosphatases), enzyme immunoassay (HRPO), enzyme therapy (Streptokinase). Immobilized enzymes.

BCH C-4: ENZYMES (PRACTICALS)
SEMESTER – II

TOTAL HOURS: 60

CREDITS: 2

1. Partial purification of acid phosphatase from germinating mung bean.
2. Assay of enzyme activity and specific activity, e.g. acid phosphatase.
3. Effect of pH on enzyme activity
4. Determination of K_m and V_{max} using Lineweaver-Burk graph.
5. Enzyme inhibition - calculation of K_i for competitive inhibition.
6. Continuous assay of lactate dehydrogenase.

SUGGESTED READINGS

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4292-3414-8.
2. Biochemistry (2011) 4th ed., Donald, V. and Judith G.V., John Wiley & Sons Asia Pvt. Ltd. (New Jersey), ISBN:978-1180-25024.
3. Fundamentals of Enzymology (1999) 3rd ed., Nicholas C.P. and Lewis S., Oxford University Press Inc. (New York), ISBN:0 19 850229 X.


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH C-5: METABOLISM OF CARBOHYDRATES AND LIPIDS
(THEORY)
SEMESTER - III

TOTAL HOURS: 60

CREDITS: 4

Unit 1 Basic design of metabolism

No. of Hours: 4

Autotrophs, heterotrophs, metabolic pathways, catabolism, anabolism, ATP as energy currency, reducing power of the cell.

Unit 2 Glycolysis

No. of Hours: 4

Glycolysis - a universal pathway, reactions of glycolysis, fermentation, fates of pyruvate, feeder pathways for glycolysis, galactosemia.

Unit 3 Gluconeogenesis and pentose phosphate pathway

No. of Hours: 4

Synthesis of glucose from non-carbohydrate sources, reciprocal regulation of glycolysis and gluconeogenesis, pentose phosphate pathway and its importance.

Unit 4 Glycogen metabolism

No. of Hours: 4

Glycogenesis and glycogenolysis, regulation of glycogen metabolism, glycogen storage diseases.

Unit 5 Citric acid cycle

No. of Hours: 6

Production of acetyl CoA, reactions of citric acid cycle, anaplerotic reactions, amphibolic role, regulation of citric acid cycle, glyoxalate pathway, coordinated regulation of glyoxalate and citric acid pathways.

Unit 6 Synthesis of carbohydrates

No. of Hours: 8

Calvin cycle, regulation of calvin cycle, regulated synthesis of starch and sucrose, photorespiration, C₄ and CAM pathways, synthesis of cell wall polysaccharides, integration of carbohydrate metabolism in plant cell.

Unit 7 Fatty acid oxidation

No. of HOURS: 10

Digestion, mobilisation and transport of cholesterol and triacyl glycerols, fatty acid transport to mitochondria, β oxidation of saturated, unsaturated, odd and even numbered and branched chain fatty acids, regulation of fatty acid oxidation, peroxisomal oxidation, ω oxidation, ketone bodies metabolism, ketoacidosis.

Unit 8 Fatty acid synthesis

No. of Hours: 6

Fatty acid synthase complex. Synthesis of saturated, unsaturated, odd and even chain fatty acids and regulation.

Unit 9 Biosynthesis of eicosanoids, cholesterol, steroids and isoprenoids

No. of Hours: 6

Synthesis of prostaglandins, leukotrienes and thromboxanes. Synthesis of cholesterol, regulation of cholesterol synthesis. Synthesis of steroids and isoprenoids.

Unit 10 Biosynthesis of membrane lipids

No. of Hours: 4

Synthesis of membrane phospholipids in prokaryotes and eukaryotes, respiratory distress

syndrome, biosynthesis of triacylglycerol, biosynthesis of plasmalogens, sphingolipids and glycolipids, lipid storage diseases.

Unit 11 Starve-feed cycle

No. of Hours: 4

Well-fed state, early fasting state, fasting state, early re-fed state, energy requirements, reserves and caloric homeostasis, five phases of glucose homeostasis.

BCH C-5: METABOLISM OF CARBOHYDRATES AND LIPIDS (PRACTICALS) SEMESTER - III

TOTAL HOURS: 60

CREDITS: 2

1. Estimation of blood glucose.
2. Sugar fermentation by microorganisms.
3. Assay of salivary amylase.
4. Isolation of lecithin, identification by TLC, and its estimation.
5. Isolation of cholesterol from egg yolk and its estimation.

SUGGESTED READINGS

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13:978-1-4641-0962-1 / ISBN:10:1-4641-0962-1.
2. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New Jersey), ISBN:978-0-470-28173-4.
3. Biochemistry (2012) 7th ed., Berg, J.M., Tymoczko, J.L. and Stryer L., W.H. Freeman and Company (New York), ISBN:10:1-4292-2936-5, ISBN:13:978-1-4292-2936-4.


PRINCIPAL (Acting)
Sri Venkateswara College
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Okhla Kuan, New Delhi-110021

B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH C-6: MEMBRANE BIOLOGY AND BIOENERGETICS (THEORY)
SEMESTER - III

TOTAL HOURS: 60

CREDITS: 4

Unit 1 Introduction to biomembranes

No. of Hours: 4

Composition of biomembranes - prokaryotic, eukaryotic, neuronal and subcellular membranes. Study of membrane proteins. Fluid mosaic model with experimental proof. Monolayer, planar bilayer and liposomes as model membrane systems.

Unit 2 Membrane structures

No. of Hours: 6

Polymorphic structures of amphiphilic molecules in aqueous solutions - micelles and bilayers. CMC, critical packing parameter. Membrane asymmetry. Macro and micro domains in membranes; lipid rafts, caveolae and RBC membrane architecture. Role of tight junctions in polarized cells.

Unit 3 Membrane dynamics

No. of Hours: 6

Lateral, transverse and rotational motion of lipids and proteins. Techniques used to study membrane dynamics - FRAP, TNBS labeling etc. Transition studies of lipid bilayer, transition temperature. Membrane fluidity, factors affecting membrane fluidity.

Unit 4 Membrane transport

No. of Hours: 10

Thermodynamics of transport. Simple diffusion and facilitated diffusion. Passive transport - glucose transporter, anion transporter and porins. Primary active transporters - P type ATPases, V type ATPases, F type ATPases. Secondary active transporters - lactose permease, Na⁺-glucose symporter. ABC family of transporters - MDR, CFTR. Group translocation. Ion channels - voltage-gated ion channels (Na⁺/K⁺ voltage-gated channel), ligand-gated ion channels (acetyl choline receptor), aquaporins, bacteriorhodopsin. Ionophores - valinomycin, gramicidin.

Unit 5 Vesicular transport and membrane fusion

No. of Hours: 6

Types of vesicle transport and their function - clathrin, COP I and COP II coated vesicles. Molecular mechanism of vesicular transport. Membrane fusion. Receptor mediated endocytosis of transferrin.

Unit 6 Introduction to bioenergetics

No. of Hours: 6

Laws of thermodynamics, state functions, equilibrium constant, coupled reactions, energy charge, ATP cycle, phosphorylation potential, phosphoryl group transfers. Chemical basis of high standard energy of hydrolysis of ATP, PEP, 13 BPG and thioesters. Redox reactions, standard redox potentials and Nernst equation. Universal electron carriers.

Unit 7 Oxidative phosphorylation

No. of HOURS: 12

Mitochondria. Electron transport chain - its organization and function. Inhibitors of ETC and uncouplers. Peter Mitchell's chemiosmotic hypothesis. Proton motive force. F₀ F₁ ATP synthase, structure and mechanism of ATP synthesis. Metabolite transporters in mitochondria. Regulation of oxidative phosphorylation. ROS production and antioxidant mechanisms. Thermogenesis. Alternative respiratory pathways in plants.

Unit 8 Photophosphorylation

No. of Hours: 10

General features of photophosphorylation, historical background, Hills reaction, photosynthetic pigments, light harvesting systems of plants and microbes and resonance energy transfer. Bacterial photophosphorylation in purple bacteria, Green sulfur bacteria and *Halobacterium salinarum*. Photophosphorylation in plants - structure of chloroplast, molecular architecture of Photosystem I and Photosystem II, Z-scheme of photosynthetic electron flow, oxygen evolving complex and action of herbicides. Cyclic photophosphorylation and its significance. Photo inhibition. Evolution of oxygenic photosynthesis.

BCH C-6: MEMBRANE BIOLOGY AND BIOENERGETICS (PRACTICALS) **SEMESTER - III**

TOTAL HOURS: 60

CREDITS: 2

1. Effect of lipid composition on the permeability of a lipid monolayer.
2. Determination of CMC of detergents.
3. RBC ghost cell preparation and to study the effect of detergents on membranes.
4. Separation of photosynthetic pigments by TLC.
5. Isolation of mitochondria from liver and assay of marker enzyme SDH.
6. Study photosynthetic O₂ evolution in hydrilla plant.
7. Isolation of chloroplast from spinach leaves, estimation of chlorophyll and photosynthetic activity.

SUGGESTED READINGS

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13:978-1-4641-0962-1 / ISBN:10:1-4641-0962-1.
2. Molecular Cell Biology (2013) 7th ed., Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., W.H. Freeman & Company (New York), ISBN:13:978-1-4641-0981-2.
3. Biochemistry (2010) 4th ed., Garret, R. H. and Grisham, C.M., Cengage Learning (Boston), ISBN-13:978-0-495-11464-2.
4. Principles of Biochemistry (2008) 3rd ed., Voet, D.J., Voet, J.G. and Pratt, C.W., John Wiley & Sons, Inc. (New York), ISBN:13: 978-0470-23396-2


PRINCIPAL (Acting)
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Chaula Kuan, New Delhi-110021

B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH C-7: HORMONE: BIOCHEMISTRY AND FUNCTION (THEORY)
SEMESTER – III

TOTAL HOURS: 60

CREDITS: 4

Unit 1 Introduction to endocrinology

No. of HOURS: 6

Functions of hormones and their regulation. Chemical signaling - endocrine, paracrine, autocrine, intracrine and neuroendocrine mechanisms. Chemical classification of hormones, transport of hormones in the circulation and their half-lives. Hormone therapy. General introduction to Endocrine methodology.

Unit 2 Hormone mediated signaling

No. of HOURS: 16

Hormone receptors - extracellular and intracellular. Receptor - hormone binding, Scatchard analysis. G protein coupled receptors, G proteins, second messengers - cAMP, cGMP, IP₃, DAG, Ca²⁺, NO. Effector systems - adenylyl cyclase, guanylyl cyclase, PDE, PLC. Protein kinases (PKA, PKB, PKC, PKG). Receptor tyrosine kinases - EGF, insulin, erythropoietin receptor; ras - MAP kinase cascade, JAK - STAT pathway. Steroid hormone/ thyroid hormone receptor mediated gene regulation. Receptor regulation and cross talk.

Unit 3 Hypothalamic and pituitary hormones

No. of HOURS: 8

Hypothalamic - pituitary axis. Study the physiological and biochemical actions of hypothalamic hormones, pituitary hormones - GH, prolactin, TSH, LH, FSH, POMC peptide family, oxytocin and vasopressin, feedback regulation cycle. Endocrine disorders - gigantism, acromegaly, dwarfs, pigmies and diabetes insipidus.

Unit 4 Thyroid hormone

No. of HOURS: 4

Thyroid gland. Biosynthesis of thyroid hormone and its regulation; its physiological and biochemical action. Pathophysiology - Goiter, Graves disease, cretinism, myxedema, Hashimoto's disease.

Unit 5 Hormones regulating Ca²⁺ homeostasis

No. of HOURS: 6

PTH, Vitamin D and calcitonin. Mechanism of Ca²⁺ regulation and pathways involving bone, skin, liver, gut and kidneys. Pathophysiology - rickets, osteomalacia, osteoporosis.

Unit 6 Pancreatic and GI tract hormones

No. of HOURS: 6

Regulation of release of insulin, glucagon, gastrin, secretin, CCK, GIP, adipoleptin, leptin and ghrelin. Summary of hormone metabolite control of GI function. Physiological and biochemical action. Pathophysiology - diabetes type I and type II.

Unit 7 Hormones of adrenals

No. of HOURS: 6

Aldosterone, renin angiotensin system, cortisol, epinephrine and norepinephrine. Fight or flight response, stress response. Pathophysiology – Addison's disease, Conn's syndrome, Cushing syndrome.

Unit 8 Reproductive hormones

No. of HOURS: 6

Male and female sex hormones. Interplay of hormones during reproductive cycle, pregnancy, parturition and lactation. Hormone based contraception.

Unit 9 Growth factors

PDGF, EGF, IGF-II, and erythropoietin.

No. of HOURS: 2**BCH C-7: HORMONE: BIOCHEMISTRY AND FUNCTION (PRACTICALS)
SEMESTER – III****TOTAL HOURS: 60****CREDITS: 2**

1. Glucose tolerance test.
2. Estimation of serum Ca^{2+} .
3. Estimation of serum T4.
4. HCG based pregnancy test.
5. Estimation of serum electrolytes.
6. Case studies.

SUGGESTED READINGS

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M. W.H. Freeman & Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10-14641-0962-1.
2. Vander's Human Physiology (2008) 11th ed., Widmaier, E.P., Raff, H. and Strang, K.T. McGraw Hill International Publications, ISBN: 978-0-07-128366-3.
3. Endocrinology (2007) 6th ed., Hadley, M.C. and Levine, J.E. Pearson Education (New Delhi), Inc. ISBN: 978-81-317-2610-5.
4. The Cell: A Molecular Approach (2009) 5th Ed. Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland, (Washington DC), Sinauer Associates. (MA). ISBN:978-0-87893-300-6.



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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH C-8: HUMAN PHYSIOLOGY (THEORY)
SEMESTER - IV

TOTAL HOURS: 60

CREDITS: 4

Unit 1 Homeostasis and the organization of body fluid compartments

No. of HOURS:6

Intracellular, extracellular and interstitial fluid. Homeostasis, control system and their components. Plasma as an extracellular fluid, RBC, molecular mechanism of blood coagulation, role of vitamin K in coagulation, anticoagulant and fibrinolytic systems. Anemias, polycythemia, haemophilia and thrombosis.

Unit 2 Cardiovascular physiology

No. of HOURS: 10

Pressure, flow and resistance. Anatomy of heart. Physiology of the cardiac muscle, automaticity of the cardiac muscle contraction, excitation contraction coupling, relationship between cardiac cycle, heart sound, ventricular volumes and the ECG, control of cardiac function and output. The arterial system, venous system, the microcirculation and mechanics of capillary fluid exchange. Control of blood flow to the tissues. Portal circulations. Arterial pressure and its regulation. Hypertension, congestive heart disease, atherosclerosis and myocardial infarction.

Unit 3 Respiration

No. of HOURS: 10

Organization of the pulmonary system. Mechanism of respiration, pulmonary ventilation and related volumes, pulmonary circulation. Principles of gas exchange and transport. Regulation of respiration. Pulmonary oedema and regulation of pleural fluid. Hypoxia, hypercapnea, pulmonary distress, emphysema, ARDS.

Unit 4 Renal physiology

No. of HOURS: 6

Anatomy of the kidney and the nephron. Regulation of renal blood flow. Cell biology of the Bowman's capsule. Physiology of glomerular filtration and GFR. Tubular processing of the glomerular filtrate. Micturition reflex and voluntary control of micturition. Regulation of ECF electrolyte and water content, blood volume and long term blood pressure. Blood buffer systems, renal and pulmonary control of blood pH, renal clearance. Assessment of kidney function. Acidosis and alkalosis. Glomerular nephritis, renal failure, dialysis and diuretics.

Unit 5 Gastrointestinal and hepatic physiology

No. of HOURS: 6

Histology of the gastrointestinal tract. Propulsion and motility of food and digested material. Enteric reflexes, secretory functions of the gastrointestinal tract, digestion and absorption of macro and micronutrients. Peptic ulcer, Sprue, celiac disease, IBD, regurgitation, diarrhoea and constipation. Anatomy of the hepatic lobule and blood flow into the liver. Formation and secretion of bile. enterohepatic cycle, reticuloendothelial system, metabolic importance of liver. Liver function tests. Jaundice, liver cirrhosis and fatty liver.

Unit 6 Musculoskeletal system

No. of HOURS: 4

Bone structure and formation. Physiology of muscle contraction in striated and non-striated muscle.


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Unit 7 Reproductive physiology**No. of HOURS: 8**

Sex determination and differentiation. Development of female and male genital tracts. Spermatogenesis, capacitation and transport of sperm, blood testis barrier. Ovarian function and its control. Uterine changes, fertilization and implantation. Placenta as a feto- maternal unit, gestation and parturition.

Unit 8 Neurochemistry and neurophysiology**No. of HOURS: 10**

Central Nervous system. Peripheral Nervous system. Blood brain barrier and CSF. Membrane potentials. Synaptic transmission. Neurotransmitters. Sensory receptors and neural pathways. Somatic sensation, EEG, sleep, coma, learning and memory.

**BCH C-8: HUMAN PHYSIOLOGY (PRACTICALS)
SEMESTER - IV****TOTAL HOURS: 60****CREDITS: 2**

1. Hematology.
 - a. RBC and WBC counting
 - b. Differential leucocyte count.
 - c. Clotting time.
2. Estimation of haemoglobin.
3. Separation of plasma proteins.
4. Determination of total iron binding capacity.
5. Pulmonary function tests, spirometry and measurement of blood pressure.
6. Separation of isoenzymes of LDH by electrophoresis.
7. Histology of connective tissue, liver and/ brain permanent slides.
8. Case studies (Renal clearance, GFR, ECG).

SUGGESTED READINGS

1. Vander's Human Physiology (2008) 11th ed., Widmaier, E.P., Raff, H. and Strang, K.T., McGraw Hill International Publications (New York), ISBN: 978-0-07-128366-3
2. Harper's Biochemistry (2012) 29th ed., Murray, R.K., Granner, D.K., Mayes and P.A., Rodwell, V.W., Lange Medical Books/McGraw Hill. ISBN:978-0-07-176-576-3.
3. Textbook of Medical Physiology (2011) 10th ed., Guyton, A.C. and Hall, J.E., Reed Elseviers India Pvt. Ltd. (New Delhi). ISBN: 978-1-4160-4574-8.
4. Fundamental of Anatomy and Physiology (2009), 8th ed., Martini, F.H. and Nath, J.L., Pearson Publications (San Francisco), ISBN: 10:0-321-53910-9 / ISBN: 13: 978-0321-53910-6.



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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH C-9: GENE ORGANIZATION, REPLICATION AND REPAIR
(THEORY)
SEMESTER - IV

TOTAL HOURS: 60

CREDITS: 4

Unit 1 Structure of DNA

No. of HOURS: 6

DNA structure, features of the double helix, various forms of DNA, denaturation and reassociation of DNA.

Unit 2 Genes and genomic organization

No. of HOURS: 10

Genome sequence and chromosome diversity, definition of a gene, organization of genes in viruses, bacteria, animals and plants. Nucleosome structure and packaging of DNA into higher order structures.

Unit 3 Replication of DNA

No. of HOURS: 20

The chemistry of DNA synthesis, DNA polymerase, the replication fork, origin of replication, enzymes and proteins in DNA replication, various modes of replication, stages of replication of *E. coli* chromosome, relationship between replication and cell division, replication in eukaryotes. Comparison of replication in prokaryotes and eukaryotes. Inhibitors of DNA replication and applications in medicine. Supercoiling of DNA and its importance, topoisomerases, critical role of topoisomerases in cell, topoisomerase inhibitors and their application in medicine.

Unit 4 Recombination and transposition of DNA

No. of HOURS: 12

Homologous recombination, proteins and enzymes in recombination, site-specific recombination, serine and tyrosine recombinases, biological roles of site-specific recombination, transposition, three classes of transposable elements, importance of transposable elements in horizontal transfer of genes and evolution.

Unit 5 Molecular basis of mutations

No. of HOURS: 4

Importance of mutations in evolution of species. Types of mutations - transition, transversions, frame shift mutations, mutations induced by chemicals, radiation, transposable elements, Ames test.

Unit 6 Various modes of DNA repair

No. of HOURS: 8

Replication errors and mismatch repair system, repair of DNA damage, direct repair, base excision repair, nucleotide excision repair, recombination repair, translesion DNA synthesis.

BCH C-9 : GENE ORGANIZATION, REPLICATION AND REPAIR (PRACTICALS)
SEMESTER - IV

TOTAL HOURS: 60

CREDITS: 2

1. Verification of Chargaff's rule by paper chromatography.
2. Ultraviolet absorption spectrum of DNA and RNA.
3. Determination of DNA and RNA concentration by $A_{260\text{nm}}$.
4. Determination of the melting temperature and GC content of DNA.
5. Isolation of chromosomal DNA from *E. coli* cells.

SUGGESTED READINGS

1. Molecular Biology of the Gene (2008) 6th ed., Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., Cold Spring Harbor Laboratory Press, Cold spring Harbor (New York), ISBN:0-321-50781 / ISBN:978-0-321-50781-5.
2. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W. H. Freeman & Company (New York), ISBN:13: 978-1-4292-3414-6 / ISBN:10-14641-0962-1.
3. Principles of Genetics (2010) 5th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons Asia, ISBN:978-0-470-39842-5.


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH C-10: METABOLISM OF AMINO ACIDS AND NUCLEOTIDES
(THEORY)
SEMESTER - IV

TOTAL HOURS: 60

CREDITS: 4

Unit 1 Overview of amino acid metabolism

No. of HOURS: 8

Nitrogen cycle, incorporation of ammonia into biomolecules. Metabolic fates of amino groups. Digestion and absorption of dietary proteins. Protein calorie malnutrition - Kwashiorkor and Marasmus. Nitrogen balance, transamination, role of pyridoxal phosphate, glucose-alanine cycle, Krebs's cycle, urea cycle and inherited defects of urea cycle.

Unit 2 Catabolism of amino acids

No. of Hours: 10

Catabolic pathways of individual amino acids. Glucogenic and ketogenic amino acids. Metabolism of one carbon units. Disorders of amino acids metabolism, phenylketonuria, alkaptonuria, maple syrup urine disease, methylmalonic acidemia (MMA), homocystinuria and Hartnup's disease.

Unit 3 Biosynthesis of amino acids

No. of Hours: 8

Overview of amino acid synthesis. Biosynthesis of non-essential amino acids and its regulation.

Unit 4 Precursor functions of amino acids

No. of Hours: 8

Biosynthesis of creatine and creatinine, polyamines (putrescine, spermine, spermidine), catecholamines (dopamine, epinephrine, norepinephrine) and neurotransmitters (serotonin, GABA). Porphyrin biosynthesis, catabolism and disorders of porphyrin metabolism.

Unit 5 Biosynthesis of purine and pyrimidine nucleotides

No. of Hours: 8

De novo synthesis of purine and pyrimidine nucleotides, regulation and salvage pathways.

Unit 6 Deoxyribonucleotides and synthesis of nucleotide triphosphate

No. of Hours: 6

Biosynthesis of deoxyribonucleotides and its regulation, conversion to triphosphates, biosynthesis of coenzyme nucleotides.

Unit 7 Degradation of purine and pyrimidine nucleotides

No. of Hours: 6

Digestion of nucleic acids, degradation of purine and pyrimidine nucleotides. Inhibitors of nucleotide metabolism. Disorders of purine and pyrimidine metabolism – Lesch-Nyhan syndrome, Gout, SCID, adenosine deaminase deficiency.

Unit 8 Integration of metabolism

No. of Hours: 6

Integration of metabolic pathways (carbohydrate, lipid and amino acid metabolic pathways), tissue specific metabolism (brain, muscle, and liver).


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**BCH C-10 : METABOLISM OF AMINO ACIDS AND NUCLEOTIDES (PRACTICAL)
SEMESTER - IV**

TOTAL HOURS: 60

CREDITS: 2

1. Assay of serum transaminases – SGOT and SGPT.
2. Estimation of serum urea.
3. Estimation of serum uric acid.
4. Estimation of serum creatinine.

SUGGESTED READINGS

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13:978-1-4641-0962-1 / ISBN:10:1-4641-0962-1.
2. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN: 978-0-470-28173-4 / BRV ISBN: 978-0-470-60152-5.


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH C-11: CONCEPTS IN GENETICS (THEORY)
SEMESTER - V

TOTAL HOURS: 60

CREDITS: 4

Unit 1 Introduction to model organisms and Mendelism

No. of HOURS: 3

Model organisms: *Escherichia coli*, *Saccharomyces cerevisiae*, *Drosophila melanogaster*, *Caenorhabditis elegans*, *Danio rerio* and *Arabidopsis thaliana*, Basic principles of heredity.

Unit 2 Applications of Mendel's principles & chromosomal basis of heredity

No. of HOURS: 6

Laws of probability & binomial expansion, formulating and testing genetic hypothesis, chromosomal basis of Mendelism -Sutton and Boveri hypothesis with experimental evidences.

Unit 3 Extensions of Mendelism

No. of HOURS: 4

Allelic variation and gene function - dominance relationships, multiple alleles, lethal alleles and null alleles. Pleiotropy gene interaction - epistatic and non epistatic, interaction between gene(s) and environment. Penetrance and expressivity, norm of reaction and phenocopy.

Unit 4 Genetic definition of a gene

No. of HOURS: 4

Complementation test, limitations of *cis-trans* test, intragenic complementation, rII locus of phage T₄ and concept of cistron

Unit 5 Genetics of bacteria and viruses

No. of HOURS: 6

Mechanism of genetic exchange - conjugation, transformation and transduction. Gene mapping in bacteria.

Unit 6 Linkage, crossing over and mapping techniques

No. of HOURS: 6

Linkage and crossing over, genetic mapping in eukaryotes, centromere mapping with ordered tetrads, cytogenetic mapping with deletions and duplications in *Drosophila*, detection of linked loci by pedigree analysis in humans and somatic cell hybridization for positioning genes on chromosomes.

Unit 7 Human pedigree analysis

No. of HOURS: 6

Pedigree conventions, characteristics of dominant and recessive inheritance. Applications of pedigree analysis.

Unit 8 The genetic control of development and sex determination

No. of HOURS: 6

Model organism for genetic analysis, *Drosophila* development, maternal effect genes, morphogens and zygotic gene activity in development, sex chromosomes and sex determination, dosage compensation of X-linked genes.

Unit 9 Organelle heredity and epigenetics

No. of HOURS: 6

Extra nuclear inheritance, tests for organelle heredity and maternal effect, epigenetic mechanisms of transcriptional regulation & genomic imprinting.

Unit 10 Chromosomal aberrations**No. of HOURS: 4**

Variations in chromosome number- monosomy and trisomy of sex chromosome and autosomes. Variations in chromosome structure - inversions, deletions, duplications and translocations.

Unit 11 Inheritance of complex traits & population genetics**No. of HOURS: 5**

Inheritance of complex trait, analysis of quantitative traits, narrow and broad sense heritability, quantitative trait loci (QTL) and their identification. Hardy-Weinberg law, predicting allele and genotype frequencies and exceptions to Hardy-Weinberg principle.

Evolutionary genetics**No. of HOURS: 4**

Molecular evolution - analysis of nucleotide and amino acid sequences, molecular phylogenies, homologous sequences, phenotypic evolution and speciation.

BCH C-11: CONCEPTS IN GENETICS (PRACTICALS)
SEMESTER - V

TOTAL HOURS: 60**CREDITS: 2**

1. Squash preparation of salivary glands of Dipteran larva to observe polytene chromosomes.
2. Induction of polyploidy in onion roots.
3. Smear technique to demonstrate sex chromatin in buccal epithelial cells.
4. Monohybrid crosses in *Drosophila* for studying sex linked inheritance.
5. PTC testing in a population and calculation of allele and genotype frequencies.
6. Study of abnormal human karyotype and pedigrees (dry lab)

SUGGESTED READINGS

1. Genetics (2012) 6th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2.
2. Genetics - A Conceptual Approach (2012), 4th ed., Pierce, B.A., W.H. Freeman & Co. (New York), ISBN:13:978-1-4292-7606-1 / ISBN:10:1-4292-7606-1.
3. An Introduction to Genetic Analysis (2010), 10th ed., Griffiths, A.J.F, Wessler, S. R, Carroll, S. B. and Doebley, J., W.H. Freeman & Company (New York), ISBN:10: 1-4292-2943-8.


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH C-12: GENE EXPRESSION AND REGULATION (THEORY)
SEMESTER - V

TOTAL HOURS: 60

CREDITS: 4

Unit 1 Biosynthesis of RNA in prokaryotes

No. of HOURS: 8

RNA polymerases, transcription cycle in bacteria, sigma factor, bacterial promoters, identification of DNA binding sites by DNA footprinting, the three stages of RNA synthesis, initiation, elongation and termination, rho-dependent and rho-independent termination. Inhibitors of transcription and applications as anti-microbial drugs.

Unit 2 Biosynthesis of RNA in eukaryotes

No. of HOURS: 8

Comparison between prokaryotic and eukaryotic transcription. Transcription by RNA polymerase II, RNA polymerase II core promoters, general transcription factors, various types of RNA processing, transcription by RNA polymerase I and III. Inhibitors of eukaryotic transcription and their applications. Comparison of fidelity of transcription and replication.

Unit 3 RNA splicing

No. of HOURS: 6

Chemistry of RNA splicing, the spliceosome machinery, splicing pathways, group I and group II introns, alternative splicing, exon shuffling, RNA editing.

Unit 4 The genetic code

No. of HOURS: 4

Degeneracy of the genetic code, wobble in the anticodon, features of the genetic code, nearly universal code.

Unit 5 Biosynthesis of proteins

No. of HOURS: 10

Messenger RNA, transfer RNA, attachment of amino acids to tRNA, the ribosome - initiation, elongation and termination of translation, regulation of translation. Comparison of prokaryotic and eukaryotic protein synthesis. Use of antibiotics in understanding protein synthesis and applications in medicine.

Unit 6 Protein targeting and degradation

No. of HOURS: 6

Post translational modifications, glycosylation, signal sequences for nuclear transport, bacterial signal sequences, import of proteins by receptor mediated endocytosis, specialized systems for protein degradation.

Unit 7 Regulation of gene expression in prokaryotes

No. of HOURS: 8

Principles of gene regulation, negative and positive regulation, concept of operons, regulatory proteins, activators, repressors, DNA binding domains, regulation of lac operon and trp operon, induction of SOS response, synthesis of ribosomal proteins, regulation by genetic recombination, transcriptional regulation in λ bacteriophage.

Unit 8 Regulation of gene expression in eukaryotes

No. of HOURS: 10

Heterochromatin, euchromatin, chromatin remodeling, regulation of galactose metabolism in yeast, regulation by phosphorylation of nuclear transcription factors, regulatory RNAs, riboswitches, RNA interference, synthesis and function of miRNA molecules, phosphorylation of nuclear transcription factors.

BCH C-12: GENE EXPRESSION AND REGULATION (PRACTICALS)
SEMESTER - V

TOTAL HOURS: 60

CREDITS: 2

1. Estimation of RNA by Orcinol Method
2. Extraction of total nucleic acids from plant tissue.
3. Diauxic growth curve effect.
4. Isolation of Total RNA from bacteria/yeast.
5. Effect of inhibitors on protein synthesis.

SUGGESTED READINGS

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman & Company (New York), ISBN:13: 978-1-4292-3414-6 / ISBN:10-14641-0962-1.
2. Molecular Biology of the Gene (2008) 6th ed., Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., Cold Spring Harbor Laboratory Press, Cold Spring Harbor (New York), ISBN:0-321-50781 / ISBN: 978-0-321-50781-5.


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH C-13: GENETIC ENGINEERING AND BIOTECHNOLOGY
(THEORY)
SEMESTER - VI

TOTAL HOURS: 60

CREDITS: 4

Unit 1 Introduction to recombinant DNA technology

No. of HOURS: 6

Overview of recombinant DNA technology. Restriction and modification systems, restriction endonucleases and other enzymes used in manipulating DNA molecules, separation of DNA by gel electrophoresis. Extraction and purification of plasmid and bacteriophage DNA.

Unit 2 Cloning vectors for prokaryotes and eukaryotes

No. of HOURS: 10

Plasmids and bacteriophages as vectors for gene cloning. Cloning vectors based on *E. coli* plasmids, pBR322, pUC8, pGEM3Z. Cloning vectors based on M13 and λ bacteriophage. Vectors for yeast, higher plants and animals.

Unit 3 Joining of DNA fragments

No. of HOURS: 4

Ligation of DNA molecules. DNA ligase, sticky ends, blunt ends, linkers and adapters. Synthetic oligonucleotides, synthesis and use.

Unit 4 Introduction of DNA into cells and selection for recombinants

No. of HOURS: 6

Uptake of DNA by cells, preparation of competent cells. Selection for transformed cells. Identification for recombinants - insertional inactivation, blue-white selection. Introduction of phage DNA into bacterial cells. Identification of recombinant phages. Introduction of DNA into animal cells, electroporation.

Unit 5 Methods for clone identification

No. of HOURS: 6

The problem of selection, direct selection, marker rescue. Gene libraries, identification of a clone from gene library, colony and plaque hybridization probing, methods based on detection of the translation product of the cloned gene.

Unit 6 Polymerase chain reaction

No. of HOURS: 4

Fundamentals of polymerase chain reaction, designing primers for PCR. Studying PCR products. Cloning PCR products. Real time PCR.

Unit 7 DNA sequencing

No. of HOURS: 6

DNA sequencing by Sanger's method, modifications based on Sanger's method. Automated DNA sequencing. Pyrosequencing.

Unit 8 Expression of cloned genes

No. of HOURS: 6

Vectors for expression of foreign genes in *E. coli*, cassettes and gene fusions. Challenges in producing recombinant protein in *E. coli*. Production of recombinant protein by eukaryotic cells. Fusion tags and their role in purification of recombinant proteins.

Unit 9 Applications of genetic engineering in Biotechnology

No. of HOURS: 12

Site-directed mutagenesis and protein engineering. Applications in medicine, production of recombinant pharmaceuticals such as insulin, human growth hormone, factor VIII. Recombinant

vaccines. Gene therapy. Applications in agriculture - plant genetic engineering, herbicide resistant crops, problems with genetically modified plants, safety concerns.

