Resolution No. AC/II(23-24).2.RUS2

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

RUIA COLLEGE
Explore • Experience • Excel

Syllabus for

Program: SYBSc

Program Code: RUSMJBCH

(As per the guidelines of National Education Policy 2020 - Academic year 2024-25)

(Choice Based Credit System)

GRADUATE ATTRIBUTES

S.P. Mandali's Ramnrain Ruia Autonomous College has adopted the Outcome Based Education model to make its science graduates globally competent and capable of advancing in their careers. The Bachelor's Program in Science also encourages students to reflect on the broader purpose of their education.

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 workplace 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 **A student completing Bachelor's Degree in SCIENCE program in the subject of BIOCHEMISTRY will be able to:**
PO 1	Achieve better understanding of the major thrust areas of the disciplines like Chemistry of Biomolecules & their metabolism, Cell biology (Basics, Membrane biochemistry, Cancer), Enzymology, Genetics, Plant Biochemistry, Pharmacology, Microbiology & Immunology.
PO 2	Gain acumen of the fundamental biochemical processes occurring at the molecular and gene level.
PO 3	Understand the role of Biochemistry in food and human nutrition
PO 4	Get insights into multiple important analytical tools for Biochemical testing and apply contextual knowledge and tools of biochemical research for problems solving.
PO 5	Acquire and empower technical knowledge by connecting disciplinary and interdisciplinary aspects of biochemistry.
PO 6	Compile and interpret Biological data using Biostatistics and Bioinformatics tools.
PO 7	Express ideas persuasively through scientific writing and oral presentation which will help in the development of the leadership qualities.
PO 8	Possess scientific temperament by research project-based learning.
PO 9	Procure hands-on real time experience in industries.
PO 10	Get exposure to the strong theoretical and practical understanding of various dimensions of Biochemistry and take up research-oriented courses in the fields of Biochemistry, Nutrition & Dietetics, Molecular Biology, etc.

CREDIT STRUCTURE BSc

Semester	Subject 1		Subject 2	GE/ OE course (Across disciplines)	Vocational and Skill Enhancement Course (VSC) & SEC	Ability Enhancement Course/ VEC/IKS	OJT/FP/CE PCC, RP	Total Credits
	DSC	DSE						
1	4		4	4 (2*2)	VSC-2 + SEC -2	AEC- 2 (CSK) + VEC- 2 (Env Sc.) + IKS-2		22
2	4		4	4 (2*2)	VSC-2 + SEC-2	AEC-2 (CSK)+ VEC-2 (Understanding India)	CC-2	22
Total	8		8	8	8	10	2	44
Exit option: award of UG certificate in Major with 44 credits and an additional 4 credit Core NSQF course/ Internship or Continue with Major and Minor								
3	Major 8		Minor 4	2	VSC-2	AEC-2 MIL	FP -2, CC-2	22
4	Major 8		Minor 4	2	SEC-2	AEC-2 MIL	CEP-2, CC-2	22
Total	16		8	4	4	4	8	44
Exit option: award of UG Diploma in Major with 88 credits and an additional 4 credit Core NSQF course/ Internship or Continue with Major and Minor								
5	DSC 12	DSE 4	Minor 2		VSC-2		CEP/FP-2	22
6	DSC 12	DSE 4	Minor 2				OJT-4	22
Total	24	8	4		2		6	44
	Exit option: award of UG Degree in Major with 132 credits or Continue with Major for Honours/ Research							

