Minutes of the Meeting of the Board of Studies, Department of Biosciences

An ordinary meeting of the Board of Studies, Department of Biosciences was held on October 20-21, 2016 at 10.00 AM onwards in the Chamber of the Head of the Department. The following members were present:

1.	Prof. M. Moshahid A. Rizvi	Chairman
2.	Prof. Sharif Ahmad	Member
3.	Prof. Ejaz Hussain	-do-
4.	Prof. Qayyum Husain, AMU, Aligarh	-do-
5.	Prof. Tasneem Fatma	- do-
6.	Prof. Syed Akhtar Husain	-do-
8.	Prof. Seemi Farhat Baseer	-do-
9.	Prof. Luqman A. Khan	-do-
10.	Prof. M. Moshahid A. Rizvi	-do-
11.	Prof. Qazi Mohd. Rizwanul Haq	-do-
12.	Prof. Mohd. Aman Jairajpuri	-do-
13.	Dr. Meryam Sardar	-do-
14	Mr. Amit Kumar	-do-
15.	Dr. Nida Jamil Khan	-do-
16.	Dr. Nadeem Ahmad	-do-
17.	Dr. Mohd. Mohsin	-do-

The following agenda items were discussed:

1. Confirmation of Minutes:

Minutes of Board of Studies meetings held on 10.05.2016 and 24.6.2016 were approved.

2. Ph. D. admissions:

A total of 42 candidates turned up for the interview. After interviewing the candidates and assessment of their synopses BoS recommended the following (18) candidates for admission to Ph.D. Programme.

Dr. M. Moshahid A. Rizvi
Professor & Head
Department of Biosciences
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New Delhi-110025

25	Hammad Alam	Dr. Meryam Sardar
26	Mohammad Perwez	Dr. Meryam Sardar
27	Nafeesa khatoon	Dr. Meryam Sardar
28	Jahirul Ahmed Mazumdar	Dr. Meryam Sardar
29	Ovais Manzoor	Dr. Mohammad Mohsin
30	Neha Soleja	Dr. MohammadMohsin
31	Farheen Shamshi	Dr. Mohammad Abid/ Prof. M Moshahid A. Rizvi

5. Memorial Lecture:

The Chairman informed the members on the proposal of Mohd. Amin Memorial Lecture on annual basis as decided in the Departmental meeting held on 27.09.2016. The BoS approved this memorial lecture preferably to be organized in the month of February.

6. Any other Items

(a) Ph.D Course Work

The revised course structure comprising two compulsory papers {*(i) Annotated bibliography and (ii) Research methodology*} and three optional papers {Advances in Biosciences I, II & III} were approved. The candidate will opt any two of the three optional papers. Total course credits will be16 (4 for each paper). The mode of assessment of the Annotated Bibliography shall be through the presentation as detailed in **Annexure II.**

(b)UG/PG syllabi

B.Sc. / M.Sc. (Biosciences) syllabi of various papers were finally approved with certain minor modifications by the concerned teachers along with the Chairman BoS. The syllabus shall offer 4 units in every paper with 4 credit value. There shall be an educational tour programme as designed in earlier syllabus with defined marks both in B.Sc. (after semester- IV/V exams) and M.Sc. (after semester-I/II exams).

(c) Prof. Syed Akhtar Husain wanted to know about the implication of the last BoS proceeding on the equipment acquired from the departmental grant. The Chairman clarified that equipment acquired by individual grants are to be maintained by the concerned faculty members.

The meeting ended at 5:00 PM with the thanks of the Chair.

Dr. M. Moshahid A. Rizvi
Professor & Head

Dr. M. Moshahid A. Rizvi
Professor & Head
Department of Sciences
Jamia Millia Islamia
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Department of Biosciences
Jamia Millia Islamia
New Delhi-110025.

23 4. 2018

NOTICE

An ordinary **meeting of Board of Studies** will be held on **27.4.2018 at 10:30 AM** in the office of the undersigned. Kindly make it convenient to attend. Following will be the Agenda:

1. Confirmation of minutes of the previous BoS meeting.
2. Teaching allocation for session 2018-19
3. Technical Writing & Seminar and Project Dissertation allocations of M.Sc Biosciences/Biochemistry
4. Review of syllabi of UG/PG
5. Ph.D related matters
6. Any other issue.

(Dr. M. Moshahid A. Rizvi)
Professor & Head

Dr. M. Moshahid A. Rizvi
Professor & Head
Department of Biosciences
Jamia Millia Islamia
New Delhi-110025

Copy to:

1. Dean, Faculty of Natural Sciences, JMI
2. Prof. Waseem Ahmad, chairman, Deptt. of Zoology, Aligarh Muslim University Aligarh.
3. Prof. Shayamal K. Goswami, School of Life Sciences, Jawaharlal Lal Nehru, University,
4. Prof. Mohammad Zahid Ashraf, Deptt. of Biotechnology, JMI
5. Prof. Mohammad Mahfuzul Haque, Deptt. of Biotechnology, JMI.
6. All faculty members, Deptt. of Biosciences, JMI.
7. Concerned folder.

Minutes of the meeting of the Board of Studies, Department of Biosciences

An ordinary meeting of BoS was held on **27.04.2018** at **10:30 AM.** in the Chamber of the Head of the Department. The following members were present:

1.	Prof. M. Moshahid A. Rizvi	Chairman
2.	Prof. Waseem Ahmad	Member
3.	Prof. Tasneem Fatma	-do-
4.	Prof. Syed Akhtar Husain	-do-
5.	Prof.Luqman Ahmad khan	-do-
6.	Prof. Jawaid Ahmad Khan	-do-
7.	Prof. Qazi M. Rizwanul Haq	-do-
8.	Dr. Meryam Sardar	-do-
9.	Dr.. Amit kumar Verma	-do-
10.	Dr. Nadeem Ahmad	-do-
11.	Dr. Nida Jamil Khan	-do-
12.	Dr. Mohammad Abid	-do-
13.	Dr. Mohd. Mohsin	-do-

At the outset the chairman introduced Prof. Waseem Ahmad Deptt. of Zoology, AMU, Aligarh, as the external member of the BoS and welcomed him in this meeting. He further outlined contributions/achievement of Prof. Waseem Ahmad and expected the Deptt. will be hugely benefitted by his experience during the course of time.

The following agenda items were discussed:

1. Confirmation of the minutes of previous meeting

Minutes of Board of Studies meeting held on 16.3.2018 was approved.

2. Teaching Allocation for the session 2018-19

M. Sc. Biosciences

Sr. no.	Title of the Paper	Name of the Teacher	Credits
M.Sc. Biosciences Semester I			
1.	BSM-101 Biochemistry	Prof. Luqman A. Khan	4
2.	BSM -102 Cell biology	Prof. Mohammad Aman Jairajpuri	4
3.	BSM -103 Genetics	Prof. Syed Akhtar Husain	4
4.	BSM-104 Bioinformatics & Biostats **(CBCS Elective)**	Dr Nadeem Ahmad + GT	4
5.	BSM -105 Lab Course I	---	6

Suha Rizvi	Shempy Kumari	Prof. Tasneem Fatma
Summaya Perveen	Shereen Bajaj	Prof. Syed Akhtar Husain
Vaishali walecha	Shiba Khan	Prof. Luqman Ahmad Khan
Varnita Anand	Srijan Suyal	Prof. Jawaid Ahmad Khan
Zainy Zehra	Swati Sharma	Prof. Qazi Mohd. Rizwanul Haq
Zofishan Iqra Anjum	Umaima Hasan	Prof. Mohd. Aman Jairajpuri
	Vaishali Chaturvedi	Dr. Meryam Sardar
	Zainab Butool	Dr. Nikhat Manzoor

4. Review of UG/PG syllabi

BoS approved the following two Committees for UG/PG programme under the Chairmanship of Head of the Department.

Undergraduate Programme

1. Prof. M. Moshahid A. Rizvi, HoD	Chairman
2. Prof. Tasneem Fatma	Member
3. Prof. Luqman Ahmad khan	Member
4. Dr. Mohammad Abid	Member
5. Dr. Amit Kumar Verma	Member
6. Prof. Qazi M. Rizwanul Haq	Convener

PG/PhD Programmes

1. Prof. M. Moshahid A. Rizvi, HoD	Chairman
2. Prof. Syed Akhtar Husain	Member
3. Prof. M. Aman Jairajpuri	Member
4. Dr. Meryam Sardar	Member
5. Dr. Nida Jamil Khan	Member
6. Dr. Mohammad Mohsin	Member
7. Prof. Jawaid Ahmad Khan	Convener

5. Ph.D related matters:

(a) Request of Sheeba Naaz for change in the Ph.D topic

The matter was earlier placed before the previous meeting of the BoS (16.03.2018). The BoS referred back the application to her supervisor with the directives that topic does not reflect the specialization of supervisor.

Her request was again placed before the BoS. The BoS considered the request and approved the change in PhD topic.

JMI Mail

HoD, Biosciences, JMI <biosciences@jmi.ac.in>

Syllabus revision

HoD, Biosciences, JMI <biosciences@jmi.ac.in> Wed, Sep 4, 2019 at 12:35 PM
To: "Advisor to VC, (Academic and Research)" <advisor.ac@jmi.ac.in>

This is to certify that the syllabi for the following programmes in department of Biosciences have been revised and updated:

1. B.Sc. Biosciences

The quantum of change in new syllabus is approx. 20-25 percent.

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Professor and Head
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New Delhi-110025, India
qhaque@jmi.ac.in

On Mon, Jul 29, 2019 at 6:12 PM Advisor to VC, (Academic and Research) <advisor.ac@jmi.ac.in> wrote:
[Quoted text hidden]

Department of Biosciences
Jamia Millia Islamia
New Delhi-25

30.07.2019

This is to certify that the syllabi for the following programmes in department of Biosciences have been revised and updated:

1. M.Sc. Biosciences
2. M.Sc Biochemistry
3. M.Sc Microbiology

The quantum of change in new syllabus is approx. 25-35 percent.

(Dr. Qazi. M. Rizwanul Haq)
Professor & Head

Advisor to Vice-Chancellor-Academic & Research
Jamia Millia Islamia
New Delhi-25

JMI Mail

HoD, Biosciences, JMI <biosciences@jmi.ac.in>

Syllabus revision

HoD, Biosciences, JMI <biosciences@jmi.ac.in> Thu, Sep 26, 2019 at 10:27 AM
To: "Advisor to VC, (Academic and Research)" <advisor.ac@jmi.ac.in>

This is to certify that the syllabi for the following programmes in department of Biosciences have been revised and updated:

1. Ph.D. program

The quantum of change in new syllabus is approx. 25-35 percent.

Dr Qazi Mohd Rizwanul Haq
Professor and Head
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qhaque@jmi.ac.in

[Quoted text hidden]

Course Structure of B.Sc. Biosciences under CBCS pattern

B.Sc. Biosciences

Semester-I

S.No.	Code and Title	Cr
1.	BSB-101 Animal Diversity-I	**4**
2.	BSB-102 Plant Diversity-I	**4**
3.	BSB-103 Essential Maths (CBCS)	**4**
4.	BSB-104 Lab Course Biosciences –I	**4**
5. 6. 7.	Gen English-I Islamiat-I Urdu-I	**4**
	Total	**20**

Semester-II

S.No.	Code and Title	Cr
1.	BSB-201 Animal Diversity-II	**4**
2.	BSB-202 Plant Diversity-II	**4**
3. 4.	BSB-203 Chemistry- I BSB-204 Biomathematics & Biostatistics (CBCS)	**4** **4**
5.	BSB-205 Lab Course Biosciences–II	**4**
6. 7. 8.	Gen English-II Islamiat-II Urdu-II	**4**
	Total	**24**

Semester-III

S.No.	Code and Title	Cr
1.	BSB-301 Cell Biology	**4**
2.	BSB-302 Molecular Biology	**4**
3. 4.	BSB-303 Chemistry- II BSB-304 Environmental Sciences (AECC)	**4** **4**
5.	BSB-305 Lab Course Biosciences–III	**4**
	Total	**20**

Semester-IV

S.No.	Code and Title	Cr
1.	BSB-401 Developmental Biology	**4**
2. 3.	BSB-402 Animal Physiology BSB-403 Plant Physiology	**4** **4**
4.	BSB-404 Biophysics (CBCS)	**4**
5.	BSB-405 Lab Course Biosciences–IV	**4**
	Total	**20**

Semester-V

S.No.	Code and Title	Cr
1.	BSB-501 Microbiology	**4**
2. 3. 4.	BSB-502 Immunology BSB-503 Genetics BSB-504 Bioinformatics & Information Technology (CBCS)	**4** **4** **4**
5.	BSB-505 Lab Course Biosciences–V	**4**
	Total	**20**

Semester-VI

S.No.	Code and Title	Cr
1.	BSB-601 Biochemistry	**4**
2. 3. 4.	BSB-602 Ecology BSB-603 Organic Evolution BSB-604 Techniques in Biology (SEC)	**4** **4** **4**
5.	BSB-605 Lab Course Biosciences–VI	**4**
	Total	**20**

Total Credit= 124

BSB-101
Animal Diversity-I

Credits: 04
Lectures: 60

Unit I
Principles of taxonomy and relationship with systematic. General characters and criteria for classification of invertebrates. An outline classification of non-chrodates.

Classification of Protozoans. Type study of *Paramecium caudatum* and *Plasmodium vivax*. Locomotion and reproduction in Protozoa. Leishmaniasis, Trypanosomiasis, toxoplasmosis, Giardiasis and Amoebiasis.

Unit II
Organization of metazoa including symmetry, metamerism and body cavity or coelom. Theories of origin of metazoa. General characters and classification of phylum Porifera. Canal system and skeleton in Sponges. General characters and classification of Coelenterates. Type study of *Aurelia*. Polymorphism, corals and coral reefs. General characters and classification of phylum Platyhelminthes

Unit III
General characters and classification of nematodes. Type study of *Ascaris lumbricoides*. Nematodes and human diseases. *Coenorhabditis elegans* and its application in research.
General characteristics and classification of Arthropods. Mouth parts of insects. Vision in arthropods. Metamorphosis in insects. Larval forms of Crustaceans. Social insects and their life cycle. Economic importance of insects. Lac culture, Sericulture, Apiculture and Prawn culture.

Unit IV
General characters and classification of phylum Mollusca. Type study of *Pila globosa*. Torsion and detorsion in gastropods. General characters and classification of phylum Echinodermata.
Water vascular system in star fish, Larval form in Echinoderm, Structure and affinities of *Balanoglossus.*

Recommended Books:

1. Ruppert, E. E. and Barnes, R. D., Invertebrate Zoology, Saunders College Publishing.
2. Parker, T. J. and Haswell, W. A., Textbook of Zoology, Vol. 1 (Invertebrates), Low Price Publications.
3. Kotpal, R. L., Modern Textbook of Zoology: Invertebrates, Rastogi Publications.
4. Jordan, E. L. and Verma, P. S., Invertebrate Zoology, S. Chand & Co.
5. Anderson, D. T., Invertebrate Zoology, Oxford University Press, India.

BSB-102
Plant Diversity – I

Credits: 4
Lectures: 60

Unit I
Cyanobacteria and Algae: General features, Classification, Distribution, Range of thallus organization, Reproduction, Life Cycle and Economic importance with special reference to *Nostoc, Volvox, Oedogonium, Chara, Ectocarpus,* and *Polysiphonia.*

Unit II
Fungi: General features, Reproduction and economic importance with special reference to Slime molds, *Albugo, Phytophthora, Aspergillus* and *Puccinia*. Fungal Diseases: White rust of crucifers, Late blight of potato, Black stem rust of wheat
Lichens: Thallus organization, Reproduction and their ecological significance.

Unit III
Bryophytes: General features, Habitat, Range of thallus organization and reproduction, Affinities with Algae and Pteridophytes. Type study of *Marchantia, Anthoceros* and *Funaria.*

Unit IV
Pteridophytes: General features, Habitat, Stelar system, Heterospory and seed habit, Adaptive features: Spores, cuticle, stomata and tracheids. Morphology anatomy and reproduction of Psilotum, *Selaginella* and *Pteris.*

Recommended Books:

1. Hait, Bhattacharya & Ghosh, A Text Book of Botany ,Volume I (NCBA).
2. Sporne. Morphology of Bryophytes (Oxford Publishing House).
3. Alexopoulus C.J , Mims C.W. and Blackwel M.I . Introductory Mycology. (John Wiley and Sons Inc).
4. George N. Agrios, Plant Pathology (Elsevier).
5. Tortora, G.J., Funke, B.R., Case, C.L. Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A.
6. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.

