

# UNIVERSITY OF JAMMU

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

Academic Section Email: <u>academicsectionju14@gmail.com</u>

# NOTIFICATION (23/April/Adp./13)

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 Studies in the subject of Biotechnology for Semester IIIrd and IVth of Four Year Under Graduate Programme (FYUGP) 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

Biotechnology

Semester-III Semester-IV For the examinations to be held in the year

December 2023, 2024 and 2025 May 2024, 2025 and 2026

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

Sd/-DEAN ACADEMIC AFFAIRS

No. F. Acd/II/23/1674-1699 Dated:04/5/23

# Copy for information and necessary action to:

- 1. Dean Faculty of Science
- 2. HOD/Convener, Board of Studies Biotechnology
- 3. Sr. P.A. to the Controller of Examinations
- 4. All members of the Board of Studies
- 5. C.A. to the Controller of Examinations
- 6. Director, Computer Centre, University of Jammu
- 7. Deputy Registrar/Asst. Registrar (Conf. /Exams. UG. Exam. Non.Prof)
- N. Incharge University Website for necessary action please

# **UNIVERSITY OF JAMMU**

# SYLLABI AND COURSE OF STUDY IN BIOTECHNOLOGY For the Examination to be held in Year 2023, 2024, 2025, 2026

# **BIOTECHNOLOGY COURSE**

UG SEMESTER III & IV UNDER NEP-2020

# UNIVERSITY OF JAMMU SYLLABI AND COURSES OF STUDY IN BIOTECHNOLOGY For the examination to be held in 2023, 2024 and 2025 UG SEMESTER-III UNDER NEP-2020

S.	Course	purse Course No. Course Title	Course Title	Credits	Marks				Total
No	type				Theory	1	Practical/Tu	torial	Marks
1.	Major	UMJBTT-301	General Microbiology	4 (3+1)	Mid Semester: 15 Marks	End exam: 60 marks	Assessment: 10 marks	Exam: 15 Marks	100
2.	Major	UMJBTT-302	Cell Biology and Genetics	4 (3+1)	Mid Semester: 15 Marks	End exam: 60 marks	Assessment: 10 marks	Exam: 15 Marks	100
3.	Minor	UMIBTT-303	Basic Microbiology	4 (3+1)	Mid Semester: 15 Marks	End Semester Exam: 60 Marks	Assessment: 10 marks	Exam: 15 Marks	100
4.	Multidiscipl inary	UMDBTT-304	Biotechnology for Human Welfare	3+0	Mid Semester: 15 Marks	End Semester Exam: 60 Marks	NA	NA	75
5.	SEC	USEBTT-305	Basic Molecular Diagnostics	2 (1+1)	Mid Semester: 5 Marks	End Semester Exam: 20 Marks	Assessment: 10 marks	Exam: 15 Marks	50

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Course Code: UMJBTT-301 Course Title: General Microbiology 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 hours

#### **Objectives and Expected Learning Outcomes**

The course provides an introduction to the fundamentals of microbiology concepts such as history and development; microscopy; classification of microbes like bacteria, viruses, fungus, algae. After successfully completing this course, the students will be able to understand the microbial structures; life cycle and their patho-mechanisms. Course will also provide the information about the application of microbes for improving human health.

#### Unit 1: Bacteriology

Prokaryotic classification and diversity; structure & function of prokaryotic cell membrane, flagella, pili and capsule; bacterial reproduction; transformation, transduction and conjugation; bacterial growth and kinetics; factors affecting bacterial growth, control of bacterial growth. Archeae: diversity, structure and function; halophiles, methanophiles and hyperthermophiles.

#### Unit 2: Mycology

Introduction to mycology; fungi: distribution, morphology, cell structure, reproduction and life cycle; fungal classification, lower fungi and higher fungi; economic importance of fungi. Lichens: distribution, morphology, cell structure and life cycle; economic importance of lichens.

#### Unit 3: Phycology

Introduction to phycology; algae: distribution, cellular and subcellular structure, classification; algal nutrition; algal reproduction and life cycle; algal ecology; algal biotechnology; economic importance of algae in agriculture, environment, industry, medicine and food.

#### **Unit 4: Virology**

Viruses: discovery, nomenclature and classification, morphology and structure, capsid, envelop, viral genome; viral multiplication and transmission. Distinctive properties and cultivation of viruses, viroids and prions. Viruses infecting bacteria, plant and animals.

Course Code: UMJBTT-301 Course Title: General Microbiology 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 hours

#### Practicals:

- 1. Preparation of different types of microbial culture media
- 2. To study the growth curve of given microbe
- 3. Isolation and identification of microbe from different spoiled foods
- 4. Isolation of amylase producing bacteria from soil
- 5. To demonstrate conjugation and transduction using student teaching kits
- 6. Simple biochemical tests of bacteria
- 7. Antibiotic sensitivity tests
- 8. Methylene blue reductase test for accessing the quality of milk.
- 9. Screening of microbial culture for the ability to produce extracellular enzymes
- 10. Identification of different algae from pond water and other water bodies
- 11. To visit nearby research Institution/University to get acquainted with advanced techniques in related subject

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	<b>-</b>	-	10
			(Based on Daily Performance only)
External Practical			15

#### NOTE FOR PAPER SETTING

# A) Mid Term Assessment test: (15 Marks) Time Allotted 1 1/2 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.

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Course Code: UMJBTT-301 Course Title: General Microbiology 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 hours

> 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.

