University of Kashmir

Department of Biotechnology

(NAAC Accredited Grade-A+)
Hazratbal, Srinagar, Kashmir- 190006

Dated: 06/06/2023

Minutes of Meeting

Minutes of meeting of Board of Undergraduate Studies in Biotechnology held on 6th June 2023 at 11:00 a.m.

Agenda: Course titles of undergraduate Biotechnology courses and framing syllabi for 3rd and 4th semester.

The board of undergraduate studies meeting was held on 6th of June 2023 at 11:00 a.m under the chairmanship of Professor Mahboobul Hussain in the departmental library of Department of Biotechnology. With the onset of meeting, the chairman welcomed the members and declared the meeting open. The members were granted the mandate for framing the titles for the courses and designing the syllabi for 3rd and 4th semester undergraduate courses in Biotechnology.

The major outcomes/recommendations of the meeting are:-

1. The titles for all the 18 courses for undergraduate Biotechnology were finalized.
2. The syllabi for the third semester CT-1 course entitled "Cell Biology" was finalized.
3. The syllabus for four semester courses CT-1 to CT-3 were finalized.
4. The "expected learning outcomes" and "books recommended" were also finalized.

The meeting ended with a vote of thanks to the chair.

Professor Mahboobul Hussain
(Chairman)

Dr. Roohi

Muzaffer Ahmad Ahanger

Dr. Mohd Ashraf Khan 06.06.23

Bilal Ahmed

Forwarded to the Dean Biological Sc for recommendations please.

HoD
Prof & Head
Deptt. of Bio-Technology
University of Kashmir

Proposed titles for undergraduate programme in Biotechnology under NEP 2020

Semester	CT1	CT2	CT3
I	Biomolecules: Structure and Function (4 + 2) Major/Minor		
II	Microbiology and Immunology (4 + 2) Major/Minor		
III	Molecular Cell Biology (4 + 2) Major/Minor		
IV	Biotechniques (3 + 1) Major/Minor	Molecular Biology (4 + 2)	Recombinant DNA Technology (4 + 2)
V	Developmental and Systems Biology (3 + 1) Major/Minor	Animal Biotechnology (4 + 2)	Biostatistics and Bioinformatics (4 Credits) **Internship/Tutorial (2 credits)**
VI	Environmental Biotechnology (3 + 1) Major/Minor	Plant Biotechnology (4 + 2)	OMICS: Genomics, transcriptomics and proteomics (4 + 2)
VII	Molecular Genetics and Epigenetics (3 + 1) Major/Minor	Bioprocess Engineering and Technology (4+2)	Molecular Diagnostics and Drug Design (4 + 2)
VIII (Hons)	IPR, Bioethics and Biosafety (3 + 1) Major/Minor	Food Biotechnology and Nutrigenomics (4+2)	Cell Signaling and Cancer Biology (4+2)
VIII (Research)	IPR, Bioethics and Biosafety (3 + 1) Major/Minor	**Project (12 credits)**	

Prof. M U Hussain
Chairman

Dr Shah Ubaidullah

Dr Roohi Mushtaq

Muzaffer Ali Ahanger

Dr. Ajaz Ahmad Ganai

Dr. Mohd Ashraf Khan

Programme Outcomes for Undergraduate Program in Biotechnology

A. Understanding of the molecules of life and demonstrate interdisciplinary skills acquired in biomolecules, microbiology, cell biology, immunology, molecular biology.
B. Demonstrate the different lab skills acquired in biomolecules, cell biology, immunology, microbiology with emphasis on applied part.
C. Competent and apply the knowledge and skill gained in the subjects of biotechniques, recombinant DNA technology, Animal and Plant Biotechnology, Bioprocess and Food technology in research, dairy, agriculture, food and other biotechnology product development industries.
D. Critically analyze environmental problems and apply the knowledge gained for their solutions and conserving environment.
E. Apply the knowledge and skills gained from biochemistry, immunology, microbiology, genetics, drug design, bioinformatics to solve the different problems of mankind and help to combat diseases and better drug design for sustainable life.
F. Examine and interpret data and use the different tools of biostatistics, bioinformatics and omics technologies for better health and sustainable development.
G. Demonstrate communication and presentation skills, scientific writing, data collection and interpretation in the different fields of biotechnology.
H. Learn professional skill and ethics in handling microbes, recombinant DNA technology products their management and ethics of research and communication.
I. Use of biotechnology concepts and expertise, innovative thinking to address present and future challenges especially of health, food and environment.

