

Resolution No: AC/II (22-23).3.RUS1

S. P. Mandali's
Ramnarin Ruia Autonomous College

(Affiliated to University of Mumbai)



Integrated M.Sc. in Bioanalytical Sciences

(F.Y.B.Sc. Syllabus)

Program Code: RUSBAS

As Per Guidelines of National Education Policy 2020 – Academic Year 2023-24

(Choice Based Credit System)



GRADUATE ATTRIBUTES

GA	GA Description
	A student completing Bachelor's Degree in Science program will be able to:
GA 1	Recall and explain acquired scientific knowledge in a comprehensive manner and apply the skills acquired in their chosen discipline. Interpret scientific ideas and relate its interconnectedness to various fields in science.
GA 2	Evaluate scientific ideas critically, analyse problems, explore options for practical demonstrations, illustrate work plans and execute them, organise data and draw inferences.
GA 3	Explore and evaluate digital information and use it for knowledge upgradation. Apply relevant information so gathered for analysis and communication using appropriate digital tools.
GA 4	Ask relevant questions, understand scientific relevance, hypothesize a scientific problem, construct and execute a project plan and analyse results.
GA 5	Take complex challenges, work responsibly and independently, as well as in cohesion with a team for completion of a task. Communicate effectively, convincingly and in an articulate manner.
GA 6	Apply scientific information with sensitivity to values of different cultural groups. Disseminate scientific knowledge effectively for upliftment of the society.
GA 7	Follow ethical practices at work place and be unbiased and critical in interpretation of scientific data. Understand the environmental issues and explore sustainable solutions for it.
GA 8	Keep abreast with current scientific developments in the specific discipline and adapt to technological advancements for better application of scientific knowledge as a lifelong learner.



PROGRAM OUTCOMES

PO	Description
PO 1	A student completing Bachelor's Degree in Science program in the subject of Bioanalytical Sciences will be able to: This course will impart high quality science education in a vibrant academic ambience with the faculty of distinguished teachers and scientists.
PO 2	It will also equip students for the future who will take up the challenge of doing quality research & teaching and also contribute to industrial production and R & D in the fields of Bioanalysis, Bioinformatics and Nutraceutical Sciences.
PO 3	It will amalgamate classical analytical chemical techniques with modern genomic and proteomic technologies of manufacturing and analysis to better characterize the products useful as medicines as well as nutraceuticals.



S. P. Mandali's
Ramnarain Ruia Autonomous College
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F.Y. B.Sc. (Semester I & II)



Program Code: RUSBAS

(Choice Based Credit System

for

the academic year 2023-24)



Subject I: Bioanalytical Sciences RUSBAS.0101

Course Title: Biodiversity and Bioprospecting

Academic Year 2023-24

F.Y.B.Sc.

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Explain the importance of plant diversity, various metabolic functions in plants and with plant bioprospecting.
CO 2	describe the significance of plant and animal anatomy study, different model organisms for in-vivo studies and the functions of specialized cells present them.
CO 3	elaborate on the basic concepts of microbiology, and apply the significance.
CO 4	Perform aseptic transfer techniques & microbial bioprospecting.



Paper Code	Semester I	Credits/ Hours
RUSBAS.O101	Biodiversity and Bioprospecting	3/45
101.1 Microbial Diversity & Bioprospecting		15
Types of Microorganisms- Bacteria, Viruses, Protozoa, Algae, Fungi Significance and Scope of Microbiology, Significance of <i>E. coli</i> , Yeast & <i>Neurospora crassa</i> as type specimens Microbial prospecting Commercial applications of microorganisms with suitable examples: Pharmaceutical industry: Vaccine production, Antibiotic production (any one example), Food and Dairy Industries. Applications of microorganisms in sustainable development		
101.2 Plant Diversity & Bioprospecting		15
Plant Diversity & Conservation Cultivation of plants Physiological and Biochemical processes in plants - seed germination and photosynthesis, Storage compounds in plants Commercial applications and plant bioprospecting		
101.3 Animal Diversity & Bioprospecting		15
Animal diversity, conservation Animal bioprospecting Animal models in drug research: Significance of Zebra Fish, Mice, Guinea Pig, Non-human primates, Ethical considerations for use of animals in research. Research involving human subjects		
RUSBASP.O101	PRACTICALS	
1. Study of storage compounds from microorganisms and plants 2. Screening of samples for antibiotic producers/pesticide degraders 3. Extraction and analysis of betalains. 4. Titrimetric Estimation of Vitamin C 5. Extraction from oils from plant and animal sources.		

