SECTION X
FACULTY OF BASIC SCIENCES AND HUMANITIES

General Information

Disciplines

• Biochemistry
• Botany
• Business Studies
• Chemistry
• Economics and Sociology
• Journalism, Languages and Culture
• Mathematics, Statistics and Physics
• Microbiology
• Zoology
• Course curriculum for Award of 3-year B.Sc. Degree on opting out of 5-year integrated M.Sc. (Hons) Programme in Biochemistry
• Semester-wise Programme for 5-year Integrated M.Sc. (Hons) in Biochemistry
• Course curriculum for Award of 3-year B.Sc. Degree on opting out of 5-year integrated M.Sc. (Hons) Programme in Botany
• Semester-wise Programme for 5-year Integrated M.Sc. (Hons) in Botany
• Course curriculum for Award of 3-year B.Sc. Degree on opting out of 5-year integrated M.Sc. (Hons) Programme in Chemistry
• Semester-wise Programme for 5-year Integrated M.Sc. (Hons) in Chemistry
• Course curriculum for Award of 3-year B.Sc. Degree on opting out of 5-year integrated M.Sc. (Hons) Programme in Microbiology
• Semester-wise Programme for 5-year Integrated M.Sc. (Hons) in Microbiology
• Course curriculum for Award of 3-year B.Sc. Degree on opting out of 5-year integrated M.Sc. (Hons) Programme in Zoology
• Semester-wise Programme for 5-year Integrated M.Sc. (Hons) in Zoology
Basic Sciences provide scientific capital from which practical application of knowledge is
drawn. Keeping in view the significance of basic sciences and humanities for proper understanding
and development of different areas of agriculture and allied fields, the College of Basic Sciences
and Humanities was established in October, 1965. Dr A S Kahlon was the founder Dean of the
College and he continued in this position up to October, 1978. Subsequently, Dr Kulbir Singh Gill
(December, 1978 to February, 1982; August, 1983 to January, 1986), Dr I S Bhatia (February, 1982
to July, 1983), Dr S S Guraya (January, 1986 to May, 1990), Dr C P Malik (June, 1990 to June,
1994), Dr D R Singh (June, 1994 to July, 1996), Dr H S Garcha (April, 1998 to March, 2000), Dr
M.A. Zahir (April, 2000 to December, 2002), Dr A P S Mann (January, 2003 to September, 2005)
and Dr Tejwant Singh (October, 2005 to July, 2009), Dr R S Sidhu (December, 2009 to January,
2015) served as Deans of the College. Presently, Dr (Ms) G K Sangha is working as the Dean of
the College since March, 2015. As a constituent college of the University, the College of Basic
Sciences and Humanities strives to be a centre of excellence for advanced studies in the various
fields within its jurisdiction.

Its teaching and research objectives are:

i) To impart training and to equip students in basic sciences and humanities (both at UG and PG
levels) to provide a scientific base for proper understanding and appreciation of the applied
subjects of agriculture, home science and agricultural engineering and technology as well.

ii) To perform integrated functions of resident instruction, research and extension in all the
disciplines of basic sciences and humanities.

iii) To promote inter-disciplinary resident instruction, research and extension education
programmes at the Punjab Agricultural University.

Before the establishment of PAU, the subjects in basic sciences were taught to B.Sc. (Agri)
students by different sections of Govt. Agricultural College, Ludhiana. After the establishment of
PAU in 1962, five independent departments (viz., Department of Agricultural Journalism,
Languages and Culture; Department of Chemistry and Biochemistry; Department of Economics and
Sociology; Department of Genetics and Department of Physics, Mathematics and Statistics) were
created in 1963 to teach the subjects of basic sciences and humanities.

The Department of Microbiology was established in the College in 1969. The Department of
Business Management was established in 1971 to train students in entrepreneurship and
management disciplines. Two more independent departments were established in 1972, viz.,
Department of Botany by splitting the Department of Botany and Plant Pathology (COA) and
Zoology by splitting the Department of Zoology and Entomology (COA). In the same year, an
independent Department of Physics was also carved out of combined Department of Physics,
Mathematics and Statistics. In 1976, the Department of Chemistry was established by bifurcating
the Department of Chemistry and Biochemistry. Keeping in view the role of biotechnology in
augmenting agricultural production, an independent Biotechnology Centre was established in 1992
which was merged with Department of Genetics in the year 2000, which has now been shifted to
the College of Agriculture. An independent Department of Fisheries was carved out from the
Department of Zoology in 1994, which was later shifted to Guru Angad Dev Veterinary and Animal
Sciences University in the year 2006. The upgradation of the Department of Business Management
to School of Business Studies was done in the year 2012.

At present, the College has eight departments namely, Agricultural Journalism Languages
and Culture; Biochemistry; Botany; Chemistry; Economics and Sociology; Mathematics, Statistics
and Physics; Microbiology; Zoology and one School i.e. the School of Business Studies. The
College is running 28 teaching programmes, which comprise 8 Ph.D., 12 M.Sc., 5 M.Sc.(Hons)
Integrated and 1 Diploma in French, in addition to two Certificate Courses, one in French, and the
second in Interactive Skills and Personality Enhancement.

The details of various degree courses are given below. The year of start of these
programmes is shown in parentheses.

<table>
<thead>
<tr>
<th>Course</th>
<th>M.Sc. Year(s)</th>
<th>Ph.D. Year(s)</th>
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<td>Agricultural Economics</td>
<td></td>
<td>(1963), (1965)</td>
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<tr>
<td>Business Administration</td>
<td>MBA (1971), Ph.D. (1971)</td>
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<td>Business Administration (Agribusiness)</td>
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<tr>
<td>Journalism and Mass Communication</td>
<td>MJMC (2008)</td>
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<tr>
<td>Physics</td>
<td>M.Sc. (2011)</td>
<td></td>
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</tbody>
</table>

M.Sc. and Ph.D. programmes in Statistics were started in 1966 and 1968 but discontinued
from academic year 1999-2000 and 1998-99, respectively. M.Sc. in Statistics has been revived
w.e.f academic year 2016-17. Ph.D. programme in Physics was started in 1992 but discontinued
from the academic session 1998-99. B.Sc. (Hons) programmes in Biochemistry, Botany, Chemistry,
Statistics and Zoology were initiated from academic session 1970-71. The programme in Statistics
was discontinued from the academic session 1975-76 while the remaining 4 programmes were
discontinued from the academic session 1985-86. Total number of students who received B.Sc.(Hons) degree were 366 (Biochemistry-106, Botany-70, Chemistry- 96, Statistics-10 and Zoology-84).

The College of Basic Sciences and Humanities has a special role to play in the University
because it gives support to all the other Colleges. The College, through its own Board of Studies,
approves courses in basic sciences and humanities for all the constituent colleges of the University,
as per their needs and requirements. Since students in the College of Agriculture, College of Home
Science and College of Agricultural Engineering and Technology are admitted after 10th and 10+2,
they are deficient in knowledge in some of the basic sciences and the languages. For the students
admitted after 10th at IOA, Gurdaspur and IOA, Bathinda, the new courses were framed to make
them equivalent with PSEB curriculum of 10+1 and 10+2. The courses offered by the College, thus,
form the scientific base for studying applied courses for the students of these colleges. Many of the
courses offered by the various departments of the College are taken by the postgraduate students
of different disciplines of the other colleges as minor or supporting courses.

The undergraduate and postgraduate courses offered by the College were revised and
updated in the academic year 1982-83. Later on, when the University switched over to semester system in 1988-89, all the courses were again revised/rescheduled and new courses were designed to impart knowledge in Molecular Biology, Genetic Engineering and Biotechnology, Physiology of Plants and Animal and specialized areas in Microbiology including mushroom cultivation. Based on recent advances and changing scenario in sciences, again many of the courses have been revised/modified and new courses added in the academic year 1998-99. New curricula was designed for M.Sc. (Hons) 5 year Integrated programmes in 2008. The entire curriculum for PG courses was restructured again in the year 2010-11 in accordance with the ICAR guidelines. The undergraduate courses offered by the College has been revised as per Fifth Deans' Committee recommendations.

The College has well equipped centralized facilities such as PG Research Laboratory, Molecular Biology Laboratory and Computer Laboratory to cater to the needs of faculty and research scholars. The College has been recognized for its role through various awards and honours received by the faculty and students over the years. The distinguished awards include Shanti Swaroop Bhatnagar Award, Rafi Ahmed Kidwai Award, Hari Om Trust Ashram Award, Hira Lal Chakraborty Award, Basanti Devi and Amar Chand Award and the RT Doshi Foundation Award. The faculty/students have been nominated/elected fellows of NAAS, FNA, German Academic Exchange (DAAD) Fellowship, Fulbright Nehru Fellowship, Cambridge Nehru Scholarship, Commonwealth Academic Staff Scholarships and others.
BIOCHEMISTRY

PROGRAMMES
M.Sc.
Ph.D.
Five Year Integrated M.Sc. (Hons)

COURSE REQUIREMENTS

M.Sc.
Field of Specialization: Plant Biochemistry, Molecular Biochemistry, Enzymology, Abiotic and Biotic Stress Biochemistry.
Supporting Courses: Stat. 421, PGS 501 and other courses from subject matter fields (other than minor) relating to area of special interest and research problem.
Minor Fields: Botany, Microbiology, Food Science and Technology, Plant Breeding and Genetics, Biotechnology or any other as approved by the Dean, Postgraduate Studies.
Deficiency Courses: As recommended by the student's Advisory Committee and approved by the Dean, Postgraduate Studies.

Ph.D.
Field of Specialization: Plant Biochemistry, Molecular Biochemistry, Enzymology, Abiotic and Biotic Stress Biochemistry.
Required Courses: Biochem. 601, Biochem. 602.
Supporting Courses: Courses from subject matter fields (other than minor) relating to area of special interest and research problem.
Minor Fields: Botany, Microbiology, Food Science and Technology, Plant Breeding and Genetics, Biotechnology or any other as approved by the Dean, Postgraduate Studies.
Deficiency Courses: As recommended by the student's Advisory Committee and approved by the Dean, Postgraduate Studies.

Five Year Integrated M.Sc. (Hons)
Field of Specialization: Plant Biochemistry, Molecular Biochemistry, Enzymology, Abiotic and Biotic Stress Biochemistry.
Required Courses: All courses listed for semesters I to VI (Page No. ___*) and Biochem. 501, Biochem. 502, Biochem. 503, Biochem. 504, Biochem. 505 and Biochem. 506.
Supporting Courses: Stat. 421, PGS 501 and other courses from subject matter field (other than Minor) relating to the area of special interest and research problem.
Minor Fields: Botany, Microbiology, Food Science and Technology, Plant Breeding and Genetics, Biotechnology or any other as approved by the Dean, Postgraduate Studies.
Deficiency Courses: As recommended by the student's Advisory Committee and approved by the Dean, Postgraduate Studies.

* Page number according to new RBI.
DESCRIPTION OF COURSE CONTENTS

Undergraduate courses/Integrated M.Sc. (Hons)

Biochem. 101 Introduction to Biochemistry  
2+1  
Sem. I


Biochem. 102 Nutritional Biochemistry-I  
2+1  
Sem. I

Introduction to Biochemistry - Definition, objectives, scope and inter relationship between biochemistry and other biological sciences. Enzymes - Definition, types and classification of enzymes, definition and types of coenzymes, specificity of enzymes, isozymes, enzyme kinetics including factors affecting enzyme action, velocity of enzyme catalyzed reactions, enzyme inhibition. Intermediary metabolism. Carbohydrate metabolism- glycolysis, TCA cycle and energy generation, gluconeogenesis, glycogenesis, glycogenolysis, blood sugar regulation. Lipid metabolism - oxidation and biosynthesis of fatty acids (saturated and mono-unsaturated), synthesis and utilization of ketone bodies, ketosis, fatty liver. Protein metabolism - general reactions of amino acid metabolism, urea cycle, lipoproteins - types, composition, role and significance in disease.

Practical: Handling of equipment and instruments, preparation of samples, solutions and buffers, blood constituents: Estimation of serum protein (Biuret method and Lowry method), blood glucose (Folin Wu method), serum inorganic phosphorus (Fiske and SubbaRow method), creatinine, Urine constituents: Estimation of protein levels, glucose levels in urine, ketone bodies in urine, urine constituents- Repeat.

Biochem. 103 Nutritional Biochemistry- II  
3+0  
Sem. II

Biochem. 104 Principles of Biochemistry 2+1 Sem. II

Biochem. 203 Structure and Function of Biomolecules 3+0 Sem. II

Biochem. 204 Metabolism I 2+0 Sem. I

Biochem. 205 Metabolism II 3+0 Sem. I

Biochem. 206 General Enzymology 2+0 Sem. II

Biochem. 207 Basic Biochemistry 3+1 Sem. II


Biochem. 208 Food Biochemistry and Nutrition 2+1 Sem. II


Biochem. 301 Introduction to Molecular Biochemistry 3+0 Sem. I

Biochem. 302 Basic Experiments in Biochemistry 0+3 Sem. II
Biochem. 303 Introduction to Membrane Biochemistry 3+0  Sem. I

Biochem. 304 Enzymology and Enzyme Technologies 2+1  Sem. I

Biochem. 421 Fundamentals of Biochemistry 3+0  Sem. I & II

Biochem. 423 Fundamentals of Molecular Biochemistry 2+0  Sem. I

Biochem. 424 Experiments in Biochemistry 0+3  Sem. I & II

Biochem. 425 Fundamentals of Plant Biochemistry 2+0  Sem. I

Biochem. 426 Fundamentals of Animal Biochemistry 3+0  Sem. II

**Biochem. 429 Biochemical and Biophysical Techniques**  
3+0  
Sem. II

**Biochem. 430 Fundamentals of Enzymology**  
3+0  
Sem. II

**Biochem. 431 Fundamentals of Membrane Biochemistry**  
2+0  
Sem. II

**Postgraduate Courses**

**Biochem. 501 General Biochemistry**  
3+0  
Sem. I

**Biochem. 502 Intermediary Metabolism**  
3+0  
Sem. II
The living cell a unique chemical system, introduction to metabolism, methods of studying

Biochem. 503 Enzymology 2+0  Sem. I
Enzyme nomenclature and classification. Enzyme compartmentalization in cell organelles. Isolation and purification of enzymes, measurement of enzyme activity. Ribozymes, isozymes, abzymes, enzyme structure, enzyme specificity, active site, active site mapping, mechanism of enzyme catalysis. Cofactors, coenzymes their structure and role, enzyme kinetics, enzyme inhibition and activation, multienzyme complexes, allosteric enzymes and their kinetics, regulation of enzyme activity. Applications of enzymes in chemical and food industry, enzyme immobilization, biosensors and clinical applications of enzymes.

Biochem. 504 Molecular Biochemistry 3+0  Sem. II
Historical development of molecular biology, nucleic acids as genetic material, chemistry and structure of DNA and RNA. Genome organization in prokaryotes and eukaryotes, super coiling. DNA replication, DNA repair, recombination, reverse transcriptase, repetitive and non-repetitive DNA, satellite DNA. Transcription in prokaryotes and eukaryotes process, RNA editing, RNA processing. Genetic code, ribosome structure and function, organization of ribosomal proteins and RNA genes, genetic code, aminoacyl t-RNA synthases, inhibitors of replication, transcription and translation. Translation and post translational modification; protein targeting, nucleases and restriction enzymes, regulation of gene expression in prokaryotes and eukaryotes, molecular mechanism of mutation. DNA sequencing, recombinant DNA technology, different types of vectors, genomic and cDNA library, selection of recombinants, PCR, site directed mutagenesis. Application of recombinant DNA technology.

Biochem. 505 Techniques in Biochemistry 2+0  Sem. I
Chromatographic and electrophoretic methods of separation: Principles and applications of paper, thin layer and HPTLC, gas-liquid chromatography, HPLC and FPLC; paper and gel electrophoresis, different variants of polyacrylamide gel electrophoresis (PAGE) like native and SDS-PAGE, 2D-PAGE, capillary electrophoresis. Spectrophotometry: Principles and applications of UV-Visible, fluorescence, IR and FTIR, Raman, NMR and FTNMR, ESR and X-Ray spectroscopy. Hydrodynamic methods of separation of biomolecules. Viscosity and sedimentation-their principles, variants and applications. Tracer techniques in biology: concept of radioactivity, radioactivity counting methods with principles of different types of counters, concept of α, β and γ emitters, scintillation counters, γ rays spectrometers, autoradiography, and application of radioactive tracers in biology, principles and applications of phosphor imager.

Biochem. 506 Practicals in Biochemistry 0+3  Sem. I
Isolation and determination of important metabolites like soluble sugars, starch, glycogen, amino acids, proteins and peptides, urea, uric acid, fatty acids, triacylglycerols, phospho- and glycolipids, cholesterol from tissues/serum. Applications of paper, thin layer and gas liquid chromatography. Estimation of enzymes of clinical importance. Study of the effect of enzyme and substrate concentrations and determination of Km and Vmax, hemoglobin, vitamins, RNA and DNA. Restriction fragmentation and separation of DNA fragments by agarose electrophoresis. RAPD analysis of DNA Isolation, purification and characterization of enzymes by gel permeation, ion exchange and affinity chromatography. Estimation of nitrate reductase, Isolation of plant and animal cell organelles. Application of centrifugation, PAGE, FPLC and HPLC in the separation of biomolecules. Use of radioisotopes in metabolic studies. Antibody
antigen reaction. Enzyme immobilization. Application of PCR. Antigen-Antibody interaction, ELISA.

Biochem. 507 Immunochemistry 2+0 Sem. II
History and scope of immunology, antigens, Adjuvants, immune system, organs, tissues and cells, immunoglobulin’s, molecular organization of immunoglobulin. Classes of antibodies, antibody diversity, theories of generation of antibody diversity, vaccine, monoclonal antibodies, polyclonal antibodies, hybridoma, recombinant antibodies, complement system-classical and alternate. Cellular interactions in the immune response, major histocompatibility complex, cell mediated immune response, cytokines. Immunoregulation, immunological tolerance, hypersensitivity, mechanisms of immunity, Innate resistance and specific immunity. Current immunological techniques-ELISA, RIA.

Biochem. 508 Plant Biochemistry 3+0 Sem. I

Biochem. 509 Animal Biochemistry 3+0 Sem. II
Digestion and absorption of food, vitamins detoxification, biochemistry of specialized tissues - connective tissue, skin, muscle, nervous tissue and blood and other body fluids. Water, electrolyte and acid-base balance, biochemistry of respiration, structure, function and mechanism of major trace elements. Hormones of thyroid, hypothalamus, pituitary, pancreas, adrenals and sex hormones. Membrane receptors of hormones signal transduction, biochemistry of reproduction.

Biochem. 510 Food and Nutritional Biochemistry 2+1 Sem. I
Fundamentals of human nutrition, concept of balanced diet, biochemical composition, energy and food value of various food grains (including cereals, pulses, and oilseeds), fruits and vegetables. Physico-chemical, functional and nutritional characteristics of carbohydrates, proteins and fats and their interactions (emulsions, gelation, browning etc.). Biochemical and nutritional aspects of vitamins, minerals, nutraceuticals, anti-nutritional factors, biochemistry of post-harvest storage. Enzymes in food industry. Effect of cooking, processing and preservation of different food products on nutrients, biochemical aspects of food spoilage, role of lipase and lipoxigenase, oxidative rancidity and antioxidants. Food additives (coloring agents, preservatives etc.), biogenesis of food flavors and aroma, nutritional quality of plant, dairy, poultry and marine products.

Biochem. 601 Advanced Enzymology 3+0 Sem. II
Theory of enzymatic catalysis, specificity, concept of active site and enzyme substrate complex, different approaches for determining active site amino acids, active site mapping, acid-base and covalent catalysis, factors associated with catalytic efficiency, proximity and orientation,
distortion and strain, induced fit hypothesis, mechanism of enzyme reactions. Effect of different factors affecting enzyme activity, transition state theory, enzyme purification, Arrhenius equation, determination of energy of activation, kinetics of pH and temperature and determination of pKa and $\Delta$H° on of active site amino acids, Kinetics of bi-substrate reactions, product inhibition and use of competitive inhibitors in the study of substrate binding order. Mechanism determination by radioisotope exchange, kinetics of mixed inhibitions, substrate and product inhibition. Role of enzymes in regulation of metabolism, allosteric enzymes and their kinetics, enzyme engineering, Bi-functional enzymes.

**Biochem. 602 Advanced Molecular Biochemistry** 3+0 Sem. II

**Biochem. 603 Biochemistry of Biotic and Abiotic Stress** 3+0 Sem. I
Plant-pathogen interaction and disease development; molecular mechanisms of fungal and bacterial infection in plants; changes in metabolism, cell wall composition and vascular transport in diseased plants. Plant defense response, antimicrobial molecules; genes for resistance, hypersensitive response and cell death; systemic and acquired resistance. Plant viruses, host-virus interactions, disease induction, virus movement, and host range determination; viroids, pathogen-derived resistance. Biochemical basis of abiotic stresses namely osmotic (drought, salinity), temperature, heavy metals, air and water pollutants, synthesis and functions of proline and glycine betaine in stress tolerance, interaction between biotic and abiotic stresses; stress adaptation. Reactive oxygen species and biotic and abiotic stress, antioxidants, enzymes defense system. Role of calcium, nitric oxide and salicylic acid in plant development. Molecular strategies for imparting tolerance against biotic and abiotic stress.

**Biochem. 604 Current Topics in Biochemistry** 2+0 Sem. II
Advanced topics related to nutrition, metabolism, enzymology, industrial biochemistry, molecular biochemistry, immunology, signal transduction, metabolic engineering and bioprospecting. Any other advance topic of current interest.

**Biochem. 605 Genomics, Proteomics and Metabolomics** 3+0 Sem. I
Protein and nucleic acid sequencing, various methods of sequencing including automated sequencing and microarrays, whole genome sequencing analysis Comparative genomics, functional genomics, transcriptomics, gene identification, gene annotation, pair- wise and multiple alignments, application of genomics, quantitative PCR, SAGE, MPSS, microarray analysis. Proteome technology 2 D- PAGE, MSMS, MALDI-TOF, protein microarray, comparative proteomics and structural proteomics. Metabolic pathway engineering, vitamin A engineering in cereals, role of bioinformatics in functional genomics.

**Biochem. 591 Seminar**

**Biochem. 600 Master's Research**

**Biochem. 700 Ph.D. Research**
**BOTANY**

**PROGRAMMES**

**M.Sc.**

**Ph.D.**

**Five Year Integrated M.Sc. (Hons)**

**COURSE REQUIREMENTS**

**M.Sc.**

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<th>Field of Specialization</th>
<th>Plant Physiology, Biosystematics</th>
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<tr>
<td>Required Courses</td>
<td>Bot. 501, Bot. 502, Bot. 503, Bot. 504, Bot. 505</td>
</tr>
<tr>
<td>Supporting Courses</td>
<td>Stat. 421, PGS 501 and other courses from subject matter fields (other than Minor) relating to area of special interest and research problem.</td>
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</tbody>
</table>

**Minor Fields**

Biochemistry, Biotechnology, Horticulture, Microbiology, Plant Breeding and Genetics, Plant Pathology, Vegetable Crops or any other as approved by the Dean, Postgraduate Studies.

**Deficiency Courses**

As recommended by the student's Advisory Committee and approved by the Dean, Postgraduate Studies

**Ph.D.**

<table>
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<th>Field of Specialization</th>
<th>Plant Physiology, Biosystematics</th>
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<tr>
<td>Required Courses</td>
<td>Bot. 601, Bot. 602</td>
</tr>
<tr>
<td>Supporting Courses</td>
<td>Courses from subject matter fields/other than Minor relating to area of special interest and research problem.</td>
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**Minor Fields**

Biochemistry, Biotechnology, Horticulture, Microbiology, Plant Breeding and Genetics, Plant Pathology, Vegetable Crops or any other as approved by the Dean, Postgraduate Studies.

**Deficiency Courses**

As recommended by the student's Advisory Committee and approved by the Dean, Postgraduate Studies

**Five Year Integrated M.Sc. (Hons)**

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<th>Field of Specialization</th>
<th>Plant Physiology, Biosystematics</th>
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<td>Required Courses</td>
<td>All courses listed for Semester I to VI (P-____ *) and Bot. 501, Bot. 502, Bot. 503, Bot. 504, Bot. 505, Bot. 591.</td>
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<tr>
<td>Supporting Courses</td>
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**Minor Fields**

Biochemistry, Biotechnology, Horticulture, Microbiology, Plant Breeding and Genetics, Plant Pathology, Vegetable Crops or any other as approved by the Dean, Postgraduate Studies.

**Deficiency Courses**

As recommended by the student's Advisory Committee and approved by the Dean, Postgraduate Studies.

* Page number according to new RBI.
DESCRIPTION OF COURSE CONTENTS

Undergraduate courses/Integrated M.Sc. (Hons)

Bot. 51 Agricultural Botany 1+1 Sem. I
Practical: Study of one specimen from each group of plant kingdom. Morphology of root and stem and their modifications. Parts of leaf, types of leaf, phyllotaxy, venation and modifications of leaf. Racemose, cymose and special types of inflorescence. Different types of fruits. Structure of monocot and dicot seed. Epigeal and hypogeal germination. Study of one specimen from each of the above mentioned families

Bot. 91 Basic Plant Physiology 3+1 Sem. II
Plant water relations-diffusion, imbibition, osmosis, plasmolysis, water potential; transport in plants: movement of water, gases and nutrients; cell to cell transport- diffusion, facilitated diffusion, active transport long distance transport of water- absorption, apoplast, symplast, transpiration pull, root pressure and guttation; opening and closing of stomata uptake and translocation of mineral nutrients; transport of food; phloem transport, mass flow hypothesis mineral nutrition- essential minerals, macro and micronutrients and their role; deficiency symptoms; mineral toxicity; elementary idea of hydroponics as a method to study mineral nutrition nitrogen metabolism- nitrogen cycle, biological nitrogen fixation photosynthesis- site of photosynthesis, pigments involved in photosynthesis (elementary idea); photochemical (cyclic and non cyclic photophosphorylation) and biosynthetic phases (C₃, C₄ and CAM pathways) of photosynthesis, factors affecting photosynthesis respiration- exchange of gases; cellular respiration - glycolysis, fermentation (anaerobic),TCA cycle and electron transport system (aerobic); energy relations - number of ATP molecules generated; respiratory quotient. Plant growth and development- phases of plant growth and plant growth rate; conditions of growth; differentiation, dedifferentiation and redifferentiation; seed germination; factors affecting germination and seed dormancy, types of dormancy and factors affecting it phytohormones- auxin, gibberellin, cytokinin, ethylene, ABA, brief account of senescence, photoperiodism and vernalization

Bot. 92 Plant Reproduction and Biotechnology 3+1 Sem. II
Modes of reproduction- asexual and sexual, binary fission, budding, fragmentation, vegetative propagation Sexual reproduction in flowering plants Development of male and female gametophytes; Pollination-types, agencies and examples; Outbreeding devices; pollen-pistil interaction. Double fertilization; Post fertilization events- development of embryo and endosperm Development of seed and fruit formation and significance of seed and fruit formation. Special modes-apomixis, parthenocarpy, polylembrony. Principles and process of biotechnology; Genetic engineering (recombinant DNA technology) Application of biotechnology in agriculture; Gene therapy; Genetically modified organisms- Bt crops;
Biosafety issues - biopiracy and patents.
Practical: Exercise on controlled pollination- emasculation, tagging and bagging. Study of pollen grains of different plants by making slides. Comparative study of various flowers adapted to pollination by different agencies (wind, insects)

Bot. 101 Basic Botany 2+1  Sem. I
Plant kingdom and features of each group; Morphology, modifications and functions of root, stem, leaf, flower and inflorescence; Pollination and fertilization; Fruit types; Structure of dicot and monocot seed, seed germination. Cell structure; DNA, chromosome and genes; Cell and tissue types; Internal structure of root, stem and leaf. Plant taxonomy, systems of classification; Characteristics and economic importance of Poaceae, Brassicaceae, Fabaceae, Malvaceae, Rutaceae, Rosaceae, Asteraceae and Solanaceae families.
Practical: Description of one plant species from each group of plant kingdom; Study of morphology and modifications of root, stem, leaf, flower; Types of inflorescence; Structure of various types of seeds and fruits; Demonstration of cell structure, tissue types; Structure of monocot and dicot root, stem and leaf; One flower from each family.

Bot. 104 Fundamentals of Crop Physiology 1+1  Sem. II
relationship of fruit types; detailed morphology of important crop plants: cereals, pulses, fibre crops and oilseeds.

**Bot. 203 Systematic Botany**  
3+0  Sem. II  
History of plant taxonomy, modern systems of classification; principles of taxonomy; International rules of nomenclature; botanical gardens and herbaria; General account of floral variation, evolutionary affinities and economic importance of representative families of various orders of the series: Thalamiflorae, Disciflorae, Calyciflorae, Infereae, Heteromerae, Curvembryeae, Multiovulatae aquaticae, Multiovulatae terrestris, Microembryeae, Daphnales, Achlamydosporeae, Unisexualae and Ordines anomali. Evolution of families from the series: Microspermae, Epigynae, Coronarieae, Calycinae, Nudiflorae, Apocarpeae and Glumaceae.

**Bot. 204 Plant Histology**  
2+0  Sem. I  
Ultrastructure of cell and its inclusions; cell wall organization and its growth; tissues and tissue systems; shoot and root apical meristems and vascular cambium; anatomy of root, stem, leaf and flower; secondary growth and anomalous secondary growth; distribution of mechanical tissues in plants; galls and tumours; applications of plant anatomy.

**Bot. 205 Botany of Economic Plants**  
2+0  Sem. I  
Recent trends and scope of economic botany; Botanical description and commercial products of major categories of food plants (cereals, millets, pulses, nuts, vegetables and fruits), sugar producing plants, oils (essential and edible oils, fatty oils), beverage-, fibres-, latex- (rubber and other latex products), paper and medicinal plants (drugs obtained from various plant parts), biofuels.

**Bot. 301 Fundamentals of Plant Physiology**  
3+0  Sem. II  
Plant physiology, its scope in agriculture. Structure and functions of cell organelles; osmosis, imbibition, water potential and its components, water absorption, water translocation and transpiration; stomatal mechanisms; source, physiological roles and deficiency symptoms of major and minor elements, absorption and translocation of minerals and cell sap; concepts of photosynthesis and respiration, photorespiration, water culture technique; processes involved in growth and development; plant growth regulators: occurrence, biosynthesis, mode of action and commercial applications.

**Bot. 302 Basic Experiments in Botany**  
0+3  Sem. I  
Description of plant species from each family in technical terms, study of morphology of different plant parts viz., root, stem and leaf; floral biology of important plants; study of cells and tissues by hand sectioning and maceration; study of anatomical structures in longitudinal and transverse sections of root, stem and leaf. Study of cell, cytoplasm and nucleus; demonstration of processes of osmosis, imbibition, plasmolysis; role of factors affecting photosynthesis and respiration; deficiency symptoms of nutrients in crop plants; processes involved in growth and development.

