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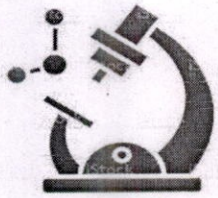
CBCS CURRICULUM OF

M.Sc. BIOTECHNOLOGY PROGRAMME



SUBJECT CODE = BTM

FOR POST GRADUATE COURSE UNDER KOLHAN UNIVERSITY

Academic session 2021 -2023

16/09/2021

DEAN
FACULTY OF SCIENCE
KOLHAN UNIVERSITY
CHAIBASA

CENTER FOR BIOTECHNOLOGY

KOLHAN UNIVERSITY

CHAIBASA

Kolhan University, Chaibasa

M.Sc.(Bio-Tech) Semester Wise Distribution of Courses

Semester-I

Course Code	Name of Paper	Credit	Hrs./Week	Full Marks	ESUE*	SIA*(For Theory) / Viva-Voce (For Practical)	Pass Marks (External)	Pass Marks (Internal)
FCBTM101	Microbiology	4	3(L)+1(T)	100	70	30	28	12
BTM102	Cell Biology	4	3(L)+1(T)	100	70	30	28	12
BTM103	Biochemistry & Biophysics	4	3(L)+1(T)	100	70	30	28	12
BTM104	Genetics and Molecular Biology	4	3(L)+1(T)	100	70	30	28	12
BTM105	Practical Based on BTM101, BTM102, BTM103 & BTM104	6	12(L)	100	80	20	32	08

Semester-II

Course Code	Name of Paper	Credit	Hrs./Week	Full Marks	ESUE*	SIA* (For Theory) / Viva-Voce (For Practical)	Pass Marks (External)	Pass Marks (Internal)
BTM201	Biology of the Immune System	**4**	3(L)+1(T)	**100**	**70**	**30**	**28**	**12**
BTM202	Enzymology & Enzyme Technology	**4**	3(L)+1(T)	**100**	**70**	**30**	**28**	**12**
BTM203	Genetic Engineering	**4**	3(L)+1(T)	**100**	**70**	**30**	**28**	**12**
BTM204	Genomics and Proteomics	**4**	3(L)+1(T)	**100**	**70**	**30**	**28**	**12**
BTM205	Practical Based on BTM201, BTM202, BTM203 & BTM204	**6**	12(L)	**100**	**80**	**20**	**32**	**08**

Semester-III

Course Code	Name of Paper	Credit	Hrs./Week	Full Marks	ESUE*	SIA* (For Theory)/ Viva-Voce(For Practical)	Pass Marks (External)	Pass Marks (Internal)
BTM301	Animal Cell Culture	4	3(L)+1(T)	100	70	30	28	12
BTM302	Bioprocess Engineering & Technology	4	3(L)+1(T)	100	70	30	28	12
BTM303	Plant Biotechnology	4	3(L)+1(T)	100	70	30	28	12
BTM304	Practical Based on BTM301, 302 & BTM303	6	12	100	80	20	32	08
BTM305	Project / Dissertation - I	6	12	100	80	20	32	08

Semester-IV

Course Code	Name of Paper	Credit	Hrs./Week	Full Marks	ESUE*	SIA*(For Theory) / Viva-Voce (For Practical)	Pass Marks (External)	Pass Marks (Internal)
EBTM401	Environmental Biotechnology	4	3(L)+1(T)	100	70	30	28	12
BTM402	Bioinformatics	4	3(L)+1(T)	100	70	30	28	12
BTM403	Biostatistics	4	3(L)+1(T)	100	70	30	28	12
BTM404	Based on BTM401 & BTM402	6	12	100	70	30	28	12
BTM405	Project / Dissertation - II	6	12	100	80	20	32	8

