



UNIVERSITY OF JAMMU

(NAAC ACCREDITED 'A' GRADE' UNIVERSITY)
Baba Sahib Ambedkar Road, Jammu-180006 (J&K)

Academic Section

Email: academicsectionju14@gmail.com

NOTIFICATION

(22/Sept./Adp/25)

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the Academic Council, is pleased to authorize the adoption of the Syllabi and Courses of Study in the subject of **Bio-Chemistry** of Semesters **Ist and IInd** for **Four Year Under Graduate Programme** under the **Choice Based Credit System** as per **NEP-2020** (as given in the annexure) for the examinations to be held in the years as per the details given below:

Subject	Semester	for the examination to be held in the years
Bio-Chemistry	Semester-I	December 2022, 2023 and 2024
	Semester-II	May 2023, 2024 and 2025

The Syllabi of the courses is available on the University website: www.jammuuniversity.ac.in

Sd/-
DEAN ACADEMIC AFFAIRS

No. F. Acd/II/22/5728-5749

Dated: 19-9-2022

Copy for information and necessary action to:

1. Special Secretary to the Vice-Chancellor, University of Jammu for information of Hon'ble Vice-Chancellor
2. Dean, Faculty of Science
3. HOD/Convener, Board of Studies in Bio-Chemistry/Biotechnology
4. Sr. P.A. to the Controller of Examinations
5. All members of the Board of Studies
6. Confidential Assistant to the Controller of Examinations
7. I/C Director, Computer Centre, University of Jammu
8. Deputy Registrar/Asst. Registrar (Conf. /Exams. UG/ Exam Eval Non-Prof/CDC)
9. Incharge, University Website for Uploading of the notification.

Sunita Sharma
Deputy Registrar (Academic)

15/9/22

UNIVERSITY OF JAMMU

**SYLLABI AND COURSE OF STUDY IN
BIOCHEMISTRY**

**For the Examination to be held in Year 2022,
2023, 2024 & 2025**

BIOCHEMISTRY COURSE

UG SEMESTER I & II

UNDER

NEP-2020

UNIVERSITY OF JAMMU
SYLLABI AND COURSES OF STUDY IN BIO-CHEMISTRY
For the examination to be held in December 2022, 2023, 2024
UG SEMESTER-I
UNDER NEP-2020

S. No	Course Type	Course No.	Course Title	Credits (T+P)	Marks				Total Marks
					Theory		Practical		
1	Major	UMJBCHT-101	Fundamentals of Biochemistry-I	4 (3T + 1P)	Mid Semester: 15 Marks	End Semester Exam: 60 Marks	Daily Assessment: 10 Marks	Final Exam: 15 Marks	100
2	Minor	UMIBCHT-102	Basics of Biochemistry-I	4 (3T + 1P)	Mid Semester: 15 Marks	End Semester Exam: 60 Marks	Daily Assessment: 10 Marks	Final Exam: 15 Marks	100
3	Multi-disciplinary	UMDBCHT-103	Nutrition & dietetics	3+0	Mid Semester: 15 Marks	End Semester Exam: 60 Marks	NA	NA	75
4	Skill Enhancement	USEBCHT-104	Instrumentation & Biochemical Techniques	2 (40 marks Theory +10 marks Practical)	Mid Semester: 10 Marks	End Semester Exam: 30 Marks		10 Marks	50

University of Jammu
Syllabi of Bio-Chemistry for FYUP under CBCS as per NEP-2020
Semester – I
(Examination to be held in December 2022, 2023, 2024)
MAJOR COURSE

Course Code: UMJBCHT-101
Course Title: Fundamentals of Biochemistry-I
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

The course provides an introduction to cell biology, role of water in biological systems, Biomolecules and Metabolic concepts. After successful completion of course, the students will be able to understand:

1. Cell theory, Basic cell structure, functions of various cell organelles in eukaryotic cell, Plasma membrane structure and function.
2. Role of water in biochemical reactions occurring within living systems, pH maintenance in living organisms and physiological buffers.
3. Biological significance of carbohydrates, amino acids, proteins, lipids and nucleic acids present in the cell.
4. Concept of anabolism, catabolism, amphibolism, energy relationship between synthetic and degradative pathways, characteristics of metabolic pathways.

THEORY

Unit 1: Introduction to Cell Biology

Cell: Atoms to molecules to cell, Major organic compounds of cell, Cell theory, Types of Cell; Prokaryotic and Eukaryotic cell, General organisation of Prokaryotic cell, Eukaryotic Cell structure, An overview of Eukaryotic cellular organelles; Nucleus, Mitochondria, endoplasmic reticulum, Golgi apparatus, lysosomes, ribosomes, cytosol, Fluid-Mosaic model of Plasma membrane, composition of Plasma membrane, Transport function; active and passive transport, uniport, Symport and Antiport.

Unit 2: Water, pH and Buffers

Water is essential for life, Structure and shape of water molecule, polar nature, Physical properties, Hydrogen bonding, water form hydrogen bonds with polar solutes, water interacts electrostatically with charged solutes, Entropy increases as crystalline substance dissolve, behaviour of Non-Polar gases and compounds with water, hydrophobicity and hydrophilicity; Dissociation constant of water.

Acid- Base; Bronsted- Lowry concept of acids and bases, The pH scale, pH of some aqueous fluids, weak acids and bases their dissociation constant, Buffers; buffer solution, Henderson-Hasselbalch equation and its significance, Physiological buffers; Phosphate buffer system, Bicarbonate buffer system; Maintenance of blood pH.