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PROGRAMME LEARNING OUTCOMES OF THE MAJOR DISCIPLINE FROM I[st] TO THE LAST SEMESTER:

SEMESTER	COURSE CODE	LEARNING OUTCOMES											
		A	B	C	D	E	F	G	H	I	J	K	L
I	BTG122J	✓	✓			✓		✓					
II	BTG222J	✓	✓	✓		✓			✓	✓			
III	BTG322J	✓	✓	✓		✓	✓	✓					
IV	BTG 422J1		✓	✓	✓	✓	✓	✓	✓	✓			
	BTG422J2	✓	✓	✓	✓	✓	✓	✓	✓	✓			
	BTG422J3	✓	✓	✓	✓	✓	✓	✓	✓	✓			
V	BTG522J1	✓		✓		✓	✓						
	BTG522J2		✓	✓		✓		✓	✓				
	BTG522J3				✓	✓	✓	✓	✓				
VI	BTG622J1	✓	✓			✓			✓				
	BTG622J2		✓	✓		✓		✓	✓				
	BTG622J3		✓	✓	✓	✓	✓		✓	✓			
VII	BTG722J1	✓	✓	✓	✓	✓				✓			
	BTG722J2		✓	✓		✓			✓				
	BTG722J3		✓	✓	✓	✓	✓		✓	✓			
VIII (R)	BTG822J1			✓			✓	✓	✓	✓			
	BTG822JP												
VIII (H)	BTG822J1			✓			✓	✓	✓	✓			
	BTG822J2	✓	✓	✓	✓	✓	✓			✓			
	BTG822J3	✓	✓	✓		✓				✓			

(NOTE: IN THE ABOVE TABLE LEARNING OUTCOMES SHALL BE SPECIFIED IN PLACE OF A, B, C ... L etc. AND RELEVANT BOXES IN THE TABLE SHALL BE TICK MARKED)

Head of the Department / Convenor BOUGS

Prof & Head
Deptt. of Bio-Technology
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BACHELOR'S PROGRAMME WITH BIOTECHNOLOGY AS MINOR SUBJECT

SEMESTER	COURSE CODE	TYPES OF COURSE	TITLE OF COURSE	CREDITS		
				THEORY 4	PRACTICAL 2 or 0	TUTORIAL 0 or 2
I	BTG122N	MINOR	Biomolecules: Structure and Function	4	2	
II	BTG222N	MINOR	Microbiology and Immunology	4	2	
III	BTG322N	MINOR	Molecular Cell Biology	4	2	
IV	BTG422N	MINOR	Biotechniques	3	1	
V	BTG522N	MINOR	Developmental and Systems Biology	3	1	
VI	BTG622N	MINOR	Environmental Biotechnology	3	1	
VII	BTG722N	MINOR	Molecular Genetics and Epigenetics	3	1	
VIII	BTG822N	MINOR	IPR, Bioethics and Biosafety	3	1	