Semester I

BTM 101 : Microbiology **Credits 4**

1. History of Microbiology, Discovery of the microbial world.
2. Isolation, pure culture techniques, Methods of sterilization and Enrichment culture techniques.
3. Bacterial identification, nomenclature and classification, New approaches to bacterial taxonomy /classification including ribotyping and ribosomal RNA sequencing.
4. General structure and features, Brief account of all group of bacteria and cyanobacteria, Rickettsias,Chlamydias and Mycoplasmas, Archaea : Archaebacteria and extremophilic microbes – their biotechnological potentials
5. The definition of growth, growth curve, measurement of growth and growth yields, Culture collection and maintenance of cultures.
6. Different modes of nutrition in bacteria, Sulfate reduction, Nitrogen metabolism – nitrate reduction,nitrifying and denitrifying bacteria, Nitrogen fixation and Microbes used as biofertilizer.
7. Viruses : Classification, morphology and composition of viruses in general,Plant viruses (TMV, Gemini Virus), Animal viruses (baculo viruses),Bacteriophages : Lambda, φX 174, cyanophages,
8. Viroids and Prions.

BTM 102 : Cell Biology **Credits 4**

1. Principles of Microscopy: Optical (including Phase contrast and Differential interference);

Fluorescence, Confocal and Electron Microscopy.

2. Structure of Cell (Bacterial, Plant and Animal): Cell membranes, Composition & architecture of Cell Wall,
3. Structure and function of organelles (mitochondria, chloroplast, Nucleus, Golgi apparatus, Lysosomes, Ribosomes) and Cytoskeletal elements.
4. Cell adhesion; cell junctions, cell adhesion molecules & extra-cellular matrix.
5. Basic concepts of signal transduction.
6. Transport across bio-membranes: facilitated transport, group translocation, Active transport, Na+-K+ATPase pump.
7. Cell cycle and its control.
8. Oncogenesis.
9. Brief introduction to the biology of following pathogens: AIDS, Malaria, Tuberculosis and Kalajar.
10. Animal cloning and in vitro fertilization

BTM103 : Biochemistry & Biophysics **Credits 4**

1. Carbohydrates; Glycolysis, Gluconeogenesis, Krebs' Cycle, Electron transport chain, Oxidative Phosphorylation.

2. Fatty acids; general properties and ß- oxidation.
3. Nitrogen metabolism: Amino acids (general properties); Amino acid sequencing and composition; end group analysis.
4. Proteins: Protein structure (primary, secondary, tertiary & quartenary), Globular, Fibrous proteins; Ramachandran plot, Circular Dichroism, Hydrophobic and hydrophilic interactions. PAGE, SDSPAGE,Diagonal Electrophoresis, MALDI.
5. Protein folding (Introduction / Tools to study folding – unfolding phenomenon)
6. DNA - protein interactions; DNA-drug interactions.
7. Photosynthesis; carbon fixation and photorespiration

BTM 104 : Genetics and Molecular Biology **Credits 4**

1. Introduction to cell division, Mendelian Laws and physical basis of inheritance, dominance and its molecular basis.
2. Basics of gene interaction, cis-trans-test and complementation test, lethal genes, polygenic traits,linkage and gene maps.
3. Double helix: Physico-chemical considerations.
4. Organization of prokaryotic and eukaryotic genomes, supercoiling, repetitive DNA.
5. DNA replication: Mechanism of replication of Prokaryotic & Eukaryotic Chromosome.
6. Mutation: Types and molecular mechanisms of mutations, mutagens, DNA Repair.
7. Transposition: Mechanisms of transposition, role of transposons in mutation.
8. Gene transfer in prokaryotes: Transformation, conjugation, transduction, construction of genetic mapsin bacteria.
9. Recombination: Homologous and site - specific recombination.
10. Gene expression in bacteria: Transcription and its regulation; operons, attenuation, anti-termination and anti-sense controls.
11. Prokaryotic translation machinery, mechanism and regulation of translation.
12. Gene expression in eukaryotes: Transcription, general and specific transcription factors, regulatory elements and mechanism of regulation, processing of transcripts.

BTM105 (Practicals): Based on BTM101,BTM102, BTM103 & BTM104 Credits 6

Semester II

BTM201 : Biology of the Immune System **Credits 4**

1. Introduction: Innate and acquired immunity, clonal nature of immune response.
2. Nature of antigens.
3. Antibody structure and function.
4. Antigen - antibody reactions and applications.
5. Major histocompatibility complex.
6. Complement system.
7. Hematopoiesis and differentiation.