**Bot. 303 Algae, Fungi and Lichens**  
2+1  Sem. I  
Introduction, classification, comparative morphology, reproduction, perennation; economic importance; interrelationships and evolutionary tendencies of algae; structure, reproduction and life cycle of algal species belonging to the different groups viz., Cyanophyta, Chlorophyta, Xanthophyta, Chrysophyta, Euglenophyta, Phaeophyta and Rhodophyta. Nomenclature and classification of fungi belonging to classes Phycomycetes, Ascomycetes, Basidiomycetes and Fungi Imperfecti; general characteristics and life cycles of important genera of fungi and lichens.  
Practical: Study of the morphology of different algae and fungi, monographic study of some important algae and fungi.
**Bot. 304 Bryophyta** 2+1 Sem. II
Introduction; classification, origin and economic importance of bryophytes, their ecology and distribution. Hepaticae and Anthoceratae: General characters and classification, gametophytes of thalloid and leafy liverworts. Asexual reproduction, sporophytes of liverworts. General account of Anthoceratae and their evolutionary tendencies. Musci: General characters and classification, range of gametophyte structure, asexual and sexual reproduction, sporophyte and alternation of generation; origin and evolution of sporophyte; geographical distribution; cytogenetics and speciation. Practical: Study of representative types belonging to different groups.

**Bot. 305 Pteridophyta** 2+1 Sem. II
Introduction; general features; classification; life cycle and alternation of generation; salient features of different groups like Psilophyta, Lycophyta, Sphenophyta and Pterophyta. Study of life histories of following important genera e.g. Selaginella, Psilotum, Lycopodium, Isoetes, Equisetum, Ophioglossum, Dryopteris, Marsilea, Azolla and Salvinia. Origin of Pteridophyta, apogamy and apospory; stelar system, telome theory and evolution of sporophyte; heterospory and seed habit, gametophytes of pteriodophytes; fossil pteriodophytes. Practical: Study of representative types belonging to different groups.

**Bot. 306 Gymnosperms** 2+1 Sem. II
General description; Differences between gymnosperms, higher cryptogams and angiosperms; classification of gymnosperms; detailed study and life cycle of Gingko, Cycas, Biota, Pinus, Ephedra, Gnetum, Welwitschia, Juniperus and Cupressus; process of fossilization. Practical: Study of morphology, anatomy and reproduction of important genera pertaining to above. Examination of fossil slides.

**Bot. 307 Plant Biodiversity and Environment** 2+1 Sem. I
Concepts of biodiversity, conservation and protection of biodiversity for its suitable utilization; agro-biodiversity and its missions. Diversification of cropping system; introduction of herbal crops in Punjab; vulnerability and extinction of species; endangered species in various ecosystems; use of plant species to check deforestation and desertification; germplasm banks. Response of plants to environmental stresses, greenhouse effect, environmental pollution, pollution of soil and water bodies. Practical: Plant survey methods; excursions and field visits. Effect of environmental factors on plant growth, assimilation rate and biomass partitioning.

**Bot. 401 Plant Physiology-I (Plant Water Relations and Mineral Nutrition)** 2+1 Sem. II
Plant cell, membranes, cell organelles; properties of water; osmotic potential, water potential, pressure potential and their relationships; soil water, absorption and translocation of water; plasmolysis, imbibition, stomatal mechanisms, factors affecting water loss, wilting, drought resistance; essential elements: physiological functions and deficiency symptoms of macro and microelements. Mechanism of mineral absorption, factors affecting mineral absorption; microorganisms in relation to nutrient acquisition, nutrient use efficiency. Nutrients in metabolism and disease tolerance. Practical: Cell structure; preparation of solutions. Demonstrations of processes of diffusion, osmosis, imbibition and plasmolysis; measurements of water potential, membrane permeability, root pressure, guttation, ascent of water, transpiration.; deficiency symptoms of nutrients in crop plants; phloem mobility; cation exchange capacity in plant species.

**Bot. 402 Plant Physiology-II (Plant Metabolism)** 2+1 Sem. II
Photosynthesis; plant pigments, photosystems, light and dark reactions in C3, C4 and CAM plants; respiration, glycolysis, pentose phosphate pathway, citric acid cycle, electron transport chain; photorespiration and its significance in plant productivity; secondary metabolites and plant defense systems.

Practical: Characterization of pigments; determination of Hill reaction activity; experiments on photosynthesis and respiration.

**Bot. 403 Plant Physiology-III (Growth, Differentiation and Morphogenesis)**
Mechanics of growth and differentiation in plants; factors affecting growth and differentiation; Plant growth regulators (growth promoters, inhibitors and retardants); photoperiodism and vernalization; physiology of seed formation, maturation, dormancy and germination; fruit ripening. Senescence and programmed cell death. Brief account of morphogenesis; polarity, symmetry, regeneration, tissue culture and abnormal growth. Effect of light, water, temperature and growth on morphogenesis.

Practical: Sigmoid growth curve, bioassays of plant growth regulators, their effects on seed germination and plant growth. Experiments on seed dormancy, senescence and fruit ripening.

**Undergraduate /M.Sc. Supporting /Minor Courses**

**Bot. 421 Water Relations and Mineral Nutrition**
Plant cell, membranes, cell organelles, their structure and function; properties of water; osmotic potential, water potential, pressure potential and their relationship; plasmolysis, imbibition; absorption and translocation of water; stomata, stomatal mechanism, factors affecting water loss, drought resistance -physiological and molecular basis, essential elements, deficiency symptoms; physiological roles and deficiency diseases; mineral absorption and translocation. Ion uptake, microorganisms in relation to nutrient acquisition, uptake by roots; nitrogen metabolism - proteins, nucleic acids and enzymes; yield and mineral nutrition, nutrient use efficiency; molecular aspects of nutrient uptake and transport.

Practical: Cell structure; preparation of solutions, diffusion, osmosis, imbibition, plasmolysis, measurements of \( \psi_w \) and \( \psi_s \); membrane permeability, root pressure, guttation, ascent of water, transpiration experiments; deficiency and toxicity symptoms of nutrients in crop plants; demonstration of ion channels; phloem mobility of various nutrients; estimation of ferrous ions in leaves; plant analysis for N, P and S; cation exchange capacity in plant species; catalase, peroxidase and nitrate reductase activities as indicators of nutrient status of a crop; effect of toxic elements on germination and growth of seedlings.

**Bot. 422 Photosynthesis, Respiration and Metabolism**
Photosynthesis: history, structure of chloroplast, pigments; principles of light absorption by chloroplast, photosystems, photophosphorylation, ATP synthesis; \( \text{CO}_2 \) fixation and reduction, carbohydrate synthesis, \( \text{C}_3 \), \( \text{C}_4 \) and CAM plants; translocation of metabolites; photorespiration - its mechanism and significance in plant productivity; environmental and agricultural aspects of photosynthesis, photosynthetic efficiency, source-sink relationships and productivity. Respiration: history, mitochondria structure, glycolysis, Krebs cycle, oxidative phosphorylation, cyanide resistant respiration, climacteric and salt induced respiration; energy relationship of aerobic and anaerobic respiration; pentose phosphate pathway, anaerobic respiration; metabolism of lipids and other natural products; fats and oil, phenolic compounds, phytoalexins, lignin, flavonoids, betalains, alkaloids, waxes, cutin and suberin.

Practical: Experiments related to photosynthesis; chlorophyll and other pigment determinations, Hill reaction activity; anatomical characterization of \( \text{C}_3 \), \( \text{C}_4 \) and CAM plants. Experiments related to respiration; respiratory quotient; determination of sugar, starch and...
proteins.

**Bot. 423 Physiology of Growth and Development** 2+1 Sem. I
Concepts of growth, differentiation and pattern formation; growth curves, meristems, growth kinetics, factors affecting growth and general aspects of development, level of differentiation, control of development at genetic level. Hormones and growth regulators - auxins, gibberellins, cytokinins, ethylene, ABA, other inhibitors, retardants, polyamines, aliphatic alcohols, brassins, hormonal regulation of growth and development, plant movements; photoperiodism, phytochrome, flowering hormones, vernalization, abscission, ageing, senescence; physiology of seed and fruit development; seed germination; seed and bud dormancy. Plant physiology and agriculture

**Bot. 424 Plant Anatomy** 2+1 Sem. II
Cell structure, cell wall, meristems; tissues and tissue systems; primary and secondary xylem and phloem; vascular cambium; periderm; internal structure of monocot and dicot root, stem, leaf, fruit and seed; secondary growth - normal and anomalous; storage region in root and tuber crops; origin of lateral and adventitious roots; healing of wounds, grafting and abscission; ecological anatomy; leaf anatomy of C3, C4 and CAM plants.
Practical: Cell structure, cell wall - permanent slides and slide preparation; simple and double staining to study different types of simple and permanent tissues, leaf, root, stem, fruit and seed; study of normal and anomalous secondary growth; anatomy of representative storage roots and tuberous crops.

**Bot. 425 Taxonomy of Angiosperms** 2+1 Sem. I
History of plant taxonomy; modern systems of classification; principles of taxonomy, modern trends in plant classification; chemotaxonomy; numerical taxonomy; international rules of nomenclature; relationships of experimental and orthodox taxonomy; taxonomy in relation to anatomy, cytology, palynology, embryology and chemistry. General account of floral variations, evolutionary affinity and economic importance of families-Ranunculaceae, Papaveraceae, Brassicaceae, Malvaceae, Rutaceae, Caesalpinaceae, Mimosaceae, Rosaceae, Scrophulariaceae, Chenopodiaceae, Euphorbiaceae, Solanaceae, Cucurbitaceae, Papilionaceae, Liliaceae, Amaryllidaceae, Cyperaceae and Poaceae.
Practical: Technical terms and symbols used in description of plants and descriptive procedure for taxonomic studies, detailed study of taxonomic features of at least one plant belonging to above families. Demonstration of various herbarium techniques and collection of local flora.

**Bot. 426 Morphology of Crop Plants** 2+1 Sem. II
General morphology and origin of important crop plants, i.e. wheat, rice, maize, cotton, groundnut, mustard, sunflower, sugarcane, potato and pulses; vegetative and reproductive growth of these plants with emphasis on their floral biology, mode of reproduction, seed formation and economic importance.
Practical: Study of morphology and floral biology of the above crop plants.

**Postgraduate Courses**

**Bot. 501 Cellular and Developmental Plant Physiology** 3+1 Sem. I
Structure and physiological functions of plant cell and cell inclusions; mechanism of water uptake, aquaporins, transpiration, stomata structure, stomatal movement, antitranspirants; mineral elements, their role in plant metabolism; transport proteins; mechanism of uptake and translocation of minerals in plants, nutrient deficiency and toxicity; N, P and S metabolism;
photosynthesis, its importance in bioproductivity, photochemical reactions, CO2 fixation in C3, C4 and CAM plants, photorespiration, carbohydrate synthesis, translocation of photosynthates and source-sink relationship; mitochondrial respiration, ATP synthesis, cyanide resistant respiration; plant growth regulators, their biosynthesis, mechanism of action and their role in agriculture; regulation of growth and development; physiology and biochemistry of seed dormancy and seed germination; photomorphogenesis, photoreceptors, photoperiodism; vernalization; senescence and abscission; fruit growth and ripening; biotic and abiotic stresses (drought, flooding, salinity, high and low temperature, anoxic and radiation) affecting plant metabolism and growth; signal transduction in plants cells.

Practical: Measurement of plant water status; determination of water potential and its components; physiological role and deficiency symptoms of macro- and micro-elements; characterization of plastids; pigments; determination of Hill reaction activity; experiments demonstrating involvement of ion channels in ion uptake and calcium in signal transduction; sigmoid growth at organ and whole plant level; bioassays to demonstrate the occurrence of plant hormones; experiments demonstrating physiological effects of PGRs; experiments on tropism, seed dormancy, germination, senescence and fruit ripening.

Bot. 502 Plant Anatomy and Embryology 2+1 Sem. I
Modular, tissue and cellular organization of plant body; differentiation, totipotency and morphogenesis; ultrastructure of plant cell, development of cell wall; tissues - their ontogeny in relation to functional specialization, transfer cells; meristems; structure and development of stem, root and leaf, stomata and secretory tissues; origin of cambium, unusual secondary growth, structure of flower, mega and microsporogenesis, pollen pistil interactions, fertilization, embryo development, polyembryony, parthenogenesis, parthenocarpy, abscission, healing of wounds and union of grafts; application of applied plant anatomy and embryology in crop improvement.
Practical: Study of structure of parenchyma, collenchyma, sclerenchyma, xylem and phloem, transfer cells, laticifers, stomata, epidermal glands; structure and organization of shoot apex and root apex; origin of procambium and cambium; secondary growth and anamolous secondary growth; variations in organization in stem, root and leaf.

Bot. 503 Taxonomy and Biosystematics 2+1 Sem. I
Principles of taxonomy as applied to systematics and classification of plant kingdom; plasticity of phenotype, phenotypic variability; plant geography; sympatric and allopatric taxa; primary and secondary centres of origin; adaptive radiations; abrupt and general speciation mechanisms; speciation in vegetatively reproducing plants; ecological properties of a species; pattern of ecotypic differentiation; structural, biochemical and molecular systematics; modern systems of classification; numerical taxonomy; herbaria; botanical gardens; floristics and botanical survey of India; taxonomic structure; diagnostic features and economic importance of important families. origin and evolution of economically important plants; plants and civilization; botany, utilization, cultivation and improvement of plants of food, drug, fibre and industrial use; unexploited plants of potential economic value; plants as a source of renewable energy.
Practical: Description of families (Magnoliaceae; Papaveraceae; Brassicaceae; Malvaceae; Rutaceae; Meliaceae; Fabaceae; Rosaceae; Myrtaceae; Cucurbitaceae; Apiaceae; Rubiaceae; Asteraceae (Compositae); Solanaceae; Scrophulariaceae; Lamiaceae; Chenopodiaceae; Euphorbiaceae; Orchidaceae; Musaceae; Zingiberaceae; Amaryllidaceae; Liliaceae; Arecales; Araceae; Cyperaceae and Poaceae) collection of plants and preparation of herbarium; identification of economic plants and plant products. Excursions and field visits.

Bot. 504 Plant Ecology 2+1 Sem. II
Concepts of ecology, autecology, synecology; concepts and dynamics of ecosystems, types of ecosystem; components of food chains and energy flow; succession, management and ecological pyramids; community structure and dynamics, biogeochemical cycling, climate and vegetation of India; ecological adaptations; environment pollution, environmental monitoring, environment impact assessment, sustainable development, remote sensing of ecological research, economic importance of microbes, plants and animals.

Practical: Experiments on community structure and dynamics, floristic composition; succession. Experiments on pollution, remote sensing of agricultural and ecological systems.

**Bot. 505 Plant Biotechnology**  
2+0  
Sem. II

Principles and methods of genetic engineering of plants with particular reference to photosynthesis, nitrogen fixation and seed proteins; rapid plant propagation by tissue culture; cell lines; cell clones; in vitro approaches to the genetic manipulation of plants; blotting technique; polymerase chain reaction, protoplast fusion, somatic hybridization; hybrid and cybrid production; haploid plant production; somatic embryogenesis and artificial seeds; hybridoma technology; allopheny; pre-fertilization treatments of pollen for directed genetic change; in vitro manipulation of ovule tissues; germplasm maintenance and storage; growth regulators in relation to plant productivity; Prospects of Plant Biotechnology in crop improvement; molecular farming; molecular probes; omics technologies and their applications.

**Bot. 506 Histochemistry and Plant Ultrastructure**  
1+1  
Sem. II

Histochemistry and cytochemistry - principles; botanical microtechniques; stains and staining procedures; microscopy - principles of light and electron microscopes; microscopic measurements; general structure, importance and histochemical procedures for localization of reserve substances like polysaccharides, lipids, proteins, nucleic acids and some important enzymes in plant tissues; histochemical analysis of some plant processes like abscission, reproductive development, stomatal movement, etc. Ultrastructure of plant cell membrane, cell wall, nucleus and some organelles; endoplasmic reticulum; lysosomes; ultrastructure of meristematic cells; phloem, cambium, guard cells, embryosac, etc.; role of histochemistry in collation of structure with function.

Practical: Processing of plant material for microtome sectioning and preparation of slides; histochemical localization of reserve substances and enzymes in plant cells/tissues in hand sections and microtome sections.

**Bot. 507 Plant Biodiversity and Environmental Conservation**  
1+1  
Sem. I

Agrobiodiversity, its missions and concerns; conservation and protection of biodiversity for its sustainable utilization; multipurpose tree management; diversification of cropping system; introduction of herbal crops in Punjab; vulnerability and extinction of species; distribution and ecology of endangered species in various ecosystems; use of plant species to check deforestation, desertification and pollution of water bodies; germplasm banks.

Practical: Plant survey methods; plant diversity at PAU campus, diversity in medicinal herbs, shrubs and trees, diversity in ornamental and field visits.

**Bot. 508 Plant Morphogenesis**  
2+1  
Sem. II

Organization of structure and function at molecular, cellular, tissue, organ and whole plant level, cellular polarity and regulation of cell and tissue dimension, pattern formation and cellular differentiation, organization of shoot apical meristem, leaf development and differentiation, root apical meristem, root hair, stomata and trichome development, floral development and differentiation, seed and fruit development; Organogenesis of root, stem, leaf, flower, fruit, and seed. Totipotency; apical dominance and phase change; biochemical, physiological and hormonal plant mutants, hormones, agonists; elements of cellular transduction in relation to differentiation in plants; programmed cell death;
photomorphogenesis; in vitro regulation of differentiation and development in higher plants.
Practical: Effect of light, temperature and plant growth regulators on cellular differentiation and organogenesis.

Bot. 509 Environmental and Stress Physiology 2+1 Sem. II
Principles of environmental physiology; Response of plants to abiotic stresses and its effect on productivity; interactions between biotic and abiotic stresses; plant responses to freezing, chilling and high temperature- role of membrane lipids, HSP's; drought, osmoprotectants, water use efficiency as drought resistant trait; soil salinity, species variation to salt tolerance, flooding and anaerobiosis; radiation stress; air and water pollutants; green house effects at cellular and whole plant levels; heavy metal stress; physiological and molecular mechanisms to combat stresses by plants; stress and hormones, ABA as signaling molecule; cytokinin as a negative signal, oxidative stress and role of reactive oxygen species (ROS) scavenging system (SOD and Catalase etc); basic principles of crop improvement programmes under stress. mineral cycling and energy transfer in biotic and abiotic components; mutualism, competition, allelopathy; crop-land ecosystem.
Practical: Laboratory and field experiments on the effect of abiotic stresses, e.g. water high temperature salinity, heavy metal toxicity, pollutants, radiation; estimation of free fatty acids level, membrane integrity; and proline content in relation to abiotic stresses, estimation of nitrates in irrigation waters, allelopathy and composition in agri-ecosystems.

Bot. 510 Growth Regulators 2+1 Sem. II
Plant growth regulators; definition, classification, biosynthesis, transport, metabolism, physiological role and mechanism of action of auxins, gibberellins, cytokinins, ethylene, abscisic acid, polyamines, phenols, salicylic acid, triacontanol, brassinolides, jasmonic acid; concept of death hormone - nitric oxide, etc.; inhibitors, retardants, synthetic growth regulators and their practical utility in agriculture and horticulture; concept of second messengers; hormone receptors; pathways of signal transduction associated with plant hormones; hormone mutants and transgenic plants in relation to hormone action; hormonal regulation of gene expression; application of hormones in rooting of cuttings, apical dominance, flowering and fruit development.
Practical: Bioassasys, effects and mechanism of action of growth regulators; demonstration of hormonal mediated signal transduction.

Bot. 601 Advances in Botany 3+0 Sem. II
Plant development- new perspectives, molecular and hormonal coordination of plant development; recent development in control of phyllotaxic patterns of plants; programmed cell death; secretory tissues in plants; applications of plant anatomy in structure-function correlations; impact of environmental pollution on plant structure; plant defense mechanism in disease resistance; epicuticular waxes and role in stress tolerance; phytoremediation; phytoextraction of toxic metals; molecular mechanisms of roots nodule development; nitrogen fixation by legumes in tropical and sub- tropical crops; biofertilizers; long-distance signaling to control root nodule number and role of flavonoids; recent development in plant tropism: providing the power of movement to sessile organisms; membrane traffic within the golgi apparatus and intra-golgi cargo transport; COPI vesicles as long distance carriers; alkaloid biosynthesis- histochemistry and metabolism; crop simulation models in agriculture; mechanism of carnivorous nutrition in higher plants; retrograde signaling in plants: from plastid to nucleus; weed biology, ecology and physiology, weed and crop competition, allelochemicals their nature and impact, weed- seed physiology; application of nanotechnology in agriculture.

Bot. 602 Advances in Plant Physiology 3+0 Sem. II
Recent advances in plant physiology and molecular biology; plant hormones and their role in
integration of growth and development; hormones receptors, transduction process, effector molecules and gene expression; hormone action mutants, elements of signaling pathways and mechanism of signal transduction; two components sensing system; cross talk in the signaling of different hormones; calcium a silver bullet in signaling and regulation of metabolism; abiotic stress signaling, case studies with different stresses; transgenic approaches in improving physiological processes; importance of mutants in unraveling physiological processes; molecular aspects of nutrient uptake and transport, nutrient sensing and signaling; ABC- transporters; conventional and biotechnological approaches to improve yield potential and quality of crop plants. New emerging technologies and their scope in crop improvement; scope of plant physiology in the era of second green revolution.

Bot. 603 Advances in Reproductive Biology 2+0 Sem. I
Introduction; approaches to study mechanisms of reproductive development; cell determination and cell interactions in reproductive meristems; floral induction, physiological signals and multi-factorial system of control of floral metamorphosis; ABC model for floral organ specifications; development of egg cell and its role in fertilization; suspensor and its importance in embryo development; endosperm origin, development and functions; molecular basis of microsporogenesis; Self-incompatibility mechanisms; mutations affecting gametophyte development; regulation of pollen viability, germination and tube growth; pollen-pistil interactions, new concepts of recognition in plants; seed development, deposition of storage reserves, embryo maturation and desiccation; cytoplasmic male sterility and hybrid seed production; fruit development, fruit ripening and role of fruit wall in seed development; physiological and molecular aspects of fruit ripening and senescence, role of plant hormones in reproductive development; scope for genetic modification of post harvest life of flowers and fruits; mechanism of seed and fruit abortion and means to overcome it; impact of environmental factors on reproductive development in relation to productivity.

Bot. 604 Advances in Morphogenesis 2+0 Sem. I
Introduction, phenology of morphogenesis; cell cycle - historical perspectives, mechanism and regulation; cytokinesis in pattern formation- meristems in plant development; initiation and regulation of development pathways; hormonal regulation of developmental processes; apical dominance; abnormal plant growth- hormonal and elemental control; photomorphogenesis- photoreceptors for various light regions; phytochrome and light control of plant development; blue-light mediated responses and morphogenesis; photoregulated gene expression in plants; phytochrome transgenes - their biotechnological applications; plasmodesmata-dynamics, domains and patterning and intracellular communication through plasmodesmata; morphogenesis and molecular genetic analysis of trichome development; asymmetric cell division in plants; plasma membrane interaction with the cytoskeleton and cell wall; morphogenetic and molecular aspects of stomatal development; orientation of spacing and patterning of stomata; genetic architecture of leaf morphogenesis, model for leaf morphogenesis.

Bot. 605 Molecular Approaches for Improving Physiological Traits in Crop Plants 3+0 Sem. I
Introduction to physiological traits relevant to growth, development and productivity, nutrient acquisition; abiotic and biotic stress tolerance; importance of mutants in unraveling important physiological processes; importance of molecular plant breeding in crop improvement; basic aspects of genomics, proteomics, and metabomics and their potential applications; genetic markers and their comparison with conventional methods; PCR : rationale, techniques and applications; DNA- based marker systems and their applications; strategies for quantitative traits loci (QTL) introgression and marker assisted selection (MAS) for crop improvement; recombinant DNA technology: gene transfer methods; selection of transformants and their analysis using physiological / biochemical and molecular
approaches; applications of transgenics; molecular farming; issue related to biosafety and registration of genetically modified (GM) crops.

Bot. 606 Plant Responses to Climatic Change and Abiotic Stresses
2+0 Sem. II
Climate change and its implications; greenhouse gases and their influence on global warming and climate change; long and short-term projections of climate change: effects on natural vegetations and ecosystems, crop-pest interaction, area shift, food production and supply. plant responses to freezing, chilling, heat, drought stress; role of membrane lipids in stress tolerance; function of HSP’s; osmoprotectants, water use efficiency as drought resistant trait; mechanism for tolerance to salinity, heavy metals, flooding, radiation and oxidative stress; ROS and scavenging system; basic principles of crop improvement programme under stress. Approaches to mitigate climate change through studies on plant responses; direct and indirect effects of environmental stresses on plant processes: phenology, net carbon assimilation, water relations, grain development and quality, nutrient acquisition and yield; conventional and biotechnological approaches to improve the crop adaptation to climate change; relevance of "Genome wide mutants" to identify genes/processes for improved adaptation to changing environments; International conventions and global initiatives on carbon sequestration, carbon trading.

Bot. 607 Seed Physiology
2+0 Sem. I
Importance and structure of seeds; physiology of seed and fruit development; environmental effects on seed development: physiological and molecular aspects; seed development patterns and source of assimilates; control processes in mobilization of assimilates in developing seeds of monocots and dicots; chemical composition, biosynthesis, storage of carbohydrates, proteins and fats in seeds; gene imprints and seed and fruit abortion and means to overcome it; seed respiration; seed ageing; chemistry of oxidation of starch, protein and fats, utilization of breakdown products by embryonic axis; inception of germination: hormonal and molecular regulation of seed germination events; seed maturation and desiccation damage: role of LEA proteins; precocious seed germination; seed viability: physiological and genetic aspects to prolong viability; seed vigour: concept, importance, measurement; invigoration - methods and physiological basis: orthodox and recalcitrant seeds; types of seed dormancy, structural and chemical basis of seed coat impermeability and hard seededness; means to overcome dormancy.

Bot. 591 Seminar
Sem. I & II
Bot. 600 Master's Research
Bot. 700 Ph. D. Research
BUSINESS STUDIES

PROGRAMMES

M.B.A.

Ph.D.

M.B.A. (Agribusiness)

COURSE REQUIREMENTS

M.B.A.

Field of Specialization

Required Courses
Mgt. 501, Mgt. 502, Mgt. 503, Mgt. 504, Mgt. 505, Mgt. 506, Mgt. 507, Mgt. 508, Mgt. 509, Mgt. 510, Mgt. 511, Mgt. 512, Mgt. 513.

Supporting Courses
Stat 421, PGS 501 and other courses from subject matter fields (other than Minor) relating to area of special interest and research problem.

Minor Fields
Economics, Sociology, Extension Education, Statistics, Computer Science or any other as approved by the Dean, Postgraduate Studies.

Deficiency Courses
As recommended by the Student's Advisory Committee and approved by the Dean, Postgraduate Studies.

Ph.D.

Field of Specialization
Financial Management, Marketing Management

Required Courses
Mgt. 601, Mgt. 602, Mgt. 695.

Supporting Courses
Courses from subject matter fields (other than Minor) relating to area of special interest and research problem.

Minor Fields
Economics, Statistics, Electrical Engineering (Systems and Control) or any other as approved by the Dean, Postgraduate Studies.

Deficiency Courses
As recommended by the Student's Advisory Committee and approved by the Dean, Postgraduate Studies.

M.B.A. (Agribusiness)

Field of Specialization
Agribusiness Management

Required Courses
ABM 501, ABM 502, ABM 503, ABM 504, ABM 505, ABM 506, ABM 507, ABM 508, ABM 509, ABM 510, ABM 511, ABM 512, ABM 513.

Supporting Courses
Stat 421, PGS 501 Eng 503 and other courses from subject matter fields (other than Minor) relating to area of special interest and research problem.

Minor Fields
Economics, Sociology, Extension Education, Statistics, Computer Science or any other as approved by the Dean, Postgraduate Studies.

Deficiency Courses
As recommended by the Student's Advisory Committee and approved by the Dean, Postgraduate Studies.
DESCRIPTION OF COURSE CONTENTS

Undergraduate Courses

Mgt. 51 Introduction to Marketing Management 2+0 Sem. I
Introduction to marketing management. Marketing concepts and managerial functions of marketing. Understanding market and marketing management, segmentation targeting and positioning. Marketing mix-product, price, place and promotion. Developing marketing strategies for services. Marketing practices of selected Indian companies.

Mgt. 52 Production and Personnel Management 2+0 Sem. II

Mgt. 53 Accounting and Financial Management 2+0 Sem. II

Mgt. 54 Entrepreneurial Development 2+0 Sem. II
Introduction to the concept of entrepreneurship, classification and types of entrepreneurs, women entrepreneurs, institution in aid of entrepreneurs. Steps for starting a small industry, site selection, selection of type of organization. Brief introduction to various functional area of enterprise management viz. finance and accounts, marketing production/operation, personnel, MIS and R&D. Problems of entrepreneurs specially problems faced by women entrepreneurs, key success factors in small scale industry.

Mgt. 201 Entrepreneurship Development and Business Management 2+1 Sem I/II
transforming Indian agribusiness. Government as a regulatory body in agribusiness.
Opportunities and challenges to Indian agribusiness.
Practical: Case studies of successful entrepreneurs, analysis and discussion – assessing
entrepreneurial traits, problem solving skills, managerial skills, achievement motivation and
creativity. Visits to subject specific enterprises and agri-business houses and interaction with
successful entrepreneurs. Formulation of project and report writing for starting a new venture
– idea generation, market and demand feasibility, technical and financial feasibility and project
appraisal techniques. Preparation of complete marketing plan of selected product / service.

Mgt. 202 Marketing Management and International Trade 2+0 Sem. I
Marketing Management - concept, functions and scope. Marketing mix - concept and
elements. Market structure, environment and consumer buying behavior. Marketing research
and marketing information systems. Market measurement and forecasting. Market
segmentation, targeting and positioning. Marketing planning process. Product - policy,
planning and life cycle. Product-mix, product line and new product development process.
Branding, packaging and service decisions. Marketing channel decisions. Retailing,
wholesaling and distribution. Pricing decisions - determination and pricing policy of milk
products in organized and unorganized sectors of dairy industry. Promotion-mix decisions.
Advertising - objectives, budget and message, media planning, personal selling, publicity and
sales promotion. World consumption of food – patterns and type of food consumption across
the globe. Salient features of international marketing, composition and direction of Indian
exports, international marketing environment, and international market entry decision. Direct
exports, indirect exports, licensing, joint ventures, direct investment and internationalization
process, international distribution channels. WTO and world trade agreements related to food
business, export trends and prospects of food products in India; Government institutions
related to international food trade - APEDA, Tea Board, Spice Board, MOFPI, etc.

