KANNUR UNIVERSITY

(Abstract)

M.Sc. Molecular Biology Programme under Choice Based Credit Semester System in the University Department– Revised Scheme, Syllabus & Model Question Papers Implemented with effect from 2015 admission- Orders issued.

ACADEMIC 'C'SECTION

U.O. No.Acad/C4/ 6447/2015 Civil Station P.O, Dated, 30-10-2015

Read:
1. U.O No.Acad/C3/2049/2009 dated 11.10.2010.
2. U.O No.Acad/C3/2049/2009 dated 05.04.2011.
3. Meeting of the Syndicate Sub-Committee held on 16.01.2015.
4. Meeting of the Curriculum Committee held on 10.04.2015.
5. Meeting of the Department Council held on 16.05.2015.
6. U.O No.Acad/C4/14536/2014 dated 29.05.2015.
7. Letter from the Course Director, Dept. of Molecular Biology, Dr. P.K. Rajan Memorial Campus, Nileswaram.
8. Meeting of the Curriculum Committee held on 03.09.2015.

ORDER

1.The Regulations for Post Graduate Programmes under Choice Based Credit Semester System were implemented in the Schools/Departments of the University with effect from 2010 admission as per the paper read (1) above and certain modifications were effected to the same vide paper read (2).

2. The meeting of the Syndicate Sub-Committee recommended to revise the Scheme and Syllabus of all the Post Graduate Programmes in the University Schools/Departments under Choice Based Credit Semester System (CCSS) with effect from 2015 admission vide paper read (3) above.

3. As per the paper read (4) above, the meeting of the Curriculum Committee recommended certain modifications/ additions to the Regulations for Post Graduate Programmes under Choice Based Credit Semester System and the Regulations were modified in the University w.e.f. 2015 admission vide paper read (6).

4. The Department Council vide paper read (5) above has approved the Scheme, Syllabus & Model Question Papers for M.Sc. Molecular Biology Programme under Choice Based Credit Semester System(CCSS) for implementation with effect from 2015 admission.

5. The Course Director, Dept. of Molecular Biology vide paper read (7) above, has forwarded the Scheme, Syllabus & Model Question Papers for M.Sc. Molecular Biology Programme in line with the revised Regulations for Choice Based Credit Semester System for implementation with effect from 2015 admission.

P.T.O.

6. The meeting of the Curriculum Committee held on 03.09.2015 approved the Scheme, Syllabus & Model Question Papers for M.Sc. Molecular Biology Programme under Choice Based Credit Semester System in the Department vide paper read (8)

7. The Vice Chancellor after considering the matter in detail, and in exercise of the powers of the Academic Council conferred under section 11(1) of KU Act 1996, and all other enabling provisions read together with, has accorded sanction to implement the Scheme, Syllabus & Model Question Papers for M.Sc. Molecular Biology Programme under Choice Based Credit Semester System, offered in the Department, w.e.f 2015 admission, subject to report to the Academic Council.

8. Orders are, therefore, issued accordingly.

9. The revised Scheme, Syllabus and Model Question Papers of M.Sc. Molecular Biology Programme effective from 2015 admission are appended.

JOINT REGISTRAR (ACADEMIC)
FOR REGISTRAR

To

The Course Director, Department of Molecular Biology
Dr. P.K. Rajan Memorial Campus, Nileswaram

Copy To:

1. The Examination Branch (through PA to CE)
2. PS to VC/PA to PVC/PA to R/PA to CE/PA to FO
3. JR/AR I Academic
4. The Computer Programmer *(for uploading in the website)*
5. SF/DF/FC

Forwarded/By Order

SECTION OFFICER

KANNUR UNIVERSITY
CIVIL STATION P.O.
KANNUR
Pin-670 002
THAVAKKARA

For more details: log on www.kannur university .ac.in

KANNUR UNIVERSITY
Regulations, Scheme and Syllabus for
M.Sc. MOLECULAR BIOLOGY
(w.e.f. 2015 Admission)

PREAMBLE

Molecular Biology is the emerging area of Modern Biology with vast potential for application in diverse areas including basic sciences, biomedical sciences and other allied applied areas. The Molecular Biology Course envisages empowering the blended students to equip to do research in any area of interest in Modern Biology and hence is amenable to a multidisciplinary approach. This course is intended for young students with high academic calibre from diverse fields and provides greater opportunity to prepare themselves for competitive examinations (CSIR/UGC, GATE etc.) for those with an ambition of becoming researchers / teachers. The students joining this course are taught fundamental subjects in the first two semesters and specialized areas during the third semester. In the fourth semester of the course, students carry out research project in the area of Molecular Biology.

Eligibility for Admission

Candidate with the degree of Bachelor of Science in any branch of Life Sciences (Zoology, Botany, Microbiology, Biotechnology, Bioinformatics, Genetics or equivalent), Chemical, Medical, Veterinary, and Agricultural Sciences from any recognized Indian or Foreign University, with not less than 50% marks in aggregate (excluding languages) are eligible for admission to this course. But in the case candidates belonging to backward communities the minimum eligibility cut off marks is 45%. Candidates belonging to SC/ST category who have passed the qualifying examination are eligible to apply for admission. Those have appeared for the final year examinations can also apply, however, they should produce the mark lists before the publication of the results of the entrance examination.

Mode of Selection

The selection of the candidate is based on the marks secured in the entrance test . The entrance test will cover Molecular Biology, Biotechnology, Microbiology, Cell Biology, Genetics, Biochemistry and related areas at the undergraduate level. Students coming under the payment / NRI quota are exempted from entrance test.

Course Structure

The course is offered under the Choice Based Credit and Semester System (CCSS) with duration of 2 years (4 Semesters). Credit system defines the quantum of contents / syllabus prescribed for a course and determines the number of hours of instruction required per week. There shall be at least sixteen-week schedule per semester to complete the course contents.