BCH C-13: GENETIC ENGINEERING AND BIOTECHNOLOGY (PRACTICALS)
SEMESTER - VI

TOTAL HOURS: 60

CREDITS: 2

1. Isolation of plasmid DNA from *E. coli* cells.
2. Digestion of plasmid DNA with restriction enzymes.
3. Amplification of a DNA fragment by PCR.
4. Transformation of *E. coli* cells with plasmid DNA.
5. Hyper expression of poly histidine-tagged recombinant protein and purification using Ni-affinity resin.
6. Complementation of β -galactisidase for Blue and White selection.

SUGGESTED READINGS

1. Gene Cloning and DNA Analysis (2010) 6th ed., Brown, T.A., Wiley-Blackwell publishing (Oxford, UK), ISBN: 978-1-4051-8173-0.
2. Principles of Gene Manipulation and Genomics (2006) 7th ed., Primrose, S.B., and Twyman, R. M., Blackwell publishing (Oxford, UK) ISBN:13: 978-1-4051-3544-3.
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA (2010) 4th ed., Glick B.R., Pasternak, J.J. and Patten, C.L., ASM Press (Washington DC), ISBN: 978-1-55581-498-4 (HC).


PRINCIPAL (Acting)
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Dhaura Kuan, New Delhi-110021

B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH C-14: IMMUNOLOGY (THEORY)
SEMESTER - VI

TOTAL HOURS: 60

CREDITS: 4

Unit 1 Cells and organs of the immune system

No. of HOURS: 4

Hematopoiesis, cells of the immune system, primary and secondary lymphoid organs and tissues (MALT).

Unit 2 Innate immunity and leukocyte extravasation

No. of HOURS: 6

Anatomical barriers, cell types of innate immunity, soluble molecules and membrane associated receptors (PRR), connections between innate and adaptive immunity, cell adhesion molecules, chemokines, leukocyte extravasation, localized and systemic response.

Unit 3 Immunogens and antigens

No. of HOURS: 4

Antigens and haptens, factors that dictate immunogenicity, B and T cell epitopes.

Unit 4 Antibody structure and function

No. of HOURS: 4

Structure and distribution of classes and subclasses of immunoglobulins (Ig), Ig fold, effector functions of antibody, antigenic determinants on Ig and Ig super family.

Unit 5 Generation of receptor diversity

No. of HOURS: 4

Dreyer-Bennett hypothesis, multigene organization of Ig locus, mechanism of V region DNA rearrangement, ways of antibody diversification.

Unit 6 Biology of the B lymphocyte

No. of HOURS: 6

Antigen independent phase of B cell maturation and selection, humoral response – T-dependent and T-independent response, anatomical distribution of B cell populations.

Unit 7 Complement system

No. of HOURS: 4

Complement activation by classical, alternate and MB lectin pathway, biological consequences of complement activation, regulation and complement deficiencies.

Unit 8 MHC complex and antigen presentation

No. of HOURS: 4

General organization and inheritance of MHC, structure, distribution and role of MHC class I and class II proteins, linkage disequilibrium, pathways of antigen processing and presentation.

Unit 9 Biology of the T lymphocyte

No. of HOURS: 4

Structure and role of T cell receptor, and co-receptor, T cell development, generation of receptor diversity, selection and differentiation.

Unit 10 Cell mediated cytotoxic responses

No. of HOURS: 4

General properties of effector T cells, cytotoxic T cells (Tc), natural killer cells; NKT cells and antibody dependent cellular cytotoxicity (ADCC).

Unit 11 Tolerance, autoimmunity and hypersensitivity

No. of HOURS: 8

Organ specific and systemic autoimmune diseases, possible mechanisms of induction of autoimmunity, Gell and Coombs classification, IgE mediated (Type I) hypersensitivity, antibody

mediated cytotoxic (Type II) hypersensitivity, immune complex mediated (type III) hypersensitivity and delayed type (Type IV) hypersensitivity.

Unit 12 Transplantation immunology and vaccines

No. of HOURS: 8

Immunological basis of graft rejection, clinical manifestations, immunosuppressive therapy and privileged sites. Vaccines - active and passive immunization, types of vaccines.

BCH C-14: IMMUNOLOGY (PRACTICALS) SEMESTER - VI

TOTAL HOURS: 60

CREDITS: 2

1. Isolation of lymphocytes from blood and spleen.
2. Purification of immunoglobulins.
3. Assays based on precipitation reactions - Ouchterlony double diffusion (ODD) and Mancini radial immunodiffusion.
4. Assays based on agglutination reactions - Blood typing (active) & passive agglutination.
5. Enzyme linked immune-sorbent assay (ELISA).
6. DOT blot
7. Immunoblot

SUGGESTED READINGS

1. Kuby Immunology (2007) 6th ed., Kindt, T.L., Goldsby, R.A. and Osborne, B.A., W.H Freeman and Company (New York), ISBN:13: 978-0-7167-8590-3 / ISBN: 10:0-7617-8590-0.
2. Immunology: A Short Course (2009) 6th ed., Coico, R and Sunshine, G., John Wiley & sons, Inc (New Jersey), ISBN: 978-0-470-08158-7.
3. Janeway's Immunobiology (2012) 8th ed., Murphy, K., Mowat, A., and Weaver, C.T., Garland Science (London & New York), ISBN: 978-0-8153-4243-4.


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**B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
DISCIPLINE SPECIFIC ELECTIVES**



PRINCIPAL (Acting)
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Dhaura Kuan, New Delhi-110021

B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH DSE-1: NUTRITIONAL BIOCHEMISTRY (THEORY)
SEMESTER – V/VI

TOTAL HOURS: 60

CREDITS: 4

Unit 1 Introduction to Nutrition and Energy Metabolism

No. of HOURS: 8

Defining Nutrition, role of nutrients. Unit of energy, Biological oxidation of foodstuff. Physiological energy value of foods, SDA. Measurement of energy expenditure. Basal and Resting metabolism, physical activity, factors affecting energy input - hunger, appetite, energy balance. Recommended Nutrient Intakes (RNI) and Recommended Dietary Allowances for different age groups.

Unit 2 Dietary carbohydrates and health

No. of HOURS: 8

Review functions of carbohydrates. Digestion, absorption, utilization and storage, hormonal regulation of blood glucose. Dietary requirements and source of carbohydrates, Dietary fiber, role of fibre in lipid metabolism, colon function, blood glucose level and GI tract functions.

Unit 3 Dietary lipid and health

No. of HOURS: 8

Review of classification, sources, functions, digestion, absorption, utilization and storage. Essential Fatty Acids; Functions of EFA, RDA, – excess and deficiency of EFA. Lipotropic factors, role of saturated fat, cholesterol, lipoprotein and triglycerides. Importance of the following: a) Omega – fatty acids. Omega 3/ omega 6 ratio b) Phospholipids c) Cholesterol in the body d) Mono, Polyunsaturated and Saturated Fatty Acids. Dietary implications of fats and oils, Combination ratios of n6 and n3, MUFA, PUFA and SFA.

Unit 4 Dietary Proteins and health

No. of HOURS: 8

Review of functions of proteins in the body, Digestion and absorption. Essential and Non-essential amino acids. Amino Acid Availability Antagonism, Toxicity and Imbalance, Amino acid Supplementation. Effects of deficiency. Food source and Recommended Dietary Allowances for different age group. Amino acid pool. NPU, Biological Value, Nitrogen balance. PEM and Kwashiorkor.

Unit 5 Fat and water soluble Vitamins

No. of HOURS: 8

Vitamin A, D, E, K Dietary sources, RDA, Adsorption, Distribution, Metabolism and excretion(ADME), Deficiency. Role of Vitamin A as an antioxidant, in Visual cycle, dermatology and immunity. Role of Vitamin K in Gamma carboxylation. Role of Vitamin E as an antioxidant. Extra-skeletal role of Vitamin D and its effect on bone physiology. Hypervitaminosis. Vitamin C role as cofactor in amino acid modifications. Niacin- Metabolic interrelation between tryptophan, Niacin and NAD/ NADP. Vitamin B6-Dietary source, RDA, conversion to Pyridoxal Phosphate. Role in metabolism, Biochemical basis for deficiency symptoms. Vitamin B12 and folate; Dietary source, RDA, absorption, metabolic role Biochemical basis for deficiency symptoms.

Unit 6 Minerals

No. of HOURS: 12

Calcium, Phosphorus and Iron - Distribution in the body digestion, Absorption, Utilization, Transport, Excretion, Balance, Deficiency, Toxicity, Sources, RDA. Iodine, Fluoride, Mg, Cu, Zn, Se, Manganese, Chromium, Molybdenum Distribution in the human body, Physiology, Function, deficiency, Toxicity and Sources

Unit 7 Assessment of Nutritional status**No. of HOURS: 4**

Anthropometric measurements. Biochemical assessment. ROS assessment, GTT and glycosylated Hb, Differential diagnosis of B12 and folate.

Unit 8 Food and drug interactions and Nutraceuticals**No. of HOURS: 4**

Nutrient interactions affecting ADME of drugs, Alcohol and nutrient deficiency, Anti-depressants, psychoactive drugs and nutrient interactions, Appetite changes with drug intakes and malnutrition. Food as medicine.

BCH DSE-1: NUTRITIONAL BIOCHEMISTRY (PRACTICALS)
SEMESTER – V/VI

TOTAL HOURS: 60**CREDITS: 2**

1. Bioassay for vitamin B12/B1.
2. Serum/ urine MMA estimation.
3. Anthropometric identifications for Kwashiorkor, Marasmus and Obesity.
4. Determination of oxidative stress: TBARS, antioxidant enzymes in hemolysate.
5. Vitamin A/E estimation in serum.
6. Case studies.

SUGGESTED READINGS

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.
2. Nutrition for health, fitness and sport (2013) ; Williams.M.H,Anderson,D.E, Rawson,E.S. McGraw Hill international edition. ISBN-978-0-07-131816-7.
3. Krause's Food and Nutrition Care process.(2012); Mahan, L.K Strings,S.E, Raymond,J. Elsevier's Publications. ISBN- 978-1-4377-2233-8.
4. The vitamins, Fundamental aspects in Nutrition and Health (2008); G.F. Coombs Jr. Elsevier's Publications. ISBN-13- 978-0-12- 183493-7.
5. Principles of Nutritional Assessment (2005) Rosalind Gibson. Oxford University Press. ISBN: 9780195171693


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH DSE-2: RESEARCH METHODOLOGY
SEMESTER – V/VI

Total HOURS: 20 hrs Theory and 140 hrs Practical

CREDITS: 6

Unit 1 Introduction to Research Methodology

No. of HOURS: 4

Objectives and motivation in research.

Unit 2 Defining the Research Problem

No. of HOURS: 4

Selecting and defining a research problem, Reviewing and conducting literature search, Developing a research plan.

Unit 3 Designing of Experiment

No. of HOURS: 4

Different experimental designs – single and multifactorial design, Making measurements and sources of error in measurements, Methods of data collection and record keeping.

Unit 4 Data Processing and Statistical Analysis

No. of HOURS: 8

Processing operations, tabulation, and graphical representation, Statistics in research: Concepts of sample and population, Measure of central tendency, dispersion, asymmetry (skewness, kurtosis), Normal distribution (p-value), Statistical tests and hypothesis (Standard error, t-test, chi-square test), and regression analysis, Report writing, Writing a research paper - abstract, introduction, methodology, results and discussion.

Based on the teaching above, each student will undertake the following exercises.

1. A teacher (adviser) who would guide the student will discuss with student and identify a topic of mutual interest.
2. The student will collect the literature, collate the information and write the same in the form of a term paper with proper incorporation of references using appropriate software such as EndNote.
3. The student will identify scope of research on the topic and will frame objectives to be addressed in the project through a work plan.
4. The student will write standard operating protocols (SOPs) and identify requirement for equipment and reagents.
5. Each student will be asked to make presentation about the project including literature available, objective sought and work plan including methodologies as described above.

SUGGESTED READINGS

1. Research in Education (1992) 6th ed., Best, J.W. and Kahn, J.V., Prentice Hall of India Pvt. Ltd. ISBN-978-81-203-3563-9.
2. At the Bench: A Laboratory Navigator (2005) Barker, K., Cold Spring Harbor Laboratory Press (New York), ISBN: 978-087969708-2.

3. Research Methodology - Methods and Techniques (2004) 2nd ed., Kothari C.R., New Age International Publishers. ISBN – 81-224-1522-9
4. Research Methodology: A Step by Step Guide for Beginners (2005) 2nd ed., Kumar R., Pearson Education. ISBN: 978-1-4129-6467-8.
5. Biostatistics: A Foundation for Analysis in the Health Sciences (2013) 10th ed., Daniel W.W., John Wiley and Sons Inc. ISBN-13: 978-1118302798 ISBN-10: 1118302796
6. Statistics at the Bench: A Step-by-Step Handbook for Biologists (2010) Bremer, M. and Doerge, R.W., Cold Spring Harbor Laboratory Press (New York), ISBN: 978-0-879698-57-7.


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH DSE-3 : MOLECULAR BASIS OF NON-INFECTIOUS HUMAN
DISEASES (THEORY)
SEMESTER – V/VI

Total HOURS: 60

CREDITS: 4

Unit 1 Nutritional disorders

No. of HOURS: 10

Overview of major and minor nutrient components in the diet. Balanced diet and the concept of RDA. Nutrient deficiencies; Kwashiorkor and Marasmus, Scurvy, beri beri, pellagra and B12 deficiency, Xerophthalmia and Night blindness, Vitamin D deficiency, Vitamin K deficiency. Discuss with relation to biochemical basis for symptoms.

Unit 2 Metabolic and Lifestyle disorders

No. of HOURS: 12

Obesity and eating disorders like Anorexia nervosa and Bulimia. Diabetes mellitus A metabolic syndrome and the relationship with hypertension, obesity, hypothyroidism and stress. Cardio vascular disorders and Atherosclerosis-defining the broad spectrum of ailments that fall in this category, understanding the factors that contribute to the syndrome, stages of disorder and the management of the condition. Irritable bowel syndrome- biochemistry behind the disorder and the influence of diet, stress and environment on the condition.

Unit 3 Multifactorial complex disorders and Cancer

No. of HOURS: 20

Understanding the definition of multifactorial diseases. Polygenic diseases and the relationship of environmental factors and genetic makeup in the onset of diseases.

Cancer: characteristics of a transformed cell, causes and stages of Cancer, molecular basis for neoplastic growth and metastasis, Proto-oncogenes and tumor suppressor genes; Cancer causing mutations; Tumor viruses; Biochemical analysis of cancer; Molecular approaches to cancer treatment.

Disorders of mood : Schizophrenia, dementia and anxiety disorders.

Polycystic ovarian syndrome, Parkinson's disease, ALS.

Unit 4 Diseases due to misfolded proteins

No. of HOURS: 8

Introduction to protein folding and proteasome removal of misfolded proteins; etiology and molecular basis for Alzheimer's, Prion diseases, Huntington's Chorea, sickle cell anemia, Thalassemia.

Unit 5 Monogenic diseases

No. of HOURS: 10

In born errors in metabolism: PKU, Alkaptonuria, Maple syrup urine disease; Receptor and transport defects: Cystic fibrosis, Long QT syndrome, familial hypercholesterolemia, Achondroplasia. Hemoglobinopathies and clotting disorders.


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**BCH DSE-3 : MOLECULAR BASIS OF NON-INFECTIOUS HUMAN DISEASES
(PRACTICALS)
SEMESTER – V/VI**

Total HOURS: 60

CREDITS: 2

1. Anthropometric measurements for normal and high risk individuals and identifications for Kwashiorkor, Marasmus and Obesity
2. Estimation of homocysteine levels in serum
3. Estimation of glycosylated hemoglobin
4. Permanent slides for different types of cancer
5. Diagnostic profile for assessment of CVS and Diabetes mellitus using case studies.
6. Case Studies

SUGGESTED READINGS

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.
2. Introduction to Human Physiology (2012) 8th edition; Lauralee Sherwood. Brooks/Cole, Cengage Learning. ISBN-13: 978-1133104544 ISBN-10: 1133104541
3. The World of the cell, 7th edition (2009). Lewis J. Kleinsmith, Jeff Hardin, Gr Wayne M. Becker. ISBN-13: 978-0805393934 ISBN-10: 0805393935.
4. Genetics (2012) 6th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2.
5. The Cell: A Molecular Approach (2009) 5th ed., Cooper, G.M. and Hausman, R.E., ASM Press & Sunderland (Washington DC), Sinauer Associates, MA, ISBN:978-0-87893-300-6.


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH DSE-4 : MOLECULAR BASIS OF INFECTIOUS DISEASES
(THEORY)
SEMESTER – V/VI

Total Hours: 60

CREDITS: 4

Unit 1 Classification of infectious agents

No. of HOURS: 12

Bacteria, Viruses, protozoa and fungi. Past and present emerging and re-emerging infectious diseases and pathogens. Source, reservoir and transmission of pathogens, Antigenic shift and antigenic drift. Host parasite relationship, types of infections associated with parasitic organisms. Overview of viral and bacterial pathogenesis. Infection and evasion.

Unit 2 Overview of diseases caused by bacteria

No. of HOURS: 18

Detailed study of tuberculosis: History, causative agent, molecular basis of host specificity, infection and pathogenicity, Diagnostics, Therapeutics, inhibitors and vaccines. Drug resistance and implications on public health. Other bacterial diseases including Typhoid, Diphtheria, Pertussis, Tetanus, Typhoid and Pneumonia.

Unit 3 Overview of diseases caused by Viruses

No. of HOURS: 12

Detailed study of AIDS, history, causative agent, pathogenesis, Diagnostics, Drugs and inhibitors. Other viral diseases including hepatitis, influenza, rabies, chikungunya and polio.

Unit 4 Overview of diseases caused by Parasites

No. of HOURS: 8

Detailed study of Malaria, history, causative agents, Vectors, life cycle, Host parasite interactions, Diagnostics, Drugs and Inhibitors, Resistance, Vaccine development. Other diseases including leishmaniasis, amoebiasis.

Unit 5 Overview of diseases caused by other organisms

No. of HOURS: 10

Fungal diseases, General characteristics. Medical importance of major groups, pathogenesis, treatment.

BCH DSE-4 : MOLECULAR BASIS OF INFECTIOUS DISEASES (PRACTICALS)
SEMESTER – V/VI

Total HOURS: 60

CREDITS: 2

1. Permanent slides of pathogens. Mycobacterium tuberculosis, Leishmania, Plasmodium falciparum
2. WIDAL test
3. Gram staining
4. Acid fast staining
4. PCR based diagnosis
5. Dot Blot ELISA

SUGGESTED READINGS


PRINCIPAL (Acting)
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1. Klein's Microbiology (2008) 7th Ed., Prescott, Harley, Willey, J.M., Sherwood, L.M., Woolverton, C.J. Mc Graw Hill International Edition (New York) ISBN: 978-007-126727.
2. Principles and practices of Infectious diseases, 7th edition, Mandell, Douglas and Bennett. S, Volume, 2. Churchill Livingstone Elsevier. ISBN: 978-0-443-06839-3
3. Sherris Medical Microbiology: An Introduction to Infectious Diseases. (2010). Kenneth J. Ryan, C. George Ray, Publisher: McGraw-Hill. ISBN-13: 978-0071604024 ISBN-10: 0071604022
4. Medical Microbiology. (2012). Patrick R. Murray, Ken S. Rosenthal, Michael A. Pfaller, Elsevier Health Sciences. ISBN: 978-0-323-08692-9.


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Chaula Kuan, New Delhi-110021

B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH DSE-5 : RESEARCH PROJECT
SEMESTER – V/VI

Total HOURS: 180
6

CREDITS:

This paper would focus on the project work / dissertation to be carried out by the students in the supervision of the teachers in the colleges. The topic of the project would be selected by each student in consultation with the teacher (Advisor). This would train the student to retrieve the literature and collate the information sufficient to make a presentation, the collated literature would also prepare the base for initiating the research. The student would carryout experiments to achieve the planned objectives, collation and analysis of data, presentation of the result in the form of a Dissertation. The grading would be based on continuous evaluation that would include punctuality, hard work, record keeping, intellectual inputs, data presentation, interpretation etc.


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH DSE-6: ADVANCED CELL BIOLOGY (THEORY)
SEMESTER – V/VI

Total HOURS: 60

CREDITS: 4

Unit 1 Plasma Membrane and Nuclear Transport

No. of HOURS: 4

Properties and Composition of Cell Membrane; Structure of Nuclear Envelope; Nuclear Pore Complex; Transport Across Nuclear Envelope; Regulation of Nuclear Protein Import and Export.

Unit 2

Protein Sorting and Secretory Pathway

No. of HOURS: 12

Overview of The Endomembrane System; Targeting, modification and sorting of Proteins From And Into Endoplasmic Reticulum; Synthesis And Targeting Mitochondrial Protein; Chloroplast Proteins And Peroxisomal Proteins; Mechanism Of Vesicular Transport; Coat Proteins And Vesicle Budding; Vesicle Fusion; Targeting Of Proteins To Membranes; Receptor Mediated Endocytosis.

Unit 3

Cytoskeleton and Cell Motility

No. of HOURS: 10

Function and origin of The Cytoskeleton; Organization and Assembly of Actin Filaments And Myosin; Assembly and Dynamics of Microtubules And Intermediate Filaments; Assembly and organization of Cilia and Flagella, Muscle Contractility; Cell Polarization And migration.

Unit 4 Cell-Cell Interaction

No. of HOURS: 8

Cell-Cell Interactions and Cell-Matrix Interactions; Components of Extracellular Matrix: Collagen and Non-Collagen Components; Role Of Cell Interaction In Development.

Unit 5 Cell Cycle and Programmed Cell Death

No. of HOURS: 10

Overview of The Cell Cycle; Eukaryotic Cell Cycle; Events Of Mitotic Phase; Cytokinesis; Events Of Meiosis And Fertilization; Regulation Of Cell Division And Cell Growth; Apoptosis And Necrosis, Stem Cells And Maintenance of Adult Tissues, Hematopoiesis, Embryonic Stem Cells and Therapeutic Cloning.

Unit 4 Cancer Biology

No. of HOURS: 10

Development and causes Of Cancer; Genetic Basis of Cancer; Oncogenes, Tumor Viruses; Molecular Approach to Cancer Treatment.

Unit 5 Advanced Methods in Cell Biology

No. of HOURS: 6

Ultracentrifugation, Fluorescence Microscopy- FACS, FRET, Confocal Microscopy, Electron Microscopy, Plant and Animal Cell Culture, Immunohistochemistry.


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BCH DSE-6 : ADVANCED CELL BIOLOGY (PRACTICALS)
SEMESTER – V/VI

Total HOURS: 60

CREDITS: 2

1. Isolation of organelles by sub-cellular fractionation.
2. Study of cell viability /death assay by use of trypan blue and MTT assay.
3. Study of apoptosis through analysis of DNA fragmentation patterns.
4. Identification and study of cancerous cells using permanent slides and photomicrographs.

SUGGESTED READINGS

1. The Cell: A Molecular Approach (2009) 5th ed., Cooper, G.M. and Hausman, R.E., ASM Press & Sunderland (Washington DC), Sinauer Associates, MA, ISBN:978-0-87893-300-6.
2. Molecular Cell Biology (2012) 7th ed., Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J., W.H. Freeman & Company (New York), ISBN:13:978-1-4641-0981-2 / ISBN:10: 1-4641-0981-8.
3. Molecular Biology of the Cell (2008) 5th ed., Alberts, B., Johnson, A., Lewis, J., and Enlarge, M., Garland Science (Princeton), ISBN:0-8153-1619-4 / ISBN:0-8153-1620-8.
4. The World of the cell, 7th edition (2009). Lewis J. Kleinsmith, Jeff Hardin, Gr Wayne M. Becker. ISBN-13: 978-0805393934 ISBN-10: 0805393935.
5. Cell and Molecular Biology: Concepts and Experiments. (2010). Karp, G., 6th edition. John Wiley & Sons. Inc. ISBN : 978-1-118-65322-7


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH DSE-7: PLANT BIOCHEMISTRY (THEORY)
SEMESTER – V/VI

Total HOURS: 60

CREDITS: 4

Unit 1 Introduction to Plant cell structure

No. of HOURS: 4

Plasma membrane, Vacuole and tonoplast membrane, cell wall, plastids and peroxisomes.

Unit 2 Photosynthesis and Carbon assimilation

No. of HOURS: 14

Structure of PSI and PSII complexes, Light reaction, Cyclic and non cyclic photophosphorylation, Calvin cycle and regulation; C₄ cycle and Crassulacean acid metabolism (CAM), Photorespiration.

Unit 3 Respiration

No. of HOURS: 12

Overview of glycolysis, Alternative reactions of glycolysis, Regulation of plant glycolysis, Translocation of metabolites across mitochondrial membrane, TCA cycle, Alternative NAD(P)H oxidative pathways; Cyanide resistant respiration.

Unit 4 Nitrogen metabolism

No. of HOURS: 14

Biological Nitrogen fixation by free living and in symbiotic association, structure and function of enzyme Nitrogenase. Nitrate assimilation: Nitrate and Nitrite reductase. Primary and secondary ammonia assimilation in plants; ammonia assimilation by Glutamine synthetase-glutamine oxoglutarate amino transferase (GS-GOGAT) pathway. Seed storage proteins in legumes and cereals.

Unit 5 Regulation of plant growth

No. of HOURS: 4

Introduction to plant hormones and their effect on plant growth and development, Regulation of plant morphogenetic processes by light.

Unit 6 Secondary metabolites

No. of HOURS: 8

Representatives alkaloid group and their amino acid precursors, function of alkaloids, Examples of major phenolic groups; simple phenylpropanoids, Coumarins, Benzoic acid derivatives, flavonoids, tannins and lignin, biological role of plant phenolics, Classification of terpenoids and representative examples from each class, biological functions of terpenoids.

Unit 6 Plant tissue culture

No. of HOURS: 4

Cell and tissue culture techniques, types of cultures: organ and explants culture, callus culture, cell suspension culture and protoplast culture. Plant regeneration pathways: organogenesis and somatic embryogenesis. Applications of cell and tissue culture and somoclonal variation.


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BCH DSE-7: PLANT BIOCHEMISTRY (PRACTICALS)
SEMESTER – V/VI

Total HOURS: 60

CREDITS: 2

1. Induction of hydrolytic enzymes proteinases /amylases/lipase during germination
2. Extraction and assay of Urease from Jack bean
3. Estimation of carotene/ascorbic acid/phenols/tannins in fruits and vegetables
4. Separation of photosynthetic pigments by TLC
5. Culture of plants (explants).

SUGGESTED READINGS

1. Plant Biochemistry (2008), Caroline Bowsher, Martin steer, Alyson Tobin, Garland science ISBN 978-0-8153-4121-5
2. Biochemistry and molecular Biology of plant-Buchanan. (2005) 1 edition. Publisher: I K International. ISBN-10: 8188237116, ISBN-13: 978-8188237111.
3. Plant Biochemistry by P.M Dey and J.B. Harborne (Editors) (1997) Publisher: Academic Press ISBN-10:0122146743, ISBN-13:978-0122146749


PRINCIPAL (Acting)
Sri Venkateswara College
(University of Delhi)
Dhaura Kuan, New Delhi-110021

B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH DSE-8: BASIC MICROBIOLOGY (THEORY)
SEMESTER – V/VI

Total HOURS: 60

CREDITS: 4

Unit 1 History of Development of Microbiology

No. of Hours: 12

Development of microbiology as a discipline, Spontaneous generation vs. biogenesis. Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming. Role of microorganisms in fermentation, Germ theory of disease, Development of various microbiological techniques and golden era of microbiology, Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Elie Metchnikoff, Edward Jenner

Unit 2 Diversity of Microbial world

No. of Hours: 12

Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms. General characteristics of different groups: acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Archaea, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.

Unit 3 Viruses, viroids and prions

No. of Hours: 10

An introduction to viruses with special reference to the structure and replication of the following: Poxvirus, Poliovirus, HIV, T4 and λ phage, lytic and lysogenic cycles.

Unit 4 Bacteria

No. of Hours: 10

An account of typical eubacteria, chlamydiae & rickettsiae (obligate intracellular parasites), mycoplasma, and Archaea. Applications of bacteria and Archaea in industry, environment and food.

Unit 5 Algae

No. of Hours: 6

History of phycology; General characteristics of algae including occurrence, thallus organization, algae cell ultra structure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction. Applications of Algae in agriculture, industry, environment and food.

Unit 6 Fungi

No. of Hours: 6

Historical developments in the field of Mycology, significant contributions of eminent mycologists. General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism. Economic Importance of Fungi in Agriculture, environment, Industry, medicine, food, biodeterioration, mycotoxins

Unit 7 Protozoa

No. of Hours: 4

General characteristics with special reference to Amoeba


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BCH DSE-8 : BASIC MICROBIOLOGY (PRACTICALS)
SEMESTER – V/VI

Total HOURS: 60

CREDITS: 2

2. Microbiology Laboratory Practices and Biosafety.
3. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter)
4. Preparation and sterilization of culture media for bacterial cultivation
5. Study of different shapes of bacteria, fungi, algae, protozoa using permanent slides/pictographs
6. Staining of bacteria using Gram stain
7. Isolation of pure cultures of bacteria by streaking method.
8. Estimation of CFU.
9. Determination of MIC of an antibiotic.

SUGGESTED READINGS

1. Principles of Microbiology. (1997). Atlas RM., 2nd edition. W M.T.Brown Publishers. ISBN 10: 0071140271 / ISBN 13: 9780071140270
2. Microbiology. (1993). Pelczar MJ, Chan ECS and Krieg NR. 5th edition. McGraw Hill Book Company


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**B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
GENERIC ELECTIVES**


PRINCIPAL (Acting)
Sri Venkateswara College
(University of Delhi)
Dhaura Kun, New Delhi-110021

B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH GE-1 : BIOCHEMISTRY OF CELL (THEORY)

TOTAL HOURS: 60

CREDITS: 4

Unit 1 Biomolecules in their cellular environment

No. of HOURS: 6

The cellular basis of life. Cellular structures – prokaryotes and eukaryotes. Chemical principles in biomolecular structure. Major classes of biomolecules. Role of water in design of biomolecules.

Unit 2 Amino acids and peptides

No. of HOURS: 10

Types of amino acids and their chemistry, derivatives of amino acids and their biological role. Introduction to biologically important peptides.

Unit 3 Sugars and polysaccharides

No. of HOURS: 10

Basic chemistry of sugars, optical activity. Disaccharides, trisaccharides and polysaccharides - their distribution and biological role.

Unit 4 Nucleosides, nucleotides and nucleic acids

No. of HOURS: 10

Structures and chemistry, DNA structures and their importance, different types of RNA. Unusual DNA structures, other functions of nucleotides.

Unit 5 Lipids

No. of HOURS: 10

Various classes of lipids and their distribution, storage lipids, structural lipids in membranes, lipids as signals, cofactors and pigments.

Unit 6 Vitamins, coenzymes and metal ions

No. of HOURS: 8

Occurrence and nutritional role. Coenzymes and their role in metabolism. Metal ion containing biomolecules - heme, porphyrins and cyanocobalamin; their biological significance.

Unit 7 Signalling molecules

No. of HOURS: 6

Second messengers - cAMP, cGMP, IP₃, diacyl glycerol, Ca²⁺, NO. Brief account of their importance and role in signalling and signal transduction.

BCH GE-1 : BIOCHEMISTRY OF CELL (PRACTICALS)

TOTAL HOURS: 60

CREDITS: 2

1. General safety procedures in a laboratory. Use of auto pipettes. Making solutions and buffer preparation - acetate and tris buffers.
2. Qualitative tests for biomolecules - carbohydrates, lipids, amino acids, proteins, bases and nucleic acids.
3. Separation of amino acids by paper chromatography.
4. Separation of sugars/bases by TLC and their identification.
5. Estimation of ascorbic acid in fruit juices.

SUGGESTED READINGS

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13; 978-1-4641-0962-1 / ISBN:10-14641-0962-1.
2. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4.


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH GE-2 : PROTEINS AND ENZYMES (THEORY)

Total HOURS: 60

CREDITS: 4

Unit 1 Introduction to proteins

No. of HOURS: 4

Polypeptides and proteins. Subunit structures, conjugated proteins, diversity of function.

Unit 2 Isolation and analysis of proteins

No. of HOURS: 12

Techniques to isolate and analyze proteins- salt fractionation, ion-exchange chromatography, gel permeation, HPLC, SDS-PAGE, IEF. Protein primary structure - sequencing by Edman degradation, use of enzymes and chemical reagents to obtain overlap peptides. Synthesis of peptides using Merrifield method.

Unit 3 Introduction to protein three-dimensional structures

No. of HOURS: 10

Secondary structure- helices and sheets, Ramachandran maps. Nature of non-covalent bonds and covalent bonds in protein folding. Tertiary and quaternary structures.

Unit 4 Myoglobin and haemoglobin - structure and function

No. of HOURS: 4

Oxygen binding curves, cooperativity models for haemoglobin.

Unit 5 Introduction to enzyme catalysis

No. of HOURS: 8

Features of enzyme catalysis, superior catalytic power. General mechanisms of catalysis. Nomenclature.

Unit 6 Enzyme kinetics

No. of HOURS: 10

Principles of reaction rates, order of reactions and equilibrium constants. Derivation of Michaelis-Menten equation. Significance of K_m and V_{max} . Catalytic efficiency parameters. Competitive and mixed inhibitions. Kinetics and diagnostic plots. Types of irreversible inhibitors.

Unit 7 Mechanisms of enzyme action and regulation

No. of HOURS: 6

Mechanism of action of chymotrypsin. Inhibitors of enzymes - antibiotics. Regulation of enzyme activity and its importance - aspartate transcarbamoylase.

Unit 8 Enzymes in medicine and industry

No. of HOURS: 6

Enzymes used in clinical biochemistry as reagents, diagnostics and therapy. Role of immobilized enzymes in industry.