8. Regulation of the immune response: Activation of B and T-lymphocytes, Cytokines, T-cell
regulation, MHC restriction, Immunological tolerance.
9. Cell-mediated cytotoxicity : Mechanism of cytotoxic T cells and NK cells mediated target cell lysis,Antibody dependent cell mediated cytotoxicity, macrophages mediated cytotoxicity.
10. Hypersensitivity.
11. Autoimmunity.
12. Transplantation.
13. Immunity to infection and tumours.

BTM 202 : Enzymology & Enzyme Technology **Credits 4**

1. Classification and nomenclature of enzymes.
2. Isolation, purification and large-scale production of enzymes.
3. Coenzymes and Cofactors.
4. Steady state kinetics: Methods for estimation of rate of enzyme catalyzed reaction with specialreference to Michaelis-Menten equation. Effects of substrate, temperature, pH and inhibitors on
enzyme activity and stability.
5. Mechanism of enzyme action (active site, chemical modification) and regulation (Zymogens,Isozymes).
6. Enzyme engineering.
7. Applications of enzymes.
8. Immobilization of Enzymes.

BTM 203 : Genetic Engineering **Credits 4**

1. Restriction endonucleases, Modification methylases and other enzymes needed in genetic engineering.
2. Cloning vectors: Plasmids and plasmid vectors, Phages and Phage Vectors,
phagemids, cosmids, artificial chromosome vectors (YAC, BAC), CHEF analysis.
Animal virus derived vectors - SV40 and retroviral vectors.
3. Molecular cloning: Recombinant DNA techniques, construction of genomic DNA and cDNA libraries,screening of recombinants.
4. Expression strategies for heterologous genes.
5. DNA analysis: labeling of DNA and RNA probes. Southern and fluorescence *in situ* hybridization,DNA fingerprinting, chromosome walking.
6. Techniques for gene expression: Northern and Western blotting, gel retardation technique, DNA footprinting, Primer extension, Sl mapping, Reporter assays.
7. Sequencing of DNA, chemical synthesis of oligonucleotides; techniques of *in vitro* mutagenesis. Sitedirectedmutagenesis, gene replacement and gene targeting.
8. Polymerase chain reaction and its applications.
9. Use of transposons in genetic analysis: Transposon and T-DNA tagging and its use in identificationand isolation of genes.

10. Applications of genetic engineering: Transgenic animals, production of recombinant
pharmaceuticals, gene therapy, disease diagnosis.
11. Biosafety regulation: Physical and Biological containment.

BTM 204: Genomics and Proteomics Credits 3

1. Strategies for genome sequencing: Chain termination method, automated sequencing, pyro-sequencing.
2. Sequence assembly: Clone contig and shotgun approaches.
3. Organization of genomes: main features of bacterial and eukaryotic genome organization.
4. Human genome project and its applications.
5. Locating the genes: ORF scanning, homology searches,
6. Determination of the functions of genes: gene inactivation (knock-out, anti-sense and RNA
interference) and gene over expression.
7. Approaches to analyze global gene expression: Transcriptome, Serial Analysis of Gene Expression(SAGE), Expressed Sequence Tags (ESTs), Massively Parallel Signature Sequencing (MPSS),microarray and its applications, gene tagging,
8. Proteome: Methodology to study the proteome, analysis of the functions of proteins, differential display, two hybrid system.

BTM 205 (Practicals) : Based on BTM201,BTM202, BTM203 & BTM204 Credits 6

Semester III

BTM 301 Animal Cell Culture Credits 4

1. Introduction to the balanced salt solutions and simple growth medium. Brief discussion on thechemical, physical and metabolic functions of different constituents of culture medium.
2. Biology and characterization of the cultured cells.
3. Measuring parameters of growth.
4. Basic techniques of mammalian cell cultures *in vitro*.
5. Serum & protein free defined media and their applications.
6. Measurement of viability and cytotoxicity.
7. Apoptosis
8. Cell synchronization
9. Cell transformation.
10. Applications of animal cell culture: cell culture based products, vaccines, Hybridoma technology andmonoclonal antibodies, stem cells and their applications,.
11. Organ, organotypic and histotypic cultures.