Semester III

Course Code: RUSMJBCHO201

Course Title: Enzymology

Type of course: Discipline Specific Core Course

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Have a deeper insight in to the fundamentals enzyme properties, nomenclatures, characteristics and mechanisms
CO 2	Describe structure, functions and the mechanism of action of enzymes. Learning kinetics of enzyme catalysed reactions and enzyme inhibitions and regulatory process, Enzyme activity, Enzyme Units, Specific activity
CO 3	Apply biochemical calculation for enzyme kinetics.
CO 4	Discuss the factors affecting enzymatic reactions.
CO 5	Describe the concepts of co-operative behaviour, enzyme inhibition and allosteric regulation
CO 6	Compare methods for production, purification, characterization and immobilization of enzymes.
CO 7	Describe the major applications of enzymes in industry, understand the principles of enzyme immobilisation techniques and enzyme extraction procedures
CO 8	Develop new ideas for the development of enzyme-based diagnostic kits
CO 9	Discuss various application of enzymes that can benefit human life
CO 10	Discover the current and future trends of applying enzyme technology for the commercialization purpose of biotechnological products.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title Enzymology RUSMJBCHO201	Credits/ Hours 3 / 45 Hours
I	**1**	**Introduction to enzymes**	**15**
	1	Introduction to enzymology	
	1.1	Understanding the basic terminology in enzymology Enzyme, Apoenzyme, Holoenzyme, Prosthetic group, Active site, Turnover number, Specific activity, Katal, IU, Coenzyme and Cofactor	
	1.1.1	Proteolytic cleavage of zymogens and enzyme denaturation	
	1.1.2	Classification of enzyme- IUB system	
	1.2	Principle types of reactions catalysed by enzymes	
	1.3	Group transfer reactions – Acyl group transfer, Phosphoryl group transfer, Glycosyl group transfer	
	1.3.1	Oxido-reduction reactions	
	1.3.2	Elimination, isomerization and rearrangement reactions	
	1.3.3	Enzyme specificity	
	1.4	Theories of specificity of enzyme: Fischer's, lock & key and Koshland's, induced fit theories	
	1.4.1	Characteristics of enzymes and enzyme substrate complex	
	1.4.2	Concept of active center, binding sites, Stereo specificity and ES complex formation	
	1.4.3	Enzyme activity	
	1.5	Factors affecting enzyme activity	
	1.5.1	Concept of activation energy and transition state theory	
II	**2**	**Enzyme – kinetics, regulation, inhibition**	**15**
	2.1	Enzyme kinetics	
	2.1.1	Derivation of Michaelis - Menten equation and Lineweaver Burke equation and Graphical procedures for monosubstrate reactions	
	2.1.2	Significance of Vmax & Km	
	2.2	Enzyme regulation	
	2.2.1	Introduction & its importance	
	2.2.2	Types of regulatory mechanisms- Product inhibition, Feedback	
	2.3	Enzyme inhibition	

	2.3.1	Types of inhibitors- Competitive, Non-competitive and Uncompetitive, and their mode of action and experimental determination considering suitable example.	
	2.3.2	Graphical understanding of effect of different inhibitors on enzyme kinetics (Use of LB Plot)	
	2.3.3	Numericals based on the above concepts	
III	**3**	**Immobilized enzymes and Application of enzymes**	**15**
	3.1	Immobilized enzymes	
	3.1.1	Introduction	
	3.1.2	Importance of immobilization	
	3.1.3	Methods of immobilization- Ionic bonding, Adsorption, Covalent bonding (based on R group of amino acids), Microencapsulation and Gel entrapment	
	3.1.4	Enzyme extraction and optimum conditions, kinetics of immobilized enzyme	
	3.1.5	Industrial examples related to the technique	
	3.1.6	Problems associated with enzyme immobilization	
	3.2	Isoenzymes	
	3.3	Application of enzymes	
	3.3.1	Enzyme immunoassay (HRP)	

Practical

Sr. No	**Course code-** RUSMJBCHPO201 **Practical Title-** Practicals based on theory DSC I	1 Credit
1	Determination of optimum pH of β-Amylase	
2	Determination of optimum temperature of β-Amylase	
3	Determination of Km and Vmax of β-Amylase	
4	Assay to determine enzyme activity and specific activity	
5	Study the effect of inhibitor on β-Amylase	
6	Demonstration of separation of isoenzymes of LDH by electrophoresis	

References:

1. A.L., Lehninger, Principles of Biochemistry (1982), Worth Publishers, Inc. New York.
2. Harper's Biochemistry – Murray, Granner, Mayes, and Rodwell – Prentice Hall International Inc.
3. Textbook of medical physiology - A. C. Gyton, and J. E Hall - Saunders Elsevier Publications
4. Advances in Enzymology and Related Areas of Molecular Biology, Mechanism of Enzyme Action - Daniel Purich
5. Medical Biochemistry - Ramakrishnan (2012)
6. Molecular and cellular enzymology - Jeannine Yon-Kahn, G. Hervé
7. Biochemical methods - S Sadashivam and A Manickam - New Age International publishers
8. Laboratory Manual in Biochemistry - J. Jayaraman - New Age International
9. Understanding enzymes by Trevor Palmer