University of Jammu
Syllabi of Bio-Chemistry for FYUP under CBCS as per NEP-2020
Semester – I
(Examination to be held in December 2022, 2023, 2024)
MAJOR COURSE

Course Code: UMJBCHT-101
Course Title: Fundamentals of Biochemistry-I
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

Unit 3: Introduction to Biomolecules

Definition, functions and classification of carbohydrates, Oligosaccharides; components and functions of important oligosaccharides; Polysaccharides; components and functions of important polysaccharides, Amino acids: Classifications Proteins: Classification and functions, Physical properties: salting in and salting out, peptide bond, Organization of protein structure into primary, secondary, tertiary and quaternary structures, Lipids: Introduction, classification, properties of Fatty acids, Saturated and unsaturated fatty acids, Essential fatty acids, Triacylglycerol, simple and mixed Triacylglycerol, Nucleic Acids: Introduction, purine and pyrimidine bases, General composition of nucleic acids, nucleosides, nucleotides, DNA, Chargaff's rules of DNA composition, various form of DNA, RNA and its types.

Unit 4: Metabolic Concepts

Definition of metabolism, terminology of metabolism; catabolism, anabolism and amphibolism, classification of general metabolic terms, functions of metabolism, classical subdivisions of metabolism, Metabolic pathways-Schematic representation of linear, irreversible, branched metabolic pathways, catabolic pathway, anabolic pathway, Energy relationship between catabolic and anabolic pathways, catabolism versus anabolism, Unifying themes of metabolic pathways; common activated carriers, key reactions, mode of regulation.

Practicals

1. Safety measures in laboratory.
2. Acquaintance to lab Instruments/equipments, glasswares and plasticwares.
3. Basic expressions denoting the strength of a solution; standard solution, molar solution, molal solution, normal solution, percent solution, ppm solution.
4. Calculation and preparation of standard solutions; molar solution, normal solution and percent solution.
5. Different methods for determination of pH.
6. Principle and working of compound microscope.
7. Micrographs of prokaryotic and Eukaryotic cell.
8. Qualitative tests for carbohydrates.
9. Qualitative tests for aminoacids, proteins.
10. Qualitative tests for lipids.

University of Jammu
Syllabi of Bio-Chemistry for FYUP under CBCS as per NEP-2020
Semester – I
(Examination to be held in December 2022, 2023, 2024)
MAJOR COURSE

Course Code: UMJBCHT-101
Course Title: Fundamentals of Biochemistry-I
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

A) Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours

B) External End Semester Examination: (60 Marks) Time Allotted 3 Hours

- a) External End Semester Theory Examination will have two sections (A & B).
- b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
- c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks.

Suggested Books:

1. Cell and Molecular Biology Concepts and Experiments, G. Karp, John Wiley & Sons, Inc. 8th Edition (2015).
2. Lehninger's Principles of Biochemistry, Nelson and Cox, W. H. Freeman and company, New York. 8th Edition (2021).
3. Fundamentals of Biochemistry, Jain and Jain, S. Chand. 7th edition (2016).
4. Biochemistry, Satyanarayana and Chakrapani, Arunabha Sen Books and Allied (P) Ltd. 5th Edition (2020).
5. An Introduction to Practical Biochemistry, David, T. Plummer, Mc Graw Hill Education (India) Pvt. Ltd. 3rd Edition (2017).
6. Standard Methods of Biochemical Analysis, S. R. Thimmaiah, Kalyani Publisher. 2nd Edition (2016).
7. Laboratory Manual of Microbiology and Biotechnology, K. R. Aneja, Medtech, 2nd Edition (2018).

University of Jammu
Syllabi of Bio-Chemistry for FYUP under CBCS as per NEP-2020
Semester – I
(Examination to be held in December 2022, 2023, 2024)
MINOR COURSE

Course Code: UMIBCHT-102
Course Title: Basics of Biochemistry-I
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

The course provides an introduction to cell biology, role of water in biological systems, biomolecules and metabolic concepts. After successful completion of course, the students will be able to understand:

1. Cell theory, Basic cell structure, functions of various cell organelles in eukaryotic cell, Plasma membrane structure and function.
2. Role of water in biochemical reactions occurring within living systems, pH maintenance in living organisms and physiological buffers.
3. Biological significance of carbohydrates, amino acids, proteins, lipids and nucleic acids present in the cell.
4. Concept of anabolism, catabolism, amphibolism, energy relationship between synthetic and degradative pathways, characteristics of metabolic pathways.

THEORY

Unit 1: Introduction to Cell Biology

Cell: Atoms to molecules to cell, Major organic compounds of cell, Cell theory, Types of Cell; Prokaryotic and Eukaryotic cell, General organisation of Prokaryotic cell, Eukaryotic Cell structure, An overview of Eukaryotic cellular organelles; Nucleus, Mitochondria, endoplasmic reticulum, Golgi apparatus, lysosomes, ribosomes, cytosol, Fluid-Mosaic model of Plasma membrane, composition of Plasma membrane, Transport function; active and passive transport, uniport, Symport and Antiport.

Unit 2: Water, pH and Buffers

Water is essential for life, Structure and shape of water molecule, polar nature, Physical properties, Hydrogen bonding, water form hydrogen bonds with polar solutes, water interacts electrostatically with charged solutes, Entropy increases as crystalline substance dissolve, behaviour of Non-Polar gases and compounds with water, hydrophobicity and hydrophilicity; Dissociation constant of water.

Acid- Base; Bronsted- Lowry concept of acids and bases, The pH scale, pH of some aqueous fluids, weak acids and bases their dissociation constant, Buffers; buffer solution, Henderson-Hasselbalch equation and its significance, Physiological buffers; Phosphate buffer system, Bicarbonate buffer system; Maintenance of blood pH.