BTM 302: Bioprocess Engineering & Technology **Credits 4**

1. Screening and improvement of industrially important microorganisms.
2. Microbial Growth and Death Kinetics.
3. Media for Industrial Fermentation.
4. Air and Media Sterilization.
5. Types of fermentation processes - Analysis of batch, Fed-batch and continuous bioreactions, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed,fluidized, photobioreactors etc.,)
6. Measurement and control of bioprocess parameters.
7. Downstream Processing
8. Whole cell Immobilization and their Industrial Applications.
9. Industrial Production of Chemicals - Ethanol, Acids (citric, acetic and gluconic), solvents (glycerol,acetone, butanol), Antibiotics (penicillin, streptomycin, tetracycline), Semisynthetic antibiotics, Aminoacids (lysine, glutamic acid), Single Cell Protein.
10. Aeration and agitation: requirement of Oxygen in industrial processes. Concept of volumetric Oxygentransfer coefficient and its determination (kLa). Factors affecting(Kla)
11. Use of microbes in mineral beneficiation and oil recovery.
12. Introduction to Food Technology

- Elementary Idea of canning and packing.
- Sterilization and Pastuerization of Food Products.
- Technology of Typical Food/Food products (bread, cheese, idli).

BTM 204 : Plant Biotechnology **Credits 4**

1. Tissue culture media, Initiation and maintenance of callus and suspension cultures; single cell clones.
2. Biochemical production.
3. Totipotency: Organoganesis; somatic embryogenesis; transfer and establishment of whole plants in soil
(hardening).
4. Rapid clonal propagation and production of virus -free plants.
5. *In vitro* pollination; embryo culture and embryo rescue.
6. Protoplast fusion, selection of hybrid cells; symmetric and asymmetric hybrids, cybrids.
7. Nuclear cytology of cultured plant cells and somaclonal variations.
8. Production of haploid plants and their utilization.
9. Cryopreservation and slow growth for germ plasm conservation.
10. Gene transfer in nuclear genome and chloroplasts; *Agrobacterium*-mediated gene transfer, direct gene
transfer, antibiotic marker-free transgenics.
11. Transgenic plants: insect resistance, virus resistance, abiotic stress tolerance, longer shelf life
(including strategies for suppression of endogenous genes), male sterility, enhanced nutrition (golden

rice), edible vaccines.
12. Molecular markers: RFLP, RAPD, AFLP, applications of molecular markers

BTM 304 (Practicals): Based on BTM 301, BTM 302 & BTM 303 Credits 6
BTM 305 (Project Dissertation - I): Credits 6

Project / dissertation will be equivalent to master's thesis, which will be supervised by faculty members and will be carried to next Semester *i.e.,* IV. At the end of the 4th Sem, the final thesis will be submitted, as per the departmental instruction, however a small report will be submitted at the end of 3rd semester, along with presentation. The student will be encouraged to participate in national / international conferences, present their work and to publish the outcome in SCI indexed journals.

Semester IV

BTM 401 Environmental Biotechnology Credits 4

1. Environment: Basic Concepts; Environmental Pollution; Types of Pollution; Measurement of Pollution; Environmental Management
2. Water Pollution and Its Control: Water as a Resource; Water Bodies; Need for Water Management; Sources of Water Pollution; Measurement of Water Pollution

Waste Water Treatment- Basic Concepts; Physicochemical and biological Treatment Processes, Tertiary Treatment; Disinfection and Disposal

3. Biological Treatment Processes: Biochemistry and Microbiology of Aerobic and Anaerobic Treatment Processes; Suspended and Attached Growth Type Aerobic Processes- Activated Sludge, Oxidation Ditch, Aerated Lagoons, Oxidation Ponds and Their Variations; Trickling Filters, Rotating Biological Contactors, Other Aerobic Processes.