#### **Reference Book:**

- 1. Microbiology- Prescott, L.M., Harley, J.P. and Klein, D.A., McGraw Hill, USA, 12th edition (2022).
- 2. Principle of Virology- Flint, J.V.R., Racaniello, G.F., Rall, T., Hatziioannou, A.M. and Skalka, ASM press (2020).
- Brock Biology of Microorganisms- Madigan, M.T., Martinko, J.M. and Parker, J., Pearson Benjamin Cummings Publishing, San Francisco, 16<sup>th</sup> edition (2020).
- Microbiology- Pelczar, M.J.J., Chan, E.C.S. and Kreig, N.R., Tata McGraw Hill Education Pvt. Ltd., New Delhi, 7<sup>th</sup> edition (2019).
- 5. Microbiology: An introduction- Tortora, G.J., Funke, B.R and Case, C.L., Pearson Education Inc., 14<sup>th</sup> edition (2019).
- Fundamentals of Microbiology- Pommerville, J.C., Jones & Bartlett Learning, 12<sup>th</sup> edition (2021).
- 7. Microbiology- Tortora, G.J., Funke, B.R. and Case, C.L., Pearson Education India, 11<sup>th</sup> edition (2016).
- 8. Virology- Saravanan, P., M.J.P. Publication (2007).
- 9. An Introduction to Modern Virology- Dimmock, N.J., Easton, A.J. and Leppard, K.N., Blackwell publications, 5<sup>th</sup> edition (2007).
- 10. Principle of Microbiology- Sumbali, G. and Mahotra, R., Tata Mc Graw Hill (2009).
- 11. Introductory Mycology- Alexopoulos, C.J., Mims, C.W. and Meredith, M.B. Blackwell Wiley, 4<sup>th</sup> edition (2017).
- 12. Phycology- Lee, R.E., Cambridge University Press, 5th edition (2018).

Course Code: UMJBTT-302 Course Title: Cell Biology and Genetics 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 hours

## **Objectives and Expected Learning Outcomes**

This course focuses on understanding the concept of cellular transport, biogenesis of cellular organelles and cell energetics, communication mechanisms of cells, its division and cell death. The course also provides fundamental understanding of genetics that contribute to heredity and variation among organisms and variations related to mutations and transposable elements

# Unit 1: Cellular organisation and transport

Plasma membrane, modification of plasma membrane and intracellular junctions; nuclear pore complex, membrane transport, solute transport by simple diffusion, facilitated diffusion and active transport. Biogenesis of cellular organelles: mitochondria, chloroplast, endoplasmic reticulum, golgi complex. Protein structure, folding, and regulation, protein sorting and vesicular transport. Bioenergetics: laws of thermodynamics, Gibbs free energy, relationship between equilibrium constant and change in free energy, feasibility of chemical reactions, importance of coupled reactions.

#### Unit 2: Cell cycle and cell communication

Cell division: mitosis and meiosis, phases of cell division; cell cycle, regulation of cell cycle, cell cycle checkpoints, significance of cell cycle. Cell senescence and programmed cell death. General principles of cellular signalling. Cytoskeleton and cell adhesion: microtubules, intermediate filaments, actin filaments, extracellular matrix.

#### Unit 3: Post Mendelian genetics, linkage & crossing over

Post Mendelian concept of heredity, partial or incomplete dominance, co-dominance, penetrance and expressivity, epistasis. Multiple allelism: blood groups in Humans-ABO and Rh. Chromosomal theory of linkage, kinds of linkage, linkage groups; crossing over, types of crossing over, mechanism of crossing over and its importance, cytological detection of crossing over.

## Unit 4: Mutations and Transposable elements

Mutations and their types, mutagens, mutation at the molecular level, applications of mutations; chromosomal variations: general account of structural and numerical aberrations; chromosomal evolution in wheat and cotton. An overview of transposable elements and their significance: Ac/Ds elements in maize, P elements in Drosophila and IS elements in bacteria.

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Course Code: UMJBTT-302 Course Title: Cell Biology and Genetics 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 hours

#### Practical

- 1. To measure the length and breadth of the given cell sample by using micrometer.
- 2. To study the mitosis and the cell cycle in onion root-tip cells
- 3. To study the polytene chromosomes from salivary gland of Drosophila.
- 4. Identification, maintenance and culturing of Drosophila stock.
- 5. Experiments on epistatic interactions including test cross and back cross.
- 6. Determination of linkage and cross-over analysis
- 7. Demonstration of partial or incomplete dominance, co-dominance in flowers/plants.
- 8. Experiments to understand the basic concept of the ABO blood group type.
- 9. Effect of UV radiations on E. coli for different time periods.
- 10. To visit nearby research Institution/University to get acquainted with advanced techniques in related subject

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		Japania in spailité de La color de la colorité	10 (Based on Daily Performance only)
External Practical	-		15

#### NOTE FOR PAPER SETTING

# A) Mid Term Assessment test: (15 Marks) Time Allotted 1 1/2 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

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Course Code: UMJBTT-302 Course Title: Cell Biology and Genetics 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 hours

> 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.

#### **References Books:**

- Cell and Molecular Biology: Concepts and Experiments- Karp, G., John Wiley & Sons. Inc, 8<sup>th</sup> edition (2021).
- 2. The World of the Cell- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G.P, Pearson Benjamin Cummings Publishing, San Francisco, 8<sup>th</sup> edition (2021).
- 3. The Cell: A Molecular Approach- Cooper, G.M. and Hausman, R.E, Sinauer Associates Inc. and ASM Press, 8<sup>th</sup> edition (2019).
- 4. Genetics: Analysis and Principles- Brooker, R.J., McGraw Hill Education, 6<sup>th</sup> edition (2019).
- 5. Genes XI- Lewin, B., Jones and Bartlett Publishers, 11th edition (2021).
- 6. Genetics: Analysis and Principles- Brooker, R.J., McGrawl Hill Education, 6<sup>th</sup> edition (2019).
- Principles of Genetics- Snustad, P.D. and Simmons, M.J., John Wiley & Sons, Inc., 7<sup>th</sup> edition (2019).
- 8. Lewin's Genes XII- Goldstein, E.S., Krebbs, J.E., Kilpatrick, S.T., Jones and Bartlett Publishers, Inc., 12<sup>th</sup> edition (2020).
- 9. Genetics-Strickberger, M.W., Macmillain Publishers, New York, 5th edition (2013).
- 10. Principles of Gene Manipulations- Old, R.W. and Primrose, S.B., Black Well Scientific Publications, 7<sup>th</sup> edition (2011).