Course Code: RUSMJBCHO202

Course Title: Basics of Genetics

Type of course: Discipline Specific Core Course

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Learn basic concepts of genetics and transmission of genetic information.
CO 2	Acquire knowledge about Organization of DNA in genome
CO 3	Strengthen the fundamentals of Mendelian and neo-Mendelian genetics.
CO 4	Explain derivatives from Mendel's model of the inheritance of traits.
CO 5	Learn and apply concepts like epistasis, and Pedigree analysis which will be helpful in competitive examinations
CO 6	Enlist different types of mutations, agents causing mutations and disorders resulting from mutations.
CO 7	Recognize normal and abnormal karyotypes, describing the abnormalities in chromosomal number.
CO 8	Study of Human Pedigree analysis in understanding the inheritance of genes in humans

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title Basics of Genetics RUSMJBCHO202	Credits/ Hours 3 / 45 Hours
I	**1**	**Genes & Chromosomes**	**15**
	1.1	Prokaryotic Genome: Organization of circular chromosome	
	1.2.1	Eukaryotic chromosomes, Unique and repetitive sequences of DNA, Organization of DNA into chromosomes (upto Solenoid structure)	
	1.2.2	DNA supercoiling, Topoismerase, Chromatin structure, Euchromatin, Heterochromatin, structure of condensed chromatin, Nucleosomes [Centromere, kinetochrome, telomere], cohesion protein, Acetylation & deacetylation of histones, Role of Telomerase	
	1.3.1	Comparison of chromosomal structure in prokaryotes and eukaryotes	
	1.3.2	Lampbrush & polytene chromosomes, Cot curves and its significance, C-value paradox	
	1.4.1	Transformation: Definition and transformation in *S.pneumoniae*	
	1.4.2	Transduction: Definition; Explain general features with one example	
	1.4.3	Conjugation: Mechanism, F+, F- and Hfr strain	
II	**2**	**Mendelian & Non-Mendelian Genetics**	**15**
	2.1	Introduction, Concept of alleles, genotype & Phenotype	
	2.2.1	Monohybrid cross- principle of segregation, Confirmation of principle using back cross	
	2.2.2	Dihybrid cross- principle of independent assortment	
	2.3	Deviation from Mendelian genetics	
	2.3.1	Multiple allele- ABO blood group, Drosophila eye colour, Relation of multiple allele with molecular genetics	
	2.3.2	Inheritance pattern of single gene- Wild type allele, Mutant allele, Dominant mutant allele & their effect on phenotype	
	2.4	Numericals based on above concepts	
	2.5	Non –Mendelian inheritance	

	2.5.1	Molecular mechanism of Incomplete dominance, co-dominance & Overdominance	
	2.5.2	Incomplete penetrance	
	2.5.3	Epistasis & Environmental effect on phenotype	
	2.5.4	Sex linked inheritance, Sex influenced inheritance & Sex limited inheritance	
	2.5.5	Allelic effects- Pleiotropy, Polygenic inheritance	
	2.5.6	Maternal gene effect, Maternal inheritance & cytoplasmic inheritance	
III	**3**	**Mutations & Chromosomal Basis of Inheritance**	**15**
	3.1	Mutations	
	3.1.1	Types of mutations	
	3.1.2	Physical, chemical and Biological agents causing mutations	
	3.1.3	Reverse mutations, Mutagenesis, Ames test.	
	3.2	Chromosomal aberration	
	3.2.1	Variations in chromosome structure - inversions, deletions, duplications and translocations	
	3.2.2	Variations in chromosome number - Euploidy and aneuploidy (Autosomal and Sex chromosomes)	
	3.3	Syndromes resulting from chromosomal abnormalities	
	3.3.1	Monosomies (Turner syndrome)	
	3.3.2	Disomies and trisomies (Down Syndrome, Klinefelter's syndrome)	
	3.3.3	Cri-du-chat syndrome, Philadelphia chromosome	
	3.3.4	Chromosomal Microdeletions – Prader-Willi Syndrome & Angelman Syndrome	
	3.4	Human Pedigree Analysis	
	3.4.1	Standard symbols used in pedigree analysis	
	3.4.2	Applications of pedigree analysis – Autosomal recessive and dominant traits, X-linked recessive and dominant traits, Y-linked traits	
	3.4.3	Problems based on this concept	

Practical

Sr. No	**Course code-** RUSMJBCHPO202 **Practical Title-** Practicals based on theory DSC II	1 Credit
1	Visualization of nuclear fraction by acetocarmine stain	
2	Cytochemical staining of RNA by Methyl Green Pyronin	
3	Demonstration of induction of polyploidy in onion roots	
4	Problems on Mendelian genetics –Mono & dihybrid cross, Back cross, Test cross	
5	Isolation and spooling of DNA from onion/ moong	
6	Study of abnormal human karyotype	
7	Study of human pedigrees	