University of Jammu
Syllabi of Bio-Chemistry for FYUP under CBCS as per NEP-2020
Semester – I
(Examination to be held in December 2022, 2023, 2024)
MINOR COURSE

Course Code: UMIBCHT-102
Course Title: Basics of Biochemistry-I
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

Unit 3: Introduction to Biomolecules

Definition, functions and classification of carbohydrates, Oligosaccharides; components and functions of important oligosaccharides; Polysaccharides; components and functions of important polysaccharides, Amino acids: Classifications Proteins: Classification and functions, Physical properties: salting in and salting out, peptide bond, Organization of protein structure into primary, secondary, tertiary and quaternary structures, Lipids: Introduction, classification, properties of Fatty acids, Saturated and unsaturated fatty acids, Essential fatty acids, Triacylglycerol, simple and mixed Triacylglycerol, Nucleic Acids: Introduction, purine and pyrimidine bases ,General composition of nucleic acids, nucleosides, nucleotides, DNA, Chargaff's rules of DNA composition, various form of DNA, RNA and its types.

Unit 4: Metabolic Concepts

Definition of metabolism, terminology of metabolism; catabolism, anabolism and amphibolism, classification of general metabolic terms, functions of metabolism, classical subdivisions of metabolism, Metabolic pathways; Schematic representation of linear, irreversible, branched metabolic pathways, catabolic pathway, anabolic pathway, Energy relationship between catabolic and anabolic pathways, catabolism versus anabolism, Unifying themes of metabolic pathways; common activated carriers, key reactions, mode of regulation.

Practicals

1. Safety measures in laboratory.
2. Acquaintance to lab Instruments/equipments, glasswares and plasticwares.
3. Basic expressions denoting the strength of a solution; standard solution, molar solution, molal solution, normal solution, percent solution, ppm solution.
4. Calculation and preparation of standard solutions; molar solution, normal solution and percent solution.
5. Different methods for determination of pH.
6. Principle and working of compound microscope.
7. Micrographs of prokaryotic and Eukaryotic cell.
8. Qualitative tests for carbohydrates.
9. Qualitative tests for aminoacids, proteins.
10. Qualitative tests for lipids.

University of Jammu
Syllabi of Bio-Chemistry for FYUP under CBCS as per NEP-2020
Semester – I
(Examination to be held in December 2022, 2023, 2024)
MINOR COURSE

Course Code: UMIBCHT-102
Course Title: Basics of Biochemistry-I
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Internal Theory Assessment	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

A) Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours

B) External End Semester Examination: (60 Marks) Time Allotted 3 Hours

- a) External End Semester Theory Examination will have two sections (A & B).
- b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
- c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks.

Suggested Books:

1. Cell and Molecular Biology Concepts and Experiments, G. Karp, John Wiley & Sons, Inc. 8th Edition (2015).
2. Lehninger's Principles of Biochemistry, Nelson and Cox, W. H. Freeman and company, New York. 8th Edition (2021).
3. Fundamentals of Biochemistry, Jain and Jain, S. Chand. 7th edition (2016).
4. Biochemistry, Satyanarayana and Chakrapani, Arunabha Sen Books and Allied (P) Ltd. 5th Edition (2020).
5. An Introduction to Practical Biochemistry, David, T. Plummer, Mc Graw Hill Education (India) Pvt. Ltd. 3rd Edition (2017).
6. Standard Methods of Biochemical Analysis, S. R. Thimmaiah, Kalyani Publisher. 2nd Edition (2016).
7. Laboratory Manual of Microbiology and Biotechnology, K. R. Aneja, Medtech, 2nd Edition (2018).

University of Jammu
Syllabi of Bio-Chemistry for FYUP under CBCS as per NEP-2020
Semester – I
(Examination to be held in December 2022, 2023, 2024)
MULTIDISCIPLINARY COURSE

Course Code: UMDBCHT-103

Course Title: Nutrition and Dietetics

Credits: 3

Total No. of Lectures: Theory: 45 hours

Maximum Marks: 75

Theory: 75

Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

The course provides knowledge of nutrition and diet. After successful completion of course, the students will be able to understand:

1. Functions of food, food pyramid, concept of nutrition, RQ of food stuff, Basal Metabolic Rate, composition of balance diet, RDA for different age groups.
2. Nutritional significance of carbohydrates, amino acids, proteins, lipids in diet.
3. Nutritional significance of Macro elements and trace elements and their nutritional deficiencies.
4. Principles of diet therapy, diet therapy for various life style disease and Protein energy malnutrition.

THEORY

Unit 1 Introduction to Nutrition

Food- functions of food, food groups, food pyramid, Nutrition; Ideal, under and over nutrition, Nutrition and Energy supply; Energy content of foods, Respiratory Quotient of foodstuffs, Utilization of energy in man; Basal Metabolic Rate (BMR), factors affecting BMR, significances of BMR, Energy requirements for different physical activities, Composition of Balanced Diet, Recommended Dietary allowances RDA for Infants, Children, Adolescent, Adult male, female, Pregnant, Lactating women and old age.

Unit 2: Elements of Nutrition-I

Dietary Carbohydrates; Composition, Physiological Functions, food sources, digestion, lactose intolerance, dietary requirements, Dietary fibre; types, Benefits and adverse affects.

Dietary lipids; Classification, sources, functions, essential fatty acids; functions of EFA, RDA, deficiency of EFA, Cholesterol in the body, saturated and unsaturated fattyacids.

Dietary Proteins; Composition, Physiological role of proteins in the body, Essential, Semi essential and nonessential amino acids, Food source and RDA of proteins for different age group, Biological value of proteins, Nitrogen balance.

Unit 3: Elements of Nutrition-II

General functions and classification, biochemical functions, dietary requirements, sources and disease states of principle elements-Ca, P, Na, K, biochemical functions, dietary requirements, sources and disease states of trace elements- Fe, I and Zn.