Mgt. 204 Business Management and Economics 2+0 Sem. II
Management - definition and principles. Management functions - planning, organizing, staffing,
directing – motivation concept and Maslow's hierarchy of needs theory and controlling.
Organization - structure and principles. Types of organization - formal and informal, line and
staff, matrix and hybrid. Introduction to economics - definition, nature, scope, difference
between microeconomics and macroeconomics. Theory of demand and supply, elasticity of
demand, price and income elasticity. Markets - types and their characteristics. National
income - GDP, GNP, NNP, disposable personal income, per capita income and inflation.
Theory of production - production function and factors of production. Law of variable
proportions and law of returns to scale. Cost - short run and long run, fixed, variable, total,
average, marginal and opportunity cost. Break even analysis. Financial management -
definition, scope and objectives. Different systems of accounting – financial, management and
cost accounting. Human resource management - definition, objectives of manpower planning,
process, sources of recruitment, process of selection. Corporate social responsibility –
importance and business ethics.

Mgt. 301 Fundamentals of Entrepreneurship 2+0 Sem. II
Basic concepts of entrepreneurship: need and scope of entrepreneurship, forms of
organization. Steps for starting a small business, various functional areas of business
management. Finance: sources of funds. Production management: production system, site
selection. Marketing: various marketing concepts, marketing mix, distribution and retail
management. Introduction to other functional areas: HRM, MIS, R&D. Institutions supporting
small entrepreneurs. Problems of small entrepreneurs, key success factors for small business.

Mgt. 302 Accounting and Inventory Management 2+0 Sem. I
Preparation of financial statements, understanding published financial statements. Cost accounting: basic concepts, classification of costs, preparation of cost sheet, cost-volume-profit analysis and its applications, use of accounting software. Inventory management: definition, costs, risks, inventory management techniques economic order quantity, re-order level, safety stock, ABC analysis, VED analysis, FSN analysis, ageing schedule etc.

Mgt. 303 Fundamentals of Agri-business Management and Entrepreneurship Development
2+0
Sem. II


Mgt. 304 Agribusiness Management
2+1
Sem. II


Mgt. 401 Fundamentals of Agribusiness Management
2+0
Sem. II


Mgt. 421 Introduction to Management and Marketing
2+0
Sem. II

Nature and process of management, forms of business organization, nature and process of planning. Organizing - nature, process, authority relationship, delegation of authority, centralization and decentralization, directing, communication, motivation, leadership. Controlling - nature and concept, functional areas of management, marketing management -
nature and concept, marketing decisions, marketing strategy, market segmentation and consumer purchase behavior.

Mgt. 422 Agribusiness Management and Trade 3+0 Sem. I

Mgt. 423 Introduction to Entrepreneurship and Marketing 2+1 Sem. I

Mgt. 424 Fundamentals of Marketing Management 2+0 Sem. I

Mgt. 433 Financial and Project Management 3+1 Sem. I

**Mgt. 434 Retailing and Supply Chain Management** 3+0 Sem. I

**Mgt. 491 Agro – Industrial attachment** 0+4 Sem. I
Agribusiness Industry in Public / Private Sector
(for agribusiness Management Practices / Processes)

**Postgraduate Courses**

**Mgt. 501/ABM 501 Principles of Management and Organizational Behaviour** 3+0 Sem. I

**Mgt. 502/ABM 502 Business Environment** 3+0 Sem. II

**Mgt. 503/ABM 503/Econ. 501 Managerial Economics/Micro Economics** 3+0 Sem. I

Mgt. 504/ABM 504 Managerial Accounting and Control 2+1 Sem. I

Mgt. 505/ ABM 505 Marketing Management 3+0 Sem. I

Mgt. 506/ABM 506 Human Resource Management 3+0 Sem. II
handling procedures, arbitration and adjudication, law related to health, safety and welfare of human resources.

**Mgt. 507/ABM 507 Financial Management** 3+0  Sem. II


**Mgt. 508/ ABM 508 Production and Operations Management** 3+0  Sem. II

Nature and scope of production and operations management- its relationship with other systems in the organization. Production functions, work and job design, facilities planning, product and process selection. Product design and development- importance of product design, characteristics of good design, technical process of new product development, design for manufacture, concurrent engineering. Facilities location- importance, location analysis techniques, facilities layout and materials handling. Capacity planning measuring capacity, process of capacity planning, methods for altering capacity in long term and short term. Production planning and control for different types of manufacturing systems, planning and control of projects, work study, method study, work measurement, work sampling, maintenance management, value engineering, quality assurance and quality circles. Total quality management, purchase system and purchase principles, inventory management, stores management, standardization, codification, quality control, certification systems and waste management.

**Mgt. 509/ABM 509 Research Methodology in Business** 2+1  Sem. II


**Mgt. 510/ABM 510 Strategic Management** 3+0  Sem. II

Mgt. 511/ ABM 511/IT 530 Management Information System 2+1 Sem. I
Practical: Use of software packages and simulations for business decision making, use of word processor for report writing and business correspondence, use of spreadsheets for problem solving and analysis of business situations, use of presentation graphics for making business presentations, use of internet and search engines.

Mgt. 512/ ABM 512/Econ. 508/Stat. 527 Quantitative and Optimization Techniques for Economics and Management 2+1 Sem. II
Role of quantitative methods in decision making, probability and decision making under risk and uncertainty, the value of additional information, Bayes theorem, probability models and decision making. Sample survey methods, measurement and forecasting, index numbers, time series analysis, optimization models, linear programming: formulation and simplex method, primal and dual, sensitivity analysis, transportation models and assignment models, dynamic programming, network analysis, PERT and CPM. Game theory: concept, two person constant sums, zero sum games, saddle point, solution to mixed strategies, Markov chain analysis, Queuing models- waiting line problem, characteristics of waiting lines, single channel model, multiple- channel model, constant-service time model, finite population model, sequencing and replacement models. Simulation and Monte Carlo methods.
Practical: Graphical and algebraic formulation of linear programming models. Solving of maximization and minimization problems by simplex method. Formulation of simplex method by typical farm situations. Solution of other numerical problems, case studies, analysis and discussion.

Mgt. 513/ ABM 513 Project Management and Entrepreneurship 2+1 Sem. II
Concept and nature of projects, characteristics and types of projects, generation, identification and screening of project ideas, project life cycle. Formulation of projects: market and demand, technical and financial feasibility, preparation of feasibility report, methods for evaluation and
ranking of projects, risk analysis for projects, impact of inflation on projects, public and private projects, financing of projects, sources of finance and structure of financial institutions related to project financing, venture capital, central and state incentives, contract management for projects. implementation of project: network methods, project scheduling and resource allocation, project control and information system, monitoring and feedback, operational problems in implementation of projects. Concept and theories of entrepreneurship, significance of entrepreneurship in economic development, types of entrepreneurs, women and rural entrepreneurs, qualities of an entrepreneur, entrepreneurship development programmes and role of various institutions in developing entrepreneurship, lifecycle of new business, environmental factors affecting success of a new business, reasons for the failure and visible problems for business, developing effective business plans, procedural steps for setting up an industry.

Practical: Exercises in project formulation, numerical related to project evaluation, risk analysis and case studies.

Mgt. 514 Brand and Advertising Management 2+1 Sem. I

Practical: Case studies, analysis and discussions.

Mgt. 515 International Marketing 3+0 Sem. II

Mgt. 516 Sales Management and Consumer Behavior 2+1 Sem. I

Practical : Case studies, analysis and discussions.

Mgt. 517 Retail Management 3+0 Sem. I

**Mgt. 518 Managing Rural Markets** 2+1 Sem. II  
Nature and magnitude of rural markets in India. Socio-cultural factors in rural marketing. Rural sales organization, special requirements for marketing in the rural areas with regard to product planning, communication channels, media and messages, marketing of agricultural inputs, distribution channels and systems, demand creation and market development, marketing of agri-inputs such as seeds, fertilizers, pesticides and farm machinery. Marketing of agricultural outputs. Determination of agricultural output and prices with special reference ACP Commission, systems of procurement - role of FCI and other procurement agencies, grading farm products, warehousing and cooperative marketing.  
Practical: Case studies

**Mgt. 519 Physical Logistics** 2+1 Sem. II  
Concept and significance of physical logistics and distribution system; marketing and physical distribution process, elements of physical distribution system, transportation and its relation to plant location, warehousing and inventory; modes of transportation optimum relationship between size and frequency of shipments; transportation model; cost analysis and logistic system design; organization and management of physical distribution and logistic systems.  
Practical: Exercise, case studies, analysis and discussions.

**Mgt. 520 Management of Financial Institutions** 2+1 Sem. I  
Concept of capital market - role of specialized financial institutions and commercial banks. Consideration of bank functions, objectives, policies, organizations; management of primary and secondary reserves cash management and portfolio management; management of loans and advances, credit analysis and control. Tandon Committee and Chore Committee recommendations for Bank Financing. Management of funds and income, deposit and deposit mobilization, profitability analysis of commercial banks, management control and appraisal-transfer price mechanism, performance budgeting, evaluation of bank performance. Genesis of specialized financial institutions - IDBI, IFCI, ICICI, UTI, NABARD, LIC, SFCs and Sides - a brief overview of their objectives, functions and role, adequacy of capital and strategy of growth.  
Practical: Case studies, analysis and discussions.

**Mgt. 521 Management Control Systems** 2+1 Sem. I  
Functioning and structure - nature, functioning and objectives of control systems-strategic planning, management control and operational control, organizational relationships in management control, behavioral implications, motivation and goal congruence, management control structure - decentralization, responsibility centers-expense, profit and investment centers. Control process, budgeting and budgetary control, types of budgets and their preparation. Installation and evaluation of comprehensive budgeting control system. Standard costing and budgetary control. Analysis and reporting performance. Special management control situations-service organization, non-profit organizations and control of projects.  
Practical: Case studies and Analysis.

**Mgt. 522 Management of Financial Services** 3+0 Sem. I

**Mgt. 523 Investment Management**

Investment objectives and constraints, types of investors. Investment analysis and stock exchanges in India. Market efficiency, modern portfolio theory, types of investment products. Security analysis- quantitative and qualitative variables, fundamental and technical analysis techniques, fixed income securities, portfolio management and performance measurement, derivative products - futures and options.

Practical: Numerical exercises and case studies, analysis and discussions.

**Mgt. 524 International Financial Management**


**Mgt. 525 Tax Planning**

Concepts and significance of tax planning, tax evasion and avoidance. Tax environment, implications and their impact on financial decision making and enterprise behavior. Fiscal policy and impact of central and state budgets, taxes under the jurisdiction of Union and state governments classification of taxes. Salient features and main legal provisions of income tax and other acts relating to incentives and concessions. Tax planning for individuals and corporate sector.

Practical: Numerical exercises and case studies.

**Mgt. 526 Production Planning and Control**

Nature and objectives of production planning and control, variables subject to control. Production control for continuous, intermittent and project systems. Learning curve effects, production forecasting and production inventories. Aggregate planning guidelines, graphic and charting methods, mathematical planning models. Scheduling philosophy, scheduling methodology and control techniques. Development of means to reporting production and comparison of schedule with actual performance development of standards.

Practical: Exercises in the use of quantitative techniques and analysis and discussion of case studies.

**Mgt. 527/ Econ. 503/ Stat. 511 Econometrics**

Introduction - relationship between economic theory, mathematical economics, models and

Practical: Practicals on single equation two variable model specification and estimation, hypothesis testing, transformations of functional forms and OLS application. Estimation of multiple regression models - hypothesis testing, testing and correcting specification errors, testing and managing multicollinearity, heteroscedasticity, autocorrelation. Estimation of regressions with dummy variables, estimation of regression with limited dependent variable. Identification of equations in simultaneous equation systems.

Mgt. 528 Cost Control and Value Analysis 2+1 Sem. I

Practical: Case studies in value engineering.

Mgt. 529 Work Study 2+1 Sem. II
Work measurement, work simplification or reduction of human effort through simplifying, combing, eliminating or changing processes. Study of process charts, study of symbols. Meaning of effecting work simplification through time and motion study. Development of standard method's and standard times for all operations.

Practical: Exercises, case studies, analysis and discussions.

Mgt. 530 Operations Management 3+0 Sem. II
Planning and organization of operations, operations management concepts, material and equipment inputs, human resource inputs and capital inputs. Use of advanced computer techniques. Directions and control of operations, product and process analysis, forecasting various control techniques including inventory, quality, maintenance and cost control. Operating environment.

Mgt. 531 Purchasing and Materials Management 3+0 Sem. II
Fundamentals of purchasing and materials management, determinants of right materials, quality specifications and standardization, reliability and inspection, price, service and delivery, sources of supply, make or buy decisions, inventory control systems, value analysis/engineering, traffic, stores and record keeping, management of procurement and materials activities, institutional and government purchasing.

Mgt. 532 Personnel Management Practices 2+1 Sem. I
Role of personnel manager in organisation, status and background and personnel managers, personnel policies framework, formulation and execution of policies relating to major personnel functions, current development and role of social and demographic factors in personnel functions. Industrialization - its growth implications and problems. Role of industrial
psychology in job analysis and personnel testing. Performance appraisal, training and development, job and work situation and job satisfaction. Current developments and personnel practices on effective functioning of an organisation.
Practical: Case studies, analysis and discussions.

Mgt. 533 Human Resource Development 3+0 Sem. I
Concept, significance and mechanisms of HRD. Line managers and HRD, Developmental supervision, Management development and HRD. Motivational aspects of HRD. Career planning and development, performance management and internal mobility. Executive training- satisfaction of training needs of executives, supervisions and managers, training programmes, methods and techniques evaluations of training programme and progress, training budget. Management training and development in India. Organizational culture and Quality of Work Life. Organization development (OD) and HRD-components, process and technology of OD, team building.

Mgt. 534 Industrial Relations in India 2+1 Sem. I
Industrial relations, role of government in IR and industrial conflicts, code of discipline, standing orders, grievance handling, mediation, conciliation, adjudication, arbitration, trade unions and industrial relations, collective bargaining, industrial democracy. Labour welfare-concept, nature and types of welfare plans, welfare administration. Welfare legislation -social security administration. Industrial relations in western countries. Industrial relations in public and private sectors in India. Problems of industrial relations at major industrial towns.
Practical: Case studies, analysis and discussions.

Mgt. 535 Business Ethics and Indian Management 3+0 Sem. II
Societal concept and social responsibility of business: spectrum of social issues-conservation of natural resources, pollution control and other environmental issues. Fair business practices, human resources, consumer and community involvement. Business ethics and unethical behaviour of managers. Ethical code and legal requirements in different areas. Ethical pressure points, pressure from superiors, comparative conceptual disparity and ambiguous situations. Ethical climate of organisation, policies and guidelines of ethics, educational influence, code of conduct, ethical advisor, value systems of Indian managers.

Mgt. 536 Industrial and Labour Laws 2+1 Sem. II
Practical: Case studies, analysis and discussion.

Mgt. 537 Farm Business Management 3+0 Sem. I
Nature, scope and functions of farm business management, working out existing and alternative farm plans, farm labour, farm capital and its problems, farm machinery and its utilization, decision making process in farm management, application of quantitative techniques in agricultural production, marketing of agricultural output, purchasing the agricultural inputs, management of other special farm projects like poultry, dairy, fishery, beekeeping and piggery, farm forecasting and other special managerial problems of farms.

Mgt. 538 Management of Cooperatives 3+0 Sem. I
Nature of cooperative principles, management principles and their applications to cooperative organizations, structure and functions of various types of cooperatives, managerial problems of cooperatives, consumer stores, role of government, financing of cooperatives, staffing and
training, efficiency criteria, public accountability, price, output and profit policies of cooperatives. Special problems of cooperatives in agricultural and industrial sectors, management practices of successful cooperatives in India.

Mgt. 539 Agricultural Marketing 3+0 Sem. I
Advanced study of organization and function of agricultural marketing in India. Market structure and performance, determination of price and marketing margins, technological evolution and integration in agricultural processing, distribution; warehousing and cooperative marketing; methods of grading of farm product-market grades, unique features of commodity marketing in India. Market legislation- a historical and critical review; magnitude and dimensions of marketed and marketable surplus of agricultural commodities; efficiency of marketing, storage, transportation and financial management in agricultural marketing, perishability, seasonability and processing of different agricultural products, pricing of processed products and demand creation.

Mgt. 540 Rural Finance 3+0 Sem. II
Functions, structure and working of rural financial market in India, role of rural financing institutions like NABARD, RRBs, credit policies of various financing institutions, agricultural credit policy since independence, mobilizing rural savings, rural deposits mobilization by cooperatives, innovative financing, intensive financing, village adoption.

Mgt. 541 Management of Strategic Organizations 3+0 Sem. II
Concept and significance of strategic organizations, public sector enterprises, Sunrise industries, research and training institutions, development oriented voluntary organizations, extension and promotional agencies, form, objectives, special features, internal structure, staffing and training, efficiency criteria, public accountability, motivation, control and leadership in strategic organizations with special reference to public sector enterprises and developmental agencies.

Mgt. 542 Management of Agro-Industrial Projects 2+1 Sem. II
Nature of agro-industrial projects. Formulation of agro-industrial projects - economic, technical and financial feasibility, generation of alternative project ideas and preliminary screening; methods for evaluation and ranking of projects, preparation of feasibility report, financing of agro-industrial projects, sources of finance and structure of financial institutions, central and state incentives, implementation of project, organization viability, management control and information system, monitoring and feedback, operational problems in implementation of projects.
Practical: Exercises in project formulation and case studies.

Mgt. 543 Management of Research and Development 2+1 Sem. II
Role of research and development activities within business enterprises. Effective management of research and development functions - determining research and development needs of organization, establishing priorities, developing R & D plans and strategies, preparing budgets, characteristics of effective R & D programmes. Personnel, financial and accounting control, schedule control, project evaluation and corrective action.
Practical: Case studies, analysis and discussion.

Mgt. 544 Managing E-Business 3+0 Sem. I
Mgt. 545 E-Commerce Technologies  
Practical: Practicals related to Internet and Intranet browsing, downloading and development of internet and intranet based business solutions. Case studies related to E-business and technologies used therein.

Mgt. 546 Data Management for Decision Makers  
Practical: Applications in RDBMS for business solutions.

Mgt. 547 Current Issues in E-Business  
Latest developments in the area of e-business/e-commerce and e-governance including technical, legal and behavioural issues. Impact of these issues in the overall business environment and emergence of various opportunities and threats. Development of Strategies.

Mgt. 595 In-Industry Training  
Each student is required to undergo "In-Industry Training" in a business organization for six weeks. The purpose is to expose the students to the practical aspects of management. At the end of the training programme, the student is required to submit a report. This report and the overall performance of the student in the organization form the basis of evaluation of student's work.

Mgt. 601 Management Thought  

Mgt. 602 Comparative Management  
Need, importance and scope of comparative management. Impact of national and cultural differences on management. Management in different economic systems-Chinese, Japanese,
American and Indian. Lessons from the collapse of socialistic system in Russia, Globalization and management convergence - globalization and internationalism and rationalization, Managing and developing cross cultural organizations, Hofstede's cultural theory. Management in public sector and third sector organisations - management of hospitals, educational institutions and tourism. Management in agriculture. Forest Management.

Mgt. 603 Advanced Financial Management 3+0 Sem. I

Mgt. 604 Management Information and Control Systems 3+0 Sem. II
Management information systems - perspectives, management information needs, purpose, scope, design of management information systems, major and minor management information systems, need for control, need for management training, implementing management information systems, problems and pitfalls, simulation and information retrieval, management information systems and automation, managerial interference, technology and foundation of management information systems. Management Control Systems - profit planning and control, sales, production and expenses, performance reports for management control.

Mgt. 605 Advanced Accounting Theory and practice 3+0 Sem. II

Mgt. 606 International Financial Management 2+0 Sem. I

Mgt. 607 Financial Reporting 2+0 Sem. I

Mgt. 608 Statutory Cost and Management Audit 2+0 Sem. II
Auditing philosophy, audit objectives and techniques, principles of auditing, methodology of audit, audit programme design, audit of cash and trading transactions, audit of impersonal and
personal ledgers, balance sheet audit, verification and investigation of assets. Rights, duties
and responsibilities of an auditor. Independence in audit, concentration of audit, statistical
sampling techniques and auditing. Cost audit-principles and procedure, audit and internal
control, audit reporting problems. Management audit - problems in developing performance
standards, management audit procedures and reporting on management audit.

Mgt. 609 Portfolio Management 2+0 Sem. I
Concepts of portfolio management, strategy of risks and returns, different approaches to
portfolio management, personal portfolio management, portfolio management of investment
companies, trusts, commercial banks, development institutions, insurance companies and
pension funds. Role of computer in portfolio management.

Mgt. 610 Advanced Marketing Management 3+0 Sem. II
Development of marketing thought, marketing environment in India - Historical analysis,
innovative marketing, marketing information, marketing productivity, cost and profitability.
Productivity analysis of goods and services, customers and territories, advertising, distribution
and field sales operations. Model building for analysis and interpretation of marketing data,
deterministic optimizing models, stochastic process models, experimental designs,
discriminant and canonical analysis, factors and cluster analysis, heuristic models, behaviour
models.

Mgt. 611 Marketing Strategy 3+0 Sem. I
Marketing strategy, marketing mix strategies for consumer, consumer durables and non-
durable goods, marketing strategies during stagflation and shortages, principles of marketing
planning, planning systems, resources and objectives, corporate marketing strategies,
forecasting, designing marketing, campaign facilities. Implementation of marketing strategies -
organization system, testing a plan, performance analysis, efficiency control and marketing
audit.

Mgt. 612 Retail and Wholesale Management 3+0 Sem. II
Locating, planning and organizing store, merchandise planning and buying. Pricing stock
holding, stock control, control of expenses. Brief introduction to marketing channels, operation
of retail and wholesale enterprises. Concept of retailing and wholesale, functions of retailer
and wholesaler. Retailer's and wholesaler's environment. Theory of retailer- supplier conflict,
control and co-operation. Salesmanship and sales promotion, pattern of evolution in retailing
and wholesale institutions. Innovation and change.

Mgt. 613 Marketing Legislation in India 2+0 Sem. I
Various central and states statutes and legislation. Evolution of various governmental
regulations. Selected statutes such as MRTP Act, Essential Commodities Act, Quality, Price
and Distribution Control Legislation, Pure Food Legislation, Trade Mark, Copyright and Patent
Legislation.

Mgt. 614 Financial Strategies for Marketing Operations 2+0 Sem. II
Analytical and creative approach to financial dimensions of marketing decisions. Setting
financial objectives of marketing functions in an organization, marketing investment and
management. Financial analysis of decisions involving product service expansion, contraction
and substitution, product service development, credit sales analysis, analysis for pricing
decisions, financial aspects of promotion, sales force management and other marketing
operations.

Mgt. 615 Systems Analysis 2+0 Sem. I
An overview of systems types, purposive systems, man made systems, cybernetics and
systems models, control and analysis of hierarchical systems, adaptive systems and learning models, control theory of social and economic systems, mathematical models, decision frame work for systems evaluation, criteria for evaluating public planning programme and budgeting systems.

**Mgt. 616 Project Management with PERT and CPM**  
2+0  
Sem. I

Developing project network, time estimates and their distributions, basic scheduling computations, variations of basic scheduling computations, scheduling activities to satisfy resource constraints, time- cost trade-off procedures. An introduction to network cost control. PERT-statistical approach, critical path methods.

**Mgt. 617 Inventory Management**  
2+0  
Sem. II

Various types of inventory systems, maintaining smooth supply of raw-materials and finished products for production and marketing. Structure of optimal inventory policies, deterministic and stochastic models. Planning horizon theorem, parametric production planning, stochastic ordering, single critical level policies, myopia policies, Bayesian models, dependence of optimum policies in various parameters.

**Mgt. 695 Advanced In-Industry training**  
0+7 (NC)

To provide in-depth knowledge of the field problems and actual operation of business organization, the student will be sent for in-industry training for 6-8 weeks and will be required to submit training report and collect cases. This will form the basis of evaluation.

**Mgt. 591 Seminar**

**Mgt. 600 Project Research**

**Mgt. 700 Ph.D. Research**

**ABM 501/ Mgt. 501 Principles of Management and Organizational Behaviour**  
3+0  
Sem. I


**ABM 502/Mgt. 502 Business Environment**  
3+0  
Sem. II


**ABM 503/Mgt. 503 / Econ. 501 Managerial Economics /Micro 3+0 Sem. I**

**Economics**

**ABM 504/Mgt. 504 Managerial Accounting and Control 2+1 Sem. I**


**ABM 505/ Mgt. 505 Marketing Management 3+0 Sem. I**


**ABM 506/Mgt. 506 Human Resource Management 3+0 Sem. II**

ABM 507/Mgt. 507 Financial Management 3+0 Sem. II

ABM 508/Mgt. 508 Production and Operations Management 3+0 Sem. II
Nature and scope of production and operations Management - its relationship with other systems in the organization. Production functions, work and job design, facilities planning, product and process selection. Product design and development - importance of product design, characteristics of good design, technical process of new product development, design for manufacture, concurrent engineering. Facilities location - importance, location analysis techniques, facilities layout and materials handling of various agricultural products. Capacity planning - measuring capacity, process of capacity planning, methods for altering capacity in long term and short term. Production planning and control for different types of manufacturing systems related to agri-business, planning and control of projects, work study, method study, work measurement, work sampling, maintenance management, value engineering, quality assurance and quality circles. Total quality management, commodity purchase system and purchase principles, inventory management, stores management, food grading, packaging, standardization, codification, quality control, certification systems and agri-waste management.

ABM 509/ Mgt. 509 Research Methodology in Business 2+1 Sem. II
Management
Introduction to research methodology, research process, identification and formulation of problem. Research designs - exploratory research design, descriptive research design including cross-sectional design and longitudinal design. Secondary data, primary data, survey techniques and observation. Causal research design - experimentation, classification of experimental designs. Measurement and scaling techniques nominal scale, ordinal scale,

Practical: Case discussions, data collection, tabulation, analysis and report writing. Use of statistical packages for agribusiness solutions.

ABM 510/ Mgt. 510 Strategic Management 3+0 Sem. II

ABM 511/ Mgt. 511 Management Information System 2+1 Sem. I
Concepts, needs and scope of Management Information System (MIS) in business organization. Understanding business as a social system and information approach to management and organization theory. Types of management information systems- transaction processing systems, office automation systems, decision support systems, executive support systems, knowledge based expert systems. Business process reengineering, design and implementation of MIS. Components of MIS, system flow charts, developing data base, integration of sub-systems, developing organization structure for MIS, MIS and control system. Enterprise Resource Planning (ERP)- concepts, selection & implementation, and key success factors for ERP use, aligning strategy & information systems. Use of internet in agribusiness. GIS and remote sensing.
Practical: Use of software packages and simulations for agribusiness decision making, use of word processor for report writing and business correspondence, use of spreadsheets for problem solving and analysis of business situations, use of presentation graphics for making business presentations, use of internet and search engines.

ABM 512/Econ. 508/ Mgt. 512/Stat. 527 Quantitative and Optimization Techniques for Economics and Management 2+1 Sem. II
Role of quantitative methods in decision making, probability and decision making under risk and uncertainty, the value of additional information, Bayes theorem, probability models and decision making. Sample survey methods, measurement and forecasting, index numbers, time series analysis, optimization models, linear programming: formulation and simplex method, primal and dual, sensitivity analysis, transportation models and assignment models, dynamic programming, network analysis, PERT and CPM. Game Theory: concept, Two person constant sums, zero sum games, saddle point, solution to mixed strategies, Markov...
chain analysis, Queuing models- waiting line problem, characteristics of waiting lines, single channel model, multiple-channel model, constant-service time model, finite population model, sequencing and replacement models. Simulation and Monte Carlo methods.

Practical: Graphical and algebraic formulation of linear programming models, Solving of maximization and minimization problems by simplex method. Formulation of simplex method by typical farm situations, Solution of other numerical problems, case studies, analysis and discussion.

ABM 513/ Mgt. 513 Project Management and Entrepreneurship 2+1 Sem. II Development
Concept and nature of agro-industrial projects, characteristics and types of projects. Generation, identification and screening of project ideas, project life cycle. Formulation of agro industrial projects - market and demand, technical and financial feasibility, methods for evaluation and ranking of projects, risk analysis for agro-industrial projects, impact of inflation on projects, preparation of feasibility report. Financing of agro-industrial projects, sources of finance and structure of financial institutions related to agribusiness, venture capital. Central and state incentives for agribusiness. Implementation of project: network methods, project scheduling and resource allocation, project control and information system, monitoring and feedback, operational problems in implementation of agribusiness projects. Entrepreneurship, Significance of entrepreneurship in economic development, qualities of an entrepreneur, entrepreneurship development programmes and role of various institutions in developing entrepreneurship, lifecycle of new business, environmental factors affecting success of a new business, reasons for the failure and visible problems for business, developing effective business plans, procedural steps for setting up an industry.
Practical: Exercises in project formulation, numerical problems related to project evaluation, risk analysis and case studies.

ABM 514 Rural Marketing Management 2+0 Sem. I
Rural marketing- concept and importance, characteristics and structure of rural markets, problems in rural marketing. Environmental factors affecting rural marketing- socio-cultural, economic, demographic, technological and other factors. Rural consumer behaviour, customer relationship management, rural market research. Rural marketing strategies- segmenting, targeting, positioning of rural markets, product planning, product mix, pricing policy and pricing strategy. Distribution and promotion strategies for rural markets- Rural communication and problems. Marketing of agricultural inputs, consumer durables and farm produce. Packaging, transportation, grading and standardization, storage and processing of agricultural produce, financing for rural marketing, marketing agencies and institutions for rural markets, innovation in rural marketing.

ABM 515 Management of Food Processing Industry 2+0 Sem. II
Overview of food processing industry scenario in India, world trade in processed foods-prospects and challenges. Present status of food industry, deteriorative factors and hazards during processing, storage, handling and distribution. Management of functional areas of food processing units- capacity planning , sourcing of raw material, scope of contract farming, problems faced by food processing units, packaging of foods. Analysis of costs in food organization, risk management. Laws and regulations related to food industry and food production and marketing. Quality management- quality standards, PFA and ISO. Case studies on project formulation in various types of food industries- milk and dairy products, cereal milling, oil-seed and pulse milling, sugarcane milling, honey production, baking, confectionary, oil and fat processing, fruits and vegetable storage and handling, processing of fruits and vegetables, egg, poultry, fish and meat handling and processing.

ABM 516 International Trade and Marketing for Agribusiness 3+0 Sem. I
Introduction, scanning the international environment for agribusiness, composition of international trade-comparative and competitive advantage, recent trends in world trade and India's foreign trade in the area of agribusiness. India's foreign trade policy and its importance for developing economy, instruments of trade policy - quotas, antidumping duties, quantitative and qualitative restrictions, tariff, non-tariff measures and trade control, India's balance of payments, exchange rate. WTO and its agreements, implications of WTO for Indian economy and agriculture sector in particular, TRIPS, TRIMS, subsidies- green and red boxes, countervailing duty measures, carbon trade, SPS agreement. Regional economic groupings, export promotion institutions with special emphasis on EPCs and commodity boards, MPEDA, APEDA and service institutes. Import- export documentation, role of ECGC in insurance, identifying foreign markets for agri products, international marketing - market entry methods, international product planning, pricing, promotion, distribution, problems of exporters, legal dimensions of international marketing. Exercises in international agribusiness management, case studies.