BSB-103
Essential Mathematics (CBCS)

Credits: 4
Lectures: 60

Unit-I

The factorial introduction, fundamental principle of counting, permutation as arrangement, practical problems on permutations, permutation under certain conditions, Combinations, practical problems on combinations, combinational identities, Binomial theorem for any positive integral exponent (without proof), general and middle term, Binomial theorem for any index. Set and their representations, finite and infinite sets, subsets, type of sets, operations on sets and their algebraic properties, Venn diagram, ordered pair, Cartesian product & relation.

Unit-II

Concept of functions and Relation in biological terminology, its domain and range, Types and classification of function, graphs of some well known functions, even and odd functions, periodic functions, algebra of functions, composite functions, inverse of a function. Limits, left hand and right hand limits, algebra of limits, continuity of a function at a point, over an open/closed interval, differentiability of a function at a point, left hand and right hand differentiability, relation between continuity and differentiability, Derivative of a function, its geometrical and physical significance, Applications.

Unit-III

Introduction of indefinite integral, anti-derivative or primitive function, standard formulae, and fundamental laws of integrations, methods of integration: by substitution, by parts, by long division, by partial fractions, by successive reduction, Integration of some well known forms. Definition of definite integral as the limit of sum, The fundamental theorem of calculus (without proof), evaluation of definite integral, transformation of definite integral by substitution, by parts. Properties of definite integral and problems based on these properties, Applications.

Unit-IV

Definition and examples of matrices, types of matrices, basic operations, equality of matrices, addition and scalar multiplication of matrices, properties of addition and scalar multiplication, transpose of a matrix, symmetric and skew symmetric matrices and their properties, matrix multiplication in general and its properties. Definition of Determinant, minors and cofactors of an element of a determinant, singular and non-singular matrices, multiplicative inverse of a matrix and its properties, Applications.

Recommended Books:

1. Seymour Lipschutz, 1981, Set Theory, (Schaum's Outline Series) McGraw-Hill Book Co.
2. Frank Ayres, J.R., 1974, Matrices, (Schaum's Outline Series) McGraw-Hill Inc.
3. Shanti Narayan, 1999, Differential and Integral Calculus, S.Chand & Company Ltd.
4. Frank Ayres, Jr. and Elliott Mendelson, 1992, Differential and Integral Calculus, Schasun's Outline series, McGraw Hill Book Company.
5. N. Piskunov, Differential and Integral Calculus, 1981, CBS Publishers & Distributors.

BSB- 201
Animal Diversity-II

Credit: 4
Lectures: 60

Unit I: Introduction and classification of Chordates
General Characters, origin and ancestry of Chordates. A brief classification of phylum Chordata. Diversity of chordates and comparison with non-chordates. General characters and classification of subphylum Urochordata. Characteristics and affinities of *Herdmania*. General characters and classification of subphylum Cephalochordata. Characters and structure of *Branchiostoma*.

Unit II: Superclass Pisces
General characters and classification of superclass Pisces. Type study of Class Cyclostomata: *Petromyzon*. Scales of fishes. Air or swim bladder and accessory respiratory organs. Migration and parental care in fishes. Pisciculture. Dipnoi Freshwater and Brackish water fisheries in India.

Unit III: Class Amphibia and Reptilia
General characters, origin and classification of Amphibians. Parental care in class Amphibia. Origin, general characters and classification of Reptiles. Identification of snakes. Poisonous and non-poisonous snakes biting mechanism in snakes. Venom and anti-venom. Extinct reptiles (Dinosaurs), Evolution and adaptive radiation of reptiles.

Unit IV: Class Aves and Mammalia
General characteristics and classification of class Aves. Affinities, origin and ancestry of birds. Mechanism and modes of flight adaptations. Type of beaks in birds. Flight adaptation in birds. Migration in birds. Economic importance of birds. General characters and classification of class Mammalia. Origin and ancestry of mammals. Dentition in mammals, Prototheria and Metatheria.

Recommended Books:

1. Young J Z (2004) The life of vertebrates III edition, Oxford university press.
2. Kent GC & Karr RK (2000) Comparative anatomy of Vertebrates, 9th Edition, The Mcgraw – hill companies.
3. Kardong KV (2005) Vertebrates comparative anatomy, function and evolution 4th edition. The Mcgraw – hill higher Education.
4. RL Kotpal (2016) Modern textbook of zoology-vertebrates

BSB-202
Plant Diversity – II

Credits: 4
Lectures: 60

Unit I
Gymnosperms: Introduction, Diversity, Economic importance, Classification, origin and Evolutionary significance. Affinities of Gymnosperms with Angiosperms and Pteridophytes.

Unit II
General features, Habitat and distribution, External features, Anatomy of vegetative and reproductive structures, Development and reproduction of C*ycas*, *Pinus*, and *Gnetum*

Unit III:
Inflorescence, Flower and floral parts of Angiosperms. Taxonomy of Angiosperms: Introduction and outlines of systems of classification of Angiosperms; Bentham and Hooker's system, Hutchinson's system, Engler & Prantel's System.

Unit IV:
Systematic study, Affinities, Distinguishing features and economic importance of dicot families *viz. Ranunculaceae, Solanaceae, Moraceae, Malvaceae, Fabaceae , Umbelliferae, Asteraceae*, and monocot families *Liliaceae* and *Poaceae.* Economic botany: Food, drug, fiber, spices, beverages, timber and rubber yielding plants.

Recommended Books:

1. Swingle, D.B. A Text book of Systematic Botany. (Mc Graw Hill)
2. Harrison, H.J., New Concepts of Flowering Plant Toxonomy, (Hieman Educational BooksLtd., London.)
3. Simpson, M.G. Plant Systematics. Elsevier Academic Press, San Diego, CA, U.S.A.
4. Hait, Bhattacharya & Ghosh, A Text Book of Botany ,Volume II (NCBA)
5. Bhatnagar, S.P. and Moitra, A., Gymnosperms (New Age International).
6. Biswas C and Johari B.M, The Gymnosperms (Narosa Publishing House)
7. Stewart W.N. and Rathwell G.W. Paleobotany and the Evolution of plants (Cambridge University Press).
8. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. Biology. Tata McGraw Hill, Delhi, India.

BSB-203
Chemistry-I

Credit: 4
Lectures: 60

Unit I: Fundamentals of Organic Chemistry

Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Polarity of Bonds and molecules, Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Unit II: Stereochemistry

Fischer Projection, Newman and Sawhorse Projection formulae and their interconversions;

Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations.

Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers,

Molecules upto two chiral-centres, Distereoisomers, meso structures, racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.

Unit III: Hydrocarbons

Alkanes: Structure of methane, ethane, propane and butane, Nomenclature, Physical Properties. *Reactions:* Free radical Substitution: Halogenation of alkanes, selectivity of bromine towards substitution reactions.

Alkenes: Structure of ethylene, propylene and butylenes, Isomerism in alkenes, Nomenclature, Physical Properties. *Reactions:* cis-addition (alk. KMnO4) and trans-addition (bromine). Addition of HX (Markownikoff's and anti-Markownikoff's addition). Hydration, Ozonolysis, oxymecuration-demercuration, hydroboration-oxidation.

Aromatic Hydrocarbons

Aromaticity: Huckel's rule, aromatic character of arenes, cyclic carbocations/carbanions and

heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism.

Unit IV: Alkyl and aryl halides

Preparation: from alkenes and alcohols. Structure, classification, nomenclature and physical properties, Reactions: Williamson ether synthesis, Nuleophilic substitution reactions (Nucleophiles & leaving groups, Thermodynamics & kinetics, SN^I & SN^2 reactions: mechanism, kinetics, stereochemistry and reactivity, Carbocations: structures, relative stabilities & rearrangement, Factors affecting rates of SN^I & SN^2 reactions), Elimination reactions of Alkyl halides: Dehydrohalogenation, E^1 & E^2 reactions. Elimination vs substitution.

Aryl halides: Preparation: from phenol, Sandmeyer and Gattermann reactions and important reactions. Reactivity and relative strength of C-X bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Recommended Books:

1. I. L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
2. R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
3. Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry,* S. Chand
4. Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry,* Orient Longman.

BSB-204
Biomathematics and Biostatistics (CBCS)

Credit: 4
Lectures: 60

Unit I
Differential equation, order and degree of a differential equation, solution of a (first order and first degree) differential equation by the method of variable separable, Homogeneous differential equation and their solution, solution of the linear differential equation of the first order of type: $dy/dx+P(x).y=Q(x)$.

Unit II
Mathematical Modeling, Steps in building Mathematical Models, Relation of Models to data, Evolution, Choosing Mathematics for the models. Linear and Non linear First order Discrete Time Model; Differential Equation Models, Population dynamics, Discrete Dynamical Models, Continuous Models, Epidemic Models, Models, Growth Models.

Unit III
Methods of sampling, measure of central tendency (mean, median and mode), measures of variation (mean deviation and standard deviation).Correlation, covariance, Karl Pearson's coefficient of correlation, degree of correlation, Regression, coefficient of regression, Method of Least Square.

Unit IV
Random experiment and associated sample space, events, definition of probability of event, algebra of events, and addition and multiplication theorem on probability (without proof), Conditional probability, Independent event, Baye's theorem (without proof), Binomial, Poisson and Normal distributions.

Recommended Books:

1. Frank Ayres, J.R., 1992, Theory and Problems of Differential Equations. Schaum's Outline Series, McGraw-Hill Book Co
2. Arora, P.N. and P.K. Malhan, 2002, Biostatistics, Himalaya Publishing House.
3. Murray R. Spiegel, 1980, Probability and Statistics, Schaum's Outline Series) McGraw-Hill Book Co.

BSB-301
Cell Biology

Credit: 4
Lectures: 60

Unit I: Cell Organelles

Structure and functions of Endoplasmic reticulum, SRP based targeting of proteins to ER, folding and disulfide bond formation, mechanism of vesicle transport, Mitochondria (DNA & pathways), lysosomes and their role in degradation, Golgi apparatus (post translational modifications of proteins and lipid synthesis).

Unit II: Cytoskeleton network

Structure and organization of actin, myosin, muscle contraction system and intermediate filaments, microtubules and their role. Cell Shape, Mitotic Spindle, 9+2 Array, Filipodia Structure.

Unit III: Nucleus organization and cell cycle

Structure and Function of Nucleus. Nuclear Membrane and Transport, Nuclear Pore complex, chromosomal structure and positioning. Potentiated genes, Cell cycle: controls and checkpoints.

Unit IV: Membrane Transport and Cell signaling

Lipid bilayer and membrane proteins, Ionic channels, Ion pumps, membrane transport (Simple, Fecilitated, Active and Voltage gated). Signaling molecules and their receptors (GPCR, Tyrosine, Kinase based) , Role of protein kinase , functions, intracellular signal transduction pathways (selected pathways), signaling networks and cross talk.

Recommended Books:

1. Cell and Molecular Biology by Robertis De, E.D.P. and E.M.F. De Robertis
2. Molecular Biology of the Cell by Bruce Albert, Dannis Bray, Julian Lewis, Martin Raff
3. Molecular Cell Biology by Harvey Lodish
4. Molecular Cell Biology by Darnell, J.E.

BSB – 302
Molecular Biology

Credit: 4
Lectures: 60

Unit I

Replication of DNA: Types of DNA polymerase and enzymes involved, replication origin, replication fork, semi conservative replication of double stranded DNA, mechanism of replication, proof reading. Replication in Eukaryotes. RNA Synthesis: Types of RNA polymerases, mechanism of transcription, RNA processing, capping, polyadenylation, splicing; small interfering RNA, micro RNA. Transcription in Eukaryotes.

Unit II

Protein Synthesis: Genetic Code, Wobble Hypothesis, tRNA, Ribosome, formation of initiation complex, initiation, elongation and termination, folding and processing of proteins. Comparison of Prokaryotic and Eukaryotic translation. Expression and Regulation of genes: Negative and positive regulation, operons, gene expression in prokaryotes, chromatin remodeling, eukaryotes; gene silencing: transcriptional, post transcriptional, antisense RNA.

Unit III

Restriction enzymes, DNA polymerases, ligase, kinase, phosphatase, nuclease; molecular cloning: Cloning Vectors: Lamda phage, plasmid, M13 phage, cosmid, shuttle vectors, yeast and viral vectors, construction of genomic and cDNA library.

Unit IV

Nucleotide sequencing methods and amplification of DNA; types of PCR: RT-PCR, inverse PCR, asymmetric PCR, DNA fingerprinting, molecular markers, RAPD, RFLP, AFLP, SNPs analysis of gene expression, micro array, production of genetically modified crops, transgenic animals

Recommended Books:

1. Principles of Gene Manipulations & Genomics, S.B. Primrose, M. Twyman, John & Willey Publishers
2. Molecular Biotechnology: Principles and Applications of Recombinant DNA, Bernard R.Glick and Jack J.Pasternack, 2010, Panima Publishing Corporation.
3. Molecular Biology: Genes to Proteins, 2010, Burton E.Tropp, Jones and Bartlett Publishers.
4. Molecular Biology, David Clark, 2010, Publisher A P Cell.

BSB-303
Chemistry-II

Credit: 4
Lectures: 60

Unit I: Carbonyl Compounds: Structure, Nomenclature and Physical properties, Nucleophilic addition to carbon-oxygen double bond, Reaction of Aldehydes and Ketones: Oxidation, Baeyer Villager oxidation, Reduction to alcohols & hydrocarbons: Clemmensen & Wolff Kishner reduction, Reductive amination, Addition of water & alcohols, Additions of derivatives of ammonia, Addition of hydrogen cyanide & sodium bisulphite, Addition of Halides : Wittig reaction, Aldol reactions: enolate ions, keto-enol tautomerism, reactions via enol and enolate ions.

Carboxylic acids and their Derivatives: Structure, Nomenclature, Physical properties and Acidity of carboxylic acids, Reactions of carboxylic acids: Nucleophilic substitutions at acyl carbon, Conversion into acyl chloride, anhydrides, lactones, nitriles esters, amides and lactams, Reduction of carboxylic acids, substitution in alkyl or aryl group, Decarboxylation of carboxylic acids, Reactions of acyl chloride and acid anhydrides, Reaction of Esters: Conversion into acids and acids and acid derivatives, Reduction to alcohols, Reactions with carbanion.

Unit II: Definition and type of solution; expressing the concentration of solution; colligative properties (definition); Roults' law, Roults' law and molecular weight of the solute; elevation of boiling point; depression of freezing point, osmotic pressure; definition, laws of osmotic pressure, vant Hoff theory of dilution; determination of molecular weight, theoretical explanation of osmosis. Osmotic behaviour of living cells: tonicity, turgor pressure.

Unit III: Electrolytes (True and Potential), Ionization of electrolytes, Colligative properties of true electrolytes (The vant Hoff factor, the nonideality of solution, ionic strength of the solution and its effect on Debye-Huckel limiting law) Colligative properties of potential electrolytes; (Ionization and degree of ionization. Solubility of Salts: Thermodynamic and apparent solubility products, salt or electrolyte effect, the common in effect.

Introduction (Biological relevance of pH); Concepts of acids and bases. The exact treatment of the ionization of monoprotic acid in water; Relation between initial acid concentration, pKa and pH, Henderson-Hasselbalch equation, dependence of ionization on pH of solution, uses of the H-H equation, titration of strong and weak acids with strong base. Exact treatment of the ionization of diprotic acid. Exact treatment of Bronsted lowery type monobase. Salt hydrolysis. Buffer mixtures. pH indicators, Biological relevance of pH: buffering in living organism, effect of pH on protoplasmic components.

Unit IV: Definition of terms: reaction rate, order and molecularity. Rate measurements and rate laws, Factors influencing rates of reactions. Zero, I and II order reaction with examples. Mathematical treatments of rate constants of I and II order reactions. Calculation of activation energy, Collision and absolute theory of reaction rates.

Recommended Books:

1. L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.

1. R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.
2. Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand
3. Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
4. Atkins, P.W. 2001, Physical Chemistry, W.H. Freeman & Co. 7th Edition.
5. Clydel., R., Metz, 1988, Schaum's Series Outline of Physical Chemistry, McGrawHill.
6. Puri & Sharma, 2002, Physical Chemistry, S. Chand & Sons Co.
7. Bahl & Tuli, 2002, Essential of Physical Chemistry, S. Chand & Sons. Co.
8. Gordon, G., Hammes, 2000, Thermodynamics and Kinetics for the Biological Sciences, John Wiley & Sons.

BSB-304
Environmental Science (AECC)

Credit: 4
Lectures: 60

Unit I: Multidisciplinary nature of environmental studies, Scope and importance, Sustainable development, Forest conservation act. International agreements: Montreal protocol, Kyoto protocol. Conservation of biological diversity. Soil formation (weathering of rocks, mineralization and humi fiction), soil nutrient, soil cotton exchange capacity, nutrient availability, soil moisture, soil type, soil texture, soil aerator, soil mixing.