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Course Code: UMIBTT-303 Course Title: Basic Microbiology 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 hours

## **Objectives and Expected Learning Outcomes**

The course provides an introduction to the fundamentals of microbiology concepts such as history and development; microscopy; classification of microbes like bacteria, viruses, fungus, algae. After successfully completing this course, the students will be able to understand the microbial structures; life cycle and their patho-mechanisms. This will also provide the information about the application of microbes for improving human health.

#### Unit 1: Bacteriology

Prokaryotic classification and diversity; structure & function of prokaryotic cell membrane, flagella, pili and capsule; bacterial reproduction; transformation, transduction and conjugation; bacterial growth and kinetics; factors affecting bacterial growth, control of bacterial growth. Archeae: diversity, structure and function; halophiles, methanophiles and hyperthermophiles.

#### Unit 2: Mycology

Introduction to mycology; fungi: distribution, morphology, cell structure, reproduction and life cycle; fungal classification, lower fungi and higher fungi; economic importance of fungi. Lichens: distribution, morphology, cell structure and life cycle; economic importance of lichens.

#### Unit 3: Phycology

Introduction to phycology; algae: distribution, cellular and subcellular structure, classification; algal nutrition; algal reproduction and life cycle; algal ecology; algal biotechnology; economic importance of algae in agriculture, environment, industry, medicine and food.

#### **Unit 4: Virology**

Viruses: discovery, nomenclature and classification, morphology and structure, capsid, envelop, viral genome; viral multiplication and transmission. Distinctive properties and cultivation of viruses, viroids and prions. Viruses infecting bacteria, plant and animals.

Course Code: UMIBTT-303 Course Title: Basic Microbiology 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 hours

#### Practicals:

- 1. Preparation of different types of microbial culture media
- 2. To study the growth curve of given microbe
- 3. Isolation and identification of microbe from different spoiled foods
- 4. Isolation of amylase producing bacteria from soil
- 5. To demonstrate conjugation and transduction using student teaching kits
- 6. Simple biochemical tests of bacteria
- 7. Antibiotic sensitivity tests
- 8. Methylene blue reductase test for accessing the quality of milk.
- 9. Screening of microbial culture for the ability to produce extracellular enzymes
- 10. Identification of different algae from pond water and other water bodies
- 11. To visit nearby research Institution/University to get acquainted with advanced techniques in related subject

#### 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)	
<b>External Practical</b>	-	-	15	

#### A) Mid Term Assessment test: (15 Marks) Time Allotted 1 1/2 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

Course Code: UMIBTT-303 Course Title: Basic Microbiology 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 hours

> 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.

#### **Reference Books:**

- Microbiology- Prescott, L.M., Harley, J.P. and Klein, D.A., McGraw Hill, USA, 12<sup>th</sup> edition (2022).
- 2. Principle of Virology- Flint, J.V.R., Racaniello, G.F., Rall, T., Hatziioannou, A.M. and Skalka, ASM press (2020).
- Brock Biology of Microorganisms- Madigan, M.T., Martinko, J.M. and Parker, J., Pearson Benjamin Cummings Publishing, San Francisco, 16<sup>th</sup> edition (2020).
- Microbiology- Pelczar, M.J.J., Chan, E.C.S. and Kreig, N.R., Tata McGraw Hill Education Pvt. Ltd., New Delhi, 7<sup>th</sup> edition (2019).
- 5. Microbiology: An introduction- Tortora, G.J., Funke, B.R and Case, C.L., Pearson Education Inc., 14<sup>th</sup> edition (2019).
- 6. Fundamentals of Microbiology- Pommerville, J.C., Jones & Bartlett Learning, 12<sup>th</sup> edition (2021).
- 7. Microbiology- Tortora, G.J., Funke, B.R. and Case, C.L., Pearson Education India, 11<sup>th</sup> edition (2016).
- 8. Virology- Saravanan, P., M.J.P. Publication (2007).
- 9. An Introduction to Modern Virology- Dimmock, N.J., Easton, A.J. and Leppard, K.N., Blackwell publications, 5<sup>th</sup> edition (2007).
- 10. Principle of Microbiology- Sumbali, G. and Mahotra, R., Tata Mc Graw Hill (2009).
- 11. Introductory Mycology- Alexopoulos, C.J., Mims, C.W. and Meredith, M.B. Blackwell Wiley, 4<sup>th</sup> edition (2017).
- 12. Phycology- Lee, R.E., Cambridge University Press, 5th edition (2018).

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Course Code: UMDBTT-304 Course Title: Biotechnology for Human Welfare Credits: 3 Total No. of Lectures: 45 hours Maximum Marks: 75 Theory: 75 **Duration of Examination: 3 hours** 

Objectives and Expected Learning Outcomes: The course provides an introduction to biotechnology and the application of biotechnology for human welfare including Agriculture, industry, environment and human health care. After successfully completing this course, the students will be able to understand the scope and application of biotechnology in various areas.

# Unit 1: Introduction to Biotechnology

Definition & scope of Biotechnology, conventional biotechnology, modern Biotechnology, main subfields of Biotechnology: Medical (red) Biotechnology, Agricultural (green) Biotechnology, Industrial (white) Biotechnology, Marine (blue) Biotechnology, Food Biotechnology, and Environmental Biotechnology. Introduction to microbes: beneficial microbes, harmful microbes. Principles of Genetic Engineering & Bioprocess Technology.

Unit 2: Biotechnology in Agriculture & Environmental management

Introduction to Genetically Modified (GM) crops, safety and challenges for their acceptance, need for GM crops, Golden Rice, Bt Cotton, FlavrSavr Tomato.

Biodegradation of potential pollutants, recycling of wastes and other waste treatment technologies. Controlling environmental pollution through bioremediation; biomonitoring, biotreatment and biodegradation of solid, liquid and gaseous wastes.

# Unit 3: Industrial Applications of Biotechnology

Basic principles of Fermentation Technology- historical perspective, overview of fermentation in making of bread, curd, yogurt, cheese, beer, wine, etc.; basic design of fermenters; overview of industrial production of alcoholic beverages, antibiotics & enzymes, bioplastics and biofuels.

