AC/II(23-24).2.RUS9

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

Syllabus for

Program: S.Y.B.Sc. (Microbiology)

Program Code: RUSMIC

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

(Choice based Credit System)

GRADUATE ATTRIBUTES

S. P. Mandali's Ramnarain 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 Bachelors 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:**
GA1	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.
GA2	Evaluate scientific ideas critically, analyse problems, explore options for practical demonstrations, illustrate work plans and execute them, organise data and draw inferences.
GA3	Explore and evaluate digital information and use it for knowledge upgradation. Apply relevant information so gathered for analysis and communication using appropriate digital tools.
GA4	Ask relevant questions, understand scientific relevance, hypothesize a scientific problem, construct and execute a project plan and analyse results.
GA5	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.
GA6	Apply scientific information with sensitivity to values of different cultural groups. Disseminate scientific knowledge effectively for upliftment of the society.
GA7	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.
GA8	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 Statistics will be able to:**
PO1	Recall, explain and summarize basic concepts related to cytology, biochemistry, physiology, genetics and reproduction of prokaryotes and compare it with eukaryotes.
PO 2	Appreciate and exemplify the diversity in the microbial world and evaluate their ecological role as well as state their significance to humankind.
PO 3	Understand the basic concepts associated with growth and control of microorganisms and apply it in pure culture and preservation techniques.
PO 4	Differentiate, classify and characterize microorganisms based on their morphological, cultural, biochemical, and molecular properties.
PO 5	Explore, compare and evaluate the role of microorganisms in different natural environments as well as plants, animals and humans, and evaluate and exemplify their interrelationships.
PO 6	Apply the understanding of microbial processes to diverse science areas such as medical, industrial, agricultural and food and evaluate their potential for human well-being, for tackling environmental issues and exploring sustainable solutions
PO 7	Recall and explain the nature of biomolecules and metabolic processes; the role and kinetics of enzymes as well as the thermodynamic laws that drive these reactions.
PO 8	Recall the basic working principles of various bioanalytical techniques and tools and apply them to detect, estimate and structurally evaluate biomolecules present in the microbial cells.
PO 9	Understand and explain the nature of genetic material and elaborate the molecular mechanisms underlying various genetic processes like replication, transcription, translation, gene transfer and recombination in bacteria; and explain basic concepts in virology.

PO 10	Apply the basics of genetics and molecular biology to understand and evaluate techniques in genetic engineering and also for the use of bioinformatic tools for presentation and processing of data.
PO 11	Recognize and explain the role of microorganisms in different diseases, attribute pathogenesis mechanisms to their properties and extrapolate it to disease diagnosis, treatment and prevention. Outline and recall concepts in epidemiology of diseases. Classify and evaluate different chemotherapeutic agents.
PO 12	Recall, classify and summarize mechanisms of defense in humans, detail out the functioning of our immune system, correlate it to disease and its prevention and outline its association to health. Apply immunological principles for diagnosis of diseases.
PO 13	Understand and outline different biochemical mechanisms and their regulation; retrieve and construct biochemical pathways in microbial metabolism of major macromolecules and, recall and integrate the bioenergetics of metabolic reactions.
PO 14	Evaluate, exemplify and outline the role of microorganisms in different industrial fermentations, summarize technological aspects of bioprocesses, recall knowledge about patents, copyright and regulatory practices and QA.
PO 15	Demonstrate key practical skills/competencies in working with microbes for their study and use in the laboratory as well as outside, including the use of good microbiological practices. Analyze problems involving microbes, articulate them and devise innovative and creative solutions.
PO 16	Hypothesize, design experiments, construct experimental plans, execute them and analyze data with a basic understanding of statistics. Demonstrate an ability to be unbiased and critical in interpretation of scientific data
PO 17	Communicate effectively to express scientific ideas and/or their experimental data in an effective, precise and concise manner.