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BCH GE-2 : PROTEINS AND ENZYMES (PRACTICALS)

Total HOURS: 60

CREDITS: 2

10. Protein estimation by UV absorbance and Biuret method.
11. Protein microassay by Lowry/Bradford method.
12. Ammonium sulphate fractionation of crude homogenate from germinated mung bean.
13. Setting up assay for acid phosphatase and activity measurements of the ammonium sulphate fractions (progress curve and effect of pH).
14. Determination of K_m and V_{max} of enzyme enriched fraction.
15. Inhibition of acid phosphatase activity by inorganic phosphate.

SUGGESTED READINGS

3. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13; 978-1-4641-0962-1 / ISBN:10-14641-0962-1.
4. Fundamentals of Enzymology (1999) 3rd ed., Price, N.C and Stevens, L., Oxford University Press Inc., (New York), ISBN:13: 978-0-19-806439-8.


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH GE-3 : INTERMEDIARY METABOLISM (THEORY)

Total HOURS: 60

CREDITS: 4

Unit 1 Basic concepts and design of metabolism

No. of HOURS: 4

The nature of metabolism. Role of oxidation and reduction and coupling of these. ATP as energy currency.

Unit 2 Glycolysis and gluconeogenesis

No. of HOURS: 6

Glycolysis a universal pathway, fructose and galactose oxidation, anaerobic glycolysis, fermentation, gluconeogenesis, reciprocal regulation of glycolysis and gluconeogenesis.

Unit 3 The citric acid cycle

No. of HOURS: 6

Pyruvate dehydrogenase complex, oxidation of acetyl CoA, amphibolic role, regulation and glyoxylate pathway.

Unit 4 Oxidative phosphorylation

No. of HOURS: 6

The respiratory chain in mitochondria, proton gradient powering ATP synthesis, glycerol-3-phosphate and malate-aspartate shuttle, regulation of oxidative phosphorylation.

Unit 5 Photosynthesis, Calvin cycle and pentose phosphate pathway

No. of HOURS: 8

The light reaction, chlorophyll, accessory pigments, reaction centres, two photo systems, generation of proton gradient and NADPH, Calvin cycle, synthesis of glucose, starch, sucrose, regulation, C₄ pathway. Pentose phosphate pathway, importance and regulation.

Unit 6 Glycogen metabolism

No. of HOURS: 6

Glycogenolysis, phosphorylase regulation, role of epinephrine and glucagon for glycogenolysis, glycogenesis; reciprocal regulation of glycogenesis and glycogenolysis.

Unit 7 Fatty acid synthesis and degradation

No. of HOURS: 6

TAG as energy source, β oxidation of fatty acids in mitochondria and peroxisomes, ketone bodies. Biosynthesis of fatty acids - elongation and unsaturation of fatty acids. Regulation of fatty acid oxidation and synthesis.

Unit 8 Amino acid catabolism and anabolism

No. of HOURS: 6

Protein degradation to amino acids, urea cycle, feeder pathways into TCA cycle. Nitrogen fixation, synthesis of non-essential amino acids.

Unit 9 Nucleotide metabolism

No. of HOURS: 6

Biosynthesis - *de novo* and salvage pathways, regulation of nucleotide synthesis by feedback inhibition, degradation and excretion.

Unit 10 Integration of metabolism

No. of HOURS: 6

Brief role of hormones - catecholamines, insulin, glucagon; metabolic shifts to provide fuel to brain during fasting and starvation, role of cortisol in signalling stress - increase in gluconeogenesis and muscle protein breakdown.

BCH GE-3 : INTERMEDIARY METABOLISM (PRACTICALS)

Total HOURS: 60

CREDITS: 2

1. Alcohol fermentation by yeast.
2. H₂S production, indole production and ammonia production by bacteria.
3. Urea estimation.
4. Uric acid estimation.

SUGGESTED READINGS

1. Biochemistry (2012) 7th ed., Campbell, M.K. and Farrel, S.O. Brooks/Cole, Cengage Learning (Boston), ISBN: 13:978-1-111-42564-7.


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH GE-4 : GENE ORGANIZATION, EXPRESSION AND REGULATION
(THEORY)

Total HOURS: 60

CREDITS: 4

Unit 1 Structure of genes and chromosomes

No. of HOURS: 8

Definition of a gene, chromosomal organization of genes in viruses, bacteria and eukaryotes. Supercoiling of DNA.

Unit 2 Replication of genomes

No. of HOURS: 12

General features of DNA replication, properties of prokaryotic and eukaryotic DNA polymerases. Replication of DNA and telomeres in linear chromosomes. Replication of RNA genomes.

Unit 3 Recombination of DNA

No. of HOURS: 4

Homologous genetic recombination, Holliday model, proteins and enzymes mediating recombination.

Unit 4 Gene mutations and repair

No. of HOURS: 6

Molecular basis of mutations, multiple repair systems, mismatch repair, base excision repair, nucleotide excision repair, direct repair and translesion DNA synthesis.

Unit 5 Transcription of genes

No. of HOURS: 10

General features of gene transcription, prokaryotic and eukaryotic RNA polymerases, stages of transcription, initiation, elongation and termination. Inhibitors of transcription.

Unit 6 RNA processing

No. of HOURS: 4

Processing of eukaryotic mRNA, splicing of introns, alternate splicing and editing, ribosomal and tRNA processing.

Unit 7 Protein synthesis

No. of HOURS: 10

Features of the genetic code, amino acylation of tRNAs, structure and assembly of ribosomes; three stages of protein synthesis - initiation, elongation and termination. Inhibitors of protein synthesis.

Unit 8 Regulation of gene expression

No. of HOURS: 6

Regulation of transcription in prokaryotes, concept of operons. Lac operon - control by negative and positive regulatory proteins, Trp operon - control by attenuation. Regulation of transcription in eukaryotes, regulatory sequences - enhancers, silencers response elements, nucleosome alterations, DNA-protein interactions and RNA interference.


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BCH GE-4 : GENE ORGANIZATION, EXPRESSION AND REGULATION (PRACTICALS)

Total HOURS: 60

CREDITS: 2

1. Quantitative determination of DNA and RNA by absorbance at 260 nm and using A_{260}/A_{280} ratio to distinguish between them.
2. Estimation of DNA by DPA method.
3. Estimation of RNA by Orcinol.
4. Isolation of chromosomal DNA from *E. coli*.
5. Isolation of total RNA from yeast cells.

SUGGESTED READINGS

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10-14641-0962-1.
2. Biochemistry (2012) 7th ed., Berg, J.M., Tymoczko, J.L. and Stryer, L., W.H Freeman and Company (New York), ISBN: 13:978-1-4292-7635-1.


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH GE-5 : FUNDAMENTALS OF CELL BIOLOGY AND
IMMUNOLOGY (THEORY)

Total HOURS: 60

CREDITS: 4

Unit 1 Cells and organelles

No. of HOURS: 6

Prokaryotic and eukaryotic cells. Plasma membrane, the nucleus, intracellular membranes and organelles, mitochondria, chloroplast, endoplasmic reticulum, Golgi complex, lysosome, peroxisome, cytoskeleton, extracellular matrix, cell wall. Mitosis and meiosis.

Unit 2 Membrane structure and function

No. of HOURS: 8

Composition of membranes, membrane lipids, membrane proteins, isolation and characterization. Integral, peripheral and lipid anchored protein. Transport across membranes, simple and facilitated diffusion, active transport.

Unit 3 Endoplasmic reticulum and Golgi complex

No. of HOURS: 6

The two types of endoplasmic reticulum, rough and smooth. The Golgi complex. Role of Golgi in protein glycosylation and protein trafficking.

Unit 4 Signalling mechanisms, messengers and receptors

No. of HOURS: 8

Chemical signals and cellular receptors. G-protein linked receptors, protein kinase associated receptors. Hormonal signalling, cell signals and apoptosis.

Unit 5 Cell cycle and its regulation

No. of HOURS: 4

Overview of the cell cycle. Regulation of the cell cycle, cyclin dependent kinases.

Unit 6 Overview of the immune system

No. of HOURS: 4

Self versus nonself. Humoral and cellular immunity. Innate and adaptive immunity. Cells of the immune system, primary and secondary lymphoid tissues and organs. Cellular and humoral responses.

Unit 7 Innate immunity

No. of HOURS: 8

Defensins. Non-immunological barriers. Cells and soluble mediators of innate immunity. Acute phase proteins. Cytokines. Complement system.

Unit 8 Humoral B cell response

No. of HOURS: 8

Structure of antibodies, types of immunoglobulins, generation of antibody diversity, B cell activation, theory of clonal selection, formation of plasma and memory cells; T-independent B-response; antigens, haptens carriers and adjuvants.

Unit 9 Cell mediated immunity

No. of HOURS: 8

T-cell development, MHC locus. Structure, function and distribution of MHC glycoproteins. Antigen processing and presentation. Cell mediated immune responses by different T-cell sub populations. Hypersensitive reactions. Concept of autoimmunity.

BCH GE-5 : FUNDAMENTALS OF CELL BIOLOGY AND IMMUNOLOGY (PRACTICALS)

Total HOURS: 60

CREDITS: 2

1. Visualization of animal and plant cell by methylene blue.
2. Identification of different stages of mitosis in onion root tip.
3. Isolation of organelles by sub-cellular fractionation.
4. Isolation of IgG from serum by ion exchange chromatography.
5. Antigen-antibody interaction by Ouchterlony double diffusion.
6. Blood group analysis by agglutination.

SUGGESTED READINGS

2. The World of the Cell (2009), 7th ed., Becker W.M., Kleinsmith, L.J., Hardin., J., Bertoni, and G.P., Pearson Benjamin Cummings (CA), ISBN: 978-0-321-55418-5.
3. Prescott, Harley, Klein's Microbiology (2008) 7th Ed., Willey, J.M., Sherwood, L.M., Woolverton, C.J. Mc Graw Hill International Edition (New York) ISBN: 978-007-126727.
4. Molecular Cell Biology (2013) 7th Ed., Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., Macmillan International Edition (New York), ISBN:13: 978-1-4641-0981-2.
5. Kuby Immunology (2007) 6th ed., Kindt, T.L., Goldsby, R.A. and Osborne, B.A., W.H Freeman and Company (New York), ISBN:13: 978-0-7167-8590-3 / ISBN: 10:0-7617-8590-0.
6. Immunology: A Short Course (2009) 6th ed., Coico, R and Sunshine, G., John Wiley& sons, Inc (New Jersey), ISBN: 978-0-470-08158-7.


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH GE-6 : FUNDAMENTALS OF GENETIC ENGINEERING (THEORY)

Total HOURS: 60

CREDITS: 4

Unit 1 Introduction to recombinant DNA technology

No. of HOURS: 8

Overview of recombinant DNA technology. Plasmids and bacteriophage DNA as cloning vectors, pBR322, pUC8. Purification of plasmid and bacteriophage DNA. Enzymes used in manipulating DNA, separation by electrophoresis.

Unit 2 Cloning vectors for prokaryotes and eukaryotes

No. of HOURS: 12

Plasmids and bacteriophages as vectors for gene cloning. Cloning vectors based on *E. coli* plasmids, pBR322, pUC8, pGEM3Z. Cloning vectors based on M13 and λ bacteriophage. Vectors for yeast, higher plants and animals.

Unit 3 Construction, selection and identification of recombinants

No. of HOURS: 12

Ligation of DNA molecules. Transformation and electroporation, selection for transformed cells. Identification for recombinants, blue-white selection. Identification of recombinant phages. Direct selection, marker rescue. Gene libraries. Identification of a clone from gene library, colony and plaque hybridization probing, methods based on detection of the translation product of the cloned gene.

Unit 4 Polymerase chain reaction and DNA sequencing

No. of HOURS: 8

Fundamentals of polymerase chain reaction, designing primers for PCR. Analysis of PCR products. DNA sequencing by Sanger's method and automated DNA sequencing.

Unit 5 Expression of cloned genes

No. of HOURS: 10

Vectors for expression of foreign genes in *E. coli*, cassettes and gene fusions. Challenges in producing recombinant protein in *E. coli*. Production of recombinant protein by eukaryotic cells. Fusion tags and their role in purification of recombinant proteins.

Unit 6 Applications of genetic engineering in biotechnology

No. of HOURS: 10

Expression of cloned genes. Vectors for expression of foreign genes in *E. coli*, cassettes and gene fusions. Production of recombinant pharmaceuticals such as insulin. Gene therapy. Genetically modified plants such as herbicide resistant crops.


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BCH GE-6 : FUNDAMENTALS OF GENETIC ENGINEERING (PRACTICALS)

Total HOURS: 60

CREDITS: 2

1. Ultraviolet absorption spectrum of DNA and RNA.
2. Isolation of plasmid DNA and restriction digestion.
3. Amplification of a DNA fragment by PCR
4. Virtual lab exercise on recombinant DNA techniques.

SUGGESTED READINGS

1. Molecular Biology of the Gene (2008) 6th ed., Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., Cold Spring Harbor Laboratory Press, Cold Spring Harbor (New York), ISBN:0-321-50781 / ISBN: 978-0-321-50781-5.
2. Gene Cloning and DNA Analysis (2010) 6th ed., Brown, T.A., Wiley-Blackwell Publishing (Oxford, UK), ISBN: 978-1-4051-8173-0.
3. Principles of Gene Manipulation and Genomics (2006) 7th ed., Primrose, S. B., and Twyman, R. M., Blackwell publishing (Oxford) ISBN: 13: 978-1-4051-3544-3.
4. Molecular Biotechnology: Principles and Applications of Recombinant DNA (2010) 4th ed., Glick B.R., Pasternak, J.J. and Patten, C.L., ASM Press (Washington DC), ISBN: 978-1-55581-498-4 (HC).


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH GE-7 : BIOCHEMICAL CORRELATIONS IN DISEASES (THEORY)

Total HOURS: 60

CREDITS: 4

Unit 1 Inborn errors of metabolism

No. of HOURS: 8

Alkaptonuria, Phenylketonuria, Glycogen and Lipid storage diseases, SCID, Clotting disorders.

Unit 2 Nutritional deficiency based diseases

No. of HOURS: 8

Kwashiorkor, Marasmus, Beri-beri, Scurvy, Pellagra, Anaemia, Night blindness, Rickets, Osteomalacia, Osteoporosis, Wilson's disease.

Unit 3 Life style diseases

No. of HOURS: 8

Obesity, Cardiovascular diseases, Atherosclerosis, Diabetes mellitus-II. Inflammatory Bowel Disease (IBD).

Unit 4 Hormonal Imbalances

No. of HOURS: 8

Outline of hormone action and imbalances leading to disease - precocious puberty, hyper and hypopituitarism. Hyper and hypothyroidism.

Unit 5 Autoimmune diseases

No. of HOURS: 6

Concepts in immune recognition - self and non self discrimination, organ specific autoimmune diseases – Hashimoto's thyroiditis, Grave's disease, Myasthenia Gravis;. Systemic diseases - SLE, rheumatoid arthritis; Diabetes Mellitus-I.

Unit 6 Diseases caused due to misfolded proteins

No. of HOURS: 8

Alzheimer's, Huntington's disease, Kuru, Creutzfeldt-Jakob disease, Sickle cell anaemia, Thalassemia.

Unit 7 Infectious diseases

No. of HOURS: 16

Viral infection (polio, measles, mumps, influenza, HIV); Bacterial infections (tetanus, diphtheria, tuberculosis, typhoid, cholera); Protozoan (*Plasmodium* and *Trypanosoma*) and parasitic infections. Vaccines against diseases. General strategies in the design and development of vaccines.

BCH GE-7 : BIOCHEMICAL CORRELATIONS IN DISEASES (PRACTICALS)

Total HOURS: 60

CREDITS: 2

1. Glucose tolerance test.
2. Lipid profile: triglycerides and total cholesterol.
3. Obesity parameters; BMI.
4. RBC counting and haemoglobin estimation.
5. Blood pressure measurements.
6. Calcium estimation

SUGGESTED READINGS

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.
2. Immunology: A Short Course (2009) 6th ed., Coico, R and Sunshine, G., John Wiley & sons, Inc (New Jersey), ISBN: 978-0-470-08158-7
3. Biochemistry (2012) 7th ed., Berg, J.M., Tymoczko, J.L. and Stryer, L., W.H Freeman and Company (New York), ISBN: 13:978-1-4292-7635-1.
4. Genetics (2012) 6th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2.


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
SKILL ENHANCEMENT COURSES
(Three hours class with one hour theory and two hours practical)


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH SEC-1 : TOOLS AND TECHNIQUES IN BIOCHEMISTRY
SEMESTER – III/IV

TOTAL HOURS: 15 hrs theory + 30 hrs practical

CREDITS : 2

Unit 1 Biochemical reagents and solutions

No. of Hours: 5 + 10

Safety practices in the laboratory. Preparation and storage of solutions. Concepts of solution concentration and storing solutions. Quantitative transfer of liquids. Concept of a buffer, Henderson-Hasselbach equation, working of a pH meter.

Exercise

- Preparation of a buffer of given pH and molarity.

Unit 2 Spectrophotometric techniques

No. of HOURS: 9 + 18

Principle and instrumentation of UV-visible and fluorescence spectroscopy.

Exercises

- Determination of the absorption maxima and molar extinction coefficient (of a relevant organic molecule).
- Determination of concentration of a protein solution by Lowry/BCA method.

Unit 3 Introduction and importance of virtual labs in biochemistry

No. of Hours: 1 + 2

SUGGESTED READINGS

1. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN:978-0-470-85602-4 / ISBN:978-0-470-85603-1.
2. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder, D., W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.
3. An Introduction to Practical Biochemistry (1998) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.


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B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH SEC-2 : PROTEIN PURIFICATION TECHNIQUES
SEMESTER – III/IV

TOTAL HOURS: 15 hrs theory + 30 hrs practical

CREDITS: 2

Unit 1 Purification and characterization of a protein from a complex mixture (native or heterologously expressed) involving the following methods/techniques

No. of HOURS: 13 + 26

Exercises

- Preparation of the sample.
- Ion-exchange chromatography.
- Gel filtration chromatography.
- Affinity chromatography.
- Electrophoresis.

Unit 2 Demonstration of High Performance Liquid Chromatography (HPLC)

No. of HOURS: 2 + 4

SUGGESTED READINGS

1. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN:978-0-470-85602-4 / ISBN:978-0-470-85603-1.
2. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder, D., W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.
3. An Introduction to Practical Biochemistry (1998) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.


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B.Sc. (HONS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH SEC-3 : CLINICAL BIOCHEMISTRY
SEMESTER – III/IV

TOTAL HOURS: 15 hrs theory + 30 hrs practical

CREDITS: 2

Unit 1 Introduction

No. of Hours: 1 + 2

Organization of clinical laboratory, Introduction to instrumentation and automation in clinical biochemistry laboratories safety regulations and first aid. General comments on specimen collection, types of specimen for biochemical analysis. Precision, accuracy, quality control, precautions and limitations. Collection of blood and storage.

Exercises

- Separation and storage of serum.

Unit 2 Evaluation of biochemical changes in diseases

No. of Hours: 5 + 10

Basic hepatic, renal and cardiovascular physiology. Biochemical symptoms associated with disease and their evaluation. Diagnostic biochemical profile.

Assessment of glucose metabolism in blood

Clinical significance of variations in blood glucose. Diabetes mellitus.

Exercises

- Estimation of blood glucose by glucose oxidase peroxidase method.

Lipid profile

Composition and functions of lipoproteins. Clinical significance of elevated lipoprotein.

Exercises

- Estimation of triglycerides.

Unit 3 Liver and kidney function tests

No. of HOURS: 5 + 10

Exercises

- Estimation of bilirubin (direct and indirect).

Renal function tests and urine analysis

Use of urine strip / dipstick method for urine analysis.

Exercises

- Quantitative determination of serum creatinine and urea.

Unit 4 Tests for cardiovascular diseases

No. of HOURS: 4 + 8

Involvement of enzymes in diagnostics of heart disease including aspartate transaminase, isoenzymes of creatine kinase and lactate dehydrogenase and troponin.

Exercises

- Estimation of creatine kinase MB.

SUGGESTED READINGS

1. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol. I (2010), Mukherjee, K.L., Tata Mc Graw–Hill Publishing Company Limited (New Delhi). ISBN:9780070076594 / ISBN:9780070076631
2. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol. II (2010), Mukherjee, K.L., Tata Mc Graw – Hill Publishing Company Ltd. (New Delhi), ISBN: 9780070076648.
3. Medical Biochemistry (2005) 2nd ed., Baynes, J.W. and Dominiczak, M.H., Elsevier Mosby Ltd. (Philadelphia), ISBN:0-7234-3341-0.
4. Experimental Biochemistry: A Student Companion (2005) Rao, B.S. and Deshpande, V., IK International Pvt. Ltd. (New Delhi), ISBN:81-88237-41-8.


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B.Sc. (HONS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH SEC-4 : BIOINFORMATICS
SEMESTER – III/IV

TOTAL HOURS: 15 hrs theory + 30 hrs practical

CREDITS: 2

Unit 1 Introduction to bioinformatics

No. of HOURS: 1 + 2

Computer fundamentals - programming languages in bioinformatics, role of supercomputers in biology. Historical background. Scope of bioinformatics - genomics, proteomics, computer aided drug design (structure based and ligand based approaches) and Systems Biology. Applications of bioinformatics.

Unit 2 Biological databases and data retrieval

No. of HOURS: 4 + 8

Introduction to biological databases - primary, secondary and composite databases, NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss-Prot, TrEMBL, PDB), metabolic pathway database (KEGG, EcoCyc, and MetaCyc), small molecule databases (PubChem, Drug Bank, ZINC, CSD). Structure viewers (Ras Mol, J mol), file formats.

Exercises

- Sequence retrieval (protein and gene) from NCBI.
- Structure download (protein and DNA) from PDB.
- Molecular file formats - FASTA, GenBank, Genpept, GCG, CLUSTAL, Swiss-Prot, FIR.
- Molecular viewer by visualization software.

Unit 3 Sequence alignment

No. of HOURS: 2 + 3

Similarity, identity and homology. Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms, amino acid substitution matrices (PAM and BLOSUM), BLAST and CLUSTALW.

Exercises

- BLAST suite of tools for pairwise alignment.
- Multiple sequence alignment using CLUSTALW.

Unit 4 Phylogenetic analysis

No. of HOURS: 2 + 3

Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees - maximum parsimony, maximum likelihood and distance methods.

Exercise

- Generating phylogenetic tree using PHYLIP.

Unit 5 Protein structure prediction and analysis

No. of HOURS: 4 + 8

Levels of protein structure. Protein tertiary structure prediction methods - homology modeling, fold recognition and *ab-initio* methods. Significance of Ramachandran map.

Exercises

- Primary sequence analyses (Protparam).

- Secondary structure prediction (GOR, nnPredict).
- Tertiary structure prediction (SWISSMODEL).
- Protein structure evaluation - Ramachandran map (PROCHECK).

Unit 6 Genomics

No. of HOURS: 2+6

Introduction to genomics, comparative and functional genomics, gene structure in prokaryotes and eukaryotes, gene prediction methods and tools.

Exercise

- Gene prediction using GENSCAN and GLIMMER.

SUGGESTED READINGS

1. Bioinformatics: Sequence and Genome Analysis (2001), 1st ed., Mount, D.W. Cold Spring Harbor Laborator Press (New York), ISBN: 0-87969-608-7.
2. Bioinformatics and Functional Genomics (2003), 1st ed., Pevsner, J., John Wiley & Sons, Inc. (New Jersey), ISBN: 0-47121004-8.
3. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins (2005), 3rd ed., Baxevanis, A.D. and Ouellette, B.F., John Wiley & Sons, Inc. (New Jersey), ISBN: 0-47147878-4.
4. Bioinformatics – Principles and Applications (2008), 1st ed. Ghosh, Z. and Mallick, B., Oxford University Press (India), ISBN: 9780195692303.


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B.Sc. (HONS) BIOCHEMISTRY (CBCS STRUCTURE)
BCH SEC-5: RECOMBINANT DNA TECHNOLOGY
SEMESTER – III/IV

TOTAL HOURS: 15 hrs theory + 30 hrs practical

CREDITS: 2

Unit 1 Work flow for *in silico* cloning

No. of HOURS: 1 + 2

Unit 2 Preparation of media, antibiotic solution, culturing of *E. coli*, isolation of single colonies

No. of HOURS: 3 + 6

Exercises

- Preparation of LB broth and agar.
- Inoculation of medium.
- Preparation of glycerol stocks of bacterial strains.
- Obtaining isolated colonies by streak plate method.
- Preparation of stock solutions.

Unit 3 Overview of plasmid vectors and methods of isolation **No. of HOURS: 4 + 8**

Exercises

- Isolation of plasmid by alkaline lysis method.
- Isolation of plasmid DNA using column chromatography (kit).

Unit 4 Characterization of plasmid by gel electrophoresis **No. of HOURS: 2 + 4**

Exercise

- Digestion of plasmid DNA with restriction enzymes and analysis of the fragments.

Unit 5 Cloning of a gene in a vector and functional analysis **No. of HOURS: 5 + 10**

Polymerases chain reaction (parametric optimization, primer designing), ligation, introduction of DNA construct into host cells, selection of recombinants.

Exercises

- Amplification of DNA segment/gene of interest by PCR.
- Purification of PCR product, digestion of insert and vector by restriction enzymes for directional cloning, purification of insert and digested vector by gel extraction.
- Ligation of vector and insert.
- Preparation of competent cells of *E. coli* DH5 α and transformation with the ligation mixture.
- Functional selection of recombinants (blue/white selection and eGFP fluorescence).

SUGGESTED READINGS

1. Molecular Cloning: A laboratory Manual (2012) Vol. 1-3, 4th ed., Green M.R. and Sambrook J., Cold Spring Harbour Laboratory Press (New York). ISBN: 978-1-936113-41-5 / ISBN: 978-1-936113-42-2.


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**Industrial and Environmental Microbiology
(BHDS3)
Discipline Specific Elective - (DSE) Credit:6**

Course Objective (2-3)

1. To introduce students with the industrial microbiology: concepts, principles, scope and application
2. To introduce students with the environmental microbiology: concepts, principles, scope and application

Course Learning Outcomes

Upon successful completion of the course, students are expected to be able to:

1. Understand how microbiology is applied in manufacturing of industrial products
2. Know about design of bioreactors, factors affecting growth and production
3. Understand the rationale in medium formulation & design for microbial fermentation, sterilization of medium and air
4. Comprehend the different types of fermentation processes
5. Comprehend the techniques and the underlying principles in upstream and down- stream processing
6. Learn the occurrence, abundance and distribution of microorganism in the environment and their role in the environment and also learn different methods for their detection
7. Understand various biogeochemical cycles – Carbon and Nitrogen, and microbes involved
8. Understand the basic principles of environment microbiology and application of the same in solving environmental problems – waste water treatment and bioremediation
9. Comprehend the various methods to determine the quality of water

Unit 1

Scope of microbes in industry and environment; institutes of microbial research (4 lectures)

Unit 2

Bioreactors/Fermenters and fermentation processes (12 lectures)

Solid-state and liquid-state (stationary and submerged) fermentations; Batch and continuous Fermentations; Components of a typical bioreactor, Types of bioreactors: laboratory, pilotscale and production fermenters; Constantly stirred tank fermenter, tower fermenter, fixed bed and fluidized bed bioreactors and air-lift fermenter.

Unit 3

Microbial production of industrial products (14 lectures)

Microorganisms involved, microorganisms generally regarded as safe (GRAS), media, fermentation conditions, downstream processing and uses; Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying; production of industrially important products: enzyme (amylase); organic acid (citric acid); alcohol (ethanol); antibiotic (penicillin)

Unit 4

Microbial enzymes of industrial interest and enzyme immobilization (8 lectures)

Overview of enzymes used for industrial applications, Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes: glucose isomerase and penicillin acylase

Unit 5

Microbes and quality of environment. (6 lectures)

Distribution of microbes in air, soil and water; isolation of microorganisms from soil, air and water.

Unit 6

Microbial flora of water. (10 lectures)

Water pollution: various sources and control measures; role of microbes in sewage and domestic waste water treatment systems. Microorganisms as indicators of water quality: coliforms and fecal coliforms.

Practical

1. Principles and functioning of instruments in microbiology laboratory (autoclave, laminar air flow, incubators, types of fermenters)
2. Preparation of different culture media (Nutrient medium/ Luria Bertani medium/Potato dextrose medium/Czapek Dox medium)

3. Hydrolysis of casein / starch by microorganisms
4. Alcohol production by yeast using sugar/ jaggery
5. Serial dilution method for isolation of microorganisms from water and soil and study of aeromicroflora.
6. Determination of BOD, COD, TDS and TOC of water samples
7. Determination of coliforms in water samples using eosin methylene blue (EMB) medium
8. A visit to any educational institute/ industry to see an industrial fermenter, and other downstream processing operations and a report to be submitted.

References

Suggested Readings

1. Pelczar, M.J. Jr., Chen E.C. S., Krieg, N.R. (2010). Microbiology: An application based approach. Tata McGraw Hill Education Pvt. Ltd., Delhi.
2. Tortora, G.J., Funke, B.R., Case. C.L. (2007). Microbiology. Pearson Benjamin Cummings, San Francisco, U.S.A. 9th edition
3. Peter F Stanbury, Allan Whitaker, Stephen J Hall, (2000). *Principles of Fermentation Technology* . Oxford: Butterworth-Heinemann,
4. Patel, A.H. (2011). Industrial Microbiology, New Delhi: Laxmi Publications,
5. PK Mohapatra, (2008). *Textbook of Environmental Microbiology*. New Delhi, IK International.
6. Jean-Claude Bertrand, Pierre Caumette, Philippe Lebaron, Robert Matheron, Philippe Normand, Télesphore Sime-Ngando.(2015). *Environmental Microbiology: Fundamentals and Applications*, UK:Springer

Additional Resources:

1. Cassida, L.E.. (1968). *Industrial Microbiology*, New Jersey: John Wiley & Sons
 2. Atlas, R.M., Bartha, R. (1998), *Microbial Ecology*, Tx: USA, Benjamin / Cummings Publishing Company.
 3. Sharma, P.D. (2005). *Environmental Microbiology*, Meerut: Rastogi Publications
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Teaching Learning Process

- i) The acquired knowledge in the classroom will be integrated with practical classes to impart a sound understanding of the course
- ii) More emphasis on hands on practical sessions
- iii) Visits to various research institutes/industries to understand the application of microbes for commercial productions.
- iv)Visits to industries/ research institutions working towards mitigation of various environmental issues through microbial application.

Medicinal Botany
(BHSE4)
Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective(2-3)

1. To introduce students to complementary and alternative medicine and provide them an opportunity
2. To explore uses of plants as medicine ranging from traditional indigenous approach for treating ailments to modern pharmaceuticals
3. To inculcate awareness about the rich diversity of medicinal plants in India.

Course Learning Outcomes

Knowledge Skills

- An appreciation of the contribution of medicinal plants to traditional and modern medicine and the importance of holistic mode of treatment of the Indian traditional systems of medicine.
- To develop an understanding of the constraints in promotion and marketing of medicinal plants.

Professional and Practical Skills

- Transforming the knowledge into skills for promotion of traditional medicine.
- Developing entrepreneurship skills to establish value addition products, botanical extracts and isolation of bioactive compounds.

Unit 1

Scope and importance of medicinal plants in the traditional systems of medicine and modern medicine. Importance of preventive and holistic healing in the Indian traditional systems of medicine. Ayurveda: History, origin, fundamental doctrine and concepts of Panchamahabhutas, Saptadhatu and Tridosha in relation to health and disease.

Unit 2

Therapeutic and pharmaceutical uses of important plants used in the Ayurveda system of medicine. Concept of Rasayan drugs. Siddha :

Origin, concepts, therapeutic and pharmaceutical uses of important plants used in Siddha system of medicine. Unani : History, concept of Umoor-e-Tabiya(Fundamentals of Physique), therapeutic and pharmaceutical uses of plants used in Unani system of medicine

Unit 3

Nutraceuticals and polyherbal formulations. Plants used for the treatment of hepatic disorders, cardiac diseases, infertility, diabetes, blood pressure, cancer and skin diseases. Role of AYUSH, NMPB and AIIA in the promotion of medicinal plants.

Unit 4

Adulteration of herbal drugs. Evaluation and Standardization of crude drugs. Fundamentals of Pharmacognosy. Organoleptic, microscopic and phytochemical evaluation of plant drugs.

Unit 5

Conservation of Endangered and Endemic Medicinal plants. Red Data List Criteria. In-situ Conservation : Biosphere Reserves, National Parks, Sacred Groves. Ex-situ conservation : Botanic Gardens, National Gene Banks, Plant cell, tissue, and Organ culture, Cryopreservation. Role of NBPGR, CIMAP, JNTBGRI and RRL.


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Unit 6

General aspects of cultivation and propagation of medicinal plants. WHO Guidelines of Good Agricultural and Cultivation Practices (GACP). Objectives of the Nursery, classification and important components of nursery. Greenhouse technology. Propagation through cuttings, layering, grafting and budding.

Practical

1. Identification and medicinal value of locally available medicinal plants in the field.
2. Study of organoleptic, macroscopic and microscopic parameters of any two plant drugs. Sections and powder microscopic evaluation.
3. Isolation of bioactive compounds in the lab and phytochemical analysis of the crude extract of various parts of medicinal plants.
4. Study of ingredients and medicinal uses of common polyherbal formulations used in the traditional systems of medicine.
5. Project Report based on visit to Pharmaceutical Industries and/or Institutes.
6. E-presentations : Traditional Systems of Medicine, Contribution of medicinal plants to alternative and modern medicine, Conservation strategies of medicinal plants, Nutraceuticals, Rasayana drugs, Medicinal plants and non-communicable diseases, Cultivation, marketing and utilisation of medicinal plants.
7. Laboratory Records

References

1. Chaudhry, B. (2019). *A Handbook of Common Medicinal Plants Used in Ayurveda*. Kojo Press, New Delhi. (For Units 1-3).
2. Purohit, Vyas (2008). *Medicinal Plant Cultivation : A Scientific Approach*, 2nd edition. Jodhpur, Rajasthan: Agrobios. (Chapter 1 for Unit 1; Chapter-6 for Unit 6, Chapter 12 for Unit 5).
3. S.B. Gokhale, C.K. Kokate (2009). *Practical Pharmacognosy*. Pune, Maharashtra: Nirali Prakashan. (For Unit 4).
4. Trivedi, P.C. (2006). *Medicinal Plants Traditional Knowledge*. New Delhi, Delhi: I.K. International Publishing House Pvt. Ltd. (Chapter 1 for Unit 4; Chapter 2 and 11 for Unit 3)

Additional Resources:

1. Trivedi, P.C. (2009). *Medicinal Plants. Utilisation and Conservation*. Jaipur, Rajasthan: Aavishkar Publishers. (Chapter 1 and 19 for Unit 5; Chapter 20 for Unit 3).
2. William Charles Evans (2009) *Trease and Evans's Pharmacognosy*, 16th edition. Edinburg, London, Philadelphia, Pennsylvania: Saunders Ltd. (Chapter 1, and Chapters 42-44 for Unit 4).
3. ayush.gov.in (Ministry of AYUSH) (for Unit 1 and 2).