# Unit 4: Biotechnology in Human healthcare

Introduction to Animal Biotechnology, transgenic animals and ethical issues associated with it; application of Animal Biotechnology in development of disease resistance, better milk and meat yielding animals, fisheries and poultry improvement.

Introduction to Human Genome Project. Molecular diagnostics tools like PCR and DNA fingerprinting; an overview of vaccines.

Course Code: UMDBTT-304 Course Title: Biotechnology for Human Welfare Credits: 3 Total No. of Lectures: 45 hours Maximum Marks: 75 Theory: 75 Duration of Examination: 3 hours

#### 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 1/2 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.

# **Reference Books:**

- 1. Gene Cloning and DNA Analysis: An Introduction- Brown, T.A., Wiley Blackwell, 8<sup>th</sup> edition (2020).
- Principles of Gene Manipulations and Genomics- Primrose, S.B and Twyman, R., Black Well Scientific Publications, 8th edition (2016).
- Biotechnology: A textbook of Industrial Microbiology- Crueger, W. and Crueger, A., Panima Publishing Co. New Delhi, 3<sup>rd</sup> edition (2017).
- Environmental Biotechnology Concepts and Applications- Hans-Joachim, J. and Winter, J., Wiley Blackwell, 1<sup>st</sup> edition (2004).
- 5. Elements of Biotechnology- Gupta, P.K., Rastogi and Co., Merrut, India, 2<sup>nd</sup> edition (2010).
- 6. Introduction to Plant Biotechnology- Chawla, H.S., C.R.C. Press, 3rd edition (2020).
- 7. Text Book of Biotechnology- Das, H.K., Wiley India Pvt. Limited, 5th edition (2017).

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# University of Jammu Syllabi of Biotechnology for FYUP under CBCS as per NEP-2020 Semester - III (Examination to be held in December 2022, 2023, 2024) Skill Enhancement Course

Course Code: USEBTT-305 Course Title: Basic Molecular Diagnostics Credits: 2 (Theory: 25 Marks + Practicals: 25 Marks) Total No. of Lectures: Theory: 25 hours Practical: 30 hours Maximum Marks: 50 Theory: 25 Practical: 25 Duration of Examination: 2.5 hours

# **Objectives and Expected Learning Outcomes:**

To provide practical knowledge on various molecular techniques used in the field of diagnostics. Upon completion of the course the participants should be able to defines basic terminology and describes concepts in molecular diagnostics, perform molecular techniques including nucleic acid extraction, conventional, real-time polymerase chain reaction and Understand the concept of nucleic acid sequencing and various immune-assays.

# Unit 1: Nucleic acid based diagnostics

Developing standard operating protocols (SOP) for a molecular diagnostic laboratory; basic methods of documentation and other protocols for molecular diagnostic facility. Nucleic acid-based diagnostics for infectious diseases and non-infectious diseases: Polymerase Chain Reaction (PCR), quantitative Polymerase Chain Reaction (qPCR), isothermal amplification, nucleic acid hybridization, Fluorescence In Situ Hybridization (FISH), micro-arrays, DNA Sequencing.

# Unit 2: Protein based diagnostics

Protein based diagnostics, antibody technology, antigen-antibody interaction, western blotting; immunoassays and their applications: RIA (Radioimmunoassay), ELISA (Enzyme Linked Immunosorbent Assay), chemiluminescent immunoassays; FACS (Fluorescence Activated Cell Sorting) and ChIP (Chromatin Immunoprecipitation) - to study protein gene interaction.

# Unit 3: Practicals

- 1. Collection of clinical samples
- 2. DNA extraction and its preservation
- 3. RNA extraction and preservation
- 4. To study, use and maintenance of a thermocycler machine
- 5. To design and validate primers for Polymerase Chain Reaction (PCR)
- 6. To prepare master mixture for Polymerase Chain Reaction (PCR)
- 7. To set up and perform in silico Polymerase Chain Reaction (PCR)
- 8. To demonstrate quantitative Polymerase Chain Reaction (qPCR)
- 9. Demonstration of antigen-antibody interaction assays
- 10. To demonstrate Enzyme-Linked Immunosorbent Assay (ELISA)
- 11. To visit nearby research Institution/University to get acquainted with advanced
- techniques in related subject

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## University of Jammu Syllabi of Biotechnology for FYUP under CBCS as per NEP-2020 Semester – III (Examination to be held in December 2022, 2023, 2024) Skill Enhancement Course

Course Code: USEBTT-305 Course Title: Basic Molecular Diagnostics Credits: 2 (theory: 25 Marks + Practicals: 25 Marks) Total No. of Lectures: Theory: 25 hours Practical: 30 hours Maximum Marks: 50 Theory: 25 Practical: 25 Duration of Examination: 2.5 hours

#### 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%	0.5 Hours	5
External Theory End Semester	100%	2.5 Hours	20
Internal Practical			10 (Based on Daily Performance only)
External Practical	-		15

A) Internal Assessment Test 5 Marks (Time Allotted 0.5 Hour)

B) End Semester Examination 20 Marks (Time Allotted 21/2 Hours)

- a) External theory exam shall be of 20 marks and consists of 2 sections.
- b) Section A shall be of 6 marks and comprise of 4 short answer type questions of 1<sup>1</sup>/<sub>2</sub> marks each, from Unit I and II (All compulsory).
- c) Section B shall be of 14 marks and will comprise of four medium type questions of 7 marks each, two from Unit I and two from Unit II. A candidate has to attempt one from each unit.

C) External Practical Exam shall be of 15 marks to be conducted by the college and 10 marks shall be for internal practical assessment.