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BACHELOR'S PROGRAMME WITH BIOTECHNOLOGY AS MAJOR SUBJECT

SEMESTER	COURSE CODE	TYPES OF COURSE	TITLE OF COURSE	CREDITS		
				THEORY	PRACTICAL	TUTORIAL/ INTERNSHIP
I	BTG 122J	MAJOR	Biomolecules: Structure and Function	4	2	
II	BTG 222J	MAJOR	Microbiology and Immunology	4	2	
III	BTG 322J	MAJOR	Molecular Cell Biology	4	2	
IV	BTG 422J1	COURSE TYPE-1	Biotechniques	3	1	
	BTG 422J2	COURSE TYPE-2	Molecular Biology	4	2	
	BTG 422J3	COURSE TYPE-3	Recombinant DNA Technology	4	2	
V	BTG 522J1	COURSE TYPE-1	Developmental and Systems Biology	3	1	
	BTG 522J2	COURSE TYPE-2	Animal Biotechnology	4	2	
	BTG 522J3	COURSE TYPE-3	Biostatistics and Bioinformatics	4		Internship: 2
VI	BTG 622J1	COURSE TYPE-1	Environmental Biotechnology	3	1	
	BTG 622J2	COURSE TYPE-2	Plant Biotechnology	4	2	
	BTG 622J3	COURSE TYPE-3	OMICS: Genomics, transcriptomics and proteomics	4	2	
VII	BTG 722J1	COURSE TYPE-1	Molecular Genetics and Epigenetics	3	1	
	BTG 722J2	COURSE TYPE-2	Bioprocess Engineering and Technology	4	2	
	BTG 722J3	COURSE TYPE-3	Molecular Diagnosis and Drug Design	4	2	
VIII (Hons with research)	BTG 822J1	COURSE TYPE-1	IPR, Bioethics and Biosafety	3	1	
	BTG 822JP	PROJECT	PROJECT	-	12	-
VIII (Hons)	BTG 822J1	COURSE TYPE-1	IPR, Bioethics and Biosafety	3	1	
	BTG 822J2	COURSE TYPE-1	Food Biotechnology and Nutrigenomics	4	2	
	BTG 822J3	COURSE TYPE-1	Cell Signaling and Cancer Biology	4	2	

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PROGRAMME LEARNING OUTCOMES OF THE MINOR DISCIPLINE FROM 1ST TO THE LAST SEMESTER:

SEMESTER	COURSE CODE	LEARNING OUTCOMES											
		A	B	C	D	E	F	G	H	I	J	K	L
I	BTG122J	✓	✓			✓		✓					
II	BTG222J	✓	✓	✓		✓			✓	✓			
III	BTG322J	✓	✓	✓		✓	✓	✓					
IV	BTG422N		✓	✓	✓	✓	✓	✓	✓	✓			
V	BTG522N	✓		✓		✓	✓						
VI	BTG622N	✓	✓			✓			✓				
VII	BTG722N	✓	✓	✓	✓	✓				✓			
VIII	BTG822N			✓			✓	✓	✓	✓			

(NOTE: IN THE ABOVE TABLE LEARNING OUTCOMES SHALL BE SPECIFIED IN PLACE OF A, B, C ... L etc. AND RELEVANT BOXES IN THE TABLE SHALL BE TICK MARKED)

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Course title: Molecular Cell Biology **Semester-III** **Theory: 4, Practicals: 2**

Objectives: *Cell being the basic unit of life, this course is aimed to provide students an insight about basic cellular structure, functioning of cell organelles and cell cycle.*

Expected Learning Outcomes*: Students will be able to;*

- *Draw the organization of cell membrane and distinguish between different types of transport across it.*
- *Analyze the functioning of Endoplasmic reticulum, Golgi complex and associated vesicle transport.*
- *Describe the structure and functioning of nucleus and other organelles.*
- *Gain an understanding of the functions performed by the cytoskeleton and the significance of cell-cell interactions and distinguish between different phases of the cell cycle.*

UNIT I **15 lectures**

Introduction to cell (animal and plant cell). Cell Membrane – structure and function. Membrane organization (Fluid Mosaic Model). Transport across membrane – Active and Passive transport (Ca^{++}-ATPase, Na^{+}/K^{+}ATPase, Na^{+}linked, Na^{+}-linked Antiporter, $Ca^{++}$from cardiac muscle, symporters, diffusion and facilitated diffusion).

UNIT II **15 lectures**

Endoplasmic reticulum, Golgi complex and Lysosomes: Structure and function. Role in Protein sorting and transport. Mechanism of vesicular transport (COP I, COP II and Clathrin coated vesicles). Endocytosis, Pinocytosis and Phagocytosis.