Credit Structure for SYBA/BSc/BVoc/BACM

Semester	Subject 1 (Major)		Subject 2 (Minor)	GE/ OE course	Vocational and Skill Enhancement Course (VSC) & SEC	Ability Enhancement Course/ VEC/IKS	OJT/FP/CEPCC, RP	Total Credits
	DSC	DSE						
3	Major 8		Minor 4	2	VSC-2-Major	AEC-2 MIL (Marathi/Hindi)	FP -2, CC-2	22
4	Major 8		Minor 4	2	SEC-2	AEC-2 MIL (Marathi/ Hindi)	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								

Course Code-Department Specific Course: RUSMIC.O201

Course Title: Introduction to Biomolecules

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Recall the characteristics and structures of biomolecules and classify and detect them in various samples
CO 2	Discriminate the structure of DNA and RNA focusing on the different forms of DNA
CO 3	Understand the central dogma of molecular genetics
CO 4	Recall & compare the different cell disintegration methods & elaborate the working principles of centrifugation, electrophoretic & chromatographic techniques used for studying cell analytes
CO 5	Understand the principle, instrumentation & application of different laboratory instruments used in biochemical studies.
CO 6	Design an experiment for extraction, purification & estimation of biomolecules, & evaluate the statistical relevance of the data generated.

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Credits/ Hours
RUSMIC. O201		**INTRODUCTION TO BIOMOLECULES**	**3/45**
	Unit I	**Microbial Biomolecules**	**1/15**
	1.1.	**Chemical foundations**	**06**
		a) Biomolecules as compounds of carbon with a variety of functional groups. b) Universal set of small molecules. c) Macromolecules as the major constituents of cells. d) Configuration and Conformation with definitions and suitable examples only. e) Types of Stereoisomers and importance of stereoisomerism in biology. f) Types of bonds and their importance: Hydrogen, van der Waal's, Electrovalence, covalent, ester, phosphodiester, thioester, peptide, glycosidic.	
	1.2	**Water- Structure, properties in brief**	**01**
	1.3	**Carbohydrates and glycobiology**	**04**
		a) Definition, Classification, Biological role. b) Monosaccharides, (Chair and boat conformation) oligosaccharides (maltose, cellobiose, sucrose, lactose) and polysaccharides (starch, glycogen, peptidoglycan, cellulose), glycoproteins (glycosaminoglycans and proteoglycans), glycome.	
	1.4	**Lipids**	**04**
		a) Fatty acids as a basic component of lipids b) Classification, nomenclature, storage lipids and structural lipids. c) Types of lipids with the general structure of each and mention examples.	
	Unit II	**Protein and nucleic acids**	**1/15**
	2.1	**Amino acids & proteins**	**5**
		a) General structure and features of amino acids (emphasis on amphoteric nature)	

		b) Classification by R-group, Uncommon amino acids and their functions Peptides and proteins- Definition and general features and examples with biological role. c) Primary, secondary, tertiary, and quaternary structures of proteins- Brief outline.	
	2.2	**Nucleic acids**	**4**
		a) Nitrogenous bases- Purines, Pyrimidines b) Pentoses-Ribose, Deoxyribose c) Nomenclature of Nucleosides and nucleotides d) N-β-glycosidic bond e) polynucleotide chain to show bonding between nucleotides (Phosphodiester bonds).	
	2.3	**Structure of DNA**	**3**
		Different 3D forms and unusual structures DNA methylation	
	2.4	**Structure of chromosomes**	**1**
	2.5	**Structure of RNA**	**2**
	Unit III	**Techniques for separation and detection of biomolecules**	**1/15**
	3.1	**Disintegration of cells**	**2**
		a) Physical methods b) Chemical methods c) pH measurement and Importance of buffers	
	3.2	**Separation Techniques**	
		a) Centrifugation techniques: i. Basic principles of sedimentation ii. Types of centrifuges and their use: preparative & analytical, ultracentrifuges iii. Differential, Density Gradient & isopycnic centrifugation	**2**
		b) Electrophoretic techniques: i. General Principles ii. Factors affecting electrophoresis iii. Support media- Agarose gels and PAGE	**3**

		c) Chromatographic Techniques: i. General principles ii. Types and applications- Partition, adsorption, ion exchange, affinity and size exclusion iii. Modes- Paper, TLC, HPLC, GC, Reverse Phase	**6**
		d) UV Vis Spectrophotometer Principle of working, Sources of light, types of monochromators, Use of colorimeter for qualitative and quantitative analysis of biomolecules	**2**

Practical: RUSMICP.O201

Course code	Practical	1 Credit
RUSMICP.O201	1. Disintegration of cells using physical & chemical methods and separation of biomolecules 2. Determination of λ_{max} 3. Verification of Beer's law and determination of extinction coefficient 4. Estimation of Reducing Sugars by DNSA method 5. Estimation of Proteins by Biuret method 6. Bradford's Method for Protein Estimation 7. Estimation of RNA by Orcinol method 8. Extraction of DNA from onion and *E. coli* 9. Study of pH meter and preparation of buffers 10. Density gradient centrifugation 11. Demonstration of agarose gel electrophoresis (AGE) 12. Demonstration of Polyacrylamide gel electrophoresis (PAGE) 13. Separation of amino acids using paper chromatography 14. Separation of carbohydrates using TLC 15. Demonstration of column chromatography 16. Visit to HPLC, HPTLC and GC facility	