References:

1. Voet, D. and Voet, J.G. (2004) Biochemistry, 3rd Edition, John Wiley & Sons, Inc. USA. Biochemistry by Zubay, Geoffrey L.; Wm. C. Brown publishers
2. Zubay, Geoffrey L., Biochemistry; Wm. C. Brown publishers
3. Peter J. Russel , i-Genetics
4. Benamin Lewin, Gene VII , Oxford University Press
5. M.W. Strickberger, Genetics
6. Biochemical methods by S. Sadashivam & A. Minackam, New Age International publisher.Experiments in Molecular Biology - Biochemical Applications - Zachary F. Burton, Jon M. Kaguni
7. Jane B Reece; Neil A Campbell, Campbell biology 9th edition, Boston : Benjamin Cummings / Pearson, ©2011
8. Fundamentals of Cell and Molecular Genetics by Arvind Kumar Misra
9. Genetics From Genes to Genomes by Leland Hartwell, Michael L. Goldberg, Janice Fischer, Leroy Hood
10. Molecular Biology of the Gene: Watson, Baker, Bell, Gann, Levine, Losick; Pearson Benjamin Cummings & CSHL Press
11. Gene cloning & DNA analysis: an introduction; seventh edition; T A Brown; Wiley Blackwell publications

Modality of Assessment: Discipline Specific Core Course (3 Credit Theory Course for BSc) Semester III

DSC I and II

A) Internal Assessment- 40%- 30 Marks

Sr No	Evaluation type	Marks
1	Class test	20
2	Class test/ Project/ Assignment/ Presentation	10
	TOTAL	**30**

B) External Examination- (Semester End) 60%- 45 Marks

Semester End Theory Examination:

1. Duration - These examinations shall be of **One hour and 30 Minutes** duration.
2. Theory question paper pattern:

Paper Pattern:

Question	Options	Marks	Questions Based on
Q1.	Any 3 out of 5	15	UNIT I
Q2.	Any 3 out of 5	15	UNIT II
Q3.	Any 3 out of 5	15	UNIT III
	TOTAL	**45**	

DSC I and II

Semester End Practical Examination:

Practical Examination Pattern:

	Particulars	Marks
1	Laboratory work	20
2	Viva & Journal	05
	TOTAL	**25**

Semester IV

Course Code: RUSMJBCHE211

Course Title: Membrane Biochemistry

Type of course: Discipline Specific Core Course

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Understand the importance of carbohydrates, lipids and proteins as a structural component of biomembranes.
CO 2	Summarize the composition and structure of biomembranes, transport mechanisms across biological membranes.
CO 3	Illustrate the mechanism of oxidative phosphorylation, photophosphorylation and basic concept of Bioenergetics
CO 4	Learn the concept and mechanism of ATP synthesis
CO 5	Describe factors that contribute to cancer development, discuss cancer prevention and currently available therapeutic treatments.
CO 6	Develop an understanding on various genetic and molecular changes which takes place during transformation into malignant cells.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title Membrane Biochemistry RUSMJBCHE211	Credits/ Hours 3 / 45 Hours
I	**1**	**Biomembranes & Cell Surface**	**15**
	1.1	Overview of membrane functions	
	1.2	Fluid mosaic model	
	1.3	Chemical Composition of Membranes	
	1.3.1	Membrane lipids (Phospholipids, Glycolipids, sterols (Cholesterol), Lipid rafts	
	1.3.2	Membrane proteins - Classification- Peripheral Proteins, Integral Membrane Proteins and Lipid-Anchored proteins Peripheral Proteins- Spectrin on RBC Integral Membrane Proteins- Glycophorin A on RBC Lipid-Anchored proteins- Role of GPI anchored protein in blood grouping	
	1.3.3	Membrane carbohydrate – Role of membrane glycoproteins	
II	**2**	**Membrane Transport and Vesicular Transport**	**15**
	2.1	Introduction to the transport mechanism across cell membrane	
	2.2	Passive transport – Passive diffusion (Polar & Non polar), diffusion and osmosis, facilitated diffusion of ions and molecules	
	2.3	Ion channels- Ligand gated, mechanical gated, Voltage gated	
	2.4.1	Primary Active transport ATPases pump- Na^+-K^+ Pump, ABC transporter	
	2.4.2	Secondary active transports Symport (Mechanism of Absorption of peptides by eneterocytes)	
	2.5	Specialized ion channels- Aquaporins	
	2.6	Antiport -Absorption of peptides by eneterocytes,	
III	**3**	**Bioenergetics & Oxidative Phosphorylation**	**15**
	3.1.1	Principle of Bioenergetics	
	3.1.2	Importance of thermodynamics, concept of Gibb's free energy, enthalpy, entropy, Standard free energy change and equilibrium constant	