Suspended and Attached Growth Type Anaerobic Processes- Anaerobic Digesters, Fixed and Fluidized Types of Anaerobic Bioreactors, UASB Bioreactors Treatment of Typical Industrial Effluents- Diary, Distillery, Sugar, and Antibiotic Industries

4. Degradation of Xenobiotic Compounds in Environment: Decay Behaviour and Degradative Plasmids; Hydrocarbons; Substituted Hydrocarbons; Oil Pollution; Surfactants; Bioremediation of Contaminated Soils.
5. Biopesticides and biofertilizers; their role in pest and nutrient Management; Wormi culture
6. Solid Wastes: Sources and Management; Composition; Methane Production; Food, Feed and Fuelfrom Biomass
7. Global Environmental Problems: Ozone Depletion; UV-B and Green House gases and

Biotechnological Approaches of their Management

BTM 402: Bioinformatics Credits 4

1. Introduction to Bioinformatics
2. Searching database and locating genes, Alignment of gene sequences, Local and Global.
3. Analysis of DNA sequence: Finding and calculating core nucleotide sequence, Predicting ORFs, location of transcription start point and end point, getting

polypeptide sequence of the extractedcore nucleotide sequence, designing primers of specific gene, generation of restriction maps,

4. Generating phylogenetic trees based on DNA sequence and evolutionary relationship
5. Analysis of proteins: Protein classification, homology modeling, trading, prediction of proteinstructure (secondary and 3 dimensional), tools for structure prediction, validation and visualization.

BTM 403: Biostatistics

Credits 4

1. Computer assisted drug design- concept, methods and practical approaches, various computational methods applied to design the drugs: QSAR and 3DQSAR methods, CADD software demonstration
2. Diagrammatic, graphical and tabular representations of data; measures of central tendency, dispersion, skewness and kurtosis.
3. Linear regression, Pearson correlation coefficient and Rank correlation
4. Basic concepts of hypothesis testing, two kinds of error, level significance, p value, t- Test for mean and difference between two means, partial t-test., and Chi square test for goodness of fit.
5. Analysis of variance for one way and two way classified data

BTM 404 (Practicals): Based on BTM 401& BTM 402

Credits 6

BTM 405 (Project Dissertation - II): **Credits 6**

Project / dissertation will be equivalent to master's thesis, which will be supervised by faculty members and will be carried to next Semester *i.e.,* IV. At the end of the 4th Sem, the final thesis will be submitted, as per the departmental instruction, however a small report will be submitted at the end of 3rd semester, along with presentation. The student will be encouraged to participate in national / international conferences, present their work and to publish the outcome in SCI indexed journals.

SUGGESTED READING

Recommended Books-

1. Clinical Chemistry and Molecular diagnostic- Carl A Burtis, Edward R. Ashwood David E. Boons, Elsivier publication, USA, 5th edition (2012).

2. Molecular Diagnostic for the clinical laboratorian, William B. Coleman, Gregory J. Tsongalis, Humana Press,USA, 2nd edition,.

3. The organic chemistry of drug design and drug action-Richard B. Silverman ,Academic press, Cambridge, (2nd edition), 2004.

4. Drug Design- Kenneth M Merz Je, Dagmar Ringe, Charles M. Renyolds, Cambride University Press, (2010 edition).

5. Molecular cloning : A Laboratory Manual , J. Sambrook & Russeel, 3rd Edition, CSHL Press

6. Molecular Biology LabFax, T.A. Brown (Ed) Bios Scientific Publishers Ltd. Oxford, 1991.

7. Molecular Biology of the Gene (6th edition), J.D. Watson, Pearson

8. Molecular Cell Biology 5th Edition) J. Darnell, H. Lodish and D. Baltimore, , Freeman, American Books, Inc., USA, 1994.

9. Molecular Biology of the Cell (4th Edition) B. Alberts, Garland Science

10. Gene VI (6th Edition) Benjamin Lewin, Oxford University press, U.K., 1998.

11. Molecular Biology- David Freifelder, 2nd Edition, Narosa Publishing House.

12. Molecular Cell Biology-6th Edition, Lodish, Berk, Kaiser, Krieger, Scott, Bretscher, Ploegh, Matsudaira, 6th Edition- Free Man Publishing.