The Department Council will assign every student admitted to an advisor. He/She will advice the students about academic programme and counsel on the choice.

The course structure encompasses: (1) Core Courses, (2) Elective Courses and (3) Open Courses. Elective course will be offered depending on the availability of resource persons / teachers.

The minimum duration for completion of the M.Sc. Molecular Biology course is four semesters. The maximum period for completion is eight semesters.

No student shall register for more than 24 credits and less than 12 credits per semester.

There shall be a one-hour lecture excluding tutorials/seminars and 2 to 3 hours of practical work per week for one credit.

A total of 80 credits shall be the minimum for the successful completion of the course and the minimum credit required for Core course is 60.

Evaluation

All the semesters will have Continuous and End semester assessments. The course instructors carry out the internal assessment for each paper. For theory papers, the proportion of the distribution of marks among the continuous assessment and end semester examination shall be 40:60. Duration of theory examination is 3 hours.

Continuous assessment includes assignments, seminars, periodic written examinations and end semester viva-voce for each paper. Weightage to the components of the continuous assessment shall be given for all theory papers of the course as follows.

Written test papers (minimum of two tests for each paper) : 40% (16 Marks)
Assignment (minimum of two assignments for each paper) : 15% (06 Marks)
Seminar (minimum of one seminar for each paper) : 20% (08 Marks)
End semester Viva : 25% (10 Marks)

For the end semester examination (theory), the scheme of question paper is as follows.

I.	Essay (any two out of three)	: 2 x 12 = 24 Marks
II.	Short essay (any two out of three)	: 2 x 8 = 16 Marks
III	Short notes (any four out of six)	: 4 x 5 = 20 Marks
	Total	: 60 Marks

Practical Examination: There shall be no external practical examinations. For practical courses, marks shall be awarded internally by continuous assessment and end semester examination. The departmental council will decide the distribution of these marks for each semester.

Attendance is compulsory for each semester and the minimum requirement for appearing for the end semester examinations shall be as per the general regulations of M.Sc. programme of the University.

Grading system and pass requirements shall be governed by the general rules and regulations of the CCSS of the PG programme framed by the University.

1. An alphabetic grading system shall be adopted for the assessment of student's performance in the course. The grade is based on a six point scale. The following table gives the range of marks for the grade points and the alphabetic grades.

Range of Marks	Grade points	Alphabetical Grade
90 -100	9	A+
80 - 89	8	A
70 - 79	7	B+
60 - 69	6	B
50 -59	5	C
Below 50	0	F

2. A minimum of grade point 5 (Grade C) is needed for the successful completion of a course.

3. Performance of a student at the end of each semester is indicated by the Grade Point Average (GPA) and is calculated by taking the weighted average of grade points of the course successfully completed. Following formula is used for the calculation. The average will be rounded off to two decimal places.

$$GPA = \frac{\text{Sum of (Grade points in a course multiplied by its credit)}}{\text{Sum of Credits of Courses.}}$$

4. The overall performance of a student is indicated by the Cumulative Grade Point Average (CGPA), and is calculated using the same formula given above.

5. Approximate percentage of marks can be calculated by using the formula CGPA x 10 + 5

6. Based on CGPA overall letter grade of the student shall be in the following way.

CGPA	OVERALL LETTER GRADE	CLASSIFICATION OF THE SCORE
8.5 and above	A+	First Class with Distinction
7.5 and above but less than 8.5	A	First Class with Distinction
6.5 and above but less than 7.5	B+	First Class
5.5 and above but less than 6.5	B	First Class
4.5 and above but less than 5.5	C	Second Class

Project Work: All the M.Sc. students are required to carry out a research project. For this, the students are encouraged to go to National Research Institutes, in order to acquire hands-on-training and exposure to a research culture.

Scheme of evaluation of dissertation is as follows: 8 Credits
Total Marks : 150 (90 external + 60 internal)
Content : 25% (22.5 ,, + 15 ,,)
Methodology & presentation : 50% (45 ,, + 30 ,,)
Dissertation viva-voce : 25% (22.5 ,, +15 ,,)

General Viva-voce: A compulsory components of the programme based on entire courses (4 Credits). Total Marks: 100 (60 external + 40 internal)

Re-appearance of end semester examination: A student who has failed in a paper can re-appear for the end-semester examination of the same paper along with the next batch or choose another paper in the subsequent semester to acquire the minimum credits needed for the completion of the programme. Those who fail in any paper need to appear for re-examination on that paper only. There shall be no supplementary examination. No student shall be allowed to take more than eight consecutive semesters for completing the programme from the date of enrolment.

Syllabus: The appended syllabus is applicable from 2015 admission onwards.

SYLLABUS

The course comprises of the following theory and practical papers.

SEMESTER – I

MOB C 101: Molecular Cell Biology	- 4 credits
MOB C 102: Microbial Science	- 4 credits
MOB C 103: Biological Chemistry	- 4 credits
MOB C 104: Biophysics	- 4 credits
MOB P 105: Lab in Cell Biology & Microbiology	- 3 credits
MOB P 106: Lab in Biological Chemistry & Biophysics	- 3 credits

SEMESTER - II

MOB C 201: Genetics & Molecular Biology – 1	- 4 credits
MOB C 202: Cell Physiology	- 4 credits
MOB C 203: Immunology	- 4 credits
MOB P 204: Lab in Genetics and Molecular Biology – 1	- 3 credits
MOB P 205: Lab in Physiology & Immunology	- 3 credits
MOB E 206: Biometrics	- 3 credits
MOB E 207: Ecology and Biodiversity	- 3 credits