Unit II: Threat to biodiversity : Deforestation, Overgrazing, Agriculture, Shifting cultivation, Mining, Urbanization; Threat to wild life : Hunting and export, Habitat loss, Selective destruction, Domestication Man –wild life conflicts, Biological invasions; Extinct and threatened species; Red data book; Conservation of biodiversity : Habitat conservation, Providing critical resources, Captive breeding, Development of reserves; UNESCO Biosphere Reserve Programme, Man –wild life conflicts, Biological invasions, Controlling introduction of alien species, Reducing pollution, Research and documentation, Legal actions, Environmental movements - Chipko, Appiko, Silent valley, Bishnoi community of Rajasthan, In -situ and Ex-situ conservation, Project Tiger, Environmental ethics : Role of religious and cultural activities.

Unit III: Pollution : Types, causes, effects and control (Air , water, soil, Noise, Thermal, Radiation, Pesticide , Heavy metal , Particulate, Solid waste pollution); Climate Change; Global warming; Ozone depletion; Acid rain; Minimata disease; Itai-Itai disease; Skeltal fluorosis; Occupational hazards; Pollution Monitoring (Physical, Chemical and Biological). Forest Conservation Act; International Agreements : Montreal Protocols, Kyoto Protocols and Convention on Biological Diversity.

Unit IV: Renewable energy sources: Flowing water, Wind, Tides, Oceanic waves, Biofuel (Biodiesel, Biogas, Bioethanol, Hydrogen), Nuclear, Geothermal, Antimatter ; Non-renewable energy sources : Fossil Fuel (Coal, Petroleum, Natural Gas); Rain water harvesting, Conflicts over water (International and interstate).

Suggested Readings:

1. Groom Martha J, Gary K Meffe and Carl Ronald Carroll. 2006. Principles of Conservationn Biology. Sunderland: Sinauer Associates.
2. Peeper IL, Gerba,CP, Brusseau ML. 2011.Environmental and Pollution Science. Academic Press.
3. Raven PH, Hassenzahl DM and Berg LR. 2012. Environment. 8th Edition. John Wiley & Sons.
4. Singh JS, Singh SP and Gupta SR. 2014. Ecology, Environmental Science and Conservation. S Chand Publishing , New Delhi .
5. World Commission on Environment and Development. 1987. Our Common Future. Oxford University Press.

6. Julian E Andrews, Peter Brimblecombe, Tim D Jickells, Peter S Liss, and Brian J. Reid. 2004. An Introduction to Environmental Chemistry. Blackwell Publishing.
7. Pandey SN, Misra SP. 2011. Environment and Ecology, Ane Books Pvt. Ltd.
8. LSE-02 Ecology Blocks (1,2,3,4). IGNOU.

BSB- 401
Developmental Biology

Credit: 4
Lectures: 60

Unit I
Gametogenesis: Spermatogenesis and Oogenesis, Ovulation and hormonal Control, Menstruation Cycle, Fertilization: Molecular basis of Fertilization, Block of Polyspermy, Cortical Reaction, Role of Zona Pellucida.

Unit II
Post Fertilization Events: Zygote formation, Morula, Cleavage, Compaction, Cavitation, Differentiation, ICM, Trophoblast and importance of Blastula. Implantation. Formation of Gastrula, Germ Layers, Primitive Streak, Types of morphogenetic Movements: Bilaminar Disk, Epiblast and Hypoblast. Neuralation: Neuronal Tube, Neuronal Plate, Axon Guidance, Somite and Notochord.

Unit III
Fundamental Process in Development: Gene activation, determination, induction, differentiation, morphogenesis, intracellular communications, Cell movements, Cell death: Apoptosis and Apoptotic regulatory genes

Unit IV
Organogenesis: Myogenesis: Myofibril, Satellite Cells, importance of myoblast and gene activation. Ossification: Intramembranous and Endochondral, Formation of Limb, Sex determination factors and reproductive organs, Development of Heart and Kidney.

Recommended Books:

1. Gilbert. S. F. (2006). Developmental Biology, VIII edition, Sinauer Associates Inc, Publishers, Sunderland, Massachusetts, USA
2. Balinsky. B. I. (2008). 'An introduction to Embryology', International Thomson Computer Press.
3. Carison. Bruce M (1996). 'Patten's Foundation of Embryology', McGraw Hill Inc.
5. C.C. Chatterjee's, 'Human Physiology', CBS Publishers and Distributors pvt ltd.

BSB-402
Animal Physiology

Credit: 4
Lectures: 60

Unit I: Endocrinology
Hormones, Mechanism of Action, Types and Classes. Endocrine glands (Hypothalamus, Pitutary, Thyroid, Adernal, Parathyroid, Pancreas, Gonads). Neuroendocrine System, Enteric hormones

Unit II: Digestion and Respiration
Histology of digestive tract, Digestive enzymes of mouth, stomach & intestine and associated gland, Enzymes, Absorption of food, Energy nalance. Pulmonary ventilation, Respiratory volumes and capacities, Transport and exchange of gases, Neuronal and chemical regulation of respiration, Breathing and respiration, Cellular respiration, Hemoglobin, Binding and release of O2 its regulation.

Unit III: Excretion and Cardiovascular system
Kidney, structure of nephron, mechanism of Urine formation, Renin Angiotensin System, Blood: Composition, Hemostasis, Heart structure, Origin and conduction of the cardiac impulse, Cardiac cycle, Neuronal regulation.

Unit IV: Nerve and muscle systems
Anatomy of Brain, CNS & PNS. Structure of a neuron, resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres, vision and hearing, Types of muscle fibre, Ultrastructure of cardiac muscle, Molecular and chemical basis of muscle contraction

Recommended Books:

1. Tortora, G.J.& Derrickson, B.H. (2009). Principles of Anatomy and Physiology, 12th edn., John Wiley & Sons, Inc.
2. Widmaier, E.P., Raff, H. & Strang, K.T. (2008) Vander's Human Physiology, 11th ed,
   McGraw Hill.
3. Guyton, A.C. & Hall, J.E. (2011) Textbook of Medical Physiology, 12th ed, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
4. Human Physiology, CC Chatterjee.

BSB-403
Plant Physiology

Credit: 4
Lectures: 60

Unit I

Water Transport: Movement of water in plants in relation to water potential, osmotic potential, pressure potential and metric potential. Ascent of sap: mechanism of water absorption, Guttation Physiology of stomatal opening and closing.

Nitrogen Assimilation: Uptake and assimilation of nitrogen by plants. Nitrogen fixation: Nonsymbiotic and symbiotic nitrogen fixation, Assimilation of ammonia. Role of glutamine synthase and glutamine dehydrogenase.

Unit II

Photosynthesis: Role of photosynthetic pigments. PS II and PS I complex and their inter-relationship. Mechanism of photosynthetic electron transport, Photophosphorylation. Mechanism of carbon dioxide fixation in C3, C4 and CAM Plants, Photorespiration. Dormancy: Significance, Seed dormancy, bud dormancy.

Unit III

Translocation: Translocation of photo-assimilates in plants. Phloem loading and unloading. Plant growth regulators: Auxin, Ethylene, Cytokinins, Gibbrelins and abscicis acid. Distribution and mechanism of action of plant growth regulators. Photropism: Phototropic signal perception & Signal transduction. Gravitropism: Graviperception & Signal Transduction. Vernalization.

Unit IV

Tissue Culture & Techniques: Introduction to *in vitro* methods, General techniques, Factors involved in totipotency, embryogenesis, organogenesis and their applications. Auxillary bud, shoot tip and meristem culture. Haploids and their applications, Somaclonal variations and applications, Single cell suspension culture and their applications in selection of variants. Introduction to protoplast isolation, principles and applications. Somatic hybridization and practical applications.

Recommended Books:

1. Taiz, L., Zeiger, E. Plant Physiology. Sinauer Associates Inc., U.S.A.
2. Hopkins, W.G., Huner, N.P. Introduction to Plant Physiology. John Wiley & Sons, U.S.A.
3. Bajracharya, D. Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.
4. Plant Biotechnology, 2011, 3rd Ed, BD Singh.

BSB-404
Biophysics (CBCS)

Credit: 4
Lectures: 60

Unit I

Thermodynamics of living systems: Laws of Thermodynamics, Conservation of energy in living systems, Entropy and Life, Gibbs and Standard free energy, Equilibrium constant, Coupled reactions. Osmosis, Osmotic pressure, Osmoregulation, Viscosity and biological importance, Surface tension, Factors influencing surface tension. Dialysis. Colloids, colloidal systems of life. Buffer, buffer capacity, Buffers in life systems

Unit II

Energy requirements in cell metabolism, role and structure of mitochondria, high energy phosphate bond, electron transfer phenomenon and biological transfer. Oxidation and reduction, redox potential and its calculation by Nernst equation, examples of redox potential in biological system.

Unit III

Micelles, reverse micelles, bilayers, liposomes, phase transitions of lipids, active, passive and facilitated transport of solutes and ions, Diffusion, Laws of diffusion, Active transport, Facilitated diffusion, Fick's Laws, Nernst Planck Equations, Donnan effect, permeabilily coefficient. Ionophores, transport equation. Application of biological membranes in drug delivery

Unit IV

Basic principles of electromagnetic radiations, spectroscopic techniques, energy, wavelength, wave numbers and frequency. Absorption laws, Basic principles of microscopy, light and electron microscopy. Uses and applications.

Recommended Books:

1. A text book of Biophysics by Dr. R. N. Roy
2. Biophysics: An introduction by Rodney Cotterill
3. Biophysics by K. Sarn

BSB-501
Microbiology

Credits: 4
Lectures: 60

Unit I

History of Microbiology: The microscope, Cell theory, spontaneous generation, theory of biogenesis, Koch's postulates, fermentation, pasteurization. Vaccination, germ theory of diseases, Microbial Diversity: Algae, fungi, protozoa, bacteria, viruses and prions.
Microscopy: Bright Field Microscope, Dark Field Microscope, Phase contrast Microscope. Electron microscope: Transmission electron microscope & scanning electron microscope.

Unit II

Bacterial Morphology: Bacterial size, shapes and pattern of arrangement; the cell wall structure: Gram positive and gram negative bacteria, Structures external to cell wall, Structures internal to cell wall, Gram staining technique
Reproduction and growth of bacteria: modes of cell division, generation time, Growth curve. Bacteriological media: Selective media, maintenance media, differential media.Isolation of pure cultures and maintenance of culture.

Unit III

Control of microorganisms, Definitions and fundamentals of control, Physical agents/processes for control: high temperature, low temperature, filteration, desiccation, osmotic pressure, high pressure, radiation. Chemical agents and their mode of action: Phenol & Phenolic compounds, Halogens, Aldehydes, Heavy metals, Antibiotics.

Unit IV

Architecture of viruses: Capsid morphology, Nucleic acid and envelop. Transmission & replication of viruses, Transmission of plant viruses, Animal viruses & bacteriophages, Replication of Animal viruses & Lambda phage, Replication of RNA virus and DNA virus.

Recommended Books:

1. Microbiology by Pelczar M J
2. Principles of Microbiology Ronald M. Atlas
3. Prescott's Microbiology by Christopher J. Woolverton, Joanne Willey, and Linda Sherwood
4. A text book of Microbiology by R. C Dubey

BSB-502
Immunology

Credits: 4
Lectures: 60

Unit I

The immune system and immunity historical perspective. Types of immunity Humoral & Cell Mediated. The cells and organs of the immune system. Innate immunity. Anatomical barriers, cell types of innate immunity, connection between innate and adaptive immunity

Unit II

Adaptive immunity. Antigens and haptens Factors that dictate immunogenicity. Structure and distribution of classes and substances of immunoglobulins(Ig), Ig fold, effector functions of antibody, antigenic determinants on Ig and Ig super family. Generation of antibody diversity. Complement and its activation by classical, alternate and lectin pathway; biological consequences of complement activation; regulation of complement activity.

Unit III

Immunological methods-Antgen-antibody interactions. Agglutination, hemagglutination. Precipitin reactions in solution and in gels; immunoassays. Selection, Antigen presentation, Activation of T and B cells. Cytokines.

Unit IV

Immunological tolerance-Primary and secondary. Hypersensitivity and its types. Immune response against major classes of pathogens. Vaccines: Live attenuated, Inactivated, Toxoid, subunit/conjugate vaccine. Monoclonial Antibody.

Recommended Books:

1. Immunology by Kuby.
2. Fundamentals of Immunology by William E. Paul.
3. Text book of Immunology by Seemi Farhat Basir, Abbas, Published PHI 2012.
4. Cellular and molecular Immunology by Abdul Abbas, Andrew H Lichtman & Shiv Pillai

BSB- 503
Genetics

Credits: 4
Lectures: 60

Unit I

Mendelism and law of inheritance, Law of segregation, Law of Independent assortment, Phenotypes and genotypes, Chromosomal theory of inheritance, Linkage, Recombination, Linkage maps, Crossing over, Double cross over, Coincidence & interference, Sex-linkage, X-linked inheritance.

Unit II

Multiple Alleles, Incomplete dominance, Over- dominance and co- dominance, Sex-link trait and their inheritance, Non-allelic or inter allelic gene interaction: example of modified dihybrid ratio 9:3:4, 9:7, 12:3:1, 15:1, 13:3, 9:6:1, 7:6:1, 7:6:3, 6:3:3:4, and 7:4:3:2.

Recombination in bacteria, Transformation, Transduction and Conjugation.

Unit III

Population genetics: Mendelian population, Hardy – Weinberg equilibrium, Gene and genotype frequencies, Factors affecting the frequencies of gene in population, Pleiotropism, lethal gene, Penetrance and Expressivity.

Extra-chromosomal Inheritance, Mitochondrial genome, Cytoplasmic inheritance, maternal effects, Extra nuclear genome, Variegation in leaves of higher plants, Shell coiling in snail.

Unit IV

Structural organization of Chromosome, Nucleosome model, Euchromatin and Heterochromatin, Structure of Chromosome, special chromosome(Polytene and lampbrush chromosome), Banding pattern in human chromosome, Structural and numerical aberrations involving chromosome, Hereditary defects, Klinefelters ,Turner, Cri-du-Chat and Down Syndrome, Abnormal Euploidy, Polyploidy, Autotetraploid. Mutations, spontaneous and induced mutagenesis.

Recommended Books:

1. Principles of Genetics by Gardner, Simmons and Snustad.
2. Genetics: A Conceptual Approach by Benjamin A. Pierce.
3. Genetics by Monroe E. Strickberger.

BSB-504
Bioinformatics & Information Technology (CBCS)

Credits: 4
Lectures: 60

Unit I

Computer and its components, Characteristics of Computer, Types of Digital Computer, Hardware basics: Processors, motherboard, slots / cards, bus, parallel and serial ports.
Various storage devices, Input/Output, Memory unit, Software basics: Data vs. information, Software: types of software, Operating systems, Languages, Compilers, Interpreters, Ideas of portability and platform dependence. Basic word processing in Microsoft word. Power Point and Excel, Preparing and processing text documents.
Internet: Introduction and back ground, functioning, governing bodies, uses.

Unit II

What is Bioinformatics, Use of information technology for studying Biosciences, Emerging areas in Bioinformatics, Future prospects of Bioinformatic, Introduction to Genomics, Introduction to Proteomics, Human Genome Project, Biological Software, Public Database, Gen Bank.

Unit III

National Center for Biotechnology Information (NCBI): Tools and Databases of NCBI, Database Retrieval Tool, Sequence Submission to NCBI, Basic local alignment search tool (BLAST), Nucleotide Database, Protein Database, Gene Expression Database.
EMBL Nucleotide Sequence Database (EMBL-Bank): Introduction, Sequence Retrieval, Sequence Submission to EMBL, Sequence analysis tools.
DNA Data Bank of Japan (DDBJ): Introduction, Resources at DDBJ.

Unit IV

Protein Information Resource (PIR): About PIR, Resources of PIR, Databases of PIR, Data Retrieval in PIR, Swiss-Prot: Introduction and Salient Features. Phylogenetic analysis, Protein sequence analysis, Protein structure prediction. Basics of database management system, SQL, Artificial Neutral Network Technology, Gentic alogorithm, Decision trees.

Recommended Books:

1. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley- Blackwell.
3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.

BSB-601
Biochemistry

Credit: 4
Lecture: 60

Unit-I (Enzymology)
Enzymes as biological catalysts: characteristics, nomenclature and classification, coenzymes: structure and function, Enzyme kinetics: Michaelis-Menten equation, significance of Km and Vmax, Analysis of kinetics data, Enzyme inhibition: competitive, uncompetitive and mixed inhibition, Enzyme catalytic mechanisms: Acid-base, covalent, metal ion, proximity and orientation effects. Mechanism of action of lysozyme and chymotrypsin.

Unit-II (Carbohydrate)
Occurrence, classification, characteristics, structure and function of monosaccharides, disaccharides and polysaccharides, Mucopolysaccharides, glycosaminoglycans, proteoglycans, glycoproteins, Glycolysis: reactions and regulation, Gluconeogenesis, HMP pathway, Citic acid cycle, Glycogen degradation and synthesis.