Reference Books:

1. Micheal J. Pelczar, Jr., E.C.S.Chan, Noel R. Krieg – Microbiology
2. B.R. Vashishta, A K Sinha, Adarsh, Botany for Degree Students Part III: Bryophyta
3. B. P. Pandey, Plant Anatomy, S Chand Gerald Karp, Cell Biology
4. David Hopkin Lewis, Storage Carbohydrates in Vascular Plants: Distribution, Physiology, and Metabolism
5. David Nelson, Michael Cox: Lehninger's Principle of Biochemistry: Springer
6. S. Mukherji and A. K. Ghosh, Plant Physiology, New Central Book Agency (P) Ltd
7. Russell; Hunter, W.D. and McMillan: Life of Invertebrates
8. Kotpal, R.L.: Zoology Phylum – Arthropoda, Rastogi Publication



Subject II- Chemical Sciences RUSBAS.0102

Course Title: Organic Chemistry I

Academic Year 2023-24

F.Y.B.Sc.

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Analyse & identify the organic molecules and draw their structures.
CO 2	Explain with a suitable diagram of stereochemical structures of organic compounds.
CO 3	differentiate between different types of organic reactions according to their mechanism.

Paper Code	Semester I	Credits/Hours 3/45
RUSBAS.0102	Organic Chemistry I	
102.1 IUPAC Nomenclature and Aromaticity		15
<p>IUPAC: Rules of IUPAC nomenclature, IUPAC nomenclature of basic functional groups, aliphatic poly functional compounds, including monocyclic compounds on the basis of IUPAC priority order. (Line formulae expected) IUPAC nomenclature of Spiro, Biphenyls, Bicyclic compounds.</p> <p>Aromaticity: Characteristic properties of aromatic compounds, Huckel's rule, Aromaticity and anti-aromaticity, Resonance energy,</p> <p>Aromatic hydrocarbons: Benzenoid & Nonbenzenoid compounds (benzene, naphthalene, anthracene, phenanthrene, cyclopropenium, cyclopentadienyl, cycloheptatrieniumcation)</p>		
102.2 Stereochemistry		15
<p>Optical and Geometrical isomers: Study of enantiomers, diastereoisomers, Geometrical isomerism due to restricted rotation around C-C double bond and Substituted cycloalkanes</p> <p>Idea of configuration. Stereochemistry of carbon compounds with one and two similar and dissimilar asymmetric carbon atoms: enantiomers, diastereomers, and racemic mixtures and their properties, threo, erythro and mesoisomers.</p>		



<p>Representation of configuration by 'flying wedge formula' and projection formulae- Fischer, Newman and Sawhorse & interconversion of formula. Conformational analysis of ethane, propane, n-butane. Molecular chirality and element of symmetry: Plane of Symmetry, Centre of Symmetry, Alternating axis of symmetry. Chirality without asymmetric carbon Conformations of cyclohexane and their relative stabilities. Assigning stereo descriptors to chiral centres: Cahn-Ingold-Prelog(CIP), Rules for assigning absolute configuration(R&S) to a stereogenic center. Substitution reactions- SN1, SN2, SNi (reaction of alcohol with thionyl chloride). E2-anti-elimination-Base induced dehydrohalogenation of 1-bromo-1,2-diphenylpropane. Addition reactions to olefins-i) Catalytic hydrogenation ii) Bromination (electrophilic anti addition) iii) Synhydroxylation (molecular addition) with OsO₄ and KMnO₄.</p>	
<p>102.3 Fundamentals of Organic Reactions</p>	<p>15</p>
<p>Electronic effects in organic molecules: Polarization or Inductive effect Nature and polarity of a covalent bond, ionic bond dipole moment, Hyperconjugation and Tautomerism, General Idea of types of reaction: Introduction and few examples of following types of reaction expected: Addition, Elimination, Substitution, Condensation, Rearrangement, Pericyclic reactions, Oxidation-reduction. Homolysis & Heterolysis, Concepts of intermediate, carbocation, carbanion and free radicals. Mechanism and applications of Pinacol-Pinacolone rearrangement, Lossen rearrangement, Knoevenagel condensation, Reimer-Teimann reaction, Aldol condensation, Baeyer-Villiger Oxidation, Beckmann rearrangement, Corey-Kim Oxidation, Cornforth rearrangement, Favorskii rearrangement, Luche Reduction.</p>	
<p>RUSBASP.O102 PRACTICALS</p>	
<ol style="list-style-type: none"> 1. Stoichiometric calculations. 2. Study of organic structures using models 3. Identification of organic compounds- acid, base, neutral, phenol 4. SMILES notation of organic compounds 5. Synthesis of Dibenzylidene acetone (condensation) 6. Nitration of salicylic acid 7. Preparation of suitable derivatives from organic compounds- Acetyl Salicylic Acid. 	