SEMESTER – III

MOB C 301: Molecular Biology – 2	- 4 credits
MOB C 302: Genetic Engineering and Biotechnology	- 4 credits
MOB C 303: Genomics and Bioinformatics	- 4 credits
MOB P 304: Lab in Molecular Biology -2 & Genetic Engineering and Biotechnology	- 4 credits
MOB P 305: Lab in Genomics and Bioinformatics	- 2 credits
MOB E 306: Developmental biology	- 3 credits
MOB E 307: Molecular Evolution	- 3 credits

SEMESTER – IV

MOB C 401: RESEARCH PROJECT related to Molecular Biology	- 8 credits
MOB C 402: General Viva-voce	- 4 credits
MOB E 403: Industrial Biotechnology	- 3 credits
MOB E 404: Human Genetics	- 3 credits
MOB E 405: Ethics, patency and intellectual property rights	- 3 credits
MOB E 406: Environmental Biotechnology	- 3 credits
MOB O : Life and Genes	- 3 credits

DETAILED SCHEME OF VALUATION

Semester – I

Sl. No	Course Code	Title of the Course	Contact Hours/Week			Marks			Credits
			L	T/S	P	ESE	CE	Total	
1	MOB C 101	Molecular Cell Biology	4	1		60	40	100	4
2	MOB C 102	Microbial Science	4	1		60	40	100	4
3	MOB C 103	Biological Chemistry	4	1		60	40	100	4
4	MOB C 104	Biophysics	4	1		60	40	100	4
5	MOB P 105	Lab in Cell Biology & Microbiology			5	60	40	100*	3
6	MOB P 106	Lab in Biological Chemistry & Biophysics			5	60	40	100*	3
		Total	16	4	10	360	240	600	22

*There is no external practical examination. CE includes marks for lab record, attendance and practical viva.

Semester – II

Sl. No	Course Code	Title of the Course	Contact Hours/Week			Marks			Credits
			L	T/S	P	ESE	CE	Total	
1	MOB C 201	Genetics & Molecular Biology – 1	4	1		60	40	100	4
2	MOB C 202	Cell Physiology	4	1		60	40	100	4
3	MOB C 203	Immunology	4	1		60	40	100	4
4	MOB P 204	Lab in Genetics & Molecular Biology-1			5	60	40	100*	3
5	MOB P 205	Lab in Physiology & Immunology			5	60	40	100*	3
6	MOB E 206	Biometrics	2	1		60	40	100	3
	MOB E 207	Ecology and Biodiversity							
		Total	14	4	10	360	240	600	21

*There is no external practical examination. CE includes marks for record, attendance and practical viva.

Semester - III

Sl. No	Course Code	Title of the Course	Contact Hours/Week			Marks			Credits
			L	T/S	P	ESE	CE	Total	
1	MOB C 301	Molecular Biology – 2	4	1		60	40	100	4
2	MOB C 302	Genetic Engineering & Biotechnology	4	1		60	40	100	4
3	MOB C 303	Genomics and Bioinformatics	4	1		60	40	100	4
4	MOB P 304	Lab in Molecular Biology – 2 & Genetic engineering and biotechnology			6	60	40	100*	4
5	MOB P 305	Lab in Genomics and Bioinformatics			4	30	20	50*	2
6	MOB E 306	Developmental Biology	2	1		60	40	100	3
	MOB E 307	Molecular Evolution							
		Total	14	4	10	330	220	550	21

*There is no external practical examination. CE includes marks for lab record, attendance and practical viva.

Semester – 1V

Sl. No	Course Code	Title of the Course	Contact Hours/Week			Marks			Credits
			L	T/S	P	ESE	CE	Total	
1	MOB C 401	RESEARCH PROJECT related Molecular Biology				90	60	150	8
2	MOB C 402	General Viva				60	40	100	4
3	MOB E 403	Industrial Biotechnology	2	1		60	40	100	3
	MOB E 404	Human Genetics							
4	MOB E 405	Ethics, Patency and Intellectual property rights	2	1		60	40	100	3
	MOB E 406	Environmental Biotechnology							
		Total				270	180	450	18

Open Course

1.	MOB O	Life and Genes		60	40	100	3

SEMESTER -I

MOB C 101: Molecular Cell Biology

60 hours **4 Credits**

1. Introduction to cell Biology- Basic properties of cells- different classes-Cellular dimension-Size of cells and their composition-Cell origin and Evolution (Endosymbiotic theory)– Molecules of the Cell.
2. Cell Membrane-Proteins and Lipids-Organisation-Lipid bilayer:Composition and properties(Hydropathic plot)-Membrane permeability and transport-Principles of membrane transport-Pores and Channels-Pumps-Differentiation of cell membrane – microvilli – tight junction – belt and spot desmosomes - intercellular communications and gap junctions – cell coat and cell recognition.
3. Synthesis, sorting and trafficking of proteins: site of synthesis of organelle and membrane proteins – transport of secretary and membrane proteins across ER – post-translational modification in RER – transport to mitochondria, nucleus, chloroplast and peroxisome - protein glycosylation – mechanism and regulation of vesicular transport – golgi and post-golgi sorting and processing – receptor mediated endocytosis; Synthesis of membrane lipids.
4. Ribosomes: Specific association rRNA and r-proteins –Nucleolus- ribosome biogenesis – in-vitro assembly experiments to understand ribosome formation and also for understanding the functions of various ribosomal components – active centers of ribosomes.
5. Nucleus: Nuclear envelope – Nuclear pore complexes-nuclear matrix – organization of chromatin – supercoiling, linking number, twist - nucleosome and high order of folding and organization of chromosome(Solenoid and Zigzag model)-Global structure of chromosome –(Lamp brush and polytene chromosomes).
6. Cell cycle and its regulation(Cyclin and kinases)-Experiments(Fission Yeast,Xenopus,Sea Urchin)-Check points-mitosis and meiosis.
7. Cell Death: Apoptosis versus necrosis-Apoptotic pathways – autophagy – ageing.