# University of Jammu Syllabi of Biotechnology for FYUP under CBCS as per NEP-2020 Semester – III (Examination to be held in December 2022, 2023, 2024) Skill Enhancement Course

Course Code: USEBTT-305 Course Title: Basic Molecular Diagnostics Credits: 2 (theory: 25 Marks + Practicals: 25 Marks) Total No. of Lectures: Theory: 25 hours Practical: 30 hours Maximum Marks: 50 Theory: 25 Practical: 25 Duration of Examination: 2.5 hours

#### **Reference Book:**

- 1. Gene Cloning and DNA Analysis: An Introduction- Brown, T. A., Wiley Blackwell, 7<sup>th</sup> edition (2016).
- Principles of Gene Manipulations and Genomics- Primrose, S.B and Twyman, R., Black Well Scientific Publications, 8th edition (2016).
- 3. Elements of Biotechnology- Gupta, P.K., Rastogi and Co., Merrut, India, 3rd edition (2010).
- 4. RNA and DNA Diagnostics- Erdmann, V.A., Jurga, S. and Barciszewski, J., Springer International Publishing, New York (2015).
- Molecular Diagnostics- Patrinos, G.P., Danielson, P.B. and Ansorge, W.J., Academic Press Elsevier, 3<sup>rd</sup> edition (2017).
- Cellular and Molecular Immunology- Abbas, A., Lichtman, A.H. and Pillai, S., Academic Press Elsevier, 10<sup>th</sup> edition (2021).
- 7. Clinical Immunology-Rezaei, M., Academic Press Elsevier (2022).

# UNIVERSITY OF JAMMU SYLLABI AND COURSES OF STUDY IN BIOTECHNOLOGY For the examination to be held in 2023, 2024 and 2025 UG SEMESTER-IV UNDER NEP-2020

	Course No. Course Title Credits Marks					Marks			
S. Course	Course	Course 110.			Theory		Practical/Tutorial		Marks
No 1.	Major	UMJBTT-401	Molecular Biology	4 (3+1)	Mid Semester: 15 Marks	End exam: 60 marks	Assessment: 10 marks	Exam: 15 Marks	100
2.	Major	UMJBTT-402	Enzymology	4 (3+1)	Mid Semester: 15 Marks	End exam: 60 marks	Assessment: 10 marks	Exam: 15 Marks	100
3.	Major	UMJBTT-403	Immunology	4 (3+1)	Mid Semester: 15 Marks	End exam: 60 marks	Assessment: 10 marks	Exam: 15 Marks	100
4.	Major	UMJBTT-404	Biochemistry and Metabolism	4 (3+1)	Mid Semester: 15 Marks	End exam: 60 marks	Assessment: 10 marks	Exam: 15 Marks	100
5.	Minor	UMIBTT-405	introduction to Molecular Biology	4 (3+1)	Mid Semester 15 Marks	End exam: 60 marks	Assessment 10 marks	: Exam 15 Mark	: 10 s

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Course Code: UMJBTT-401 Course Title: Molecular Biology 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 hours** 

# **Objectives and Expected Learning Outcomes:**

This course will guide students about the basic background (physical and chemical) of molecular biology. After successfully completing this course, the students will be able to understand the basic concepts in molecular biology, basic composition of nucleic acids, their structure and their mode of replication, conversion of genetic information coded in DNA to cellular macromolecules.

# Unit 1: Structure of Nucleic Acid

Structure of nucleic acids: nucleosides & nucleotides, purines and pyrimidines. Watson and Crick model of DNA structure, A, B & Z forms of DNA, supercoiled and relaxed DNA, denaturation and renaturation of DNA, melting temperature (Tm), hyperchromic effect. RNA structure and types of RNA: mRNA, tRNA, rRNA, siRNA, miRNA, snoRNA, SnRNA.

#### Unit II: Replication

Semiconservative replication, chromosomal replication and regulation with reference to E. coli: initiation, elongation and termination; factors and elements required in replication; regulation of replication. DNA replication vis a vis cell cycle in E. coli and replication of plasmid DNA. Introduction to replication in eukaryotic organisms: replication in yeast and SV 40.

# Unit III: Transcription

Organization of gene: concept of promoter, enhancer, silencer; transcription factors, RNA polymerase. Transcription in prokaryotes: initiation, elongation and termination; operon concept, inducible and repressible operons. Transcription in eukaryotes: initiation, elongation and termination. Co and post transcriptional processing of RNA transcripts.

#### **Unit IV: Translation**

Genetic code: salient features, start codon, stop codon, wobble hypothesis, degeneracy of codon, codon bias; Concept of reading frame. Translation: structure and function of ribosomes; protein synthesis in prokaryotes: initiation, elongation and termination. Protein synthesis in eukaryotes initiation, elongation and termination. Post translational modification of proteins.

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Course Code: UMJBTT-401 Course Title: Molecular Biology 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 hours

#### Practicals:

- 1. Preparation of stock solutions, concept of molarity, normality and concentration.
- 2. Isolation of DNA from living cell.
- 3. Quantification of DNA by spectrophotometer.
- 4. Agarose gel electrophoresis of isolated DNA.
- 5. Estimation of purity of DNA by spectrophotometry.
- 6. Quantification of DNA using agarose gel by normalization.
- 7. Determination of molecular weight of given DNA sample using semi log paper
- 8. Effect of concentration of agarose on the migration of DNA through agarose gel
- 9. Effect of various physical agents on DNA
- 10. Effect of various chemical agents on DNA
- 11. To visit nearby research Institution/University to get acquainted with advanced techniques in related subject

# 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		and Angeleric and Angeleric Angeleric and Angeleric	10 (Based on Daily Performance only)
External Practical	-	n Miller an t <b>e</b> ceastraith a	15

#### A) Mid Term Assessment test: (15 Marks) Time Allotted 1 1/2 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.

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Course Code: UMJBTT-401 Course Title: Molecular Biology 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 hours

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.

# Reference books:

- 1. Cell and Molecular Biology: Concepts and Experiments- Karp, G., Iwasa, J. and Marshall, W., Wiley and Sons Inc., 8th edition (2021).
- 2. The Cell: A Molecular Approach- Cooper, G.M. and Hausman, R.E., Sinauer Associates Inc. and ASM Press, 8th edition (2019).
- 3. Lewin's Genes XII- Goldstein, E.S., Krebbs, J.E. and Kilpatrick, S.T., Jones and Bartlett Publishers Inc., 12<sup>th</sup> edition (2020).
- 4. Cell and Molecular Biology- De Robertis, E.D.P. and De Robertis, E.M.F., Blaze publishers
- and Distributors Pvt. Ltd., 8th edition (2017). 5. Principles of Gene Manipulations and Genomics- Primrose, S.B and Twyman, R., Black Well Scientific Publications, 8th edition (2016).