Unit-III (Lipid)
Classification and type of lipids, structure and function of phospholipids, sphingolipids and glycolipids, Lipid linked proteins and lipoproteins, Mobilization of lipids for oxidation, beta-oxidation of saturated, unsaturated and odd chain fatty acids, synthesis of palmitic acid by fatty acid synthase system.

Unit-IV (Amino Acids and Protein)
Structure, nomenclature, classification and acid-base behaviour of amino acids, primary structure of proteins and its determination, Secondary structure of proteins: peptide group, helical and beta structures, Bonds and forces which stabilize native protein structure, protein denaturation. Oxidation of amino acids: transamination reactions and urea biosynthesis. Flow sheet diagram of amino acid catabolism and synthesis (without structures).

Recommended Books:

1. Principles of Biochemistry by Albert L. Lehninger, David L. Nelson, Michael M. Cox.
2. Biochemistry by Stryer.

BSB-602
Ecology

Credit: 4
Lecture: 60

Unit I

General ecology : Atmosphere, Weather, Climate, Weather Assessment, Fine weather; Cloudy weather; Biosphere, Biomes and Ecosystems, (Tundra, Taiga, Grassland, Desert and aquatic), Concept, components and types of ecosystem (Tundra, Taiga, Grassland, Desert and aquatic- Fresh water, Marine and Brakkish water), ecological range (Eury, Steno), Ecological factors (abiotic and biotic), Ecological pyramids, Food chains; Food web, Productivity, Biogeochemical cycles : Gaseous and sedimentary.

Unit II

Community ecology: Community gradients and boundaries- Ecotone and species diversity, Edge effect. Qualitative characters of community (Floristic composition, Stratification of vegetation, periodicity, vitality and vigour, life forms), Quantitative characters of community (Population density, Cover, Height, weight of plants). Community dynamics (Succession)- Processes in succession, Primary and secondary succession, Kind of succession-Hydrach and Xerarch succession, Autogenic and Allogenic succession, Autotrophic and heterotrophic succession, Models of Succession, Trends in succession, Climax Concept : Monoclimax and polyclimax , Preclimax, Postclimax, Disclimax etc).

Unit III

Community organization: Habitat and Niche, Keystone species; Dominant species, Indicator species, Umbrella species, Flagship species, Views of community organization, Species interaction-Neutralism, Competition, Predation including herbivory, Parasitism, Commensalism, Mutualism, Amenalism, Competition - Lotka and Voltera equation for competition and predation, Competition in laboratory population- Gause principle, competition in natural populations, Competative exclusion, Resource partitioning, Evolution of competitive ability- territorial behavior, Predation- Parasitoidism, herbivory, Cannibalism, Predation in laboratory, predation in field, Co- evolution of predator and prey system; Herbivory, - defence mechanism in plants, Herbivore counter measures, Herbivore interactions, Phenotypic and genotypic plasticity, Canalization.

Unit IV

Population dynamics: Density; Natality, Mortality, Immigration; Emigration, Survivorship curves, Population dispersal, Age distribution, Factors affecting biotic potential, Population growth- exponential and logistic growth equations, r and K selection, Carrying capacity, Population regulation-density dependent factors, density independent factors, Gene diversity of population.

Recommended Books:

1. Wilkenson DM. Fundamental Processes in Ecology.
2. Odum EP . 2008. Fundamentals of Ecology.
3. Singh JS, Singh SP and Gupta SR. 2014. Ecology, Environmental Science and Conservation. S Chand Publishing , New Delhi .
4. LSE-02 Ecology Blocks (1,2,3,4), IGNOU.
5. Pandey SN, Misra SP. 2011. Environment and Ecology, Ane Books Pvt. Ltd.

BSB- 603
Organic Evolution

Credit: 4
Lectures: 60

Unit I
Origin of life, theories of the origin of life, cosmozoic, chemogeny, biogeny, experimental evidences in support of biochemical origin of life. Evidence in favour of evolution, evidence from embryology, paleontology, taxonomy connecting links. Evidence from biology, physiology and genetics.

Unit II
Lamarck and Lamarckism, Darwinism and theory of natural selection, Neo Lamarckism, Neo Darwinism, modern synthetic theory of evolution. Patterns of evolution, polymorphism types of polymorphism, monophyletic, polyphyletic and paraphyletic evolution, divergent evolution, convergent evolution, co-evolution, microevolution, megaevolutions, adaptive radiations.

Unit III
Fossils. Geological distributions of animals, Era, Period Epoch and their features. Origin and evolution of Horse, phylogeny of human.

Unit IV
Biogeography, various theories of zoogeography regions and sub regions in spatial distributions with special reference to the Indian sub regions.

Recommended Books:

1. Organic evolution by Veer Bala Rastogi, Kedarnaath Ramnaath Publishers, Meerut
2. Organic Evolution, a text book by Lull, Richard Swann, 1867
3. Strickberger's Evolution by Brian K. Hall and Bennedikt Hallgrimsson
4. A text book of Organic Evolution by Mohan P. Arora and Himanshu Arora

BSB- 604
Techniques in Biology (SEC)

Credit: 4
Lectures: 60

Unit I
Spectroscopic techniques: Principle and applications of UV-visible, FTIR, Fluorescence and CD spectroscopy. Principle and applications of Colorimeter, Spectrophotometer, Flame photometer. Beer and Lambert's law.

Unit II
Separation techniques: Principle and applications of paper chromatography, thin layer chromatography, ion exchange chromatography, affinity chromatography and HPLC. Electrophoresis – principle and applications of PAGE, agarose gel electrophoresis. Ultra centrifuge and organelle separation.

Unit III
Immunological techniques: Immunodiffusion (Single & Double) - Immuno electrophoresis Techniques immuno detection - Immunocyto / histochemistry - Immunoblotting, immunodetection, immunofluroscence. ELISA, RIA, Hybridoma technology, Histological techniques - Principles of tissue fixation - Microtomy - Staining - Mounting – Histochemistry, Cell culture techniques. Design and functioning of tissue culture laboratory - Culture media, essential components and Preparation - Cell viability testing.

Unit IV
Cytological techniques: Mitotic and meiotic chromosome preparations. Chromosome banding techniques (G.C.Q. R. banding) – Flowcytometry, Molecular cytological techniques - In site hybridization (radio labelled and non-radio labelled methods) - FISH - Restriction banding. Molecular biology techniques - Southern hybridization, Northern hybridization, Polymerase chain reaction (PCR) & its types.

Recommended Books:

1. Introduction to instrumental analysis-Robert Braun-McGraw Hill.
2. A biologist Guide to principles and Techniques of Practical Biochemistry- K. Wilson and K.H. Goulding ElBS Edn.
3. Clark & Swizer. Experimental Biochemistry. Freeman, 2000.
4. Locquin and Langeron. Handbook of Microscopy. Butterwaths, 1983
5. Boyer. Modern Experimental Biochemistry. Benjamin, 1993
6. Freifelder. Physical Biochemistry. Freeman, 1982.
7. Wilson and Walker. Practical Biochemistry. Cambridge, 2000.

M.SC. BIOSCIENCES

Head of Department:	**Prof. M. Moshahid Alam Rizvi** (Coordinator UGC-SAP Phase-II & M.Sc.Biochemistry & M.Sc.Microbiology)
Students' Advisor:	**Dr. Nida Jameel Khan**
Girls Grievance Advisor:	**Dr. Maryam Sardar**
Placement Coordinator:	**Prof. Q.M.R. Haque**

Faculty Members

1. Prof. M.Moshahid A. Rizvi:	Molecular Oncology and Therapeutics
2. Prof. Tasneem Fatma:	Cyanobacteria & Algae
3. Prof. Syed Akhtar Husain:	Human Genetics
4. Prof. Seemi F. Basir:	Biochemistry
5. Prof. Luqman A. Khan:	Fungal Biochemistry
6. Prof. Jawaid A. Khan:	Plant Virology
7. Prof. Q.M.R. Haque:	Plant Virology
8. Prof. M. Aman Jairajpuri:	Protein structure function
9. Prof. Meryam Sardar:	Protein Chemistry
10. Dr. NikhatManzoor:	Medical Mycology
11. Dr. Nadeem Ahmad:	Biomathematics, Bioinformatics
12. Dr. Nida Jamil Khan:	Animal Biotechnology
13. Dr. Amit Kumar Verma:	Fisheries
14. Dr. Mohammad Abid	Medicinal chemistry
15. Dr. Mohammad Mohsin	Plant Physiology

Department of Biosciences: A Brief Profile

Department of Biosciences at Jamia Millia Islamia was established in 1985 with an aim to impart an interdisciplinary nature of teaching where the students do not feel handicapped in deciphering the complex issues of life process. It was designed to equip the students with arsenal of modern biology and aroma of interface in physical sciences like, Bioinformatics, Biomathematics, Biostatics and Biophysics in addition to strong back up of Chemistry/Biochemistry.

Our undergraduate and postgraduate teaching programmes in Biosciences are highly inclusive in nature and provide enough space for various disciplines of life sciences. Both programmes strive to build seamless connectivity and synergy between Biological and Physical Sciences excellence zone being the interaction of Biology and other allied sciences. Numerous students from this department have found placement as academician and researchers in the leading institutes of India and abroad. The scientific/research contribution of the department has definitely and hugely contributed in getting laurels to the university both in NAAC accreditation ('A') and highly honoured international ranking.

In addition to well equipped teaching and research laboratories, the Department maintains an state of art Human Tissue Culture facility where more than 20 different human cancer as well as normal cell lines are routinely reared and employed for various drug development/toxicity studies for anticancer drug efficacies and molecular cross talk analysis of cancer causing genes. The department has an strong Departmental Instrumentation Facility which houses DST FIST assisted Plant tissue culture & Green House facility, Bioinformatics lab with rich Central Instrumentation Facility which houses equipments as Ultra-Centrifuge, A range of High Speed Centrifuges, HPLC, Stopped flow apparatus, Spectrophotometers, Spectrofluorometer, Microplate readers, a large range of shakers and sonicators, Ultrapure water purification systems, Light, Inverted & Fluorescence Microscopes, Gel Documentation systems, Gradient PCRs, Quantitative PCR, Ultra Low Temperature Freezers, Organ Bath System. These facilities complement project support mobilized from external funding agencies like UGC, CSIR, DST,DRDO, DBT, ICMR, MoEF, etc., and underpin research in a range of biological processes from Plant pathology (virology, molecular biology), Protein Chemistry/ Structural biology, Environmental Biology, Microbiology, Nanobiotechnology, Muscular physiology and Oncology. The department has been granted second phase UGC SAP in the area of cancer therapeutics as a testimony of the department in this research field.

The department of biosciences has been pioneer in the creation of other 'centre' and 'Department' during the course of time as its offshoot like the department of Biotechnology, Centre for Physiotherapy and Centre for Interdisciplinary Research in Basic Sciences (CIRBSc). At present the department is running two program under the SFS category M.Sc. Biochemistry since (2007) and M.Sc. Microbiology (2018) with a commitment to transform the program into a full-fledged department.

Course Structure of M.Sc. Biosciences w.e.f. 2018-19
(Approved by Board of Studies dated 19.12.2018)

Semester-I		Credits
BSM-101 Biochemistry	4 periods/wk Marks : 75*+25**=100	**4**
BSM-102 Cell Biology	4 periods/wk Marks : 75*+25**=100	**4**
BSM-103 Genetics	4 periods/wk Marks : 75*+25**=100	**4**
BSM-104 Bioinformatics & Biostats (CBCS)	4 periods/wk Marks : 75*+25**=100	**4**
BSM-105 Lab Course-I	12 periods/wk Marks : 150	**6**

Semester-II		Credits
BSM-201 Animal Physiology	4 periods/wk Marks : 75*+25**=100	**4**
BSM-202 Microbiology	4 periods/wk Marks : 75*+25**=100	**4**
BSM-203 Genome Biology	4 periods/wk Marks : 75*+25**=100	**4**
BSM-204 Biophysics (CBCS)	4 periods/wk Marks : 75*+25**=100	**4**
BSM-205 Recombinant DNA Technology (SEC)	4 periods/wk Marks : 75*+25**=100	**4**
BSM-206 Lab Course-II	12 periods/wk Marks : 150	**6**
Educational Tour	(After Semester-I /II Exams)	

Semester-III		Credits
BSM-301 Immunology	4 periods/wk Marks : 75*+25**=100	**4**
BSM-302 Plant Physiology	4 periods/wk Marks : 75*+25**=100	**4**
BSM-303 Molecular Biology	4 periods/wk Marks : 75*+25**=100	**4**
BSM-304 Technical Writing & Seminar (AECC)	4 periods/wk Marks : 75*+25**=100	**4**
BSM-305 Environmental Biology (CBCS)	4 periods/wk Marks : 75*+25**=100	**4**
BSM-306 Lab Course-III	12 periods/wk Marks : 150	**6**

Semester-IV		Credits
BSM-401 Physical Chemistry of Macromolecules (PCMM)	4 periods/wk Marks : 75*+25**=100	**4**
BSM-402 Toxicology (CBCS)	4 periods/wk Marks : 75*+25**=100	**4**
BSM-403 Lab Course IV	4 periods/wk Marks : 50	**2**
BSM-404 Project and Dissertation	Marks : 200	**8**

***End term Examination** **Total Credits=92**

****Mid term Examination**

BSM-101
BIOCHEMISTRY

Unit I: Carbohydrate and Lipid Metabolism:

Glycolysis, HMP pathway, Glycogenolysis, PDH reaction, Tricarboxylic Acid Cycle: Kreb's discovery, isotopic tests, amphibolic nature, energetics and regulation. Gluconeogenesis, Synthesis of Glycogen and important disaccharides, hormonal regulation of Carbohydrate metabolism.

Oxidation of lipids: beta-oxidation, oxidation of unsaturated and odd chain fatty acids, regulation of Fatty acid oxidation, Formation and oxidation of Ketone bodies. Biosynthesis of saturated fatty acids: carbon sources, acetyl CoA carboxylase and reaction of Fatty acid synthase. Synthesis of odd chain and unsaturated fatty acids. Biosynthesis of Triacylglycerol and phosphoglycerides. Biosynthesis of cholesterol and its regulation.

Unit II: Amino Acid Metabolism Amino acid oxidation:

flow sheet, deamination and transamination reactions, alpha- ketoglutarate, succinate, fumarate and oxaloacetate pathways of amino acid oxidation. Metabolic fates of amino groups, role of glutamate and glutamine. Urea Cycle: reaction and regulation, Biosynthesis of standard essential and non-essential amino acids. Regulation of amino acid biosynthesis. Genetic defects in amino acid metabolism.

Unit III: Nucleotide and Heme Metabolism:

Degradation of purinc & pyrimidine ribonucleotides and its regulation. Biosynthesis of purine & pyrimidine 4 ribonucleotides: de-novo pathways and salvage. Reactions and regulation of ribonucleotide reductase and thymidylate synthase, purine nucleotide cycle. Genetic defects, in nucleotide metabolism. Enzymes of Nucleotide metabolism as chemotherapeutic targets. Heme biosynthesis and degradation

Unit IV: Enzymology:

Enzyme catalysis: Acid-Base, metal ion, covalent and electrostatic catalysis, Reaction coordinates. Transition state stabilization and entropy reduction by enzymes. Enzyme kinetics: Substrate velocity curve, MichaelisMenten mechanism for single substrate reactions, Meaning and significance of Km, Ks, Kcat and specificity constant. Lineweaver-Burk and Eadie-Hofstee plots, kinetics of bisubstrate reactions. Enzyme Inhibition: Mechanism and kinetics of competitive, uncompetetitve, mixed and noncompetitive inhibitions.

Recommended Books:

1. Nelson, David L., Albert L. Lehninger, and Michael M. Cox. Lehninger principles of biochemistry. Macmillan, 2008. Berg, Jeremy M., John L. Tymoczko, and Lubert Stryer. "Biochemistry 5th ed." (2002).
2. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. Fundamentals of Biochemistry 2002 Update. John Wiley & Sons, 2002.

BSM-102
CELL BIOLOGY

Unit I: Cytoskeletal Network Intramembrane System

Cytoskeletal network, alpha and beta tubulins, actin-myosin system intermediatary filaments and Dynein activator complex. Structure and Function of Endoplasmic Reticulum, Golgi body and Lysosome.

Unit II: Nucleus, Cell cycle and Molecular Structure of Gene

The nuclear envelop and traffic between nucleus and cytoplasm, internal organization of the nucleus, the nucleolus, nucleus during mitosis. The eukaryotic cell cycle, regulation of cell cycle progression. Nuclear compartment chromosomal organization of genes, functional rearrangement in chromosomal DNA, Morphology and functional elements of eukaryotic chromosome, mitochondrial DNA.