Reference:

1. Lodish *et al*., Molecular Cell Biology. W H Freeman & Co.
2. Becker W M *et al*., The World of the Cell. Pearson.

3. DeRobertis E D F and DeRobertis E MF, Cell and Molecular Biology. Saunders
4. Karp and Gerald, Cell and Molecular Biology. John Wiley.
5. Polland Thomas D, Cell Biology. Saunders.
6. Standzinski George P Editor, Cell growth, differentiation and senescence. Oxford University Press.
7. Alberts B, Molecular Cell Biology.
8. Casimeris *et al*., Lewin's cells. Jones and Bartlett.
9. Plopper, Principles of cell Biology. Jones and Bartlett.
10. Gartner, Cell Biology and Histology. LWW.
11. Pollard et al., Cell Biology. Sounders.
12. Copper, The Cell a Molecular approach. Sinauer.

MOB C 102: Microbial Science

60 Hours **4credis**

1. History and scope of Microbiology.
2. Microbial Diversity: Place of microorganisms in the living world – criteria used in microbial taxonomy; Classification of bacteria – past and present status – classification based on morphology- gram's staining and culture characteristics – classification based on Bergey's manual of systematic bacteriology (details of sections not expected); Classification of viruses – classification based host, viral morphology and nucleic characteristics.
3. Structural organization of bacteria and viruses: Ultra structure of bacterial cell wall – cell membrane – flagella – pili – capsule and genome; Structure and architecture of bacteriophages.
4. Fungi-Molds and Yeasts.
5. Bacterial culturing: Physical and chemical methods of sterilization – growth media – mixed microbial population – selection of pure culture – physical conditions of growth – growth curve – storage and transport of microbes.
6. Microbial toxins: Exotoxins – endotoxin and other virulence factors.
7. Disinfectants and antibiotics: Methods of testing antimicrobial substances – mechanism and action of important classes of disinfectants and antibiotics – drug resistance of antibiotics.
8. Benefits of microbes in various fields: Microbes in fermentation – microbial biogas from biological wastes – microbes in value addition of fish and meat – microbial bioremediation.
9. Microbes and diseases: Bacterial diseases – Streptococcal diseases – Tuberculosis –

Plague – Anthrax – Syphilis – Cholera – Tetanus – Leprosy; Viral diseases – Chicken pox – Small pox – Influenza – Rabies – AIDS and Ebola.

Reference:

1. Prescott, Harley and Klein, Microbiology. McGraw-Hill
2. Jacquelyn G Black, Microbiology: Principles and Exploration. John Wiley & Sons.
3. Nester et al., Microbiology: A human perspective. McGraw Hill.
4. Albert G Moat et al., Microbial Physiology. John Wiley & Sons.
5. Kathleen Park Talaro, Arthur Talaro, Foundations in Microbiology. Mc Graw Hill.
6. Alcamo, Foundations of Microbiology. Jones and Bartlett Publishers.
7. Cappuceino James, Microbiology: A Laboratory Manual. Pearson Education
8. Toratora Gerad, Microbiology: An Introduction. Pearson Education.
9. Edward A I, Microbiology. Tata McGraw Hill.
10. Lim Daniel, Microbiology. Mc Graw Hill.
11. Pelczar M J Jr, Chan E C S Krieg, Microbiolgy.
12. Wheelis, Principles of Modern Microbiology. Jones and Barttlett.
13. C.J.Alexopoulos. Introducing Mycology. Wiley.
14. Basman. Microbiology with diseases by holy systems. Pearson.
15. Madigan et al. Biology of Microorganisms. Pearson.

MOB C 103: Biological Chemistry

60 Hours **4 Credits**

1. Atomic bond and molecular interaction: Covalent bonds – ionic interactions – hydrogen bonds – Vander Waal's interactions – hydrophobic effect – binding of biomolecules.
2. Biomolecules: Carbohydrates – classification, structure and properties – carbohydrate derivatives – sugar alcohols, sugar acids, amino sugars etc. – biological function of carbohydrates; Proteins – classification of amino acids, structure and properties – classification of proteins and biological functions – levels of organization – primary, secondary, tertiary, quaternary and quitary – sequencing of proteins; Lipids – classification, structure and properties – biological application; Nucleic acids – structure of nitrogen bases – nucleosides – structure of DNA and RNA.
3. Enzymes: IUB classification, nomenclature and specificity – mechanism of enzyme action – Michaeli's-Menten equation – derivation, double reciprocal plot – Line-Weaver-Bruke-method – significance of Km and Vmax values – factors

effecting enzyme action – regulation of enzymatic activity – enzyme inhibition – allosteric enzymes – positive and negative modulation – vitamin as co-enzymes – and RNA as enzymes.

4. Bioenergetics: Enthalpy – entropy – free energy concepts – living body as thermodynamic system – energy of activation – standard free energy – energy rich compounds – ATP – creatine phosphate and pyrophosphate.
5. Cellular metabolism: Carbohydrate metabolism – Glycolysis – Kreb's cycle – glycogenolysis – glycogenesis – glucogenesis – gluconeogenesis – pentose phosphate pathway – glyoxylic acid cycle; Amino acid metabolism - Biosynthesis and degradation of amino acids – deaminationa and transamination (metabolism of glutamic acid, phenyl alanine, methionine, tryptophan, isoleucine and histidine to be given emphasis). Fat metabolism – Biosynthesis and oxidation of fatty acids (beta oxidation) – biosynthesis of phospholipids sphingolipids – glycolipid and cholesterol metabolism; Nucleic acid metabolism – Biosynthesis and degradation of purines and pyrimidines; Biological oxidation – electron transport system in mitochondria – redox potential – mechanism of oxidative phosphorylation – chemiosmotic coupling hypothesis.
6. Photosynthesis: Chloroplast as photosynthetic unit –Hill reaction–photosynthesis I and II – Calvin cycle.