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Course Code: UMJBTT-402 Course Title: Enzymology 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 hours

#### **Objectives and Expected Learning Outcomes**

**Objectives:** To provide a deeper insight in to the fundamentals of enzyme, mechanisms and kinetics with integrated practical knowledge and to prepare students proficiently work with enzyme systems in academia, clinical laboratory and industry on current applications and future potential of enzymes. After completion of course students will able to understand the importance of enzymes in biological reactions and able to differentiate between chemical catalyst and biocatalyst, molecular basis of enzyme catalysed reactions along with their kinetics and inhibition, become conscious about importance of enzymes in clinical diagnosis and industrial applications.

#### Unit 1: Introduction to Enzymes and Enzyme catalysis

Enzyme concept - catalyst vs biocatalyst, chemical nature and properties of enzymes - isoenzymes, enzyme specificity, active site, units of enzyme activity, basis of IUBMB classification and nomenclature of enzymes, role of cofactors, coenzymes, prosthetic group in enzyme catalysis and metal ions with special emphasis on coenzyme functions, models for understanding the binding of substrate to active site.

#### Unit 2: Enzyme Kinetics

Pre-steady state kinetics and relaxation kinetics, kinetics of uni-substrate reactions: derivation of Michaelis-Menton equation,  $k_m$  and its significance, Lineweaver Burk plot and its limitations, Eadie-Hofstee plot. Concepts of multi-substrate enzyme kinetics - Ping-pong bi-bi, random order and compulsory order mechanism. Enzyme inhibition: competitive, non-competitive and uncompetitive inhibition (concepts with example).

#### Unit 3: Mechanism of Enzyme action

Mechanisms of catalysis: acid base catalysis, covalent catalysis, electrostatic catalysis, metal ion catalysis, proximity and orientation effects, mechanism of actions of chymotrypsin and carboxypeptidase. Determination of active site amino acids and functional group analysis by different methods. Biochemical basis of factors influencing the enzyme activity.

#### Unit 4: Industrial and clinical uses of enzymes

Industrial uses of enzymes: sources of industrial enzymes, thermophilic enzymes, amylases, glucose isomerases, cellulase, lipases, proteases in meat, leather industry, detergents and cheese production. Enzymes in pharmaceutical industry. Clinical enzymology: thrombolytic agents, anti-inflammatory agents, diagnostic tool, biosensor. Enzyme immobilization: techniques of immobilization, effect of immobilization on enzyme activity, application of immobilized enzyme.

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Course Code: UMJBTT-402 Course Title: Enzymology 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 hours

#### Practicals

- 1. Extraction of amylase from germinating wheat seeds and estimation of amylase activity.
- 2. Effect of incubation time on enzyme activity.
- 3. Effect of temperature on enzyme activity and determination of optimum temperature.
- 4. Effect of pH on enzyme activity and determination of optimum pH.
- 5. Effect of substrate concentration on enzyme activity.
- 6. Effect of inhibitor on enzyme activity.
- 7. Assay of serum/tissue alkaline phosphatase activity and acid phosphatase activity.
- 8. Assay of serum creatinine phosphokinase activity
- 9. Assay serum ALT activity.
- 10. Assay serum AST activity.
- 11. Subcellular fractionation of organelles from liver cells and identification by marker enzymes LDH
- 12. To visit nearby research Institution/University for getting acquainted with advanced techniques in related subject

#### 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

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Course Code: UMJBTT-402 Course Title: Enzymology 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 hours

# A) Mid Term Assessment test: (15 Marks) Time Allotted 1 1/2 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.

#### Reference Book:

- Enzymes: Biochemistry, Biotechnology and Clinical Chemistry- Palmer, T. and Bonner, P., Woodhead Publishing Limited, 2<sup>nd</sup> edition (2007).
- Fundamentals of Enzymology- Price, N.C. and Stevens, L., Oxford University Press Inc. (New York), 3<sup>rd</sup> edition (2009).
- Biocatalysis Fundamentals and Applications- Andreas S. Bommarius and Bettina R., Riebel-Bommarius. Wiley VCH, Verlag GmBH and Co., USA (2004).
- Biochemistry- Mathews, C.K., Van Holde, K.E. and Ahern, K.G., Pearson Education Inc., Singapore, 4<sup>th</sup> edition (2012).
- 5. Fundamentals of Enzymology- Nicholas, C.P. and Lewis, S., Oxford University Press Inc. (New York), 3<sup>rd</sup> edition (2009).
- Understanding Enzymes: An Introductory Text- Arya, A., Kumar, A. and Jha, J., Drawing Pin Publishing, New Delhi, India, 1<sup>st</sup> edition (2018).
- An Introduction to Practical Biochemistry- Plummer, D.T., Mc Graw Hill Education (India) Pvt. Ltd., 3<sup>rd</sup> edition (2017).
- Standard Methods of Biochemical Analysis- Thimmaiah, S.R., Kalyani Publisher, 2<sup>nd</sup> edition (2016).

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2. Biochemistry- Voet, D. and Voet, J., John Wiley and Sons, USA, 3<sup>rd</sup> Edition (2004).

Course Code: UMJBTT-403 Course Title: Immunology 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 hours

# **Objectives and Expected Learning Outcomes**

The objective of this course is to familiarize students with the immune system, immune effector mechanisms, immunotechniques and immunodiagnosis, hypersensitivity and vaccination etc. The course will provide technical knowledge as to how different diseases are caused and various responses mediated by living cells to combat pathogen attack. The course will provide sound knowledge of how immune system deals with various pathogens, different processes and cell types involved in prevention of disease. Along with this, the students will become aware about concept,

synthesis and action mechanism of vaccines. Understanding immune response in our body, both innate and adaptive, to different pathogens, tissue injury, allergy, and graft reactions and autoimmune response. Understand what happens if our immune system overreacts to foreign substances (hypersensitivities and allergies). Understand what happens if our body recognize self as non-self (autoimmunity). Understand the biology of different vaccines against infectious agents and solutions to produce better vaccines

Overview of immune system, T and B cell development, positive and negative selection, B and T cell receptor and role of co-receptors in signaling, organization and expression of lymphocyte receptor genes, B-cell receptor expression and multigene organization of Ig genes, the mechanism of V(D)J recombination, T-cell receptor genes and expression, TCR gene rearrangement.