Reference Books:

1. Morrison AND Boyd: Organic chemistry: Allyn & Bacon publication



2. Richard O.C. Norman, James M. Coxon: Principles of Organic Synthesis, 3rd Edition: CRC Press
3. Peter Sykes: A Guidebook to Mechanism in Organic Chemistry: 6 Edition: Pearson
4. P.S Kalsi: Organic Reactions and Their Mechanisms: Third Edition, New Age
5. Ira N. Levine: Physical Chemistry: McGraw-Hill

Ramnarain Ruia Autonomous College



Subject III- Pharmaceutical Sciences RUSBAS.0103

Course Title: Human Anatomy & Physiology

Academic Year 2023-24

F.Y.B.Sc.

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Describe the organization of human body, body fluids system, and skin.
CO 2	Elaborate on the organization of human nervous, cardiovascular, and digestive system.
CO 3	Explain the organization of human respiratory, endocrine, and urinary system.

Paper Code	Semester I	Credits/ Hours
RUSBAS.0103	Human Anatomy & Physiology	3/45
103.1	Introduction to Human Body, Cell & Tissue level Organization systems: Integumentary system, Body Fluids, Blood and Lymphatic System	15
Concept of cell, tissues, and organs, Structure and functions of cell, with special emphasis on cell membrane, classification of tissues, introduction to cell signalling and transport, Homo sapiens sapiens as type specimen Body fluids, composition and functions of blood, blood cells, hemopoiesis, mechanisms of coagulation, blood grouping, Rh factors, Reticulo endothelial system, Overview of Lymphatic system Structure and functions of skin		
103.2	Organ Systems: Nervous, Cardiovascular & Digestive	15
Overview of nervous system, Origin and functions of spinal and cranial nerves, neuron, neuroglia, classification and properties of nerve fiber, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters. Overview of cardiac and circulatory system, elements of conduction system of heart and heartbeat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, disorders of heart.		



Overview of Digestive system, Acid production in the stomach, regulation of acid production through parasympathetic nervous system, functions of salivary glands, pancreas and liver, digestion and absorption of nutrients.		
103.3 Organ Systems: Respiratory, Endocrine and Urinary		15
<p>Overview of respiratory system, mechanism of respiration, endocrine, and urinary system.</p> <p>Overview of urinary system, physiology of urine formation, role of kidneys in acid base balance, role of RAS in kidney</p> <p>Classification of hormones, mechanism of hormone action, structure and functions of hypothalamus, pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas,</p>		
RUSBASP.0103	PRACTICALS	Credits/ Hours 1/30
<ol style="list-style-type: none"> 1. Analysis of Urine 2. Bleeding time, clotting time 3. Microscopic examination of blood components 4. Blood grouping 5. Separation of plasma from blood 6. Study of striated muscles 7. Study of amylase from saliva 8. Understanding Human pathological reports (CBC, liver profile). 		

Reference Books:

1. Chatterjee, C.C., Human Physiology. Medical Allied Agency, Kolkata.
2. Ganong, W.F., Review of Medical Physiology. Prentice-Hall International, London.
3. Guyton, A.C., Textbook of Medical Physiology. W. B. Saunders Co., Philadelphia, USA.
4. Tortora, G.J. and Grabowski, S.R., 2005. Principles of Anatomy and Physiology. Harper Collins College Publishers, New York.
5. Vander, A.J., Sherman, J.H. and Luciano, D.S., Human Physiology. McGraw-Hill Publishing Co., USA.