Reference:

1. Smith E L et al., Principles of Biochemistry. Vol. I and Vol.II.
2. Lubert Stryer, Biochemistry. W H Freeman & Co.
3. Lehninger A L, Principles of Biochemistry. CBS publishers.
4. Conn and Stumpf, Concepts in Biochemistry.
5. Mahler H R & Cordes E H, Basic Biological Chemistry. Harper & Row.
6. Awapara J, Introduction to Biological Chemistry. Prentice-Hall of India.
7. Cohn E E & Stumpf P K, Outlines of Biochemistry. Wiley Eastern.
8. Wilson J & Walker K Practical Biochemistry: Principles and Techniques. Cambridge.
9. Sadasivan S & Manikam A, Biochemical methods. New Age International.
10. Patabhiraman T N Laboratory Manual in Biochemistry. All India Publishers.
11. Nelson David L, Principles of Biochemistry. McMillan.
12. Chatterji M N & Rana Shindo, Text Book of Medical Biochemistry. J P Brothers.
13. Das Debjyoti , Biochemistry. Academic Publishers.
14. Voet Donald & Voet Judith, Biochemistry.
15. Garrot Reginald H, Biochemistry, Thomson Publishers.
16. Elliot Willim H & Eliot C Daphne, Biochemistry and Molecular Biology.

17. Camphell Peter N, Biochemistry Illustrated. Churchill Living Stone.
18. Kamal Ritu, Biochemistry of Biomolecules. Paragon International.
19. Metzier David E, Biochemistry: the chemical reactions of living cells. Academic Press.
20. McKee Trudy, Biochemistry: the molecular basis of life. McGraw Hill.
21. Sheehan. Physical Biochemistry. Willy Blackwell.
22. Perasena. Enzymology. Oxford.
23. Heldt et al. Plans Biochemistry. Academic press.

MOB C 104: Biophysics

4Credits

60 Hours

1. Principles and applications of Biophysical Methods: microscopy – light, phase, contrast, fluorescence, confocal,Atomic force,Tunneling,scanning and transmission electron microscopy; Cytophotometry – flow cytometry ;chromatography:Baic principles and Types- gel filtration; Ion exchange and affinity chromatography – thin layer and gas chromatography – high pressure liquid chromatography (HPLC); Electrophoresis; PAGE, agarose, IEF, 2D;Centrifugation – Svedberg Unit-gradient and differential – ultracentrifugation-Types of Centrifuges; X-ray Crystallography;Spectroscopy – fluorescence, UV, ORD/CD, visible, NMR, ESR – Atomic absorption – Plasma emission spectroscopy – mass spectroscopy-GCMS.
2. Radiation Biology: Principles and applications of tracer techniques in biology – radiation dosimetry – sources of ionizing radiations use of x-ray in biomedical application – radioisotopes – half-life of isotopes – effect of radiation in biological system; autoradiography – liquid scintillation – G M Counter-gamma counter.
3. Physics of photobiological system: Photodynamic sensitation – photoelectric effects – electron displacement by light quantum theory – Biophysics of photosynthesis; Laser and its application in biology – use of laser as a tool in surgery and therapy.
4. Biophysics of vision: Light and its attenuation for vision – eye as optical instrument – formation of image.
5. Biomagnetism: Generation and nature of biomagnetic fields.
6. Bioacoustics: Sound and its characteristics – physical basis of hearing – limit of

intensity of sound – audible sound frequency – physical organization of the ear – physical aspects of transmission of sound in the ear – traveling waves – electrical response of cochlea – pitch reception and theories – physical basis of voice – infra or sub sonic sounds and ultrasonic sounds – echolocation – echocardiography – Doppler ultrasonography – lithotripsy.

7. Bioelectricity and bioluminescence.

Reference:

1. Chatwal G R, Biophysics, Himalaya Publishing House.
2. Cotterill Rodney M J Biophysics: An Introduction. John Wiley.
3. Pattabhi Vasantha & Gautham M, Biophysics. Narosa.
4. Subramanyan M A, Biophysics. MJP
5. Roy K N, A Text Book of Biophysics, New Central Book Agency.
6. Ackerman E, Biophysical Science. Prentice-Hall Inc.
7. Kane J W & Steinhein M M , Life Science Physics. John Wiley.
8. Thiravia Raj S, Biophysics. Saras Publications.
9. Glaser. Biophysics. Springer.
10. Pranab Kumar Banerjee,Introduction to biophysics,S Chand
11. Tuszynski et al.,Introduction to molecular Biophysics,CRC Press
12. Nolting,Methods in Modern Biophysics,Springer

MOB P 105 : Lab in Cell Biology & Microbiology

3 Credits

1. Study of meiosis in grasshopper testis squash and determination of chiasma frequency.
2. Preparation of chromosome spread from rat bone marrow and analysis of metaphase chromosome by means of G and C banding.
3. Preparation of Human karyotype from photographs of chromosome spreads – normal and abnormal.
4. Staining of buccal epithelial smear to demonstrate Barr body.
5. Preparation of human blood smears to demonstrate drumsticks in neutrophils.
6. Induction of chromosome aberration in onion root tips by a suitable clastogenic agent and its demonstration by means of root tip squashes.
7. Cell fractionation and isolation of nuclei and mitochondria from any suitable material (Rat liver).
8. Preparation and sterilization of culture media.
9. Pure culture technique: Streak plates, spread plate, and pour plate methods.
10. Staining methods: Simple, negative, Acid fast, Gram staining, spore staining, capsule staining, lactophenol cotton blue staining.