Unit III: Cell to Cell Signaling

Overview of extracellular signaling, Arachadanic acid Nitriconide based signaling, G-protein coupled receptors and their effectors, Receptor tyrosine kinase and RAS, MAP kinase pathways. Program cell death.

Unit IV: Molecular basis of Cancer

Tumor cells and onset of cancer, Protooncogene and tumor suppressor gene, oncogenic mutations affecting cell proliferation, mutation causing loss of cell cycle control, mutation affecting genome stability.

Recommended Books:

1. The Cell, A Molecular Approach – 6th Edition – Geoffrey M. Cooper/Robert E. Hausman- Sinauer Associates, Inc.
2. Molecular Biology of the Cell - 5th Edition - Bruce Alberts et al - Garland Science
3. Molecular Cell Biology - 7th Edition - Harvey Lodish, Arnold Berk & Chris A. Kaiser - W.H. Freeman
4. Lewin's Cells – 2nd Edition – Cassimeris/Lingappa/Plopper – Johns & Bartlett Publishers
5. Cell Biology, A Short Course – 3rd Edition – Stephen R. Bolsover et al – John Wiley& Sons
6. Microbial Physiology: Moat, Foster and Spector
7. Cell and molecular biology: Gerald Karp.
8. Cell and molecular biology: DeRobertis and DeRobertis

BSM – 103
GENETICS

UNIT-I.
Chromatin structure, Nucleosome, Chromosome structure-centromere and telomere. Tandomly repeated non-coding DNA Interspersed repeated non-coding DNA Expression and processing of heterogeneous nuclear RNA, r RNA, t RNA. Alternate transcription and processing on individual genes. Mitochondrial genome and diseases.

UNIT-2.
General homologous recombination. Non-homologous end joining. Site specific recombination, Transposable elements, Mechanism of Transposition. The Lac -operon positive, negative and repression. Arabinose operon.Tryptophan operon. The lambda phase: a complex of operon.

UNIT-3.
Molecular basis of gene mutation. Gain of function mutation. Loss of function mutation and their consequences. Chemical mutagenesis in higher organism.Repair of DNA damage. Photoreactivatrion. SOS repair mechanism. Base excision repair. Nucleotide excision repair. Stability of the genome.

UNIT-4. •
Population and gene pool. Calculating allele frequencies. The Hardy-Weinberg law. Extension of Hardy -Weinberg law, Natural selection, Mutation, Migration,Genetic drift, Non-random mating. Adaptive radiation and modification, Isolating mechanism, Speciation- Allopatric and Sympatric, Convergent evolution, Sexual selection, Co-evolution.

Recommended Books:

1. Introduction to Genetic Analysis. 9th Edition by Griffiths et al. 2008.
2. Concept of Genetics. 9th Edition, by Klug et al.2009.
3. Principles of Genetics by Snustad et al. 2004.
4. Genes IX Lewin 2008.
5. Molecular Biology of the Gene Watson et al. 6th Edition 2009.
6. Molecular Cell Biology by Lodish et al. 2008
7. Molecular Biology of the Cell Alberts et al. 5th Edition. 2007.

BSM – 104 (CBCS)
BIOINFORMATICS & BIOSTATISTICS

Unit I:

What is Bioinformatics, Biosciences, Emerging areas in Bioinformatics, Future prospects of Bioinformatics, Introduction to Genomics, Introduction to Proteomics, Human Genome Project, Public Database, Gene Bank, Using Public Database? Computer Basics: Computer and its components, Characteristics of computer, Classification of Computers, Hardware: Processor/CPU, Input/Output devices, motherboard slots/cards, bus parallel and serial ports, various storage devices/media, Client-Server concepts, Memory. Software basics: Data vs. information, Software: types of software's, Firmware, Operating system, Programming Languages, Compilers, Interpreters, Ideas of portability and platform dependence, MS-DOS, Windows, UNIX, Linux.

Unit II:

DNA and Protein sequence analysis, tools, BLAST, FASTA, Protein Visualization tools, Ras Mol. VMDL, Chime, ORF finder, Gene finder, Gene Scan. Biological databases: Medline EMBL Gene bank, Pub Med, PDB, Entry and retrieval of Data from public databases. Database: Database basics, RDBMS, MS Access, My SWL, ER- Diagram, Relationship.Internet: Computer networking: LAN & WAN, Internet and its application, Major features, WWW and its attributes, web browsers & web server, websites/ address/ pages, Client Server Principles, Protocols and search engines/tools, Bioinformatics resources on internet.

Biostatistics

Unit III:

Measures of central tendency- average, mean, median, mode, measures of location-percentile, graphic method, Arithmetical method, application and uses of percentiles, Types, biological, real, experimental, measures of variability, range, semi-inter quartile range (Q), mean deviation, standard deviation (SD), and coefficient of variation (CV), Probability: Addition law of probability, multiplication law, binomial probability distribution, Poisson distribution, probability chance from shape of normal distribution or normal curve. Basic introduction to Muetrovariate statistics.

Unit IV:

Idea of parametric and non parametric statistics, Hypothesis testing (Large and small samples test), types of errors and level of significance, confidence interval, test of significance (F-test & T-test), chi-square test, Significance of difference in proportions of large samples, Correlation and regression, Design and methodology of an experiment or a study: Step and methodology, format for presentation of any research work.

Recommended Books:

1. Fundamental Concepts of Bioinformatics Dan E. Krane, Wright State University Michael L. Raymer, Wright State University
2. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins By Andreas Baxevanis and Francis Ouellette'
3. Bioinformatics: A Biologist's Guide to Biocomputing and the Internet By Stuart Brown
4. All of Statistics: A Concise Course in Statistical Inference by Larry Wasserman
5. Biostatistics: The Bare Essentials Geoffrey R. Norman PhD, David L. Streiner PhD
6. Principles and Practice of Biostatistics B Antonisamy, Prasanna S. Premkumar

BSM-201
ANIMAL PHYSIOLOGY

Unit I: Cardiovascular System and Respiratory System:

Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG-its principle and significance, cardiac cycle, blood pressure, regulation of blood pressure.
Comparison of respiration in different species, transport of gases (oxygen transport, oxygen–haemoglobin dissociation curve, carbon dioxide transport), exchange of gases,waste elimination,regulation of respiration.

Unit II: Digestive System and Excretory System:

Physiological anatomy of Gastro-Intestinal Tract (GIT), Digestion and absorption of food (carbohydrates, proteins and fats) in the GIT, Energy balance, BMR.
Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, acid-base balance, homeostasis,Renin-Angiotensin System.

Unit III: Nervous System:

Neurons,action potential,gross neuroanatomy of the brain and spinal chord,central and peripheral nervous system.Vision , Hearing and Tactile response.

UNIT IV: Endocrine system and Reproductive System:

Endocrine glands(Hypothalamus, pituitary gland,pineal gland, thyroid gland,parathyroid gland,thymus,adrenal gland, pancreas,testis, ovary), basic mechanism of hormone action, hormones and diseases. Male reproductive system, female reproductive system, reproductive processes (spermatogenesis, oogenesis), Neuroendocrine regulation.

Recommended Books:

1. Barret Kim E., Boitano Scott, Barman Susan M., Brooks Heddwen L. Ganong's Review of Medical Physiology. 25th ed.New York:McGraw Hill Medical,2015.
2. Hall John E.Guyton and Hall Textbook of Medical Physiology. 13th ed. Philadelphia, PA: Saunders Elseviar, 2015.

BSM 202
MICROBIOLOGY

Unit I:

Bacterial taxonomy: Characteristics used in classification of microorganisms, Bergey's Manual Trust, A brief account of Bergey's Manual of Determinative Bacteriology and Bergey's Manual of Systematic Bacteriology, Structure and functions of bacterial cell wall: Gram positive bacteria, Gram Negative bacteria, Archaebacteria. Bacterial Endospore: Structure, formation and germination.

Unit II:

Electron Microscopy: Transmission Electron Microscope, Scanning Electron Microscope. Cultivation of bacteria: Bacteriological media, Physical conditions required for growth, Batch culture, Continuous cultures, Chemostat, Turbidostat. Measurement of growth. Control of microorganisms: Definitions and fundamentals of control, mode of action of antimicrobial agents, Conditions influencing antimicrobial action.

Unit III:

Human microbe interaction: Normal microbiota of Skin, Eye, Respiratory tract, Intestinal tract, and Genitourinary tract. Gnotobiotic animals. Determinants of infectious diseases: Transmission, Attachment, Colonization, Entry, Growth and multiplication, Exotoxins, Endotoxins, Leucocidins and Hemolysins. Antibacterial drugs. Drug Resistance: Mechanism of drug resistance, Origin and transmission.

Unit IV:

Morphology and Ultrastructure of Viruses: Icosahedral, Helical and complex symmetry. Viral genome, Capsid and capsomers, Envelope and enzymes. Replication of Viruses: Replication of animal viruses (HIV and Poliovirus), Transmission and Replication of plant viruses with special reference to TMV. Bacteriophage (T4 Phage): Adsorption, Penetration, Synthesis of nucleic acid and protein, Assembly and release.

Recommended Books:

1. Prescott, Harley & Klein, Microbiology (WCB)
2. Ronald M. Atlas, Microbiology, Fundamentals and Application (McGraw Hill)
3. Tortora, Funke & Case, Microbiology, An Introduction (Addison Wesley and Longman Inc.)
4. Volk, Beniganin, Kodner & Parsons. Essentials of Medical Microbiology.
5. Alcamo's, Fudamentals of Microbiology, Addition Wesley Long Inc.
6. R.E.F. Mathews, Plant Virology (Academic Press)

BSM-203
GENOME BIOLOGY

Unit I: Genome Organization & Transgenesis

Elements of eukaryotic genome organization; Human genome and organization of genes; Epigenome and regulation of genes through epigenetic mechanism, genomic imprinting; Uni Parenta Disomy(UPD).Principle, methods and types of gene transfer in animal oocytes and embryonic stem cells. Production of transgenic/gene knock out animal (Mice), applications of transgenic animal; animal cloning and its broad spectrum applications, advantages, disadvantages and ethical concern.

Unit II: Molecular Pathology

Understanding chromosomal and molecular basis of genetic diseases in man. Molecular pathology of single gene multifactorial and sex linked diseases with special reference to Marfan Syndrome, Prader Willi Syndrome, Fragile 'X' Syndrome, sickle cell anemia, and DMD. Cancer and characteristics of cancer cells, involvement of tumor suppressor genes and oncogenes in cancer.

Unit III: Molecular Diagnosis

Prenatal diagnosis, Chorionic Villi Sampling Amniocentesi, Cordocentesis. Application of molecular, Cytogenetic and immunohistochemical techniques in diagnosis of various chromosomal and molecular pathogenisis.

Unit IV: Molecular Therapeutics

Types and models of gene therapy; gene delivery system, viruses in delivery system. Application of gene therapy in correction of different genetic diseases. Ethics associated with somatic and germ cell gene therapy. Interferon and other cytokines in therapeutics. Therapeutical application and ethical implication of cloned animals.

Recommended Books:

1. Human Genetics: Proceedings of the 7th International Congress Berlin 1986Paperback – Import, 17 Nov 2011
2. Vogel and Motulsky's Human Genetics: Problems and Approaches Hardcover – Import, 1 Feb 1982
3. Genetics of Sex Determination (Advances in Genome Biology Book 4) Kindle Edition by R. S. Verma (Editor)
4. Genomes 4 Paperback – 21 Jun 2017 by T. A. Brown (Author)
5. Genome Refactoring (Synthesis Lectures on Synthetic Biology) Paperback – Import, 1 Jun 2009
6. Lewin's GENES XII Hardcover – 1 Feb 2017 by Jocelyn E. Krebs (Author), Elliott S. Goldstein (Author), Stephen T. Kilpatrick (Author)

BSM – 204 (CBCS)
BIOPHYSICS

Unit I: Bioenergetics

Free energy changes, Gibbs energy, Flow of energy in the biological system, concepts of chemical energy, Redox Potential, Nerst Equation, Ion electrochemical potential, Proton electrochemical potential, Membrane potential,equilibrium across a semi-permeable membrane, Donnan potential, respiratory chains , mitochondrialrespiratory chains, respiratory control and oxidative phosphorylation,photosynthetic generators of protonmotive force.

Unit II: Membrane Biophysics

Structure and organization of cell membrane, membrane models and drug delivery system.Energy transducing membranes, measurement of driving forces, metabolite and ion transport, active and passive transport, influx and efflux mechanisms, proton circuit and electrochemical gradient, Ionophores, Uniport, antiport and symport mechanisms, Shuttle systems.ATP synthase, Transport ATPases, Na+/K+ATPase and H+/K+ATPase, Molecular mechanisms of calcium transport, use of Na+ as an alternative to H+ in energy transduction.

Unit III: Radiation Biophysics

Electromagnetic spectrum, properties of non-ionizing and ionizing radiation, radiation units, principles of detection and measurement, Interaction of radiation with matter, free radicals, ions pair and dosimetry, dose effect graphs and target theory, direct and indirect radiation action, radiation effects on proteins, nucleic acids, carbohydrates, cell and whole organism, genetic effects of radiation, repair of radiation induced damages, radiation in diagnosis and therapeutics.

Unit IV: Biophysical Techniques

Spectroscopy: Principle instrumentation and applications of UV-visible Fluorescence, Infra Red, Raman and CD spectroscopies. Basic concept of NMR and X-ray crystallography.Dynamic Light Scattering, Surface Plasmon Resonance, Differential scanning and Isothermal Calorimetry.Mass Spectrometry; MALDI-TOF, ESI/MS. **Microscopy:** Optical, Phase Contrast, Fluorescence Microscopy, Scanning Electron, Transmission Electron.

Recommended Books:

1. Keith Wilson and John Walker. Practical Biochemistry Principles and Techniques. Cambridge University Press.,1997
2. Creighton TE. Proteins Structures and Molecular Properties. W.H. freeman & Company, New York.,2006
3. David Freifelder. Physical Biochemistry: applications to Biochemistry and Molecular Biology. W.H. freeman and Company.,2006
4. New Era of Bioenergetics, by YasuoMukohata, Publisher Academic Press, 2012, ISBN 0323140297, 9780323140294.
5. Principles of Bioenergetics: Authors, Vladimir P. Skulachev, Alexander V. Bogachev, Felix.
6. Fundamentals of Molecular Spectroscopy, 5th Edn, McGraw Hill, ISBN-10 1259062597, ISBN-13 9781259062599, 2013 May.
7. Chadwick K.H. &Leenbouts H.P. Molecular Theory of Radiation Biology, Springer Verlag.
8. Atlik F.H. Introduction to Radiological Physics and Radiation Dosimetry, John Wiley

BSM – 205 (SEC)
RECOMBINANT DNA TECHNOLOGY

Unit I:
History of recombinant technology, restriction modification system in bacteria, DNA modifying enzymes and their mechanisms of action, functions of adapters, linkers and homopolymer linking in molecular cloning, purification of DNA from living cells, construction of genomic and cDNA libraries, screening of libraries, substrative hybridization for tissue specific DNA libraries

Unit II:
Expression of foreign genes in *E. coli*, production of recombinant protein by prokaryotic expression vectors, eukaryotic expression vectors, mammalian expression vectors; fusion tags, role in purification of recombinant proteins, detection of expressed proteins

Unit III
Chemical synthesis of DNA, changing gene: Random and site-directed mutagenesis, strategies for gene transfer to animal cells, genetic manipulation of mammals, genetic transformation of plant cells - biolistics and *Agrobacterium* mediated, next generation and advanced sequencing, pyrosequencing, recent advances in protein engineering and metabolic engineering

Unit IV
Nucleic acid sequences as diagnostic tools, new drugs and new therapies for genetic diseases, gene therapy for genetic diseases, production of recombinant pharmaceuticals, hormones, recombinant vaccines, antisense therapy, gene knockout

Recommended Books:

1. Singh BD (2010) Biotechnology 4 th Edition, Kalyani Publications
2. Nair AJ (2008) Introduction to Genetic Engineering and Biotechnology. Infinity Science Press
3. Brown T (2010) Gene cloning and DNA analysis: an introduction. John Willey & Sons

BSM 301
IMMUNOLOGY

Unit I

Introduction and Overview of the Immune System. Origin of Immunology and its evolution. Infection and immunity. Types of immunity- Innate and acquired, active and passive, humoral and cell mediated. Clonal selection theory. Organs and cells of the immune system: structure and function. Hematopoesis. Lymphocyte traffic. Antigens and immunogens. Adjuvants. Requirements for immunogenicity.