Modality of Assessment for: F.Y.B.Sc. Semester I

Sr. No.	Number of Credits	Total Marks	Internal Assessment (Marks)	Internal Assessment (Pattern)	Semester End Examination (Marks)	Semester End Examination (Pattern)	Duration of Sem End Exam
1.	3	75	30	a)1 Class Test of 20 Marks b)1 Assignment of 10 Marks	45	Three Questions of 15 Marks each	1 Hr 30 Mins
2.	2	50	20	Class Test/Assignment/ Open Book Test	30	Two Questions of 15 marks each/Three Questions of 10 Marks each	1 Hr
3.	1 (Practical)	25	NA	NA	25	Required Experiments Performed with appropriate principle, approach, Observations, Result, Demonstration of skills, Conclusion and Viva.	45 Minutes



Semester II

Major Subject I: Bioanalytical Sciences RUSBAS.E111

Course Title: Physiology & Biochemistry

Academic Year 2023-24

F.Y.B.Sc.

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Explaining the efficient way on how cells perform their biological functions while strictly obeying the laws of thermodynamics.
CO 2	Calculating the entropy, enthalpy, and free energy change for biochemical reactions
CO3	Demonstrate metabolic pathways in a sequential manner.
CO4	Learn about the metabolic pathways with the perspective of their applications in drug design.



Paper Code	Semester II	Credits/Hours
RUSBAS.E111	Physiology & Biochemistry	3/45
111.1	Biochemical basis of Life, Introduction to Biomolecules, Enzymes & Coenzymes	15
Introduction to biomolecules, types of biomolecules and their physiological roles, Enzymes: Chemical nature, properties, nomenclature, classification, units of enzyme activity: katal specific activity. Mechanism of enzyme action: concept of active site, activation energy, binding energy, energy diagram for enzyme catalysed reactions, lock & key Vs induced fit mechanism; Enzyme kinetics: Michaelis-Menton equation, Lineweaver-Burk plot Enzyme inhibitors: Equations & Graphs, Allosteric enzymes, Types of catalysis: Acid base, covalent, metal ion, Overview of Coenzyme types with suitable examples.		
111.2	Bioenergetics, Metabolism of Carbohydrates	15
Concept of catabolism, anabolism & metabolism. Concept of Gibbs free energy, enthalpy, entropy, free energy change (ΔG) and standard free energy change (ΔG°) with suitable examples, Laws of thermodynamics with suitable examples. Glycolysis, Krebs Cycle, Pentose Phosphate Pathway, Gluconeogenesis, Glycogenesis, Glycogenolysis, Metabolic disorders		
111.3	Metabolism of Lipids, Proteins and Nucleic Acids	15
Lipid Metabolism & Metabolic Disorders Nucleic Acid metabolism: Synthesis of Purines & Pyrimidines (<i>De novo</i> & <i>Salvage pathway</i>), Catabolism of Purines & Pyrimidines Amino Acid: Synthesis of Amino acids, Urea Cycle		
RUSBASP.E111	PRACTICALS	Credits/Hours 1/30
1. Estimation of reducing sugars by DNSA method 2. Enzymology: a) Extraction of amylase from starch using buffers. b) Determination of optimum pH, temperature c) Optimization of substrate and enzyme concentration d) Determination of K_m value e) Effect of inhibitor(s) 3. Extraction and immobilization of Invertase from yeast. 4. Application of enzyme in diagnostics (Example of glucose oxidase kit, Glucometer demonstration) 5. Estimation of Protein by Lowry's Method 6. Estimation of cholesterol by zak's method		



Reference Books:

Physiology & Biochemistry	<ul style="list-style-type: none">• Robert Copeland : Enzyme: 2nd edition: Wiley publication• William .P. Jencks: Catalysis in Chemistry and Enzymology : Courier Dover Publications• Tim Bugg: Introduction to Enzyme and Coenzyme Chemistry : 2nd Edition :Blackwill publication• David Nelson, Michael Cox : Lehninger’s Principle of Biochemistry : Springer• Buns, G. W.: Science of Genetics - An introduction to heredity, Macmillan, New York.• William S. Kluge and Cummings, M.R.:Concepts of Genetics, Pearson Edu.• Alberts, Bruce: Essentials of Cell Biology: 5th edition.• David Hopkin Lewis, Storage Carbohydrates in Vascular Plants:Distribution, Physiology, and Metabolism• U. Satyanarayana, U. Chakrapani – Biochemistry• Micheal M. Cox and David L. Nelson, Lehninger Principles of Biochemistry
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Subject II- RUSBAS.E112
Course Title: Basic Chemistry
Academic Year 2023-24
F.Y.B.Sc.