	3.2	Oxidative phosphorylation Electron transfer reactions in mitochondrion (Complexes I to IV; Q cycle in Complex III)	
	3.3	Structure of ATP synthase and ATP synthesis Models for ATP synthesis - chemiosmotic model & Rotational Catalysis	
	3.4	Inhibitors & Uncouplers of ETC and ATP synthesis	

Practicals

Sr. No	**Course code-** RUSMJBCHPE211 **Practical Title-** Practicals based on theory DSC I	1 Credit
1	Osmosis across semi-permeable membrane	
2	Effect of hypotonic, isotonic and hypertonic solutions on the cells	
3	Effect of temperature and molecular weight on diffusion	
4	Effect of organic solvent on cell membrane	
5	Staining and visualization of mitochondria by Janus Green Stain	
6	Mitochondrial respiration and effect of different Inhibitors for ETC (Dry lab)	
7	Sums based on Bioenergetics	

References:

1. Jain MK. Introduction to Biological membranes, John Wiley and sons New York, 1988
2. Vance DE & Vance JE, Biochemistry of lipids and Biomembranes, Benzamin Cummings 1985
3. Biomembranes by RB Gennis Springer Verlag 2012 2nd edition
4. Jones MN & Chapman D. Micelles monolayers and biomembranes Wiley-Lis New York, 1995
5. Molecular Biology of Cell: Bruce Alberts, 4th Edition, Garland Science
6. Biochemistry by Voet & Voet, International student version
7. Lehninger's - Principles of Biochemistry by David L. Nelson
8. Introductory Practical Biochemistry by Sawhney
9. Practical Biochemistry by David Plummer
10. Biochemical methods by S Sadashivam & A Minackam, New Age International publisher.
11. Principles of Genetics by D. Peter Snustad, Michael J. Simmons
12. Concepts of Genetics by William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Michael A. Palladino, Darrell Killian

Course Code: RUSMJBCHE212

Course Title: Microbiology & Industrial Biotechnology

Type of course: Discipline Specific Core Course

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Demonstrate practical skills in microscopy and handling techniques related to it and staining procedures
CO 2	Apprehend the basic microbial structure and function and study the structural similarities and differences among various physiological groups of microorganisms
CO 3	Know various Culture media and their applications in order to apply them for the industrial production
CO 4	Acquire information about large scale production and purification of various industrially important produces.
CO 5	Appreciate how microbiology is applied in manufacture of industrial products
CO 6	Appreciate the different types of fermentation processes
CO 7	Master aseptic techniques and be able to perform routine culture handling tasks safely and effectively
CO 8	Know about design of bioreactors, factors affecting growth and production, heat transfer, oxygen transfer and Understand the rationale in medium formulation & design for microbial fermentation
CO 9	Procure information about types and applications of biosensors in the field of biology
CO 10	Appreciate the technological advances in the field of Biosensors and get fascinated with the advances in the research field and try to pursue them.
CO 11	Quantitative estimation of biomolecules like vitamins & antibiotics will help in understanding their efficacy

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title Microbiology & Industrial Biotechnology RUSMJBCHE212	Credits/ Hours 3 / 45 Hours
I	**1**	**Microbiology & Fermentation Technology**	**15**
	1.1	General characteristics (size, shape, and structure) of Bacteria	
	1.2	Microbial Taxonomy: Microbial species and strains. Classification of bacteria based on morphology (shape and flagella). staining reaction, nutrition and extreme environment (extremophiles: Thermophiles, Psychrophiles, Halophiles, Magnetotactic, Radiation resistant organisms: examples with their application)	
	1.3	Bacterial cell wall: Structure and function, components of peptidoglycan framework	
	1.4	Basics of fermentation	
	1.5	Types of fermentation processes based on the products formed (biomass, enzymes, metabolites, recombinant products, transformation process to modify a product)	
	1.6	Stages of a typical fermentation process	
	1.7	Basic design of fermenter	
II	**2**	**Physicochemical Principles of food**	**15**
	2.1	Introduction & Importance	
	2.2	Physical & chemical characteristics of food	
	2.3	Factors affecting physicochemical properties	
	2.4	Enzymatic reactions- softening, Oxidation (Ascorbic acid & Phenolic oxidation) Glycolytic reaction, Hydrolytic reactions, pigmentation (Cholorophylase) browning, Maillard reaction & Caramelization reaction	
	2.5	Chemical reactions- 1. Lipid oxidation, non-enzymatic browning 2. Colour changes - Chlorophylls - Anthocyanins - Carotenoids (lipid soluble compounds) 3. Flavour changes 4. Phenophytinisation -photo- oxidation. – Oxidation – Enzyme-induced oxidative breakdown of unsaturated fatty acids	