13. Kuby immunology, 4th Edition, R.A. Goldsby, Thomas J.Kindt, Barbara, A. Osbarne. (Freedom)

14. Immunology-A short Course, 4th Edition- Ell Benjamin, Richard Coico, Geoffrey Sunshine (Wiley-Liss).

15. Fundamentals of immunology, William Paul, 7th edition, Lippincotts Williams and wilkins (2012).

16. Roitt's essential Immunology, Roitt I.M. and Delves P.J., Blackwell Science Ltd., (2001).

17. Culture of Animal Cells (3rd Edition), R. Ian Freshmney. Wiley-Liss.

18. Animal Cell Culture – Practical Approach, Ed . John R W Masters. Oxford Univ Press. 2000

19. Animal Cell Culture Techniques, Ed Martin Clynes, Springer. 1998

20. Methods in Cell Biology, Vol. 57, Animal Cell Culture Methods, (Ed.) Jenni P.Mather and David Barnes, Academic Press

21. Biochemical Engineering, S Aiba, AE Humphrey and NF Millis, Academic Press. New York 1973

22. Biochemical Reactors, B Atkinson, Pion Ltd., London. 1974

23. Biochemical Engineering Fundamentals (2nd edition), JE Baily and DF Ollis, McGraw Hill BookCo. New York. 1986

24. Bioprocess Engineering: Basic Concepts (2nd edition), ML Shuler, and F Kargi, Prentice Hall,Engelwood Cliffs. 2003

25. Principles of Fermentation Technology (2nd edition), PF Stanbury, A Whittaker and SJ Hall,Pergamon Press, Oxford. 1995

26. Chemical Engineering Problems in Biotechnology, M L Shuler, (Ed) AICE. 1989

27. Biochemical Engineering, J M Lee, Prentice Hall Inc. 1991

28. T, J. Fu, G. Singh and W.R. Curtis (Eds): Plant Cell and Tissue Culture for the Production of Food Ingredients. Kluwer Academic/Plenum Press. 1999.

29.H.S. Chawla: Plant Biotechnology,2nd Edition, Oxford & IBH publishing co.pvt.ltd

30. R.J. Henry: Practical Application of Plant Molecular Biotechnology. Chapman and Hall. 1997.

31. P.K. Gupta Elements of Biotechnology. Rastogi and Co. Meerut. 1996

32. Plant Biotechnology,M.K.Razdan,2nd Edition,Oxford & IBH publishing co.pvt.ltd

33. Plant Biotechnology: J. Hammond, P. McGarvey and V Yusibov (Eds):, Springer Verlag, 2000

34. Wastewater Engineering – Treatment, Disposal and Reuse, Metcalf and Eddy. Inc. Tata McGrawHill, New Delhi. 1991

35. Environmental Science (5th Edition) by WP Cunninghum & BW Saigo., Mc Graw Hill. 1999.

36. Environmental Chemistry, A.K. De. Wiley Eastern Ltd. New Delhi(1996).+

37. Introduction to Biodeterioration , D Allsopp and K J Seal, ELBS/Edward Arnold. Cambridge UnivPress. 2004.

38. Ecology & Environment,P.D.Sharma,, 11th edition, Rastogi publicxation.

39.Microbial Ecology,Ronald M. Atlas & Richarad Bartha, Pearson publication,4th edition

40. Kotler, Philip –Marketing Management, Analysis, Planning, Implementation and Control (Pearson 12th Edition).

41. Stanton William J-Fundamentals of Marketing (Mc Graw Hill)

42. Kotler, Philip and Armstrong Graw- Principles of Marketing (Pearson Education, 11th Edition).

43. Kotler, Philip, Keller Kevin Lane, Koshy Abraham and Jha Mithileshwar- Marketing Management: A south. Asian Perspective (Pearson Education 12th Education)

44. Ramasw3amy V.S. and Namakumari S.-Marketing Management : Planning, Implementation and Control(Mac Millan, 3rd Edition)

45. Etzel M.J., Walker B.J. and Stanton William J- Marketing concept & Cases special Indian Edition. (Tata Mc Graw Hill, 13th Edition)

46. Mc. Carthy and Perreault- Basic Marketing: A global Marketting Approach (Tata Mc Graw Hill, 15th Edition).

47. Kurtz and Boone- Principles of Marketing (Thomson India Edition)

48. Biotechnology Expanding Horizons,,B.D.Singh,Kalyanai Publishers

49. A Text Book of Biotechnology, R.C.Dubey, S.Chand Publication

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