References:

1. D. Nelson and M. Cox, Lehninger's Principles of Biochemistry, 4th Edition, 2005, W.H. Freeman and Company
2. Principles and Techniques of Biochemistry and Molecular Biology by Keith Wilson and John Walker, 7th edition, 2010, Cambridge University Press.
3. Laurence A. Moran, H. Robert Horton, K. Gray Scrimgeour, Marc D. Perry, Principles of Biochemistry, 5th Edition, 2012, Pearson
4. James Watson, Molecular Biology of Gene, 5th edition,2004, Pearson Benjamin Cummings CSHL Press.
5. Norris & Ribbon, Methods in Microbiology, Vol.5B, Edition,1971, Academic Press
6. J. Jayaraman, Laboratory Manual in Biochemistry, 2003, New Age International Publishers

7. Plummer David, An Introduction to Practical Biochemistry ,1979, TMH

Course Code-Department Specific Course: RUSMICO202/ RUSMIMICO202

Course Title: Microbial Taxonomy and Microbial Ecology

Academic year: 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Differentiate between vast pool of microbes on the basis of morphological, cultural, biochemical and genetic characteristics
CO 2	Understand, apply and evaluate techniques in microbial taxonomy
CO 3	Construct phylogenetic trees using simple computational tools
CO 4	Recall & explain the role of microorganisms in maintaining balance of the ecosystem
CO 5	Exemplify microbial interactions with plants, animals and other microorganisms
CO 6	Evaluate the ecological, medical and evolutionary significance of microbial interactions with plants, animals and other microorganisms
CO 7	Recall & explain the role of microorganisms in biogeochemical cycles
CO 8	Apply basic principles of environmental microbiology for understanding and solving environmental problems through biodegradation and bioremediation

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Credits/ Hours
RUSMIC. O202		MICROBIAL TAXONOMY AND MICROBIAL ECOLOGY	3/45
	Unit I	Microbial Taxonomy	1/15
	1.1	Introduction to Microbial Taxonomy and Taxonomic Ranks	01
	1.2	Techniques for studying Microbial Taxonomy	08
		a) Conventional methods: Microscopic & macroscopic morphology and biochemical characterisation b) Chemical analysis c) Serological analysis d) Genetic and Molecular analysis: i) Nucleic acid sequencing and fingerprinting ii) Determination of G+C content iii) Nucleic acid hybridization iv) Amino acid sequencing e) Community DNA analysis, Introduction to Metagenomics	
	1.3	Introduction to Microbial Phylogeny	04
		a) Phylogenetic tree i) Types ii) Construction (an overview) b) Numerical taxonomy	
	1.4	Bergey's Manual of Systematic Bacteriology	02

		Introduction, Use of manual for classification and identification of Bacteria, Significance.	
	Unit II	**Microbes in Natural Environments, Microbial Interactions**	**1/15**
	2.1	**Microbes in natural environments**	**03**
		a) Microenvironments b) Introduction to microbial biofilms c) Mixed populations and microbial consortia d) Introduction to Quorum Sensing e) Introduction to various microbial interactions	
	2.2	**Microbial Interactions with Plants**	**07**
		a) Phyllosphere b) Rhizosphere & Rhizoplane c) Mycorrhizae d) Nitrogen fixation: i) Biochemistry of nitrogen fixation, ii) Nodulation in Rhizobia, iii) Azolla-*Anabaena* symbiosis, iv) Actinorrhizae, v) Stem nodulating Rhizobacteria e) Fungal & Bacterial endophytes f) Plant pathogens -Fungal, bacterial and viral diseases	
	2.3	**Microbial Interactions with Animals**	**03**
		a) Microbial symbionts in invertebrates b) Bacterial flora in the Rumen c) Microbe- insect interactions d) Introduction to Zoonotic diseases	
	2.4	**Microbe-Microbe Interactions**	**02**
		a) Lichens b) Endosymbionts of Protozoa c) Parasitism in microbes	