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Elaborate on the nature, synthesis and reactions of heterocyclic compounds.
CO 2	Learn about the basics of Stoichiometry and Preparation of Standard Solutions, Titrimetric analysis.
CO 3	Solving problems based on chemical kinetics and thermodynamics

Paper Code	Semester II	Credits/Hours
RUSBAS.E112	Basic Chemistry	3/45
112.1 Heterocyclic Compounds		15
<p>Introduction: Electronic structure and aromaticity of furan, pyrrole, thiophene and pyridine.</p> <p>Synthesis: Synthesis of furans, pyrroles, and thiophenes by Paal-Knor synthesis. Pyridines by Hantzsch synthesis and from 1,5-diketones.</p> <p>Reactivity: Reactivity towards electrophilic substitution reactions-of furan, pyrrole and thiophene on basis of stability of intermediate; and of pyridine on the basis of electron distribution. Nucleophilic substitution reaction of pyridine on the basis of electron distribution.</p> <p>Reactions of heterocycles: The following reactions of furan, pyrrole and thiophene: Halogenation, Nitration, Sulphonation, Vilsmeier formylation reaction, Friedel-Crafts reaction.</p> <p>Furan: Diels-Alder reaction. Ring opening of furan.</p> <p>Pyrrole: Acidity and basicity of pyrrole -Comparison of basicity of pyrrole and pyrrolidine, Acid catalyzed polymerization of pyrrole. Pyridine: Basicity. Comparison of basicity of pyridine, pyrrole and piperidine.</p>		
112.2 Stoichiometry and Preparation of Standard Solutions, Titrimetric analysis		15
Methods of expressing concentration of solutions-molarity, normality, molality, mole fraction, dilution of solutions, interconversion between different concentration units, concept of milliequivalents, millimols, ppm and ppb		



<p>Primary and secondary standards, Preparation of standard solutions, Calculation of concentration of commercial samples of acids and bases, Use of computers in chemical calculations.</p> <p>Requirements for a reaction to be used in titrimetric analysis, classification of titrimetric analysis, Terms: titration, titrand, titrant, titre value, indicator, endpoint, equivalence point, titration error.</p> <p>Principles of acid-base, oxidation–reduction, and complexometric titrations. Theory of acid base indicators, choice of an indicator for the titration, dependence on the pH at the equivalence point. Acid-base, redox and metal-ion indicators</p> <p>Acid-base Titrations: Construction of titration curves and choice of indicators in the titration of Strong acid and strong base, Strong acid and weak base, Weak acid and strong base, Weak acid and weak base</p> <p>Precipitation titrations: Argentometric titrations, construction of the titration curve, Volhard’s method, Mohr’s method.</p>		
112.3 Chemical Kinetics and Chemical Thermodynamics		
<p>Chemical Kinetics:</p> <p>Rate of reaction, definition of rate constant, measurement of reaction rates, order and molecularity, integrated rate equations for zero, first and second order reactions (for second order reactions only a=b to be considered), kinetic characteristics of first and second order reactions, pseudo first order reactions.</p> <p>Chemical Thermodynamics</p> <p>Transition state theory, Transition State-Activation energy, Measurement of Activation energy, Reaction profile diagram, the rate determining Step, Hammond’s postulate, Principle of microscopic reversibility, Kinetics Vs. thermodynamic control.</p> <p>Product analysis, Kinetic studies, Stereochemical outcome, Detection and trapping of intermediates, Crossover experiments, Kinetic isotope effect –primary kinetic & secondary kinetic isotope effect.</p>	15	
RUSBASP.E112	PRACTICALS	Credits/ Hours 1/30
<ol style="list-style-type: none"> 1. Chemical Kinetics & Chemical Thermodynamics: To determine the rate of acid hydrolysis of methyl acetate and determination of order by graphical method. 2. Gravimetric Estimation of mixture of BaSO₄ and NH₄Cl 3. Estimation of Sodium chloride I. P. by precipitation titration 4. Volumetric analysis (Calculation of % error expected) <ol style="list-style-type: none"> a) Acid – Base titration b) Estimation of Iron using Internal Indicator c) Estimation of iodine in iodised common salt using iodometry. 		