Unit III **15 lectures**

Mitochondria, chloroplast, ribosomes, vacuoles and peroxisomes: Structure and function. Structure and organization of nucleus, organization of nuclear pore. Structure and functions of microtubules, microfilaments and intermediate filaments.

UNIT IV **15 lectures**

Extra cellular matrix and cell-matrix interactions. Cell-cell interactions: Adherence junctions, tight junctions, gap junctions, desmosomes, hemidesmosomes, focal adhesions and plasmodesmata. Cell cycle (mitosis and meiosis), regulation of cell cycle. Apoptosis - brief idea.

Practicals:

1. Studying of different cellular organelles with animations and micrographs.
2. Studying the different stages of mitosis by preparing slides of onion root tip.
3. Staining of cells.
4. Karyotyping.
5. Observations on the permeability of Plasma membrane- effect of Isotonic, Hypotonic and Hypertonic solutions on Mammalian R.B.Cs or any other cell.
6. Field trip/subject tour/report.

Books:

1. Molecular Biology of the Cell by Alberts, B Taylor and Francis, New York. USA.
2. Cell and Molecular Biology: Concepts and Experiments by G. Karp, John Wiley & Sons.
3. Cell and Molecular Biology by De Robertis and De Robertis Lippincott Williams and Wilkins, Philadelphia.
4. The Cell: A Molecular Approach by Cooper, G.M. and Hausman, ASM Press.
5. The World of the Cell by Becker, Kleinsmith, Hardin. J. and Berton, Pearson Benjamin Cummings Publishing,

Prof. M.U. Mullah Chairman

Dr Shafi Ahmad Mullah

Muzaffer Ali Ahanger

Dr. Mohd Ashraf Khan

Dr. Aijaz Ahmad Gami

Dr. Rochi Mushtaq

BACHELOR WITH BIOTECHNOLOGY AS MAJOR

4th Semester

BTG 422J3: RECOMBINANT DNA TECHNOLOGY

CREDITS: THEORY – 4, PRACTICAL – 2

MAXIMUM MARKS: 100, MINIMUM MARKS: 36

Objective: *Through this course, students will learn about the different tools used in recombinant DNA technology and its applications.*

Expected Learning Outcomes: *At the end of the course students should be able to:*

1. *Use different enzymes for cloning, modification and amplification of DNA.*
2. *Select and use the suitable vector for cloning and screening of transformants.*
3. *Express recombinant proteins and purify them.*
4. *Make cDNA library, edit and target different genes.*

THEORY (4 CREDITS: 60 HOURS)

UNIT I **15 Hours**

Introduction to Recombinant DNA technology, tools of recombinant DNA technology: Restriction endonucleases (types, nomenclature, cleavage pattern-blunt and cohesive end cutters), DNA polymerases (pol I, Klenow fragment, Taq), DNA ligases, kinases, phosphatases, nucleotidyl transferase, exonucleases, reverse transcriptase. Use of linker and adapters, homopolymer tailing.

Unit II **15 Hours**

Plasmid vectors- general features. Features of pBR322 and pUC. Bacteriophage vectors: insertion and replacement, M13, cosmids, phagemids, YAC and BAC. Basic cloning methodology in plasmid vectors: Vector and insert preparation, ligation, competent cells, transformation (heat-shock and electroporation) screening of recombinants (antibiotic resistance and blue-white screening). Preparation of probe – radioactive and non radioactive labeling. Sequence based screening (colony, hybridization, PCR)

UNIT III **15 Hours**

Recombinant protein expression in heterologous systems: expression in E.coli (inducible promoter system), yeast, insect and mammalian systems. Recombinant protein purification using tags (His, GST, Flag, HA). Reporter genes (luciferase, CAT, GFP, GUS) and their applications. In vitro transcription and translation and its applications.

Unit IV **15 Hours**

M.V. Hussain Chairman

Dr Ubaid Ullah

Dr. Ajaz Ahmad

Dr. M.A.M

Mr. Muzaffer Ali Khanzada

Dr. Kochi Mushtaq

Genomic and cDNA library construction, screening of libraries. Gene knock downs: antisense RNA technology and RNA interference. Gene knock out by Cre-LoxP system. Gene editing by CRISPR-CAS system. Gene targeting: Site directed mutagenesis (single primer extension, double primer extension, PCR based mutagenesis). Protein engineering for increased thermal stability, activity, shelf life.