11. Measurement of growth – Direct haemocytometer count, viable count, growth curve, determination of growth rate and generation time.
12. Effect of pH, temperature and antibiotics on growth of bacteria.

MOB P 106: Lab in Biological Chemistry & Biophysics

3 Credits

1. Qualitative analysis of monosaccharide (glucose & fructose), disaccharide (lactose, maltose and sucrose), and polysaccharide (dextrin and starch).
2. Qualitative analysis of protein (albumin, casein, peptone and gelatin).
3. Qualitative analysis of lipids.
4. Estimation of glucose.
5. Estimation of protein.
6. Estimation of amino acid.
7. Estimation of triglycerol / phospholipids / cholesterol.
8. Enzyme kinetics – assay of alkaline phosphatase.
9. Preparation of buffer and measurement of pH (Tris, Phosphate, Acetate buffer).
10. Practical aspects of microscopy, micrometry and camera lucida.
11. Demonstration of diffusion using dialysis tubing.
12. Separation of amino acids by paper, thin layer chromatography and identification of amino acids.
13. Ion exchange chromatography and Molecular sieve chromatography.
14. Separation of proteins by polyacrylamide gel electrophoresis and determination of molecular weight of unknown protein.

SEMESTER II

MOB C 201: Genetics & Molecular Biology – 1

60 Hours **4 credits**

1. Overview of Genetics – Mendalian inheritance – non-Mendalian inheritance - Linkage, crossing over and chromosome mapping – polygenic inheritance.
2. Chromosomal aberrations – deficiency – duplication – inversion – and translocation; Ploidy – aneuploidy – euploidy; Chromosomal aberrations in human; Mutation – molecular basis of mutation – radiation induced mutation – chemically induced mutation – mutation frequency.
3. Genetic transfer in bacteria – Transformation, transduction and conjugation- Temporal mapping in E.Coli

4. Genetic basis of Cancer: Characteristic features of cancer cells – carcinogen – chemical and physical carcinogen; Oncogenes – viral oncogenes – cellular oncogenes –chromosome rearrangement and cancer – tumor suppressor genes – inherited cancers.
5. Genetic material: Experiments, which proves DNA as genetic material and RNA as genetic material in RNA viruses.
6. Introduction to 3D structure of DNA and RNA; Synthesis of DNA – semi conservative – experiments of Meselson and Stahl – Cairn's Experiment – Replicon – Semi-discontinuous synthesis – rolling circles – D-loop model – enzymes involved in replication; Triplex DNA – Types of DNA: A, B, Z, P and G DNA.
7. Restriction, modification and repair of DNA: Direct and Indirect repair,excision repair pathways – error prone repair – recombination repair – SOS system.
8. Transcription: Biosynthesis of RNA in prokaryotes – enzymatic machinery – promoter selection and role of RNA polymerase and ancillary factors; Transcription in eukaryotes – eukaryotic RNA polymerase – promoter and enhancer – rho factor mediated termination – antitermination – inhibition of termination. Biosynthesis of ribosomal, transfer and messenger RNA – RNA splicing and processing – post transcriptional modification in transfer and messenger RNA.
9. Protein Synthesis: Genetic code – t RNA – structure of ribosome – specific association of
   r RNA and r-proteins - translation in prokaryotes and eukaryotes – factors of protein synthesis and their role – inhibitors of protein synthesis – post translational modification.
10. Population Genetics:Gene pool-Genotypic frequency-allelic frequency-Hardy Weinberg Law-Factors affecting allelic frequency;Speciation-Allopatricity and sympatricity

Reference:

1. Rober J Brooker, Genetics:Analysis and Principles. Addison Wesley Longman
2. Klug W S & Cummings W S, Concepts of Genetics. Prentice Hall.
3. Gardnerand Simmon, Principles of Genetics. John wiley & Sons.
4. Strickberger , Genetics. Monroe w.
5. Bhasin M K & Walter H , Genetics of Castes and Tribes in India. Kamala Raj Ent.
6. Hartwell Leland H, Genetics from Genes to Genome.

7. Stent G, Molecular Genetics. Freeman.
8. Burns G W & Hottins P J, The science of Genetics.Mapwell –Macmillan.
9. Strickberger M W, Experiments in Genetics with Drosophila. John Wiley.
10. Hartl, David L, Genetics. Jones and Bartlett.
11. King William S & M R Qummings. Genetics. Prentice Hall.
12. Benjamin Lewin, Genes IX. John Wiley.
13. Benjamin Lewin , Gene Expression Vol1 -3. John Wiley.
14. Watson J D et al., Molecular Biology of the Gene. The Benjamin / Cummings.
15. Lodish H et al., Molecular Cell Biology. Scientific American Books. W H Freeman.
16. David Freidfelder, Molecular Biology. Narosa.
17. Brown T A, Genomes. Bioscientific.
18. Winnackeer Ernst L, From genes to Clones. Panima.
19. Dale J W and von Schantz, From genes Genomes. John Wiley.
20. Micklos D A et al, DNA Science. Cold Spring Harbor.
21. Weaver Robert F, Molecular Biology. Mc Graw Hill.
22. Turner P C, Molecular Biology. Viva Books.
23. Kreuzer Helen, Molecular Biology and Biotechnology: A Guide for Teachers.
24. Alber Bruce, Molecular Biology of the Cell. Garland Science.
25. Calladine, Horace Drew, Ben Luisi, Understanding DNA. Elsevier.
26. Benjamin A Pierce,Genetics A Conceptual approach,w.Freeman
27. Simmons et al.,Principles of Genetics

MOB C 202 : Cell Physiology

60 Hours **4 Credits**

1. Cell Differentiation: General Characteristics–Nucleocytoplasmic interactions – molecular mechanisms of cell differentiation.
2. Intercellular communications and signal transduction.
3. Homeostasis: Basic mechanisms – Regulation – factors regulating homeostasis.
4. Cellular and Molecular Neurobiology: General organization and function of nerve fibers - synaptic transmission and structure of synapse – synaptic vesicle and release of neurotransmitter – synaptic receptors and physiologic response.
5. Sensory physiology – photoreception – eyes and vision – mechanoreceptor: touch and pressure – mechanoreceptors of motion and position – proprioceptor – chemoreceptor – mechanism of hearing, olfaction, gustatory receptors
6. Cellular and Molecular Biology of the Muscle: structure of striated muscle fiber – smooth muscle – molecular organization of contractile system – molecular

mechanism of muscle contraction – energetics of muscle contraction – regulation.