Unit 4: Dietetics

Principles of Dietetics, therapeutic diets for anaemia, heart diseases, obesity and diabetes mellitus, Protein Energy Malnutrition (Kwashiorkor), Undernutrition (Marasmus) their preventive and curative measures.

University of Jammu
Syllabi of Bio-Chemistry for FYUP under CBCS as per NEP-2020
Semester – I
(Examination to be held in December 2022, 2023, 2024)
MULTIDISCIPLINARY COURSE

Course Code: UMDBCHT-103
Course Title: Nutrition and Dietetics
Credits: 3
Total No. of Lectures: Theory: 45 hours
Maximum Marks: 75
Theory: 75
Duration of Examination: 3 hrs

NOTE FOR PAPER SETTING

Examination Theory / Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Internal Theory Assessment	50%	1½ Hours	15
External Theory End Semester	100%	3 Hours	60

A) Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours

B) External End Semester Examination: (60 Marks) Time Allotted 3 Hours

- a) External End Semester Theory Examination will have two sections (A & B).
- b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
- c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks.

Suggested Books:

1. Krause's Food and the Nutrition Care Process, Mahan, and Raymond, Elsevier. 14th Edition (2016).
2. Fundamentals of Biochemistry, Jain and Jain, S. Chand. 7th edition (2016).
3. Biochemistry, Satyanarayana and Chakrapani, Arunabha Sen Books and Allied (P) Ltd. 5th Edition (2020).
4. Nutrition and Dietetics, S. A. Joshi, McGraw-Hill Education, 5th Edition (2021).
5. Food Biochemistry, J. K. Dickson, CBS Publisher & Distributor Pvt. Ltd. 1st Edition (2020).

University of Jammu
Syllabi of Bio-Chemistry for FYUP under CBCS as per NEP-2020
Semester – I
(Examination to be held in December 2022, 2023, 2024)
SKILL ENHANCEMENT COURSE

Course Code: USEBCHT-104

Course Title: Instrumentation and Biochemical Techniques

Credits: 2 (40 marks Theory+10 marks Practical)

Total No. of Lectures: Theory: 25 hours

Practical: 30 hours

Maximum Marks: 50

Theory: 40

Practical: 10

Duration of Examination: 2.30 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

The course provides knowledge of Laboratory Instruments and Biochemical techniques. After successful completion of course, the students will be able to understand:

1. Principle and working of various laboratory instruments/equipments.
2. Various biochemical techniques and their applications in separation of chemicals like biomolecules, organic chemicals, drugs etc.
3. Application of immunological techniques in Medical field.

THEORY

Unit 1: Instrumentation

Laboratory safety rules and regulations, Principle and Working of; Weighing balance, pH meter, Laminar air flow, Autoclave, Hot-air oven, Bacteriological incubator, Colony counter, Haemocytometer, Water bath, Bunsen burner, Compound microscope, Usage and care of Glass wares, Serological pipettes, micro pipettes, centrifuges, Spectrophotometer; Principle, Components, working of spectrophotometer.

Unit 2: Biochemical Techniques

Cell Fractionation; Tissue Homogenisation, Separation of Cell organelles from homogenate, Centrifugation; Principles of centrifugation, various types of centrifuges, application of centrifugation, Spectroscopy; Lambert's Law, Beer's Law, applications of UV-visible absorption spectrophotometry in biochemistry, Chromatography; General Principle and application, Principle and application of TLC, Adsorption chromatography, Molecular sieve chromatography, Paper chromatography, Electrophoresis; General Principle, Factors affecting migration of molecules, Technique/steps involve in electrophoresis, Basic principles of agarose gel electrophoresis, Immunotechniques; Principle and applications of Precipitation reactions, agglutinations, Immunofluorescence, Enzyme linked immunosorbant assays (ELISA), Types of ELISA.

Practicals:

1. Verification of Beer-Lambert Law.
2. Demonstration and working of Spectrophotometer.
3. Determination of absorption maxima (λ_{max}) of small molecules and macromolecules.
4. Separation of amino-acids by Paper chromatography/TLC.
5. Preparation agarose gel, Electrophoresis.
6. Perform Blood grouping test.
7. Demonstration of ELISA.
8. Demonstration and operation Centrifugation.

University of Jammu
Syllabi of Bio-Chemistry for FYUP under CBCS as per NEP-2020
Semester – I
(Examination to be held in December 2022, 2023, 2024)
SKILL ENHANCEMENT COURSE

Course Code: USEBCHT-104

Course Title: Instrumentation and Biochemical Techniques

Credits: 2 (40 marks Theory+10 marks Practical)

Total No. of Lectures: Theory: 25 hours

Practical: 30 hours

Maximum Marks: 50

Theory: 40

Practical: 10

Duration of Examination: 2.30 hrs

NOTE FOR CONDUCTING EXAMINATION IN USEBCHT-101 & PAPER SETTERS

Total marks of the USEBCHT-101 are 50. 20% marks shall be reserved for internal assessment (10 Marks). 80% of the marks (40 marks) shall be reserved for external examination to be conducted by the University/College.

Internal Assessment Test (10 Marks) Time Allotted 1 Hour

Internal assessment paper of 10 marks shall consist of theory questions of 5 marks from Unit I/II and 5 marks of Practical exercise.

External End Semester University/College Examination 40 Marks (Time Allotted 2½ Hours)

1. External theory exam shall be of 30 marks and consists of 2 sections.
 - a. Section A shall be of 10 marks and comprise of 4 short answer type questions of 2½ marks each, from Unit I and II (All compulsory).
 - b. Section B shall be of 20 marks and will comprise of four long answer type questions of 10 marks each, two from Unit I and four from Unit II. A candidate has to attempt one question from each unit.
2. External Practical Exam shall be of 10 marks to be conducted by the college with practical exercise of 5 marks and Viva voce of 5 marks.