Teaching Learning Process

- To encourage innovation, to link theoretical knowledge with practical training and application of knowledge to find practical solutions to the challenges encountered in the field of traditional medicine.
- To hold regular and structured workshops, seminars, field trips, collaboration with Research institutions, Industry and other Government Organizations, in order to facilitate peer learning and skill enhancement.
- To complement classroom teaching with discussions, presentations, quizzes, interpretation of results, short projects, writing project reports and field exposure.

Week 2: Unit I

Week 3: Unit II

Week 4: Unit II

Week 5: Unit III

Week 6: Unit III

Week 7: Field visit

Week 8: Unit IV

Week 9: Unit IV

Week 10: Mid semester Exam

Week 11: Mid Semester Break

Week 12: Unit V

Week 13: Unit V

Week 14: Unit VI

Week 15: Unit VI

Assessment Methods

Continuous Evaluation

(Project/ E-presentation :10 marks, Lab Records :

Attendance in Practicals

Practical Examination :

Unit No	Course learning Outcome	Teaching and Learning Activity	Assessment Task
Unit I:	Scope and importance of medicinal plants in the traditional systems of medicine and modern medicine. Importance of preventive and holistic healing in the Indian traditional systems of medicine. Ayurveda : History, origin, fundamental doctrine and concepts of Panchamahabhutas, Saptadhatu and Tridoshas in relation to health and disease.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
Unit II:	Therapeutic and pharmaceutical uses of important plants used in the Ayurveda system of medicine. Concept of	Class room lectures and Practical demonstration,	Hands on exercises, PPT, assignments,

	Rasayanadrugs. Siddha : Origin, concepts, therapeutic and pharmaceutical uses of important plants used in Siddha system of medicine. Unani : History, concept of Umoor-e-Tabiya (Fundamentals of Physique), therapeutic and pharmaceutical uses of plants used in Unani system of medicine	experiments	tests
Unit III:	Nutraceuticals and polyherbal formulations. Plants used for the treatment of hepatic disorders, cardiac diseases, infertility, diabetes, blood pressure, cancer and skin diseases. Role of AYUSH, NMPB and AIIA in the promotion of medicinal plants.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
Unit IV:	Adulteration of herbal drugs. Evaluation and Standardization of crude drugs. Fundamentals of Pharmacognosy. Organoleptic, microscopic and phytochemical evaluation of plant drugs.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
Unit V:	Conservation of Endangered and Endemic Medicinal plants. Red Data List Criteria. In-situ Conservation : Biosphere Reserves, National Parks, Sacred Groves. Ex-situ conservation : Botanic Gardens, National Gene Banks, Plant cell, tissue, and Organ culture, Cryopreservation. Role of NBPGR, CIMAP, JNTBGRI and RRL.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
Unit VI:	General aspects of cultivation and propagation of medicinal plants. WHO Guidelines of Good Agricultural and Cultivation Practices (GACP). Objectives of the Nursery, classification and important components of nursery. Greenhouse technology. Propagation through cuttings, layering, grafting and budding	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests

Keywords

Keywords : Medicinal plants, Ayurveda, Siddha, Unani, Holistic healing, Phytochemicals, Pharmacognosy, Polyherbals, Conservation, Propagation.

**Ecology
(BHCC9)
Core Course - (CC) Credit:6**

Course Objective (2-3)

To introduce the students with environmental factors affecting the plants, the basic principles of ecology and phytogeography. To make them understand complex community patterns and processes, and ecosystem functioning.

Course Learning Outcomes

It acquaint the students with complex interrelationship between organisms and environment; make them understand methods to studying vegetation, community patterns and processes, ecosystem functions, and principles of phytogeography. This knowledge is critical in evolving strategies for sustainable natural resource management and biodiversity conservation.

Unit 1

Introduction (4 lectures): Brief History, Basic concepts, Levels of organization, Inter-relationships between the living world and the environment, the components and dynamism, homeostasis (with reference to Ecosystem).

Unit 2

Soil (8 lectures): Importance; Origin; Formation; Composition: Physical, Chemical and Biological components; Soil profile; Role of climate in soil development.

Unit 3

Water (3 lectures): Importance; States of water in the environment; Atmospheric moisture; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Water in soil; Water table.

Unit 4

Light, Temperature, Wind and Fire (6 lectures): Variations; adaptations of plants to their variation.

Unit 5

Biotic interactions (2 lectures): Definition; types of biotic interactions


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Unit 6

Population ecology (4 lectures): Distribution and characteristics of populations; population growth; population dynamics; Ecological Speciation (Ecads, ecotypes, ecospecies, etc)

Unit 7

Plant communities (9 lectures): Concept of ecological amplitude; Habitat (types) and Ecological niche (types); Community characters (analytical and synthetic); Ecotone and edge effect; Methods to studying vegetation; Dynamics of communities; Succession: processes, types (Lithosere, Hydrosere); climax concepts.

Unit 8

Ecosystems (5 lectures): Structure; Types; Processes; Trophic organisation; Food chains and Food webs; Ecological pyramids.

Unit 9

Functional aspects of ecosystem (9 lectures): Principles and models of energy flow; Production and productivity; Measurement of productivity; Ecological efficiencies; Biogeochemical cycles; Cycling of Carbon, Nitrogen and Phosphorus.

Unit 10

Phytogeography (10 lectures): Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical division of India; Vegetation of Delhi.

Practical

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of pH of various soil and water samples (pH meter, universal indicator/Lovi bond comparator and pH paper)
3. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.
4. Determination of organic matter of different soil samples by Walkley & Black rapid titration method.
5. Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats.
6. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.
7. (a). Study of morphological adaptations of hydrophytes and xerophytes (four each).
(b). Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Rootparasite (*Orobanch*), Epiphytes, Predation (Insectivorous plants).
8. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).
9. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.
10. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus.
11. Field visit to familiarize students with ecology of different sites.

References

1. Odum, E.P. (2005). *Fundamentals of Ecology*. New Delhi, India: Cengage Learning India Pvt. Ltd., 5th edition. (Chapter 3, 4 for Unit 8; Chapter 6 for Unit 6; Chapter 7 for Unit 7; Chapter 10 for Unit 10)
2. Singh, J.S., Singh, S.P., Gupta, S.R. (2014). *Ecology, Environmental Science and Conservation*. New Delhi, India: S. Chand. (Chapter 4 for Unit 2; Chapter 5 for Unit 4; Chapter 8 for Unit 6; Chapter 9 for Unit 5; Chapter 10, 11, 12 for Unit 7; Chapter 13 for Unit 8; Chapter 15, 16 for Unit 9; Chapter 18 for Unit 10)
3. Sharma, P.D. (2015-16). *Ecology and Environment*. Meerut, India: Rastogi Publications. 12th edition.(Chapter 2 for Unit 4; Chapter 3 for Unit 2; Chapter 5 for Unit 5; Chapter 7 for Unit 6; Chapter 8 for Unit 7; Chapter 9 for Unit 8; Chapter 19 for Unit 10)
4. Kormondy, E.J. (2017). *Concepts of Ecology*. India: Pearson India Education Services Pvt. Ltd. 4th edition.(Chapter 7, 8 for Unit 8; Chapter 10, 11 for Unit 6; Chapter 12 for Unit 7; Chapter 14 for Unit 10)

Additional Resources:

1. Ambasht, R.S. and Ambasht, N.K. (2008). *A text book of Plant Ecology*, CBS Publishers & Distributors PVT. LTD. 14th Edition (Chapter 2 for Unit 8; Chapter 3, 7 for Unit 4; Chapter 9 for Unit 6; Chapter 10 for Unit 7; Chapter 11, 17, 18 for Unit 10)
 2. Majumdar, R and Kashyap, R (2019). *Practical Manual of Ecology and Environmental Science*, New Delhi, India: Prestige Publishers (chapters 1-11 For Practicals 1 to 10)
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Teaching Learning Process

The Class room teaching is integrated with practical classes, and field visit to impart a sound understanding of the course. The theory topics are covered in lectures with the help of blackboard teaching and PowerPoint presentations. When the entire syllabus is completed, a few lectures are devoted to discuss the previous years' question papers.

Every practical session begins with detailed instructions, followed by students conducting the experiment/s in the laboratory/college campus. When all the students have collected the data, the observations are discussed. Any deviation from the expected trend in results is explained. The students are encouraged to graphically represent the data and record the experiment during class hours. The students are asked to submit their record notebooks to the teacher/s for checking. College teachers can also form a group and prepare e-contents for theory as well as for practicals. Field visit is also be organised to familiarise the students with local plant species, and to understand community pattern and processes.

Teaching Learning Plan:

- Week 1: Unit I
- Week 2: Unit II
- Week 3: Unit II
- Week 4: Unit III
- Week 5: Unit IV
- Week 6: Unit V

Week 7: Unit VI
 Week 8: Unit VII
 Week 9: Unit VII
 Week 10: Mid semester Exam
 Week 11: Mid Semester Break
 Week 12: Unit VIII
 Week 13: Unit IX
 Week 14: Unit IX, Unit X
 Week 15: Unit X

Assessment Methods

Theory: The students are continuously evaluated based on assignments/presentation and class test. After marking, the answer scripts of the test are returned to the students.

In fact, presentations by students improve their reasoning and communication skills. The presentations of students are evaluated by the teacher based on the content, effectiveness of the presentation, whether any new information has been added, and lastly on the answers given by students to the questions posed by the teacher. An assignment can be given in place of the presentation.

The Internal Assessment has a break-up as 10 marks for the test, 10 marks for the presentation/assignment and 5 marks for the attendance, and comprises 25 % of the total marks.

Practicals: For continuous evaluation, 10 marks are allotted for test, 10 marks for record /field report, and 5 marks for attendance. The Internal Assessment for practicals comprises 50 % of the total marks.

Assessment method

Unit No	Course learning Outcome	Teaching and Learning Activity	Assessment Task
I	Introduction	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
II	Soil	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
III	Water	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
IV	Light, Temperature, Wind and Fire	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
V	Biotic Interactions	Class room lectures	Hands on exercises, PPT,

		and Practical demonstration, experiments	assignments, tests
VI	Population Ecology Distribution and characteristics of populations; population growth; population dynamics; Ecological Speciation	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VII	Plant Communities Concept of ecological amplitude; Habitat and Ecological niche; Community characters (analytical and synthetic); Ecotone and edge effect; Methods to studying vegetation; Dynamics of communities; Succession	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
VIII	Ecosystems Structure; Types; Processes; Trophic organisation; Food chains and Food webs; Ecological pyramids.	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
IX	Functional aspects of ecosystems Principles and models of energy flow; Production and productivity; Measurement of productivity; Ecological efficiencies; Biogeochemical cycles	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests
X	Phytogeography Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes; Phytogeographical division of India; Vegetation of Delhi	Class room lectures and Practical demonstration, experiments	Hands on exercises, PPT, assignments, tests

Keywords

Environmental factors, Soil profile, Biotic interactions, Ecological niche, Succession, Ecosystem functions, Homeostasis, Endemism, Phytogeography


 PRINCIPAL (Acting)
 Sri Venkateswara College
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 Dhaura Kuan, New Delhi-110021

Medicinal Botany
(LSSE2)
Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective (2-3)

To introduce students to complementary and alternative medicine and provide them an opportunity

To explore uses of plants as medicine ranging from traditional indigenous approach for treating ailments to modern pharmaceuticals

To inculcate awareness about the rich diversity of medicinal plants in India.

Course Learning Outcomes

Knowledge Skills

· An appreciation of the contribution of medicinal plants to traditional and modern medicine and the importance of holistic mode of treatment of the Indian traditional systems of medicine.

· To develop an understanding of the constraints in promotion and marketing of medicinal plants.

Professional and Practical Skills

· Transforming the knowledge into skills for promotion of traditional medicines.

· Developing entrepreneurship skills to establish value addition products, botanical extracts and isolation of bioactive compounds.

Unit 1

Scope and importance of medicinal plants in the traditional systems of medicine and modern medicine. Importance of preventive and holistic healing in the Indian traditional systems of medicine. Ayurveda: History, origin, fundamental doctrine and concepts of Panchamahabhutas, Saptadhatus and Tridoshas in relation to health and disease.

Unit 2

Therapeutic and pharmaceutical uses of important plants used in the Ayurveda system of medicine. Concept of Rasayanadrugs. Siddha Origin, concepts, therapeutic and pharmaceutical uses of important plants used in Siddha system of medicine. Unani: History, concept of Umoor-e-Tabiya (Fundamentals of Physique), therapeutic and pharmaceutical uses of plants used in Unani system of medicine

Unit 3

Nutraceuticals and polyherbal formulations. Plants used for the treatment of hepatic disorders, cardiac diseases, infertility, diabetes, blood pressure, cancer and skin diseases. Role of AYUSH, NMPB and AIIA in the promotion of medicinal plants.

Unit 4

Adulteration of herbal drugs. Evaluation and Standardization of crude drugs. Fundamentals of Pharmacognosy. Organoleptic, microscopic and phytochemical evaluation of plant drugs.

Unit 5

Conservation of Endangered and Endemic Medicinal plants. Red Data List Criteria. In situ Conservation: Biosphere Reserves, National Parks, Sacred Groves. Ex-situ conservation: Botanic Gardens, National Gene Banks, Plant cell, tissue, and Organ culture, Cryopreservation. Role of NBPGR, CIMAP, JNTBGRI and RRL.

Unit 6

General aspects of cultivation and propagation of medicinal plants. WHO Guidelines of Good Agricultural and Cultivation Practices (GACP). Objectives of the Nursery, classification and important components of nursery. Greenhouse technology. Propagation through cuttings, layering, grafting and budding.

Practical

1. Identification and medicinal value of locally available medicinal plants in the field.
2. Study of organoleptic, macroscopic and microscopic parameters of any two plant drugs. Sections and powder microscopic evaluation.
3. Isolation of bioactive compounds in the lab and phytochemical analysis of the crude extract of various parts of medicinal plants.
4. Study of ingredients and medicinal uses of common polyherbal formulations used in the traditional systems of medicine.
5. Project Report based on visit to Pharmaceutical Industries and/or Institutes.
6. E-presentations : Traditional Systems of Medicine, Contribution of medicinal plants to alternative and modern medicine, Conservation strategies of medicinal plants, Nutraceuticals, Rasayana drugs, Medicinal plants and non-communicable diseases, Cultivation, marketing and utilisation of medicinal plants.
7. Laboratory Records

References

1. Chaudhry, B. (2019). *A Handbook of Common Medicinal Plants Used in Ayurveda*. Kojo Press, New Delhi. (For Units 1-3).

B.Com. (Hons.): Semester-III
Paper BCH 3.3: MANAGEMENT PRINCIPLES AND APPLICATIONS

Duration: 3 Hours**Marks: 100****Credits: 6****Course Objective**

The objective of the course is to familiarize the learner with extant and emerging management theories and practices for reflective and holistic thinking on management principles and practices.

Course Learning Outcomes

After completing the course, the student shall be able to:

- CO1: understand the evolution of management and apprehend its effect on future managers.
- CO2: analyze how organisations adapt to an uncertain environment and decipher decision making techniques managers use to influence and control the internal environment.
- CO3: comprehend the changes happening in organisation structure over time.
- CO4: analyze the relationship amongst functions of management i.e. planning, organizing, directing and controlling.
- CO5: appreciate the changing dynamics of management practice.

Course Contents**Unit I: Introduction**

Meaning and importance of management; Coordination mechanisms in organisations, management as an eclectic modern discipline; Theory base of management- classical, neo-classical and modern constructions of management; Managerial functions, roles (Mintzberg), levels and competencies.

Unit II: Planning

Organisational objective setting; Decision Making: environment (certainty, risk, uncertainty), and techniques for individual and group decision-making; Forecasting and Scheduling; Planning vis-à-vis Strategy- meaning and elements of environment of business firm –micro (immediate), meso (intermediate e.g. industry), macro (domestic); Industry structure, Business-level strategic planning.

Unit III: Organizing

Division of Labor; Decentralization and Delegation; Organisational forms (Mintzberg); Factors affecting organisational design; Departmentalization; Staffing as a function; Organisational structures and Organograms- traditional and modern - comparative suitability and changes over time, formal- informal organisations' interface.

Unit IV: Directing and Controlling

Motivation- meaning, importance and factors affecting motivation; Leadership – meaning, importance and factors affecting leadership, leadership styles, and followership; Principles of controlling; relationship amongst planning, organizing, directing and controlling; Performing controlling function; Measures of controlling and accountability for performance.

Unit V: Salient Developments and Contemporary Issues in Management

Management challenges of the 21st Century; Factors reshaping and redesigning management

purpose, performance and reward perceptions- internationalization; Digitalization; Entrepreneurship & innovation; Values & ethics, holistic purpose and measures of firm performance; Workplace diversity; Democracy and Sociocracy; Subaltern management ideas from India.

References

- Kumar, Pardeep. *Management : Principles and Applications*. JSR Publication House LP, Delhi.
- Mahajan, J.P. and Mahajan Anupama. *Management Principles and applications*. Vikas Publications
- Drucker, P. F. (1954). *The Practice of Management*. Newyork: Harper & Row.
- Drucker, P. F. (1999). *Management Challenges for the 21st Century*. HarperCollins Publishers Inc.
- Griffin, R. W., Phillips, J. M., & Gully, S. M. (2017). *Organisational Behavior: Managing People and Organisations*. Cengage Learning.
- Griffin. *Management Principles and Application*. Cengage.
- Koontz, H., & Weihrich, H. (2012). *Essentials of Management: An International and Leadership Perspective*. Paperback.

Note: Latest edition of readings may be used

Teaching Learning Process

Interactive class room sessions with the help of power point presentations, case discussions and group discussions to ensure active participation and continuous learning.

Assessment Methods

Class tests/Assignments, Class participation, Presentations, End-semester examination

Keywords

Management Theories, Organisational Design, Motivation, Leadership, Entrepreneurship and Innovation and Workplace Diversity


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B.Com. (Hons.): Semester-IV
Paper BCH 4.2: BUSINESS MATHEMATICS

Duration: 3Hrs.**Marks:100****Credits: 6****Course Objective**

The objective of this course is to familiarize the students with the basic mathematical tools with special emphasis on applications to business and economic situations.

Course Learning Outcomes

After completing the course, the student shall be able to:

- CO1: comprehend the concept of systematic processing and interpreting the information in quantitative terms to arrive at an optimum solution to business problems.
- CO2: develop proficiency in using different mathematical tools (matrices, calculus, linear programming, and mathematics of finance) in solving daily life problems.
- CO3: acquire competence to use computer for mathematical computations, especially with Big data.
- CO4: obtain critical thinking and problem-solving aptitude.
- CO5: evaluate the role played by mathematics in the world of business and economy.

Course Contents**Unit I: Matrices and Determinants**

- 1.1 Definition and types of matrix, Algebra of matrices, Inverse of a matrix- Business Applications.
- 1.2 Solution of system of linear equations (having unique solution and involving not more than three variables) using matrix inversion method and Cramer's Rule.
- 1.3 Leontief Input Output Model (Open Model Only).

Unit II: Basic Calculus

- 2.1 Mathematical functions and their types (linear, quadratic, polynomial, exponential, logarithmic and logistic function). Concepts of limit and continuity of a function.
- 2.2 Concept of Marginal Analysis. Concept of Elasticity, Applied Maxima and Minima problems including effect of Tax on Monopolist's Optimum price and quantity, Economic Order Quantity.

Unit III: Advanced Calculus

3.1 Partial Differentiation: Partial derivatives up to second order. Homogeneity of functions and Euler's theorem. Total differentials. Differentiation of implicit functions with the help of total differentials.

3.2 Maxima and Minima involving two variables – Applied optimization problems and Constraint optimization problems using Lagrangean multiplier involving two variables having not more than one constraint.

3.3 Integration: Standard forms & methods of integration- by substitution, by parts and by use of partial fractions. Definite integration. Finding areas in simple cases

3.4 Application of Integration to marginal analysis; Consumer's and Producer's Surplus. Rate of sales, The Learning Curve.

Unit IV: Mathematics of Finance

4.1 Rates of interest: nominal, effective and their inter-relationships in different compounding situations.

4.2 Compounding and discounting of a sum using different types of rates. Applications relating to Depreciation of assets and Equation of value.

4.3 Types of annuities: ordinary, due deferred, continuous, perpetual. Determination of future and present values using different types of rates of interest. Applications relating to Capital expenditure, Leasing, Valuation of simple loans and debentures, sinking fund. (excluding general annuities).

Unit V: Linear Programming

5.1 Formulation of Linear programming problems (LPPs), Graphical solutions of LPPs. Cases of unique solutions, multiple optimal solutions, unbounded solutions, infeasibility, and redundant constraints.

5.2 Solution of LPPs by simplex method - maximization and minimization cases. Shadow prices of the resources, Identification of unique and multiple optimal solutions, unbounded solution, infeasibility and degeneracy.

5.3 The dual problem: Formulation, relationship between Primal and Dual LPP, Primal and Dual solutions (excluding mixed constraints LPPs). Economic interpretation of the dual.

Practical Lab

In addition to the lectures, the students are expected to work on a software package for solving linear programming problems, problems related to mathematics of finance and analyze the results obtained there from. This will be evaluated through internal assessment.

References

- Kapoor, V.K. *Business Mathematics, Theory & Applications*. Sultan Chand & Sons
- Sharma, S.K. & Kaur, Gurmeet. *Business Mathematics*. Sultan Chand
- Thukral, J.K. *Business Mathematics*. Mayur Publications.

Additional Resources:

- Anthony, M. and Biggs, N. *Mathematics for Economics and Finance*. Cambridge University Press
- Ayres, Frank Jr. *Theory and Problems of Mathematics of Finance*. Schaum's Outlines Series. McGraw Hill Publishing Co.
- Budnick, P. *Applied Mathematics*. McGraw Hill Publishing Co.
- Dowling, E.T. *Mathematics for Economics*. Schaum's Outlines Series. McGraw Hill Publishing Co.
- Wikes, F.M. *Mathematics for Business, Finance and Economics*. Thomson Learning

Note: Latest edition of text books may be used.

Teaching Learning Process

This course is well structured and sequenced attainment of knowledge and skills. It will constitute an important aspect of teaching learning process. the course would involve lectures supported by group tutorials, open ended projects and self study.

Assessment Methods

The Assessment for this paper would include a theory exam of 75 marks and Internal assessment of 25 marks. Internal assessment will include 10 marks for practical exam, 10 marks for class tests/assignments, and 5 marks for attendance. There shall be 4 Credit Hrs. for Lectures + one Credit Hr. (Two Practical Periods per week per batch) for Practical Lab + one credit Hr. for Tutorials (per group). Use of simple calculator is allowed. Proofs of theorems/ formulae are not required. Trigonometric functions are not to be covered.

Keywords

Matrices and Determinants, Basic Calculus, Advanced Calculus, Mathematics of Finance, Linear Programming


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B.Com. (Hons.): Semester-IV
Paper BCH 4.3: COMPUTER APPLICATIONS IN BUSINESS

Duration: 3 Hrs.**Marks: 100****Credits: 6****Course Objective**

To provide computer knowledge to commerce students and equip them with computational skills using ICT tools.

Course Learning Outcomes

After completing the course, the student shall be able to:

- CO1: understand the various concepts and terminologies used in computer networks and internet and be aware of the recent developments in the fast changing digital business world.
- CO2: handle document creation for communication.
- CO3: acquire skills to create and make good presentations
- CO4: make various computations in the area of accounting and finance and represent the business data using suitable charts. S/He should be able to manipulate and analyze the business data for better understanding of the business environment and decision making
- CO5: understand and apply the various database concepts and tools in the related business areas with the help of suggested popular software.

Course Contents**Unit1: Data Processing, Networking and Recent trends in computing**

Computing: Concept of computing, Data and information; Computing Interfaces: GUI, CLI, Touch Interface, NLI; data processing; applications of computers in business.

Computer Networks: Meaning of computer network; objectives/ needs for networking; Applications of networking; Basic Network Terminology; Types of Networks; Network Topologies; Distributed Computing; Client Server Computing, Peer- to- peer Computing; Wireless Networking; Securing Networks: firewall.

Basic Internet Terminology: I.P. Address, Modem, Bandwidth, Routers, Gateways, Internet Service Provider (ISP), World Wide Web (www), Browsers, Search Engines ,Proxy Server, Intranet and Extranet; Basic Internet Services; Internet Protocols: TCP/IP, FTP, HTTP(s), Uses of Internet to Society; Cyber Security: Cryptography, digital signature.

Recent trends in computing : Tools of business collaboration: emails, wikis, file sharing, screen sharing, web presenting, work scheduling; Cloud computing: meaning, types of cloud services: IaaS, PaaS, SaaS; Grid Computing; Virtualization; Green Computing; E-Commerce:

meaning, business models , Electronic Data Interchange (EDI), Payment Gateways; Internet of Things (IoT)

Unit 2: Word Processing

Introduction to word Processing, Word processing concepts, Use of Templates, Working with word document: Editing text, Find and replace text, Formatting, spell check, Autocorrect, Autotext; Bullets and numbering, Tabs, Paragraph Formatting, Indent, Page Formatting, Header and footer, Tables: Inserting, filling and formatting a table; Inserting Pictures and Video; Mail Merge: including linking with Databases and spreadsheet files; Printing documents; Citations and Footnotes.

Creating Business Documents using the above facilities

Unit 3: Preparing Presentations

Basics of presentations: Slides, Fonts, Drawing, Editing; Inserting: Tables, Images, texts, Symbols, hyperlinking, Media; Design; Transition; Animation; and Slideshow.

Creating Business Presentations using above facilities

Unit 4: Spreadsheet and its Business Applications

Spreadsheet concepts, Managing worksheets; Formatting, conditional formatting, Entering data, Editing, and Printing and Protecting worksheets; Handling operators in formula, Project involving multiple spreadsheets, Organizing Charts and graphs; Working with Multiple worksheets; controlling worksheet views, naming cells and cell ranges.

Spreadsheet functions: Mathematical, Statistical, Financial, Logical, Date and Time, Lookup and reference, Database functions, Text functions and Error functions

Working with Data: Sort and filter; Consolidate; Tables; Pivot tables; What-if-analysis: Goal seek, Data tables and Scenario manager; Data analysis ToolPak: Descriptive Statistics, Moving averages, Histogram, Covariance, correlation and Regression analysis (only for projection)

Creating business spreadsheet: Loan and Lease statement; Ratio Analysis; Payroll statements; Capital Budgeting; Constraint optimization, Assignment Problems, Depreciation Accounting; Graphical representation of data; Frequency distribution and its statistical parameters; Correlation and Regression Analysis

Unit 5: Database Management System (Theory)

Theoretical background of Database Designs for Accounting and Business Applications: Database, Database Management System, Database System; Comparison of Database System with Traditional File System; Entity Relationship Model (ER-Model); Relational Database Model: Creating Relationship between Tables, Concept of Keys, Fundamental Integrity Rules; ERD to Relational Mapping; Normalization of databases upto 3 Normal Forms.

SQL and Retrieval of Information: Basic Queries in SQL; Embedded Queries in SQL; Insert, Delete and Update statements in SQL

DBMS Software: Environment; Tables; Forms; Queries; Reports; Modules;

Applying DBMS in the areas of Accounting, Inventory, HRM and its accounting, Managing the data records of Employees, Suppliers and Customers.

Practical

Note: There shall be 4 credit hours (4 lectures) and 2 credit hours (4 practical lab periods) per batch.

References

- Elmasari, Ranez and Shamkant B. Navathe, *Fundamentals of Database Systems*, Pearson Education
- Jain Hem Chand and Tiwari H. N. (2019), *Computer Applications in Business*, Taxmann
- Madan Sushila, *Computer Applications in Business*, Scholar Tech Press.
- Mathur Shruti and Jain Pooja, *Computer Applications in Business*, Galgotia Publishing Company
- Sharma S.K. and Bansal Mansi, *Computer Applications in Business*, Taxmann
- Wayne Winston, *Data Analysis & Business Modeling*, PHI.

Additional Sources

- Simon Benninga, *Financial Modeling*, The MIT Press

Note: The latest editions of the books should be referred.

Teaching Learning Process

The course would involve lectures supported by group discussion, real life projects, open ended projects and hands-on-practice in computer labs.

Assessment Methods

There shall be practical examination of 50 Marks (2 hours duration (External)), theory exam of 25 marks (1 hour duration) and Internal Assessment of 25 marks (Class Test-10 Marks, Work Book- 10 Marks and attendance- 5 marks).

Keywords

Computer Application in Business, Spreadsheet Solver, Database Management System, Mail Merge, Word Processing, Data Analysis, Pivot Table.


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B.Com. (Hons.): Semester-IV
Paper BCH 4.5(c): LEADERSHIP AND TEAM DEVELOPMENT

Duration: 3Hrs.**Marks: 100****Credits: 4****Course Objective**

The underlying objective of this course is to create an in-depth understanding of the concept of leadership and team building as well as help undergraduate students to examine leadership in contemporary context and learn principles of building highly effective teams.

Course Learning Outcomes

After completing the course, the student shall be able to:

- CO1: gain theoretical and practical knowledge to evaluate leadership skills, styles and strategies in contemporary world so as to become a successful leader and effective employee in organisation.
- CO2: understand the group dynamics and group decision making so as to develop acumen to utilize the leadership and team building concepts, tools and techniques to handle the complex organisational problems at different levels.
- CO3: recognize the dynamics of group decision making.
- CO4: understand the working of various teams in organisations.
- CO5: evaluate the role of women as leader and using various social media platforms as effective means of communication in contemporary world as a leader.

Course Contents**Unit I: Leadership**

Styles and attributes of Leadership; Transactional and transformational leadership; Ethical leadership, culture and leadership (the emerging trends in leadership are to be discussed with case studies and projects).

Unit II: Groups and Group Processes

The nature and types of groups; Group dynamics- group cohesion, group roles and group norms, threat to group effectiveness; Managing group and inter-group dynamics; Managing culturally diverse groups.

Unit III: Leaders and Group Decisions

Group decision making; Power and influence in teams; Leadership and team empowerment; Challenges in team decision making.

Unit IV: Team Building and Team Effectiveness

Group vs. team; Evolution of group into teams; Stages of team development (team development case studies); Emotionally intelligent teams; Characteristics of effective team; Collaborative communication in teams; Problem solving and conflict resolution in teams.

Unit V: Emerging Trends in Leadership

Women in leadership; Leadership skills- coaching and mentoring; leadership and social media.

Practical

Case studies can be used in teaching various units.

References

- Luthans, F. (1997). *Organisational Behavior*. McGraw-Hill International Editions.
- Robbins, S. T., Judge, T. A., & Hasham, E. S. (2013). *Organisational Behavior*. Pearson.
- Singh, K. (2015). *Organisational Behavior: Texts & Cases* (3rd Edition ed.). India: Pearson.
- Griffin, R. W., Phillips, J. M., & Gully, S. M. (2017). *Organisational Behavior: Managing People and Organisations*. Cengage Learning.
- Greenberg, J., & Baron, R. A. *Behavior in Organisations*. Prentice Hall of India Pvt. Ltd., New Delhi.
- Hersey, P. K., Blanchard, D., & Johnson, D. *Management of Organisational Behavior: Leading Human Resources*. Pearson Education.
- Gratton, L. E. (2007). *Eight ways to build collaborative teams*. Harvard Business Review. 85 (11), 100-109.
- Katzenbach, J. R., Douglas S. K. (2001). *Discipline of Teams*. Harvard Business Review. 71(2). 111-120.

Additional Resources:

- Hogg, M. & Vaughan, G.M. (2008). *Social Psychology*. Prentice Hall.
- Kohn, S. E., & O'Connell, V. D. (2007). *6 Habits of Highly Effective Teams*.
- Lakes, F. *Leadership: Theory and Practice by Peter G. Northouse*. Sage Publication (6th edition). New Jersey: Career Press. ISBN: 9781452203409.

Note: Latest edition of readings may be used

Teaching Learning Process

The course combines learning through analysis and discussion of case studies and active participation in experiential exercises and simulations.

Assessment Methods

Class tests/Assignments, Class participation, Presentations, End-semester examination

Keywords

Ethical Leadership, Group Dynamics, Group Decisions, Coaching, Mentoring.


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B.Com. (Hons.): Semester-IV
Paper BCH 4.3: COMPUTER APPLICATIONS IN BUSINESS

Duration: 3 Hrs.**Marks: 100****Credits: 6****Course Objective**

To provide computer knowledge to commerce students and equip them with computational skills using ICT tools.

51/137**Course Learning Outcomes**

After completing the course, the student shall be able to:

- CO1: understand the various concepts and terminologies used in computer networks and internet and be aware of the recent developments in the fast changing digital business world.
- CO2: handle document creation for communication.
- CO3: acquire skills to create and make good presentations
- CO4: make various computations in the area of accounting and finance and represent the business data using suitable charts. S/He should be able to manipulate and analyze the business data for better understanding of the business environment and decision making
- CO5: understand and apply the various database concepts and tools in the related business areas with the help of suggested popular software.