Reference Books:

Basic Chemistry	<ul style="list-style-type: none">• Dand Harvey: Modern Analytical Chemistry: Mc Grow Hill Publishers• Hobart.H.Williard, Lyne.L.Meritt, John.A.Dean, Frank.A.Settle.Jr. : Instrumental Methods of Analysis: CBS Publisher.• David Harvey: Modern Analytical Chemistry : Mc Grow Hill Publishers• Peter Atkins & Julio de Paulo: Physical Chemistry: Oxford University Press• Ira N. Levine: Physical Chemistry: McGraw-Hill
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Ramnarain Ruia Autonomous College



Subject III- Pharmaceutical Sciences RUSBAS.E113

Course Title: **Pharmaceutics**

Academic Year **2023-24**

F.Y.B.Sc.

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
CO 1	Explaining the basics of different dosage forms, pharmaceutical incompatibilities, and pharmaceutical calculations
CO 2	Learning the basics of Pharmaceutical Manufacturing, Packaging and Quality Assurance

Paper Code	Semester II	Credits/ Hours
RUSBAS.E113	Pharmaceutics	3/45
113.1 Basic Pharmaceutical Chemistry		15
Definition of a drug, Requirements of an ideal drug, Classification of drugs (based on therapeutic action) Nomenclature of drugs: Generic name, Brand name, Systematic name Definition of the following medicinal terms: Pharmacon, Pharmacophore, Prodrug, Half-life efficiency, LD50, ED50, Therapeutic Index. Brief idea of the following terms: Receptors, Drug-receptor interaction, Drug Potency, Bioavailability, Drug toxicity, Drug addiction, Spurious Drugs, Misbranded Drugs, Adulterated Drugs, Pharmacopoeia. Routes of drug administration with advantages and disadvantages Introduction to Drug Discovery, Design and Development, Discovery of a Lead compound: Screening, drug metabolism studies and clinical observation		
113.2 Dosage forms Classifications and Definitions		15
Routes of drug administration with advantages and disadvantages Formulations, Different dosage forms (emphasis on sustained release formulations)		
113.3 Overview of Pharmaceutical Manufacturing, Packaging and Quality Assurance		15
Overview of Pharmaceutical manufacturing 2. Importance of Schedule M (D& C) in pharmaceutical manufacturing process 3. Regulatory requirements in pharmaceutical manufacturing process 4. Unit operations and advances in: Manufacturing of oral solid dosage forms, oral liquid dosage forms, sterile injectables and topical dosage forms		



<p>RUSBASP.E113 Practicals on Pharmaceutics</p> <ol style="list-style-type: none"> 1. Demonstration of preparation of tablet using a tablet maker 2. Study of different dosage forms and packaging material (Case study) 3. Study of Indian Pharmacopeia and pharmacopoeia monograph 4. Assay of the Sodium benzoate I. P. by non-aqueous titration 5. Assay of the Hydrogen peroxide I. P./B. P. by Permanganometry 6. Visit to a pharmaceutical manufacturing facility/ QA lab 	<p>Credits/ Hours 1/30</p>

Reference Books:

<p>Pharmaceutics</p>	<ol style="list-style-type: none"> 1. H.C. Ansel et al., Pharmaceutical Dosage Form and Drug Delivery System, Lippincott Williams and Walkins, New Delhi. 2. Carter S.J., Cooper and Gunn's-Dispensing for Pharmaceutical Students, CBS publishers, New Delhi. 3. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, CBS Publications, New Delhi. 4. E.A. Rawlins, Bentley's Text Book of Pharmaceutics, English Language Book Society, Elsevier Health Sciences, USA. 5. Alfonso R. Gennaro Remington. The Science and Practice of Pharmacy 6. Lippincott Williams, New Delhi. 8. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, CBS Publications, New Delhi
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Modality of Assessment for: F.Y.B.Sc. Semester II

Sr. No.	Number of Credits	Total Marks	Internal Assessment (Marks)	Internal Assessment (Pattern)	Semester End Examination (Marks)	Semester End Examination (Pattern)	Duration of Sem End Exam
1.	3	75	30	a)1 Class Test of 20 Marks b)1 Assignment of 10 Marks	45	Three Questions of 15 Marks each	1 Hr 30 Mins
2.	2	50	20	Class Test/Assignment/ Open Book Test	30	Two Questions of 15 marks each/Three Questions of 10 Marks each	1 Hr
3.	1 (Practical)	25	NA	NA	25	Required Experiments Performed with appropriate principle, approach, Observations, Result, Demonstration of skills, Conclusion and Viva.	45 Minutes