Note: during the submission of marks to University of Jammu final pattern will be 10 (internal) and 40 (external).

Suggested Books:

1. Principles and Techniques of Biochemistry and Molecular Biology, Wilson and Walker, Cambridge University Press. 8th Edition (2018).
2. Experimental Biochemistry, J. M. Clark, W. H. Freeman and Co. New York. 3rd Edition (1999).
3. Immunology, Kuby et al., W. H. Freeman and company, New York. 7th Edition (2014).
4. Principles of Molecular Biology, V. B. Rastogi, Medtech. 2nd Edition (2016).
5. Biochemistry, Satyanarayana and Chakrapani, Arunabha Sen Books and Allied (P) Ltd. 5th Edition (2020).
6. An Introduction to Practical Biochemistry, David, T. Plummer, Mc Graw Hill Education (India) Pvt. Ltd. 3rd Edition (2017).
7. Standard Methods of Biochemical Analysis, S. R. Thimmaiah, Kalyani Publisher. 2nd Edition (2016).
8. Laboratory Manual of Microbiology and Biotechnology, K. R. Aneja, Medtech, 2nd Edition (2018).

UNIVERSITY OF JAMMU
SYLLABI AND COURSES OF STUDY IN BIO-CHEMISTRY
For the examination to be held in May 2023, 2024, 2025
UG SEMESTER-II
UNDER NEP-2020

S. No.	Course Type	Course No.	Course Title	Credits (T+P)	Marks				Total Marks
					Theory		Practical		
1	Major	UMJBCH T-201	Fundamentals of Biochemistry-II	4 (3T + 1P)	Mid Semester: 15 Marks	End Semester Exam: 60 Marks	Daily Assessment: 10 Marks	Final Exam: 15 Marks	100
2	Minor	UMIBCH T-202	Basics of Biochemistry-II	4 (3T + 1P)	Mid Semester: 15 Marks	End Semester Exam: 60 Marks	Daily Assessment: 10 Marks	Final Exam: 15 Marks	100
3	Multidisciplinary	UMDBCH T-203	Vitamins & Hormones	3+0	Mid Semester: 15 Marks	End Semester Exam: 60 Marks	NA	NA	75
4	Skill Enhancement	USEBCH T-204	Basic Medical Lab Technology	2 (40 marks Theory +10 marks Practical)	Mid Semester: 10 Marks	End Semester Exam: 30 Marks		10 Marks	50

University of Jammu
Syllabi of Bio-Chemistry for FYUP under CBCS as per NEP-2020
Semester – II
(Examination to be held in May 2023, 2024, 2025)
MAJOR COURSE

Course Code: UMJBCHT-201

Course Title: Fundamentals of Biochemistry-II

Credits: 4 (3Theory+1Practical)

Total No. of Lectures: Theory: 45 hours

Practical: 30 hours

Maximum Marks: 100

Theory: 75

Practical: 25

Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

The course provides an introduction to Nutritional Biochemistry, Enzymes, Molecular Biology and Immunology. After successful completion of course, the students will be able to understand:

1. Functions of food, food pyramid, concept of nutrition, RQ of food stuff, Basal Metabolic Rate, composition of balance diet, RDA for different age groups. Nutritional significance of carbohydrates, amino acids, proteins, lipids in diet, Macro elements and trace elements and their nutritional deficiencies.
2. Fundamental knowledge on enzymes and their importance in biological systems.
3. Knowledge related to discovery of DNA as genetic material, DNA replication, transcription, translation, genetic code and mutation.
4. Overview of different types of immunity, cells of immune system, Antigens, Antibodies. They will be acquainted with importance of antigen-antibody interactions in disease diagnosis.

THEORY

Unit 1: Nutritional Biochemistry

Food- functions of food, food groups, food pyramid, Nutrition definition, Energy content of foods, Respiratory Quotient of foodstuffs, Utilization of energy in man; Basal Metabolic Rate (BMR), factors affecting BMR, significances of BMR, Energy requirements for different physical activities, Composition of Balanced Diet, Nutritional and physiological functions of Carbohydrates, proteins and lipids, Nitrogen Balance, biochemical functions and disease state of minerals (Ca, P, Na, K, Fe, I, Zn).

Unit 2: An Introduction to Enzymes

Classification and nomenclature of enzymes, Chemical nature and properties of enzymes, isoenzymes, active site, factors affecting enzymes activity; substrate concentration, enzyme concentration, pH and temperature, mechanism of enzyme action; Lock and key model, Induced fit theory, concept of enzyme inhibition Allosteric enzymes, application of enzymes.

Unit 3: Basic Molecular Biology

Evidence that DNA is genetic material, features of Watson and Crick model of DNA, Central dogma; General overview of DNA replication, transcription and translation in prokaryotes, Genetic code and its characteristics, Concept of reverse transcription, Mutations and its types.

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MAJOR COURSE

Course Code: UMJBCHT-201
Course Title: Fundamentals of Biochemistry-II
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

Unit 4: Immunology

Immunity; Innate and Acquired immunity, Active and Passive immunity, Concept of vaccine, Introduction to Central and peripheral lymphoid organs, B-cells and T-cells, Antigens; types of antigens, Antibodies; MHC complex, General structure of antibody, antigen- antibody reaction; Precipitation, Agglutination, Immunofluorescence, ELISA, definition of Hypersensitivity, allergy, sensitizing dose and shocking dose.