Course Contents**Unit1: Data Processing, Networking and Recent trends in computing**

Computing: Concept of computing, Data and information; Computing Interfaces: GUI, CLI, Touch Interface, NLI; data processing; applications of computers in business.

Computer Networks: Meaning of computer network; objectives/ needs for networking; Applications of networking; Basic Network Terminology; Types of Networks; Network Topologies; Distributed Computing; Client Server Computing, Peer- to- peer Computing; Wireless Networking; Securing Networks: firewall.

Basic Internet Terminology: IP. Address, Modem, Bandwidth, Routers, Gateways, Internet Service Provider (ISP), World Wide Web (www), Browsers, Search Engines ,Proxy Server, Intranet and Extranet; Basic Internet Services; Internet Protocols: TCP/IP, FTP, HTTP(s), Uses of Internet to Society; Cyber Security: Cryptography, digital signature.

Recent trends in computing : Tools of business collaboration: emails, wikis, file sharing, screen sharing, web presenting, work scheduling; Cloud computing: meaning, types of cloud services: IaaS, PaaS, SaaS; Grid Computing; Virtualization; Green Computing; E-Commerce:

meaning, business models, Electronic Data Interchange (EDI), Payment Gateways; Internet of Things (IoT)

Unit 2: Word Processing

Introduction to word Processing, Word processing concepts, Use of Templates, Working with word document: Editing text, Find and replace text, Formatting, spell check, Autocorrect, Autotext; Bullets and numbering, Tabs, Paragraph Formatting, Indent, Page Formatting, Header and footer, Tables: Inserting, filling and formatting a table; Inserting Pictures and Video; Mail Merge: including linking with Databases and spreadsheet files; Printing documents; Citations and Footnotes.

Creating Business Documents using the above facilities

Unit 3: Preparing Presentations

Basics of presentations: Slides, Fonts, Drawing, Editing; Inserting: Tables, Images, texts, Symbols, hyperlinking, Media; Design; Transition; Animation; and Slideshow.

Creating Business Presentations using above facilities

Unit 4: Spreadsheet and its Business Applications

Spreadsheet concepts: Managing worksheets; Formatting, conditional formatting, Entering data, Editing, and Printing and Protecting worksheets; Handling operators in formula, Project involving multiple spreadsheets, Organizing Charts and graphs; Working with Multiple worksheets; controlling worksheet views, naming cells and cell ranges.

Spreadsheet functions: Mathematical, Statistical, Financial, Logical, Date and Time, Lookup and reference, Database functions, Text functions and Error functions

Working with Data: Sort and filter; Consolidate; Tables; Pivot tables; What-if-analysis: Goal seek, Data tables and Scenario manager; Data analysis ToolPak; Descriptive Statistics, Moving averages, Histogram, Covariance, correlation and Regression analysis (only for projection)

Creating business spreadsheet: Loan and Lease statement; Ratio Analysis; Payroll statements; Capital Budgeting; Constraint optimization, Assignment Problems, Depreciation Accounting; Graphical representation of data; Frequency distribution and its statistical parameters; Correlation and Regression Analysis

Unit 5: Database Management System (Theory)

Theoretical background of Database Designs for Accounting and Business Database, Database Management System, Database System; Comparison of with Traditional File System; Entity Relationship Model (ER-Model); Relational Model: Creating Relationship between Tables, Concept of Keys, Fundamental ERD to Relational Mapping; Normalization of databases upto 3 Normal Forms.

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SQL and Retrieval of Information: Basic Queries in SQL; Embedded Queries in SQL; Insert, Delete and Update statements in SQL

DBMS Software: Environment; Tables; Forms; Queries; Reports; Modules; Applying DBMS in the areas of Accounting, Inventory, HRM and its accounting. Managing the data records of Employees, Suppliers and Customers.

Practical

Note: There shall be 4 credit hours (4 lectures) and 2 credit hours (4 practical lab periods) per batch.

References

- Elmasari, Ramez and Shamkant B. Navathe, *Fundamentals of Database Systems*, Pearson Education
- Jain Hem Chand and Tiwari H. N. (2019), *Computer Applications in Business*, Taxmann
- Madan Sushila, *Computer Applications in Business*, Scholar Tech Press.
- Mathur Shruti and Jain Pooja, *Computer Applications in Business*, Galgotia Publishing Company
- Sharma S.K. and Bansal Mansi, *Computer Applications in Business*, Taxmann
- Wayne Winston, *Data Analysis & Business Modeling*, PHI

Additional Sources

- Simon Benninga, *Financial Modeling*, The MIT Press

Note: The latest editions of the books should be referred.

Teaching Learning Process

The course would involve lectures supported by group discussion, real life projects, open ended projects and hands-on-practice in computer labs.

Assessment Methods

There shall be practical examination of 50 Marks (2 hours duration (External)), theory exam of 25 marks (1 hour duration) and Internal Assessment of 25 marks (Class Test-10 Marks, Work Book- 10 Marks and attendance- 5 marks).

Keywords

Computer Application in Business, Spreadsheet Solver, Database Management System, Mail Merge, Word Processing, Data Analysis, Pivot Table.


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B.Com. (Hons.): Semester-V
Paper BCH 5.4(d): BUSINESS STATISTICS

Duration: 3Hrs.**Marks: 100****Credits: 6****Course Objective**

To familiarize students with the basic statistical tools used to summarize and analyze quantitative information for business decision making.

Course Learning Outcomes

After completing the course, the student shall be able to:

- CO1: acquire a fair degree of proficiency in comprehending statistical data, processing and analysing it using descriptive statistical tools.
- CO2: gather knowledge about various probability concepts and distributions and their business applications.
- CO3: understand the relationship between two variables using concepts of correlation and regression and its use in identifying and predicting the variables.
- CO4: develop an understanding of the index numbers and their utility in daily life and stock market.
- CO5: become aware of the patterns revealed by the time series data and to use it to make predictions for the future.

Course Contents**Unit 1: Descriptive Statistics****1.1 Measures of Central Tendency**

- (a) Concept and properties of mathematical averages including arithmetic mean, geometric mean and harmonic mean.
- (b) Positional Averages including Mode and Median (and other partition values - quartiles, deciles, and percentiles) with graphic presentation.

1.2 Measures of Dispersion: absolute and relative.

Range, quartile deviation, mean deviation, standard deviation, and their coefficients; Properties of standard deviation/variance.

1.3 Moments: Calculation and significance; Skewness: Meaning and Measurement (Karl Pearson and Bowley's measures); Kurtosis.**Unit II: Probability and Probability Distributions****2.1 Theory and approaches of probability.****2.2 Probability Theorems: Addition and Multiplication (Proof not required).**

2.3 Conditional probability and Bayes' Theorem (Proof not required).

2.4 Expectation and variance of a random variable. Business Applications.

2.5 Probability distributions:

- (a) Binomial distribution: Probability distribution function, Constants, Shape, Fitting of binomial distribution.
- (b) Poisson distribution: Probability function (including Poisson approximation to binomial distribution), Constants, Fitting of Poisson distribution.
- (c) Normal distribution: Properties of Normal curve and computation of Probabilities.

Unit III: Simple Correlation and Regression Analysis

3.1 Correlation Analysis: Meaning and types of Correlation; Correlation Vs Causation; Pearson's co-efficient of correlation: computation and properties (proofs not required). Probable and standard errors; Rank correlation.

3.2 Regression Analysis: Principle of least squares and regression lines; Regression equations and estimation; Properties of regression coefficients; Relationships between Correlation and Regression coefficients; Standard Error of Estimate.

Unit IV: Index Numbers

4.1 Meaning and uses of index numbers; Construction of Index numbers: fixed and chain base, univariate and composite; Methods of constructing Index numbers: Aggregatives and average of relatives – simple and weighted.

4.2 Tests of adequacy of index numbers; Base shifting, splicing and deflating; Problems in the constructions of index numbers.

4.3 Construction and Utility of Consumer Price Indices; BSE SENSEX and NSE NIFTY.

Unit V: Time Series Analysis

5.1 Time Series Data; Components of time series; Additive and Multiplicative models.

5.2 Trend analysis; Fitting of trend line using principle of least squares – linear, second degree parabola and exponential; Shifting of Origin and Conversion of annual linear trend equation to quarterly/monthly basis and vice-versa; Moving averages.

5.3 Seasonal variations- Calculation of Seasonal Indices using Simple averages, Ratio-to-trend and Ratio-to-moving averages methods; Uses of Seasonal Indices.

Practical Lab

The students will be familiarized with software (Commonly used Statistical Packages) and the statistical and other functions contained therein related to formation of frequency distributions and calculations of averages, measures of dispersion, correlation and regression co-efficients, CPI, BSE SENSEX & NSE NIFTY. This will be evaluated through internal assessment.

References

- Anderson, Sweeney and William. *Statistics for Students of Economics and Business*. Cengage

- Gupta, S.P. and Gupta, Archana. *Statistical Methods*. Sultan Chand and Sons, New Delhi.
- Levin, Richard, David S. Rubin, Rastogi, and Siddiqui. *Statistics for Management*, Pearson Education.
- Thukral, J.K., *Business Statistics*, Taxmann Publications
- Vohra, N.D. *Business Statistics*, McGraw Hill.

Additional Resources:

- Siegel, Andrew F., *Practical Business Statistics*, McGraw Hill Publishing Co.2.
- Spiegel, M.D. *Theory and Problems of Statistics*, Schaum's Outline Series. McGraw Hill Publishing Co.

Note: Latest edition of text books may be used.

Teaching Learning Process

This course is well structured and sequenced attainment of knowledge and skills. It will constitute an important aspect of teaching learning process. The course would involve lectures, supported by group tutorials, computer lab practicals, open ended projects and self study.

Assessment Methods

The Assessment would include Theory examination of 75 Marks, Internal Assessment of 25 marks will include 10 marks for practical exam, 10 marks for class tests/assignments, and 5 marks for attendance. There shall be 4 Credit Hrs. for Lectures + one Credit Hr. (Two Practical Periods per week per batch) for Practical Lab + one credit Hr. for Tutorials (per group).

Keywords

Descriptive Statistics, Central Tendency, Dispersion, Skewness, Kurtosis, Moments, Correlation.


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B.Com. : Semester III
Paper BC 3.2: INCOME TAX LAW & PRACTICE

Duration: 3 Hrs.**Marks: 100****Credits: 6****Course Objective**

To impart knowledge of laws pertaining to levy of income tax in India and to enable students to apply the same practically.

Course Learning Outcomes

After completing the course, the student shall be able to:

CO1: understand the basic concepts in the law of income tax and determine the residential status of different persons.

CO2: identify the five heads in which income is categorised and to compute income under the heads 'Salaries' and 'Income from House Property'.

CO3: compute income under the head 'Profits and gains of business or profession', 'Capital gains' and 'Income from other sources'.

CO4: understand clubbing provisions, aggregate income after set-off and carry forward of losses, and deductions allowed under the Income Tax Act.

CO5: compute tax liability of individuals and firms and understand the provisions of filing return of income.

Course Contents**Unit I : Introduction**

Basic concepts: Income; agricultural income; person, assessee; assessment year; previous year; Gross total income; total income; maximum marginal rate of tax; Permanent Account Number (PAN); *Residential status*; Scope of total income on the basis of residential status; Exempted income under section 10.

Unit II: Computation of income under different heads-1

Income from Salaries; Income from house property.

Unit III: Computation of income under different heads-2

Profits and gains of business or profession; Capital gains; Income from other sources.

Unit IV: Total income and tax computation

Income of other persons included in assessee's total income; aggregation of income and set-off and carry forward of losses; deductions from gross total income; rebates and reliefs

Unit V: Computation of total individuals and firms

Tax liability of individual and firm; Preparation of return of income; filing of returns: manually, online filing of returns of income & TDS; provision and procedures of compulsory on-line filing of returns for specified assesses.

Note:

1. There shall be a practical examination of 20 Marks on E-filing of Income Tax Returns using a software utility tool. The student is required fill appropriate Form and generate the XML file.

2. There shall be 4 credit hours for lectures + one credit hour (Two Practical Periods per week per batch) for practical lab + one credit hour for tutorials (per group)

• Practical Examination of 20 marks (External examiner). The practical exam will be of one hour.

• Theory exam shall carry 80 marks (Including Internal Assessment of 25 Marks) of a duration of 2.5 hours

References

- Ahuja, Girish and Ravi Gupta. *Systematic Approach to Income Tax*. Bharat Law House, Delhi.
- Singhania, Vinod K. and Monica Singhania. *Students' Guide to Income Tax*, University Edition. Taxmann Publications Pvt. Ltd., New Delhi.

Additional Resources

- *Current Tax Reporter*. Current Tax Reporter, Jodhpur.
- *Income Tax Reports*. Company Law Institute of India Pvt. Ltd., Chennai.
- *Corporate Professionals Today*. Taxmann. New Delhi.

Software

- 'Excel Utility' available at incometaxindiaefiling.gov.in
- Singhania, Vinod K. *e-filing of Income Tax Returns and Computation of Tax*, Taxmann Publication Pvt. Ltd, New Delhi. Latest version

Note: Latest edition of text books and soft-wares may be used.

Teaching Learning Process

The teaching learning process would include classroom lectures to introduce students to the law pertaining to the levy of income tax. This would be supported by case studies to enable an understanding of the practical implications of the income tax law. Further, to enable the students to apply the law practically, presentations by students and practical on online filing would be included in the teaching learning process.

Assessment Methods

The assessment methods would include end semester examination, assignments and class tests. Further, practical exams may be conducted to gauge the understanding of students regarding application of relevant provisions of the income tax law.

B.Com. (Hons.): Semester-III
Paper BCH 3.2: INCOME TAX LAW AND PRACTICE

Duration: 3 Hrs.**Marks: 100****Credits: 6****Course Objective**

This course aims to impart knowledge of law pertaining to levy of income tax in India. It also aims to enable the students to apply the same practically.

Course Learning Outcomes

After completing the course, the student shall be able to:

- CO1: understand the basic concepts in the law of income tax and determine the residential status of different persons.
- CO2: identify the five heads in which income is categorised and compute income under the heads 'Salaries' and 'Income from House Property'.
- CO3: compute income under the head 'Profits and gains of business or profession', 'Capital gains' and 'Income from other sources'.
- CO4: understand clubbing provisions, aggregate income after set-off and carry forward of losses, and deductions allowed under the Income Tax Act; and further to compute taxable income and tax liability of individuals and firms.
- CO5: develop the ability to file online returns of income.

Course Contents**Unit1:Introduction**

Basic concepts: Income; Agricultural income; Person; Assessee; Assessment year; Previous year; Gross Total Income; Total income; Maximum marginal rate of tax; Permanent Account Number (PAN) *Residential status:* Scope of total income on the basis of residential status; Exempted income under section 10.

Unit 2: Computation of Income under different heads-1

Income from Salaries; Income from House Property

Unit 3: Computation of Income under different heads-2

Profits and gains of business or profession; Capital gains; Income from other sources

Unit 4: Computation of Total Income and Tax Liability

Income of other persons included in assessee's total income; Aggregation of income and set-off and carry forward of losses; Deductions from gross total income; Rebates and reliefs; Computation of total income of individuals and firms; Tax liability of an individual and a firm; Five leading cases decided by the Supreme Court

Unit 5: Preparation of Return of Income

Filing of returns: Manually, on-line filing of Returns of Income & TDS; Provision & Procedures of Compulsory on-line filing of returns for specified assesses

References

- Ahuja, Girish and Gupta Ravi. *Systematic Approach to Income Tax*. Bharat Law House, Delhi.
- Singhania, Vinod K. and Singhania Monica. *Students' Guide to Income Tax, University Edition*. Taxmann Publications Pvt. Ltd., New Delhi.

Additional Resources

Software

- Vinod Kumar Singhania, e-filing of Income Tax Returns and Computation of Tax, Taxmann Publication Pvt. Ltd, New Delhi. Latest version
- 'Excel Utility' available at incometaxindiaefiling.gov.in

Journals

- *Current Tax Reporter*. Current Tax Reporter, Jodhpur.
- *Income Tax Reports*. Company Law Institute of India Pvt. Ltd., Chennai.
- *Corporate Professionals Today*. Taxmann. New Delhi.

Note: Latest edition of readings may be used

Teaching Learning Process

The teaching learning process would include classroom lectures to introduce students to the law pertaining to the levy of income tax. This would be supported by case studies to enable an understanding of the practical implications of the income tax law. Further, to enable the students to apply the law practically, presentations by students and practicals on online filing would be included in the teaching learning process.

Assessment Methods

The assessment methods would include end semester examination, assignments and class tests. Further, practical exams may be conducted to gauge the understanding of students regarding application of relevant provisions of the income tax law.

Keywords

Assessment Year, Previous Year, Assessee Person, Finance Act , Income, Income Tax, Standard Deduction.

Note:

There shall be 4 credit hours for lectures + one credit hour (Two Practical Periods per week per batch) for practical lab + one credit hour for tutorials (per group)

- Practical Examination of 20 marks (External examiner) on E-filing of income tax return using software utility tool. The practical exam will be of one hour. The student is required to fill appropriate form and generate the XML file.
- Theory exam shall carry 80 marks (Including Internal Assessment of 25 Marks) of a duration of 2.5 hours

B.Com. (Hons.): Semester-VI
Paper BCH 6.2: GOODS & SERVICES TAX (GST) AND CUSTOMS LAW

Duration: 3 Hrs.**Marks: 100****Credits: 6****Course Objective**

To impart knowledge of principles and provisions of GST and Customs Law, the important legislation dealing with indirect tax system in India; and to enable the students to apply the same practically.

Course Learning Outcomes

After completing the course, the student shall be able to:

- CO1: connect with the genesis of goods and services tax (GST), decipher the constitutional amendment carried out to install GST in India and comprehend the composition and working of GST council.
- CO2: understand the meaning of supply under GST law, differentiate between intra-state and inter-state supply, comprehend rules related to the place of supply and compute the value of supply.
- CO3: comprehend the utilization of input tax credit, and the reverse charge mechanism of paying GST and to know the procedure for claiming refund under GST law.
- CO4: understand the provisions for registration under GST along with special provisions such as those related to anti-profiteering; avoidance of dual control; e-way bills and penalties.
- CO5: know the basic concepts of Customs Act and to compute the assessable value for charging customs duty.

Course Contents**Unit 1: Introduction**

Constitutional framework of indirect taxes before GST (taxation powers of Union & State Government); Concept of VAT: meaning, variants and methods; Major defects in the structure of indirect taxes prior to GST; Rationale for GST; Structure of GST (SGST, CGST, UTGST & IGST); GST Council; GST Network; State compensation mechanism.

Unit 2: Levy and collection of GST

Taxable event- “Supply” of goods and services; Place of supply: intra-state, inter-state, import and export; Time of supply; Valuation for GST- valuation rules; Taxation of reimbursement of expenses; Exemption from GST: Small supplies and Composition scheme; Classification of goods and services: Composite and Mixed supplies.

Unit 3: Input Tax Credit

Eligible and ineligible input tax credit; Apportionments of credit and blocked credits; Tax credit in respect of capital goods; Recovery of excess tax credit; Availability of tax credit in special circumstances; Transfer of input credit (Input Service Distribution); Payment of taxes; Refund; Doctrine of unjust enrichment; TDS; TCS; Reverse Charge Mechanism; Job work.

Unit 4: Procedures and Special Provisions under GST

Registration; Tax Invoice; Credit and debit notes; Returns; Audit in GST; Assessment: Self-assessment; Summary and scrutiny; Taxability of e-Commerce; Anti-profiteering; Avoidance of dual control; e-way bills; Zero-rated supply; Offences and penalties; Appeals.

Unit 5: Customs Law

Basic concepts; Territorial waters; High seas; Types of custom duties; Valuation; Baggage rules & exemptions.

Note: In case of any subsequent notifications/amendments regarding GST or customs law by the government, the syllabus would be updated accordingly.

References

- Ahuja, Girish, Gupta Ravi, *GST & Customs Law*.
- Babbar, Sonal, Kaur, Rasleen and Khurana, Kritika. *Goods and Service Tax (GST) and Customs Law*. Scholar Tech Press.
- Bansal, K. M., *GST & Customs Law*, Taxmann Publication.
- Gupta, S.S. , *GST- How to meet your obligations (April 2017)*, Taxmann Publications
- Gupta, S.S., *Vastu and Sevakar*, Taxmann Publications, 2017
- Sahi, Shilpi. *Concept Building Approach to Goods & Service Tax, & Customs Laws*. Cengage
- Singhania V. K , *GST & Customs Lax*, Taxmann Publication.
- Sisodia Pushpendra, *GST Law*, Bharat Law House.

Additional Resources

- *The Central Goods and Services Tax, 2017*
- *The Constitution (One hundred and First Amendment) Act, 2016*
- *The Goods and Services Tax (Compensation to States), 2017*
- *The Integrated Goods and Services Tax, 2017*
- *The Union Territory Goods and Services Tax, 2017*
- *Vastu and Sevakar Vidhan*, by Government of India

Note: Latest edition of readings may be used

Teaching Learning Process

The teaching learning process would include classroom lectures to introduce students to the provisions of GST and customs law. This would be supplemented by case studies to enable an understanding of the practical aspects of GST and customs law. In addition, class presentations and class discussion to be included in the teaching learning process.

Assessment Methods

The assessment methods would include end semester examination and assignments. Further, class tests may be conducted to gauge the understanding of students regarding GST and customs and application of relevant tax provisions.

Keywords

State Compensation Cess, Job Work Way Bill, Inter State Sppl, IGST, SGST, UTGST, CGST, GST Network



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B. Com. : Semester IV
Paper BC 4.4 (c): PERSONAL TAX PLANNING

Duration: 3 Hrs.**Marks: 100****Credits : 4****Course Objective**

To provide basic knowledge of Income Tax and its planning to students in easily comprehensible manner with a view to equip them to use the legitimate tool of planning in their economic life.

Course Learning Outcomes

After completing the course, the student shall be able to:

CO1: understand the concept of Tax Planning and relevance of residential status to plan the scope of income.

CO2: apply critical thinking and problem solving skills to minimize tax liability.

CO3: devise tax planning strategy in relation to income from house property and business.

CO4: devise tax planning strategies w.r.t. capital gains and income from other sources.

CO5: understand provisions related to clubbing and certain deductions under Income Tax Act.

Course Contents**Unit I: Concept of Tax Planning**

- (i) Meaning of tax planning, tax avoidance, tax evasion and tax management; Objectives of tax planning; Case studies relating to tax planning, tax avoidance, tax evasion and tax management.
- (ii) Tax Planning with reference to residential status: Relevance of residential status in computing taxable income; Determination of residential status of an individual, HUF, company, other persons; Relationship between residential status and incidence of tax; Case studies relating to residential status.
- (iii) Provisions relating to concept of agricultural income; Tax treatment and tax planning of agricultural income.

Unit II: Tax Planning with Reference to Salary Income

- (i) Tax planning in respect of salary income: Bonus; Fees; Commission and allowances; Valuation of perquisites; Allowances; Retirement benefits like gratuity, leave encashment, pension tax relief under Section 89 (1) (arrears of salary).
- (ii) Case studies based on designing pay package.

Unit III: Tax Planning in relation to Income from House Property and Business Income

- (i) Tax Planning in respect of self-occupied house property, let-out house property, partly let out and partly self-occupied house property; and property used for business or profession of the assessee.
- (ii) Set-off and carry forward of house property losses.
- (iii) Tax planning related to Section 80C.
- (iv) Tax Planning related to business income covering only Presumptive schemes of computing business income (Section 44AD, 44ADA, 44AE).

Unit IV: Tax Planning in relation to Capital gains and other sources

- (i) Tax planning with reference to long-term and short-term capital assets and choice of price-inflation indexation; Capital gains on equity and non-equity financial instruments.
- (ii) Tax planning in relation to gifts received from relatives and non-relatives.

Unit V: Other Areas of Tax Planning

- i) Income of others' liable for clubbing.
- ii) Deductions under Sections 80C, 80CCD(1), 80CCD(1B), 80CCD (2), 80D, 80DD, 80DDB, 80E, 80G, 80TTA, 80TTB
- iii) Rebate under Section 87A.

References

- Ahuja, G. and Gupta, R., *Corporate Tax Planning and Management*. Bharat Law House, Delhi, 2017.
- Singhania, Vinod K. and Singhania, K., *Direct Taxes Law & Practice -With special reference to Tax Planning*. Taxmann Publications Pvt. Ltd., New Delhi, 2017.

Additional Resources

- Jain, R.K., *Ayakar Vidhan avam Likhankan*, Rajeev Bansal Publications, 2017.
- Mehrotra, H.C. and Goyal, S.P., *Ayakar Vidhan avam Likhankan (Income Tax Law and Accounts)*, Sahitya Bhawan, Agra, 2016.
- Mehrotra, H.C. and Goyal, S.P., *Direct Tax including Tax Planning & Management*. Sahitya Bhawan, Agra, 2017.

Note: Latest edition of text books may be used.

Teaching Learning Process

Classroom lectures; Case studies; Presentations; Class discussion.

Assessment Methods

End semester examination; Class participation; Assignments; Class tests.

Keywords

Tax Planning, Residential status, Agricultural Income, Perquisites, Allowances.

B.Com. (Hons.): Semester-VI
Paper BCH 6.3(d): CONSUMER AFFAIRS & CUSTOMER CARE

Duration: 3 Hrs.**Marks: 100****Credits: 6****Course Objective**

This paper seeks to familiarize the students with their rights and responsibilities as a consumer within the social and legal framework of protecting the consumers in India. It also provides an understanding of the mechanism available for address of consumer complaints and the role played by different agencies in establishing product and service standards. The student should be able to comprehend the business firms' interface with consumers and the related regulatory and business environment.

Course Learning Outcomes

After completing the course, the student shall be able to:

- CO1: understand the importance of consumer buying process and to identify the ethical and legal issues in advertisements and in packaging.
- CO2: learn how to pursue the consumer rights under consumer protection act 1986.
- CO3: understand the procedure of filing a complaint.
- CO4: analyse the role of industry regulators in consumer protection.
- CO5: comprehend the hearings, enquiry and appeal provisions.

Course Contents**Unit I Introduction**

Experiencing and Voicing Dissatisfaction: Concept of Consumer, Consumer buying process and Post-Purchase behaviour, Factors affecting voicing of consumer grievances, Alternatives available to Dissatisfied Consumers: Private action and Public Action; Conciliation and Intermediation for out-of-court Redressal.

Consumer and Markets: Nature of markets: online and offline, urban and rural; Concept of Price in Retail and Wholesale, Maximum Retail Price (MRP), Fair Price, Grey Market, GST, ethical and legal aspects of misleading advertisements and deceptive packaging; Concept of Consumerism, Consumer Organisations: Formation, functioning, and their role in consumer protection. Recent Developments in consumer protection in India.

Unit II The Consumer Protection Act (CPA), 1986

Objectives and Basic Concepts: Consumer rights and UN Guidelines on consumer protection, Consumer, goods, defect in goods, spurious goods and services, service, deficiency in service, unfair trade practice, restrictive trade practice.

Organisational set-up under the Consumer Protection Act: Advisory Bodies: Consumer Protection Councils at the Central, State and District Levels; Adjudicatory Bodies: District Forums, State Commissions, National Commission: Their Composition, Powers, and Jurisdiction (Pecuniary and Territorial), Role of Supreme Court under the CPA with important case law.

Unit III: Grievance Redressal Mechanism under the CPA, 1986

Filing and handling of Complaints: Who can file a complaint; Grounds of filing a complaint; Limitation period; Procedure for filing and hearing of a complaint; Disposal of cases; Relief/Remedy available; Temporary Injunction; Enforcement of order; Appeal; Frivolous and vexatious complaints; Offences and penalties.

Leading Cases decided under Consumer Protection law by Supreme Court/National Commission: Medical Negligence; Banking; Insurance; Housing & Real Estate; Electricity Supply; Telecommunication; Education; Defective Products; Unfair Trade Practices.

Unit IV: Consumer Protection in India

Quality and Standardisation: Voluntary and Mandatory standards; Indian Standards Mark (ISI), Ag-mark, Hallmarking, Consumer Grievance Redressal under the BIS Act, 2016; ISO 10000 suite.

Industry Regulators and Consumer Complaint Redressal Mechanism

Banking Ombudsman; Insurance Ombudsman; Telecommunication: TRAI; Food Products: FSSAI; Advertising Standard Council of India; Real Estate Regulatory Authority.

Unit V: Competition Act, 2002

Objectives and basic concepts: Consumer, goods, service; Prohibition of anti-competitive agreements; Prohibition of Abuse of Dominant Position; Regulation of Combination; Composition and Powers of Competition Commission of India, Complaints and Procedures For Investigation, Hearings and Enquiry and Appeal Provisions.

Note: Unit 2 and 3 refers to the Consumer Protection Act, 1986. Any change in law would be added appropriately after the new law is notified

References

- Aggarwal V. K. (2018) *Consumer Protection: Law and Practice*, Bharat Law House, Delhi
- Kapoor Sheetal, (2019) *Consumer Affairs and Customer Care, 2nd Edition*, Galgotia Publishing Company
- Rajya Laxmi Rao, (2012) *Consumer is King, 3rd Ed.* Universal Law Publishing Company
- Sharma, Deepa, (2011) *Consumer Protection and Grievance-Redress in India (LAP LAMBERT, Germany)*

Additional Resources

- Choudhary, R. N. (2005) *Consumer Protection: Law and Practice. 5th Ed.* Bharat Law House, Delhi.
- *Consumer Voice Magazine*

- *The Bureau of Indian Standards, 2016*
- *The Competition Act, 2002*
- *The Consumer Protection Act, 1986*
- *The Food Safety and Standards Act, 2005*
- E-books :- www.consumereducation.in
- Empowering Consumers e-book, www.consumeraffairs.nic.in
- www.bis.org
- www.delhistatecommission.nic.in
- www.ncdr.nic.in

Note: Latest edition of readings may be used

Teaching Learning Process

All the relevant cases and updated important judgements alongwith e-resources shall be used in lectures to explain the different concepts on the Consumer Protection Act, 1986, method of filing a complaint, provisions of the Consumer Protection Act, 1986.

Assessment Methods

Presentation/project, Tests, quizzes and role playing techniques may be used.

Keywords

Consumer Affairs, Customer Care


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PAPER D3
LITERATURE AND CASTE
Semester 5

Course Objectives

This course aims to

- expose the student to non-hegemonic and non-canonical literary forms and expressions;
- make the student aware of a completely different literary aesthetic that a literature grounded in an engagement with caste generates;
- foreground the reality of caste, in Indian society, and to explore the way in which it has been engaged with, in the field of literature;
- discuss issues of caste, class and gender and its representation in literature;
- and
- expose the student to the rich variety of Dalit writing from various regional spaces.

Course Learning Outcomes

Understanding:

- 1) The concept of Caste
- 2) Dalit Literature
- 3) The different genres that engage with caste
- 4) How women experience caste
- 5) How caste is theorised
- 6) Dalit aesthetics

Facilitating the Achievement of Course Learning Outcomes

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
1.	Understanding concepts	Interactive discussions in small groups in Tutorial classes	Reading material together in small groups initiating discussion topics participation in discussions
2.	Expressing concepts through writing	How to think critically and write with clarity	Writing essay length assignments
3.	Demonstrating conceptual and textual understanding in tests and exams	Discussing exam questions and answering techniques	Class tests

Course content

Unit 1

Autobiography

Om Prakash Valmiki, *Joothan: A Dalit's Life*, trans. Arun Prabha Mukerjee (Kolkatta: Samya, 2003).

Unit 2

Novel

P. Sivakami, *The Grip of Change*, and author's notes, trans. P. Sivakami (New Delhi: Orient Longman, 2016).

Unit 3

Poems

a) Namdeo Dhasal, (i) 'Hunger'; (ii) 'Mandakini Patil', in *Namdeo Dhasal: Poet of the Underworld, Poems 1972–2006*, trans., Dilip Chitre (Delhi: Navayana Publishing, 2007).

b) N. D. Rajkumar, (i) 'My son wants me to buy him a toy car'; (ii) 'You my demon who delights in dancing'; (iii) 'If anyone other than our own people', in *Poems in Tamil Dalit Writing*, eds Ravikumar and Azhagarasan (OUP, 2012) pp. 15-17.

c) Manohar Mouli Biswas, (i) 'I shall go to war'; (ii) 'Valmiki', in *Poetic Rendering as Yet Unborn* (Chaturta Duniya, 2010).

d) Jayant Parmar, (i) 'The last will of a Dalit poet', in *Listen to the Flames: Texts and Readings From the Margins*, eds Tapan Basu, Indranil Acharya, A. Mangai (New Delhi: Oxford University Press, 2017).