ABM 517 Supply Chain Management 3+0  Sem. I
Supply chain- changing business environment. Supply Chain Management (SCM)- present need, conceptual model of SCM, evolution of SCM. Concept and significance of physical logistic and distribution system as applicable in agribusiness, marketing and physical distribution process, elements of physical distribution system, transportation and its relation to plant location, warehousing and inventory, modes of transportation, optimum relationship between size and frequency of shipments, transportation model. Vendor Managed Inventory (VMI), third -party logistics, GPS technology. Supply chain management in agri-business, procurement management in agri supply Chain - purchasing cycle, types of purchases, contract/corporate farming. Various models of supply chain management as followed by developed countries. Cost analysis and logistic system design, organisation and management of physical distribution and supply chain. Concept of Information Technology (IT) - IT Applications in SCM, SCM in electronic business, role of knowledge in SCM. Performance measurement and controls in agri supply chain management.

ABM 518 Marketing of Agricultural Inputs 2+0  Sem. I
Agricultural input marketing: meaning and importance, management of distribution channels, agricultural inputs and their types, role of cooperative, public and private sectors in agri input marketing. Seed- importance, types of seeds- hybrid, high yielding and quality seeds. Demand and supply, marketing channels, pricing, export and import. Role of NSC and State Seed Corporation. Chemical fertilizers - production, exportimport, supply, demand and consumption, pricing policy, subsidy, marketing system, problems in distribution. Role of IFFCO and KRIBCO. Plant protection chemicals- production, export/import, consumption, marketing system. Farm machinery - production, supply, demand, marketing and distribution, agro industries corporation and marketing of farm machines implements and equipments.

ABM 595 In-Industry Training 0+5 (NC)
Each student is required to undergo in-industry training in a business organization for six weeks. The purpose is to expose the students to the practical aspects of management. At the end of the training program, the student is required to submit a report. This report and the overall performance of the student in the organization form the basis of evaluation of student's work.

ABM 591 Seminar

ABM 600 Project Research
CHEMISTRY

PROGRAMMES
M. Sc.
Ph.D.
Five Year Integrated M.Sc. (Hons)

COURSE REQUIREMENTS

M.Sc.
Field of Specialization
Inorganic Chemistry, Organic Chemistry, Physical Chemistry, Agrochemicals

Required Courses

Supporting Courses
Stat. 421, PGS 501 and other courses from subject matter fields (other than Minor) relating to area of special interest and research problem.

Minor Fields
Botany, Biochemistry, Microbiology, Mathematics, Statistics, Physics, Entomology, Plant Pathology, Soils, Agronomy or any other as approved by the Dean, Postgraduate Studies.

Deficiency Courses
As recommended by the Student's Advisory Committee and approved by the Dean, Postgraduate Studies

Ph.D.
Field of Specialization
Inorganic Chemistry, Organic Chemistry, Physical Chemistry, Agrochemicals

Required Courses
Chem. 601

Supporting Courses
Courses from subject matter fields (other than Minor) relating to area of special interest and research problem.

Minor Fields
Botany, Biochemistry, Microbiology, Mathematics, Statistics, Physics, Entomology, Plant Pathology, Soils, Agronomy or any other as approved by the Dean, Postgraduate Studies

Deficiency Courses
As recommended by the student's Advisory Committee and approved by the Dean, Postgraduate Studies

Five Year Integrated M.Sc. (Hons)
Field of Specialization
Inorganic Chemistry, Organic Chemistry, Physical Chemistry, Agrochemicals

Required Courses
All courses listed for Semester I-VI (P-____*) and Chem. 501, Chem. 502, Chem. 503, Chem. 504, Chem. 505.

Supporting Courses
Stat. 421, PGS 501 and other courses from subject matter fields (other than Minor) relating to area of special interest and research problem.

Minor Fields
Botany, Biochemistry, Microbiology, Mathematics, Statistics, Physics, Entomology, Plant Pathology, Soils, Agronomy or any other as approved by the Dean, Postgraduate Studies

Deficiency Courses
As recommended by the Student's Advisory Committee and approved by the Dean, Postgraduate Studies

* Page number according to new RBI.
DESCRIPTION OF COURSE CONTENTS

Undergraduate Courses/ Integrated M.Sc. (Hons)

Chem. 91 Introductory Inorganic Chemistry  4+1  Sem. I

Basic concepts of chemistry: Classification and nature of matter, laws of chemical combination, Dalton's atomic theory: Concept of elements, atoms and molecules. Atomic and molecular masses and mole concept percentage composition, empirical and molecular formula, chemical reactions, stoichiometry and calculations based on stoichiometry. Atomic structure: Fundamental particles, Discovery of electron, proton and neutron, atomic number, isotopes and isobars, Thompson's model and its limitations, Rutherford and Bohr model of atom and limitations, concepts of shells and sub shells, dual nature of matter and light, de Broglie's relationship, Heisenberg principle, Quantum numbers, shapes of orbital's, rules for filling electrons in orbital's Aufbau principle, Pauli exclusion and Hund's rule and electronic configurations of elements, stability of half filled and completely filled orbitals. Classification of elements and periodicity in properties: Brief History of the development of the periodic table, Modern periodic law, Mendeleev's and modern periodic table, types of elements: s, p, d, f-block elements, periodic trends in properties; Atomic Radii, ionic radii, ionization energy and electron affinity and electro negativity, inert gas radii, ionization enthalpy, electron gain enthalpy, nomenclature of elements with atomic number greater than 100. Chemical bonding and molecular structure: Valence electrons, Ionic bond, bond parameters, Covalent bond, Lewis structure, polar character of covalent bond, Valence bond theory, Resonance, VSEPR theory, Concept of hybridization involving s, p and d orbitals and shape of some simple molecules. Molecular orbital theory of homonuclear diatomic molecules (qualitative idea only), hydrogen bond. States of matter: Three states of matter, Role of gas laws in elucidating the concept of the molecule, Boyle's Law, Charles law, Gay lussac's law, Avogadro's Law, Ideal behavior, empirical derivation of gas equation, Avogadro's number, ideal gas equation,. Derivation from ideal behaviour, kinetic energy and molecular speeds (elementary idea), derivation from ideal behaviour, Liquefaction of gases, Critical temperature Liquid state – Vapour pressure, Viscosity and surface tension. s-Block elements: General Introduction, occurrence, electronic configuration, diagonal relationship, trends in physical and chemical properties, such as ionization energy, atomic radii, trends in chemical reactivity with oxygen, water, hydrogen and halogens. Preparation and properties of some important compounds: Sodium carbonate, sodium chloride, sodium hydroxide and sodium hydrogen carbonate, calcium oxide and calcium carbonate p-Block Elements: Group 13 elements: Electronic configuration, occurrence, variation of properties, trends in chemical properties, Anomalous properties of first element of the group – boron; Preparation and properties of boron, borax, boric acid acid and boron halides, boron hydrides, aluminum; reactions with acid and bases. Group 14 elements:General introduction, occurrence, variation of properties, trends in chemical reactivity, Anomalous behavior of first element i.e. carbon – catenation, allotropic forms, important compounds of silicon: silicon tetrachloride, silicones, silicates and zeolites and their uses Group 15 elements: General introduction, electronic configuration, occurrence, oxidation states, trends in physical and chemical properties; nitrogen; - preparation, properties and uses, compounds of nitrogen: preparation and properties of ammonia, nitric acid, oxides of nitrogen (structure only), Phosphorous-allotropic forms, compounds of phosphorous: preparation and properties of phosphine, halides (PCl₃, PCl₅) and oxoacids (elementary idea only) Group 16 elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties, dioxygen; preparation, properties and uses, simple oxides, Ozone, Sulphur - allotropic forms; compounds of sulphur; preparation, properties and uses of sulphur dioxide sulphuric acid: industrial process of manufacture, properties and uses, oxoacids of sulphur (structures only). Group 17 elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; compounds of halogens; preparation, properties and uses of chlorine and hydrochloric acid, interhalogen compounds,
oxoacids of halogens (structures only). Group 18 elements: (General introduction, electronic configuration. Occurrence, trends in physical and chemical properties, uses. d- and f-Block Elements: General introduction, occurrence electronic configuration, characteristics of transition metals, general trends in properties of the first row transition metals, metallic character, ionization enthalpy, oxidation states, ionic radii, colour, catalytic property, magnetic properties, interstitial compounds, alloy formation. Preparation and properties of K₂Cr₂O₇ and KMnO₄. Lanthanides-electronic configuration, oxidation states, chemical reactivity and lanthanide contraction. Actinides - Electronic configuration, oxidation states. Coordination compounds - introduction, ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds bonding; Werner's theory, VBT, CFT, isomerism, importance of coordination compounds (in qualitative analysis, extraction of metals and biological systems). General principles and processes of Isolation of Elements: Principles and methods of extraction - concentration, oxidation, reduction electrolytic method and refining, occurrence and principles of extraction of aluminium, copper, zinc and iron. Hydrogen: Position of hydrogen in periodic table, Occurrence, Isotopes, Preparation, properties, and uses of hydrogen, hydrides-ionic, covalent and interstitial, physical and chemical properties of water, heavy water, hydrogen peroxide, hydrogen as a fuel.

Practical: Introduction about basic laboratory techniques, crystallization of impure samples copper sulfate, alum, Quantitative estimation: Preparation of a standard solution of oxalic acid, Determination of strength of a given solution of sodium hydroxide by titrating it against standard solution of oxalic acid, determination of molarity and strength of potassium permanganate solution by titrating it with standard solution of Mohr's salt, Determination of strength of a given solution of hydrochloric acid by titrating it against standard sodium carbonate solution. Chemical equilibrium: Study of shift in equilibrium between ferric ions and thiocyanate ions. Qualitative analysis: Determination of one anion and one cation in a given salt: Cations: Pb²⁺, Cu²⁺, As³⁺, Al³⁺, Fe³⁺, Mn³⁺, Ni²⁺, Zn²⁺, Co²⁺, Ca²⁺, Sr²⁺, Ba²⁺, Mg²⁺, NH₄⁺. Anions: CO₃²⁻, S²⁻, SO₃²⁻, SO₄²⁻, NO₂⁻, NO₃⁻, Cl⁻, Br⁻, I⁻, PO₄³⁻, C₂O₄²⁻, CH₃COO⁻.

Chem. 92 Organic Chemistry-I 3+1 Sem. II


Practical: Determination of melting point and boiling point of an organic compound, Crystallization of impure sample of benzoic acid. Preparation of aspirin, iodoform, analysis of fruits and
vegetable juices for their acidity, Detection of nitrogen, sulfur, chlorine in organic compounds, Test for the functional groups present in organic compounds: Unsaturation, alcoholic, phenolic, aldehydic, ketonic, carboxylic and amino (primary) groups

Chem. 93 Fundamentals of Physical Chemistry 3+1 Sem. I

Solid state: Structure of ionic solids, close packed structure, classification of solids based on different binding forces: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea), unit cell in two dimensional and three dimensional lattices, calculation of density of unit cell, packing in solids, number of atoms per unit cell in a cubic unit cell, points defects, electrical and magnetic properties imperfections in solids and silicates. Band theory of metals, conductors, semiconductors and insulators and n and p type semi-conductors. Solutions: Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, vapour pressure of solutions, Raoult’s law, colligative properties; relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties, abnormal molecular mass and non-ideal solutions. Vant Hoff factor. Chemical energetic and laws of thermodynamics: Concept of system and its types, surrounding, work, heat, energy, extensive and intensive properties, state functions, first Law of thermodynamics, Internal energy, Enthalpy, Heat capacity, specific heat, measurement of ΔU and ΔH, Hess’s law of constant heat summation, Enthalpy of bond dissociation, combustion, formation, atomization, sublimation, phase transition, ionization, solution and dilution, Introduction to entropy as a state function, Gibb’s free energy change for spontaneous and non-spontaneous processes, criteria for equilibrium, second law of thermodynamics, third law of thermodynamics (brief introduction). Chemical equilibrium: Equilibrium in physical and chemical processes, dynamic nature of equilibrium, Law of mass action, Equilibrium constant, factors affecting equilibrium- Le Chatelier’s principle, Ionic Equilibrium, Ionization of acids and bases, Strong and weak electrolytes, Degree of Ionization, ionization of polybasic acids, acid strength, Concept of pH, Henderson equation, Hydrolysis of salts (elementary idea), Buffer solutions, Solubility product, Common ion effects (with illustrative examples). Redox reactions: Oxidation and reduction, oxidation number and redox reactions in aqueous solution. Balancing redox reactions, Application of redox reactions. Chemical kinetics: Rate of reactions (average and instantaneous), order and molecularity of reactions; factors affecting rate of reactions; concentration, temperature, catalyst; rate law and specific rate constant, integrated rate equations and half life (only for zero and first order reactions); concept of collision theory (elementary idea, no mathematical treatment)photochemical reactions and mechanism of reactions. Nuclear Chemistry: Natural radioactivity – discovery and historical development, Radioactivity, nuclear structure and properties, radioactive disintegration series, nuclear fusion and fission, group displacement law and nuclear reaction, rate of radioactive disintegration, artificial transmutation, breeder reactor, transuranic elements and applications. Synthetic and natural polymers: Classification, preparation and properties of natural and synthetic polymers and application of polymers. Surface chemistry: Concept of adsorption, physical and chemical; factors affecting adsorption of gases on solids; colloids; preparation and properties, colloidal state: distinction between true solutions, colloids and suspensions; lyophilic, lyophobic, multimolecular and macromolecular colloids, Tyndall effect, Brownian movement, catalysis, homogenous and heterogeneous, activity and selectivity, enzyme catalysis; electrophoresis, coagulation, emulsions types of emulsions. Electrochemistry: Redox reactions, conductance in electrolyte solutions, specific and molar conductivity, variation of conductance with concentration, Kohlrausch’s law, electrolysis and laws of electrolysis (elementary idea) dry cells – electrolytic cells and galvanic cells, lead accumulators, EMF of a cell, standard electrode potential, Nernst equation and its applications to chemical cells, fuel cells, corrosion, relation between Gibbs energy change and EMF of a cell. Practical: Preparation of lyophilic and lyophobic sol, determination of enthalpy of neutralization of strong acid and strong base, Determination of enthalpy change during interaction between acetone and chloroform, Enthalpy of dissolution of copper sulfate or potassium nitrate, study of
rate of Reaction between potassium iodate, KIO₃ and sodium sulphite: using starch solution as indicator, rate of reaction of ester hydrolysis, determination of molarity and strength of potassium permanganate solution by titrating it with standard solution of oxalic acid, determination of conductance of ions in a given sample, determination of refractive index of given liquids, determination of pH of given liquids using pH paper, universal indicator and pH meter, study of adsorption of oxalic acid on activated charcoal, study the viscosity and surface tension of the given liquids, determine the temporary and permanent hardness of water.

Chem. 94 Organic Chemistry-II

proteins in pure form and detection of their presence in given food stuffs.

Chem. 101 General Chemistry 2+1 Sem. I
(Extra Credit)


Chem. 102 Introductory Organic Chemistry 2+1 Sem. I

Introduction to organic chemistry. IUPAC nomenclature of carbon compounds and their isomerism in carbon compounds, hybridization, sp3, sp2 and sp. Their shapes and angles, explanation of acidity of alkynes. Preparation and properties of alkanes, alkenes, alkynes, alkyl halides, alcohols, ethers, aliphatic aldehydes and ketones, aliphatic carboxylic acids and their derivatives and aliphatic amines. Introduction to aromatic compounds. Structure of benzene, aromatic hydrocarbons, preparation and properties of benzene, aryl halides, phenol, aniline, benzene sulfonic acid, benzaldehyde, acetophenone, benzoic acid. Chemistry of esters, amides, acid chlorides, cyanides and isocyanides. An introduction to substitution and elimination reaction, carbocations, carbanions and free radicals.


Chem. 201 Organic Chemistry 3+0 Sem. I


Chem. 202 Chemistry for Agricultural Engineering 2+1 Sem. II


Practical: Volumetric, Gravimetric and Instrumental analysis. Water: Total solids, turbidity, pH value, carbonate and bicarbonate, acidity, hardness, chloride, dissolved oxygen, BOD, COD,

Chem. 203 Physical and Inorganic Chemistry 2+1 Sem. II
Practical: Separation and identification of ions (4-ions with no interference), Preparation of metal complexes, Experiments involving conductometer, pH meter, spectrophotometer, refractometer, polarimeter. Experiments concerning adsorption, solutions and chemical kinetics.

Chem. 204 Mechanism of organic reactions 2+1 Sem. II
Types of organic reactions, Reaction intermediates, assigning formal charges on intermediates and other ionic species. Methods for determination of reaction mechanism (product analysis, intermediates, isotope effect, kinetic and stereochemical studies). Mechanism of free radical halogenation of alkanes; orientation, reactivity and selectivity. Aromatic Electrophilic Substitution-Mechanism of nitration, halogenation, sulfonation and Friedel craft reaction. Concept of isomerism, types of isomerism (optical, geometrical and conformational isomerism) stereoselective and stereospecific reactions. Stereochemistry of addition of halogens to alkenes, Stereochemistry of elimination reactions. Spectroscopy: Introduction to infrared, ultraviolet visible and proton NMR spectroscopy. Use of these spectroscopic techniques for structural elucidation.

Chem. 205 Engineering Chemistry 2+1 Sem. I
(alcohol, aldehyde, ketone, carboxylic acid and amide) by IR. Chromatographic analysis. Determination of molar refraction of organic compounds.

**Chem. 301 Fundamental Organic Chemistry** 3+0  Sem. I

**Chem. 302 Chemistry of Agrochemicals, Plant Products and Growth** 1+1  Sem. I
Organic chemistry as prelude to agrochemicals. Diverse types of agrochemicals. Botanical insecticides (neem), pyrethrum and synthetic pyrethroids. Synthetic organic insecticides, major classes, chemistry and use of some important insecticides under each class. Herbicides-major classes, chemistry and use of 2,4-D, atrazine, glyphosate, butachlor, benthioicarb. Fungicides - major classes, Chemistry and use of carbendazim, carboxin, captan, tridemorph and copper oxychloride. Plant growth regulators. Practical: Argentometric and iodometric titrations - their use in the analysis of important pesticides. Compatibility of fertilizers with pesticides.

**Chem. 303 Thermodynamics and Chemical Kinetics** 3+0  Sem. II

**Chem. 304 Basic Analytical Chemistry** 3+0  Sem. II

Chem. 305 Experiments in Inorganic Chemistry 0+2 Sem. II
Quantitative analysis of inorganic mixture of four (4) ions with one interfering anion. Chromatographic separation of Cl⁻, Br⁻ and I⁻; Cd²⁺ and Hg²⁺. Colorimetric determination of Ni as Ni-diglyoxime complex, Pb as dithiazine complex and Al (or Mg) as oxinate complex. Preparation of aluminium acetylacetone, Cu (II) thiourea, Potassium trioxalato chromate (III) and Mohr's salt.

Chem. 306 Fundamental Inorganic Chemistry 2+0 Sem. I

Chem. 308 Chemistry of Agrochemicals 2+1 Sem. II
Practical: Sampling of fertilizers and pesticides. Pesticides application technology to study about various pesticides appliances. Quick tests for the identification of common fertilizers. Identification of anions and cations in fertilizers. Calculation of doses of insecticides to be used. To study and identify various formulations of insecticides available in market. Estimation of nitrogen in urea, water soluble P₂O₅ and citrate soluble P₂O₅ in single super phosphate, potassium in muraite of potash/ sulphate of potash (by flame photometer), copper in copper oxychloride and sulphur insulphur fungicide- thiram and ziram

Chem. 421 General Physical Chemistry 2+1 Sem. I

Practical: Verification of adsorptions, isotherms, charge on colloidal particles, molecular weight of polymers, preparation of buffer solutions, determination of pKa. Spectrophotometric analysis. Determination $\lambda_{\text{a}}$. Verification of Oswald's dilution law.

**Chem. 422 Electrochemistry and Surface Chemistry**  
3+0  
Sem. II  

**Chem. 423 General Organic Chemistry**  
2+0  
Sem. I  
Introduction to mechanism of various organic reactions including reaction intermediates, carbocations, carbanions, free radicals, carbenes and benzynes. Stereochemistry, optical activity, chirality, compounds with one or more chiral centres, enatiomers, diastereomers, nomenclature and assignment of configurations to simple molecules including RS, E, and ZL. Conformations of acyclic and cyclic systems including staggered, anti, gauche and chair and boat forms. Chemistry of heterocyclic compounds, thiophenes, furan, piperidine, pyridine, pyrrole, pyran. Chemistry of oils, fats and carbohydrates.

**Chem. 424 Radioactivity and Transition elements**  
2+0  
Sem. I  
Discussion of f blocks elements, lanthanides, actinides, lanthanide contraction, actinide contraction and its effects, separation of lanthanides and actinides, simple chemistry of elements like Francium, Technetium and Rhenium. Separation of inner transition elements, their salts and uses. Atomic nuclei, binding energy and stability of isotopes. Natural and induced radioactivity, kinetics and half life of radioactive elements, units of radioactivity, Carbon dating, transuranic series. Tracers and their applications. Acid-base concept, hard and soft acids and bases and the application of this concept. Role of transition elements in biological systems.

**Chem. 425 Introduction to Metal Complexes and Chelates**  
2+1  
Sem. II  

Practical: Spectrophotometry, pH metric studies in relation to stability constants of metal ligand systems.

**Chem. 426 Chemistry of Non-transition Elements**  
2+0  
Sem. I  
Organometallic compounds of magnesium and copper and their synthetic utility, Latimer and Volt-equivalent diagrams, silicates, iso and heteropolyacids, boron hydride and related compounds, boron halides/sulfurnitrogen cyclic compounds. Phosphates, oxy acids of nitrogen, phosphorous and sulfur and trends in their acidity and reduction potential, Ellingham diagram, Use of
compounds of selenium and their toxicity. Xenon compounds, oxy and flouro derivatives of xenon, their synthesis and chemical reactions structure of silicates and borates.

**Chem. 427 Spectroscopy and Structure Elucidation** 2+0  Sem. II
General introduction to principles and theory of various spectroscopic techniques, Infrared (IR) spectroscopy, group absorption, sampling techniques and interpretation of spectra. Nuclear magnetic resonance (1 H NMR and 13C NMR), Continuous wave (CW) and Pulsed Fourier Transform (FT) spectrometry, Chemical shift, Spin coupling, Chemical shift equivalence, Coupling constant, and Relaxation time. Difference in CW and FT techniques. Solvent shift and lanthanide shift studies. Theory and application of Ultraviolet spectroscopy, chromophore, auxochrome and red and blue shift, Study of Woodward rules and calculation max of highly conjugated compounds like carotene and lycopene. Mass spectrometry, molecular ion peak, base peak, fragmentation pattern of simple molecules, hydrocarbons, alcohols, ethers alicyclic and cyclic ketones, aldehydes and McLafferty rearrangement. Combined use of spectroscopy for structural elucidation of simple organic compounds.

**Chem. 428 Experiments in Chemistry** 0+3  Sem. II

**Chem. 429 Drugs, Bimolecules and Polymers** 3+0  Sem. II

**Chem. 430 Fundamental Quantum and Solution Chemistry** 3+0  Sem. II
Elementary quantum mechanics, Black body radiation, Photoelectric effect, Bohr's model and its drawbacks, de Broglie hypothesis, Heisenberg's uncertainty principle, postulates of quantum mechanics. Schrödinger's wave equation, physical interpretation of wave function, particle in one dimensional box and three dimensional box, Schrödinger's wave equation for H atom, radical distribution function, Quantum numbers, n, l, m and their importance, Eigen value and eigen function, Hamiltonian operator, physical interpretation of wave function. Molecular orbital theory, Formation of molecular orbital by linear combination of atomic orbital, Calculation of energy levels from wave functions, Physical pictures of bonding and antibonding wave function. Colloids, preparation and properties. Zeta potential, emulsion, ionic equilibria, acids and bases, pH, buffer solution and Henderson's equation, salt hydrolysis, solubility product and its application. Adsorption and adsorption isotherms. Applications of adsorption, difference between physical and
Postgraduate Courses

Chem. 501 Thermodynamics and Electrochemistry 3+0  Sem. I

Chem. 502 Spectroscopy 2+1  Sem. I
Molecular structure-molecular orbital methods for H₂ and H₂ molecule, the valence bond description H₂; electron spin functions; correlation diagram for diatomic molecules. Hückel method for calculating resonance energy, rotation and vibration of molecules-linear and non-linear molecules, derivations of energy levels, selection rules. Rotational vibrational spectroscopy, rotational and vibrational level corrections, electron spectroscopy; Raman Spectroscopy, Laser Raman Spectroscopy. Nuclear Magnetic Resonance Spectroscopy, FTNMR. Mass spectroscopy. Practical: Application of spectroscopy for structural studies. Determination of structure of simple compounds by the combined use of UV, IR, NMR and Mass spectroscopy; use of double irradiation, solvent shift experiments on compounds having hydroxyl groups, inter and intra hydrogen bond studies by FT-IR.

Chem. 503 Basic Concepts of Inorganic Chemistry 2+0  Sem. I
Review of the atomic structure-wave mechanical approach, wave functions for hydrogen atom, radial distribution curves for s, p, d and f orbitals, angular wave functions for s, p, d and f orbitals-their significance and use. Slater-type orbitals; effective nuclear charge, use of radial distribution curves to explain order of filling of orbitals in many electron systems, review of chemical bond. Application of VB, MO and VSEPR theories in explaining the structure of simple molecules. Rules for classification of molecules into point groups, group multiplication tables, degenerate and non-degenerate point groups, rules for fundamental vibrations. Inorganic free radicals-their general reactions, preparation and uses, measurement of free radical concentration and decomposition rate. Bio-inorganic chemistry, photosynthesis, metalloenzymes.

Chem. 504 Physical Organic Chemistry 2+0  Sem. I
Stereochemistry and conformation analysis-conformation and configuration, geometrical and optical isomers, methods of resolution, asymmetric synthesis. ORD and CD, aromaticity, steric effects, reactive intermediates, carbocations, carbanions, free radicals, carbenes, arynes, nitrenes. Organic reaction mechanism: substitution, addition, elimination and rearrangement reactions. Substituent isotope solvent and kinetic salt effects, tracer technique. Hammett equation, non-classical carbocation ions. Neighboring group participation, pericyclic reactions and molecular orbital symmetry.

Chem. 505 Natural Product Chemistry 2+0  Sem. II
Structures and synthesis of terpenes-geraniol, citral amyrins, α-terpeneol, α-pinene, camphor, squalene and abietic acid, isoprene rule, biogenesis of mono, di-and tri terpenoids. Synthesis and

Chem. 506 Experiments in Physical Chemistry 0+2 Sem. II
Practical: Conductivity, potentiometry, pHmetry, polarography, amperometric titration, spectrophotometry, flame-photometry, cryoscopic and ebullioscopic measurements; Chromatography. Adsorption studies, optical activity by polarimeter, refractive index and molar refraction of different solvents. Electron polarization of liquids refractometrically, Kinetic studies.

Chem. 507 Quantum Chemistry-Statistical Mechanics 3+0 Sem. I

Chem. 508 Chemical Kinetics and Surface Chemistry 2+0 Sem. II

Chem. 509 Co-ordinate Chemistry, Reaction Mechanism and Inorganic Polymers 2+1 Sem. I
Practical: Preparation of inorganic complexes like Co{Hg(SCN)₄}, Hg[Co(SCN)₄], [Co(NH₃)₅NO₂]Cl₂, Co(NH₃)₅Cl][Cl₂, [Cu(Gly)₂], K₂[Co(C₂O₄)₂], [Co(acac)₃], K₄[Co₂(C₂O₄)₄(OH)₂], [Co(NH₃)₄]SO₄ and Na₃[Co(NO₂)₆]. Determination of magnetic characteristic of above complexes. Analysis of alloys using conventional, physical and chemical techniques. Complex metric titrations.

Chem. 510 Synthesis and Characterization of Organic Compounds 0+2 Sem. II
Practical: Separation and identification of the components of a binary organic mixture. Synthetic preparations involving two steps. Quantitative analysis of phenol, aniline. Quantitative analysis of
sulphur, nitrogen, phosphorous. Isolation of essential oils from rose, ajwain, mentha and eucalyptus.

Chem. 511 Chemistry of Agrochemicals I 2+1 Sem. I
Classification of pesticides on the basis of function, mode of entry and mode of action, chemistry and structural activity relationship of different pesticides. Insecticides-organochlorines, organophosphates, carbamates, pyrethroids, rotenones fumigants and botanicals. Fungicides-Inorganics, dithiocarbamates, Diazoles and Exothions. Herbicides-phenoxy compounds, substituted ureas, sulfynyl ureas, triazines, bipyridylium compounds and dinitroanilines. Metabolic pathways of some important compounds of each chemical group. Chemistry of fertilizers.
Practical: Testing of pesticide formulations for quality, Estimation of active principles of pesticides employing different analytical techniques in different matrices, Determination of pesticide residues in different commodities by chemical and instrumental methods, analysis of fertilizers.

Chem. 512 Reaction, Reagents and Photochemistry 3+0 Sem. II

Chem. 513 Chemistry of Transition Metals 2+0 Sem. I
Transition elements-Hund's rule and spectroscopic energy states, magnetism in transition metal chemistry, origin and nature of paramagnetism, diamagnetism, ferromagnetism and antiferromagnetism. Magnetic susceptibility and magnetic moment calculations, elements of second and third row transition series, chemistry of iso- and heteropolyacids and anions of Mo and W, the metal-metal bonds. General remarks on different physical and chemical properties of compounds with two centered metal-metal bonds; metal clusters, occurrence, electronic structure, oxidation states and stereo chemistry. Magnetic and spectral properties of lanthanides and actinides, lanthanides contraction separation of lanthanides and actinides. Chemistry of rare elements francium, technitium, rhenium.

Chem. 514 General Physical and Colloidal Chemistry 3+0 Sem. I

Chem. 515 Chemistry of Agrochemicals II 2+1 Sem. II
of insecticides, safe use of insecticides. Practical: Preparation of working standard solutions of pesticides. Sampling, extraction, cleanup and estimation of insecticide residue by chemical and instrumental methods, calculations and interpretation of data.

**Chem. 601 Special Topics in Chemistry**  
3+0  Sem. II  

**Chem. 602 Advanced Physical Chemistry**  
3+0  Sem. II  
Application of computers in Chemistry, Advanced quantum mechanics, Pauli’s exclusion principle, interaction energy of electrons, method of directed valence bonds, molecular orbitals and valence, Application of statistical mechanics to reaction rates and intermolecular forces, Spectroscopy and solid state chemistry.