Practicals

1. General Handling of enzymes.
2. Verification of Beer-Lambert law.
3. Principle and Working of UV-Visible spectrophotometer.
4. Preparation of standard curve for maltose.
5. Study of activity of salivary amylase under optimum conditions.
6. Estimation of Vitamin C by titration method.
7. Isolation of Plasmid DNA/Genomic DNA.
8. To know the blood group from blood sample.
9. To know the Rh factor from blood sample.
10. Demonstration of ELISA.

NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Mid Term Assessment test	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

University of Jammu
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Semester – II
(Examination to be held in May 2023, 2024, 2025)
MAJOR COURSE

Course Code: UMJBCHT-201
Course Title: Fundamentals of Biochemistry-II
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

A) Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours

B) External End Semester Examination: (60 Marks) Time Allotted 3 Hours

- a) External End Semester Theory Examination will have two sections (A & B).
- b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
- c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks.

Suggested Books:

1. Krause & Food and the Nutrition Care Process, Mahan, and Raymond, Elsevier. 14th Edition (2016).
2. Biochemistry, Biotechnology and Clinical Chemistry, T. Palmer and P. Bonner, Woodhead Publishing Limited. 2nd Edition (2007).
3. Lehninger's Principles of Biochemistry, Nelson and Cox, W. H. Freeman and company, New York. 8th Edition (2021).
4. Molecular Biology of the Gene. James D. Watson et al., Cold Spring Harbor Laboratory (CSHL) Press. 7th Edition (2017).
5. Immunology, Kuby et al., W. H. Freeman and company, New York. 7th Edition (2014).
6. Fundamentals of Biochemistry, Jain and Jain, S. Chand. 7th edition (2016).
7. Biochemistry, Satyanarayana and Chakrapani, Arunabha Sen Books and Allied (P) Ltd. 5th Edition (2020).
8. Textbook of Microbiology, C. P. Baveja, Arya Publications. 6th Edition (2019).
9. Nutrition and Dietetics, S. A. Joshi, McGraw-Hill Education, 5th Edition (2021).
10. Food Biochemistry, J. K. Dickson, CBS Publisher & Distributor Pvt. Ltd. 1st Edition (2020).
11. Enzymology, T. Devasena. Oxford University Press. 1st Edition (2015).
12. Understanding Enzymes: An Introductory Text, A. Arya, A. Kumar and J. Jha, Drawing Pin Publishing, New Delhi, India, 1st Edition (2018).
13. An Introduction to Practical Biochemistry, David, T. Plummer, Mc Graw Hill Education (India) Pvt. Ltd. 3rd Edition (2017).
14. Standard Methods of Biochemical Analysis, S. R. Thimmaiah, Kalyani Publisher. 2nd Edition (2016).
15. Laboratory Manual of Microbiology and Biotechnology, K. R. Aneja, Medtech, 2nd Edition (2018).

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Semester – II
(Examination to be held in May 2023, 2024, 2025)
MINOR COURSE

Course Code: UMIBCHT-202
Course Title: Basics of Biochemistry-II
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

The course provides an introduction to Nutritional Biochemistry, Enzymes, Molecular Biology and Immunology. After successful completion of course, the students will be able to understand:

1. Functions of food, food pyramid, concept of nutrition, RQ of food stuff, Basal Metabolic Rate, composition of balance diet, RDA for different age groups. Nutritional significance of carbohydrates, amino acids, proteins, lipids in diet, Macro elements and trace elements and their nutritional deficiencies.
2. Fundamental knowledge on enzymes and their importance in biological systems.
3. Knowledge related to discovery of DNA as genetic material, DNA replication, transcription, translation, genetic code and mutation.
4. Overview of different types of immunity, cells of immune system, Antigens, Antibodies. They will be acquainted with importance of antigen-antibody interactions in disease diagnosis.

THEORY

Unit 1: Nutritional Biochemistry

Food- functions of food, food groups, food pyramid, Nutrition definition, Energy content of foods, Respiratory Quotient of foodstuffs, Utilization of energy in man; Basal Metabolic Rate (BMR), factors affecting BMR, significances of BMR, Energy requirements for different physical activities, Composition of Balanced Diet, Nutritional and physiological functions of Carbohydrates, proteins and lipids, Nitrogen Balance, biochemical functions and disease state of minerals (Ca, P, Na, K, Fe, I, Zn).

Unit 2: An Introduction to Enzymes

Classification and nomenclature of enzymes, Chemical nature and properties of enzymes, isoenzymes, active site, factors affecting enzymes activity; substrate concentration, enzyme concentration, pH and temperature, mechanism of enzyme action; Lock and key model, Induced fit theory, concept of enzyme inhibition Allosteric enzymes, application of enzymes.

Unit 3: Basic Molecular Biology

Evidence that DNA is genetic material, features of Watson and Crick model of DNA, Central dogma; General overview of DNA replication, transcription and translation in prokaryotes, Genetic code and its characteristics, Concept of reverse transcription, Mutations and its types.

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MINOR COURSE

Course Code: UMIBCHT-202
Course Title: Basics of Biochemistry-II
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

Unit 4: Immunology

Immunity; Innate and Acquired immunity, Active and Passive immunity, Concept of vaccine, Introduction to Central and peripheral lymphoid organs, B-cells and T-cells, Antigens; types of antigens, Antibodies; General structure of antibody, antigen- antibody reaction; Precipitation, Agglutination, Immunofluorescence, ELISA, definition of Hypersensitivity, allergy, sensitizing dose and shocking dose.

Practicals

1. General Handling of enzymes.
2. Verification of Beer-Lambert law.
3. Principle and Working of UV-Visible spectrophotometer.
4. Preparation of standard curve for maltose.
5. Study of activity of salivary amylase under optimum conditions.
6. Estimation of Vitamin C by titration method.
7. Isolation of Plasmid DNA/Genomic DNA.
8. To know the blood group from blood sample.
9. To know the Rh factor from blood sample.
10. Demonstration of ELISA.

NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Internal Theory Assessment	50%	1 ½ Hours	15
External Theory End Semester	100%	3 Hours	60
Internal Practical	-	-	10 (Based on Daily Performance only)
External Practical	-	-	15

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Semester – II
(Examination to be held in May 2023, 2024, 2025)
MINOR COURSE

Course Code: UMIBCHT-202
Course Title: Basics of Biochemistry-II
Credits: 4 (3Theory+1Practical)
Total No. of Lectures: Theory: 45 hours
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical: 25
Duration of Examination: 3 hrs

A) Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours

B) External End Semester Examination: (60 Marks) Time Allotted 3 Hours

- a) External End Semester Theory Examination will have two sections (A & B).
- b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
- c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks.

Suggested Books:

1. Krause's Food and the Nutrition Care Process, Mahan, and Raymond, Elsevier. 14th Edition (2016).
2. Biochemistry, Biotechnology and Clinical Chemistry, T. Palmer and P. Bonner, Woodhead Publishing Limited. 2nd Edition (2007).
3. Lehninger's Principles of Biochemistry, Nelson and Cox, W. H. Freeman and company, New York. 8th Edition (2021).
4. Molecular Biology of the Gene. James D. Watson et al., Cold Spring Harbor Laboratory (CSHL) Press. 7th Edition (2017).
5. Immunology, Kubly et al., W. H. Freeman and company, New York. 7th Edition (2014).
6. Fundamentals of Biochemistry, Jain and Jain, S. Chand. 7th edition (2016).
7. Biochemistry, Satyanarayana and Chakrapani, Arunabha Sen Books and Allied (P) Ltd. 5th Edition (2020).
8. Textbook of Microbiology, C. P. Baveja, Arya Publications. 6th Edition (2019).
9. Nutrition and Dietetics, S. A. Joshi, McGraw-Hill Education, 5th Edition (2021).
10. Food Biochemistry, J. K. Dickson, CBS Publisher & Distributor Pvt. Ltd. 1st Edition (2020).
11. Enzymology, T. Devasena. Oxford University Press. 1st Edition (2015).
12. Understanding Enzymes: An Introductory Text, A. Arya, A. Kumar and J. Jha, Drawing Pin Publishing, New Delhi, India, 1st Edition (2018).
13. An Introduction to Practical Biochemistry, David, T. Plummer, Mc Graw Hill Education (India) Pvt. Ltd. 3rd Edition (2017).
14. Standard Methods of Biochemical Analysis, S. R. Thimmaiah, Kalyani Publisher. 2nd Edition (2016).
15. Laboratory Manual of Microbiology and Biotechnology, K. R. Aneja, Medtech, 2nd Edition (2018).

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Semester – II
(Examination to be held in May 2023, 2024, 2025)
MULTIDISCIPLINARY COURSE

Course Code: UMDBCHT-203

Course Title: Vitamins and Hormones

Credits: 3

Total No. of Lectures: Theory: 45 hours

Maximum Marks: 75

Theory: 75

Duration of Examination: 3 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

The course provides knowledge of Vitamins and Hormones. After successful completion of course, the students will be able to understand:

1. Importance of fat and water soluble vitamins in growth and development, their recommended dietary allowance, dietary source and deficiency diseases.
2. Various Hormones released by endocrine glands their importance and disorders due to imbalance.

THEORY

Unit 1: Fat Soluble Vitamins

Definition, historical background, general characteristics, classification, vitamins, fat soluble vitamins- A, D, E and K, biochemical functions, recommended dietary allowance, dietary source and deficiency diseases.

Unit 2: Water Soluble Vitamins

Water soluble vitamins; Vitamin-C and B-Complex- Thiamine, Riboflavin, Niacin, Pantothenic acid, Pyridoxine, Biotin, Folic acid, Vitamin B12, biochemical functions, Recommended Dietary Allowance, dietary source and deficiency, vitamins like compounds; PABA, bioflavonoids, antivitamins.

Unit 3: Vertebrate Hormones-I

Introduction, classification, mechanism of action of steroid hormones, Hypothalamic Hormones; TRH, CRH and GnRH, Anterior and Posterior pituitary hormones; Growth Hormone, Glycoprotein hormones, oxytocin- their functions and disorders due to imbalance.

Unit 4: Vertebrate Hormones-II

Thyroid hormone, Hormones of adrenal cortex, Hormones of Gonads; androgens, estrogens and Progesterone - their functions and disorders due to imbalance, Insulin, Insulin-mediated glucose transport, regulation of blood glucose, sources of blood glucose, Diabetes Mellitus; classification, glucose tolerance test, comparison of two types of diabetes mellitus, glycosuria, metabolic changes in diabetes, management.

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MULTIDISCIPLINARY COURSE

Course Code: UMDBCHT-203
Course Title: Vitamins and Hormones
Credits: 3
Total No. of Lectures: Theory: 45 hours
Maximum Marks: 75
Theory: 75
Duration of Examination: 3 hrs

NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be covered in the Examination	Time Allotted for Exam	% Weightage (Marks)
Internal Theory Assessment	50%	1½ Hours	15
External Theory End Semester	100%	3.0 Hours	60

A) Mid Term Assessment test: (15 Marks) Time Allotted 1 ½ Hours

B) External End Semester Examination: (60 Marks) Time Allotted 3 Hours

- a) External End Semester Theory Examination will have two sections (A & B).
- b) Section A shall be of 12 Marks and will comprise of 4 short answer type questions one question from each unit carrying 03 Marks each. A candidate will have to attempt all the questions.
- c) Section B shall be of 48 Marks and will comprise of 8 long answer type questions, two from each unit. A candidate will have to attempt four questions selecting one question from each unit. Each question will carry 12 marks.