PRACTICALS (2 CREDIT: 60 HOURS) Maximum Marks: 50, Minimum Marks: 18

1. DNA/plasmid isolation from bacterial/plant/any other cell.
2. Preparation of competent cells.
3. Restriction digestion of DNA.
4. Transformation of competent cells by heat shock.
5. Easy (TA) Cloning.
6. Blue-white screening
7. Agarose gel electrophoresis.
8. Educational tour to different labs/institutes.

Suggested Readings:

1. Molecular Biotechnology: Principles and Applications of Recombinant DNA by Bernard R. Glick, Cheryl L. Pattern, ASM Press.
2. Gene Cloning and DNA Analysis: An Introduction by Brown TA Wiley-Blackwell
3. Principles of Gene Manipulation and Genomics by Primrose SB, Twyman R and Old B Wiley- Blackwell.
4. Gene Cloning and Manipulation by Christopher Howe, Cambridge University Press
5. Analysis of Genes and Genomes by Reece J Richard, Wiley-Blackwell

BACHELOR WITH BIOTECHNOLOGY AS MAJOR

4th SEMESTER

BTG 422J1: BIOTECHNIQUES

CREDITS: THEORY – 3, PRACTICAL – 1

MAXIMUMMARKS: 75, MINIMUM MARKS: 27

- Course Learning Objective: This course is designed to expose student to different techniques, handling instruments understand their working and applications for research and analysis.
- **Course outcome:** A student will be able to:
  - prepare specimens and use different types of microscopes for observation and use of UV-Vis spectroscopy for different applications.
  - Separate, purify and characterize different bio molecules using centrifugation and chromatographic techniques.
  - Analyze, separate and identify nucleic acids and proteins by different electrophoretic and blotting techniques.

Unit -1 15 hours

Centrifugation: General principle of centrifugation, sedimentation coefficient, preparative and analytical centrifugation, differential centrifugation & density-gradient centrifugation, ultracentrifugation and its applications.

Chromatography: Principle, working and applications of thin-layer chromatography, ion-exchange chromatography, gel filtration and affinity chromatography, HPLC.

Unit -2 15 hours

Electrophoresis: General principle and types: Principle, procedure and applications of native poly acrylamide gel electrophoresis, sodium dodecyl sulphate polyacrylamide gel electrophoresis, isoelectric focusing, two-dimensional gel electrophoresis and agarose gel electrophoresis, pulse field gel electrophoresis.

Blotting techniques: Southern, northern & western blotting; **PCR**: principle, methodology and applications.

Unit -3 15 hours

Microscopy: Principle, working and applications of light microscopy - bright-field, dark-field, phase-contrast, fluorescence & confocal microscopy, electron microscopy- TEM and SEM; Staining-principle and procedure of simple staining, negative staining & differential staining.

Dr Ubaid Ullah

Dr. Rooh Mukhtar

Spectroscopy: Beer-Lambert's law. Principle, working and applications of ultraviolet/visible light spectroscopy (UV/Vis spectroscopy).

PRACTICALS (1 CREDITS: 15 hours) Maximum Marks: 25, Minimum Marks: 9

1. Use of microscope – simple attaining and differential staining (Gram staining)
2. Separating cells from broth/plasma separation from blood.
3. Paper chromatography/TLC
4. SDS-PAGE.
5. Amplification of a gene by PCR/demonstration.
6. Agarose gel electrophoresis.

BOOKS RECOMMENDED

1. Principles and Techniques of Biochemistry and Molecular Biology: Wilson, K. and Walker, J. Cambridge University Press.
2. Physical Biochemistry - Applications to Biochemistry and Molecular Biology: Freifelder, D., W. H. Freeman and Company.
3. Molecular Cloning - A Laboratory Manual: Sambrook, J. and Russell, D. W., Cold Spring Harbor Laboratory Press.