**Chem. 603 Organometallic Chemistry**  
3+0  Sem. II  
Introduction, synthesis and structure of metal alkyls, metal aryls, metal carbonyls, metal carbenes and metal carbenes. Complexes with chain pi donor ligands and cyclic pi donor ligands, reaction path ways, association reactions, Substitution reactions, addition and elimination reactions, rearrangement reactions. Catalysis involving organometallic compounds-olefin hydrogenation, hydroformylation and the Wacker process. Polymerization, Fischer-Tropsch process, Cyclo-oligomerisation of olefins and acetylenes. Role of advanced spectroscopy in structure elucidation of complex organic compounds.

**Chem. 604 Bio-inorganic Chemistry**  
3+0  Sem. I  
Inorganic elements in biological systems, importance of alkali and alkaline earth metals, ions and ligands affecting the stability of complexes. Coordinating sites in biologically important ligands such as purines, pyrimidines, nucleosides, nucleotides, amino-acids and peptides. Metalloenzymes and metal activated enzyme, metal complexes as oxygen carriers-haemoglobin, myoglobin, porphyrin. Oxygen carriers-hemocyanin and haemerythrin, synthetic oxygen carriers, non-redox metallo-enzymes. Mechanism of electron transfer reactions in metal complexes as drugs and anticancer agents.

**Chem. 605 Organic Synthesis and Spectroscopy**  
3+0  Sem. II  

**Chem. 606 Constitution of Inorganic Compounds and Dynamics of Inorganic Reactions**  
3+0  Sem. II  
Symmetry of crystals, crystal system, classes of crystals, types of lattices, lattice energy, point group and space groups, symmetry parameters, defects in solids. Structure of some typical binary and ternary compounds, structure of silicates, polyacids and their salts. Introduction to
determination of crystal structure by X-ray diffraction, electron diffraction and neutron diffraction techniques. Thermodynamics, kinetics and spontaneity of reaction, Frost diagram and its relation to spontaneity and application in the prediction of chemical reactions.

Chem. 607 Green Chemistry 3+0 Sem. I
Concept of green chemistry. Chemistry and chemical technology of waste, pollution, effluent and other environmental issues which are caused by chemical manufacturing. Novel synthetic techniques. Organic reactions involving reduction of raw material/solvent usage, milder operating conditions. Use of catalyst towards green chemistry. Reactions that use heterogeneous or homogeneous catalyst leading to green scenario. Use of biocatalyst in reactions which make environment clean and friendly. Use of new reagents and solvents which are benign, environmentally friendly. Method of benign synthesis. Energy and renewable resources. Alternate energy sources. Use of renewable raw material includes ethanol, bio-diesel, etc.

Chem. 608 Advances in Agrochemicals 3+0 Sem. I

Chem. 591 Seminar
Chem. 600 Master's Research
Chem. 700 Ph.D. Research
ECONOMICS & SOCIOLOGY

A. ECONOMICS
PROGRAMMES
M.Sc. (Agricultural Economics)
Ph.D. (Agricultural Economics)

COURSE REQUIREMENTS

M.Sc.
Field of Specialization
Farm Management, Agricultural Marketing, Agricultural Finance

Required Courses
Econ.501, Econ.502, Econ.503, Econ. 506.

Supporting Courses
Stat. 421, PGS 501 and other courses from subject matter fields (other than Minor) relating to area of special interest and research problem.

Minor Fields
Statistics, Mathematics, Agri. Business Management, Business Management or any other as approved by the Dean, Postgraduate Studies.

Deficiency Courses
As recommended by the Student's Advisory Committee and approved by the Dean, Postgraduate Studies

Ph.D.
Field of Specialization
Farm Management, Agricultural Marketing, Agricultural Finance

Required Courses
Econ. 601, Econ. 602, Econ. 603.

Supporting Courses
Courses from subject matter fields (other than Minor) relating to area of special interest and research problem.

Minor Fields
Statistics, Agri. Business Management, Business Management, Extension Education or any other as approved by the Dean Postgraduate, Studies.

Deficiency Courses
As recommended by the student's Advisory Committee and approved by the Dean, Postgraduate Studies
DESCRIPTION OF COURSE CONTENTS

Undergraduate Courses

Econ. 51 Elementary Farm Management and Finance 2+1 Sem. II

Econ. 52 Marketing of Farm Products 2+0 Sem. I

Econ. 102 Fundamentals of Agricultural Economics 2+0 Sem. II

Econ. 201 Economics and Marketing 2+1 Sem. I


**Econ. 203 Introduction to Economics and Project Evaluation 2+0 Sem. I**

**Econ. 204 Agricultural Marketing, Trade and Prices 2+1 Sem. II**
Agricultural marketing: concepts, definitions; market structure, marketing mix and market segmentation. Classification and characteristics of agricultural markets. Nature and determinants of demand and supply of farm products. Producer's surplus – meaning, types, marketable and marketed surplus and factors affecting marketable surplus of agri-commodities. Product life cycle (PLC) and competitive strategies. Pricing and promotion strategies and approaches. Market promotion – advertising, personal selling, sales promotion and publicity. Marketing process-concentration, dispersion and equalization; GST and its implications for agriculture, Marketing functions- exchange functions, physical functions and facilitating functions. Market functionaries- types and importance of agencies involved in agricultural marketing; Marketing channels- meaning, definition, number of channel levels and marketing channels for different farm products. Market integration- Meaning, definition and types; marketing efficiency; Marketing costs, margins and price spread-Factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs; Role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP & DMI – their objectives and functions. Cooperative marketing in India. Risk in marketing-types, speculation & hedging and futures trading. Agricultural prices - meaning, functions and administered prices. Need for agricultural price policy; Trade: concept and need of International Trade, theories of absolute and comparative advantage. Present status and prospects of international trade in agri-commodities; GATT and WTO: Agreement on Agriculture (AoA) and its implications on Indian agriculture; IPR.
Practical: Plotting and study of demand and supply curves and calculation of elasticities; Study of relationship between market arrivals and prices of some selected commodities; Computation of marketable and marketed surplus of important commodities; Study of price behaviour over time for some selected commodities; Construction of index numbers; Visit to a local market to study various marketing functions performed by different agencies. Identification of marketing channels for selected commodity, collection of data regarding marketing costs, margins and price spread and presentation of report in the class; Visit to market institutions – NAFED, SWC, CWC, cooperative marketing society, etc. to study their organization and functioning; Analysis of principles of comparative advantage of international trade.

**Econ. 205 Agricultural Finance and Co-operation 2+1 Sem. I**
Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture. Agricultural credit-meaning, definition, need and classification. Credit analysis: 4 R’s
Sources of agricultural finance: institutional and non-institutional sources, commercial banks, social control and nationalization of commercial banks, Micro finance, KCC, Lead bank scheme and RRBs. Scale of finance and unit cost. An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, world bank, Insurance and Credit Guarantee Corporation of India. Cost of credit. Recent development in agricultural credit. Preparation and analysis of financial statements – Balance Sheet and Income Statement. Basic guidelines for preparation of project reports- Bank norms and SWOT analysis. Agricultural Cooperation – meaning, brief history of cooperative development in India, objectives, principles and significance of cooperatives in Indian agriculture. Agricultural Cooperation in India- credit, marketing, consumer and multi-purpose cooperatives, farmers’ service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDC, NAFED.


**Econ. 304 Farm Management, Production and Resource Economics**

1+1 Sem. II

Farm management-meaning, concept and objectives. Farms-meaning, types, characteristics, factor determining types and size of farms. Principles of farm management- production function and its type, factor-product, factor-factor and product-product relationship, law of equi-marginal/or principles of opportunity cost and law of comparative advantage. Cost- meaning, concept, types and their interrelationship. Importance of cost in managing farm business and estimation of gross farm income, net farm income, family labor income and farm business income. Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises. Farm records and accounts- importance, types , farm inventory, balance sheet, profit and loss accounts. Farm planning and budgeting- meaning, importance, partial and complete budgeting. Steps in farm planning and budgeting-linear programming, appraisal of farm resources, selection of crops and livestock's enterprises. Risk and uncertainty in agriculture production- concept, nature, sources and its management strategies, Crop/livestock/machinery insurance – weather based crop insurance, features, determinants of compensation. Resource economics, externalities in agriculture. Inefficiency, welfare loss and solutions. Important issues in economics and management of common property resources of land, water, pasture and forest resources etc.


**Econ. 433 Micro Economic Analysis**

3+1 Sem. I

Micro Economics: meaning, definition, importance, nature and scope. Theory of consumer behavior: marginal utility analysis and indifference curve analysis. Demand analysis: meaning, definition, derivation of demand curve. Firm and industry: meaning, types, difference between firm and industry, equilibrium conditions, short-run and long-run analysis. Production: meaning, process and factors of production, relationship between production and different factors,
production lags. Theory of producer behaviour: production function, costs, optimization of inputs use and product combinations, maximization of returns, specialization and diversification and supply analysis. Product market: meaning, types, assumptions, conditions of perfect and imperfect markets. Equilibrium of a firm and industry, determination of price and output of commodities under different market situations. Factor pricing: meaning, different theories for determination of rent, wages, interest and profit.


**Econ. 434 Macro Economic Analysis**
3+0 Sem. I

**Econ. 491 Agro-industrial Attachment**
0+4 Sem. I

**Postgraduate Courses**

**Econ. 501/Mgt. 503/ABM 503 Micro Economics/Managerial Economics**
3+0 Sem. I

**Econ. 502 Macro Economics and Policy**
3+0 Sem. I

**Econ. 503/Mgt. 527 Econometrics**
2+1 Sem. II
Introduction: relationship between economic theory, mathematical economics, models and

Practical: Practicals on single equation two variable model specification and estimation, hypothesis testing, transformations of functional forms and OLS application. Estimation of multiple regression models: hypothesis testing, testing and correcting specification errors, testing and managing multicollinearity, heteroscedasticity, autocorrelation. Estimation of regressions with dummy variables, estimation of regression with limited dependent variable. Identification of equations in simultaneous equation systems.

**Econ. 504 Agricultural Production Economics**  

Practical: Different forms of production functions: specification, estimation and interpretation of production functions, returns to scale, factor shares, elasticity of production, physical optima, economic optima, least cost combination, optimal product choice, cost function estimation, interpretation, estimation of yield gap, incorporation of technology in production functions, measuring returns to scale, risk analysis through linear programming.

**Econ. 505 Agricultural Marketing and Price Analysis**  

Econ. 506/Soc. 506/Ext. 505/HEE 501 Research Methodology for Social Sciences 2+1 Sem. I

Econ. 507 Evolution of Economic Thought 2+0 Sem. I

Econ. 508/Mgt. 512/ABM 512/Stat. 527 Quantitative and Optimization Techniques for Economics and Management 2+1 Sem. II
Role of quantitative methods in decision making, probability and decision making under risk and uncertainty, value of additional information, Bayes theorem, probability models and decision making. Sample survey, measurement and forecasting, index numbers, time-series, optimization models. Linear programming: Formulation of simplex method, primal and dual, sensitivity analysis. Transportation and assignment models, dynamic programming, network analysis, PERT and CPM. Game theory: concept, two person constant sums, zero-sum games, saddle point, solution to mixed strategies. Markov chain analysis, queuing models: waiting line problem, characteristics of waiting lines, single channel model, multiple channel model, constant service time model, finite population model, sequencing and replacement models. Simulation and Monte Carlo methods.
Practical: Graphical and algebraic formation of linear programming models. Solving of
maximization and minimization problems by simplex method. Formulation of the simplex method by typical farm situations. Solution of other numerical problems, case studies and discussion.

**Econ. 509 Agricultural Finance and Project Management**  
2+1  
Sem. II


Practical: Estimation of demand and supply gaps of institutional agricultural credit. Preparation of farm credit plan and financial statements using farm/firm level data. Farm credit appraisal techniques and farm financial analysis through financial statements. Performance of micro financing institutions: NGO's and Self-Help Groups. Identification and formulation of agricultural investment projects. Practical training of project appraisal techniques: undiscounted and discounted measures along with their limitations. Case study analysis of an agricultural project, financial risk and risk management strategies.

**Econ. 510 International Economics**  
2+1  
Sem. I


**Econ. 511 Agricultural Development and Policies**  
3+0  
Sem. II


**Econ. 512 Institutional Economics**  
1+0  Sem. I

**Econ. 513 Natural Resource and Environmental Economics**  
3+0  Sem. II

**Econ. 514 Rural Marketing**  
2+0  Sem. II
Concept and scope of rural marketing: nature, characteristics and potential. Environmental factors: socio-cultural, economic and other environmental factors affecting rural marketing. Rural consumer's behaviour: behaviour of rural consumers and farmers, buyer characteristics and buying behaviour. Rural v/s urban markets. Rural marketing strategy: marketing of consumer durable and non-durable goods and services in the rural markets with special reference to product planning, product mix, pricing course objective, pricing policy and pricing strategy. Input marketing in the rural areas. Inter linkage of rural marketing with credit. Product promotion: media planning, planning of distribution channels, and organizing personal selling in rural market in India.

**Econ. 515 Commodity Futures Trading**  
2+0  Sem. I
History and evolution of commodity markets. Terms and concepts: spot, forward and futures markets, factors influencing spot and future markets. Speculatory mechanism in commodity

**Econ. 516 Farm Management Economics** 2+1  Sem. II
Meaning and functions, development of farm management as a science, management factor in commercial agriculture. Organization and operation of the farm business for optimal resource use. Cost and returns concepts. Relationship between different farm enterprises. Farm adjustment programmes under uncertain conditions. Farm records and accounting. Efficiency measures for different types of enterprises and farm business.
Practical: Preparation of layout maps, maintenance of farm business records, summarization and analysis of the accounts and preparation of enterprise, labour and partial budgets, alternative plans and control charts in respect of the assigned farm.

**Econ. 517 Money and Banking** 2+0  Sem. I
Evolution of money. Nature and functions of money with special reference to the macro economic variables, various forms of money, changes in the value of money, monetary standards, role of commercial banks and other banking institutions. Principles and procedure of lending, documentation etc. Instruments of credit, structure and functions of a central bank in the context of economic planning, international monetary relations and institutional set up.

**Econ. 518 Agribusiness Environment and Policy** 2+0  Sem. I
Role of agriculture in Indian economy; problems and policy changes relating to farm supplies, farm production, agro-processing, agricultural marketing, agricultural finance. Structure of agriculture : linkages among sub-sectors of the agribusiness sector, economic reforms and Indian agriculture. Impact of liberalization, privatization and globalization on agribusiness sector. Emerging trends in production, processing, marketing and exports. Policy controls and regulations relating to the industrial sector with specific reference to agro-industries. Agribusiness policies: concept and formulation, and new dimensions in agri-business environment and policy. Agricultural price and marketing policies, public distribution system and other policies.

**Econ. 519 Management of Agribusiness Cooperatives** 3+0  Sem. II

**Econ. 520/Forst. 506 Forest Resource Management and Economics** 1+1  Sem. I
Importance of forests, use of economic principles in forest resources problems. Forest products: demand and supply analysis, forest product marketing, forest capital theory. Inter-regional and international trade in forest products. Impact of economics and physical variables upon forest appraisal and management decisions. Externalities and property rights. Natural and environmental resource accounting: methods and implications. Application of operations research tools in evaluating forest management alternatives in public and private forest planning.
Practical: Exercises on estimation of demand and supply functions, biodiversity valuation,
valuation of non-marketed forest products. Exercises on financial and economic appraisal of forestry projects. Exercises on marketing of forest products and international trade competitiveness. Computer applications for using programming techniques in evaluating forest management alternatives.

**Econ. 601 Advanced Micro Economic Analysis**  
2+0  
Sem. II  

**Econ. 602 Advanced Macro Economics Analysis**  
2+0  
Sem. II  

**Econ. 603 Advanced Econometrics**  
2+1  
Sem. II  

**Econ. 604 Advanced Production Economics**  
2+1  
Sem. II  
Practical: Estimation of different forms of production functions. Optimal input and product choice

Econ. 605 Quantitative Development Policy Analysis 2+1 Sem. I

Econ. 606 Advanced Agricultural Marketing and Price Analysis 2+1 Sem. I

Econ. 607 Advances in Commodity Futures Trading 2+0 Sem. II
Historical perspective of development of commodity markets. Various terms and concepts used in commodity marketing: spot, forward and futures markets, factors influencing spot and future markets. Advanced speculative mechanism in commodity futures. Transaction and settlement: delivery mechanism, role of different agents at national and international level, trading strategies, potential impact of interest rate. Foreign exchange, FDI in commodity markets. Risk in commodity trading, importance and need for risk management measures: managing market price risk, hedging, speculation, arbitrage, swaps pricing and their features. Important global and Indian commodity exchanges, contracts traded, special features. Regulation of Indian commodity exchanges, FMC and its role. Fundamental V/s technical analysis: construction and interpretation of charts and chart patterns for analysing the market trend. Market indicators-
back testing. Introduction to technical analysis software - analysing trading pattern of different commodity groups.

**Econ. 608 Advanced Environmental Economics**  
2+0  
Sem. I


**Econ. 609 Advanced Agricultural Economics**  
3+0  
Sem. I

History of agricultural development. Theories of agricultural development. Agriculture in different countries with different social, political and economic systems. Institutional setting in agriculture, inter-sectoral forward and backward linkages. Agricultural development process under various economic systems. Distributional justice, distortions by political and economic factors, impact of agricultural development on investment, capital formation and employment, agricultural taxation, World trade in agriculture and external competitiveness. Review of agriculture policy and impact and institutional changes in agricultural development.

**Econ. 610 Advanced Agricultural Financial Management**  
2+0  
Sem. I


**Econ. 591 Seminar**

**Econ. 600 Master's Research**

**Econ. 700 Ph.D. Research**
B. SOCIOLOGY PROGRAMMES

M.Sc.

Field of Specialization: Rural Sociology, Social Change

Required Courses: Soc. 501, Soc. 502, Soc. 503, Soc. 506.

Supporting Courses: Stat. 421, PGS 501 and other courses from the subject matter fields other than minor) relating to area of special interest and research problem.


Deficiency Courses: As recommended by the Student's Advisory Committee and approved by the Dean, Postgraduate Studies.

Ph.D.

Field of Specialization: Rural Sociology, Social Change

Required Courses: Soc. 601, Soc. 602

Supporting Courses: Courses from subject matter fields (other than Minor) relating to area of special interest and Research problem.


Deficiency Courses: As recommended by the student's Advisory Committee and approved by the Dean, Postgraduate Studies.
DESCRIPTION OF COURSE CONTENTS

Undergraduate Courses

**Soc. 101 Rural Sociology and Educational Psychology**  2+0  Sem. I

**Soc. 102 Introduction to Rural Sociology**  2+0  Sem. II

**Soc. 421 Applied Rural Sociology**  3+0  Sem. II

**Soc. 422 Rural Community Organization**  2+0  Sem. II
Structure and functions of rural community. Organizational and informal relationships. Process of making decisions and policy for community development through agricultural extension, school systems and other agencies. Handling a group project for the analysis of social structure. Formal and informal relationships. Decision making channels and authorities for suggesting an outline of the community action programme in a given problem area.

**Soc. 423 Society and Culture**  2+0  Sem. II
The meaning of society and culture, its significance for human being and its diverse forms. Interaction and its processes of growth. Social relations and organizations among selected people around the world including kinship, religious, fraternal, occupational and political forms of behaviour. Effects of environment on human behaviour.

**Soc. 424 Technology and Social Change**  2+0  Sem. I

**Soc. 425 Population and Society**  2+0  Sem. I
Postgraduate Courses

Soc. 501 Rural Society 3+0 Sem. I

Soc. 502 Society and Change 3+0 Sem. I

Soc. 503 Sociological Theories 2+0 Sem. I

Soc. 504 Evolution of Social Thought 2+0 Sem. II

**Soc. 505 Women Development Studies** 3+0  Sem. I


**Soc. 506/Econ. 506/Ext. 505/HEE 501 Research Methodology for Social Sciences** 2+1  Sem. I


**Soc. 507 Social Stratification** 3+0  Sem. I


**Soc. 508 Rural Leadership** 2+0  Sem. II

**Soc. 509 Human Ecology and Dynamics of Population**  
3+0  
Sem. II


**Soc. 510 Development and Quality of life**  
2+0  
Sem. I


**Soc. 601 Sociology of Development**  
3+0  
Sem. II


**Soc. 602 Recent Advances in Rural Sociology**  
3+0  
Sem. II

Critical evaluation of the recent works of rural sociology. Contribution of sociology, anthropology, economics and psychology to the understanding of structure and functions of rural society. Change in development perspective, planning and social action and rural social policy, social values and developmental change, social spatial and economic limits of social change, socio-psychological variables in planned development. Formation and destruction of communities and rural development planning. Policy planning and administration concerning

**Soc. 603 Contemporary Rural Social Problems**
3+0 Sem. I

**Soc. 604 Demographic Analysis**
3+0 Sem. I

**Soc. 605 Studies of Marginalized Sections**
2+0 Sem. II

**Soc. 606 Environment and Social Organization**
2+0 Sem. II

**Soc. 607 Peasants Movements and Indian Agrarian Structure**
2+0 Sem. II
Conceptual and historical perspectives of peasantry in India. Importance of peasantry in Indian society. Agrarian structures of traditional and contemporary societies and land tenure systems. Types of peasants. Peasant culture. Peasants unrest. Peasant movements and their role in agrarian structure: Santhal Insurrection (1855), Peasant revolt in Punjab (1930), Champaran

Soc. 608 Society in India 2+0 Sem. II

Soc. 591 Seminar
Soc. 600 Master’s Research
Soc. 700 Ph.D. Research
MJMC (Masters in Journalism and Mass Communication)

COURSE REQUIREMENTS

MJMC

Field of Specialization: Journalism & Mass Communication

Required Courses: Jour. 501, Jour. 502, Jour. 503, Jour. 504, Jour. 505, Jour. 506 and at least one course from Jour. 507 to Jour. 509

Supporting Courses: Courses from subject matter fields (other than Minor) relating to area of special interest and research problem.

Minor Fields: English, Punjabi, Extension Education, Economics, Sociology, Business Management or any other as approved by the Dean, Postgraduate Studies.

Deficiency Courses: As recommended by the Student's Advisory Committee and approved by the Dean, Postgraduate Studies.
DESCRIPTION OF COURSE CONTENTS

A. Journalism

Undergraduate Courses

Jour. 302 Agricultural Journalism 2+1 Sem. II
Nature and scope of agricultural journalism. Characteristics and training of the agricultural journalist. Comparison of agricultural journalism with other types of journalism. Newspapers and magazines as communication media. Characteristics, kinds, functions, form, content, style, language and parts of newspapers and magazines. The agricultural story - types, subject matter and structure. Gathering agricultural information - sources, interviews, coverage of events, abstracting from research and scientific materials, wire services and other agricultural news sources. Writing the story - organizing the material, treatment, writing the lead and the body and readability measures. Illustrating agricultural stories - use of photographs, artwork and writing the captions. Editorial mechanics - copy reading, headline and title writing, proofreading and lay outing.
Practical: Practice in interviewing. Covering agricultural events. Abstracting stories from research and scientific materials and from wire services. Writing different types of agricultural stories. Selecting pictures and artwork for the agricultural story. Practice in editing, copy reading, headline and title writing, proofreading and lay outing. Testing copy with a readability formula. Visit to a publishing office.

Postgraduate Courses

Jour. 501 Print Journalism 1+2 Sem. I
Introduction to journalism, basic terminology, history of Indian press and printing, printing processes, attributes of a reporter, news syndicates and agencies, concept, sources and elements of news, press releases, flash messages, kinds of feature, feature, article and editorial writing, types and sources of editorials, principles of editing, headline writing, illustrations, principles of design and layout, brief introduction to recent trends in mass media, cultural imperialism, media activism, agenda setting, gate keeping, page 3 journalism.
Practical: Writing letters to the editor, newsgathering, writing news and headlines, conducting interviews, writing specialty stories, planning and writing features and articles, news interpretation, editorial writing, proof reading and copy editing, use of appropriate computer applications for Desk Top Publishing, dummy making, page making, production of lab journal.

Jour. 502 Online Journalism 2+1 Sem. II
Introduction to online journalism, basic terminology, a technical history of the Web and early online media, comparative media characteristics (print and online), online writing and story structure, issues in online research and information gathering, concept of interactivity and its tools, ethical dilemmas in online journalism, blogging and participatory journalism, issues concerning blogging; online advertising, virtual community formation v/s atomization, massification v/s individuation of news, understanding difference between web edition and e-edition of newspapers, metajournalism, extensions of new media e.g. RSS feeds, podcasting and wireless paper, convergence.
Practical: Uses of Internet, using search engines such as Google effectively, finding useful information from local, national and international sources, content writing, news-site designing, making a webpage using HTML/ Front page.

Jour. 503 Media Planning and Advertising 2+1 Sem. I
Introduction to advertising, its origin and growth; terminology; advertising- its classification,
objectives, strategies at different levels and its future; marketing mix, promotional mix and the
communication process; structure of advertising industry – advertising agencies; advertising
coverage; types of advertising media; advertising codes, regulations and ethics; consumer
redressal forums; advertising and social issues; controversial advertising; issues concerning
surrogate advertising; constructing an advertisement; types of consumers and buying motives;
media selection and scheduling; difference between advertising and PR; media planning and
buying; brand positioning.
Practical: Preparing media-specific advertisement copies; ad layout and design; computer
graphics using appropriate applications.

**Jour. 504 Agricultural and Development Journalism** 1+1 Sem. II
Meaning, scope and importance of development journalism; problems of rural development;
development agencies; development media theory and democratic participant theory;
dominant paradigm v/s participatory approach; human development index; making sense of
development statistics; determinants of development; nation building and uplifting quality of
life; agriculture and rural development schemes; agricultural news story structure, agricultural
media dynamics and ethics; editing scientific papers, policy reports; public understanding and
media coverage of environmental issues; use of traditional media; rural press; contribution of
vernacular press; role of IT in agricultural and rural development; Right to communicate and
New World Communication Order; WTO.
Practical: Planning and writing development articles; news and information material on farm,
home and community activities; editing of popular leaflets and bulletins based on technical
material; media mix campaigns for specific targets.

**Jour. 505 Media Ethics and Press Laws** 3+0 Sem. II
Ethics – ethical reporting, code of ethics; social responsibility; invasion of privacy; sting
operations and ethical issues; organizational pressures in media ethics; **six** fundamental rights
– right to equality, freedom - especially freedom of speech and expression, against
exploitation, religion, cultural and educational rights, constitutional remedies; freedom and
accountability of press; press laws in India; Official Secrets Act 1923 – extent, application,
definitions and penalties; laws of sedition; defamation – criminal and civil law, exceptions and
liabilities, libel and slander; Contempt of Court Act 1971 – defences and punishment; Contempt
of Legislature; Privileges of the Parliament and Press; Press Council Act1978 – composition,
term, objects and functions, power to censure; Press Commission; Copyright Act 1957 –
meaning, term and infringements; registration of journals – Press and registration of Books Act
1867; Information Technology Act 2000 and cyber rights; Right to Information Act 2005;
media’s role in promotion of human rights; editor’s freedom; case studies.

**Jour. 506 Communication Theories and Research Techniques** 2+1 Sem. I
Definition, scope and importance of communication; kinds of communication - intra-personal,
inter-personal, group and mass communication, verbal and non - verbal communication;
barriers of communication; communication process; diffusion process - one step, two step and
multi step flow; communication models; theories: cognitive dissonance, selective exposure,
perception and retention, uses and gratification approach, cultivation approach; research
methods and practices for mass media; types of research e.g. survey research, readership
studies, content analysis, etc.; selection and formulation of research problems; method and
style of writing research report
Practical: Selecting a problem; conducting field surveys; writing reports; research proposal
writing; conducting pilot studies and presenting reports.

**Jour. 507 Corporate Communication and Public Relations** 2+1 Sem. I
Corporate communication- concept, definition, nature and scope; effective means of organizational and social communication; differences between corporate communication and publicity, propaganda, advertising and lobbying; corporate citizenship and culture; function of consultancies/ image advisories; event, crisis, image and conference management; counselling, issue support; direct marketing; budgeting; business communication; publics for corporate communication; media management – principles, ownership and organizational structure in management and editorial department; circulation department; definition and scope of public relations; tools and techniques of PR; use of print media, audio-visual aids and electronic media in PR; role of public relations in various institutions; public opinion, propaganda and PR; ethics in PR.

Practical: Organizing exhibitions and campaigns; organizing conferences; image management of university/ college/ department; media counselling and ghost writing for organizational heads; conducting visits; motivational campaigns for organizational staff; business correspondence; liaison with administration; space marketing features; making posters, hand bills for PR campaigns.

Jour. 508 Photojournalism 1+2 Sem. I
Photojournalism – brief history and technological developments; role of photography in communication; importance and impact of pictures in publications; understanding a photograph; qualities of a good photograph; reproduction qualities of a photograph; selection and editing of photographs; writing captions; ethics of photojournalism; legal limitations of a photojournalist. Ethics and aesthetics of image manipulation.
Practical: Camera basics; terminology; components and controls in a camera; types of camera; choosing a camera; importance of lighting and natural /artificial lighting; handling a camera; camera techniques; shutter, aperture and lens controls; elements and composition; developing and printing of photographs; digital photography; file formats and storage; image editing/ manipulation in Photoshop; printing and printers; photo sharing via internet; photo galleries, preparing photo features.

Jour. 509 Broadcast Journalism 1+2 Sem. I
Principles and characteristics of broadcast journalism; its comparison with print journalism; basic terminology in radio and TV journalism; history of radio and TV; early experiments and inventions; ethics in broadcasting; organization and functioning of radio and TV stations; writing for rural radio and TV programmes; differences between ham, community and FM radio; evolution of Internet Protocol TV (IPTV); steps in production including pre and post production stages; creating effective newscasts; narrowing v/s broadcasting; role of electronic media in rural development; impact of broadcasts and telecasts on rural life; problems of broadcasting/ telecasting.
Practical: Handling video camera, conceptualizing, drafting, interpreting and writing a radio script, drafting, interpreting and writing a TV script, preparing interview schedule for a radio/TV programme, scripting a radio/TV talk, reporting of university activities, accomplishments and research highlights through electronic media, editing scripts for development programmes on radio and TV, preparing a short documentary film.

Jour. 595 Training in Journalism 0+10 Sem.II
(NC)
For practical training, students will be attached to a newspaper/news agency/radio/TV for eight weeks.

Jour. 591 Seminar
Jour. 600 Project Research

B. English
Undergraduate Courses

Eng. 91 General Reading, Vocabulary Building and Translation  
2+1  
Sem. I
An anthology of modern prose for intensive study, a book of biographies for general reading. Practical: Use of articles, pronouns, conjunctions and prepositions, position and order of adverbs, tenses, paragraph writing, comprehension of unseen passages, punctuation, words often misspelt. Translation: English language into vernacular. (A special question for foreign students in lieu of translation).