# Unit 2: Cytokines and Complement system

Cytokines and their receptors, general properties of cytokines and chemokines, role of cytokines in activation, proliferation and differentiation of T-cells, biological functions of cytokines, role of cytokines in eliciting the activation of specific T-cell subpopulations, cytokine families and associated receptor molecules, cytokine antagonists, cytokine-related diseases, cytokine-based

Complement system, diverse functions of complement, major pathways of complement activation, generation of the MAC, complement deficiencies.

Course Code: UMJBTT-403 Course Title: Immunology 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 hours

# Unit 3: The Major Histocompatibility Complex and its role in organ transplant, cell and antibody effector response

Structure, function, general organization and inheritance of the MHC, functional relevance of MHC polymorphism, antigen processing and presentation by MHC-I and MHC-II, role of MHC in organ transplantation, different types of transplants, role of blood group and MHC, antigens in graft tolerance, hyperacute, acute, chronic rejection, immunosuppressive therapy.

Antibody mediated effector function: neutralization, opsonization, complement fixation, antibodydependent cell-mediated cytotoxicity (ADCC).

Cell-mediated effector responses: killing of tumour or infected cells via T-cell receptor activation, granzyme and perforin mediated cytolysis, Fas-FasL mediated cytolysis, NK cell mediated killing.

# Unit 4: The Immune System in Health and Disease:

Types of hypersensitivity reactions: type I-IV, autoimmunity, tolerance, establishment and maintenance of tolerance, anergy.

Autoimmune diseases: organ specific and systemic, treatment of autoimmune disorders.

Vaccines & vaccination – immunization, vaccination, herd immunity, inactivated or killed vaccines, subunit, recombinant vector and DNA vaccines, enhancing immune response to a vaccine by adjuvants.

#### Practicals:

- 1. Determination of blood groups
- 2. Separation of serum from blood
- 3. To find out the clotting time.
- 4. To find out the bleeding time
- 5. Determination of Differential Leucocytes Count (DLC)
- 6. Determination of Total Leucocytes Count (TLC)
- 7. Demonstration of Haemagglutination assay
- 8. Demonstration of Double immunodiffusion assay using specific antibody and antigen
- 9. Demonstration of Radial immunodiffusion assay using specific antibody and antigen
- 10. To visit nearby research Institution/University to get acquainted with advanced techniques in related subject

Course Code: UMJBTT-403 Course Title: Immunology 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 hours

#### 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)
<b>External</b> Practical	-	-	15

A) Mid Term Assessment test: (15 Marks) Time Allotted 1 1/2 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.

#### **Reference Book:**

- 1. Kuby Immunology- Punt, J., Stranford, S., Jones, P. and Owen, J.A., W.H. Freeman, (New York), 8<sup>th</sup> edition (2018).
- 2. Fundamental Immunology- Paul, W.E., Raven Press (New York), 7th edition (2012).
- Practical Immunology- Frank, C.H. and Olwyn, M.R.W., John Wiley and Sons Ltd., 4<sup>th</sup> edition (2002).
- Janeway's Immunobiology- Murphy, K. and Weaver, C., Garland Science (New York), 9<sup>th</sup> edition (2016).



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Course Code: UMJBTT-403 Course Title: Immunology 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 hours

- 5. Cellular and Molecular Immunology- Abbas, A., Lichtman, A.H. and Pillai, S., Elsevier, 10<sup>th</sup> edition (2021).
- 6. Roitt's Essential Immunology- Seamus, J.M., Burton, D.R., Roitt, I.M., and Peter, J.D., Wiley-Blackwell, 13<sup>th</sup> edition (2017).

Course Code: UMJBTT-404 Course Title: Biochemistry and Metabolism 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 hours Objectives and Expected Learning Outcomes

The course provides an introduction to biomolecules and their metabolic concepts. After successful completion of course, the students will be able to gain knowledge about various metabolites and their role in our body, impact of various metabolites on our health, significance of carbohydrates, amino acids, proteins, lipids and nucleic acids. The student will also get the concept of anabolism, catabolism and relationship between various metabolic pathways.

#### Unit 1: Carbohydrates

Definition, classification and structure of monosaccharides; Open and ring structure, anomeric forms, mutarotation; reaction of monosaccharides with special reference to glucose, structure and function of important oligosaccharides and polysaccharides; glycolysis and its regulation; Kreb'scycle, amphibolic nature of TCA cycle; glyoxylate cycle; glycogenesis and its breakdown, regulation of glycogen metabolism; gluconeogenesis and its regulation; pentose phosphate pathways; metabolism of fructose and galactose.

#### Unit 2: Lipids

Introduction, classification, nomenclature, structure and properties of fatty acids; saturated and unsaturated fatty acids; essential and non-essential fatty acids, chemical properties and characterization of fat hydrolysis; saponification value; Reichert – Meissel number, iodine number, rancidity of fats; triacylglycerols and cholesterol; structure and functions of phospholipids, galactolipids and sphingolipids; prostaglandins and steroids.

#### Unit 3: Amino acids and Proteins

Structure and properties of amino acids, structure of protein (primary, secondary, tertiary and quaternary), essential and non-essential amino acids, general reactions of amino acid metabolism. Digestion and absorption of dietary proteins; protein calorie malnutrition - Kwashiorkar and Marasmus; urea cycle and inherited defects of urea cycle; glucose-alanine cycle; glucogenic and ketogenic amino acids. Disorders of amino acids metabolism; phenylketonuria, alkaptonuria, maple syrup urine disease, Methylmalonic Acidemia (MMA), homocystinuria.