Unit 4

Short Stories

a) Ajay Navaria, 'New Custom', trans. Laura Brueck, in *The Exercise of Freedom: An Introduction to Dalit Studies*, eds K. Sathyanarayana, Susie Tharu (New Delhi: Navayana Publishing, 2013).

b) C. Ayyappan, 'Spectral Speech', trans. V. C. Harris, *Indian Literature* 183, Jan-Feb, 1998.

c) Sanjay Kumar, 'Black Ink', trans. Raj Kumar, in *Listen to the Flames: Texts and Readings From the Margins*, eds Tapan Basu, Indranil Acharya, A. Mangai (New Delhi: Oxford University Press, 2017).

d) Jatin Bala, 'On Firm Ground', in *Survival and Other Stories: Bangla Dalit Fiction in Translation*, eds Sankar Prasad Singha and Indranil Acharya (New Delhi: Orient Blackswan, 2012).

e) Satish Chander, 'Thappu', trans. K. Suneetha Rani, in *Vibhinna: Voices from Telugu Literature*, eds Alladi Uma, M. Sridhar and K. Suneetha Rani (Sahitya Akademi, 2015).

f) Ratan Kumar Sambharia, 'Bes' in *Thunder Storm*, trans. Mridul Bhasin (Hachette, 2015), pp 125-133

Unit 5

Prose Readings

a) Paramjit S Judge, 'Existence, Identity and Beyond: Tracing the Contours of Dalit Literature in Punjabi', *Economic and Political Weekly*, July 19, 2014, Vol XLIX No 29.

b) Sharankumar Limbale, 'Dalit Literature and Aesthetics', in *Towards an Aesthetic of Dalit Literature: History, Controversies & Considerations* (Orient Longman, 2004) pp. 103-21.

c) Gauthaman, Raj, 'Dalit Culture' in *No Alphabet in Sight*, eds., K Satyanarayana and Susie Tharu, (Penguin Books, 2011) pp. 151-157.

d) Rani, Challapalli Swaroopa, 'Caste Domination Male Domination' in *Steel Nibs are Sprouting*, eds. K Satyanarayana and Susie Tharu, (Harper Collins, 2013) pp 704-709

Teaching Plan

Paper D3: Literature and Caste

Week 1 – Introduction to Paper D3: Literature and Caste

Week 2 – Unit 1 -Autobiography:Prakash Valmiki, *Joothan: A Dalit's Life*

Week 3 – Unit 1- Autobiography: (contd..)-Om Prakash Valmiki, *Joothan: A Dalit's Life*

Week 4 – Unit 2 -Novel: The Grip of Change, and Author's Notes

Week 5 – Unit 2- Novel: (contd.) The Grip of Change, and Author's Notes

Week 6 – Unit 3- Poems:

Dhasal, (i) 'Hunger'; (ii) 'Mandakini Patil'

Rajkumar (i) 'My son wants me to buy him a toy car' (ii) 'You my demon who delights in dancing

Week 7 – Unit 3- Poems (contd.):

Biswas (i) 'I shall Go to war' (ii) 'Valmiki'

Parmar (i) 'The Last Will of a Dalit Poet'

Week 8 – Unit 4 – Short Stories

- Navaria, 'New Custom'
 Ayyappan, 'Spectral Speech'
- Week 9 -- Unit 4 - Short Stories (contd.)
 Kumar, 'Black Ink'
 Bala, 'On Firm Ground'
- Week 10 - Unit 4 - Short Stories (contd.)
 Chander, 'Thappu',
 Sambharia, 'Bes'
- Week 11 – Limbale, 'Dalit Literature and Aesthetics', in Towards an Aesthetic of
 Dalit Literature, pp. 103-21.
- Week 12 – Unit 5 - Prose Readings (contd.)
 Judge, 'Existence, Identity and Beyond: Tracing the Contours of Dalit Literature in
 Punjabi', Economic and Political Weekly, July 19, 2014, Vol XLIX No 29.
- Week 13 - --Unit 5 - Prose Readings (contd.)
 (i) Gauthaman, Raj, 'Dalit Culture' in *No Alphabet in Sight*, eds., K Satyanarayana and
 Susie Tharu, (Penguin Books, 2011) pp. 151-157.
 (ii) Rani, Challapalli Swaroopa, 'Caste Domination Male Domination' in *Steel Nibs
 are Sprouting*, eds. K Satyanarayana and Susie Tharu, (Harper Collins, 2013)pp 704-
 709
- Week 14 – – Concluding lectures; exam issues, etc.

Keywords

Caste
 Caste Hierarchy
 Caste discrimination
 Dalit
 Dalit Literature
 Dalit Aesthetics
 Dalit Women
 Protest
 Resistance


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BMATH307: Multivariate Calculus

Total Marks: 150 (Theory: 75, Internal Assessment: 25 and Practical: 50)

Workload: 4 Lectures, 4 Practicals (per week) **Credits:** 6 (4+2)

Duration: 14 Weeks (56 Hrs. Theory + 56 Hrs. Practical) **Examination:** 3 Hrs.

Course Objectives: To understand the extension of the studies of single variable differential and integral calculus to functions of two or more independent variables. Also, the emphasis will be on the use of Computer Algebra Systems by which these concepts may be analyzed and visualized to have a better understanding. This course will facilitate to become aware of applications of multivariable calculus tools in physics, economics, optimization, and understanding the architecture of curves and surfaces in plane and space etc.

Course Learning Outcomes: This course will enable the students to:

- Learn the conceptual variations when advancing in calculus from one variable to multivariable discussion.
- Understand the maximization and minimization of multivariable functions subject to the given constraints on variables.
- Learn about inter-relationship amongst the line integral, double and triple integral formulations.
- Familiarize with Green's, Stokes' and Gauss divergence theorems.

Unit 1: Calculus of Functions of Several Variables

Functions of several variables, Level curves and surfaces, Limits and continuity, Partial differentiation, Higher order partial derivative, Tangent planes, Total differential and differentiability, Chain rule, Directional derivatives, The gradient, Maximal and normal property of the gradient, Tangent planes and normal lines.

Unit 2: Extrema of Functions of Two Variables and Properties of Vector Field

Extrema of functions of two variables, Method of Lagrange multipliers, Constrained optimization problems; Definition of vector field, Divergence and curl.

Unit 3: Double and Triple Integrals

Double integration over rectangular and nonrectangular regions, Double integrals in polar co-ordinates, Triple integral over a parallelepiped and solid regions, Volume by triple integrals, Triple integration in cylindrical and spherical coordinates, Change of variables in double and triple integrals.

Unit 4: Green's, Stokes' and Gauss Divergence Theorem

Line integrals, Applications of line integrals: Mass and Work, Fundamental theorem for line integrals, Conservative vector fields, Green's theorem, Area as a line integral, Surface integrals, Stokes' theorem, Gauss divergence theorem.

Reference:

1. Strauss, Monty J., Bradley, Gerald L., & Smith, Karl J. (2007). *Calculus* (3rd ed.). Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). Delhi. Indian Reprint 2011.

Additional Reading:

- i. Marsden, J. E., Tromba, A., & Weinstein, A. (2004). *Basic Multivariable Calculus*. Springer (SIE). First Indian Reprint.

Practical / Lab work to be performed in Computer Lab.

List of practicals to be done using Mathematica / MATLAB / Maple/Maxima/Scilab, etc.

1. Let $f(x)$ be any function and L be any real number. For given a and $\varepsilon > 0$ find a $\delta > 0$ such that for all x satisfying $0 < |x - a| < \delta$, the inequality $0 < |f(x) - l| < \varepsilon$ holds. For example:
 - (i) $f(x) = x + 1, L = 5, a = 4, \varepsilon = 0.01$.
 - (ii) $f(x) = \sqrt{x + 1}, L = 1, a = 4, \varepsilon = 0.1$.
 - (iii) $f(x) = x^2, L = 4, a = -2, \varepsilon = 0.5$.
 - (iv) $f(x) = \frac{1}{x}, L = -1, a = -1, \varepsilon = 0.1$.
2. Discuss the limit of the following functions when x tends to 0:

$$\pm \frac{1}{x}, \sin\left(\frac{1}{x}\right), \cos\left(\frac{1}{x}\right), x \sin\left(\frac{1}{x}\right), x \cos\left(\frac{1}{x}\right), x^2 \sin\left(\frac{1}{x}\right),$$

$$\frac{1}{x^n} \ (n \in \mathbb{N}), [x] \text{ greatest integer function}, \frac{1}{x} \sin\left(\frac{1}{x}\right).$$
3. Discuss the limit of the following functions when x tends to infinity:

$$e^{\pm \frac{1}{x}}, \sin\left(\frac{1}{x}\right), \frac{1}{x} e^{\pm x}, \frac{x}{x+1}, x^2 \sin\left(\frac{1}{x}\right), \frac{ax+b}{cx^2+dx+e} \ (a \neq 0, c \neq 0).$$
4. Discuss the continuity of the functions at $x = 0$ in the Practical 2.
5. Illustrate the geometric meaning of Rolle's theorem of the following functions on the given interval:
 - (i) $x^3 - 4x$ on $[-2, 2]$; (ii) $(x - 3)^4(x - 5)^3$ on $[3, 5]$ etc.
6. Illustrate the geometric meaning of Lagrange's mean value theorem of the following functions on the given interval:
 - (i) $\log x$ on $[1/2, 2]$; (ii) $x(x - 1)(x - 2)$ on $[0, 1/2]$; (iii) $2x^2 - 7x + 10$ on $[2, 5]$ etc.
7. Draw the following surfaces and find level curves at the given heights:
 - (i) $f(x, y) = 10 - x^2 - y^2; z = 1, z = 6, z = 9$.
 - (ii) $f(x, y) = x^2 + y^2; z = 1, z = 6, z = 9$.
 - (iii) $f(x, y) = x^3 - y; z = 1, z = 6$.
 - (iv) $f(x, y) = x^2 + \frac{y^2}{4}; z = 1, z = 5, z = 8$.
 - (v) $f(x, y) = 4x^2 + y^2; z = 0, z = 6, z = 9$.
8. Draw the following surfaces and discuss whether limit exists or not as (x, y) approaches to the given points. Find the limit, if it exists:
 - (i) $f(x, y) = \frac{x+y}{x-y}; (x, y) \rightarrow (0,0)$ and $(x, y) \rightarrow (1,3)$.
 - (ii) $f(x, y) = \frac{x-y}{\sqrt{x^2+y^2}}; (x, y) \rightarrow (0,0)$ and $(x, y) \rightarrow (2,1)$.
 - (iii) $f(x, y) = (x + y)e^{xy}; (x, y) \rightarrow (1,1)$ and $(x, y) \rightarrow (1,0)$.
 - (iv) $f(x, y) = e^{xy}; (x, y) \rightarrow (0,0)$ and $(x, y) \rightarrow (1,0)$.
 - (v) $f(x, y) = \frac{x+y^2}{x^2+y^2}; (x, y) \rightarrow (0,0)$.
 - (vi) $f(x, y) = \frac{x^2-y^2}{x^2+y^2}; (x, y) \rightarrow (0,0)$ and $(x, y) \rightarrow (2,1)$.
9. Draw the tangent plane to the following surfaces at the given point:
 - (i) $f(x, y) = \sqrt{x^2 + y^2}$ at $(3,1, \sqrt{10})$.

- (ii) $f(x, y) = 10 - x^2 - y^2$ at $(2, 2, 2)$.
 (iii) $x^2 + y^2 + z^2 = 9$ at $(3, 0, 0)$.
 (iii) $z = \tan^{-1}x$ at $(1, \sqrt{3}, \frac{\pi}{3})$ and $(2, 2, \frac{\pi}{4})$.
 (iii) $z = \log|x + y^2|$ at $(-3, -2, 0)$.
10. Use an incremental approximation to estimate the following functions at the given point and compare it with calculated value:
 (i) $f(x, y) = 3x^4 + 2y^4$ at $(1.01, 2.03)$.
 (ii) $f(x, y) = x^5 - 2y^3$ at $(0.98, 1.03)$.
 (iii) $f(x, y) = e^{xy}$ at $(1.01, 0.98)$.
11. Find critical points and identify relative maxima, relative minima or saddle points to the following surfaces, if it exists:
 (i) $z = x^2 + y^2$; (ii) $z = 1 - x^2 - y^2$; (iii) $z = y^2 - x^2$; (iv) $z = x^2y^4$.
12. Draw the following regions D and check whether these regions are of Type I or Type II:
 (i) $D = \{(x, y): 0 \leq x \leq 2, 1 \leq y \leq e^x\}$.
 (ii) $D = \{(x, y): \log y \leq x \leq 2, 1 \leq y \leq e^2\}$.
 (iii) $D = \{(x, y): 0 \leq x \leq 1, x^3 \leq y \leq 1\}$.
 (iv) The region D bounded by $y = x^2 - 2$ and the line $y = x$.
 (v) $D = \{(x, y): 0 \leq x \leq \frac{\pi}{4}, \sin x \leq y \leq \cos x\}$.

Teaching Plan (Theory of BMATH307: Multivariate Calculus):

Week 1: Definition of functions of several variables, Graphs of functions of two variables – Level curves and surfaces, Limits and continuity of functions of two variables.

[1] Sections 11.1 and 11.2.

Week 2: Partial differentiation, and partial derivative as slope and rate, Higher order partial derivatives. Tangent planes, incremental approximation, Total differential.

[1] Chapter 11 (Sections 11.3 and 11.4).

Week 3: Differentiability, Chain rule for one parameter, Two and three independent parameters.

[1] Chapter 11 (Sections 11.4 and 11.5).

Week 4: Directional derivatives, The gradient, Maximal and normal property of the gradient, Tangent and normal lines.

[1] Chapter 11 (Section 11.6).

Week 5: First and second partial derivative tests for relative extrema of functions of two variables, and absolute extrema of continuous functions.

[1] Chapter 11 [Section 11.7 (up to page 605)].

Week 6: Lagrange multipliers method for optimization problems with one constraint, Definition of vector field, Divergence and curl.

[1] Sections 11.8 (Pages 610-614) and 13.1.

Week 7: Double integration over rectangular and nonrectangular regions.

[1] Sections 12.1 and 12.2.

Week 8: Double integrals in polar co-ordinates, and triple integral over a parallelepiped.

[1] Chapter 12 (Sections 12.3 and 12.4).

Week 9: Triple integral over solid regions, Volume by triple integrals, and triple integration in cylindrical coordinates.

[1] Chapter 12 (Sections 12.4 and 12.5).

Week 10: Triple integration in spherical coordinates, Change of variables in double and triple integrals.

[1] Chapter 12 (Sections 12.5 and 12.6).

Week 11: Line integrals and its properties, applications of line integrals: mass and work.

[1] Chapter 13 (Section 13.2).

Week 12: Fundamental theorem for line integrals, Conservative vector fields and path independence.
[1] Chapter 13 (Section 13.3).

Week 13: Green's theorem for simply connected region, Area as a line integral, Definition of surface integrals.

[1] Chapter 13 [Sections 13.4 (Pages 712 to 716), 13.5 (Pages 723 to 726)].

Week 14: Stokes' theorem and the divergence theorem.

[1] Chapter 13 [Sections 13.6 (Pages 733 to 737), 13.7 (Pages 742 to 745)].

Note. To improve the problem solving ability, for similar kind of examples based upon the above contents, the Additional Reading (i) may be consulted.

Facilitating the Achievement of Course Learning Outcomes

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
1.	Learn the conceptual variations when advancing in calculus from one variable to multivariable discussion.	(i) Each topic to be explained with illustrations.	• Presentations and class discussions. • Assignments and class tests. • Mid-term examinations. • Practical and viva-voce examinations. • End-term examinations.
2.	Understand the maximization and minimization of multivariable functions subject to the given constraints on variables.	(ii) Students to be encouraged to discover the relevant concepts.	
3.	Learn about inter-relationship amongst the line integral, double and triple integral formulations.	(iii) Students to be given homework/assignments.	
4.	Familiarize with Green's, Stokes' and Gauss divergence theorems.	(iv) Discuss and solve the theoretical and practical problems in the class.	
		(v) Students to be encouraged to apply concepts to real world problems.	

Keywords: Directional derivatives, Double integral, Gauss divergence theorem, Green's theorem, Lagrange's multipliers, Level curves, Stokes' theorem, Volume integral, Vector field.


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Semester-IV

BMATH408: Partial Differential Equations

Total Marks: 150 (Theory: 75, Internal Assessment: 25 and Practical: 50)

Workload: 4 Lectures, 4 Practicals (per week) **Credits:** 6 (4+2)

Duration: 14 Weeks (56 Hrs. Theory + 56 Hrs. Practical) **Examination:** 3 Hrs.

Course Objectives: The main objectives of this course are to teach students to form and solve partial differential equations and use them in solving some physical problems.

Course Learning Outcomes: The course will enable the students to:

- i) Formulate, classify and transform first order PDEs into canonical form.
- ii) Learn about method of characteristics and separation of variables to solve first order PDE's.
- iii) Classify and solve second order linear PDEs.
- iv) Learn about Cauchy problem for second order PDE and homogeneous and non-homogeneous wave equations.
- v) Apply the method of separation of variables for solving many well-known second order PDEs.

Unit 1: First Order PDE and Method of Characteristics

Introduction, Classification, Construction and geometrical interpretation of first order partial differential equations (PDE), Method of characteristic and general solution of first order PDE, Canonical form of first order PDE, Method of separation of variables for first order PDE.

Unit 2: Mathematical Models and Classification of Second Order Linear PDE

Gravitational potential, Conservation laws and Burger's equations, Classification of second order PDE, Reduction to canonical forms, Equations with constant coefficients, General solution.

Unit 3: The Cauchy Problem and Wave Equations

Mathematical modeling of vibrating string and vibrating membrane, Cauchy problem for second order PDE, Homogeneous wave equation, Initial boundary value problems, Non-homogeneous boundary conditions, Finite strings with fixed ends, Non-homogeneous wave equation, Goursat problem.

Unit 4: Method of Separation of Variables

Method of separation of variables for second order PDE, Vibrating string problem, Existence and uniqueness of solution of vibrating string problem, Heat conduction problem, Existence and uniqueness of solution of heat conduction problem, Non-homogeneous problem.

Reference:

1. Myint-U, Tyn & Debnath, Lokenath. (2007). *Linear Partial Differential Equation for Scientists and Engineers* (4th ed.). Springer, Third Indian Reprint, 2013.

Additional Readings:

- i. Sneddon, I. N. (2006). *Elements of Partial Differential Equations*, Dover Publications. Indian Reprint.
- ii. Stavroulakis, Ioannis P & Tersian, Stepan A. (2004). *Partial Differential Equations: An Introduction with Mathematica and MAPLE* (2nd ed.). World Scientific.

Practical / Lab work to be performed in a Computer Lab:

Modeling of the following similar problems using Mathematica/MATLAB/Maple/Maxima/Scilab etc.

1. Solution of Cauchy problem for first order PDE.
2. Plotting the characteristics for the first order PDE.
3. Plot the integral surfaces of a given first order PDE with initial data.
4. Solution of wave equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$ for any two of the following associated conditions:
 - (i) $u(x, 0) = \phi(x)$, $u_t(x, 0) = \psi(x)$, $x \in \mathbb{R}$, $t > 0$.
 - (ii) $u(x, 0) = \phi(x)$, $u_t(x, 0) = \psi(x)$, $u(0, t) = 0$, $x > 0$, $t > 0$.
 - (iii) $u(x, 0) = \phi(x)$, $u_t(x, 0) = \psi(x)$, $u_x(0, t) = 0$, $x > 0$, $t > 0$.
 - (iv) $u(x, 0) = \phi(x)$, $u_t(x, 0) = \psi(x)$, $u(0, t) = 0$, $u(l, t) = 0$, $0 < x < l$, $t > 0$.
5. Solution of one-dimensional heat equation $u_t = k u_{xx}$, for a homogeneous rod of length l . That is - solve the IBVP:

$$\begin{aligned} u_t &= k u_{xx}, & 0 < x < l, & \quad t > 0, \\ u(0, t) &= 0, & u(l, t) &= 0, & \quad t \geq 0, \\ u(0, t) &= f(x), & 0 \leq x \leq l. \end{aligned}$$

6. Solving systems of ordinary differential equations.
7. Draw the following sequence of functions on the given interval and discuss the pointwise convergence:
 - (i) $f_n(x) = x^n$ for $x \in \mathbb{R}$,
 - (ii) $f_n(x) = \frac{x}{n}$ for $x \in \mathbb{R}$,
 - (iii) $f_n(x) = \frac{x^2 + nx}{n}$ for $x \in \mathbb{R}$,
 - (iv) $f_n(x) = \frac{\sin nx + n}{n}$ for $x \in \mathbb{R}$
 - (v) $f_n(x) = \frac{x}{x+n}$ for $x \in \mathbb{R}$, $x \geq 0$,
 - (vi) $f_n(x) = \frac{nx}{1+n^2x^2}$ for $x \in \mathbb{R}$
 - (vii) $f_n(x) = \frac{nx}{1+nx}$ for $x \in \mathbb{R}$, $x \geq 0$,
 - (viii) $f_n(x) = \frac{x^n}{1+x^n}$ for $x \in \mathbb{R}$, $x \geq 0$
8. Discuss the uniform convergence of sequence of functions (i) to (viii) given above in (7).

Teaching Plan (Theory of BMATH408: Partial Differential Equations):

Week 1: Introduction, Classification, Construction of first order partial differential equations (PDE).

[1] Chapter 2 (Sections 2.1 to 2.3).

Week 2: Method of characteristics and general solution of first order PDE.

[1] Chapter 2 (Sections 2.4 and 2.5).

Week 3: Canonical form of first order PDE, Method of separation of variables for first order PDE.

[1] Chapter 2 (Sections 2.6 and 2.7).

Week 4: The vibrating string, Vibrating membrane, Gravitational potential, Conservation laws.

[1] Chapter 3 (Sections 3.1 to 3.3, 3.5 and 3.6).

Weeks 5 and 6: Reduction to canonical forms, Equations with constant coefficients, General solution.

[1] Chapter 4 (Sections 4.1 to 4.5).

Weeks 7 and 8: The Cauchy problem for second order PDE, Homogeneous wave equation.

[1] Chapter 5 (Sections 5.1, 5.3 and 5.4).

Weeks 9 and 10: Initial boundary value problem, Non-homogeneous boundary conditions, Finite string with fixed ends, Non-homogeneous wave equation, Goursat problem.

[1] Chapter 5 (Sections 5.5 to 5. and 5.9).

Weeks 11 and 12: Method of separation of variables for second order PDE, Vibrating string problem.

[1] Chapter 7 (Sections 7.1 to 7.3).

Weeks 13 and 14: Existence (omit proof) and uniqueness of vibrating string problem. Heat conduction problem. Existence (omit proof) and uniqueness of the solution of heat conduction problem. Non-homogeneous problem.

[1] Chapter 7 (Sections 7.4 to 7.6 and 7.8).

Facilitating the Achievement of Course Learning Outcomes

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
1.	Formulate, classify and transform first order PDEs into canonical form. Learn about method of characteristics and separation of variables to solve first order PDEs.	(i) Each topic to be explained with examples. (ii) Students to be encouraged to discover the relevant concepts.	• Presentations and class discussions. • Assignments and class tests. • Mid-term examinations. • Practical and viva-voce examinations. • End-term examinations.
2.	Classify and solve second order linear PDEs.	(iii) Students to be given homework/ assignments.	
3.	Learn about Cauchy problem for second order PDE and homogeneous and non-homogeneous wave equations.	(iv) Discuss and solve the theoretical and practical problems in the class.	
4.	Apply the method of separation of variables for solving many well-known second order PDEs.	(v) Students to be encouraged to apply concepts to real world problems.	

Keywords: Cauchy problem, Characteristics, Conservation laws and Burger's equations, Heat equation, Vibrating membrane, Wave equation.


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Semester-VI

BMATH613: Complex Analysis

Total Marks: 150 (Theory: 75, Internal Assessment: 25 and Practical: 50)

Workload: 4 Lectures, 4 Practicals (per week), **Credits:** 6 (4+2)

Duration: 14 Weeks (56 Hrs. Theory + 56 Hrs. Practical) **Examination:** 3 Hrs.

Course Objectives: This course aims to introduce the basic ideas of analysis for complex functions in complex variables with visualization through relevant practicals. Emphasis has been laid on Cauchy's theorems, series expansions and calculation of residues.

Course Learning Outcomes: The completion of the course will enable the students to:

- i) Learn the significance of differentiability of complex functions leading to the understanding of Cauchy–Riemann equations.
- ii) Learn some elementary functions and evaluate the contour integrals.
- iii) Understand the role of Cauchy–Goursat theorem and the Cauchy integral formula.
- iv) Expand some simple functions as their Taylor and Laurent series, classify the nature of singularities, find residues and apply Cauchy Residue theorem to evaluate integrals.

Unit 1: Analytic Functions and Cauchy–Riemann Equations

Functions of complex variable, Mappings; Mappings by the exponential function, Limits, Theorems on limits, Limits involving the point at infinity, Continuity, Derivatives, Differentiation formulae, Cauchy–Riemann equations, Sufficient conditions for differentiability; Analytic functions and their examples.

Unit 2: Elementary Functions and Integrals

Exponential function, Logarithmic function, Branches and derivatives of logarithms, Trigonometric function, Derivatives of functions, Definite integrals of functions, Contours, Contour integrals and its examples, Upper bounds for moduli of contour integrals,

Unit 3: Cauchy's Theorems and Fundamental Theorem of Algebra

Antiderivatives, Proof of antiderivative theorem, Cauchy–Goursat theorem, Cauchy integral formula; An extension of Cauchy integral formula, Consequences of Cauchy integral formula, Liouville's theorem and the fundamental theorem of algebra.

Unit 4: Series and Residues

Convergence of sequences and series, Taylor series and its examples; Laurent series and its examples, Absolute and uniform convergence of power series, Uniqueness of series representations of power series, Isolated singular points, Residues, Cauchy's residue theorem, residue at infinity; Types of isolated singular points, Residues at poles and its examples.

Reference:

1. Brown, James Ward, & Churchill, Ruel V. (2014). *Complex Variables and Applications* (9th ed.). McGraw-Hill Education. New York.

Additional Readings:

- i. Bak, Joseph & Newman, Donald J. (2010). *Complex Analysis* (3rd ed.). Undergraduate Texts in Mathematics, Springer. New York.
- ii. Zills, Dennis G., & Shanahan, Patrick D. (2003). *A First Course in Complex Analysis with Applications*. Jones & Bartlett Publishers, Inc.
- iii. Mathews, John H., & Howell, Russell W. (2012). *Complex Analysis for Mathematics and Engineering* (6th ed.). Jones & Bartlett Learning. Narosa, Delhi. Indian Edition.

Practical / Lab work to be performed in Computer Lab:

Modeling of the following similar problems using Mathematica/Maple/MATLAB/Maxima/Scilab etc.

1. Make a geometric plot to show that the n^{th} roots of unity are equally spaced points that lie on the unit circle $C_1(0) = \{z : |z| = 1\}$ and form the vertices of a regular polygon with n sides, for $n = 4, 5, 6, 7, 8$.
2. Find all the solutions of the equation $z^3 = 8i$ and represent these geometrically.
3. Write parametric equations and make a parametric plot for an ellipse centered at the origin with horizontal major axis of 4 units and vertical minor axis of 2 units. Show the effect of rotation of this ellipse by an angle of $\frac{\pi}{6}$ radians and shifting of the centre from (0,0) to (2,1), by making a parametric plot.
4. Show that the image of the open disk $D_1(-1 - i) = \{z : |z + 1 + i| < 1\}$ under the linear transformation $w = f(z) = (3 - 4i)z + 6 + 2i$ is the open disk:
 $D_5(-1 + 3i) = \{w : |w + 1 - 3i| < 5\}$.
5. Show that the image of the right half plane $\text{Re } z = x > 1$ under the linear transformation $w = (-1 + i)z - 2 + 3i$ is the half plane $v > u + 7$, where $u = \text{Re}(w)$, etc. Plot the map.
6. Show that the image of the right half plane $A = \{z : \text{Re } z \geq \frac{1}{2}\}$ under the mapping $w = f(z) = \frac{1}{z}$ is the closed disk $\overline{D_1(1)} = \{w : |w - 1| \leq 1\}$ in the w -plane.
7. Make a plot of the vertical lines $x = a$, for $a = -1, -\frac{1}{2}, \frac{1}{2}, 1$ and the horizontal lines $y = b$, for $b = -1, -\frac{1}{2}, \frac{1}{2}, 1$. Find the plot of this grid under the mapping $w = f(z) = \frac{1}{z}$.
8. Find a parametrization of the polygonal path $C = C_1 + C_2 + C_3$ from $-1 + i$ to $3 - i$, where C_1 is the line from: $-1 + i$ to -1 , C_2 is the line from: -1 to $1 + i$ and C_3 is the line from $1 + i$ to $3 - i$. Make a plot of this path.
9. Plot the line segment 'L' joining the point $A = 0$ to $B = 2 + \frac{\pi}{4}i$ and give an exact calculation of $\int_L e^z dz$.
10. Plot the semicircle 'C' with radius 1 centered at $z = 2$ and evaluate the contour integral $\int_C \frac{1}{z-2} dz$.
11. Show that $\int_{C_1} z dz = \int_{C_2} z dz = 4 + 2i$ where C_1 is the line segment from $-1 - i$ to $3 + i$ and C_2 is the portion of the parabola $x = y^2 + 2y$ joining $-1 - i$ to $3 + i$. Make plots of two contours C_1 and C_2 joining $-1 - i$ to $3 + i$.

12. Use ML inequality to show that $\left| \int_C \frac{1}{z^2+1} dz \right| \leq \frac{1}{2\sqrt{5}}$, where C is the straight line segment from 2 to $2+i$. While solving, represent the distance from the point z to the points i and $-i$, respectively, i.e. $|z-i|$ and $|z+i|$ on the complex plane $\mathbb{C}$.
13. Show that $\int_C \frac{dz}{2z^{1/2}}$, where $z^{1/2}$ is the principal branch of the square root function and C is the line segment joining 4 to $8+6i$. Also plot the path of integration.
14. Find and plot three different Laurent series representations for the function $f(z) = \frac{3}{2+z-z^2}$, involving powers of z .
15. Locate the poles of $f(z) = \frac{1}{5z^4+26z^2+5}$ and specify their order.
16. Locate the zeros and poles of $g(z) = \frac{\pi \cot(\pi z)}{z^2}$ and determine their order. Also justify that $\text{Res}(g, 0) = -\pi^2/3$.
17. Evaluate $\int_{C_1^+(0)} \exp\left(\frac{2}{z}\right) dz$, where $C_1^+(0)$ denotes the circle $\{z : |z| = 1\}$ with positive orientation. Similarly evaluate $\int_{C_1^+(0)} \frac{1}{z^4+z^3-2z^2} dz$.

Note: For practicals: Sample materials of files in the form Mathematica/Maple 2011.zip, www.jblearning.com/catalog/9781449604455/.

Teaching Plan (Theory of BMATH613: Complex Analysis):

Week 1: Functions of complex variable, Mappings, Mappings by the exponential function.

[1] Chapter 2 (Sections 12 to 14).

Week 2: Limits, Theorems on limits, Limits involving the point at infinity, Continuity.

[1] Chapter 2 (Sections 15 to 18).

Week 3: Derivatives, Differentiation formulae, Cauchy-Riemann equations, Sufficient conditions for differentiability.

[1] Chapter 2 (Sections 19 to 22).

Week 4: Analytic functions, Examples of analytic functions, Exponential function.

[1] Chapter 2 (Sections 24 and 25) and Chapter 3 (Section 29).

Week 5: Logarithmic function, Branches and Derivatives of Logarithms, Trigonometric functions.

[1] Chapter 3 (Sections 30, 31 and 34).

Week 6: Derivatives of functions, Definite integrals of functions, Contours.

[1] Chapter 4 (Sections 37 to 39).

Week 7: Contour integrals and its examples, upper bounds for moduli of contour integrals.

[1] Chapter 4 (Sections 40, 41 and 43).

Week 8: Antiderivatives, proof of antiderivative theorem.

[1] Chapter 4 (Sections 44 and 45).

Week 9: State Cauchy–Goursat theorem, Cauchy integral formula.

[1] Chapter 4 (Sections 46 and 50).

Week 10: An extension of Cauchy integral formula, Consequences of Cauchy integral formula, Liouville's theorem and the fundamental theorem of algebra.

[1] Chapter 4 (Sections 51 to 53).

Week 11: Convergence of sequences, Convergence of series, Taylor series, proof of Taylor's theorem, Examples.

[1] Chapter 5 (Sections 55 to 59).

Week 12: Laurent series and its examples, Absolute and uniform convergence of power series, uniqueness of series representations of power series.

[1] Chapter 5 (Sections 60, 62, 63 and 66).

Week 13: Isolated singular points, Residues, Cauchy's residue theorem, Residue at infinity.

[1]: Chapter 6 (Sections 68 to 71).

Week 14: Types of isolated singular points, Residues at poles and its examples.

[1] Chapter 6 (Sections 72 to 74).

Facilitating the Achievement of Course Learning Outcomes

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
1.	Learn the significance of differentiability of complex functions leading to the understanding of Cauchy–Riemann equations.	(i) Each topic to be explained with illustrations. (ii) Students to be encouraged to discover the relevant concepts. (iii) Students to be given homework/assignments. (iv) Discuss and solve the theoretical and practical problems in the class. (v) Students be encouraged to apply concepts to real world problems.	• Presentations and class discussions. • Assignments and class tests. • Student presentations. • Mid-term examinations. • Practical and viva-voce examinations. • End-term examinations.
2.	Learn some elementary functions and evaluate the contour integrals.		
3.	Understand the role of Cauchy–Goursat theorem and the Cauchy integral formula.		
4.	Expand some simple functions as their Taylor and Laurent series, classify the nature of singularities, find residues and apply Cauchy Residue theorem to evaluate integrals.		

Keywords: Analytic functions, Antiderivatives, Cauchy–Riemann equations, Cauchy–Goursat theorem, Cauchy integral formula, Cauchy's inequality, Cauchy's residue theorem, Closed contour, Contour integrals, Fundamental theorem of algebra, Liouville's theorem, Morera's theorem, Poles, Regions in complex plane, Residue, Singular points, Taylor's and Laurent's series.


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DSE-1 (iii): C++ Programming for Mathematics

Total Marks: 150 (Theory: 75 + Internal Assessment: 25 + Practical: 50)

Workload: 4 Lectures, 4 Periods practical (per week) **Credits:** 6 (4+2)

Duration: 14 Weeks (56 Hrs. Theory + 56 Hrs. practical) **Examination:** 3 Hrs.

Course Objectives: This course introduces C++ programming in the idiom and context of mathematics and imparts a starting orientation using available mathematical libraries, and their applications.

Course Learning Outcomes: After completion of this paper, student will be able to:

- i) Understand and apply the programming concepts of C++ which is important to mathematical investigation and problem solving.
- ii) Learn about structured data-types in C++ and learn about applications in factorization of an integer and understanding Cartesian geometry and Pythagorean triples.
- iii) Use of containers and templates in various applications in algebra.
- iv) Use mathematical libraries for computational objectives.
- v) Represent the outputs of programs visually in terms of well formatted text and plots.

Unit 1: C++ Essentials

Fundamentals of programming, Organization of logic flow in stored program model of computation, C++ as a general purpose programming language, Structure of a C++ program, Common compilers and IDE's, Basic data-types, Variables and literals in C++, Operators, Expressions, Evaluation precedence, and Type compatibility. Outline of program development in C++, Debugging and testing; Applications: Greatest common divisor, and Random number generation.