7. Cellular and Molecular Biology of endocrine system: Cellular secretions – mammalian endocrine glands – peptide and proteins, amines and steroid hormones – synthesis, storage and secretion of hormones – cellular mechanism of hormone action – hormone receptors – endocrine disorders – pheromones and its role behavior and reproduction – biological clocks.
8. Plant Physiology: Autotrophy-heterotrophy-intake of water and nutrients-transpiration-Growth and Reproduction: Hormones and growth regulators-auxins, gibberlins, kinins, ethylene and other compounds.

Reference:

1. Sherwool L, Klandorf H and Yancy P H, Animal Physiology: From Genes to Organisms Thompson Brooks/Cole.
2. David Randall, Burggren W and Frech K, Eckert Animal Physiology: Mechanisms and Adaptations. W H Freeman & Co.
3. Guyton A C. Text Book of Medical Physiology. W B Saunders Co.
4. Hancock John T, Cell Signalling. Oxford University Press.
5. DeRobertis E D P and DeRobertis E M F, Cell and Molecular Bilogy. Holt Saunders.
6. Taiz and Zeiger,Plant Physiology,Sinauer
7. S.Mukherji et al.,Plant Physiology,Central
8. Hopkins et al.,Introduction to plant physiology
9. Negi,Introduction to Endocrinology,PHI

MOB C 203: Immunology

60 Hours **4 Credits**

1. Introduction to immunology – types of immunity – innate and acquired – passive and active – lymphoid organ – autoimmunity – physiology of immune response – humoral and cell mediated immunity – immunohaematology.
2. Antigen: Basis of specificity – epitopes – hapten – characteristic features of immunogen - pathways of antigen processing and presentation of intracellular and extra cellular antigens – synthetic and recombinant antigens – complement activation pathways.
3. Antibody: Structure of immunoglobulin – different classes of immunoglobulin – hybridoma technique – monoclonal antibodies and polyclonal antibodies – chimeric antibodies - applications – Genetic basis of immune diversity.
4. Regulation of immune system: Immunologic tolerance – immunopathology – T-cell derived lymphokines – macrophages mediated regulation – interleukin 1 –

tumor necrosis factor – interleukin 6– interferon and related cytokines.

5. Immunogenetics: Molecular genetics of human related diseases – transplantation immunology – rejection – graft Vs host reaction – transplantation – antigen-HLA tissue typing and MHC – tumor immunology – tumor antigens - immunotherapy of malignancy – autoimmune diseases – hypersensitive immune responses.

6. Principles and methods of precipitation techniques – immunodiffusion - immunoelectrophoresis – agglutination isoeletric focusing – ELISA – RIA – cytotoxic assay labeled antibody technique in light and electron microscopy – immunohistochemistry – Vaccines - techniques of immunization – use of adjuvants – separation of lymphocytes – flow cytometry – elispot.

Reference:

1. Ivan Roitt, Essential Immunology, Blackwell Science.
2. Goldsby R A,Kindt T J,Osbor R A. Kuby Immunology. W H Freeman.
3. Hue Devis. Introductory Immunology. Chapman & Hall publishers.
4. Roitt J M, Brostaff J J and Male D K, Immunology C V Mosby Publisher.
5. Bellanti J A Immunology. W B Saunders Co.
6. Talwar G P and Gupta S K. A Hand Book of Practical Immunology (Vol. & 11).
7. Elgert,Immunology,Understanding the Immune System,Wiley Blackwell
8. Tizard,Immunology an Introduction,Cengage learning.
9. Mak et al.,Primer to immune response,Academic cell.

MOB P 204: Lab in Genetics & Molecular Biology-1

3 Credits

1. Maintenance of *Drosophila melanogaster* culture and demonstration of sex linked inheritance of any suitable gene by means of crosses.
2. Gene mapping of *Drosophila melanogaster*, using text book problems
3. Preparation and analysis of salivary gland chromosomes of *Drosophila.*
4. Extraction and estimation of chromosomal DNA from animal tissues (by diphenylamine test).
5. Extraction and estimation of total RNA from any suitable material (by Orcinol test).
6. Extraction and estimation of protein from any suitable material (by Lowry test).

7. Agarose gel electrophoretic separation and visualization of DNA using UV transilluminator.
8. Leucocyte culture and chromosome study.
9. Melting temperature of DNA - Tm analysis.

MOB P 205: Lab in Physiology & Immunology

3 Credits

1. Determination of vertebrate hemoglobin using calorimeter.
2. Enumeration of WBC, RBC; Blood grouping and Rh typing.
3. Total and differential count of WBC.
4. Determination of vertebrate serum chloride, calcium and fibrinogen.
5. Demonstration of osmotic hemolysis.
6. Preparation of antigen; immunization protocol - preparation of serum & complement.
7. Haemoagglutination test.
8. Immunodiffusion test
9. Immunoelectrophoresis – preparation of immunoglobulin-lymphocyte migration inhibition test.
10. ELISA - Widal test - VDRL tests.