Unit II

Structure and function of immunoglobulins. Antibody variants- isotypes, allotypes and idiotypes. Monoclonal antibodies. Hybridoma technology. Organization of immunoglobulin genes. Theories and genetic basis of antibody diversity. Antibody –antigen binding: affinity, avidity, cross reactivity. Antigen-antibody interactions; agglutination, hemagglutination. Precipitation reactions in solution and in gels. Immunoassays: Radioimmunoassay, ELISA, ELISPOT, immunoflourescent assays. Fluorescence activated cell sorting. Western blotting.

Unit III

Major histocompatibility complex. MHC genes and Histocompatibility antigens. Role of MHC in T cell selection. Cytokines and their role in immune regulation. Complement system. Mechanism of its fixation; complement activation and its biological activities. Classical, alternative and lectin pathways; Regulation of complement.

Unit IV

Immunological tolerance to self and to antigens; its induction and features. Immunosuppression-specific and non-specific. Allergy and hypersensitivity. Effector mechanisms and examples of each type of hypersensitivity. Transplantation immunology. Tumor immunology. Immunodeficiencies; primary and secondary. Autoimmunity: factors contributing to autoimmunity; examples and diagnosis. Immunization and Vaccines.

Recommended Books:

1. Basic Immunology by Abul Abbas Andrew H. Lichtman and Shiv Pillai, Elsevier
2. Basic immunology by Jacqueline Sharon, Williams & Wilkins
3. Kuby Immunology. W. H. Freeman & Co.
4. Immunology by Ivan Roitt, Jonathan Brostoff, and David Male, Elsevier
5. How the Immune System Works, by Lauren M. Sompayrac, Wiley
6. The Elements of Immunology by Fahim Halim Khan Pearson Education India, 2009
7. Kuby Immunology, Sixth Edition 6th Edition by Thomas J. Kindt (Author), Barbara A. Osborne (Author), Richard A. Goldsby (Author)

BSM - 302
PLANT PHYSIOLOGY

Unit I

Plant water relations, mechanism of water transport through xylem, transpiration, stomatal physiology, factors affecting transpiration, guttation. Photosynthesis: Historical background, photosynthetic pigments and light harvesting complex, photosystems I & II, mechanism of quantum capture and energy transfer system, Calvin cycle, C4 cycle and CAM pathway, translocation of solutes. Carbon allocation. Mechanism of loading and unloading of photoassimilates.

Unit II

Hydrolytic and phosphorilytic degradation of starch and sucrose. Respiration: respiratory quotient, ATP generation, factors influencing the rate of respiration (light, temperature, oxygen availability). Electron Transport system in mitochondria, oxidative phosphorylation.

Unit III

Nitrogen metabolism, biological nitrogen fixation and ammonia assimilation, nitrate reduction and its incorporation in to amino acids. Study of various plant stress, resistant strategies, plant defense mechanism against biotic and abiotic stress.

Unit IV

Tissue cultures, general tissue culture techniques, totipotency, roles of tissue culture techniques in haploid and triploid production. Biosynthesis, Physiological role and mechanism of action of various plant growth regulators like auxin, gibbrellins, cytokinin, abscissic acid and ethylene etc.

Recommended Books:

1. Introduction to Plant Physiology16 December 2008 by William G. Hopkins and Norman P. A. Hüner
2. Fundamentals of Plant Physiology2017 by V. K. Jain
3. Principles of Plant Physiology6 July 2017 by B.P. Nautiyal
4. Plant Physiology and Biochemistry 1 December 2005 | Import by H. S. Srivastava and N. Shankar

BSM-303
MOLECULAR BIOLOGY

Unit I

Enzymes used in Molecular Cloning: Restriction enzymes, DNA polymerases, ligase, kinase, phosphatase, nuclease; molecular cloning of DNA or RNA; Cloning Vectors: Lamda phage, plasmid, M13 phage, cosmid, shuttle vectors, yeast and viral vectors, construction of genomic and DNA library. DNA Sequencing and Amplification of DNA: DNA Sequencing and Amplification of DNA by polymerase chain reaction, types of PCR: RT-PCR, inverse PCR, asymmetric PCR.

Unit II

RNA Synthesis: Types of RNA polymerases, mechanism of transcription, RNA processing, capping, polyadenylation, splicing; micro RNA. Protein Synthesis: Ribosome, formation of initiation complex, initiation, elongation and termination of protein synthesis.

Unit III

Replication of DNA: DNA polymerase and other enzymes involved, replication origin, replication fork, semi conservative replication of double stranded DNA, mechanism of replication.

Unit IV

Gene Expression and Regulation: Prokaryotic and eukaryotic gene expression; gene silencing: transcriptional, post transcriptional, antisense RNA, oligonucleotide technology. Methods of Gene Transfer: Analysis of gene expression, micro arrays, restriction fragment length polymorphism, DNA finger printing, production of GMO.

Recommended Books:

1. Principles of Gene Manipulations & Genomics, S.B. Primrose, M. Twyman, John & Willey Publishers
2. Molecular Biotechnology: Principles and Applications of Recombinant DNA, Bernard R.Glick and Jack J.Pasternack, Panima Publishing Corporation.
3. Gene Cloning – An Introduction. Blackwell Publishing, Brown, T. A. , 2016, (7^{th} edition).
4. Krebs E, J., Goldstein S, E. and Kilpatrick, T. S. (2013). Lewins Gene XI. Jones and Bartlett publishers, Inc.
5. Molecular Cell Biology, Lodish, H., Berk, A., Zipursky, S., Matsudaira, P., Baltimore, D. and Darnell, J. (2016), W. H. Freeman and Company, 8^{th} Ed.
6. Molecular Biology, David P. Clark & Nanette J. Pazdernik, Elsevier Academic Press, UK, (2013), 2^{nd} Ed.

BSM – 304 (AECC)
TECHNICAL WRITING & SEMINAR

In Presence of Supervisors

BSM-305 (CBCS)
ENVIRONMENTAL BIOLOGY

Unit I:
Ecosystem Degradation by Deforestation, Overgrazing , Agriculture, Mining, Urbanisation, Shifting Cultivation, Development Projects, Fuel and Industrial Raw Material Requirements, Threat to Wild Life Through Hunting, Habitat Destruction, Selective Destruction, Domestication, Introduction of New Species, Pesticide Use, Pets Trade, Medical Research Experimentations and Captivity in Zoos , Extinct Species Categories - Threathened Species, Endangered Species, Rare Species, Depleted Species and Intermediate Species, Endemic Species, Habitat Conservation, Providing Critical Resources, Captive Breeding, Development of Biological Reserves, National Parks, Forest Reserves, Wild Life Refuges and Biosphere Reserves, Controlling Introduction of Allien Species, Pollution Reduction, Research and Development, Legal Actions, Public Participation and Awareness, Traditional and Modern Approaches Used In India for Conservation, Project Tiger, Chipko Movement, Appiko Movement, Indian Biosphere Reserve Programme.

Unit II:
Municipal water Treatment, Waste water treatment - Pre treatment, Primary Treatment, Secondary or Biological and Tertiory Treatments_ Trickling Filters, Rotating Biological Contractors, Activated Sludge Process, Oxidation Ponds. Infectious and Medical Waste Pollution and Management, Solid waste pollution and management

Unit III:
Microbial degradation of xenobiotics, Genetic engineering of biodegradative pathways – manipulation by plasmid transfer and gene alterations, Biomass utilization (Starch, Sugar, Cellulose) for commercial production of fructose, alcohol and biofuel (biodiesel & bioethanol).

Unit IV:
Microbial insecticides (*Bacillus thuringiensis & Baculo virus*) mode of action, toxin gene isolation and genetic engineering; Biofertlizers – Bacterial and Cyanobacterial nitrogen fixers, bacterial, cyanobacterial and mycorhizal phosphate solubulizers nitrogen fixing gene and their manipulations, composting, green manuring.

Recommended Books:

1. Climate Change Biology by Lee Hannah, Academic Press Elsevier 2011
2. Environmental Based Management edited by Ramchandra, CRC Press Teller & Francis Group
3. Molecular Biotechnology; Principles & Applications of Recombinant DNA by Bernard R Glick & Jack J Pasternak, ASM Press 2010
4. Biodegradation & Bioremediation by Martin Alexender, Academic Press 1999
5. Microbial Biotechnology; Fundamentals of Applied Microbiology by Alexender N Glazer & Hiroshi Ni Raido, Cambridge University Press 2007

BSM-401
PHYSICAL CHEMISTRY OF MACROMOLECULES

Unit I: Macromolecules Proteins:

Amino acids their physical & chemical properties, Peptides and polypeptides. Peptide group, charges on peptides (pH dependence), Handersen-Haselbalch equation, buffers. Primary structure of proteins, separation of amino acids, end group analysis, reduction, modification and location of disulfide bonds, sequencing of polypeptide.

Nucleic acids: Primary, secondary and tertiary structures of Nucleic acids, polymorphism of DNA (A, B, Z forms), denaturation and renaturation of DNA, supercoiled DNA, superhelix topology, measurements of supercoiling.

Unit II: Structure and function of Protein

1. Different levels in protein structure, Ramachandran plot, Secondary structure (α-helix, β-strand, β-sheet, turns and loops), Super secondary structures, tertiary structure, quaternary structure, globular and fibrous proteins.

2. Functions of different protein, Hemoglobin function, oxygen binding, hill equation, Bohr effect, binding of BPG.

Unit III: Protein folding:

Forces stabilizing the native state of proteins (electrostatic, hydrophobic and hydrogen bonding). The denatured state, modes of denaturation. Protein folding. Landmark experiments in protein renaturation, folding pathways, techniques to monitor protein folding, landscape theory of protein folding. Acessory proteins in folding: protein disulfide isomerase, Rotamases and molecular chaperones.

Unit IV: **Biophysical Techniques Chromatography:**

Paper, TLC, adsorption, partition, ion exchange, gel filtration, affinity, GLC, HPLC.
Electrophoresis: paper electrophoresis, gel electrophoresisSDS-PAGE, isoelectric focussing, gel electrophoresis of nucleic acids.
Viscosity and Sedimentation: Viscosity of macromolecules, measurement of viscosity, velocity and equilibrium sedimentation of macromolecules, diffusion of macromolecules, centrifugation techniques and their applications, ultracentrifugation (analytical and preparative), boundary and band sedimentation, estimation of molecular weight.

Recommended Books:

1. Principles and Techniques of Biochemistry and Molecular Biology by Wilson and Walker 2005
2. Nelson, David L., Albert L. Lehninger, and Michael M. Cox. Lehninger principles of biochemistry. Macmillan, 2008. Berg, Jeremy M., John L. Tymoczko, and Lubert Stryer. "Biochemistry 5th ed." (2002).
3. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. Fundamentals of Biochemistry 2002 Update. John Wiley & Sons, 2002.

BSM-402 (CBCS)
TOXICOLOGY

Unit I

History, general principles and scope of toxicology. Dose response relationships. LD_{50}, ED_{50}, LC_{50}, EC_{50}. General mechanisms of toxicity. Disposition of toxicants – adsorption, distribution, and elimination of toxicants. Biotransformation of Xenobiotics – basic properties, categories and distribution of xenobiotic biotransforming enzymes.

Unit II

Toxic agents – Toxic effects of pesticides & metals with special reference to DDT, lindane, cyclodienes, lead, arsenic, mercury, cadmium, aluminum. Health effects of radiation and radioactive materials. Important radiation episodes.

Unit III

Environmental Toxicology – air pollution & health effects, pollutants of the outdoor ambient air with special reference to sulfur dioxide, sulfuric acid, particulate matter, smog, ozone, nitrogen dioxides and carbon monoxides.

Unit IV

Applications of Toxicology : *Food Toxicology* – Safety standards for foods, food ingredients & contaminants; *Forensic Toxicology* – analytic role, toxicological investigation of a poison death, criminal poisoning of the living; *Clinical Toxicology* – strategy for treatment of the poisoned patient; *Cosmetic Toxicology , Occupational Toxicology* – Occupational diseases, worker health surveillance, exposure monitoring

Recommended Books:

1. A Textbook of Modern Toxicology by Ernest Hodgson & Patricia E Levi, III Ed. Appleton & Lange 1997
2. A Textbook of Modern Toxicology IV Edition, edited by Ernest Hodgson Wiley, 2010
3. Principles of Biochemical Toxicology by John Timbrell, IV Edition
4. Principles of Toxicology, III Edition 2015 by Karen E Sine & Thomas M Brown, CRC Press Teller & Francis Group
5. Environmental Toxicology; Current Developments Edition J. Rose 1998, CRC Press Teller & Francis Group

Course Structure of M.Sc. Microbiology under CBCS pattern

(Approved by Board of Studies dated 19.12.2018)

Semester I

Papers	**Time/Marks**	**Credits**
MBM-101 General Microbiology	(4 periods/wk) MM= 75+25=100	4
MBM-102 Microbial Cell Biology	(4 periods/wk) MM= 75+25=100	4
MBM-103 Genetics	(4 periods/wk) MM= 75+25=100	4
MBM-104 Bioinformatics & Biostats	(4 periods/wk) MM= 75+25=100	4
MBM-105 Laboratory Course-I	(12 periods/wk) MM= 100+50=150	6

Semester II

Papers	Time/Marks	Credits
MBM-201 Bacteriology	(4 periods/wk) MM= 75+25=100	4
MBM-202 Virology	(4 periods/wk) MM= 75+25=100	4
MBM-203 Immunology	(4 periods/wk) MM= 75+25=100	4
MBM-204 Biochemistry	(4 periods/wk) MM= 75+25=100	4
MBM-205 Recombinant DNA Technology	(4 periods/wk) MM= 75+25=100	4
MBM-206 Laboratory Course-II	(12 periods/wk) MM= 100+50=150	6

Semester III

Papers	Time/Marks	Credits
MBM-301 Microbial Diversity	(4 periods/wk) MM= 75+25=100	4
MBM-302 Eukaryotic Microbiology	(4 periods/wk) MM= 75+25=100	4
MBM-303 Medical Microbiology	(4 periods/wk) MM= 75+25=100	4
MBM-304 Environmental Waste Management	(4 periods/wk) MM= 75+25=100	4
MBM-305 Technical Writing & Seminar	(4 periods/wk) MM= 75+25=100	4
MBM-306 Laboratory Course-III	(12 periods/wk) MM= 100+50=150	6

Semester IV

Papers	Time/Marks	Credits
MBM-401 Food Microbiology	MM= 50+50=100	4
MBM-402 Project & Dissertation	M= 200	8
MBM-403 Fermentation	(16 periods/wk) MM= 100+100=200	8
MBM-404 Lab course-IV	(16 periods/wk) MM= 100+100=200	8

Total Credits = 100

MBM – 101
GENERAL MICROBIOLOGY

Unit I

Introduction to microbial systems. Importance of microbiology in agriculture, human health, industry and environment. Types of microorganisms, general characteristics of main groups of microorganisms. Criteria used in the classification of microorganisms-cytology, genetics, host specialization, serology.

Unit II

Preparation and sterilization of culture media using various techniques. Microbial growth: different phases of growth. Measurement of microbial growth. Effects of various environmental factors on microbial growth; Uptake of nutrients by microbial cells and their nutritional requirements. Control of microbial growth: physical control, chemical control and antibiotics.

Unit III

Isolation, culture, identification and preservation of bacteria. Gram positive and gram-negative organisms. Structure and functions of peptidoglycan in gram positive and gram-negative organisms. Functions of polymeric components in outer membrane and acidic polymers in gram-negative organisms. Special features of bacterial metabolism.

Unit IV

Classification of viruses. Virus structure, virus proteins. Virus-host interaction. Replication of RNA viruses (negative strand & positive strand) and DNA viruses (single & double strand).General Characteristic of Viroids, prions, PPLO and reckitsia.

Recommended Books:

1. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
2. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
3. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.
4. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
5. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag

MBM – 102
MICROBIAL CELL BIOLOGY

Unit I

Emergence of cellular microbiology. Cellular biology underlying prokaryotic and eukaryotic interactions: ultrastructure , cytoskeletal network, alpha and beta tubulins, actin-myosin system and Dynein activator complex.

Unit II

Prokaryotic and eukaryotic signalling mechanism: eukaryotic cell to cell signalling, endocrine signalling. Cytikins prokaryotic signalling: quorum sensing and bacterial pheromones intracellular signalling. Signalling pathway. Cell interaction; bacterial adherence: basic principles, effect of adhesion on bacteria, effect of adhesion on host cells. Bacterial invasion of host cell: mechanism, consequence of invasion survival after invasion.

Unit III

Overview of extracellular signalling, identification and purification of cell surface receptor, G-protein coupled receptor and their effectors. Protein toxins.

Unit IV

Biological membranes and Transport; Physiochemical properties of cell membranes, molecular constituents of membranes, supramolecular architecture of membranes – a symmetrical organization of lipids and proteins.

Solute transport across membrane: Types of transport, simple diffusion, passive and facilitated diffusions; Active transport. Mobile carrier and pore mechanisms; Transport by vesicle formation: endocytosis, exocytosis; Intracellular communication and cell-cell interaction through junctions; gap junctions, tight junctions and desmosomes.