Suggested Books:

1. The Vitamins: Fundamental Aspects in Nutrition and Health, F. C. Gerald and J. P. McClung, Elsevier-Academic Press. 5th Edition (2017).
2. Nutritional Biochemistry of Vitamins, D. A. Bender, Cambridge University Press, 2nd Edition (2003).
3. Principles of Anatomy and Physiology, G. J. Tortora, and B. Derrickson, John Wiley and Sons, Inc. 14th Edition (2013).
4. Guyton and Hall Textbook of Medical Physiology, J. E. Hall, Elsevier Saunders, 13th Edition (2015).
5. Fundamentals of Biochemistry, Jain and Jain, S. Chand. 7th edition (2016).
6. Biochemistry, Satyanarayana and Chakrapani, Arunabha Sen Books and Allied (P) Ltd. 5th Edition (2020).

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Semester – II
(Examination to be held in May 2023, 2024, 2025)
SKILL ENHANCEMENT COURSE

Course Code: USEBCHT-204

Course Title: Basic Medical Lab Technology

Credits: 2 (40 marks Theory+10 marks Practical)

Total No. of Lectures: Theory: 25 hours

Practical: 30 hours

Maximum Marks: 50

Theory: 40

Practical: 10

Duration of Examination: 2.30 hrs

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

The course provides knowledge of Good Laboratory Practices and Analysis of Blood and Urine. After successful completion of course, the students will be able to understand:

1. Hazards in clinical laboratory, reagents preparation, labelling, storage.
2. Sterilization and disinfection of laboratory and laboratory instruments. Quality control in laboratory.
- 3.
4. Composition, collection and analysis of blood and urine

THEORY

Unit-1: Good Laboratory Practice & Quality Control

Hazards in clinical laboratory, chemicals/Reagents, preparation of reagents, Labelling, storage and usage, First Aid in laboratory accidents - Precautions and first aid equipments, Reporting laboratory tests and keeping records, Sterilization and disinfection, General approach to quality control, unit and reference values, determination of pH.

Unit-2: Analysis of Biological samples

Urine Analysis: Composition, collection, preservation, physical examination, interfering factors, chemical examination, sugar in urine, ketone bodies in urine, bile pigments, uric acid, and microscopic examination of the urinary sediment.

Clinical Hematology: Collection of blood - Anticoagulant, preservation, Estimation of blood glucose, Hb, PCV, WBC, RBC, Platelets, ESR, Clotting time, bleeding time-normal value, clinical interpretations, Blood grouping- ABO system, ABO Grouping, Rh typing, Coombs test.

Practicals:

1. Basic expressions denoting the strength of a solution; standard solution, molar solution, molal solution, normal solution, percent solution, ppm solution.
2. Calculation and preparation of standard solutions; molar solution, normal solution and percent solution.
3. Different methods to determine pH.
4. Determination of blood sugar by Glucometer.
5. RBC counting.
6. WBC counting.
7. Determination of clotting time and its significance.
8. To perform Blood grouping test.

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SKILL ENHANCEMENT COURSE

Course Code: USEBCHT-204
Course Title: Basic Medical Lab Technology
Credits: 2 (40 marks Theory+10 marks Practical)
Total No. of Lectures: Theory: 25 hours
Practical: 30 hours
Maximum Marks: 50
Theory: 40
Practical: 10
Duration of Examination: 2.30 hrs

NOTE FOR CONDUCTING EXAMINATION IN USEBCHT-201 & PAPER SETTERS

Total marks of the USEBCHT-201 are 50. 20% marks shall be reserved for internal assessment (10 Marks). 80% of the marks (40 marks) shall be reserved for external examination to be conducted by the University/College.

Internal Assessment Test (10 Marks) Time Allotted 1 Hour

Internal assessment paper of 10 marks shall consist of theory questions of 5 marks from Unit I/II and 5 marks of Practical exercise.

External End Semester University/College Examination (Time Allotted 2½ Hours)

1. External theory exam shall be of 30 marks and consists of 2 sections.
 - a) Section A shall be of 10 marks and comprise of 4 short answer type questions of 2½ marks each, from Unit I and II (All compulsory)
 - b) Section B shall be of 20 marks and will comprise of four long answer type questions of 10 marks each, two from Unit I and four from Unit II. A candidate has to attempt one question from each unit.
2. External Practical Exam shall be of 10 marks to be conducted by the college with practical exercise of 5 marks and Viva voce of 5 marks.

Note: during the submission of marks to University of Jammu final pattern will be 10 (internal) and 40 (external).

Suggested Books:

1. Laboratory Manual of Microbiology and Biotechnology, K. R. Aneja, Medtech, 2nd Edition (2018).
2. Practical Textbook of Biochemistry for Medical Students, D. M. Vasudevan and S. K. Das, Jaypee Brothers Medical Publishers (P) Ltd. 3rd Edition (2020).
3. Practical Clinical Biochemistry; Methods and Interpretations, R. Chawla, Jaypee Brothers Medical Publisher (P) Ltd. 5th Edition (2020).
4. An Introduction to Practical Biochemistry, D. T. Plummer, Mc Graw Hill Education (India) Pvt. Ltd. 3rd Edition (2017).
5. A Textbook of Practical Physiology, C. L. Ghai, Jaypee Brothers Medical Publisher (P) Ltd. 8th Edition (2013).
6. Practical Clinical Biochemistry, S. Mohanty and A. B. Varma, Jaypee Brothers Medical Publisher (P) Ltd. 1st Edition (2013).
7. Standard Methods of Biochemical Analysis, S. R. Thimmaiah, Kalyani Publisher. 2nd Edition (2016).