#### Unit 4: Nucleic acids

Composition of DNA and RNA; Nucleotide and nucleoside - structure and properties; *De novo* synthesis of purine and pyrimidine nucleotides and their regulation, salvage pathways for nucleotide synthesis; degradation of purine and pyrimidine nucleotides. Disorders of purine and pyrimidine metabolism – Lesch-Nyhan syndrome, gout, adenosine deaminase deficiency.

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Course Code: UMJBTT-404 Course Title: Biochemistry and Metabolism 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 hours

#### Practicals

- 1. Safety measures in laboratory and acquaintance to lab Instruments/equipments, glasswares and plasticwares.
- 2. Calculation and preparation of standard solutions; molar solution, normal solution and percent solution.
- 3. Qualitative tests for carbohydrates.
- 4. Qualitative tests for amino acids and proteins.
- 5. Qualitative tests for lipids.
- 6. Estimation of ascorbic acid.
- 7. Estimation of cholesterol from known source (Mustard oil).
- 8. Separation of amino acids by paper chromatography.
- 9. Separation of amino acids by thin layer chromatography.
- 10. To visit nearby research Institution/University to get acquainted with advanced techniques in related subject

#### 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)
<b>External Practical</b>	and the second	- 100 - 100	15

- A) Mid Term Assessment test: (15 Marks) Time Allotted 1 1/2 Hours
- B) External End Semester Examination: (60 Marks) Time Allotted 3 Hours

   a) External end semester theory examination will have two sections (A & B).

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Course Code: UMJBTT-404 Course Title: Biochemistry and Metabolism 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 hours

- 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.

# **References Books:**

- 1. Lehninger Principles of Biochemistry- Nelson, D.L. and Cox, M.M., WH Freeman and Co, (New York), 8th edition (2021).
- 2. Voet's Principles of Biochemistry- Voet, D., Voet, J.G. and Pratt, C.W., Wiley and Co., 5<sup>th</sup> edition (2018).
- 3. Fundamentals of Biochemistry- Jain, J.L., Jain, S. and Jain, N.S., Chand, 7th edition (2016).
- 4. Biochemistry- Satyanarayana, U. and Chakrapani, U., Elsevier, 5th edition (2020).
- 5. An Introduction to Practical Biochemistry- Plummer, D.T., Mc Graw Hill Education (India) Pvt. Ltd., 3rd edition (2017).

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**Course Code: UMIBTT-405** Course Title: Introduction to Molecular Biology 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 hours** 

# **Objectives and Expected Learning Outcomes:**

This course will guide students about the basic background (physical and chemical) of molecular biology. After successfully completing this course, the students will be able to understand the basic concepts in molecular biology, basic composition of nucleic acids, their structure and their mode of replication, conversion of genetic information coded in DNA to cellular macromolecules.

# Unit 1: Structure of Nucleic Acid

Structure of nucleic acids: nucleosides & nucleotides, purines and pyrimidines. Watson and Crick model of DNA structure, A, B & Z forms of DNA, supercoiled and relaxed DNA, denaturation and renaturation of DNA, melting temperature (Tm), hyperchromic effect. RNA structure and types of RNA: mRNA, tRNA, rRNA, siRNA, miRNA, snoRNA, SnRNA.

#### Unit II: Replication

Semiconservative replication, chromosomal replication and regulation with reference to E. coli: initiation, elongation and termination; factors and elements required in replication; regulation of replication. DNA replication vis a vis cell cycle in E. coli and replication of plasmid DNA. Introduction to replication in eukaryotic organisms: replication in yeast and SV 40.

# Unit III: Transcription

Organization of gene: concept of promoter, enhancer, silencer; transcription factors, RNA polymerase. Transcription in prokaryotes: initiation, elongation and termination; operon concept, inducible and repressible operons. Transcription in eukaryotes: initiation, elongation and termination. Co and post transcriptional processing of RNA transcripts.

### **Unit IV: Translation**

Genetic code: salient features, start codon, stop codon, wobble hypothesis, degeneracy of codon, codon bias; Concept of reading frame. Translation: structure and function of ribosomes; protein synthesis in prokaryotes: initiation, elongation and termination. Protein synthesis in eukaryotes initiation, elongation and termination. Post translational modification of proteins.



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**Course Code: UMIBTT-405 Course Title: Introduction to Molecular Biology** 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 hours** 

#### Practicals

- 1. Isolation of DNA from living cell.
- 2. Quantification of DNA by Spectrophotometer.
- 3. Agarose gel electrophoresis of isolated DNA.
- 4. Estimation of purity of DNA by spectrophotometry.
- 5. Quantification of DNA using agarose gel by normalization.
- 6. Preparation of stock solutions, concept of molarity, normality and concentration.
- 7. Determination of molecular weight of given DNA sample using semi log paper
- 8. Effect of concentration of agarose on the migration of DNA through agarose gel
- 9. Effect of various physical agents on DNA
- 10. Effect of various chemical agents on DNA
- 11. To visit nearby research Institution/University to get acquainted with advanced techniques in related subject

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

# NOTE FOR PAPER SETTING

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.

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Course Code: UMIBTT-405 Course Title: Introduction to Molecular Biology 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 hours

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.

#### **Reference Books:**

- Cell and Molecular Biology: Concepts and Experiments- Karp, G., Iwasa, J. and Marshall, W., Wiley and Sons Inc., 8<sup>th</sup> edition (2021).
- 2. The Cell: A Molecular Approach- Cooper, G.M. and Hausman, R.E., Sinauer Associates Inc. and ASM Press, 8<sup>th</sup> edition (2019).
- 3. Lewin's Genes XII- Goldstein, E.S., Krebbs, J.E. and Kilpatrick, S.T., Jones and Bartlett Publishers Inc., 12<sup>th</sup> edition (2020).
- 4. Cell and Molecular Biology- De Robertis, E.D.P. and De Robertis, E.M.F., Blaze publishers and Distributors Pvt. Ltd., 8<sup>th</sup> edition (2017).
- 5. Principles of Gene Manipulations and Genomics- Primrose, S.B and Twyman, R., Black Well Scientific Publications, 8<sup>th</sup> edition (2016).