Recommended Books:

1. The Cell, A Molecular Approach – 6th Edition – Geoffrey M. Cooper/Robert E. Hausman-Sinauer Associates, Inc.
2. Molecular Biology of the Cell - 5th Edition - Bruce Alberts et al - Garland Science
3. Molecular Cell Biology - 7th Edition - Harvey Lodish, Arnold Berk & Chris A. Kaiser - W.H. Freeman
4. Lewin's Cells – 2nd Edition – Cassimeris/Lingappa/Plopper – Johns & Bartlett Publishers
5. Cell Biology, A Short Course – 3rd Edition – Stephen R. Bolsover et al – John Wiley& Sons
6. Microbial Physiology: Moat, Foster and Spector
7. Cell and molecular biology: Gerald Karp.
8. Cell and molecular biology: DeRobertis and DeRobertis

MBM – 103
GENETICS

Unit I

Chromatin structure, Nucleosome, Chromosome structure-centromere and telomere. Tandomly repeated non-coding DNA Interspersed repeated non-coding DNA Expression and processing of heterogeneous nuclear RNA, r RNA, t RNA. Alternate transcription and processing on individual genes. Mitochondrial genome and diseases.

Unit II

General homologous recombination. Non-homologous end joining. Site specific recombination, Transposable elements, Mechanism of Transposition. The Lac -operon positive, negative and repression. Arabinose operon.Tryptophan operon. The lambda phase: a complex of operon.

Unit III

Molecular basis of gene mutation. Gain of function mutation. Loss of function mutation and their consequences. Chemical mutagenesis in higher organism.Repair of DNA damage. Photoreactivatrion. SOS repair mechanism. Base excision repair. Nucleotide excision repair. Stability of the genome.

Unit IV

Population and gene pool. Calculating allele frequencies. The Hardy-Weinberg law. Extension of Hardy -Weinberg law, Natural selection, Mutation, Migration,Genetic drift, Non-random mating. Adaptive radiation and modification, Isolating mechanism, Speciation- Allopatric and Sympatric, Convergent evolution, Sexual selection, Co-evolution.

Recommended Books:

1. Introduction to Genetic Analysis. 9th Edition by Griffiths et al. 2008.
2. Concept of Genetics. 9th Edition, by Klug et al.2009.
3. Principles of Genetics by Snustad et al. 2004.
4. Genes IX Lewin 2008.
5. Molecular Biology of the Gene Watson et al. 6th Edition 2009.
6. Molecular Cell Biology by Lodish et al. 2008
7. Molecular Biology of the Cell Alberts et al. 5th Edition. 2007.

MBM – 104
BIOINFORMATICS & BIOSTATISTICS

Unit I:

What is Bioinformatics, Biosciences, Emerging areas in Bioinformatics, Future prospects of Bioinformatics, Introduction to Genomics, Introduction to Proteomics, Human Genome Project, Public Database, Gene Bank, Using Public Database? Computer Basics: Computer and its components, Characteristics of computer, Classification of Computers, Hardware: Processor/CPU, Input/Output devices, motherboard slots/cards, bus parallel and serial ports, various storage devices/media, Client-Server concepts, Memory. Software basics: Data vs. information, Software: types of software's, Firmware, Operating system, Programming Languages, Compilers, Interpreters, Ideas of portability and platform dependence, MS-DOS, Windows, UNIX, Linux.

Unit II:

DNA and Protein sequence analysis, tools, BLAST, FASTA, Protein Visualization tools, Ras Mol. VMDL, Chime, ORF finder, Gene finder, Gene Scan. Biological databases: Medline EMBL Gene bank, Pub Med, PDB, Entry and retrieval of Data from public databases. Database: Database basics, RDBMS, MS Access, My SWL, ER- Diagram, Relationship.Internet: Computer networking: LAN & WAN, Internet and its application, Major features, WWW and its attributes, web browsers & web server, websites/ address/ pages, Client Server Principles, Protocols and search engines/tools, Bioinformatics resources on internet.

Biostatistics

Unit III:

Measures of central tendency- average, mean, median, mode, measures of location- percentile, graphic method, Arithmetical method, application and uses of percentiles, Types, biological, real, experimental, measures of variability, range, semi-inter quartile range (Q), mean deviation, standard deviation (SD), and coefficient of variation (CV), Probability: Addition law of probability, multiplication law, binomial probability distribution, Poisson distribution, probability chance from shape of normal distribution or normal curve. Basic introduction to Muetrovariate statistics.

Unit IV:

Idea of parametric and non parametric statistics, Hypothesis testing (Large and small samples test), types of errors and level of significance, confidence interval, test of significance (F-test & T-test), chi-square test, Significance of difference in proportions of large samples, Correlation and regression, Design and methodology of an experiment or a study: Step and methodology, format for presentation of any research work.

Recommended Books:

1. Fundamental Concepts of Bioinformatics Dan E. Krane, Wright State University Michael L. Raymer, Wright State University
2. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins By Andreas Baxevanis and Francis Ouellette'
3. Bioinformatics: A Biologist's Guide to Biocomputing and the Internet By Stuart Brown
4. All of Statistics: A Concise Course in Statistical Inference by Larry Wasserman
5. Biostatistics: The Bare Essentials Geoffrey R. Norman PhD, David L. Streiner PhD
6. Principles and Practice of Biostatistics B Antonisamy, Prasanna S. Premkumar

MBM – 201
BACTERIOLOGY

Unit I

Morophology and ultra structure of bacteria – morphological types- cell walls of archaebacteria-gram negative – gram positive eubacteria, L-forms- cell wall synthesis, antigenic properties-capsule- types, composition and function, cell membranes- structure – composition – properties.

Unit II

Structure function of flagella –cilia – pili – gas vesicles – chromosomes, carboxysome – magenetosomes and phycobolisomes – nucleoid – cell division – spores. Resureve food materials – polyhydroxybutyrate – polyphosphate granules – oil droplets – cyanophycin granules and sulphur inclusions.

Unit III

Cultivation of bacteria – aerobic – anaerobic – shaker –still – nutritional types – culture media used – growth curve –generation time – growth kinetics – asynchronous – synchronous – batch – continuous culture – measurement of grouth and factor affecting growth, control of bacteria – physical and chemical agents – preservation methods.

Unit IV

Classification of micro organisms – introduction – Haeckel's three kingdom concept – Whittaker's five kingdom concept – three domain concept of Carl Woese, Basis of microbial classification, Classification and sailent feature of bacteria according to the bergey's manual of determinative bacteriology, cyanobacteria, prochlorons and cyanelles.

Recommended Books:

1. A.J Salle, fundamental Principles of Bacteriology.
2. Brock T.D Madigan M.T Biology of Microorganisms. Prentice Hall inc.
3. Pelczar M.Z Chan E.C.S, Kreig N.R. Microbiology, Mc Graw Hill.

MBM – 202
VIROLOGY

Unit I: General Virology

Brief outline on discovery of viruses, nomenclature and classification of viruses; distinctive properties of viruses; morphology & ultra structure; capsids $their arrangements; type of envelopes and their composition-viral genome, their types and structure; virus related agents (viroids, prions). Cultivation of viruses in embryonated eggs, experimental animals, and cell culture; primary & secondary cell culture; suspension cell cultures and monolayer cell culture; cell strains, cell lines.

Unit II: Bacterial and Plant Viruses

Bacteriophage structural organization; life cycle; one step growth curve; transcription; DNA replication; eclipse phase; phage production; brust size; lysogenic cycle; bacteriophage typing; application in bacterial genetics; brief details on M13,Mu,T4, and lamda P1. Assay of viruses – physical and chemical method (protein, nucleic acid, radioactivity tracers, electron microscopy)- infectivity assay (plaque method, end point method).

Unit III:

Classification and nomenclature; effects of viruses on plant; appearance of plants; historical, physiology and cytology of plants; common virus diseases of plant; paddy, cotton, tomato, and sugarcane; viruses of cyanabacteria, algae, fungi; life cycle; type species, of plant viruses like TMV, Cauliflower Mosaic Virus and potato Virus X; transmission of plant viruses with vectors (insects, nematodes, fungi) and without vectors (contact, seed and pollens); diagnostic techniques in seeds; seed stocks and diseased plants (seed morophology, seedling, symptomatology, indicator plants, serological methods, histochemical tests and fluorescent microscopy); prevention of crop loss due to virus infection –virus- free planting material; vector control.

Unit VI: Animal Viruses

Classification and nomenclature of animal human viruses; epidemiology, lifecycle, pathogenicity, diagnosis, prevention and treatment of RNA Viruses; Picorna, Ortho myxo, Paramyxo, Toga and other arthropod viruses, Rhabdo, Rota, HIV and other Oncogenic viruses; DNA viruses; Pox, Herpes, Adeno, SV 40; Hepatitis viruses. Viral vaccines (conventional vaccines, genetic recombinant vaccines used in national immunization programmes with examples, newer generation vaccines including DNA Vaccines with examples) interferons, and antiviral drugs.

Recommended Books:

1. Morang C and Timbury M.C (1994) medical virology-X- Edition. Churchill Livingstone, London.
2. Dimmock NJ, Primrose SB (1994). Introduction to modern Virology, IV Edition, Blackwell Scientific Publication, Oxford.
3. Conrat HF, Kimball PC and Levy JA (1994) Virology-III Edition Prentice Hall, Engelwood cliff, New Jersey.
4. Methew, RE.,(1992) Fuctionals of Plant virology, Academic Press, San Diego.
5. Topley and Wilson's (1995) Text Book on Principles of Bacteriology, Virology and immunology. Edward Arnold, London.

MBM - 203
IMMUNOLOGY

Unit I

Introduction and Overview of the Immune System. Origin of Immunology and its evolution. Infection and immunity. Types of immunity- Innate and acquired, active and passive, humoral and cell mediated. Clonal selection theory.

Organs and cells of the immune system: structure and function. Hematopoesis. Lymphocyte traffic. Antigens and immunogens. Adjuvants. Requirements for immunogenicity.

Unit II

Structure and function of immunoglobulins. Antibody variants- isotypes, allotypes and idiotypes. Monoclonal antibodies. Hybridoma technology. Organization of immunoglobulin genes. Theories and genetic basis of antibody diversity. Antibody – antigen binding: affinity, avidity, cross reactivity. Antigen-antibody interactions; agglutination, hemagglutination. Precipitation reactions in solution and in gels. Immunoassays: Radioimmunoassay, ELISA, ELISPOT, immunoflourescent assays. Fluorescence activated cell sorting. Western blotting.

Unit III

Major histocompatibility complex. MHC genes and Histocompatibility antigens. Role of MHC in T cell selection. Cytokines and their role in immune regulation. Complement system. Mechanism of its fixation; complement activation and its biological activities. Classical, alternative and lectin pathways; Regulation of complement.

Unit IV

Immunological tolerance to self and to antigens; its induction and features. Immunosuppression- specific and non-specific. Allergy and hypersensitivity. Effector mechanisms and examples of each type of hypersensitivity. Transplantation immunology. Tumor immunology. Immunodeficiencies; primary and secondary. Autoimmunity: factors contributing to autoimmunity; examples and diagnosis. Immunization and Vaccines.

Recommended Books:

1. Basic Immunology by Abul Abbas Andrew H. Lichtman and Shiv Pillai, Elsevier
2. Basic immunology by Jacqueline Sharon, Williams & Wilkins
3. Kuby Immunology. W. H. Freeman & Co.
4. Immunology by Ivan Roitt, Jonathan Brostoff, and David Male, Elsevier
5. How the Immune System Works, by Lauren M. Sompayrac, Wiley
6. The Elements of Immunology by Fahim Halim Khan Pearson Education India, 2009

MBM - 204
BIOCHEMISTRY

Unit I: Carbohydrate and Lipid Metabolism:
Glycolysis, HMP pathway, Glycogenolysis, PDH reaction, Tricarboxylic Acid Cycle: Kreb's discovery, isotopic tests, amphibolic nature, energetics and regulation. Gluconeogenesis, Synthesis of Glycogen and important disaccharides, hormonal regulation of Carbohydrate metabolism.
Oxidation of lipids: beta-oxidation, oxidation of unsaturated and odd chain fatty acids, regulation of Fatty acid oxidation, Formation and oxidation of Ketone bodies. Biosynthesis of saturated fatty acids: carbon sources, acetyl CoA carboxylase and reaction of Fatty acid synthase. Synthesis of odd chain and unsaturated fatty acids. Biosynthesis of Triacylglycerol and phosphoglycerides. Biosynthesis of cholesterol and its regulation.

Unit II: Amino Acid Metabolism Amino acid oxidation:
flow sheet, deamination and transamination reactions, alpha- ketoglutarate, succinate, fumarate and oxaloacetate pathways of amino acid oxidation. Metabolic fates of amino groups, role of glutamate and glutamine. Urea Cycle: reaction and regulation, Biosynthesis of standard essential and non-essential amino acids. Regulation of amino acid biosynthesis. Genetic defects in amino acid metabolism.

Unit III: Nucleotide and Heme Metabolism:
Degradation of purinc & pyrimidine ribonucleotides and its regulation. Biosynthesis of purine & pyrimidine 4 ribonucleotides: de-novo pathways and salvage. Reactions and regulation of ribonucleotide reductase and thymidylate synthase, purine nucleotide cycle. Genetic defects, in nucleotide metabolism. Enzymes of Nucleotide metabolism as chemotherapeutic targets. Heme biosynthesis and degradation.

Unit IV: Enzymology:
Enzyme catalysis: Acid-Base, metal ion, covalent and electrostatic catalysis, Reaction coordinates. Transition state stabilization and entropy reduction by enzymes. Enzyme kinetics: Substrate velocity curve, MichaelisMenten mechanism for single substrate reactions, Meaning and significance of Km, Ks, Kcat and specificity constant. Lineweaver-Burk and Eadie-Hofstee plots, kinetics of bisubstrate reactions. Enzyme Inhibition: Mechanism and kinetics of competitive, uncompetetitve, mixed and noncompetitive inhibitions.

Recommended Books:

1. Nelson, David L., Albert L. Lehninger, and Michael M. Cox. Lehninger principles of biochemistry. Macmillan, 2008. Berg, Jeremy M., John L. Tymoczko, and Lubert Stryer. "Biochemistry 5th ed." (2002).
2. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. Fundamentals of Biochemistry 2002 Update. John Wiley & Sons, 2002.

MBM – 205
RECOMBINANT DNA TECHNOLOGY

Unit I:
History of recombinant technology, restriction modification system in bacteria, DNA modifying enzymes and their mechanisms of action, functions of adapters, linkers and homopolymer linking in molecular cloning, purification of DNA from living cells, construction of genomic and cDNA libraries, screening of libraries, substrative hybridization for tissue specific DNA libraries

Unit II:
Expression of foreign genes in E. coli, production of recombinant protein by prokaryotic expression vectors, eukaryotic expression vectors, mammalian expression vectors; fusion tags, role in purification of recombinant proteins, detection of expressed proteins

Unit III
Chemical synthesis of DNA, changing gene: Random and site-directed mutagenesis, strategies for gene transfer to animal cells, genetic manipulation of mammals, genetic transformation of plant cells - biolistics and Agrobacterium mediated, next generation and advanced sequencing, pyrosequencing, recent advances in protein engineering and metabolic engineering

Unit IV
Nucleic acid sequences as diagnostic tools, new drugs and new therapies for genetic diseases, gene therapy for genetic diseases, production of recombinant pharmaceuticals, hormones, recombinant vaccines, antisense therapy, gene knockout

Recommended Books:

1. Singh BD (2010) Biotechnology 4 th Edition, Kalyani Publications
2. Nair AJ (2008) Introduction to Genetic Engineering and Biotechnology. Infinity Science Press
3. Brown T (2010) Gene cloning and DNA analysis: an introduction. John Willey & Sons

MBM – 301
MICROBIAL DIVERSITY

Unit 1

Introduction to microbial diversity – distribution – abundance – ecological niche. Oxygenic photosynthetic microbes – anoxygenic photosynthetic microbes – Oxidative transformation of metals – sulphur oxidation, iron oxidation and hydrogen oxidation. Unculturable and culturable – conventional and molecular method of studying microbial diversity. Classification of prokaryotes, fungi and algae.

Unit 2

Ecosystems, habitats, symbiosis, mutualism, parasitism, commensalism and antagonism. Microbial diversity in anoxic ecosystem – methanogens – reduction of carbon monoxide – reduction of iron, sulphur, manganese, nitrate and oxygen – microbes and mechanisms of metal reduction – bioleaching of ore metal corrosion. Microbial transformation of carbon, phosphorus, sulphur, nitrogen and mercury.