Eng. 92 Reading, Comprehension, Paragraph Writing and Applied Grammar  
2+1  
Sem. II

Eng. 93 Conversational Structure and Communicative Function  
2+1  
Sem. I
Structure of English Language-Lexical level: structural words, content words, meaning of words, connotations and denotations, relation of words in sentences, phrasal/clausal level- phrase-form and structure, clause-form and structure, forms of sentences, sentences based on structure, function and purpose, Peculiarities of English Language- the use of articles, emphatic and personal pronouns, reduction of articles, auxiliary verbs, conjunctions, prepositions and pronouns in connected speech. Situational and functional use of English Language; factors, role of audience, managing the pace of information and delivery, time and stress management, use of factors and functions in real-life situations. Practical: Functional use of language, greeting and introduction, request, permission, instruction and direction, offering help etc. Situational use of language- at the bank/post office/college office, at the grocer, at the temple, at the college canteen or restaurant, at the police station, at the railway station/ bus station, at the medical shop, at the library, at the travel agency, booking a room in a hotel, facing interviews. etc.

Eng. 94 Discourse Patterns in Spoken English  
1+2  
Sem. II
Patterns in spoken English, back channel, deixis, clause combining, conversational historical present, discourse markers discourse markers, general extenders, hedges intensifiers, narrative structure, nonstandard grammar, non-fluency textures, repetition, false starts, quotative expressions, rhetorical strategies, slang. Discourse analysis, voice modulation, use of pitch and tone depending on the structure of sentence, importune of pause and stop in spoken English, body posture and communication. Practical: Using language for effective communication- PowerPoint presentations, preparation and delivery of power point presentation, role of add-ons (illustrations, pictures and animations) in power point presentations, conversation with pattern and content, dialogue base study of structural patterns, activity using non-verbal skills to narrate a story/mime, voice modulation exercises, extempore and speech delivery, interview skills, soft skills, discussion skills, speaking activities, integrated task and independent task practice, role play, debates, group
discussions.

**Eng. 101 General English**

Reading Comprehension- Vocabulary Building- Antonyms, Synonyms, words often confused due to similar spellings or pronunciations. Functional grammar- Error Analysis- Articles, prepositions, verbs, pronouns, adjectives and adverbs. Basic sentence patterns in English- Agreement between subject and verb, proper use of phrases and clauses. Development of paragraphs- Cohesion, coherence and style. Technical Writing Skills- Nature of technical style vs. general style, writing process (prewriting, rewriting and editing). Paragraph writing, précis writing, summarizing, abstracting. Preparation of Curriculum Vitae and Job applications. Note-taking, field diary and lab record, indexing, footnote and bibliographic procedures.

Practical: Reading skills- Reading and comprehension of general and technical articles, vocabulary building tasks, exercises to help the students in the enrichment of vocabulary based on competitive examinations. Writing Skills- Note-taking, field diary and lab record, précis writing, summarizing, abstracting, preparation of curriculum vitae and job applications. Reference Skills: Use of dictionary and thesaurus, indexing, contents, glossary, footnote and bibliographic procedures.

**Eng. 201 Communication Skills and Personality Development**

Communication Skills- Meaning and process of communication, verbal and nonverbal communication, oral presentation skills, individual and group presentations, extempore presentations, public speaking, group discussions and interviews. Soft Skills- introduction to soft skills and hard skills. Personality- meaning and definition of personality, theoretical perspectives on personality, behavioural trait and humanistic personality patterns, molding the personality patterns. Personality development- self-perception, self-concept, self-esteem and gender stereotyping, persistence and changes in personality determinants (physical, intellectual, emotional, social, educational and family), aspirations, achievements and fulfillment. Cosmopolitan culture- presentational etiquettes, formal dressing, formal greetings. Stress and conflict management- goal setting, decision making, career planning, resume building, interview skills.

Practical: Organizing seminars and conferences, developing questionnaire to study impact of physique, educational institutions, aspirations on personality, developing questionnaire to study social prescriptions, gender and family on personality, aspirations and achievements. Oral presentation skills, video recorded mock group discussions and interviews, exercises on attitude management, setting and achieving a short term goal, creating a personal vision statement of life, practicing conscious body postures and movements, rapport building, video recorded practical to evaluate change in confidence level, team work exercises, time management.

**Postgraduate Courses**

**PGS 501 Technical Writing, Communication Skills & Library and Information Services**

Technical Writing-Various forms of technical writing-theses, technical papers, reviews, electronic communication etc., qualities of technical writing, parts of research communications-title page, content page, authorship, preface, introduction, review of literature, materials and methods, experimental results, documentation, photographs and drawings with suitable captions, pagination; citations, writing of abstracts, précis, synopsis; editing and proof reading. Communication Skills-defining communication, types of communication- verbal and non-verbal, assertive communication, assertive communication, using language for effective communication, techniques of dyadic communication- message pacing and message
chunking, self-disclosure, mirroring, expressing conversational intent, paraphrasing, vocabulary building- word roots, prefixes, Greek and Latin roots.

Practical: Editing and Proof reading technical articles; using language tools for effective writing, listening to audio-video conversations aimed at testing the comprehension of the students; oral presentations on a given topic related to agriculture, evaluation of body language and communication skills based on group discussions and interviews, role plays and pronunciation exercises, using eye contact and visual clues for effective listening skills, word stress application and voice modulation, soft skills; rhetoric skills, self-assessment exercises.

Introduction to Library and its services, Five laws of library science, type of documents, classification and cataloguing, organization of documents, sources of information-primary, secondary and tertiary, current awareness and SDI services, tracing information from reference sources, library survey, preparation of bibliography, use of Online Public Access Catalogue, use of CD-ROM databases and other computerized library services, CeRA, J-Gate; use of Internet including search engines and its resources, e-resources and access methods.

Eng. 501 Advanced Comprehension and Composition 2+1 Sem. I
Comprehension of passages selected from journals, newspapers and books- style, structure and format of comprehension, prerequisites of writing a comprehension, epitomization-summaries, précis, book review, abstract and synopsis writing, diction, etymology-definitions, word meaning; denotation and connotation- definitions and meanings, concrete and abstract words-definitions and meanings, choice and arrangement of words-rules of proximity, avoiding a split infinitive, use of connectives, avoiding ambiguity, position of adverbs, clichés-idioms and phrases, figurative language, words causing confusion-metaphor, simile, homonyms, homophones, pair of words; principles of effective writing- basic units of writing- kinds of sentences, classification by function and structure, important grammatical problems, objectivity, conciseness, concreteness, directness; forms of writing- scientific and technical writing, reports, articles, papers, manuals, dissertations and theses, correspondence; styles of writing-cultural, creative, journalistic writings.
Practical: Exercises in Comprehension, epitomization-summaries, précis, abstract and synopsis writing, writing of reports and book reviews, usage and composition, writing a creative piece on a given subject. Writing of words causing confusion-metaphor, simile, homonyms and homophones. Styles of writing-cultural, creative, journalistic writings. Listening to at least two tapes regarding British pronunciation techniques, recorded conversation aimed at testing the listening comprehension of students, group discussions on the current issues concerning society, planning for meetings, holding mock meetings, facing interviews by holding mock interviews, presentations by using PowerPoint and LCD projector; public speaking on any topic.

Eng. 502 Contemporary Prose 2+1 Sem. II
Critical study of selections from contemporary prose representing creative prose-style, structure and format of prose, prerequisites of writing a prose, use of figurative language, diction, choice of words and arrangement of words, Charles Lamb- Dream Children, Bachelor’s Complaint, Francis Bacon-Essays, cultural writings-style, structure and format of cultural prose, prerequisites of writing a cultural prose-glimpses of colonialism, post colonialism and Diaspora in cultural prose, scientific prose- Various forms of scientific writings-theses, technical papers, review, manuals etc., various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion) diction, choice of words and arrangement of words; journalistic writing with emphasis on Indo-Anglian Prose-Various forms of journalistic writings-Introduction, story board; style, structure and format of journalistic prose, prerequisites of writing a journalistic prose, important works of prose, especially journalistic, by western and
Indian writers known for thought and style.

Practical: Writing reviews and popular articles. Listening to at least two tapes regarding British pronunciation techniques; recorded conversation aimed at testing the listening comprehension of students; group discussions on the current issues concerning society; planning for meetings, holding mock meetings; facing interviews by holding mock interviews; presentations by using PowerPoint and LCD projector; public speaking on any topic.

**Eng. 503 Communication for Management and Business**

Sem. I

Communication process, barriers to communication, effective communication, types of communication in organizations viz. downward, upward, horizontal, static vs. dynamic, business terms viz. E-mail, Fax, Internet protocol, communication through clothes, colors, space, symbol, body language and etiquettes, interpersonal communication, self-concept and communication, assertive communication, types of business writing, writing of newsletters, preparation of reports, compiling of folders, fact sheets, press release, business communication through memos, business letters, office notices, job applications; press release; advertisements; curriculum vitae; drafting minutes of a business meeting, public relations and mass communication (meaning and need for PR, seminars, methods of mass communication).

Practical: Listening to at least two tapes regarding British pronunciation techniques, recorded conversation aimed at testing the listening comprehension of students, group discussions on the current issues concerning society, planning for meetings, holding mock meetings, facing interviews by holding mock interviews, presentations by using PowerPoint and LCD projector, public speaking on any topic.

**C. PUNJABI**

**Undergraduate Courses**

**Pbi. 101 Basic Punjabi**

Sem. I

(For undergraduate students who have not studied Punjabi upto Matric or 10 +2 level)

Gurmukhi script, sequence of letters in Punjabi alphabet and their pronunciation, similarities and dissimilarities of gurmukhi and devnagri script, why the script of Punjabi is called gurmukhi, linguistics, definition and its application on gurmukhi script, a brief note on various dialects of Punjabi e.g. Malwai, Majhi, Doabi, Puaedi; Dogri, Kangri and dialects of west Punjab, Matras, nasal sounds and their signs, word formation and pronunciation, standard spelling, correct incorrect, sentence structure, basic Punjabi grammar, idioms, proverbs, synonyms; antonyms, gender; number, one word substitution; pair of words, words having multiple meanings, agricultural terminology, paragraph, precise and letter writing, translation of simple passages from English to Punjabi, practice in spoken Punjabi, comprehension of a passage related to agriculture; practice in creative writing.

**Pbi. Cul. 101 Punjabi Culture**

Sem. I

(For ICAR nominees and Foreign Students)

Culture, definition, concepts and scope, Punjabi Culture, characteristics of Punjabi culture, Punjabi culture in the context of geography, history, language, literature, religion, art, folklore, fairs and festivals of Punjab as mirror of Punjabi culture, sports and games, customs, beliefs, rituals, legends and different occupations of rural Punjab, changing patterns of Punjabi culture through the ages, socio economic and political changes in Punjab in the context of changing international scenario, technical developments in the field of agriculture leading to the Green Revolution in the Punjab and its impact on the culture of the State, impact of Post-Green Revolution developments on the culture of Punjab like social tensions as result of Green Revolution, changed life styles and its impact on Punjabi culture.
Postgraduate Courses

Pbi. 501 Punjabi Literature and Culture 3+0 Sem. I
Major movements in Punjabi Culture with special emphasis on gurmat, sufi, kessa and heroic poetry, revivalistic and reformistic trends, western influence on Punjabi Culture and Literature impact of national liberation movement, progressive movement and experimental trends in Punjabi literature, Culture, concepts, scope; Punjabi culture: characteristics of Punjabi culture, Punjabi culture in the context of geography, history, language, literature, religion, art and architecture, folklore, drama and theatre, handicrafts, fairs and festivals, sports and games, customs, beliefs, values, rituals, myths and legends and religion, changing patterns of Punjabi culture through the ages, socio-economic and political changes and technological developments since partition and their impact on contemporary Punjabi culture, Punjabi ethos.

Pbi. 502 Punjabi Journalism 2+1 Sem. II
Origin and development of Punjabi journalism, contribution of Christian missionaries, role of Singh Sabha, Chief KhalsaDiwan, Akali and religious movements, secular trends, contemporary trends, prominent Punjabi dailies, weeklies and monthlies, famous Punjabi journals.
Practical: Writing articles, features and news on socio-historical and political movement, eminent personalities and writers, editing Punjabi News, translation news in Punjabi, common grammatical problems, writing headlines and photo captions in Punjabi analysis of editorials.

D. FOREIGN LANGUAGES
French 501 Proficiency in French 2+0 Sem. I & II
French alphabet and sound system (sounds of individual letters, diphthongs, rules of pronunciation etc); articles (definite, indefinite, partitive, contracted) and present tense/present perfect tense of verbs of the three groups such as parler, finir, entendre etc.; conjunctions (maiscommesi, meme si, cependant etc.) ; gender and number of nouns; conjugations (Affirmative, negative, interrogative); prepositions (sur, sous, devant, derriere, dans, a etc.) adverbs, adjectives (common adjectives which are placed before or after nouns, possessive adjectives etc.) and pronouns (simple pronouns, personnel pronouns), cardinal numbers from 1 to 100; translation from French to English (of words, sentences and passages); accent (aigu, grave, circonflexe).
MATHEMATICS, STATISTICS AND PHYSICS

PROGRAMMES
M.Sc.   Statistics, Physics  
Ph.D.   Statistics, Physics  

COURSE REQUIREMENTS

M.Sc. (Statistics)
- Field of Specialization: Design of experiments, Sample surveys, Applied statistics
- Supporting Courses: PGS 501 and courses related to area of special interest and research problem.
- Minor Fields: Mathematics, Economics, Business Management, Plant Breeding & Genetics or any other as approved by the Dean, Postgraduate Studies
- Deficiency Courses: As recommended by the student's Advisory Committee and approved by the Dean, Postgraduate Studies

Ph.D. (Statistics)
- Field of Specialization: Design of experiments, Sample surveys, Applied statistics
- Required Courses: Stat. 601 and Stat. 602
- Supporting Courses: Courses from subject matter fields (other than Minor) relating to area of special interest and research problem.
- Minor Fields: Mathematics, Economics, Business Management, Plant Breeding & Genetics or any other as approved by the Dean, Postgraduate Studies
- Deficiency Courses: As recommended by the student's Advisory Committee and approved by the Dean, Postgraduate Studies

M.Sc. (Physics)
- Field of Specialization: Solid State Physics, Nuclear Physics, Agricultural Physics
- Supporting Courses: Stat. 421 and other courses from subject matter fields (other than Minor) relating to area of special interest and research problem
- Minor Fields: Mathematics or any other as approved by the Dean, Postgraduate Studies
- Deficiency Courses: As recommended by the student's Advisory Committee and approved by the Dean, Postgraduate Studies

Ph.D. (Physics)
- Field of Specialization: Solid State Physics, Nuclear Physics
- Required Courses: Phys. 601, Phys. 602
- Supporting Courses: Courses from subject matter fields (other than Minor) relating to area of special interest and research problem
- Minor Fields: Mathematics or any other as approved by the Dean, Postgraduate Studies
- Deficiency Courses: As recommended by the student's Advisory Committee and approved by the Dean, Postgraduate Studies
DESCRIPTION OF COURSE CONTENTS

A) MATHEMATICS

Undergraduate Courses

Math. 101 Basic Mathematics –I  
Complex numbers: Properties of real numbers, complex numbers; theory of addition, multiplication and division, square root of complex numbers, cube roots of unity and their properties; De-Moivre’s theorem; Theory of equations: Solution of quadratic equation, equation reducible to quadratic equation, relation between roots and coefficients, nature of roots and formation of quadratic equation given roots. Geometric series: nth term of G.P. series, sum of G.P. series, geometric mean; Harmonic series, harmonic mean; Arithmetico geometric series and special series \[ \sum n, \sum n^2, \sum n^3. \]
Partial fractions; Logarithms; Binomial theorem for any index: Expansion, middle term, general term, terms independent of x.
Trigonometry: Trigonometric ratios, allied angles, graphs of trigonometric functions; Addition and subtraction formulae; Product and sum formulae; Multiple and sub-multiple angles, sine, cosine and projection formulae; Area of a triangle.

Math. 102 Basic Mathematics –II  

Math. 103 Elementary Mathematics  
Straight lines: Distance formula, section formula (internal and external division), Change of axes (only origin changed), Equation of co-ordinate axes, Equation of lines parallel to axes, Slope- intercept form of equation of line, Slope-point form of equation of line, Two point form of equation of line, Intercept form of equation of line, Normal form of equation of line, General form of equation of line, Point of intersection of two st. lines, Angles between two st. lines, Parallel lines, Perpendicular lines, Angle of bisectors between two lines, Area of triangle and quadrilateral. Circle: Equation of circle whose centre and radius is known, General equation of a circle, Equation of circle passing through three given points, Equation of circle whose diameters is line joining two points \((x_1, y_1) \) & \((x_2, y_2)\), Tangent and Normal to a given circle at given point (Simple problems), Condition of tangency of a line \(y = mx + c\) to the given circle \(x^2 + y^2 = a^2\). Differential Calculus: Definition of function, limit and continuity, Simple problems on limit, Simple problems on continuity, Differentiation of \(x^n, e^x, \sin x \& \cos x\) from first principle, Derivatives of sum, difference, product and quotient of two functions, Differentiation of functions of functions (Simple problem based on it), Logarithmic differentiation (Simple problem based on it), Differentiation by substitution method and simple problems based on it, Differentiation of Inverse Trigonometric functions. Maxima and Minima of the functions of the form \(y=f(x)\) (Simple problems based on it).
Integral Calculus: Integration of simple functions, Integration of Product of two functions, Integration by substitution method, Definite Integral (simple problems based on it), Area under
simple well-known curves (simple problems based on it).
Matrices and Determinants: Definition of Matrices, Addition, Subtraction, Multiplication, Transpose and Inverse up to 3rd order, Properties of determinants up to 3rd order and their evaluation.

Math. 107 Fundamental Mathematics 2+1 Sem. I
Trigonometry, addition and subtraction formulae, product and sum formulae, Binomial theorem, matrices, determinants and their applications to the solution of system of equations, analytical geometry of two dimensions, equations of line and circle, functions, limit, continuity, differentiation, integration. Ordinary differential equations of first order and first degree, variable separable, homogeneous, Leibnitz linear differential equations.

Math. 201 Engineering Mathematics-I 2+1 Sem. I
Matrices: Elementary transformations, rank of a matrix, reduction to normal form, Gauss-Jordon method to find inverse of a matrix, Eigen values and Eigen vectors, Cayley-Hamilton theorem, linear transformation, orthogonal transformations, diagonalisation of matrices, quadratic forms. PAQ form, Echelon form, Solution of linear equations, nature of rank, using Cayley-Hamilton theorem to find inverse of A. Differential calculus: Taylor’s and Maclaurin’s expansions; indeterminate form; curvature, function of two or more independent variables, partial differentiation, homogeneous functions and Euler’s theorem, composite functions, total derivatives, maxima and minima. Integral calculus: volumes and surfaces of revolution of curves; double and triple integrals, change of order of integration, application of double and triple integrals to find area and volume. Vector calculus: Differentiation of vectors, scalar and vector point functions, vector differential operator Del, Gradient of a scalar point function, Divergence and Curl of a vector point function and their physical interpretations, identities involving Del, second order differential operator; line, surface and volume integrals, Stoke’s, divergence and Green’s theorems (without proofs).
Practical: Tutorials on rank of a matrix, reduction to normal form, consistency and solution of linear equations, eigen values and eigen vectors, Cayley-Hamilton theorem, diagonalisation of matrices, quadratic forms; Taylor’s and Maclaurin’s expansion, indeterminate form, curvature, tracing of curves, partial differentiation, maxima and minima, volume and surface of revolution, multiple integrals, Beta and Gamma functions, differentiation of vectors, gradient, divergence and curl of a vector point function, line, surface and volume integrals, Stoke’s divergence and Green’s Theorems.

Math. 202 Engineering Mathematics-II 2+1 Sem. II
harmonic functions. Solution and application of partial differential equations.

Math. 205 Higher Mathematics-I 2+0 Sem. I
Differential calculus– Taylor’s and Maclaurin’s expansions, indeterminate form, curvature, asymptotes, tracing of curves, function of two or more independent variables, partial differentiation, homogeneous functions and Euler’s theorem, composite functions, total derivative, derivative of an implicit function, change of variables, Jacobians, error evaluation, maxima and minima. Integral calculus– reduction formulae, rectification of standard curves, volumes and surfaces of revolution of curves, double and triple integrals, change of order of integration, gamma and beta functions, application of double and triple integrals to find area and volume. Ordinary differential equations– exact and Bernoulli’s differential equations, equations reducible to exact form by integrating factors, equations of first order and higher degree, Clairaut’s equation, differential equations of higher orders, methods of finding complementary functions and particular integrals, method of variation of parameters, Cauchy’s and Legendre’s linear equations, simultaneous linear differential equations with constant coefficients, series solution techniques, Bessel’s and Legendre’s differential equations. Vector calculus– differentiation of vectors, scalar and vector point functions, vector differential operator del, gradient of a scalar point function, divergence and curl of a vector point function and their physical interpretations, identities involving del, second order differential operator, line, surface and volume integrals, Stoke’s, Divergence and Green’s theorems.

Math. 206 Higher Mathematics - II 2+0 Sem. II

Math. 207 Biomathematics 2+1 Sem. I
Rolle’s theorem, Lagrange’s theorem, Taylor’s and Maclaurin’s series, partial differentiation, Euler’s theorem on homogeneous functions, change of variable, Jacobian, maxima and minima of two or more than two variables, eigen values and eigen vectors of a matrix. Reduction formulae, definite integrals and its applications. Solution of ordinary differential equations of first degree and first order and their application for determination of volume of blood and drug distribution, epidemic models, simultaneous differential equations of first order and their applications to predator models, linear differential equations of higher order and their applications to simple biological problem. Numerical methods for solving algebraic and transcendental equations.
Practical: Tutorials on Taylor’s and Maclaurin’s expansions, partial differentiation, Euler’s theorem, change of variable, total derivative, implicit function, maxima and minima, eigen values and eigen vectors of a matrix, reduction formulae, definite integrals and their properties, epidemic models, predator models, determination of volume of blood and drug distribution. Ordinary differential equations of first order, linear differential equations of higher order and their applications to biological problems, numerical methods.

Math. 301 Engineering Mathematics- III 2+1 Sem. I

Practical: Interpolation, numerical differentiation and integration, solutions of difference equations, numerical solution of ordinary differential equations of first order and first degree, Laplace and inverse Laplace transformations and their application to solution of ordinary and simultaneous differential equations. Problems on one sample, two sample Z-tests when population S.D. is known and unknown. Problems on one sample, two sample and paired t-test. Chi-Square test – 2×2 and m × n, contingency table, calculation of correlation coefficient and its testing and F-test.

Undergraduate Elective/ M.Sc. Supporting/ Minor Courses:

**Math. 421 Fundamentals of Calculus**


**Math. 422 Matrix Algebra**

Determinants and matrices, special types of matrices, algebraic operations, partitioning of matrices, rank of a matrix, rank of a product of matrices, inverse of a matrix by Gauss elimination, Gauss-Jordan, Crout's, Dolittle's and Cholesky's methods, bilinear, quadratic, Hermitian and skew Hermitian forms. Eigen values and eigen vectors of a matrix, bounds of eigen values and determination of eigen values by iterations. Solution of homogeneous and non-homogeneous system of linear equations using matrices.

**Math. 423 Elementary Calculus for Business Management**


Postgraduate Courses

**Math. 501/Stat. 513 Optimization Techniques**


Math. 502 Computational Methods and Programming 1+1 Sem. I
Fortran-77, statement structure, algorithm structure, input/output statements, string and array manipulation. Numerical computation: numerical solution of algebraic and polynomial equations, system of linear algebraic equations, interpolation, numerical differentiation and integration, least square analysis and regression analysis.
Practical: Tutorials on: flow charting and program writing in FORTRAN-77 for the numerical methods listed in the contents.

Math. 503 Abstract Algebra and Linear Transformation 3+0 Sem. I
Group, sub-group, group of symmetries, permutation, cyclic groups and quotient groups. Lagrange's theorem. Homomorphism and isomorphism. Ring, field, integral domain and its field of quotients, subring and ideal, polynomial ring, extension and field of construction of a finite field. Vector space, subspace, basis, orthogonal basis, direct sum, quotient space, linear transformation, rank and nullity. Algebra of linear transformation, relation between linear transformation and matrix, effect of change of basis, singularity and inverse, rank of a matrix and solution of linear equations. Eigen values and eigen vectors, Cayley-Hamilton theorem, equivalence, similarity and congruence, self-adjoint, unitary and normal matrices and transformations, bilinear transformation and quadratic forms.

Math. 504 Mathematical Analysis and Topology 2+0 Sem. II

Math. 505 Functions of Complex Variables 2+0 Sem. II

Math. 506 Numerical Analysis 2+1 Sem. I
Practical: Tutorials on: divided differences, Hermite and spline interpolation, bivariate interpolation,

**Math. 507 Numerical Methods for Ordinary and Partial Differential Equations** 2+1  Sem. II

- Interpolation, Approximation, least square and uniform approximation. Numerical differentiation and integration.


**Math. 508 Differential Equations and Special Functions** 2+1  Sem. I


**Math. 509 Mathematical Physics** 2+0  Sem. I


**Math. 510 Functional Analysis** 2+0  Sem. I


**Math. 511 Theory of Calculus of Variations and Operational Calculus** 2+1  Sem. II

- Calculus of variations and variational methods for solution of boundary value problems. Laplace,
Mellin, Hankel and Fourier transforms. Solution of boundary value problems.
Practical: Tutorial on: variational calculus, solution of boundary value problems, transform methods
due to Laplace, Hankel, Mellin and Fourier.

B) STATISTICS

Undergraduate Courses

Stat. 201 Elementary Statistics 2+0 Sem. II
Definition and scope of statistics, presentation and summarization of statistical data, frequency
distribution, graphical presentation of data, measures of central tendency: mean, median, mode,
geometric mean, harmonic mean. measures of dispersion: range, quartile deviation, mean
deivation, standard deviation, coefficient of variation, test of significance; Z-test for mean(s), t-test
for mean(s), Chi- square test: goodness of fit test, contingency tables, correlation: Karl Pearson,
Spearman’s rank correlation, linear regression analysis, analysis of variance (ANOVA):one way
ANOVA, elementary ideas about sampling.

Stat. 202 Biostatistics 2+1 Sem. I
(For 5-year Integrated M.Sc.(Hons.) programme in Chemistry)
Random Variables, Baye’s theorem. Introduction to Uniform, Binomial, Poisson, Normal,
Exponential and Gamma Probability distributions, Entropy, Random mating populations, Hardy-
Weinberg Law, Introduction to Poisson Process and Markov chains, Random Walk models,
Methods of Alignment of pairs of sequence, Sensitivity and Specificity, Chi-square test of detection
and estimation of linkage, BLAST, Phylogenetic Analysis, Analysis of Variance (fixed effects) for
one-way and two-way classification with interaction, Estimation and testing of heritability.
Applications to molecular biology. Practical: Uniform, Binomial, Poisson, Normal, Exponential and
Gamma Probability distributions, Markov Chains, Alignment of pairs of sequence, Sensitivity and
specificity, Chi-square test of linkage, Phylogenetic analysis, One way and two way - Analysis of
Variance, Testing of heritability, Entropy.

Stat. 205 Statistical Methods and Numerical Analysis 2+1 Sem. I
Frequency distribution and frequency curves. Measures of central tendency, Measures of
dispersion. Normal distribution and its application. Introduction to sampling. Statistical methods,
testing of hypothesis, concepts, testing of significance based on Z-test, t-test, F-test, Chi-square
test, contingency table, correlation, regression, testing of significance of correlation and regression.
ANOVA-one-way and two-way classifications, factorial experiment concepts (2^2, 2^3). Numerical
analysis - finite differences, various difference operators and their relationships, factorial notation,
interpolation with equal intervals, Newton’s forward and backward interpolation formulae, numerical
integration by Trapezoidal, Simpson’s rules. Numerical solution of ordinary differential equations,
Runge-Kutta method. Laplace transforms - definition of Laplace transform, properties of Laplace
transforms, inverse Laplace transforms, transforms of derivatives, integrals, transform of function
multiplied by t^n, transform of function divided by t, application of Laplace transforms to solve
ordinary differential equations. Experimental designs- basic designs, completely randomized design
(CRD) - layout and analysis with equal and unequal number of observations, randomized block
design (RBD) - layout and analysis, Latin square design (LSD) – layout and analysis
Practical : Problems on one sample, two sample Z-tests when population S.D. is known and
unknown. Problems on one sample, two sample and paired t-test. Chi-square test – 2×2 and mxn
contingency table and F-test. Calculation of correlation coefficient and its testing. Fitting of simple
linear regression. ANOVA-one way/two way, 2^2, 2^3. Problems on Newton’s forward and backward
interpolation formula for equal intervals. Problems on trapezoidal rule, Problems on Simpson’s 1/3
and 3/8 rules. Problems on solution of ordinary differential equations of first order and second

Stat. 206 Basic Statistics 1+1 Sem. II
Practical : Construction of frequency distribution tables and frequency curves. Computation of arithmetic- mean, median, mode. standard deviation, variance and coefficient of variation for ungrouped and grouped data. SND test for means, Student’s t-test, F-test . Chi-square test. Correlation coefficient ‘r’ and its testing. Fitting of regression equations. Analysis of CRD, RBD, LSD.

Stat. 207 Principles of Statistics 2+1 Sem. I

Stat. 302 Fundamentals of Biostatistics 2+1 Sem. II
(For B.Tech.(Biotechnology))
Random variables- expected value and its variance. Probability distribution of random variables, conditional probability, Baye’s theorem and its applications. Introduction to uniform, binomial, Poisson, normal, exponential and gamma probability distributions. Random mating populations, Hardy-Weinberg Law. Introduction to Poisson process and Markov chains, transition probability


**Undergraduate Elective/M.Sc. Supporting/Minor Courses**

**Stat. 421 Statistical Methods for Research Workers**


**Stat. 422 Experimental Designs for Research Workers**


**Postgraduate Courses**

**Stat. 501 Probability Theory**

Stat. 502 Statistical Methods 2+1 Sem. I
Probability distribution: uniform, binomial, Poisson, geometric, hyper geometric, negative binomial, multinomial, normal, exponential, Cauchy, Gamma, Beta, Weibull, log normal, logistic and Pareto. Compound and truncated distributions. Central and non-central z, t and F. Bivariate normal and sampling distributions of correlation and regression coefficients. Distribution of quadratic forms and r-th order statistic.