	Unit III	**Biogeochemical cycles, Biodegradation and Bioremediation**	**1/15**
	3.1	**Nutrient Cycles:**	**08**
		Biogeochemical cycles of Carbon, Nitrogen, Sulphur, Phosphorus, Iron	
	3.2	**Microbial Degradation and Bioremediation**	**07**
		a) Ligno-cellulosic waste degradation b) Petroleum degradation c) Xenobiotic degradation d) Microbial leaching e) Metal transformations	

Practical: RUSMICPO202/ RUSMIMICPO202

Course code	Practical	1 Credit
RUSMICP. O202	**Practical based on RUSMIC.O202**	
	1. Isolation and identification of a bacterial isolate 2. Construction of a phylogenetic tree. 3. Dip slide technique to demonstrate microbial biofilms 4. Crowded plate technique for demonstration of antibiosis. 5. Demonstration of bacteroid forms of Rhizobia and isolation of Rhizobium species. 6. Demonstration of fungi and algae in lichens. 7. Screening for Auxin production (PGPR from Rhizosphere). 8. Setting up Winogradsky's Column, Isolation of Cellulose degraders and Sulphate reducers. 9. Isolation of Phosphate solubilizers from soil. 10. Enrichment of Phenol degraders	

References:

a) Willey, Sherwood and Woolverton, Prescott's Microbiology, 9th edition (2013), International edition, McGraw Hill.

b) Michael T. Madigan & J.M. Martin, Brock's Biology of Microorganisms 13th edition, International edition (2012), Pearson Prentice Hall.

c) Michael J. Pelczar Jr., E.C.S. Chan, Noel R. Krieg, Microbiology 5th edition (1986), Tata McGraw Hill Publishing Company

d) Stanier, Ingraham et al, General Microbiology, 5th edition (1987), Macmillan Education Ltd.

e) A.J. Salle, Fundamental Principles of Bacteriology, 7th Edition (1974), Tata McGraw Hill Publishing Company

f) Raina M. Maier, Ian L. Pepper, Charles P. Gerba, Environmental Microbiology, 2nd

Edition (2010), Academic Press

Modality of Assessment: Department Specific Course (3 Credit Theory Course for BSc)

A) Internal Assessment- 40%- 30 Marks

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

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

Semester End Theory Examination:

1. Duration – The duration for these examinations shall be of **One hour thirty Minutes**.
2. Theory question paper pattern:

Paper Pattern:

Question		Options	Marks	Questions Based on
1	A	Any two out of three questions	10	Unit 1
	B	Any 1 set out of 2 (i & ii or i & ii)	03 & 02	
2	A	Any two out of three questions	10	Unit 2
	B	Any 1 set out of 2 (i & ii or i & ii)	03 & 02	
3	A	Any two out of three questions	10	Unit 3
	B	Any 1 set out of 2 (i & ii or i & ii)	03 & 02	
		TOTAL	**45**	

Practicals- 1 Credit: Total Marks 25

Experimental tasks	20 Marks
Spots/Quiz/Viva	05 Marks

Course Code-Department Specific Course: RUSMIC.E201

Course Title: INTRODUCTION TO METABOLIC PATHWAYS AND ENZYMOLOGY

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Understand the concepts and types of metabolism. Compare the metabolic strategies & recall the role of Omics in biochemical studies
CO 2	Explain the regulatory junctions of metabolic pathways.
CO 3	Recall the properties & classes of enzymes. Illustrate enzyme-substrate interaction models & recognize the significance of cofactors & coenzymes
CO 4	Evaluate enzyme kinetics & the change in activity in the presence of variables.
CO 5	Explain the principles of Bioenergetics & attribute the role of energy currency molecule
CO 6	Understand & apply the laws of thermodynamics to microbial metabolism.
CO 7	Implement experimental procedures for enzyme purification and enzyme kinetics studies

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Credits/ Hours
RUSMIC. E201		**INTRODUCTION TO METABOLIC PATHWAYS AND ENZYMOLOGY**	3/45
	Unit I	**Introduction to Metabolism**	1/15
	1.1	**Introduction to biochemical reactions:**	4
		a) Key reactions involved in metabolism.	
	1.2	**Introduction to Metabolism:**	6
		a) Metabolism- Catabolism & Anabolism b) Types of Metabolic pathways c) Metabolic networks, use of different software d) Primary and secondary metabolism e) Energy and reducing power requirements	
	1.3	**Metabolic strategies: Managing metabolic network**	4
		a) Role of enzymes, enzyme clustering & multienzyme complexes b) Functional coupling c) Compartmentalization in cells	
	1.4	**Introduction to omics: Metabolome & Metabolomics**	1
	Unit II	**Enzymology**	1/15
	2.1	**Introduction to enzymes:**	7
		a) General properties of enzymes b) How do enzymes accelerate reactions? c) Classification of enzymes d) Enzyme kinetics: Rate law for a simple catalyzed reaction, Michaelis-Menten equation and its derivation, other plots to determine velocity of reactions.	