	2.6	Physicochemical changes in following food Changes in fruit ripening Comparison between Raw vs Ripe Fruit	
	2.7	Changes in meat- Post Mortem Changes in Meat (Pre-rigor stage, Rigor Mortis, Post Rigor Stage Lipid oxidation	
	2.8	Non enzymatic hydrolysis by Haeme protein Autolytic enzyme spoilage	
III	**3**	**Industrial Biotechnology**	**15**
	3.1	Introduction	
	3.2	Recovery and purification of fermented products	
	3.3	Industrial synthesis of different products obtained from Bioprocess technology	
	3.3.1	Penicillin, Vit B_{12}, Cheese, Amylase, Protease, Ethanol, Acetic Acid	
	3.4	Biosensors, Features of biosensors Types of Biosensors based on: Enzymes (environmental monitoring) Antibodies (detection of pathogens) Nucleic acids & Aptamers (clinical diagnosis)	

Practicals

Sr. No	**Course code-** RUSMJBCHPE212 **Practical Title-** Practicals based on theory DSC II	1 Credit
1	Basics of Microbiology Techniques and plate exposure technique	
2	Study of microbial growth curve	
3	A study of culture inoculation methods – Pour plate, Spread plate & Streak plate	
4	Determination of percentage purity of acetic acid in vinegar solution	
5	Bioassay of penicillin by agar diffusion method	
6	Assessment of factors affecting physico-chemical properties of food	
7	Estimation of anthocyanin content in vegetable	
8	Study of different stages of sugar caramelization	

References:

1. Microbiology - M. Pelczar, E.C.S. Chan and M.R. Krieg - McGraw Hill Inc., Singapore (1997).
2. General Microbiology, Vol. I & II – Powar, Daginawala – Himalaya Publishing House. (2015).
3. General Microbiology – Stanier, Adelberg, Ingraham – The Macmillan Press, London (1987)
4. Textbook of microbiology – Surinder Kumar, Jaypee Medical publication
5. Industrial microbiology - A.H. Patel - Macmillan India Ltd.
6. Total Quality Assurance for the Food Industries – WA Gould & RW Gould. CTI Publications Inc., USA 1988
7. Enzymes in food and beverage processing by Muthusamy Chandrasekaran, CRC Press
8. Enzymes in Food Processing by Tilak Nagodawithana, Gerald Reed and Steve Taylor, Academic Press
9. Industrial microbiology - L. E. Casida - New age international publishers
10. Microbial Biochemistry - G. N. Cohen
11. Industrial Fermentation - Paul Allen
12. Peter F. Stanbury, Allan Whitaker and Stephen J. Hall, Principles of fermentation technology 3rd edition,Elsevier publications
13. Biochemical methods - S Sadashivam and A Manickam - New Age International publishers
14. Laboratory Manual in Biochemistry - J. Jayaraman - New Age International

Modality of Assessment: Discipline Specific Core Course
(3 Credit Theory Course for BSc)
Semester IV

DSC I and II

C) Internal Assessment- 40%- 30 Marks

Sr No	Evaluation type	Marks
1	Class test	20
2	Class test/ Project/ Assignment/ Presentation	10
	TOTAL	**30**

D) External Examination- (Semester End) 60%- 45 Marks

Semester End Theory Examination:

3. Duration - These examinations shall be of **One hour and 30 Minutes** duration.
4. Theory question paper pattern:

Paper Pattern:

Question	Options	Marks	Questions Based on
Q1.	Any 3 out of 5	15	UNIT I
Q2.	Any 3 out of 5	15	UNIT II
Q3.	Any 3 out of 5	15	UNIT III
	TOTAL	**45**	

DSC I and II

Semester End Practical Examination:

Practical Examination Pattern:

	Particulars	Marks
1	Laboratory work	20
2	Viva & Journal	05
	TOTAL	**25**