Stat. 503 Statistical Inference 3+1 Sem. I

Stat. 504 Theory of Multivariate Techniques 2+1 Sem. I

Stat. 505 Theory of Designs and Analysis of Experiments 3+1 Sem. II
Practical: Estimation and testing of hypothesis. Analysis of : completely randomized, randomized

**Stat. 506 Theory of Sampling Techniques**  
3+1  Sem. I  

**Stat. 507 Regression Analysis**  
1+1  Sem. I  

**Stat. 508 Statistical Computing**  
1+1  Sem. II  

**Stat. 509 Time Series Analysis**  
1+1  Sem. II  


**Stat. 510 Actuarial Statistics** 2+0 Sem. I


**Stat. 511/Econ. 503 Econometrics** 2+1 Sem. II


**Stat. 512 Statistical Quality Control and Data Mining** 2+0 Sem. II


**Stat. 513 /Math. 501 Optimization Techniques** 2+1 Sem. II


Stat. 514 Statistical Ecology 2+0 Sem. I


Stat. 521 Multivariate Statistical Methods 2+1 Sem. II

Stat. 522 Designs of Surveys 2+1 Sem. II

Stat. 523 Applied Regression Analysis 2+1 Sem. II


Stat. 524 Economic Statistics 2+1 Sem. II


Stat. 525 Data Analysis Using Statistical Packages 1+1 Sem. II


Stat. 526 Non-parametric Statistics 2+1 Sem. II

Stat. 527/ABM 512/Mgt. 512/Econ. 508 Quantitative and Optimization Techniques for Economics and Management


Stat. 601 Advanced Statistical Inference


Stat. 602 Advanced Statistical Computing


Stat. 603 Advanced Statistical Methods 2+0 Sem. I

Stat. 604 Advanced Design of Experiments 2+0 Sem. II

Stat. 605 Advanced Sampling Techniques 2+0 Sem. II

Stat. 606 Advanced Time Series Analysis 2+0 Sem. II

Stat. 591 Seminar
Stat. 600 Project Research
Stat. 700 Ph.D. Research

C) PHYSICS

Undergraduate Courses

Phys. 91 Mechanics 4+1 Sem. I
Physical World and Measurement: Physics - scope and excitement, nature of physical laws, physics, technology and society. Need for measurement: units of measurement, systems of units, SI units, fundamental and derived units, Length, mass and time measurements, accuracy and precision of measuring instruments, errors in measurement, significant figures, dimensions of physical quantities, dimensional analysis and its applications. Kinematics: frame of reference, motion in a straight line, position-time graph, speed and velocity, uniform and non-uniform motion, average speed and instantaneous velocity, uniformly accelerated motion, velocity-time, position-time graphs, relations for uniformly accelerated motion (graphical treatment), elementary concepts of differentiation and integration for describing motion, Scalar and vector quantities: position and displacement vectors, general vectors and notation, equality of vectors, multiplication of vectors by a real number, addition and subtraction of vectors, relative velocity. Unit vector: resolution of a vector in a plane - rectangular components, scalar and vector product of vectors, motion in a plane, cases of uniform velocity and uniform acceleration projectile motion, uniform circular motion. Laws of Motion: intuitive concept of force, inertia, Newton’s first law of motion; momentum and Newton’s second law of motion, impulse, Newton’s third law of motion, law of conservation of linear momentum and its applications, equilibrium of concurrent forces, static and kinetic friction, laws of friction, rolling friction, lubrication, dynamics of uniform circular motion, centripetal force, examples of circular motion(vehicle on level circular road, Vehicle on banked road). Work, Energy and Power: work done by a constant force and a variable force; kinetic energy, work-energy theorem, power, notion of potential energy, potential energy of a spring, conservative forces: conservation of mechanical energy (kinetic and potential energies); non-conservative forces, motion in a vertical circle; elastic and inelastic collisions in one and two dimensions. Motion of System of Particles and Rigid Body: centre of mass of a two-particle system, momentum conversation and centre of mass motion, centre of mass of a rigid body; centre of mass of uniform rod, moment of a force, torque, angular momentum, conservation of angular momentum with some examples; equilibrium of rigid bodies, rigid body rotation and equations of rotational motion, comparison of linear and rotational motions; moment of inertia, radius of gyration; values of moments of inertia for simple geometrical objects (no derivation); statement of parallel and perpendicular axes theorems and their applications.
Practical: Use of vernier-caliper for volume of different shapes, screw-gauge, volume of irregular lamina, spherometer, parallelogram law of vectors, acceleration due to gravity, moment of inertia, co-efficient of friction, compound pendulum, Kettler’s pendulum.

Phys. 92 Matter and Thermodynamics 4+1 Sem. II
Gravitation: Kepler’s laws of planetary motion, the universal law of gravitation, acceleration due to gravity and its variation with altitude and depth, gravitational potential energy, gravitational potential;
escape velocity, orbital velocity of a satellite, geo-stationary satellites. Properties of Bulk Matter: elastic behaviour, stress-strain relationship, Hooke's law, Young's modulus, bulk modulus, shear, modulus of rigidity, poisson's-ratio, elastic energy, pressure due to a fluid column, Pascal's law and its applications (hydraulic lift and hydraulic brakes), effect of gravity on fluid pressure, viscosity, Stokes' law, terminal velocity, Reynold's number, streamline and turbulent flow, critical velocity; Bernoulli's theorem and its applications, surface energy and surface tension, angle of contact, excess of pressure, application of surface tension ideas to drops, bubbles and capillary rise; heat, temperature, thermal expansion; thermal expansion of solids, liquids and gases, anomalous expansion, specific heat capacity: Cp, Cv- calorimetry, change of state-lateral heat, heat transfer-conduction, convection radiation and thermal conductivity, qualitative idea of blackbody radiation, Newton's law of cooling and Stefan's law, Wein's displacement law, green house effect. Thermodynamics: thermal equilibrium and definition of temperature (zeroth law of thermodynamics); heat, work and internal energy; first law of thermodynamics, isothermal and adiabatic processes; second law of thermodynamics, reversible and irreversible processes; heat engines and refrigerators. Behaviour of Perfect Gas and Kinetic theory: equation of state of a perfect gas, work done on compressing a gas; kinetic theory of gases, assumptions, concept of pressure. Kinetic energy and temperature; rms, speed of gas molecules; degrees of freedom, law of equipartition of energy (statement only) and application to specific heat capacities of gases, concept of mean free path, avogadro's number. Oscillations and Waves: periodic motion, period, frequency, displacement as a function of time, periodic functions; simple harmonic motion (S.H.M) and its equation, phase, oscillations of a spring-restoring force and force constant; energy in S.H.M- kinetic and potential energies; simple pendulum-derivation of expression for its time period; free, forced and damped oscillations (qualitative ideas only), resonance; wave motion; longitudinal and transverse waves, speed of wave motion, displacement-relation for a progressive wave, principle of superposition of waves, reflection of waves, standing waves in strings and organ pipes, fundamental mode and harmonics, Beats, Doppler effect. Practical: Gravitational pull of the earth, beam balance, Hook’s law, resonance, sonometer, specific heat of the sand, coefficient of viscosity, Newton's law of cooling, surface tension, latent heat, Young's modulus.

**Phys. 93 Electricity and Magnetism**

Electrostatics: electric charges and their conservation, Coulomb's law-force between two point charges, forces between multiple charges; superposition principle and continuous charge distribution; electrical field, electric field due to a point charge, electric-field lines; electric dipole, electric field due to a dipole; torque on a dipole in uniform electric field; electric flux, statement of Gauss's theorem and its applications to find field due to infinitely long straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell (Field inside and outside); electric potential, potential difference, electric potential due to a point charge and system of charges, equipotential surfaces, electrical potential energy of a system of two point charges and of electric dipole in an electrostatic field. Conductors and Insulators: free charges and bound charges inside a conductor; dielectrics and electric polarisation, capacitors and capacitance, combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor, Van de Graaf generator. Current Electricity: electric current, flow of electric charges in a metallic conductor, drift velocity, mobility and their relation with electric current; Ohm's law, electrical resistance, V-1 characteristics (linear and non linear), electrical energy and power, electrical resistivity and conductivity; carbon resistors, colour code for carbon resistors; series and parallel combinations of resistors; temperature dependence of resistance; internal resistance of a cell, potential difference and emf of cell, combination of cells in series and in parallel; Kirchhoff's laws and simple applications, Wheatstone bridge, meter bridge, potentiometer-principle and its applications to measure potential difference and for comparing emf of two cells, measurement of internal resistance of a cell.
Magnetic Effects of Current and Magnetism: concept of magnetic field, Oersted's experiment, Biot-savart law and its application to current carrying circular loop; Ampere's law and its applications to infinitely long straight wire, straight and toroidal solenoids; Force on a moving charge in uniform magnetic and electric fields, cyclotron; force on a current-carrying conductor in a uniform magnetic field, force between two parallel current-carrying conductors, definition of ampere, torque experienced by a current loop in uniform magnetic field, moving coil galvanometers- its current sensitivity and conversion to ammeter and voltmeter, current loop as a magnetic dipole and its magnetic dipole moment, magnetic dipole moment of a revolving electron, magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to its axis, torque on a magnetic dipole (bar magnet) in a uniform magnetic field; bar magnet as an equivalent solenoid, magnetic field lines; earth’s magnetic field and magnetic elements, para-, dia- and ferro-magnetic substances with examples, electromagnets and factors affecting their strengths, permanent magnets. Electromagnetic Induction and Alternating Currents: electromagnetic induction, Faraday’s laws, induced emf and current, Lenz's Law, Eddy currents: Self and mutual inductance; alternating current, peak and rms value of alternating current/voltage; reactance and impedances; LC oscillations, (qualitative treatment only), LCR series circuit resonance, power in AC circuit, wattless current, AC generator and transformer. Electromagnetic Waves: need for displacement current, electromagnetic waves and their characteristics (qualitative ideas only), transverse nature of electromagnetic waves, electromagnetic spectrum (radio waves, radio-microwaves, infra-red, visible, ultraviolet, X-rays, gamma rays) including elementary facts about their uses.

Practical: Specific resistance of material using meter bridge, laws of combination (series/parallel) of resistance using meter bridge, compare the emf of two given primary cells, internal resistance of given primary cell, resistance of a galvanometer, frequency of the A.C. mains with a sonometer, Ohm’s law and to measure the unknown resistance, laws of combination (series/parallel) of resistance using Ohm’s law, magnetic line of forces, comparison of magnetic moment by tanA and tanB method.

Phys. 94 Optics, Nuclear Physics and Electronics 4+1 Sem. II

Optics: reflection of light, spherical mirrors, mirror formula, refraction of light, total internal reflection and its applications, optical fibers, refraction at spherical surfaces, lenses, thin lens formula, lensmaker's formula; magnification, power of a lens, combination of thin lenses in contact, combination of lens and mirror, refraction and dispersion of light through a prism, scattering of light-blue colour of the sky and reddish appearance of the sun at sunrise and sunset. Optical Instruments: human eye, image formation and accommodation, correction of eye defects (myopia, hypermetropia) using lenses; microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers. Waves Optics: wave front and Huygens' Principle, reflection and refraction of plane wave at a plane surface using wave fronts; proof of laws of reflection and refraction using Huygens ‘Principle. Interference: Young's double hole experiment and expression for fringe width, coherent sources and sustained interference of light, diffraction due to a single slit, width of central maximum; resolving power of microscopes and astronomical telescopes; polarisation, plane polarised light-Brewster's law, uses of plane polarised light and Polaroids. Dual Nature of Matter and Radiation: photoelectric effect, Hertz and Lenard's observations'; Einstein's photoelectric equation, particle nature of light, matter waves-wave nature of particles, de Broglie relation, Davission-Germer experiment (experimental details should be omitted; only conclusion should be explained). Atoms and Nuclei: alpha-particle scattering experiment, Rutherford's model of atom, Bohr model, energy levels, hydrogen spectrum, composition and size of nucleus, atomic masses, isotopes, isobars, isotones, radioactivity- alpha, beta and gamma particles/rays and their properties, radioactive decay law, mass-energy relation, mass-defect, binding energy per nucleon and its variation with mass number, nuclear fission and fusion. Electronic Devices: energy bands in solids (qualitative idea only) conductor, insulators and semiconductors; semiconductor Diode-I-V characteristics in forward and reverse bias, diode as a rectifier, I-V characteristics of LED, photodiode, solar cell and Zener
diode, Zener diode as a voltage regulator, junction transistor, transistor action. Characteristics of a transistor: transistor as an amplifier (common emitter configuration) and oscillator, logic gates (OR, AND, NOT, NAND and NOR), transistor as a switch. Communication Systems: elements of a communication system (block diagram only), bandwidth of signals (speech, TV and digital data), bandwidth of transmission medium, propagation of electromagnetic waves in the atmosphere, sky and space wave propagation, need for modulation, production and detection of an amplitude modulated wave.

Practical: Concave mirror and find their focal length, lens-maker formula, focal length of a convex mirror using a convex lens, focal length of a concave lens using a convex lens, angle of minimum deviation for a given prism, I-V characteristic curve of a p-n junction, Zener diode characteristic, characteristics of a common-emitter npn or pnp transistor, reflective index of a glass slab using a traveling microscope, refractive index of a liquid by using concave mirror and convex lens.

**Phys. 202  Fundamentals of Biophysics 2+1  Sem. II**


**Phys. 203  Engineering Physics 2+1  Sem. I**

Practical: To find the frequency of A.C. supply using an electrical vibrator; To find the low resistance using Carey Foster bridge without calibrating the bridge wire; To determine dielectric constant of material using De Sauty’s bridge; To determine the value of specific charge (e/m) for electrons by
helical method; To study the induced e.m.f. as a function of velocity of the magnet; To obtain hysteresis curve (B-H curve) on a C.R.O. and to determine related magnetic quantities; To study the variation of magnetic field with distance along the axis of a current carrying circular coil and to detuning the radius of the coil; To determine the energy band gap in a semiconductor using a p-n Junction diode; To determine the slit width from Fraunhofer diffraction pattern using laser beam; To find the numerical aperture of optical fiber; To set up the fiber optic analog and digital link; To study the phase relationships in L.R. circuit; To study LCR circuit; To study the variations of thermo emf of a copper-constantan thermo-couple with temperature; To find the wave length of light by prism.

Phys. 421 Modern Physics 2+1 Sem. I

Phys. 422 Atomic Spectra 2+0 Sem. II

Postgraduate Courses

Phys. 501 Classical and Statistical Mechanics 3+0 Sem. I

Phys. 502 Physical Electronics 2+1 Sem. I
**Phys. 503 Quantum Mechanics**  
3+0  
Sem. II  

**Phys. 504 Electrodynamics and Plasma Physics**  
3+0  
Sem. I  

**Phys. 505 Solid State Physics**  
3+1  
Sem. II  

**Phys. 506 Nuclear Physics**  
3+1  
Sem. II  

**Phys. 507 Nuclear Techniques in Agriculture**  
2+1  Sem. II


**Phys. 508 Material Science**  
2+1  Sem. I


**Phys. 509 Radiation Physics**  
2+1  Sem. II


**Phys. 510 Solid State Devices**  
2+1  Sem. I

- Practical: Study of CRO and a multimeter as a measuring device. Study of regulated power supply. Astable multivibrator. Logic gates.

**Phys. 511 Agricultural Physics**  
2+0  Sem. II


**Phys. 512 Principles of Remote Sensing and its Applications in Agriculture**  
2+0  Sem. I

**Phys. 513 Principles of Physical Techniques in Agriculture**


**Phys. 601 Current Topics in Physics**


**Phys. 602 Advanced Topics in Quantum Mechanics**


**Phys. 603 Advanced Topics in Solid State Physics I**

Discussion of topics like electrostatic screening in metals. Friedel oscillation. optical properties of solids and De Hass-Van-alphan effect. Born-Von-Karman theory. Non-crystalline solids: diffraction pattern, glasses, amorphous ferromagnets and amorphous semiconductors. Low energy excitation
in amorphous solids. Liquid crystals: classification, orientation order, intermolecular forces, magnetic effects, optical properties and applications. Polymers: effect of temperature, mechanical properties and electrical properties.

**Phys. 604 Advanced Topics in Nuclear Physics I**
3+0   Sem. II

**Phys. 605 Advanced Topics in Solid State Physics II**
3+0   Sem. I

**Phys. 606 Advanced Topics in Nuclear Physics II**
3+0   Sem. II

**Phys. 591 Seminar**

**Phys. 600 Master's Research**

**Phys. 700 Ph.D. Research**
# Microbiology

## Programmes

### M.Sc.

### Ph.D.

### Five Year Integrated M.Sc. (Hons)

## Course Requirements

### M.Sc.

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### Five Year Integrated M.Sc. (Hons)

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DESCRIPTION OF COURSE CONTENTS

Undergraduate courses/Integrated M.Sc. (Hons)

**Micro. 102 Elementary Microbiology**  
2+1  Sem. I & II


**Micro. 103 General Microbiology**  
2+1  Sem. I

Evolution and scope of microbiology. History of microbiology. Microbial classification, nomenclature and identification. Taxonomic groups. General methods of classifying bacteria. Microscopy and microscopes: Smears and staining. Morphology and fine structure of bacteria. Cultivation of bacteria, nutritional requirements. Nutritional classification of bacteria; Phototrophs, chemotrophs, autotrophs and heterotrophs; Obligate parasites; Bacteriological media, Growth of bacteria, Reproduction of bacteria; Introduction to fungi, algae and protozoa and virus, Microbiology of water and food Nutrient transport phenomenon: Passive diffusion, facilitated diffusion; Group translocation, active transport. Metabolism in bacteria –ATP generation Microbial genetics; Bacterial recombination; Bacterial conjugation, transduction; Bacterial transformation; Mutations: Types of mutations, mutagenesis; Mutation rate, repair of mutations; Phenotypes of bacterial mutants; Designation of bacterial mutants; Destruction of microorganisms: Physical agents and chemical agents; Chemotherapeutic agents and chemotherapy; Characteristics of antibiotics; Mode of action of antibiotics; Pure culture: Methods of isolation of pure cultures; Maintenance and preservation of pure cultures; Culture collections. Practical: Microscopy; Micrometry; Cleaning and sterilization of glassware and acquainting with equipment used in microbiology; Preparation of nutrient agar media and techniques of inoculation; Staining methods (monochrome staining, Gram staining, negative staining, capsule-staining, flagella staining and endospore staining); Pure culture techniques (streak plate/pour plate/spread plate); Identification procedures (morphology and cultural characteristics); Growth characteristics of fungi: Determination of microbial numbers, direct plate count, generation time; Factors influencing growth: pH, temperature, growth curves for bacteria.

**Micro. 104 Food Microbiology**  
2+1  Sem. II

Importance and significance of microbes in food science. Microbial spoilage of foods. Factors affecting kinds, numbers, growth and survival of microorganisms in foods. Intrinsic factors- pH,

Practical: Microbial examination of bacteria and molds from foods. Isolation, identification and confirmation of microbes in milk and milk products, meat and meat products, fish and other sea foods, poultry and eggs, fruits and vegetables, cereals and cereal products, sugar and sugar products, salts, spices and canned food. Determination of thermal death time. Detection of indicator organisms (Coliform/Enterococcus) in water by MPN method. Determination and enumeration of food borne pathogens from food samples.

**Micro. 201 Microbial Genetics**
2+1 Sem. I


**Micro. 202 Introduction to Microbiology**
3+0 Sem. II

**Micro. 203 Basic Bacteriology**
2+0 Sem. I
Bacterial taxonomy, cell structure and organization of bacterial cell, cell wall, periplasm, outer membranes in Gram-ve bacteria, cell surface extensions, motility, role of pili in adhesion, motility, DNA exchange, capsule, spore, heterocysts, Archaeabacteria. Unique structures in Eukaryotes, mitochondria and plastids, economic importance of bacteria.

**Micro. 204 Basic Mycology and Phycology**
3+0 Sem. I
Isolation, distribution, thallus organization, cell structure, nutrition. Sexual and asexual reproduction, spore types, heterothallism and parasyxuality in fungi. Classification of fungi and salient features of different classes. Economic importance of fungi. Mushroom cultivation, SCP.

**Micro. 205 Basic Virology**  
2+0  Sem. II  

**Micro. 207 Principles of Food Microbiology**  
2+1  Sem. I  
Basic aspects and scope of food microbiology. Intrinsic and extrinsic factors affecting microbial growth in foods. Microbial spoilage of fruits, fruit juices, vegetables, meat, poultry, sea foods, carbonated soft drinks, canned foods and cereals. Chemical changes caused by microorganisms and control of spoilage. Food preservation - physical methods, chemical preservatives, natural antimicrobial compounds and biology based preservation system. Control of microorganisms by asepsis, water activity, drying, preservatives, use of low and high temperature, radiation and pressure. Microbial contamination, spoilage and prevention of milk and milk products, fruits and vegetables, meat and meat products, fish and other sea foods, poultry and eggs, cereal and cereal products, sugar and sugar products, salts and spices.  
Practical - General laboratory practices in microbiology laboratory. Equipment used in food microbiology laboratory. Aseptic and sterilization methods. Preparation of media. Isolation and morphological identification of microorganisms. Isolation of molds from foods. Microbial analysis of vegetable and fruits, meat and meat products, fish and other sea foods, eggs and poultry, milk and milk products, cereal and cereal products, sugar, salts and spices and water.

**Micro. 303 / Biotech. 304 Introduction to Industrial Biotechnology**  
2+1  Sem. II  
Microbial products; Acids, organic solvents, vitamins, enzymes and biodegradable plastics. Microbial technology; substrates. Upstream and downstream processing, Biotransformation, Fermenters, BOD and COD treatments and disposal of effluents. Hybridization technology and production of vaccines, Production of plant secondary metabolites through cell and hairy root cultures. Concepts of industrial fermentation- batch and continuous, production of biopharmaceuticals, Immobilization techniques.  

**Micro. 304 Introduction to Applied Microbiology**  
3+0  Sem. I  
Important disciplines of applied microbiology. Importance and applications of microorganisms in food, dairy and industry. Food spoilage and food borne diseases. Food preservation and sanitation. Microbiology of milk and milk products. Industrial fermentation of alcohol, alcoholic beverages and enzymes. Brief account of agriculturally important microorganisms - biofertilizers, biopesticides and bioremediation.

**Micro. 305 Basic Experiments in Microbiology**  
0+3  Sem. II  
Microscopy. Examination of different types of bacteria, fungi and other microorganisms, motility. Media preparation, isolation, cultivation and purification of microorganisms from air, soil and water. Principle and working - autoclave, laminar flow bench, hot air oven and other commonly used laboratory equipments. Measure of bacterial cell size, DMC using haemocytometer. Sterilization techniques.
Micro. 306 Fundamentals of Food and Dairy Microbiology 3+1 Sem. I
Introduction and importance of food and dairy microbiology. Food spoilage. Food preservation by physical and chemical means. Microbiology of cereals, meat, poultry, egg, fruits and vegetables, salt, sugar. Fermented foods-bread, malt beverages. Role of microorganisms in fermented milk products - butter and cheese, etc. Microbial enzymes in food processing. Pathogenic bacteria in milk and milk products and processed foods. Food poisoning and its control.

Micro. 307 Bacterial Genetics 3+0 Sem. I
Bacteria as tool for genetic studies, nature of genetic material, DNA structure, function, replication and synthesis. DNA damage and repair. RNA - types and functions. Mutations and their chemical basis, mutagenesis, spontaneous and induced mutations, reversion and suppression of mutants. Bacterial recombination- transformation, transduction and conjugation. Bacterial plasmids, fertility factors, resistance factors, transposable elements and insertion sequences. Role of genetic engineering in improving bacterial strains.

Micro. 308 Fundamentals of Industrial Microbiology 2+1 Sem. II

Micro. 401 Practicals in Microbiology 0+2 Sem. II

Micro. 421 Fundamentals of Microbiology 2+1 Sem. II
Practical: Isolation of microorganism and their microscopic examination. Staining procedure-
simple, differential, negative, capsule and spore. Sterilization and preparation of culture media, enumeration of microorganisms and their identification.

**Micro. 426 Fundamentals of Soil Microbiology** 2+1 Sem. II

**Micro. 427 Fundamentals of Environmental Microbiology** 2+1 Sem. II

**Micro. 428 Fundamentals of Clinical Microbiology** 2+1 Sem. II
Host parasite relationship of infectious diseases, determinants of infectious diseases, attributes of pathogens and offending host-physical, chemical barriers and biological barriers, specific and non specific immune defense mechanisms of host, autoimmune diseases and allergic reactions. Introduction to pathogenic microbiology, epidemiology of infectious diseases, infectious disease cycle, transmission of infectious agents, surveillance, recognition, study and control of epidemics and nosocomial infection. Viral diseases, Characteristics of causal agents and disease control of selected diseases such as influenza, measles, yellow fever, rabies, poliomyelitis and AIDS. Microbial diseases of humans caused by Chlamydiae, rickettsiae, Gram positive and Gram negative organisms, human mycotic and parasitic protozoan infections.

**Postgraduate Courses**

**Micro. 501 Principles of Microbiology** 3+1 Sem. I


Micro. 502 Microbial Physiology and Metabolism 3+1 Sem. II


Micro. 503 Microbial Genetics 3+1 Sem. I

Practical: Genetic variability, fluctuation test and replica plating. Induced mutagenesis. Plasmid curing, purification of plasmid DNA, electroporation/conjugation. Agarose gel electrophoresis, DNA amplification by PCR.
Micro. 504 / Biotech. 507 Industrial Microbiology 2+1  Sem. II
Practicals: Isolation, maintenance and improvement of industrial important organisms. Production of alcohol, beer, citric acid, lactic acid and their recovery; Study of bio-reactors. Production of biofertilizers and biogas. Demonstration of activity of immobilized enzymes/cells.

Micro. 505 Laboratory Techniques in Microbiology 0+2  Sem. I

Micro. 506 Food and Dairy Microbiology 2+1  Sem. I
Introduction and scope; Food Microbiology - A many faceted science; Interrelationship of food microbiology with other sciences; Perspectives on food safety and Food Biotechnology. Factors of special significance in Food Microbiology - Principles influencing microbial growth in foods; Spores and their significance; Indicator organisms and Microbiological criteria; Microbial spoilage of foods- meat, milk, fruits, vegetables and their products; Food poisoning and food-borne pathogenic bacteria. Enzymes from microorganisms. Food fermentation; Fermented dairy, vegetable, meat products; Preservatives and preservation methods - physical methods, chemical preservatives and natural antimicrobial compounds. Bacteriocins and their applications; Biologically based preservation systems and probiotic bacteria. Symbiotic foods. Advanced techniques in detecting food-borne pathogens and toxins. Predictive Microbiology. Hurdle technology and Hazard Analysis and Critical Control Point systems in controlling microbiological hazards in foods.
Practical: Statutory, recommended and supplementary tests for microbiological analysis of various foods: Baby foods, canned foods, milk and dairy products, eggs, meat, vegetables, fruits, cereals, surfaces, containers and water.

Micro. 507 Soil Microbiology 2+1  Sem. II
Landmarks in the history of soil microbiology. Soil biota, Soil microbial ecology. Biotic factors in soil development. Influence of soil and environmental factors i.e. pH, temperature and organic matter and agronomic practices on soil microflora. Different types of microorganisms in soils, Soil microbial biomass; Microbial interactions; unculturable soil biota. Microbiology and biochemistry of root-soil interface; Phyllosphere, Biofertilizers; Soil enzyme activities and their importance.

Practical: Determination of soil microbial population; Soil microbial biomass; Decomposition studies in soil. Measurement of important soil microbial processes such as ammonification, nitrification. \( \text{N}_2 \) fixation, S oxidation, P solubilization and mineralization of other micro nutrients. Study of rhizosphere effect. Detection of hydrogen uptake system in Rhizobium.

**Micro. 508 Clinical Microbiology** 2+1 Sem. I

Practical: Handling of laboratory animals, blood sampling, introduction of culture method biochemical identification and serological methods. Microbiological examination of sputum, nasal discharge, urine, stool, wounds and pus, etc. Serological diagnosis and typing of pathogenic bacteria. Gel precipitation test for bacterial toxins.

**Micro. 509 Biofertilizer Technology** 2+1 Sem. I


**Micro. 510 Biology and Cultivation of Edible Fungi** 2+1 Sem. II

Practical: Micro/macросcopic characteristics of important genera. Preparation and maintenance of
spore and tissue cultures and spawn making. Compost preparation by long and short method and cultivation of important genera (Agaricus, Calocybe indica, Pleurotus, Volvariella, Auricularia and Lentinus edodes). Production, extraction and estimation of extracellular enzymes. Isolation of single spore isolates (SSI's) and in vivo somatic hybridization for mushroom strain improvement. Visit to a commercial mushroom growing unit.

**Micro. 601 Current Topics in Microbiology** 3+0  Sem. II

**Micro. 602 Advances in Microbial Physiology** 3+0  Sem. I

**Micro. 603 Regulation of Microbial Biosynthesis** 2+0  Sem. II

**Micro. 604 Advances in Soil Microbiology** 3+0  Sem. I

**Micro. 605 / Biotech. 605 Advances in Microbial Genetics and Biotechnology** 2+0  Sem. II

**Micro. 606 Advances in Fermentation** 3+0 Sem. I

**Micro. 591 Seminar**

**Micro. 600 Master's Research**

**Micro. 700 Ph.D. Research**
## PROGRAMMES

### M.Sc.

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### Five Year Integrated M.Sc. (Hons)

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DESCRIPTION OF COURSE CONTENTS

Undergraduate courses/Integrated M.Sc. (Hons)

**Zoo. 51 Fish Production**  1+1  Sem. II


**Bio. 91 Introductory Biology**  3+1  Sem. I
Diversity in Living World - What is living, Biodiversity, Need for classification, Three domains of life, Taxonomy & Systematics. Concept of species and taxonomical hierarchy, Binomial nomenclature, Tools for study of Taxonomy, Museums and Zoos. Five Kingdom classification - salient features and classification of Monera, Protista and Fungi into major groups. Lichens, Viruses and Viroids. Salient features and classification of plants into major groups - Algae, Bryophytes, Pteridophytes, Gymnosperm and Angiosperm (three to five salient and distinguishing features and at least two examples of each category). Angiosperms-classification up to class, characteristics features and examples. Structural organization in animals and salient features and classification of Animals - non chordate up to phyla level and chordate up to class level (three to five salient features and at least two examples). Structural organization in plants - morphology and modifications, functions of different parts of flowering plants - root, stem, leaf, flower, fruit and seed. Inflorescence - cymose and racemose. Morphology, anatomy and functions of different systems (digestive, circulatory, respiratory, nervous and reproductive) of an insect (cockroach) (Brief account only).

Practical: Study of parts of a compound microscope. Study of the specimens and identification with reasons - Bacteria, Oscillatoria, Spirogura, Rhizopus, mushroom, yeast. Study of the specimens and identification with reasons - liverwort, moss, fern, pine, one monocotyledonous plant, one dicotyledonous plant and one lichen. Study and describe three locally available common flowering plants from each of the following families (Solanaceae, Fabaceae and Liliaceae) including dissection and display of floral whorls, anther and ovary to show number of chambers. Types of root (tap and adventitious), stem (herbaceous and woody) and leaf (arrangement, shape, venation, simple and compound). Study of different modifications in root, stem and leaves. Study and identification of different types of inflorescence. Study of specimens and identification with reasons - Amoeba, Hydra, liverfluke, Ascaris, leech, earthworm, prawn, silkworm, honeybee, snail and starfish. Study of specimens and identification with reasons - shark, rohu, frog, lizard, pigeon and rabbit.