	2.2	**Modifying enzyme catalysis rates**	**5**
		a) Effect of temperature and pH b) Effect of Inhibitors- Reversible and irreversible, competitive, Non-competitive and uncompetitive inhibitors c) Allosteric effects in enzyme catalyzed reactions d) Multi-substrate reactions- Ordered, Random and ping-pong reactions e) Koshland- Nemethy and Filmer model f) Monod, Wyman and Chageux model	
	2.3	**Coenzymes& Co-factors:**	**3**
		a) Different types and reactions catalyzed by coenzymes (in tabular form) b) Water soluble coenzymes (NAD, Nicotinic acid) c) Fat soluble vitamins and their examples. d) Inorganic cofactors	
III	**Unit III**	**Principles of Bioenergetics**	**1/15**
	3.1	**Bioenergetics & thermodynamics:**	**6**
		a) Energy transformations b) Thermodynamic quantities, standard –free energy c) Difference between ΔG & ΔG‟	
	3.2	**ATP and its role**	**5**
		a) Structure of ATP, phosphoryl group transfer and ATP b) Types of energy –rich compounds c) Multi-roles of ATP inorganic phosphoryl group donor	
	3.3	**Biological oxidation-reduction reactions**	**4**

Practical: RUSMICP.E201

Course code	Practical	1 Credit
RUSMICP.E201	1. Using KEGG, Ecocyc, metacyc, biocyc and Brenda for understanding metabolic networking 2. Qualitative detection of a. Amylase b. Lipase c. Protease d. DNase 3. Production and purification of an enzyme 4. Assay of an enzyme and determination of enzyme units 5. Determination of km and Vmax of an enzyme 6. Effect of environment on enzyme activity: a. Effect of temperature b. Effect of pH 7. Effect of inhibitors	

References:

a) Principles of Biochemistry by Geoffery Zubay (1988) 4th Edition Wm.C. Brown Publishers.

b) Outlines Of Biochemistry,5/E, Conn P.Stumpf, G.Bruening & R.Doi,John Wiley & Sons, New York 1995

c) Fundamentals of Enzymology: Cell and Molecular Biology of Catalytic Proteins 3rd Edition Nicholas Price and Lewis Stevens

d) Lehninger: Principles Of Biochemistry,4th Ed., D. Nelson & M. Cox, W.H.Freeman & Co., (LPE)

e) A biologist's Physical Chemistry by John Gareth Morris.

f) Concepts of Biochemistry, Rodney Boyer

g) Stanier, General microbiology 5th edition ,1987, Macmillan publication

h) Principles of Biochemistry by Robert Horton (2011) 5 th Edition Pearson Publishers.

Course Code-Department Specific Course: RUSMICE202/ RUSMIMICE212

Course Title: APPLIED MICROBIOLOGY

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Understand and explain the significance of microbes in fermentation industry and compare the techniques used for their screening
CO 2	Compare different types of fermentations and fermentation processes used for industrial productions
CO 3	Exemplify components used in industrial fermentation media with an understanding of its role in the process
CO 4	Summarize the general principles of food spoilage by microorganisms and compare methods used for food preservation
CO 5	Execute experimental procedures for detection of microbes in food and dairy products and comment on its quality
CO 6	Recall the sources of microorganisms in milk and explain the significance of pasteurization techniques
CO 7	Outline and analyze the manufacturing processes of different fermented dairy products
CO 8	Apply knowledge of contamination, preservation, and quality control in food and dairy product manufacturing industries