Unit 2: Working with Structured Data

Structured data-types in C++, Arrays and manipulating data in arrays with applications in factorization of an integer and finding Euler's totient; Objects and classes: Information hiding, Modularity, Constructors and Destructors, Methods and Polymorphism; Applications: Cartesian geometry using points (2 & 3-dimensional), and Pythagorean triples.

Unit 3: Working with Containers and Templates

Containers and Template Libraries: Sets, Iterators, Multisets, Vectors, Maps, Lists, Stacks and Queues; Applications: Basic set algebra, Modulo arithmetic, Permutations, and Polynomials.

Unit 4: Using Mathematical Libraries and Packages

Arbitrary precision arithmetic using the GMP package; Linear algebra: Two-dimensional arrays in C++ with applications in finding eigenvalues, eigenvectors, rank, nullity, and solving system of linear equations in matrices; Features of C++ for input/output and visualization: strings, streams, formatting method; Processing files in a batch, Command-line arguments, Visualization packages and their use in plots.

Reference:

1. Scheinerman, Edward (2006). *C++ for Mathematicians: An Introduction for Students and Professionals*. Chapman & Hall/CRC. Taylor & Francis Group, LLC.

Additional Readings:

- i. Dale, Nell & Weems, Chip (2013). *Programming and Problem Solving with C++* (6th ed.). Comprehensive Edition. Jones & Bartlett Learning.
- ii. Gottschling, Peter (2016). *Discovering Modern C++: An Intensive Course for Scientists, Engineers, and Programmers*. Addison-Wesley. Pearson Education, Inc.
- iii. Josuttis, Nicolai M. (2012). *The C++ Standard Library: A Tutorial and Reference* (2nd ed.). Addison-Wesley. Pearson Education, Inc.
- iv. Lippman, Stanley B. (2000). *Essential C++*. Addison-Wesley.
- v. Stroustrup, Bjarne (2013). *The C++ Programming Language* (4th ed.). Addison-Wesley.

Practical / Lab work to be performed in Computer Lab:

A: Preparatory (Practical Sessions: 8 Hrs.)

1. Setting up of C++ programming environment on Linux/Windows/Mac-OS; gcc/g++/mingw/cc, Program-development methodology and use IDE's or other tools.
2. Demonstration of sample programs for
 - (i) "Hello World"
 - (ii) Sum of an arithmetic progression.
 - (iii) Value of $\sin x$ using series expansion.
3. Finding/demonstrating:
 - (i) Machine epsilon.
 - (ii) Integer and float overflow/underflow.
 - (iii) Iteration and selection based logic.

(provide a list of 8-10 problems suitable to learners needs)

B: Evaluative:

Set-I: (Practical Sessions: 8 Hrs.)

1. Greatest common divisor (including Euclid's Method).
2. Random number generation (including a Monte Carlo Program).

Set-II: (Practical Sessions: 12 Hrs.)

1. Factorization of an integer, and Euler's totient.
2. Cartesian geometry using points (2 & 3-dimensional).
3. Pythagorean triples.

Set-III: (Practical Sessions: 16 Hrs.)

1. Basic set algebra.
2. Modulo arithmetic.
3. Permutations.
4. Polynomials.

Set-IV: (Practical Sessions: 12 Hrs.)

1. Arbitrary precision arithmetic using the GMP package.
2. Finding eigenvalues, eigenvectors, rank, nullity, and solving system of linear equations in matrices.
3. Plots (using the GNU plotutils package).

Note. Exception handling in lab-exercises (SET-I to IV), Comments/Documentation using Doxygen may be emphasized.

Teaching Plan (Theory of DSE-1 (iii) C++ Programming for Mathematics):

Week 1: Fundamentals of programming, Organization of logic flow in stored program model of computation, C++ as a general purpose programming language, Structure of a C++ program, Common compilers and IDE's, Basic data-types.

[1] Chapter 1, and Chapter 2 (Sections 2.1 to 2.3).

Week 2: Variables and literals in C++, Operators, Expressions, Evaluation precedence, and Type compatibility. Outline of program development in C++, Debugging and testing.

[1] Chapter 2 (Sections 2.4 to 2.9).

Weeks 3 and 4: Applications: Greatest common divisor, and Random number generation.

[1] Chapters 3 and 4.

Week 5: Structured data-types in C++, Arrays and manipulating data in arrays. Applications: Factorization of an integer, and Euler's totient.

[1] Chapter 5 (Sections 5.1 to 5.4).

Weeks 6 and 7: Objects and classes: Information hiding, Modularity, Constructors and destructors, Methods and polymorphism; Applications: Cartesian geometry using points (two and three dimensional), and Pythagorean triples.

[1] Chapters 6 and 7.

Weeks 8 and 9: Containers and template libraries: sets, iterators, multisets, vectors, maps, lists, stacks and queues with applications in basic set algebra.

[1] Sections 8.1 to 8.7 (8.7.1-8.7.3).

Weeks 10 and 11: Applications: modulo arithmetic, permutations, and polynomials.

[1] Chapter 9, Chapter 11 (Sections 11.1, and 11.2) and Chapter 12 (Sections 12.1 to 12.3).

Week 12: Arbitrary precision arithmetic using the GMP package; Linear algebra: Two-dimensional arrays in C++ with applications in finding eigenvalues, eigenvectors, rank, nullity, and solving system of linear equations in matrices.

[1] Chapter 13 [Sections 13.1, and 13.2 (13.2.1, 13.2.2)].

Weeks 13 and 14: Features of C++ for input/output & visualization: strings, streams, formatting methods, processing files in a batch, command-line arguments, visualization packages and plots.

[1] Chapter 14 [Sections 14.1 to 14.6, and 14.8 (14.8.1-14.8.3)].

Facilitating the Achievement of Course Learning Outcomes

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
1.	Understand and apply the programming concepts of C++ which is important to mathematical investigation and problem solving.	(i) Each topic to be explained with illustrations.	• Presentations and class discussions.
2.	Learn about structured data-types in C++ and learn about applications in factorization of an integer and understanding Cartesian geometry and Pythagorean triples.	(ii) Students to be encouraged to discover the relevant concepts.	• Assignments and class tests.
3.	Use of containers and templates in various applications in algebra.	(iii) Students to be given homework/assignments.	• Mid-term examinations.
4.	Use mathematical libraries for computational objectives. Represent the outputs of programs visually in terms of well formatted text and plots.	(iv) Discuss and solve the theoretical and practical problems in the class.	• Viva-voce examinations.
		(v) Students to be encouraged to apply concepts to real world problems.	• End-term examinations.

Keywords: Array, Class, Command-line Argument, Constructor, Containers, Data-type, Debugging, Destructor, Multiset, Map, Object, Polymorphism, Queue, Vector.

Discipline Specific Elective (DSE) Course -1 (including practicals)

Any *one* of the following (at least *two* shall be offered by the college):

DSE-1 (i): Numerical Analysis

DSE-1 (ii): Mathematical Modeling and Graph Theory

DSE-1 (iii): C++ Programming for Mathematics

DSE-1 (i): Numerical Analysis

Total Marks: 150 (Theory: 75 + Internal Assessment: 25 + Practical: 50)

Workload: 4 Lectures, 4 Periods practical (per week) **Credits:** 6 (4+2)

Duration: 14 Weeks (56 Hrs. Theory + 56 Hrs. practical) **Examination:** 3 Hrs.

Course Objectives: To comprehend various computational techniques to find approximate value for possible root(s) of non-algebraic equations, to find the approximate solutions of system of linear equations and ordinary differential equations. Also, the use of Computer Algebra System (CAS) by which the numerical problems can be solved both numerically and analytically, and to enhance the problem solving skills.

Course Learning Outcomes: The course will enable the students to:

- i) Learn some numerical methods to find the zeroes of nonlinear functions of a single variable and solution of a system of linear equations, up to a certain given level of precision.
- ii) Know about methods to solve system of linear equations, such as Gauss–Jacobi, Gauss–Seidel and SOR methods.
- iii) Interpolation techniques to compute the values for a tabulated function at points not in the table.
- iv) Applications of numerical differentiation and integration to convert differential equations into difference equations for numerical solutions.

Unit 1: Methods for Solving Algebraic and Transcendental Equations

Algorithms, Convergence, Bisection method, False position method, Fixed point iteration method, Newton's method and Secant method.

Unit 2: Techniques to Solve Linear Systems

Partial and scaled partial pivoting, LU decomposition and its applications, Iterative methods: Gauss–Jacobi, Gauss–Seidel and SOR methods.

Unit 3: Interpolation

Lagrange and Newton interpolation, Piecewise linear interpolation.

Unit 4: Numerical Differentiation and Integration

First and higher order approximation for first derivative, Approximation for second derivative, Richardson extrapolation method; Numerical integration by closed Newton–Cotes formulae: Trapezoidal rule, Simpson's rule and its error analysis; Euler's method to solve ODE's, Second order Runge–Kutta Methods: Modified Euler's method, Heun's method and optimal RK2 method.

Note: Emphasis is to be laid on the algorithms of the above numerical methods. Non programmable scientific calculator may be allowed in the University examination.

Reference:

1. Bradie, Brian. (2006). *A Friendly Introduction to Numerical Analysis*. Pearson Education, India. Dorling Kindersley (India) Pvt. Ltd. Third impression 2011.

Additional Readings:

- i. Jain, M. K., Iyengar, S. R. K., & Jain, R. K. (2012). *Numerical Methods for Scientific and Engineering Computation*. (6th ed.). New Age International Publisher, India, 2016.
- ii. Gerald, C. F., & Wheatley, P. O. (2008). *Applied Numerical Analysis* (7th ed.). Pearson Education. India.

Practical / Lab work to be performed in Computer Lab:

Use of computer algebra software (CAS), for example Mathematica/MATLAB/Maple/Maxima/Scilab etc., for developing the following numerical programs:

1. Bisection method
2. Newton–Raphson method
3. Secant method
4. Regula–Falsi method
5. LU decomposition method
6. Gauss–Jacobi method
7. SOR method
8. Gauss–Seidel method
9. Lagrange interpolation
10. Newton interpolation
11. Trapezoidal rule
12. Simpson's rule
13. Euler's method
14. Second order Runge–Kutta methods.

Note: For any of the CAS: Mathematica /MATLAB/ Maple/Maxima/Scilab etc., data types-simple data types, floating data types, character data types, arithmetic operators and operator precedence, variables and constant declarations, expressions, input/output, relational operators, logical operators and logical expressions, control statements and loop statements, Arrays should be introduced to the students.

Teaching Plan (Theory of DSE-I (i): Numerical Analysis):

Week 1: Algorithms, Convergence, Order of convergence and examples.

[1] Chapter 1 (Sections 1.1 and 1.2).

Week 2: Bisection method, False position method and their convergence analysis, Stopping condition and algorithms.

[1] Chapter 2 (Sections 2.1 and 2.2).

Week 3: Fixed point iteration method, its order of convergence and stopping condition.

[1] Chapter 2 (Section 2.3).

Week 4: Newton's method, Secant method, their order of convergence and convergence analysis.

[1] Chapter 2 (Sections 2.4 and 2.5).

Week 5: Examples to understand partial and scaled partial pivoting. LU decomposition.

[1] Chapter 3 (Sections 3.2, and 3.5 up to Example 3.15).

Weeks 6 and 7: Application of LU decomposition to solve system of linear equations. Gauss–Jacobi method, Gauss–Seidel and SOR iterative methods to solve system of linear equations.

[1] Chapter 3 (Sections 3.5 and 3.8).

Week 8: Lagrange interpolation: Linear and higher order interpolation, and error in it.

[1] Chapter 5 (Section 5.1).

Weeks 9 and 10: Divided difference and Newton interpolation, Piecewise linear interpolation.

[1] Chapter 5 (Sections 5.3 and 5.5).

Weeks 11 and 12: First and higher order approximation for first derivative and error in the approximation. Second order forward, Backward and central difference approximations for second derivative, Richardson extrapolation method

[1] Chapter 6 (Sections 6.2 and 6.3).

Week 13: Numerical integration: Trapezoidal rule, Simpson's rule and its error analysis.

[1] Chapter 6 (Section 6.4).

Week 14: Euler's method to solve ODE's, Second order Runge–Kutta methods: Modified Euler's method, Heun's method and optimal RK2 method.

[1] Chapter 7 (Section 7.2 up to Page 562 and Section 7.4, Pages 582-585).

Facilitating the achievement of Course Learning Outcomes

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
1.	Learn some numerical methods to find the zeroes of nonlinear functions of a single variable and solution of a system of linear equations, up to a certain given level of precision.	(i) Each topic to be explained with illustrations. (ii) Students be encouraged to discover the relevant concepts. (iii) Students to be given homework/assignments.	• Presentations and class discussions. • Assignments and class tests. • Student presentations.
2.	Know about methods to solve system of linear equations, such as Gauss–Jacobi, Gauss–Seidel and SOR methods.	(iv) Discuss and solve the theoretical and practical problems in the class.	• Mid-term examinations.
3.	Interpolation techniques to compute the values for a tabulated function at points not in the table.	(v) Students to be encouraged to apply concepts to real world problems.	• Practical and viva-voce examinations.
4.	Applications of numerical differentiation and integration to convert differential equations into difference equations for numerical solutions.		• End-term examinations.

Keywords: Algorithm, Euler's method, Interpolation, Iterative methods, LU decomposition, Newton–Cotes formulae, Order of convergence, Order of a method, Partial pivoting.

DISCIPLINE SPECIFIC CORE COURSE – 3: PROBABILITY AND STATISTICS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Probability and Statistics	4	3	0	1	Class XII pass with Mathematics	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- To make the students familiar with the basic statistical concepts and tools which are needed to study situations involving uncertainty or randomness.
- To render the students to several examples and exercises that blend their everyday experiences with their scientific interests to form the basis of data science.

Learning Outcomes

This course will enable the students to:

- Understand some basic concepts and terminology - population, sample, descriptive and inferential statistics including stem-and-leaf plots, dotplots, histograms and boxplots.
- Learn about probability density functions and various univariate distributions such as binomial, hypergeometric, negative binomial, Poisson, normal, exponential and lognormal.
- Understand the remarkable fact that the empirical frequencies of so many natural populations, exhibit bell-shaped (i.e., normal) curves, using the Central Limit Theorem.
- Measure the scale of association between two variables, and to establish a formulation helping to predict one variable in terms of the other, i.e., correlation and linear regression.

SYLLABUS OF DSC – 3

Theory

Unit – 1

(15 hours)

Descriptive Statistics, Probability, and Discrete Probability Distributions

Descriptive statistics: Populations, Samples, Stem-and-leaf displays, Dotplots, Histograms, Qualitative data, Measures of location, Measures of variability, Boxplots; Sample spaces and events, Probability axioms and properties, Conditional probability, Bayes' theorem and independent events; Discrete random variables and probability

distributions, Expected values; Probability distributions: Binomial, geometric, hypergeometric, negative binomial, Poisson, and Poisson distribution as a limit.

Unit – 2

(15 hours)

Continuous Probability Distributions

Continuous random variables, Probability density functions, Uniform distribution, Cumulative distribution functions and expected values, The normal, exponential and lognormal distributions.

Unit – 3

(15 hours)

Central Limit Theorem and Regression Analysis

Sampling distribution and standard error of the sample mean, Central Limit Theorem and applications; Scatterplot of bivariate data, Regression line using principle of least squares, Estimation using the regression lines; Sample correlation coefficient and properties.

Practical (30 hours)

Software labs using Microsoft Excel or any other spreadsheet.

- 1) Presentation and analysis of data (univariate and bivariate) by frequency tables, descriptive statistics, stem-and-leaf plots, dotplots, histograms, boxplots, comparative boxplots, and probability plots ([1] Section 4.6).
- 2) Fitting of binomial, Poisson and normal distributions.
- 3) Illustrating the Central Limit Theorem through Excel.
- 4) Fitting of regression line using the principle of least squares.
- 5) Computation of sample correlation coefficient.

Essential Reading

1. Devore, Jay L. (2016). Probability and Statistics for Engineering and the Sciences (9th ed.). Cengage Learning India Private Limited. Delhi. Indian Reprint 2020.

Suggestive Reading

- Mood, A. M., Graybill, F. A., & Boes, D. C. (1974). Introduction to the Theory of Statistics (3rd ed.). Tata McGraw-Hill Pub. Co. Ltd. Reprinted 2017.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.


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3. Prasad, Gorakh (2016). *Differential Calculus* (19th ed.). Pothishala Pvt. Ltd. Allahabad.
4. Ross, Kenneth A. (2013). *Elementary Analysis: The Theory of Calculus* (2nd ed.). Undergraduate Texts in Mathematics, Springer. Indian reprint.

Suggestive Readings

- Apostol, T. M. (2007). *Calculus: One-Variable Calculus with an Introduction to Linear Algebra* (2nd ed.). Vol. 1. Wiley India Pvt. Ltd.
- Ghorpade, Sudhir R. & Limaye, B. V. (2006). *A Course in Calculus and Real Analysis*. Undergraduate Texts in Mathematics, Springer (SIE). Indian reprint.

DISCIPLINE SPECIFIC CORE COURSE – 6: ORDINARY DIFFERENTIAL EQUATIONS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Ordinary Differential Equations	4	3	0	1	Class XII pass with Mathematics	NIL

Learning Objectives: The main objective of this course is to introduce the students:

- The exciting world of differential equations.
- Their applications and mathematical modeling.

Learning Outcomes: The course will enable the students to:

- Learn the basics of differential equations and compartmental models.
- Formulate differential equations for various mathematical models.
- Solve first order non-linear differential equations, linear differential equations of higher order and system of linear differential equations using various techniques.
- Apply these techniques to solve and analyze various mathematical models.

SYLLABUS OF DSC-6

UNIT – I: First-Order Differential Equations (12 hours)

Concept of implicit, general and singular solutions for the first order ordinary differential equation; Bernoulli's equation, Exact equations, Integrating factors, Initial value problems, Reducible second order differential equations; Applications of first order differential equations to Newton's law of cooling, exponential growth and decay problems.

UNIT – II: Second and Higher-Order Differential Equations (18 hours)

General solution of homogenous equation of second order, Principle of superposition for a homogenous equation, Wronskian and its properties, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Method of variation of parameters, Method of undetermined coefficients, Two-point boundary value problems, Cauchy- Euler's equation, System of linear differential equations, Application of second order differential equation: Simple pendulum problem.

UNIT – III: Formulation and Analysis of Mathematical Models (15 hours)

Introduction to compartmental models, Lake pollution model; Density-dependent growth model, Interacting population models, Epidemic model of influenza and its analysis, Predator-prey model and its analysis, Equilibrium points, Interpretation of phase plane

Practical (30 hours)- Practical / Lab work to be performed in a Computer Lab:

Modeling of the following problems using SageMath/Mathematica/MATLAB/Maple/Maxima/Scilab etc.

1. Solutions of first, second and third order differential equations.
2. Plotting of family of solutions of differential equations of first, second and third order.
3. Solution of differential equations using method of variation of parameters.
4. Growth and decay model (exponential case only).
5. Lake pollution model (with constant/seasonal flow and pollution concentration).
6. Density-dependent growth model.
7. Predatory-prey model (basic Volterra model, with density dependence, effect of DDT, two prey one predator).
8. Epidemic model of influenza (basic epidemic model, contagious for life, disease with carriers).

Essential Readings

1. Barnes, Belinda & Fulford, Glenn R. (2015). *Mathematical Modeling with Case Studies, Using Maple and MATLAB* (3rd ed.). CRC Press. Taylor & Francis Group.
2. Edwards, C. Henry, Penney, David E., & Calvis, David T. (2015). *Differential Equations and Boundary Value Problems: Computing and Modeling* (5th ed.). Pearson Education.
3. Ross, Shepley L. (2014). *Differential Equations* (3rd ed.). Wiley India Pvt. Ltd.

Suggestive Reading

- Simmons, George F. (2017). *Differential Equations with Applications and Historical Notes* (3rd ed.). CRC Press. Taylor & Francis Group.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.


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Skill Enhancement Paper

SEC-1: LaTeX and HTML

Total Marks: 100 (Theory: 38, Internal Assessment: 12, and Practical: 50)

Workload: 2 Lectures, 4 Practicals (per week) **Credits:** 4 (2+2)

Duration: 14 Weeks (28 Hrs. Theory + 56 Hrs. Practical) **Examination:** 2 Hrs.

Course Objectives: The purpose of this course is to acquaint students with the latest typesetting skills, which shall enable them to prepare high quality typesetting, beamer presentation and webpages.

Course Learning Outcomes: After studying this course the student will be able to:

- i) Create and typeset a LaTeX document.
- ii) Typeset a mathematical document using LaTeX.
- iii) Learn about pictures and graphics in LaTeX.
- iv) Create beamer presentations.
- v) Create web page using HTML.

Unit 1: Getting Started with LaTeX

Introduction to TeX and LaTeX, Typesetting a simple document, Adding basic information to a document, Environments, Footnotes, Sectioning and displayed material.

Unit 2: Mathematical Typesetting with LaTeX

Accents and symbols, Mathematical typesetting (elementary and advanced): Subscript/ Superscript, Fractions, Roots, Ellipsis, Mathematical Symbols, Arrays, Delimiters, Multiline formulas, Spacing and changing style in math mode.

Unit 3: Graphics and Beamer Presentation in LaTeX

Graphics in LaTeX, Simple pictures using PSTricks, Plotting of functions, Beamer presentation.

Unit 4: HTML

HTML basics, Creating simple web pages, Images and links, Design of web pages.

References:

1. Bindner, Donald & Erickson, Martin. (2011). *A Student's Guide to the Study, Practice, and Tools of Modern Mathematics*. CRC Press, Taylor & Francis Group, LLC.
2. Lamport, Leslie (1994). *LaTeX: A Document Preparation System*, User's Guide and Reference Manual (2nd ed.). Pearson Education. Indian Reprint.

Additional Readings:

- i. Dongen, M. R. C. van (2012). *LaTeX and Friends*. Springer-Verlag.
- ii. Robbins, J. N. (2018). *Learning Web Design: A Beginner's Guide to HTML* (5th ed.). O'Reilly Media Inc.

Practical / Lab work to be performed in Computer Lab.

[1] Chapter 9 (Exercises 4 to 10), Chapter 10 (Exercises 1 to 4 and 6 to 9),
Chapter 11 (Exercises 1, 3, 4, and 5), and Chapter 15 (Exercises 5, 6 and 8 to 11).

Teaching Plan (Theory of SEC-1: LaTeX and HTML):

Weeks 1 to 3: Introduction to TeX and LaTeX, Typesetting a simple document, Adding basic information to a document, Environments, Footnotes, Sectioning and displayed material.

[1] Chapter 9 (9.1 to 9.5).

[2] Chapter 2 (2.1 to 2.5).

Weeks 4 to 6: Accents of symbols, Mathematical typesetting (elementary and advanced): Subscript/Superscript, Fractions, Roots, Ellipsis, Mathematical symbols, Arrays, Delimiters, Multiline formulas, Spacing and changing style in math mode.

[1] Chapter 9 (9.6 and 9.7).

[2] Chapter 3 (3.1 to 3.3).

Weeks 7 and 8: Graphics in LaTeX, Simple pictures using PSTricks, Plotting of functions.

[1] Chapter 9 (Section 9.8). Chapter 10 (10.1 to 10.3).

[2] Chapter 7 (7.1 and 7.2).

Weeks 9 and 10: Beamer presentation.

[1] Chapter 11 (Sections 11.1 to 11.4).

Weeks 11 and 12: HTML basics, Creating simple web pages.

[1] Chapter 15 (Sections 15.1 and 15.2).

Weeks 13 and 14: Adding images and links, Design of web pages.

[1] Chapter 15 (Sections 15.3 to 15.5).

Facilitating the Achievement of Course Learning Outcomes

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
1.	Create and typeset a LaTeX document.	(i) Each topic to be explained with illustrations on computers. (ii) Students be given homework/ assignments. (iii) Students be encouraged to create simple webpages.	• Presentations and class discussions. • Assignments and class tests. • Mid-term examinations. • End-term examinations.
2.	Typeset a mathematical document using LaTeX.		
3.	Learn about pictures and graphics in LaTeX. Create beamer presentations.		
4.	Create web page using HTML.		

Keywords: LaTeX, Mathematical typesetting, PSTricks, Beamer, HTML.


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DOCUMENT PREPARATION & PRESENTATION SOFTWARE

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
Document Preparation & Presentation Software	2	0	0	2	12 th Pass	NIL

Learning Objectives:

- To develop proficiency in the use of document preparation software such as document LaTeX, LibreOffice.
- To make a presentation using LaTeX, LibreOffice.
- To serve as a tool for conveying/communicating one's ideas, views, and observations.

Learning outcomes: On completion of the course, a student will be able to

- Create a text document using LaTeX using a standard template.
- Incorporate well-formatted mathematical equations, algorithms, figures, tables and references in a document.
- Use Zotero for reference management.
- Format text, including alignment, emphasis and fonts.
- Handle basic aspects of document structure, including sections, subsections, paragraphs, and bulleted and enumerated lists.
- Page set a document including header, footer, and page numbering.
- Make a presentation.

Syllabus:

Unit 1: Introduction

(4 Hours)

1. Create a LaTeX/ LibreOffice document having several paragraphs, including comments in LaTeX.
2. Organize content into sections, including preface/abstract. Using the article and book class of LaTeX. Handling errors.


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Unit 2: Styling Pages**(6 Hours)**

1. Loading and using packages, setting margins, header and footer, and page orientation.
2. Organizing the document into multiple columns

Unit 3: Formatting Content**(10 Hours)**

1. Formatting text (styles, size, alignment)
2. Adding colours to a block of text/ page
3. Adding ordered and unordered lists
4. Inserting mathematical expressions – subscripts, superscripts, fractions, binomials, aligning equations, operators, Greek and mathematical symbols, and mathematical fonts.

Unit 4: Tables and Figures**(10 Hours)**

1. Create basic tables
2. Adding different types of borders to a table
3. Merging rows and columns
4. Splitting tables across multiple pages.
5. Incorporating figures and subfigures, explore different properties like rotation and scaling.

Unit 5: Algorithms and Equations**(12 hours)**

1. Incorporating algorithms, body typesetting, organizing algorithms across multiple pages.
2. Incorporating equations, indentation, and captioning.

Unit 6: Referencing and Indexing**(6 hours)**

1. Insert captions, labels, and references
2. Incorporate cross-referencing (refer to sections, table, and images)
3. Incorporate a bibliography
4. Create a back index.

Unit 7: Making Presentations**(12 hours)**

1. Create a slideshow
2. Incorporate logo
3. Highlight important points
4. Create a title page
5. Make a table of contents
6. Incorporate special effects in a slideshow.

Practical Exercises:**For the following figures, create LaTeX documents using concepts from above:**

- 1.

Hello World!

Prof. Naveen Kumar

November 15, 2022

Hello World! Today I am learning L^AT_EX. L^AT_EX is a great program for writing math. I can write in line math such as $a^2 + b^2 = c^2$. I can also give equations their own space:

$$\gamma^2 + \theta^2 = \omega^2$$

2.

Integrals, Sums and Limits

Dr. Neeraj Kumar Sharma

1 Integrals

Integral $\int_a^b x^2 dx$ inside text.

The same integral on display:

$$\int_a^b x^2 dx$$

and multiple integrals:

$$\begin{aligned} & \iint_V \mu(u, v) du dv \\ & \iiint_V \mu(u, v, w) du dv dw \\ & \oint_V f(s) ds \end{aligned}$$

2 Sums and products

Sum $\sum_{n=1}^{\infty} 2^{-n} = 1$ inside text.

The same sum on display:

$$\sum_{n=1}^{\infty} 2^{-n} = 1$$

Product $\prod_{i=a}^b f(i)$ inside text.

The same product on display:

$$\prod_{i=a}^b f(i)$$

3 Limits

Limit $\lim_{x \rightarrow \infty} f(x)$ inside text.

The same limit on display:

$$\lim_{x \rightarrow \infty} f(x)$$

3.

Equations

Prof. Naveen Kumar¹, Dr. Neeraj Kumar Sharma², and Sakeena Shahid³

¹Department of Computer Science, University of Delhi

²Ram Lal Anand College, University of Delhi

³SGTB Khalsa College, University of Delhi

November 15, 2022

1 Maxwell's Equations

“Maxwell's equations” are named for James Clark Maxwell and are as follow:

$$\vec{\nabla} \cdot \vec{E} = \frac{\rho}{\epsilon_0} \quad \text{Gauss's Law} \quad (1)$$

$$\vec{\nabla} \cdot \vec{B} = 0 \quad \text{Gauss's Law for Magnetism} \quad (2)$$

$$\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t} \quad \text{Faraday's Law of Induction} \quad (3)$$

$$\vec{\nabla} \times \vec{B} = \mu_0 \left(\epsilon_0 \frac{\partial \vec{E}}{\partial t} + \vec{J} \right) \quad \text{Ampere's Circuital Law} \quad (4)$$

Equations 1, 2, 3, and 4 are some of the most important in Physics.

2 Matrix Equations

$$\begin{pmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{pmatrix} \begin{bmatrix} v_1 \\ v_2 \\ \vdots \\ v_n \end{bmatrix} = \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix}$$

4.

List of mathematical functions:

- Trigonometric functions
 - sine
 - cosine
 - tangent
- Special functions
 - Beta function
 - Gamma function
 - Riemann zeta function

5. Add the following algorithm to the document.


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Algorithm 1: Example code

Input: Your Input
Output: Your output
Data: Testing set x

```
1  $\sum_{i=1}^{\infty} := 0$                                 // this is a comment
  /* Now this is an if...else conditional loop */
2 if Condition 1 then
3   | Do something                                // this is another comment
4   | if sub-Condition then
5   |   | Do a lot
6 else if Condition 2 then
7   | Do Otherwise
  /* Now this is a for loop */
8   | for sequence do
9   |   | loop instructions
10 else
11   | Do the rest
  /* Now this is a While loop */
12 while Condition do
13   | Do something
```

6.

col1	col2	col3
Multiple row	cell2	cell3
	cell5	cell6
	cell8	cell9

7.

Country List		
Country Name or Area Name	ISO ALPHA 2 Code	ISO ALPHA 3
Afghanistan	AF	AFG
Aland Islands	AX	ALA
Albania	AL	ALB
Algeria	DZ	DZA
American Samoa	AS	ASM
Andorra	AD	AND
Angola	AO	AGO

8. Insert four sub-figures as given below, and add captions. Also, refer to these sub-figures in the text.

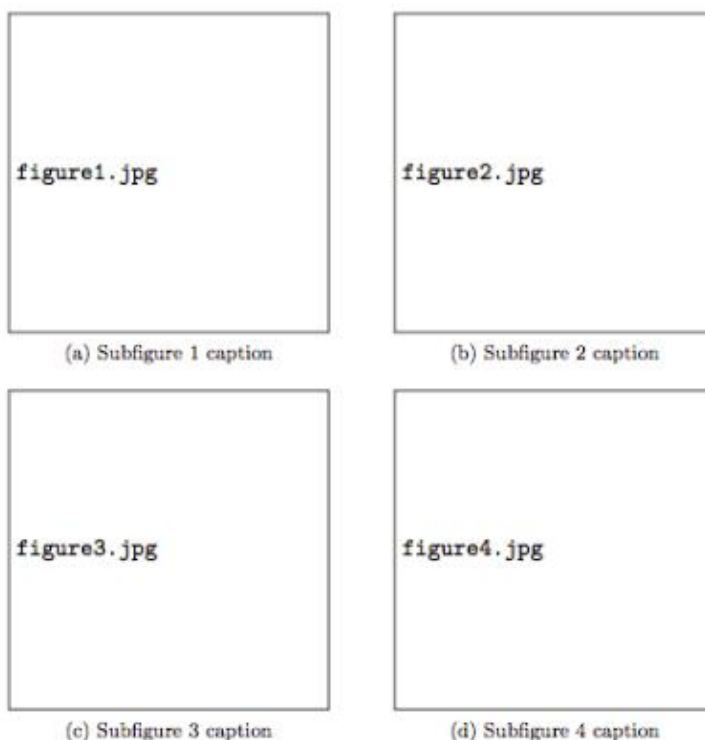


Figure 1: This is a figure containing several subfigures.

In the text, you can refer to subfigures of figure 1 as 1a, 1b, 1c and 1d and to the sub-index as (a), (b), (c) and (d).

9. Add a table of contents, a list of figures, and a list of tables in the document as given below.

Contents

Table of contents	1
1 First Section	2
2 Second Section	2

List of Tables

1 Just a table	2
--------------------------	---

List of Figures

1 This is an image	2
------------------------------	---

10. Add a list of references in the document as given below and cite them in the text.

This document is an example of `natbib` package using in bibliography management. Three items are cited: *The L^AT_EX Companion* book [2], the Einstein journal paper Einstein [1], and the Donald Knuth's website [3]. The L^AT_EX related items are [2, 3].

References

- [1] A. Einstein. Zur Elektrodynamik bewegter Körper. (German) [On the electrodynamics of moving bodies]. *Annalen der Physik*, 322(10):891–921, 1905. doi: <http://dx.doi.org/10.1002/andp.19053221004>.
- [2] M. Goossens, F. Mittelbach, and A. Samarin. *The L^AT_EX Companion*. Addison-Wesley, Reading, Massachusetts, 1993.
- [3] D. Knuth. Knuth: Computers and typesetting. URL <http://www-cs-faculty.stanford.edu/~uno/abcde.html>.

END


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Skill Enhancement Paper

SEC-2: Computer Algebra Systems and Related Software

Total Marks: 100 (Theory: 38, Internal Assessment: 12, and Practical: 50)

Workload: 2 Lectures, 4 Practicals (per week) **Credits:** 4 (2+2)

Duration: 14 Weeks (28 Hrs. Theory + 56 Hrs. Practical) **Examination:** 2 Hrs.