**Bio. 92 Cell Structure and Function**  3+1  Sem. I
Cell structure and function (Introduction). Cell theory and cell as the basic unit of life. Structure of prokaryotic and eukaryotic cell. Plant cell and animal cell - cell membrane and cell wall. Cell organelles structure and function - endomembrane system, endoplasmic reticulum, golgi bodies, lysosomes, vacuoles, mitochondria, ribosomes, plastids and microbodies. Cytoskeleton - cilia, flagella and centrioles (Ultrastructure and function). Chemical constituents of living cells:

Bio. 93 Genetics and Evolution/Biology III 3+1 Sem. I
Practical: Study of prepared pedigree charts of genetic traits such as rolling of tongue, blood groups, widow's peak, colour blindness. Study of analogous and homologous organs in various animals. Study of Mendelian inheritance using seeds of different size of any plant. Exercise on controlled pollination - Emasculation, tagging and bagging.

Bio. 94 Ecology and Environment 3+1 Sem. I
Practical: Collection of water from different water bodies and study them for pH clarity and presence of any living organisms. Study of animals found in xerophytic conditions and comment upon their adaptation ecosystem. Study of animals found in aquatic conditions and comment upon their adaptation ecosystem. Identification of common disease causing organisms like Ascaris, Entamoeba, Plasmodium, ringworm and to study symptoms of diseases that they cause through permanent slides or specimens. Collect soil from different sites and study them
for texture and moisture content. Study the pH and water holding capacity of soil correlating with the kinds of plants found in them. Study the presence of any suspended particulate matter in air at the two widely different sites. Study of plant population density by quadratic method. Study of plant population frequency by quadrate method. Study of plants found in xerophytic conditions and comment upon their adaptation ecosystem. Study of plants found in aquatic conditions and comment upon their adaptation ecosystem.

Zoo. 91 Basics of Animal Physiology 3+1 Sem. II

Zoo. 92 Animal Reproduction and Human Welfare 3+1 Sem. II

Practical: Study and identify stages of gamete development i.e. T.S. of Testis and T.S. of Ovary through permanent slides. Study of meiosis in grasshopper testis through permanent slides. Study of T.S. of Blastula through permanent slides. Identify Ascaris, Entamoeba, Plasmodium and Ringworm - comment on symptoms of diseases that they cause through permanent slides or specimens.

**Bio. 101 Introduction to Biology**

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**Bio. 102 Introductory Biology**

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**Bio. 103 Biodiversity and its Conservation**

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**Zoo. 101 Basic Zoology**

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**Zoo. 103 Elementary Human Physiology**

| 2+1 | Sem. I |


**Zoo. 201 Introduction to Animal Biodiversity**  
3+0  Sem. I

**Zoo. 203 Introduction to Cell Biology and Immunology**  
3+0  Sem. II

**Zoo. 204 Introduction to Developmental Biology**  
2+0  Sem. I
Introduction and scope of embryology. Gametogenesis, types of eggs, fertilization,

Zoo. 304 Fundamentals of Animal Physiology 3+0 Sem. I
Compound tissues and types of glands. Heterotrophic forms of nutrition, transport and mixing of food in the alimentary canal, secretory functions of digestive tract, digestion, absorption and malfunctions of GIT. Pulmonary ventilation, physiological principle of gaseous exchange, transport of oxygen and CO₂ in the blood and regulation of respiration. Circulating body fluids and blood haemostasis. Heart as a pump, origin and propagation of heart beat, pulse, blood pressure, cardiac cycle and ECG. Functional anatomy of kidney, formation of urine, control of extracellular fluid, osmolality and counter-current mechanism, role of ADH and aldosterone. Physiology of human male and female reproduction. An over-view of other endocrine organs, their hormones and disorders. Functioning of excitable tissues, membrane potential, action potential and its propagation, synaptic and junctional transmission, ultra structure of the skeletal muscle fibre and molecular mechanism of muscle contraction. Physiology of sense organs and receptors.

Zoo. 305 Fundamentals of Animal Ecology 2+0 Sem. II

Zoo. 306 Basic Experiments in Zoology 0+3 Sem. I

Zoo. 307 Systematics and Evolution of Animals 2+1 Sem. I

Zoo. 308 Applied Zoology 3+1 Sem. II
Useful animals and their products. Outlines of apiculture, sericulture, lac culture, edible and pearl oyster culture, pisciculture/aquaculture, poultry farming, dairy farming etc. Important human and veterinary parasites - protozoan and helminths. Life cycle and biology of

Practical: Study/survey of economically important animals. Study of protozoan, helminth parasites and arthropod vectors associated with human diseases. Study of vertebrate pests of agricultural crops and their control.

**Zoo. 309 Zootechniques**

1+1 Sem. II


Practical: Collection of small and large animals. Preservation of specimens for museum. Demonstration of injection routes and collection of fluids in albino rat. Sacrificing the animal and fixation of material and its processing for histological studies of selected organs of rat. Section cutting, stretching, staining and mounting of sections and their microscopic study.

**Zoo. 310 Fundamentals of Animal Behaviour**

2+1 Sem. I


Practical: Study of chemotaxis, feeding preferences and behaviour using animal maze.

**Zoo. 311 Fundamentals of Applied Human Physiology**

3+0 Sem. I


**Zoo. 312 Immunology**

2+1 Sem. I


Practical: Preparation of buffers and reagents. Precipitation and agglutination test, HA, HI test. Immunoblotting, immunoelectrophoresis and fluorescent antibody test. Enzyme immunoassays
including ELISA variants, Western blotting. Raising of antisera in laboratory animals. Collection and preservation of antisera - separation, filtration and aliquoting.

Zoo. 313 Animal Biotechnology 3+1 Sem. I
Practical: Basic cell culture techniques - oocyte aspiration from ovaries, sperm preparation and in vitro fertilization. PCR based detection of animal pathogens, PCR-RFLP. Immunohistochemical localization of protein marker in tissues/cells - meat species identification by PCREDIT.

Zoo. 401 Form, Structure and Function of Invertebrates 3+1 Sem. II
General characteristics and outline of classification of different animal groups upto classes. Interrelationships amongst the major and minor invertebrate phyla. Functional anatomy and physiology of locomotion, digestion, respiration, circulation, excretion, neural and endocrine regulation, reproduction, sense organs and receptors of invertebrates. Larval forms and their evolutionary significance.
Practical: General survey of invertebrate forms. Study of histological preparations of organs representing different systems. Dissection of earthworm, cockroach and pila to demonstrate various systems. Experiments to demonstrate the response of some invertebrates to photic, mechanical, thermal, chemical and electrical stimuli.

Zoo. 402 Form, Structure and Function of Vertebrates 2+1 Sem. II
General characteristics and outline of classification of different animal groups upto orders. Functional anatomy and physiology of muscular, digestive, respiratory, sensory, circulatory, excretory, nervous, endocrine and reproductive systems of vertebrates.

Zoo. 403 Cell Biology and Development in Animals 2+1 Sem. II
blastulation, gastrulation in frog and chick eggs and preparation of slides.

**Zoo. 404 Environmental Biology and Management**  
2+1 Sem. II  

**Zoo. 405 Introduction to Fish and Fisheries**  
2+1 Sem. I  
Practical: Collection, identification and classification of fishes of economic importance. Study of different types of nets and demonstration of fishing operation. Visit to field/fish market to analyse species composition, their size and sex ratio in a commercial catch. Assessment of fish stock.

**Zoo. 426 Applied Human Physiology**  
3+0 Sem. I  

**Postgraduate Courses**

**Zoo. 501 Functional Anatomy and Physiology of Animals**  
3+1 Sem. I  

**Zoo. 502 Cell and Developmental Biology**  
2+1  
Sem. I  

**Zoo. 503 Biosystematics and Biodiversity**  
1+1  
Sem. II  

**Zoo. 504 Animal Ecology and Bioresource Management**  
2+1  
Sem. I  

**Zoo. 505 Animal Behaviour and Wildlife Management**  
1+1  
Sem. II  

Zoo. 506 Life History and Reproductive Strategies of Invertebrates 2+1 Sem. II
Practical: Study of asexual reproduction, gametogenesis, gametes and accessory reproductive organs. Demonstration of neurosecretory cells in invertebrates.

Zoo. 507 Comparative Vertebrate Endocrinology and Reproduction 2+1 Sem. II

Zoo. 508 Biology and Management of Birds 2+1 Sem. I

Zoo. 509 Biology and Management of Mammalian Pests 2+1 Sem. II
Practical: Collection, identification and preservation of rodent pests, estimation of population by different methods, damage assessment methods in different crop fields, burrow structure and methods of control with special reference to agriculture.
Zoo. 510 Parasitology 2+1 Sem. II

Zoo. 511 Animal Biotechnology 2+1 Sem. I

Zoo. 512 Freshwater Ecology 2+1 Sem. II

Zoo. 513 Fish Production Technology 2+1 Sem. I

Zoo. 514 Fish Breeding, Genetics and Biotechnology 2+1 Sem. I

**Zoo. 601 Advances in Cell and Developmental Biology**  \(2+0\)  \(\text{Sem. II}\)

**Zoo. 602 Advances in Animal Ecology, Behaviour and Bioresource Management**  \(3+0\)  \(\text{Sem. II}\)

**Zoo. 603 Advances in Animal Biotechnology**  \(2+0\)  \(\text{Sem. II}\)

**Zoo. 604 Advances in Biosystematics and Biodiversity**  \(2+0\)  \(\text{Sem. II}\)

**Zoo. 605 Animal Genomics**  \(2+0\)  \(\text{Sem. I}\)

Zoo. 606 Advances in Reproductive Biology of Invertebrates  2+0   Sem. I

Zoo. 607 Advances in Reproductive Biology of Vertebrates  2+0   Sem. I

Zoo. 608 Molecular Endocrinology  2+0   Sem. I

Zoo. 609 Advances in Biology and Management of Birds  2+0   Sem. I
of agriculture. Significance and management of bird predators. Beneficial role of birds in agriculture and their manipulation in biocontrol of insect pests.

**Zoo. 610 Advances in Mammalian Pest Management**  
2+0  
Sem. I  

**Zoo. 611 Advances in Parasitology**  
2+0  
Sem. I  

**Zoo. 612 Applied Freshwater Ecology**  
2+0  
Sem. I  

**Zoo. 613 Advances in Fish Production Technology**  
2+0  
Sem. I  

**Zoo. 614 Advances in Fish Breeding, Genetics and Biotechnology**  
2+0  
Sem. I  
Advances in fish breeding. Selection index methodologies. Transgenics production and GMOs. Applications of genetics in commercial aquaculture. Research methodologies in fish genetics. Advances in cytogenetics. Molecular breeding. Linear models in fish genetics. Genetic

Zoo. 591 Seminar
Zoo. 600 Master's Research
Zoo. 700 Ph.D. Research
COURSE CURRICULUM FOR AWARD OF 3-YEAR B.Sc. DEGREE ON OPTING OUT OF 5-YEAR INTEGRATED M.Sc. (Hons) PROGRAMME IN BIOCHEMISTRY (CORE COURSES)

DEFIENCY COURSES

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<th>BASIC SCIENCES AND HUMANITIES</th>
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<td>For PCB base:</td>
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<tr>
<td>Math. 107</td>
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Regional Language
For students with domicile of Punjab who have not taken Punjabi at Matric/10+2 level
Pbi. 101 Basic Punjabi 0+2 (NC)

REQUIRED COURSES

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<tr>
<th>BASIC SCIENCES AND HUMANITIES</th>
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<td>PBG 102/</td>
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<td>Ent. 201/</td>
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<td>Pl. Path. 201 (Optional)</td>
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<td>Micro. 305</td>
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<td>Mgt. 421</td>
<td>Introduction to Management and Marketing</td>
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**Total Credits:** 109+3/2 (optional)+

**Final Credits:** 116/115

**AGRICULTURE**

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<td>Diseases of Field Crops and their Management</td>
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(*)Credit hours already counted 8

**AGRICULTURAL ENGINEERING AND TECHNOLOGY**

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**HOME SCIENCE**

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**NSS/NSO/NCC**

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**Total Credits:** 129/128+4 (NC)

**Final Credits:** 133/132
# Semester-Wise Programme for 5-Year Integrated M.Sc. (Hons) in Biochemistry

## First Year

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## Second Year

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<tr>
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<tr>
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## Third Year

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<th>Course</th>
<th>SEM V</th>
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<tbody>
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<td>Biochem. 301</td>
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<tr>
<td>Bot. 302</td>
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<tr>
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<td>2+0</td>
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<tr>
<td>Micro. 304</td>
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<td>Zoo. 306</td>
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<td>Biotech. 401</td>
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<td>Biochem. 431</td>
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<tr>
<td>Biochem. 423</td>
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<td>Biochem. 425</td>
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<td>Edu. Tour</td>
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### Required Courses

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<tr>
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<tbody>
<tr>
<td>Math. 107/ Bio. 101</td>
<td>Fundamental Mathematics/ Introduction to Biology</td>
<td>2+1/3+0</td>
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<tr>
<td>Zoo. 201</td>
<td>Introduction to Animal Biodiversity</td>
<td>3+0</td>
</tr>
<tr>
<td>Bot. 202</td>
<td>Plant Morphology</td>
<td>3+0</td>
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<tr>
<td>Econ. 203</td>
<td>Introduction to Economics and Project Evaluation</td>
<td>2+0</td>
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<tr>
<td>Chem. 203</td>
<td>Physical and Inorganic Chemistry</td>
<td>2+1</td>
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<tr>
<td>Eng. 301</td>
<td>Communication Skills and Technical Writing</td>
<td>1+2</td>
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<tr>
<td>Pbi. 101</td>
<td>Basic Punjabi</td>
<td>0+2 (NC)</td>
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<td>Elementary Statistics</td>
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<td>Introduction to Microbiology</td>
<td>3+0</td>
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<tr>
<td>Phys. 202</td>
<td>Fundamentals of Biophysics</td>
<td>2+1</td>
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<tr>
<td>Biochem. 203</td>
<td>Structure and Function of Biomolecules</td>
<td>3+0</td>
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<tr>
<td>Bot. 203</td>
<td>Systematic Botany</td>
<td>3+0</td>
</tr>
<tr>
<td>Zoo. 203</td>
<td>Introduction to Cell Biology and Immunology</td>
<td>3+0</td>
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<td>Mechanism of organic reactions</td>
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<td>Micro. 203</td>
<td>Basic Bacteriology</td>
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<tr>
<td>Biochem. 204</td>
<td>Metabolism-I</td>
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<td>Plant Histology</td>
<td>2+0</td>
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<td>Micro. 204</td>
<td>Basic Mycology and Phycology</td>
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<td>Metabolism-II</td>
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<td>Fundamentals of Animal Physiology</td>
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<td>Chem. 301/</td>
<td>Fundamental Organic Chemistry/</td>
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<td>Biochem. 303/</td>
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<td>Bot. 307/</td>
<td>Plant Biodiversity and Environment/</td>
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<td>Micro. 307/</td>
<td>Bacterial Genetcs</td>
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<td>Fundamentals of Animal Behaviour</td>
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<td>Zoo. 405/</td>
<td>Introduction to Fish and Fisheries</td>
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<td>Agron. 101/</td>
<td>Elements of Agronomy</td>
<td>2+1</td>
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<td>PBG 102/</td>
<td>Introductory Genetics</td>
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<td>Introductory Entomology</td>
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<td>Pl. Path. 201</td>
<td>Diseases of Field Crops and their Management</td>
<td>2+1</td>
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<td>Course Title</td>
<td>Credits</td>
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<td>Fundamentals of Plant Physiology</td>
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<td>Micro. 305</td>
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<td>Introduction to Molecular Biochemistry</td>
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<td>Basic Experiments in Botany</td>
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<td>Bryophyta</td>
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<td>Bot. 305</td>
<td>Pteridophyta</td>
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<td>Bot. 306</td>
<td>Gymnosperms</td>
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<td>Plant Physiology-I (Plant Water Relations and Mineral Nutrition)</td>
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<td>Plant Physiology-II (Plant Metabolism)</td>
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<td>Plant Physiology-III (Growth, Differentiation and Morphogenesis)</td>
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**Total: 109+3/2 (optional)+ 4(NC) = 116/115**

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<td>Agron. 101</td>
<td>Elements of Agronomy/</td>
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<td>Ent. 201</td>
<td>Introductory Entomology</td>
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<td>PBG 102</td>
<td>Introductory Genetics</td>
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<td>Diseases of Field Crops and their Management</td>
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<td>Introduction to Nanobiochemistry</td>
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<td>Introduction to Bioinformatics</td>
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<td>Introduction to Genomics and Proteomics</td>
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**Total: 8**

(*Credit hours already counted)

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**NSS/NSO/NCC**

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**Total: 129/128+4**

528
(NC) = 133/132
### SEMESTER-WISE PROGRAMME FOR 5-YEAR INTEGRATED M.Sc. (Hons) IN BOTANY

#### FIRST YEAR

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<th>Course</th>
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<td><strong>Math. 107/Bio. 101</strong></td>
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<td>CSE 101</td>
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<td><strong>Zoo. 201</strong></td>
<td>3+0</td>
<td>Stat. 201</td>
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<tr>
<td><strong>Bot. 202</strong></td>
<td>3+0</td>
<td>Micro. 202</td>
</tr>
<tr>
<td><strong>Econ. 203</strong></td>
<td>2+0</td>
<td>Phys. 202</td>
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<tr>
<td><strong>Chem. 203</strong></td>
<td>2+1</td>
<td>Biochem. 203</td>
</tr>
<tr>
<td><strong>Eng. 301</strong></td>
<td>1+2</td>
<td>Bot. 203</td>
</tr>
<tr>
<td><strong>Pbi. 101</strong></td>
<td>0+2 (NC)</td>
<td>Zoo. 203</td>
</tr>
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<td><strong>HD 106</strong></td>
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<td>Chem. 204</td>
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#### SECOND YEAR

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<tr>
<td><strong>Biochem. 204</strong></td>
<td>2+0</td>
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<td><strong>Bot. 204</strong></td>
<td>2+0</td>
<td>Bot. 301</td>
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<tr>
<td><strong>Micro. 204</strong></td>
<td>3+0</td>
<td>Biochem. 302</td>
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<tr>
<td><strong>Zoo. 204</strong></td>
<td>2+0</td>
<td>Micro. 305</td>
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<td><strong>Biochem. 205</strong></td>
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<tr>
<td><strong>Bot. 205</strong></td>
<td>2+0</td>
<td>Biotech. 307</td>
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<td><strong>Zoo. 304</strong></td>
<td>3+0</td>
<td>Mgt. 421</td>
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<td><strong>Chem. 301/Biochem. 303/0+0/3+0/</strong></td>
<td>3+0</td>
<td>Eng. 201</td>
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<td><strong>Bot. 307/Micro. 307/Zoo. 310/2+1/3+0/2+1/1/10</strong></td>
<td>2+1/3+0/2+1/1/10</td>
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<td><strong>Zoo. 405/Agron. 101/PBG 102/2+1/2+1/2+0/0/0</strong></td>
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<tr>
<td><strong>Ent. 201/Pl. Path. 201 (Optional)2+1/2+1</strong></td>
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<td><strong>NSS/NSO/NCC</strong></td>
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<td>NSS/NSO/NCC</td>
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<td><strong>Total</strong></td>
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<td>23+1 (NC) = 24</td>
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#### THIRD YEAR

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<td><strong>Biochem. 301</strong></td>
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<td>Bot. 304</td>
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<td>0+3</td>
<td>Bot. 305</td>
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<tr>
<td><strong>Bot. 303</strong></td>
<td>2+0</td>
<td>Bot. 306</td>
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<tr>
<td><strong>Micro. 304</strong></td>
<td>3+0</td>
<td>Bot. 401</td>
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<td><strong>Zoo. 306</strong></td>
<td>0+3</td>
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<td><strong>Biotech. 401</strong></td>
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<td><strong>Bot. 303</strong></td>
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<tr>
<td><strong>Edu. Tour</strong></td>
<td>0+2 (NC)</td>
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<tr>
<td><strong>Total</strong></td>
<td>20 + 2 (NC) = 22</td>
<td>23+1 (NC) = 24</td>
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COURSE CURRICULUM FOR AWARD OF 3-YEAR B.Sc. DEGREE ON OPTING OUTOF 5-YEAR INTEGRATED M.Sc. (Hons) PROGRAMME IN CHEMISTRY (CORE COURSES)

DEFICIENCY COURSES

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<th>BASIC SCIENCES AND HUMANITIES</th>
<th>Cr. Hrs.</th>
<th>Th+Pr</th>
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<tbody>
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<tr>
<td>Bio. 101 Introduction to Biology</td>
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<tr>
<td>For PCB base:</td>
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<tr>
<td>Math. 107 Fundamental Mathematics</td>
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Regional Language

For students with domicile of Punjab who have not taken Punjabi at Matric/10+2 level

Pbi. 101 Basic Punjabi 0+2 (NC)

REQUIRED COURSES

<table>
<thead>
<tr>
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<th>Cr. Hrs.</th>
<th>Th+Pr</th>
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<tr>
<td>Zoo. 201 Introduction to Animal Biodiversity</td>
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<tr>
<td>Bot. 202 Plant Morphology</td>
<td>3+0</td>
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</tr>
<tr>
<td>Econ. 203 Introduction to Economics and Project Evaluation</td>
<td>2+0</td>
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<tr>
<td>Chem. 201 Organic Chemistry</td>
<td>3+0</td>
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</tr>
<tr>
<td>Eng. 301 Communication Skills and Technical Writing</td>
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<tr>
<td>Pbi. 101 Basic Punjabi</td>
<td>0+2 (NC)</td>
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<tr>
<td>Stat. 201 Elementary Statistics</td>
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<td>Micro. 202 Introduction to Microbiology</td>
<td>3+0</td>
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<tr>
<td>Phys. 202 Fundamentals of Biophysics</td>
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<td>Biochem. 203 Structure and Function of Biomolecules</td>
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<td>Bot. 203 Systematic Botany</td>
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<td>Zoo. 203 Introduction to Cell Biology and Immunology</td>
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<td>Chem. 203 Physical and Inorganic Chemistry</td>
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<tr>
<td>Micro. 203 Basic Bacteriology</td>
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<tr>
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<td>Chem. 302 Chemistry of Agrochemicals, Plant Products and Growth Regulators</td>
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<td>Micro. 204 Basic Mycology and Phycology</td>
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<tr>
<td>Biochem. 303/ Introduction to Membrane Biochemistry</td>
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<tr>
<td>Bot. 307/ Plant Biodiversity and Environment/</td>
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<tr>
<td>Micro. 307/ BacterialGenetics</td>
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<tr>
<td>Zoo. 310/ Fundamentals of Animal Behaviour</td>
<td>2+1</td>
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<tr>
<td>Zoo. 405/ Introduction to Fish and Fisheries</td>
<td>2+1</td>
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<td>Agron. 101/ Elements of Agronomy</td>
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<td>PBG 102/ Introductory Genetics</td>
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<td>Pl. Path. 201 Diseases of Field Crops and their Management</td>
<td>2+1</td>
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<tr>
<td>Course Code</td>
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<tr>
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<td>Thermodynamics and Chemical Kinetics</td>
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<td>Biochem. 206</td>
<td>General Enzymology</td>
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<td>Bot. 301</td>
<td>Fundamentals of Plant Physiology</td>
<td>3+0</td>
</tr>
<tr>
<td>Biochem. 302</td>
<td>Basic Experiments in Biochemistry</td>
<td>0+3</td>
</tr>
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<td>Chem. 304</td>
<td>Basic Analytical Chemistry</td>
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<td>Chem. 305</td>
<td>Experiments in Inorganic Chemistry</td>
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<td>Mgt. 421</td>
<td>Introduction to Management and Marketing</td>
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<tr>
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<td>Environmental Studies and Disaster Management</td>
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<td>Basic Experiments in Botany</td>
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<td>Biomathematics</td>
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<td>Radioactivity and Transition Elements</td>
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<td>Edu. Tour</td>
<td>Educational Tour</td>
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<td>Chem. 425</td>
<td>Introduction to Metal Complexes and Chelates</td>
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<td>Interactive Languages Proficiency</td>
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**AGRICULTURE**

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<td>Elements of Agronomy/</td>
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<td>Ent. 201</td>
<td>Introductory Entomology</td>
<td>2+1*</td>
</tr>
<tr>
<td>PBG 102</td>
<td>Introductory Genetics</td>
<td>2+0*</td>
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<td>Pl. Path. 201</td>
<td>Diseases of Field Crops and their Management</td>
<td>2+1*</td>
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<td>Biotech. 303</td>
<td>Introduction to Nanobiotechnology</td>
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**AGRICULTURE ENGINEERING AND TECHNOLOGY**

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**HOME SCIENCE**

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**NSS/NSO/NCC**

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**Total**

129/128+4 (NC)=133/132
# SEMESTER-WISE PROGRAMME FOR 5-YEAR INTEGRATED M.Sc. (Hons) in CHEMISTRY

## FIRST YEAR

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<tr>
<th>SEM I</th>
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<td>Pbi. 101</td>
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## SECOND YEAR

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<td>Biochem. 206</td>
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<td>Zoo. 204</td>
<td>Bot. 301</td>
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<td>Biochem. 205</td>
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## THIRD YEAR

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<td>Math. 203</td>
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<td>Chem. 424</td>
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COURSE CURRICULUM FOR AWARD OF 3-YEAR B.Sc. DEGREE ON OPTING OUT OF 5-YEAR INTEGRATED M.Sc. (Hons) PROGRAMME IN MICROBIOLOGY (CORE COURSES)

DEFICIENCY COURSES

<table>
<thead>
<tr>
<th>BASIC SCIENCES AND HUMANITIES</th>
<th>Cr. Hrs.</th>
<th>Th+Pr</th>
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<tbody>
<tr>
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<tr>
<td>Bio. 101 Introduction to Biology</td>
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<tr>
<td>For PCB base:</td>
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<tr>
<td>Math. 107 Fundamental Mathematics</td>
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Regional Language

For students with domicile of Punjab who have not taken Punjabi at Matric/10+2 level

Pbi. 101 Basic Punjabi 0+2 (NC)

REQUIRED COURSES

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<thead>
<tr>
<th>BASIC SCIENCES AND HUMANITIES</th>
<th>Cr. Hrs.</th>
<th>Th+Pr</th>
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<tbody>
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<td>Zoo. 201 Introduction to Animal Biodiversity</td>
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<tr>
<td>Bot. 202 Plant Morphology</td>
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<tr>
<td>Econ. 203 Introduction to Economics and Project Evaluation</td>
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<td>Chem. 203 Physical and Inorganic Chemistry</td>
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<td>Eng. 301 Communication Skills and Technical Writing</td>
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<tr>
<td>Phys. 202 Fundamentals of Biophysics</td>
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<td>Biochem. 203 Structure and Function of Biomolecules</td>
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<td>Bot. 203 Systematic Botany</td>
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<td>Zoo. 203 Introduction to Cell Biology and Immunology</td>
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<td>Micro. 204 Basic Mycology and Phycology</td>
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<td>Bot. 307/ Plant Biodiversity and Environment/</td>
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<td>Micro. 307/ Bacterial Genetics</td>
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<td>Zoo. 310/ Fundamentals of Animal Behaviour</td>
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<td>Zoo. 405/ Introduction to Fish and Fisheries</td>
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<td>Agron. 101/ Elements of Agronomy</td>
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<td>Ent. 201/</td>
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<td>General Enzymology</td>
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<td>Fundamentals of Plant Physiology</td>
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<td>Biochem. 302</td>
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<td>Micro. 305</td>
<td>Basic Experiments in Microbiology</td>
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<td>Zoo. 305</td>
<td>Fundamentals of Animal Ecology</td>
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<td>Mgt. 421</td>
<td>Introduction to Management and Marketing</td>
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**AGRICULTURE**

1 Agron. 101/ Elements of Agronomy/ 2+1*
2 Ent. 201 Introductory Entomology 2+1*
3 PBG 102 Introductory Genetics 2+0*
4 Pl. Path. 201 Diseases of Field Crops and their Management 2+1*

**AGRICULTURE ENGINEERING AND TECHNOLOGY**

1 CSE 101 Information and Communication Technology in Agriculture 1+2

**HOME SCIENCE**

1 HD 106 Human Values in Education 1+1

**NSS/NSO/NCC**

1 NSS/NSO/NCC (SEM-I) 0+1 (NC)
2 NSS/NSO/NCC (SEM-II) 0+1 (NC)
3 NSS/NSO/NCC (SEM-III) 0+1 (NC)
4 NSS/NSO/NCC (SEM-IV) 0+1 (NC)

4 (NC)
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### SEMESTER-WISE PROGRAMME FOR 5-YEAR INTEGRATED M.Sc. (Hons) in MICROBIOLOGY

#### FIRST YEAR

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Total 19+3 (NC)=22

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Total 19+3/2(optional)+1(NC)= 23/22

#### THIRD YEAR

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<th>SEM V</th>
<th>SEM VI</th>
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<td>Micro. 303/Biotech. 304 2+1</td>
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<tr>
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<td>0+3</td>
<td>Micro. 401  0+2</td>
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<td>Micro. 421  2+1</td>
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<td>Micro. 306</td>
<td>3+1</td>
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<tr>
<td>Edu. Tour</td>
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Total 21+2 (NC) = 23

Total 17

Total 23+1 (NC) = 24
## COURSE CURRICULUM FOR AWARD OF 3-YEAR B.Sc. DEGREE ON OPTING OUT OF 5-YEAR INTEGRATED M.Sc. (Hons) PROGRAMME IN ZOOLOGY (CORE COURSES)

## DEFICIENCY COURSES

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<thead>
<tr>
<th>BASIC SCIENCES AND HUMANITIES</th>
<th>Cr. Hrs.</th>
<th>Th+Pr</th>
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<tbody>
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<td><strong>For PCM base:</strong></td>
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<tr>
<td>Bio. 101</td>
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<tr>
<td><strong>For PCB base:</strong></td>
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<tr>
<td>Math. 107</td>
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### Regional Language

For students with domicile of Punjab who have not taken Punjabi at Matric/10+2 level

- Pbi. 101 Basic Punjabi 0+2 (NC)

## REQUIRED COURSES

<table>
<thead>
<tr>
<th>BASIC SCIENCES AND HUMANITIES</th>
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<td>1+2</td>
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<td>General Enzymology</td>
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<td>Fundamentals of Plant Physiology</td>
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<td>Basic Experiments in Biochemistry</td>
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<td>Form, Structure and Function of Vertebrates</td>
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<td>Cell Biology and Development in Animals</td>
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AGRICULTURE

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<td>Elements of Agronomy/</td>
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<td>Ent. 201</td>
<td>Introductory Entomology</td>
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<td>PBG 102</td>
<td>Introductory Genetics</td>
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AGRICULTURE ENGINEERING AND TECHNOLOGY

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HOME SCIENCE

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NSS/NSO/NCC

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Total 130/129+4
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# SEMESTER-WISE PROGRAMME FOR 5-YEAR INTEGRATED M.Sc. (Hons) in ZOOLOGY

## FIRST YEAR

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<td>Bot. 203</td>
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## SECOND YEAR

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<td>Mgt. 421</td>
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<td>Eng. 201</td>
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<td>Env. 101</td>
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## THIRD YEAR

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<td>Zoo. 401</td>
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