DETAILED SYLLABUS

Course Code	Unit	Course/ Unit Title	Credits/ Hours
RUSMIC. E202		**Applied Microbiology**	
	Unit I	**Introduction to Industrial Microbiology**	**1/15**
	1.1	**Strains of industrially important microorganisms**	**04**
		a) Desirable characteristics of an industrial strain b) Principles and methods of primary and secondary screening	
	1.2	**Types of fermentations:**	**02**
		a) Aerobic b) Anaerobic c) Solid state fermentation	
	1.3	**Types of fermentation processes:**	**02**
		a) Surface and Submerged b) Batch, continuous, fed-batch fermentation process	
	1.4	**Media for industrial fermentations**	**05**
		Media components: - Carbon source, nitrogen source, amino acids and vitamins, minerals, water, buffers, antifoam agents, precursors, inhibitors and inducers	
	1.5	**Inoculum development**	**02**
	UNIT II	**Food Microbiology**	**15**
	2.1	**Introduction**:	**01**
		Sources of microorganisms in food	
	2.2	**Methods of detection of microorganisms in food:**	**03**
		Overview of cultural, microscopic, physical, chemical and bioassay methods	
	2.3	**Intrinsic and extrinsic factors affecting the microbial growth in food**	**02**

	2.4	**General Principles of spoilage**	**04**
		Spoilage of fresh foods: fruits and vegetables, eggs, meat, poultry and seafood	
	2.5	**General principles of food preservation**	**04**
		(Principle of each method and example of foods only) High temperature, low temperature, drying, radiations and food additives and preservatives (tabular representation), Asepsis, introduction to HACCP, Regulation	
	2.6	**Food borne diseases**	**01**
	UNIT III	**Dairy Microbiology**	**15**
	3.1	**Milk**- Definition, composition, sources of contamination of milk	**02**
	3.2	**Pasteurization of milkLTHT, HTST, UHT**	**02**
	3.3	**Milk products: production and spoilage of:**	**07**
		a) Yoghurt b) Butter c) Cheese-Cheddar and Cottage cheese d) Fermented milks	
	3.4	**Quality control of milk**	**04**
		a) Rapid platform tests b) Microbiological analysis of milk : SPC, Coliform count, LPC, Psychrophiles, Thermophilic count, DRT	

Practical: RUSMICPE202/ RUSMIMICE212

Course code	Practical	1 Credit
RUSMIC P.O201	1. Isolation of antibiotic producers from soil- Wilkin's overlay method. 2. Determination of microbial counts in food using dip slide technique (demonstration) 3. Isolation of food spoilage agent 4. Determination of TDT and TDP 5. Determination of Salt and sugar tolerance 6. Determination of MIC of a preservative 7. Visit to Food/Dairy industry 8. Rapid platform tests of raw and pasteurized milk. 9. Microbiological analysis of raw and pasteurized Milk.	

References:

a) Fundamental Food Microbiology by Bibek Ray, Arun Bhunia (2007), 4th edition CRC Press

b) Food Microbiology by Frazier 5th ed (1971), McGraw-Hill Education.

c) Modern Food Microbiology by James Jay 6th ed(2000), Springer US.

d) Applied Dairy Microbiology by Marth & Steele (2001), CRC Press BIS standards, FSSAI

f) Casida L. E., "Industrial Microbiology" 2009 Reprint, New Age International (P) Ltd,Publishers, New Delhi

g) Stanbury P. F., Whitaker A. & Hall--S. J., 1997, "Principles of Fermentation,Technology", 2nd Edition,Aditya Books Pvt. Ltd, New Delhi.

h) Prescott and Dunn's „"Industrial Microbiology"".1982 4th Edition, McMillan Publishers

i) H. A. Modi, 2009. „"Fermentation Technology"" Vol 2, Pointer Publications, India.

j) Milk and milk products. C. H. Eckles 1943 edition

k) Sukumar De, Outlines of dairy technology, 1st edition, 1983, O.U.P

l) James Jay Frazier 5th Ed Okafor, Waites & Morgan

Modality of Assessment: Department Specific Course (3 Credit Theory Course for BSc)

A) Internal Assessment- 40%- 30 Marks

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

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

Semester End Theory Examination:

3. Duration – The duration for these examinations shall be of **One hour thirty Minutes**.
4. Theory question paper pattern:

Paper Pattern:

Question		Options	Marks	Questions Based on
1	A	Any two out of three questions	10	Unit 1
	B	Any 1 set out of 2 (i & ii or i & ii)	03 & 02	
2	A	Any two out of three questions	10	Unit 2
	B	Any 1 set out of 2 (i & ii or i & ii)	03 & 02	
3	A	Any two out of three questions	10	Unit 3
	B	Any 1 set out of 2 (i & ii or i & ii)	03 & 02	
		TOTAL	**45**	

Practicals- 1 Credit: Total Marks 25

Experimental tasks	20 Marks
Spots/Quiz/Viva	05 Marks