Course Objectives: This course aims at familiarizing students with the usage of computer algebra systems (/Mathematica/MATLAB/Maxima/Maple) and the statistical software **R**. The basic emphasis is on plotting and working with matrices using CAS. Data entry and summary commands will be studied in **R**. Graphical representation of data shall also be explored.

Course Learning Outcomes: This course will enable the students to:

- i) Use of computer algebra systems (Mathematica/MATLAB/Maxima/Maple etc.) as a calculator, for plotting functions and animations
- ii) Use of CAS for various applications of matrices such as solving system of equations and finding eigenvalues and eigenvectors.
- iii) Understand the use of the statistical software **R** as calculator and learn to read and get data into **R**.
- iv) Learn the use of **R** in summary calculation, pictorial representation of data and exploring relationship between data.
- v) Analyze, test, and interpret technical arguments on the basis of geometry.

Unit 1: Introduction to CAS and Applications

Computer Algebra System (CAS), Use of a CAS as a calculator, Computing and plotting functions in 2D, Plotting functions of two variables using Plot3D and ContourPlot, Plotting parametric curves surfaces, Customizing plots, Animating plots, Producing tables of values, working with piecewise defined functions, Combining graphics.

Unit 2: Working with Matrices

Simple programming in a CAS, Working with matrices, Performing Gauss elimination, operations (transpose, determinant, inverse), Minors and cofactors, Working with large matrices, Solving system of linear equations, Rank and nullity of a matrix, Eigenvalue, eigenvector and diagonalization.

Unit 3: R - The Statistical Programming Language

R as a calculator, Explore data and relationships in **R**. Reading and getting data into **R**: Combine and scan commands, Types and structure of data items with their properties, Manipulating vectors, Data frames, Matrices and lists, Viewing objects within objects, Constructing data objects and conversions.

Unit 4: Data Analysis with R

Summary commands: Summary statistics for vectors, Data frames, Matrices and lists, Summary tables, Stem and leaf plot, Histograms, Plotting in **R**: Box-whisker plots, Scatter plots, Pairs plots, Line charts, Pie charts, Cleveland dot charts and bar charts, Copy and save graphics to other applications.

References:

1. Bindner, Donald & Erickson, Martin. (2011). *A Student's Guide to the Study, Practice, and Tools of Modern Mathematics*. CRC Press, Taylor & Francis Group, LLC.
2. Torrence, Bruce F., & Torrence, Eve A. (2009). *The Student's Introduction to Mathematica®: A Handbook for Precalculus, Calculus, and Linear Algebra* (2nd ed.). Cambridge University Press.
3. Gardener, M. (2012). *Beginning R: The Statistical Programming Language*, Wiley.

Additional Reading:

- i. Verzani, John (2014). *Using R for Introductory Statistics* (2nd ed.). CRC Press, Taylor & Francis Group.

Note: Theoretical and Practical demonstration should be carried out only in **one** of the CAS: Mathematica/MATLAB/Maxima/Scilab or any other.

Practical / Lab work to be performed in Computer Lab.

- [1] Chapter 12 (Exercises 1 to 4 and 8 to 12), Chapter 14 (Exercises 1 to 3)
[2] Chapter 3 [Exercises 3.2(1 and 2), 3.3(1, 2 and 4), 3.4(1 and 2), 3.5(1 to 4), 3.6(2 and 3)].
[2] Chapter 6 (Exercises 6.2 and 6.3) and Chapter 7 [Exercises 7.1(1), 7.2, 7.3(2), 7.4(1) and 7.6].

Note: Relevant exercises of [3] Chapters 2 to 5 and 7 (The practical may be done on the database to be downloaded from <http://data.gov.in/>).

Teaching Plan (Theory of SEC-1: Computer Algebra Systems and Related Software):

Weeks 1 to 3: Computer Algebra System (CAS), Use of a CAS as a calculator, Computing and plotting functions in 2D, Producing tables of values, Working with piecewise defined functions, Combining graphics. Simple programming in a CAS.

[1] Chapter 12 (Sections 12.1 to 12.5).

[2] Chapter 1, and Chapter 3 (Sections 3.1 to 3.6 and 3.8).

Weeks 4 and 5: Plotting functions of two variables using Plot3D and contour plot, Plotting parametric curves surfaces, Customizing plots, Animating plots.

[2] Chapter 6 (Sections 6.2 and 6.3).

Weeks 6 to 8: Working with matrices, Performing Gauss elimination, Operations (Transpose, Determinant, Inverse), Minors and cofactors, Working with large matrices, Solving system of linear equations, Rank and nullity of a matrix, Eigenvalue, Eigenvector and diagonalization.

[2] Chapter 7 (Sections 7.1 to 7.8).

Weeks 9 to 11: R as a calculator, Explore data and relationships in R. Reading and getting data into R: Combine and scan commands, Types and structure of data items with their properties. Manipulating vectors, Data frames, Matrices and lists. Viewing objects within objects. Constructing data objects and conversions.

[1] Chapter 14 (Sections 14.1 to 14.4).

[3] Chapter 2, and Chapter 3.

Weeks 12 to 14: Summary commands: Summary statistics for vectors, Data frames, Matrices and lists. Summary tables. Stem and leaf plot, histograms. Plotting in R: Box-whisker plots, Scatter plots, Pairs plots, Line charts, Pie charts, Cleveland dot charts and Bar charts. Copy and save graphics to other applications.

[1] Chapter 14 (Section 14.7).

[3] Chapter 5 (up to Page 157), and Chapter 7.

Facilitating the Achievement of Course Learning Outcomes

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
1.	Use of computer algebra systems (Mathematica/MATLAB/Maxima/Maple etc.) as a calculator, for plotting functions and animations	(i) Each topic to be explained with illustrations using CAS or R .	• Presentations and class discussions. • Assignments and class tests. • Mid-term examinations. • End-term examinations.
2.	Use of CAS for various applications of matrices such as solving system of equations and finding eigenvalues and eigenvectors.	(ii) Students to be given homework/ assignments.	
3.	Understand the use of the statistical software R as calculator and learn to read and get data into R .	(iii) Students to be encouraged to do look for new applications.	
4.	Learn the use of R in summary calculation, pictorial representation of data and exploring relationship between data. Analyze, test, and interpret technical arguments on the basis of geometry.		

Keywords: Plot3D, ContourPlot, Calculator, Summary commands, Histograms.


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SEC – 15: Programming using Python

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
	2			2		Experience with a high-level language (C/C++, Java, MATLAB) is suggested. Prior knowledge of a scripting language (Perl, UNIX/Linux shells) and Object-Oriented concepts is helpful but not mandatory.

Learning Objectives

The Learning Objectives of this course are as follows:

- To provide exposure to basic problem-solving techniques with computers
- To develop logical thinking abilities and to propose novel solutions for real world problems through programming language constructs.
- To deepen the empirical knowledge on applying programming on business domains.

Learning outcomes

The Learning Outcomes of this course are as follows:

- After studying this course, students will be able to interpret the basic representation of the data structures and sequential programming
- After studying this course, students will be able to gain knowledge of, and ability to use control framework terminologies.
- After studying this course, students will be able to work out using the core data structures as lists, dictionaries, tuples, and sets.

- After studying this course, students will be able to choose appropriate programming paradigms, interrupt and handle data using files to propose solutions through reusable modules.
- After studying this course, students will be able to propose possible error-handling constructs for unanticipated states/inputs .
- After studying this course, students will be able to implements exemplary applications on real-world problems.

SYLLABUS OF SEC-15

Unit-1: Introduction (4 weeks)

Relationship between computers and programs, Basic principles of computers, File systems, Using the Python interpreter, Introduction to binary computation, Input / Output

Unit-2: Data types and control structures (4 weeks)

Operators (unary, arithmetic, etc.), Data types, variables, expressions, and statements, Assignment statements, Strings and string operations, Control Structures: loops and decision

Unit-3: Modularization and Classes (4 weeks)

Standard modules, Packages, Defining Classes, Defining functions, Functions and arguments(signature)

Unit-4: Data structures and Object-oriented design (4 weeks)

Data Structures (array, List, Dictionary), Error processing, Exception Raising and Handling Programming types, Object Oriented Programming, Object Oriented Design, Inheritance and Polymorphism

Practical Exercises

- Running instructions in Interactive interpreter and a Python Script
- Write a program to purposefully raise Indentation Error and Correct it
- Write a program to compute distance between two points taking input from the user. (Pythagorean Theorem)
- Write a program add.py that takes 2 numbers as command line arguments and prints its sum.
- Write a Program for checking whether the given number is an even number or not.
- Using a for loop, write a program that prints out the decimal equivalents of 1/2, 1/3, 1/4, 1/10
- Write a program using a for loop that loops over a sequence. What is the sequence?
- Write a program using a while loop that asks the user for a number, and prints a countdown from that number to zero.
- Find the sum of all the primes below two million. Each new term in the Fibonacci sequence is generated by adding the previous two terms. By starting with 1 and 2, the first 10 terms will be: 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, ...
- By considering the terms in the Fibonacci sequence whose values do not exceed four million, find the sum of the even-valued terms.

- Write a program to count the numbers of characters in the string and store them in a dictionary data structure.
- Write a program to use split and join methods in the string and trace a birthday with a dictionary data structure.
- Write a program combining lists that combines these lists into a dictionary.
- Write a program to count the frequency of characters in a given file. Can you use character frequency to tell whether the given file is a Python program file, C program file or a text file?
- Write a program to print each line of a file in reverse order.
- Write a program to compute the number of characters, words and lines in a file.
- Write a function ball collide that takes two balls as parameters and computes if they are colliding. Your function should return a Boolean representing whether or not the balls are colliding. Hint: Represent a ball on a plane as a tuple of (x, y, r), r being the radius. If (distance between two balls centers) $\leq$ (sum of their radii) then (they are colliding)
- Find mean, median, mode for the given set of numbers in a list.
- Write a function nearly equal to test whether two strings are nearly equal. Two strings a and b are nearly equal when a can be generated by a single mutation on b.
- Write a function dups to find all duplicates in the list.

Essential/recommended readings

- "Starting Out with Python plus My Programming Lab with Pearson eText --Access Card Package (3rd Edition) Tony Gaddis ISBN-13: 978-0133862256".
- Python Crash Course: A Hands-On, Project-Based Introduction to Programming (2nd Edition).
- Head-First Python: A Brain-Friendly Guide (2nd Edition) by Paul Barry.
- Learn Python the Hard Way: 3rd Edition by Zed A. Shaw.
- Python Programming: An Introduction to Computer Science (3rd Edition) by John M. Zelle.
- Python Cookbook: Recipes for Mastering Python 3 (3rd Edition) by Brian Jones and David Beazley.

Examination scheme and mode:

Total Marks: 100

Internal Assessment: 25 marks

Practical Exam (Internal): 25 marks

End Semester University Exam: 50 marks

The Internal Assessment for the course may include Class participation, Assignments, Class tests, Projects, Field Work, Presentations, amongst others as decided by the faculty.


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VAC 1: VEDIC MATHEMATICS - I

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Vedic Mathematics - I	02	1	0	1	12 TH Pass	NIL

Learning Objectives

The Learning Objectives of the course are:

- Foster love for maths and remove its fear through Vedic Mathematics
- Enhance computation skills in students through Vedic Mathematics
- Develop logical and analytical thinking
- Promote joyful learning of mathematics
- Discuss the rich heritage of mathematical temper of Ancient India

Learning outcomes

The Learning Outcomes of the course are

- Overcome the fear of maths
- Improved critical thinking
- Familiarity with the mathematical underpinnings and techniques
- Ability to do basic maths faster and with ease.
- Appreciate the Mathematical advancements of Ancient India.

SYLLABUS OF VEDIC MATHEMATICS - I

UNIT – I Vedic Maths- High Speed Addition and Subtraction Sessions/Lectures (5 Weeks)

- Vedic Maths: History of Vedic Maths and its Features
- Vedic Maths formulae: Sutras and Upsutras
- Addition in Vedic Maths: Without carrying, Dot Method

- Subtraction in Vedic Maths: Nikhilam Navatashcaramam Dashatah (All from 9 last from 10)
- Fraction –Addition and Subtraction

UNIT – II Vedic Maths- Miracle Multiplication and Excellent Division (4 Weeks)

- Multiplication in Vedic Maths: Base Method (any two numbers upto three digits)
- Multiplication by Urdhva Tiryak Sutra
- Miracle multiplication: Any three-digit number by series of 1's and 9's
- Division by Urdhva Tiryak Sutra (Vinculum method)

UNIT – III Vedic Maths-Lightening Squares and Rapid Cubes (3 Weeks)

- Squares of any two-digit numbers: Base method
- Square of numbers ending in 5: Ekadhikena Purvena Sutra
- Easy square roots: Dwandwa Yoga (duplex) Sutra
- Square root of 2: Baudhayana Shulbasutra
- Cubing: Yavadunam Sutra

UNIT – IV Vedic Maths-Enlighten Algebra and Geometry (3 Weeks)

- Factoring Quadratic equation: Anurupyena, Adyamadyenantyamanty Sutra
- Concept of Baudhayana (Pythagoras) Theorem
- Circling a square: Baudhayana Shulbasutra
- Concept of pi: Baudhayana Shulbasutra
- Concept angle (θ) 0o, 30o, 45o, 60o and 90o: Baudhayana number

Practical component : (If any) (15 Weeks)

The students are expected to demonstrate the application of Vedic Maths: Sutra and Upsutra

- Conduct workshops under the supervision of the course teacher to spread awareness on the utility of Vedic Mathematics.
- Students are required to visit nearby retail shops/local vendors to purchase stationery/vegetables/bread and butter and use tricks of Vedic maths of addition and subtraction to calculate the amount to pay and receive the difference.
- Students may share their experience with the class teacher in the form of audio-video presentations of 15 minutes.
- If required, students can share their experiences in the form of a Project Report.
- Any other Practical/Practice as decided from time to time

Essential Readings

- The Essential of Vedic Mathematics, Rajesh Kumar Thakur, Rupa Publications, New Delhi 2019.
- Vedic Mathematics Made Easy, Dahaval Bathia, Jaico Publishing, New Delhi 2011
- Vedic Mathematics: Sixteen Simple Mathematical formulae from the Vedas, Jagadguru Swami Sri Bharati Krishna Trithaji, Motilal Banarasidas, New Delhi 2015.
- Learn Vedic Speed Mathematics Systematically, Chaitnaya A. Patil 2018.

Suggested Readings

- A Modern Introduction to Ancient Indian Mathematics, T S Bhanumurthy, Wiley Eastern Limited, New Delhi.
- Enjoy Vedic Mathematics, S M Chauthaiwale, R Kollaru, The Art of Living, Bangalore.
- Magical World of Mathematics, VG Unkalkar, Vandana publishers, Bangalore.

Examination scheme and mode: Subject to directions from the Examination Branch/University of Delhi from time to time




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CNC-II/093/1(23)/2022-23/

Dated: 21.03.2023

NOTIFICATION

Sub: Amendment to Ordinance V

Following addition be made to Appendix-II-A to the Ordinance V (2-A) of the Ordinances of the University;

Add the following:

**Value Addition Course (VACs)
Under UGCF-2022 listed under Appendix-II -A to the Ordinance V (2-A) of the
Ordinances of the University
(With effect from academic year 2022-23)**

The following two courses are being added under the Pool of Value Addition Courses, which are in progression of the courses (i) Vedic Mathematics-I and (ii) National Cadet Corps-I respectively :

- 1. Vedic Mathematics-II**
- 2. National Cadet Corps-II**

VAC :Vedic Mathematics - II

Course Title and Code	Credits	Credit Distribution of the Course			Eligibility Criteria	Prerequisite of the Course
		Lecture	Tutorial	Practical/Practise		
Vedic Mathematics- II	02	1	0	1	Pass in Class 12 th	VAC-Vedic Mathematics -I

Course Objectives:

- Foster the love for mathematics by creating a positive attitude through Vedic and Ancient Indian Mathematics
- Help students appreciate ancient Indian Mathematics and its contribution to the world.
- Enhance computational proficiency by involving procedures in Linear and Matrix Algebra

- Improve geometrical thinking by understanding the basic tenets of geometry such as construction of line segments, angles, triangles and circles as used in Ancient India
- Develop conceptual knowledge of mathematical concepts
- Appreciate the need of conceptual knowledge over procedural processes

Learning Outcomes:

After completion of the course, students shall be able to

- think critically
- Find mathematical solution of algebraic expressions
- Solve system of linear equations and matrices faster and with ease.
- Appreciate the Mathematical advancements of Ancient India.

Syllabus of Vedic Mathematics - II

Unit I: Contribution of Indian Mathematicians	Sessions/Lectures
● Varahmihir ● Brahmagupta ● Srinivasa Ramanujan ● Neelkanth Somayya ● Bharti Krishna Tirtha	3
Unit II: Easy Solution of linear equations	
● Introduction of simple equation ● Solutions of simple equations ● Solutions of linear equations in two variables ● Practical application of linear equations in two variables	4
Unit III: High Speed Matrix Algebra	
● Introduction and history of Matrices and Determinants ● Matrices and Determinants of third order ● Inverse of Matrices	4
Unit IV: Vedic Geometry	
● Different forms of straight lines ● The Triangle ● The Cyclic Quadrilateral, Squares, and the Circle ● Geometrical constructions (such as <i>Altars</i>) ● Transformation of simple shapes ● Kalpa Sutras-<i>Srautha Sutras</i> and <i>Sulbha Sutras</i>	4

Note: Some of the theoretical concepts would be dealt with during practice hours.

Practical/ Practice Component

(15 sessions of 2 hours each= 30 hours)

The students are expected to demonstrate the application of Vedic Maths through various *Sutras*

- Conduct workshops under the supervision of the course teacher to spread awareness on the utility of Vedic Mathematics.
- Students may share their experience with the class teacher in the form of audio-video presentations of 15 minutes.
- If required, students can share their experiences in the form of a Project Report.
- Any other Practical/Practice as decided from time to time

Essential Readings

- Vedic Mathematics, Swami Bharati Krishna Trithaji, *Motilal Banarsidas, New Delhi.*
- The Essential of Vedic Mathematics, Rajesh Kumar Thakur, *Rupa Publications, New Delhi*
- Vedic Mathematics For All Ages, Vandana Singhal, *Motilal Banarsidas Publishers.*
- Elements of Vedic Mathematics, Udayan S. Patankar, Sunil M. Patankar, TTU Press.
- Vedic Mathematics: The Problem Solver, Ronak Bajaj, *Black Rose Publications.*
- Vedic Geometry Course, S. K. Kapoor, *Lotus Press*
- Gardner, Robert and J.F. Staal. *Altar of Fire*. Documentary. The Film Study Center at Harvard University, 1976

Suggested Readings

- A Modern Introduction to Ancient Indian Mathematics, T S Bhanumurthy, *Wiley Eastern Limited, New Delhi*
- Magical World of Mathematics, VG Unkalkar, *Vandana publishers, Bangalore*
- Vedic Mathematics - Modern Research Methods, Tiwari P., *Campus Books International*
- Learning Vedic Mathematics, S. K. Kapoor, *Lotus Press Publications*
- Vedic Mathematics Made Easy, DahavalBathia, *Jaico Publishing, New Delhi*
- Vedic Mathematics New Horizons Advance Lessons, S. K. Kapoor, *Lotus Press*

Examination scheme and mode: Subject to directions from the Examination Branch/University of Delhi from time to time.


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PAPER D3
LITERATURE AND CASTE
Semester 5

Course Objectives

This course aims to

- expose the student to non-hegemonic and non-canonical literary forms and expressions;
- make the student aware of a completely different literary aesthetic that a literature grounded in an engagement with caste generates;
- foreground the reality of caste, in Indian society, and to explore the way in which it has been engaged with, in the field of literature;
- discuss issues of caste, class and gender and its representation in literature;
- and
- expose the student to the rich variety of Dalit writing from various regional spaces.

Course Learning Outcomes

Understanding:

- 1) The concept of Caste
- 2) Dalit Literature
- 3) The different genres that engage with caste
- 4) How women experience caste
- 5) How caste is theorised
- 6) Dalit aesthetics

Facilitating the Achievement of Course Learning Outcomes

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
1.	Understanding concepts	Interactive discussions in small groups in Tutorial classes	Reading material together in small groups initiating discussion topics participation in discussions
2.	Expressing concepts through writing	How to think critically and write with clarity	Writing essay length assignments
3.	Demonstrating conceptual and textual understanding in tests and exams	Discussing exam questions and answering techniques	Class tests

Course content

Unit 1

Autobiography

Om Prakash Valmiki, *Joothan: A Dalit's Life*, trans. Arun Prabha Mukerjee (Kolkatta: Samya, 2003).

Unit 2

Novel

P. Sivakami, *The Grip of Change*, and author's notes, trans. P. Sivakami (New Delhi: Orient Longman, 2016).

Unit 3

Poems

a) Namdeo Dhasal, (i) 'Hunger'; (ii) 'Mandakini Patil', in *Namdeo Dhasal: Poet of the Underworld, Poems 1972–2006*, trans., Dilip Chitre (Delhi: Navayana Publishing, 2007).

b) N. D. Rajkumar, (i) 'My son wants me to buy him a toy car'; (ii) 'You my demon who delights in dancing'; (iii) 'If anyone other than our own people', in *Poems in Tamil Dalit Writing*, eds Ravikumar and Azhagarasan (OUP, 2012) pp. 15-17.

c) Manohar Mouli Biswas, (i) 'I shall go to war'; (ii) 'Valmiki', in *Poetic Rendering as Yet Unborn* (Chaturta Duniya, 2010).

d) Jayant Parmar, (i) 'The last will of a Dalit poet', in *Listen to the Flames: Texts and Readings From the Margins*, eds Tapan Basu, Indranil Acharya, A. Mangai (New Delhi: Oxford University Press, 2017).

Unit 4

Short Stories

a) Ajay Navaria, 'New Custom', trans. Laura Brueck, in *The Exercise of Freedom: An Introduction to Dalit Studies*, eds K. Sathyanarayana, Susie Tharu (New Delhi: Navayana Publishing, 2013).

b) C. Ayyappan, 'Spectral Speech', trans. V. C. Harris, *Indian Literature* 183, Jan-Feb, 1998.

c) Sanjay Kumar, 'Black Ink', trans. Raj Kumar, in *Listen to the Flames: Texts and Readings From the Margins*, eds Tapan Basu, Indranil Acharya, A. Mangai (New Delhi: Oxford University Press, 2017).

d) Jatin Bala, 'On Firm Ground', in *Survival and Other Stories: Bangla Dalit Fiction in Translation*, eds Sankar Prasad Singha and Indranil Acharya (New Delhi: Orient Blackswan, 2012).

e) Satish Chander, 'Thappu', trans. K. Suneetha Rani, in *Vibhinna: Voices from Telugu Literature*, eds Alladi Uma, M. Sridhar and K. Suneetha Rani (Sahitya Akademi, 2015).

f) Ratan Kumar Sambharia, 'Bes' in *Thunder Storm*, trans. Mridul Bhasin (Hachette, 2015), pp 125-133

Unit 5

Prose Readings

a) Paramjit S Judge, 'Existence, Identity and Beyond: Tracing the Contours of Dalit Literature in Punjabi', *Economic and Political Weekly*, July 19, 2014, Vol XLIX No 29.

b) Sharankumar Limbale, 'Dalit Literature and Aesthetics', in *Towards an Aesthetic of Dalit Literature: History, Controversies & Considerations* (Orient Longman, 2004) pp. 103-21.

c) Gauthaman, Raj, 'Dalit Culture' in *No Alphabet in Sight*, eds., K Satyanarayana and Susie Tharu, (Penguin Books, 2011) pp. 151-157.

d) Rani, Challapalli Swaroopa, 'Caste Domination Male Domination' in *Steel Nibs are Sprouting*, eds. K Satyanarayana and Susie Tharu, (Harper Collins, 2013) pp 704-709

Teaching Plan

Paper D3: Literature and Caste

Week 1 – Introduction to Paper D3: Literature and Caste

Week 2 – Unit 1 -Autobiography:Prakash Valmiki, *Joothan: A Dalit's Life*

Week 3 – Unit 1- Autobiography: (contd..)-Om Prakash Valmiki, *Joothan: A Dalit's Life*

Week 4 – Unit 2 -Novel: The Grip of Change, and Author's Notes

Week 5 – Unit 2- Novel: (contd.) The Grip of Change, and Author's Notes

Week 6 – Unit 3- Poems:

Dhasal, (i) 'Hunger'; (ii) 'Mandakini Patil'

Rajkumar (i) 'My son wants me to buy him a toy car' (ii) 'You my demon who delights in dancing'

Week 7 – Unit 3- Poems (contd.):

Biswas (i) 'I shall Go to war' (ii) 'Valmiki'

Parmar (i) 'The Last Will of a Dalit Poet'

Week 8 – Unit 4 – Short Stories

- Navaria, 'New Custom'
- Ayyappan, 'Spectral Speech'
- Week 9 -- Unit 4 - Short Stories (contd.)
- Kumar, 'Black Ink'
- Bala, 'On Firm Ground'
- Week 10 - Unit 4 - Short Stories (contd.)
- Chander, 'Thappu',
- Sambharia, 'Bes'
- Week 11 – Limbale, 'Dalit Literature and Aesthetics', in *Towards an Aesthetic of Dalit Literature*, pp. 103-21.
- Week 12 – Unit 5 - Prose Readings (contd.)
- Judge, 'Existence, Identity and Beyond: Tracing the Contours of Dalit Literature in Punjabi', *Economic and Political Weekly*, July 19, 2014, Vol XLIX No 29.
- Week 13 - –Unit 5 - Prose Readings (contd.)
- (i) Gauthaman, Raj, 'Dalit Culture' in *No Alphabet in Sight*, eds., K Satyanarayana and Susie Tharu, (Penguin Books, 2011) pp. 151-157.
- (ii) Rani, Challapalli Swaroopa, 'Caste Domination Male Domination' in *Steel Nibs are Sprouting*, eds. K Satyanarayana and Susie Tharu, (Harper Collins, 2013) pp 704-709
- Week 14 – – Concluding lectures; exam issues, etc.

Keywords

Caste

Caste Hierarchy

Caste discrimination

Dalit

Dalit Literature

Dalit Aesthetics

Dalit Women

Protest

Resistance


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GENERIC ELECTIVES (GE-4): Lifestyle Disorders

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Lifestyle Disorders	04	02	0	02	Class XII pass	NIL

Learning Objectives

The learning objectives of this course are as follows:

- The course aims to introduce the students to the concept of health, nutrition, and the factors affecting it.
- It will apprise students of the prevalence of emerging health issues affecting the quality of life.
- The course will facilitate the understanding of different physical and psychological associated disorders and their management for a healthy lifestyle.
- It highlights the important lifestyle-related disorders and describes the risks and remedies in relation to adopting a better life.

Learning Outcomes

By studying this course, students will be able to

- have a better understanding of lifestyle choices and the diseases associated with them.
- have an in-depth understanding of making better lifestyle decisions.
- learn about various techniques for preliminary diagnosis of lifestyle disorders

SYLLABUS OF GE-4

UNIT – I Introduction to Lifestyle

05 Hours

Traditional Indian lifestyle vs modern Indian lifestyle, lifestyle diseases – definition, risk factors-erratic sleep patterns, wrong food choices, smoking, alcohol abuse, stress, lack of optimum physical activity, illicit drug use, Obesity, respiratory diseases, diet and exercise.

UNIT – II Diabetes and Obesity

05 Hours

Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes-paediatric and adolescent obesity-weight control and BMI (Body Mass Index), Prediabetes, PCOS/PCOD.

UNIT – III Cardiovascular Diseases

06 Hours

Coronary atherosclerosis-Coronary artery disease, Causes-Fat and lipid, Alcohol Abuse-Diagnosis, Electrocardiograph, Echocardiograph, Treatment, Exercise and Cardiac rehabilitation.

UNIT – IV Cancer**05 Hours**

Introduction to Cancer and general diagnostic methods to detect cancer; Lung Cancer, Mouth Cancer: associated lifestyle choices, symptoms and treatment.

UNIT – V Hypertension**04 Hours**

Risk factors, complications (brain, heart, eye and kidney) and management of hypertension.

UNIT – VI WHO Global action plan and Monitoring**05 Hours**

WHO Global action plan and Monitoring framework for prevention and control of non-communicable diseases, NPHCE (National Programme for the Health Care of Elderly), Fit India movement (Yoga and meditation).

Practical component – 60 Hours

1. Estimation of blood glucose (GOD/POD) by kit.
2. Calculation of BMI, waist to hip ratio, skin fold test.
3. Imaging techniques for cancer diagnosis. CT Scan, MRI, PET-CT scan. Confirmatory Biopsy.
4. Blood pressure measurement using a sphygmomanometer.
5. Study of cardiac rehabilitation- thrombolytic agents and balloon angioplasty.
6. Project Work based on Case studies related to risk factors of any ONE lifestyle disorder studied.

OR

7. To write a review of personal experience of using any of the available health or lifestyle-related applications over a period of time with some data to correlate.

Essential/recommended readings

1. James M.R, Lifestyle Medicine, 2nd Edition, CRC Press,2013,
2. Tortora, G.J. and Grabowski, S. (2006). Principles of Anatomy & Physiology. XI edition. John Wiley & Sons
3. Cooper, G.M., Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition, ASM Press and Sinauer Associates

Suggestive readings

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Harcourt Asia PTE Ltd/W.B. Saunders Company.
2. Widmaier E, Raff H and Strang K. (2013) Vander's Human Physiology: The Mechanism of Body Functions. McGraw-Hill Education 13th Edition.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.


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LS SEC 4: Public Health and Hygiene

Course Learning Objective:

This course is multidisciplinary in nature which can be opted by students from all science courses. Starting from the basic concepts of Environmental science, it gives a deep insight into the factors causing environmental degradation and its outcome in form of increasing number of diseases leading to deterioration of public health.

Course Learning Outcome:

Upon completion of the course, students will be able to:

- Get familiarised with various aspects of environmental risks and hazards.
- Sensitize about the climate change due to human activities.
- Be aware about the various impacts of environmental degradation on human health through case studies and modes of prevention.
- Learn about the nuclear and chemical disasters and their aftereffects through cases studies.
- Know about the various waste management technologies and their utility.
- Learn about diagnosis of various diseases and methods to prevent them.
- Be sensitized enough to understand the importance of conservation of nature for betterment of human race and all living beings.

Theory [Credits: 2] 30 hrs

Unit 1: Introduction to Public health and Hygiene 7hrs

Significance of Public health and Hygiene, Nutrition and health, Classification of foods, Major nutritional Deficiency diseases- Protein Energy Malnutrition (Kwashiorkor and Marasmus), Vitamin deficiency disorders, Iron deficiency disorders, Iodine deficiency disorders

Chapter 1 and 2: Park K.

Unit 2: Environment and Health hazards 6 hrs

Environmental degradation, Environmental Pollution – Air, water, soil and noise; Associated health hazards

Chapter 12: Park K.

Unit 3: Communicable Diseases 6hrs

Different types of communicable diseases and their control measures – Tuberculosis, Measles, Dengue, Leprosy

Chapter 5: Park K.

Unit 4: Life Style Related Non-Communicable Diseases 6hrs

Different types of Life style related non-communicable diseases - Hypertension, Coronary Heart diseases, Stroke, Diabetes mellitus, Obesity and Mental ill-health - their causes and prevention through dietary and lifestyle modifications

Chapter 6: Park K

Unit 5: Social Health Problems

5hrs

Smoking, alcoholism, drug dependence and Acquired Immuno-Deficiency Syndrome (AIDS) - their causes, treatment and prevention.

Chapter 11: Park K

Practical [Credits: 2]

1. Estimation of blood glucose level
2. Study of household pests following with reference to public health.
3. Testing potability of water for human consumption by MPN method
4. To determine the content of different pollutants in soil/water samples.
5. Calculate the BMI of students and analyse the results with suitable statistical tools.
6. Measure the blood pressure using sphygmomanometer.
7. **Data collection, case studies or interviews of the individuals suffering from diseases; and Submission of report.**

Teaching and Learning Process:

Different instructing strategies shall be adopted including: Lectures, interactive lectures, classroom discussions and practical based on a theory paper by analyzing blood glucose, water samples, soil samples, etc. Use of digital technologies will enable students to get a better understanding of the concepts. Hands-on experience, including diagnostics and student presentations will provide supplement to conventional text books. Field studies will include visits to laboratories for case studies or conducting interview of certain patients.

Assessment Methods:

- Closed-book tests to evaluate the students' knowledge and understanding of material covered in the class.
- Internal evaluation based on the experiment performed during the internal examination or class tests conducted by the internal examiners.
- Dimension of comprehension and capacity to respond to inquiries as a piece of *viva-voce*.
- Involvement in class and group discussions.
- Assignments and Power Point presentation.
- Project work (Students should execute one project of their choice or teacher may assign the project. Project report should be scanned for plagiarism through freely available software and a soft copy of the report should be mandatory).

Keywords:

Health, Hygiene, Deficiency disorders, Communicable diseases, Non-communicable diseases, Pollution, Smoking, Drug dependency, Hypertension

Recommended Books:

- Park, K. (2017), *Preventive and Social Medicine*, B.B. Publishers
- Brownson, R. C., Baker, E.A., Leet T.L., and Follespie K.N. (2003) *Evidence based Public Health*, Oxford University Press.

Suggested Readings:

- Guyton A.C. and Hall J.E. *Textbook of Medical Physiology*, Saunders
- Robbins and Cortan, *Pathologic basis of Disease*, VIII Edition, Saunders
- Engelkirk P.G. and Duben-Engelkirk J. (2015) *Burton's Microbiology for the Health Sciences*, 10th Edn. Wolters Kluwer Health.

Online Tools and Web Resources:

- https://swayam.gov.in/nd1_noc19_ee66/preview
- https://swayam.gov.in/nd1_noc19_ge24/preview
- https://swayam.gov.in/nd1_noc19_mg50/preview
- <https://www.coursera.org/lecture/screening/case-1-hypertension-bfOLx>
- <https://www.coursera.org/lecture/sustainable-agriculture/water-quality-and-regulations-4uCE2>
- <https://www.eawag.ch/en/departement/sandec/e-learning/moocs/>



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