BACHELOR WITH BIOTECHNOLOGY AS MAJOR

4th SEMESTER

BTG 422J2: Molecular Biology

CREDITS: THEORY – 4, PRACTICAL – 2

MAXIMUM MARKS: 100, MINIMUM MARKS: 34

- Course Learning Objective: aim of this course is to understand information flow at molecular level, appreciate the functions of DNA, RNA and protein and how these regulate different biological processes.
- **Course outcome:** A student will be able to;
  - Analyze the different properties of nucleic acids and genomes.
  - Interpret and predict the role of different enzymes and proteins involved in replication of DNA, mutation and repair.
  - Illustrate the process of gene expression, factors involved, processing and regulation of expression.
  - Describe how the language of the nucleic acids is translated into proteins and its regulation.

UNIT – I 15 hours

DNA as genetic material (Griffith, Avery-MacLeod-McCarty and Hershey and Chase experiments), RNA as genetic material (Fraenkel Conrat experiment). DNA structure - features of double helix, forms of DNA (A, B, Z, H). Forces stabilizing DNA, DNA topology, Genome and C-value paradox, Genome complexity (Cot curve, repetitive, non-repetitive sequences). Organization of prokaryotic and eukaryotic genomes.

UNIT – II 15 hours

DNA Relication in prokaryotes, modes of replication (semi-conservative, conservative, dispersive, continuous, discontinuous and bi-directional replication), origin of replication (prokaryotic and eukaryotic). Enzymes and proteins involved: DNA polymerases, helicases, topoisomerase and ligase, proof reading, leading and lagging strand synthesis. Rolling circle replication (λ and M13). End replication of linear DNA (telomerase). DNA Mutations: Base substitution, missense, non sense, deletion, insertion, frame shift, silent). DNA damage: radiation, alkylation and oxidative. DNA repair: photo-reactivation, base excision, nucleotide excision, mismatch and recombination repair.

UNIT – III 15 hours

Transcription in prokaryotes: RNA polymerase, role of σ factor, promoter, initiation, elongation and termination. Operon concept, positive and negative regulation with reference

to *lac* and *trp* operons. Eukaryotic transcription: RNA polymerases, promoters, promoter clearance, enhancers, silencers, transcription factors/domains (zinc finger domains, leucine zippers, basic domains). Post-transcriptional processing - 5' cap formation, splicing, polyadenylation. Brief outline of rRNA and tRNA processing. Inhibitors of transcription.

UNIT – IV 15 hours

Protein translation machinery: ribosomes, mRNA, tRNA, charging of tRNA, aminoacyl tRNA synthetases, translation initiation (prokaryotes and eukaryotes).Genetic code – its salient features. Wobble hypothesis, reading frames, mechanism of elongation and termination in prokaryotes and eukaryotes. Inhibitors of translation. Post-translational modifications of proteins. Translation regulation.

PRACTICALS (2 CREDITS: 30 hours) Maximum Marks: 50, Minimum Marks: 18

1. Isolation of genomic DNA from bacterial cells.
2. Qualitative analysis of DNA by agarose gel electrophoresis.
3. Isolation of RNA from cells.
4. Quantitative estimation of RNA and DNA by spectrophotometry.
5. DNA denaturation and renaturation curves and calculation of Tm.
6. Lab visits/ Field trip/ subject tour etc.

Suggested Reading:

1. Cell and Molecular Biology: Concepts and Experiments. Karp, G. John Wiley & Sons, Inc.
2. The Cell: A Molecular Approach. Cooper, G.M. and Hausman, R.E ASM Press
3. The World of the Cell. Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G. P. Benjamin-Cummings Pub
4. Molecular Biology of the Gene, J Watson, T Baker, S Bell, A Gann, M Levine, R Losick, Pearson
5. Lewins Genes XI J E. Krebs, S T. Kilpatrick, E S. Goldstein Jones & Bartlett Learning
6. Molecular Cell Biology Harvey Lodish, Arnold Berk, Chris A. Kaiser Monty Krieger, Anthony Bretscher, W H Freeman & Co
7. Molecular Biology. David Freifelder. Narosa Publishers.