Unit 3

Extremophiles – acidophilic, alkalophilic thermophilic, barophilic and osmophilic microbes – mechanisms and adoption. Halophiles – membrane – variation – electron transport – application of thermophiles and extremophiles.

Unit 4

Subterranean microbes – ground water contamination and microbial transformation.Biomagnification,bioaccumulation and bioremediation.catabolic of recalcitrant molecule degradation and mineralization.

Recommended Books:

1. Johri, B.N 2000. Extermophlies. Springer Veriag. New York
2. Colwd, D.1999. Microbial Diversity. Aademic Press
3. Introduction to Microbiology and Microbial Diversity Paperback – 2018 by Dr. Prasanna V Dharani Aiyer (Author)

MBM – 302
EUKARYOTIC MICROBIOLOGY

Unit I

An introduction to Fungi: General features of Fungi, Classification of Fungi, Life cycle of selected Fungi (Aspergillus, Pencillium, Yeast). Structure of Fungal cells. Hyphae and non motile unicells, motile cells, spores, dormancy, growth of population and colonies, effect of environment on growth, prevention of fungal growth.

Unit II

Fungi and ecosystem: Saprophyte, substrate groups and nutritional strategies, substrate successions, fungi and bioremediation, parasitism, mutualism and symbiosis with plants and animals, attack on fungi by other microorganisms.

Unit III

Protozoans characteristics, classifications and general account. Pathogenic protozoans and parasitism in protozoans. Ultra structure and life cycle of Plasmodium in invertebrate and vertebrate hosts.. Comparative account of various human species of Malaria pathogens, symptom, treatment and control.

Unit IV

Trypansoma: Structure and Life cycle, polymorphism in human and invertebrates host pathogens and therapy, Leishmania, systematic position, morphology, kalazar, symptoms and pathogen Entamoeba histolytica. as monogen parasite, pathogenesis, host parasite interactions.

Recommended Books:

1. Rumen Microbiology: From Evolution to Revolution1st ed. 2015 Edition, Kindle Edition by Anil Kumar Puniya (Editor), Rameshwar Singh (Editor), Devki Nandan Kamra (Editor)
2. Textbook of Medical Parasitology : Protozoology & Helminthology, 4th Edition Paperback – 2013 **by** Subhash Chandra Parija (Author)
3. Elementary Bacteriology and Protozoology19 May 2016 | Import by Herbert Fox
4. Invertebrate Zoology Paperback – 2006 by Robert D. Barnes (Author)
5. An Introduction to Fungi: 4th Edition Paperback – 2012 by H C Dube (Author)
6. Fungi and Allied Microbes Paperback – 1 Jul 2017 by O P Sharma (Author)
7. Introductory Mycology, 4ed Paperback – 2007 by C.J. Alexopoulos (Author), C.W. Mims (Author), M. Blackwell (Author)

MBM – 303
MEDICAL MICROBIOLOGY

Unit I

Early discovery of pathogenic microorganisms; development of bacteriology as s scientific discipline; contribution made by eminent scientists. Classification of medically important flora and the organisms; Normal microbial flora of human body; role of the resident flora; normal flora and the human host.

Unit II

Establishment, spreading, tissue damage and anti – phagocytic factor; mechanism of bacterial adhesion, colonization and invasion of mucous membranes of respiratory, enteric and urogenital tracts. Role of aggressions, depolymerising enzymes, organotropisms, variation and virulence. Organs and cell involved immune system and immune response.

Unit III

Classification of pathogenic bacteria. Staphylococcus, Streptococcus, Pneumococcus, Neisseria, Cornebacterium Bacillus, Clostridium, Non sporing Anaerobes, Organisms belonging to Enterobacteriacea, Vibrios, Non fermenting gram negative bacilli Yersinia, Haemophilus; Bordetella, Brucella; Mycobacteria, Spirochates, Anctiomycetes; Rickettsiae, Chlamdiae. common types of hospital infection and their diagnosis and control.

Unit IV

General properties of viruses; viruses Host interaction; Pox viruses; Herpes virus, Adeno viruses; picarno viruses; Picarno Viruses; Orthomyxo viruses; Paramyxo viruses;Arboviruses, Rahbdo viruses, Hepatitis viruses; opportunistic fungal pathogens. Description and classification of pathogenic fungi and their laboratory diagnosis.

Recommended Books:

1 Text of Microbiology , R. Anathanaryanan and C.K Jayaram Panicker, Orient Longman,1997.

2. Mackie and McCartey Medical Microbiology Vol.1: Microbial infection.Vol.2: Practical Medical MicrobiologyChurchill Lvinggdtone,1996.

3. Microbiology in clinical Practice.D.C Shanson, Wright PSG,1982.

4. Bailey and Scott's Diagnostic MicrobiologyBaron EJ, Petersone LR and Finegold SM Mosby,1990.

MBM - 304
ENVIRONMENTAL WASTE MANAGEMENT

Unit I

Introduction to environmental waste and environment protection. Biopesticides: *Bacillus thuringiences*, Baculo and begomoviruses viruses, Neem, green manuring, Phosphate solubilizing organisms. Biofertilizer: Algal, cyanobacterial and bacterial biofertilizers. Bioplastics.

Unit II

Water as a scarce natural resource, water management including rain water harvesting; Potability of water, microbial assessment of water; Municipal wastes - sewage and effluent, waste water characteristics, waste water treatment – physical, chemical and biological processes; Aerobic processes – activated sludge, oxidation ditches, trickling filters, oxidation ponds; Anaerobic processes – anaerobic digestion, anaerobic filters, anaerobic sludge, membrane bioreactors; Treatment of industrial effluents - dairy, distillery, tannery, textile, paper and sugar industries, CETP, Reverse osmosis and ultrafiltration. Sewage treatment plant.

Unit III

Waste types: Solid and liquid waste, characterization of solid and liquid waste. Waste treatment: Physical, chemical , biological; aerobic, anaerobic; Primary , secondary, tertiary; Solid waste treatment- Saccharification, gasification, composting; Utilization of solid waste - food (SCP, mushroom, Yeats), fuel (ethanol, methanol), fertilizers (composting). Biomedical waste management and disposal

Unit IV

Bioremediation: Concept and principles, microbial bioremediation, *in situ* and *ex situ* bioremediation; Biosorption and bioaccumulation of heavy metals, phytoremediation; Bioremediation of xenobiotics (heavy metals, pesticides, oil slicks, plastics), soil and water contaminated with hydrocarbons and surfactants, biofilms, xenobiotic compoundsand their sources, biomagnifications.

Recommended Books:

1. Microbial ecology by Alexander M (1971): John Wiley and sons Inc., New York.
2. Introduction to Biodeterioration by Allsopp D and K.J. Seal., (1999): Edward Arnold Publication, London.
3. Manuel of Environmental Microbiology by Christson J Harst, (1997): ASM press Washington D.C. Washington.
4. Environmental Microbiology by Hurst, C.J, (1988) : ASM Press, NJ, USA.
5. Bioremediation by Baker K H and Herson D S : Mc GrawHill , New Delhi.

MBM – 305
Technical Writing & Seminar

In presence of the supervisors…

MBM – 401
FOOD MICROBIOLOGY

Unit I

Food as substrate for microorganisms: Micro organisms important in food microbiology – Molds, Yeasts and Bacteria-General characteristics-classification and importance. Principles of food preservation. Asepsis – Removal of microorganisms,(anaerobic condition, high temperatures, low temperatures, drying,). Factor Influencing microbial growth in food – Extrinsic and intrinsic factor; Chemical preservatives and Food additives. Canning, processing for Heat treatment-D, Z and values and working out treatment parameters.

Unit II

Food –borne infection and intoxications: Bacterial and nonbacterial- with examples of infective and toxic types- Brucella, Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio, Yersinia; Nematodes, protozoa, algae, fungi and viruses. Foodborne outbreaks laboratory testing procedures; Prevention Measures- Food sanitation in manufacture and retail trade; Food control agencies and its regulations, Plant sanitation-Employee's Health standards –waste treatment- disposal – quality control.

Unit III

Contamination and spoilage: cereals sugar products, vegetables, fruits, meat and meat products, Milk products- Fish and sea foods-poultry- spoilage of Canned food. Detection of spoilage and characterization.Food fermentations: bread, cheese, vinegar, fermented vegetables, fermented dairy products; Experimental and industrial production method. Spoilage and defects of fermented dairy products – oriental Fermented food, their quality standards and control.

Unit IV

Food produced by Microbes: Fermented food, microbial cells as food (single cell proteins) – mushroom cultivation. Bioconversions - _production of alcohol –Fermented beverages – beer and wine. Steriod conversion – industrial Enzymes production – amylases, proteinases, cellulases; Aminoacid production – glutamic acid and lysine productions. Genetically modified food.

Recommended Books:

1. Adams M.R and Moss M.O (1995) food microbiology. Royal Society of Chemistry Publication, Cambridage.
2. Frazier WC and Westhoff Dc (1988). Food Microbiology. Tata McGraw Hill Publishing Compnay Ltd,New Delhi.
3. Stanbury,PF., Whiteker, and Hall, S.J (1995) principles of Fermented Technology. 2nd Edition. Programme Press.
4. Banwart,Gj (1989) Basic Food Microbilogy. CBS Publishers and Distributors,Delhi.
5. Hobbs BC and Roberts D. (1993) Food poisoning and Food Hygiene. Edward Arnold (A division of Hodder and Stoughton) London.
6. Robinson RK., (1990) Dairy Microbiology. Elservier Applied Sciences, London.

MBM – 402
PROJECT & DISSERTATION

In presence of the supervisors…

MBM – 403
FERMENTATION TECHNOLOGY

Unit I

General Consideration method pathways and metabolic control mechanisms primary and secondary metabolites.

Unit II

Fermentation in batch culture microbial growth kinetics; measurement of growth (cell number, direct and indirect method) growth and nutrient growth and product formation; heat evolution; effect of environment (temperature, pH, High nutrient concentration) media formulation. Sterilization; kinetics of thermal death of micro organisms; batch continuous sterilization.

Unit III

Continuous Culture: Continuous culture system; productivity product formation.
Aeration and agitation; power requirement oxygen transfer kinetics; concepts of Newtonian and Non - Newtonian fluids, plastics fluids apparent foam and antifoam.

Unit IV

Scale-up; instrumentation control; physical and chemical environment sensors; downstream process.

Recommended Books:

1. Stanbory P.F.A Whitaker $ Hall. 1985. Principle of Fermentation Technology Pergaman McNeul $ Harvey.1990.
2. Fermentation A. Practical Approach IRL.
3. Basic Fermentation Technology1 January 2017 by S.M. Reddy

Revised Course Structure of PhD (Biosciences)

Sl. No.	Papers	P/Wk	Credits	Internal Assessment	End semester Exam	Presentation	Total Marks
	Compulsory Papers						
I	Annotated Bibliography	-	4	25	-	75	100
II	Research Methodology	4	4	25	75	-	100
	Optional Papers (Any Two)						
I	Advances in Biosciences - I	4	4	25	75	-	100
II	Advances in Biosciences - II	4	4	25	75	-	100
III	Advances in Biosciences III	4	4	25	75	-	100
	Total		**16**				**400**

Advances in Biosciences - 1

Unit I

Internal organization of the Nucleus, Chromosomal Territories, Gene potentiation, euchromatin co-transcription and regulation; the nuclear envelop and mechanism of transport of RNA and proteins between nucleus and cytoplasm: Molecular Structure of gene and functional rearrangement in choromosomal DNA. Cell cycle and its regulation. **(Prof. AJ)**

Unit II

Antibiotics, classification of antibiotics, Modes of action; Inhibition of bacterial cell wall synthesis, Inhibition of DNA and RNA biosynthesis, inhibition of protein synthesis, Antimetabolites. Drug resistance, Resistance mechanisms: inactivation by microbial enzymes, Modification of target site, Reduction in permeability, exclusion from the cell, Over production of a target metabolite, Genetics of resistance. Spontaneous mutations, Gene transfer. Gene deletion. Prevention and control of drug resistance. **(Prof. QMR)**

Unit III Mycology

Medically important fungi – Structure and functions, diagnosis and characteristics, fungal classification: Phylum Zygomycota, Ascomycota, Deuteromycota, fungal diseases: systemic (Histoplasmosis, Blastomycosis and Coccidiodomycosis), subcutaneous (Maduromycosis, Chromoblastomycosis, Sporotrichosis), cutaneous, superficial, Opportunistic (Candidosis, Aspergillosis, Zygomycosis), Virulence factors, Host –Fungi Interaction: Infection process, Antifungal agents and targets for antifungal therapy mechanisms of antifungal resistance. **(Dr. NM)**

Unit IV

Principles and mechanisms of toxicology, Genetic and development toxiciology, toxic effect of metals, solvents and vapors, Air Pollution, Ecotoxicology, Food Toxicology and metabolism of xenobiotics, Forensic and Occupational toxicology. Toxicological assessments through invitro (MTT/LDH) method Bacterial mutation test (Ames Test), (In vivo mammalian mutation Test) **(Prof. TF)**

Advances in Biosciences -II

Unit I

Molecular basis of gene mutation and diseases, repair of DNA-damage photo reactivation, excision, post replication and SOS repair mechanisms, base excision, nucleotide excision repair, repair of DNA damage in higher organisms.mutational analysis through PCR. **(Prof. SAH)**

Unit II

Classification of genetic diseases in human, Chromosomal single, gene disorders, multifactorial diseases. Diagnostics techniques of different genetics diseases. Prenetal diagnosing of genetics disorders. Gene therapy and its future prospects. **(Prof. MAR)**

Unit III

Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cyle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis therapeutic interventions of uncontrolled cell growth, epigenetic and cancer. **(Dr. NJK)**

Unit IV

Autoimmune responses , Response to alloantigens and transplant rejection, self tolerance and its loss, Tumor associated and Tumor specific transplantation antigens, extrinsic regulation of unwanted immune response, using immune response to fight infections and tumors. Effector molecule cytokines and their role in therapeutics, monoclonal antibody, hybridoma technique, ELISA and RIA. **(Prof. SFB)**

Advance in Biosciences -III

Unit I

Photo systems I & II, mechanism of quantum capture and energy transfer system, Electron Transport system in mitochondria, oxidative phosphorylation, Biotic and Abiotic plant stresses. General tissue culture techniques, totipotency , roles of tissue culture techniques in haploid and triploid production. **(Dr. MM)**

Unit II

History of Plant Virology, Transmission of plant viruses: insect, nematodes and seed mediated, mechanical transmission. Movement of plant viruses: cell to cell movement, long –distance movement. Identification of Plant viruses based on symptomatology, serology and nucleic acid. Control of plant viruses: breeding for resistance, virus elimination through tissue culture, transgenic resistance. **(Prof. JAK)**

Unit III

Economic importance of cyanobacteria and Algae: Natural pigments, Restriction enzyme, Bioplastic, Biofertilizer, Medicine Aquaculture Food, feed and bioremediation etc. **(Prof. TF)**

Unit IV

Shikimate, hydroxycinnamte and phenylpropanoid pathways. Hydroxycoumarins, hydroxybenzoates, flavonoids, lignins. Tannins and quinines. General pathway of terpenoid biosynthesis, monoterpenoids, sesquiterpenoids, di-, tri- and poly-terpendoids, carotenoids. Non-protein amino acids, amines, cyanogenic glycosides and glycosides and glucosinolates, alkaloids. **(Prof. LAK)**

Paper II Research Methodology

Unit I. Separation and Isolation

Principles of chromatography, Performance parameters in chromatography, Modes of chromatography, high Performance liquid chromatography, Fast protein liquid chromatography, Perfusion chromatography, Ultracentrifugation (velocity and buoyant). **(Dr. AKV)**

Principles of Electrophoresis, Non –denaturing and Denaturing electrophoresis, Isoelectric focusing, 2-D SDS PAGE, Agarose gel Electrophoresis, Immunoelectrophoresis, Electroblotting Procedures (Western, Northern and Southern Blot). **(Dr. MS)**

Unit II. Spectroscopic Techniques

Basic principles and applications of Absorption and Fluorescence Spectroscopy, Circular Dichroism and ORD, Infra –red and UV Spectroscopy, NMR Spectroscopy, X ray crystallography and Mass spectroscopy. **(Dr. Abid)**

Unit III. Biostatistics

Measure of central tendency, Measure of Variability, standard deviation (SDVC) and coefficient of variation (CV), Probability laws of probability Binomial Probability, Poissons's Distribution. Test of Hypothesis, types of error, Level of Significance, confidence interval, test of significance, Chi square test, F&T test, Correlation and regression. **(Dr. MN)**

Unit IV. Bioinformatics

DNA and Protein sequence analysis tools, BLAST, FASTA, Primer design tools, Protein visualization tools, ORF findinder, Biological Database, EMBL, DDBJ, Pub med, PDB etc. Bioinformatics Resources on internet **(Dr. MM/GT)**