SEMESTER III

MOB C 301: Molecular Biology-2

60 Hours **4 Credits**

1. Molecular mechanisms involved in recombination of DNA: Holliday intermediate – -Reciprocal recombination-batch recombination-heteroduplex DNA – gene conversion – Rec A protein ant its role in recombination.
2. Eukaryotic genome: C-value paradox –Gene numbers– unique, moderately repetitive and highly repetitive DNA sequences – reassociation kinetics – Cot value and complexity of genome-Interrupted genes – satellite – Rot value.
3. Regulation of gene expression in Prokaryotes: various models - operon - details of lac operon-negative and positive control lac operon - catabolite

repression-basic features of tryptophan, arabinose, and galactose operon. Gene regulation in bacteriophage.

4. Regulation gene expression in eukaryotes: Regulation of transcription - regulation of RNA processing and translation.
5. Developmental Genetics: Induction and competence – maternal effects of genes – homeotic genes
6. Microarray and gene expression analysis.
7. Transposon in bacteria and eukaryotes: retroviruses and transposition – phage Mu as transposable elements.
8. DNA sequencing: Maxam Gilbert chemical method - Sanger's enzymatic chain termination method – foot printing.
9. Molecular probes – cDNA probes – RNA probes – nick translated probes; Restriction mapping – RFLP.
10. Blotting techniques: Northern blotting – western blotting – dot blots- Southern blotting

Reference:

1.Walker J M and Gringold EB, Molecular Biology and Biotechnology. Panima.
2.Benjamin Lewin.Genes 1X. John Wiley.
3.Sambrook J, Fritsch E F and Maniatis T, Molecular cloning: A laboratory Manual. Cold Spring Harbor Laboratory.
4.Hartwell L H et al., Genetics: From Genes to Genome. Mc Graw Hill.
5.Watson J D et al., Molecular Biology of the Gene. The Benjamin / Cummings.
6.Lodish H et al., Molecular Cell Biology. Scientific American Books. W H Freeman.
7.David Freidfelder, Molecular Biology. Narosa.
8.Adrin J Harwood, Methods in Molecular Biology,Vol.58, Basic DNA and RNA protocols. Humana Press.
9.Chris R Calladine et al., Understanding DNA. Elsevier.
10.Micklos D A et al., DNA Science. Cold Spring Harbour.
11.Cox et al,Molecular Biology,Principles and Practice,Freeman
12.Tropp,Molecular Biology,Genes to proteins,Jones and Bartlett
13.Allison,Fundamental Molecular Biology,Wiley.
14.Ernst L Winnacker,From genes to clones,Panima.

MOB C 302: Genetic Engineering & Biotechnology

60 Hours **4 Credits**

1. Fundamentals of biotechnology: History – emergence of molecular biotechnology – revolution.
2. Genetic Engineering: (a) Enzymes in genetic engineering – restriction enzymes

type I, II & III, ligases, enzymes to modify the ends of DNA molecules; alkaline phosphatase, polynucleotide kinase, terminal transferase, polymerases, reverse transcriptase etc. (b) Gene cloning vectors: plasmids – pBR 322, pUC, Ti plasmids – bacteriophages – lambda phage, M13, – cosmids – phagemids – BAC, PAC - special vectors – shuttle vectors, expression vectors, yeast artificial chromosomes, MAC etc. (c) Gene isolation, identification and synthesis; Construction of chimeric DNA – cohesive end ligation – use of linkers – blunt end ligation; construction and screening of cDNA and genomic libraries– colony hybridization – plaque hybridization – chromosome walking, chromosome jumping, subtractive cDNA hybridization, differential mRNA display; Studying cloned gene expression and function.

3. Tissue culture: Plant tissue culture – principle and methodology – callus culture – tissue and organ culture – whole embryo culture; Animal tissue culture – primary, secondary and established cell lines
4. Protoplast fusion – techniques of protoplast fusion – enzymes involved in cell wall digestion – factors effecting protoplast fusion – fate of products of protoplast fusion.
5. PCR technology – gene amplification – primer designing – variation in PCR – real time PCR, RACE, inverse, nested etc-Applications of PCR

6 Gene transfer in animals and plants: Gene transfer method (transfection) – direct gene transfer – Ti plasmid – electroporation – uptake by protoplast – microinjection – liposome mediated DNA delivery – Transgenic animals and plants.

7 DNA finger printing – Variable number of tandem repeats (VNTR) – applications; Gene therapy – somatic and germ line gene therapy – ex-vivo and in-vivo gene therapy – antisense therapy – application of gene therapy in the correction of adenosine deaminase (ADA) – future prospects of gene therapy; RNAi and gene silencing; gene targeting and embryonic stem cells; Terminator genes.

8 Gene Knockout, animal pharming, nanoparticles for labeling, delivery of drugs and DNA and RNA.

Reference:

1. Brown T A, Gene Cloning and DNA Analysis Blackwell Science.
2. B R and Pasternack J J, Molecular Biotechnology: Principles and Applications of Recombinant DNA. Panima.
3. James D Watson et al., Recombinant DNA: A Short Course. Scientific American Books, W H Freeman & Co.
4. Old R W & Primrose S B, Principles of Gene Manipulations. Black Well

Science
5. Winnaker E L, From Genes to Clones: Introduction to Gene Technology. VCH Publications.
6. Purohit S S & Mathur S K, Biotechnology: Fundamentals and Applications. Agrobios.
7. Eric Grace, Biotechnology Unzipped: Promises and Realities. University Press.
8. Fumento Michael, Biotechnology: How it is changing our Life. Jaico Publishing.
9. Bourgaize David, Biotechnology demystifying the concepts.
10. Meyers Robert A, Molecular Biology Biotechnology. John Wiley.
11. Sambrook J, Fritsch E F and Maniatis T, Molecular cloning: A laboratory Manual. Cold Spring Harbor Laboratory.
12. Howe,Gene cloning and Manipulation,Cambridge
13. Lodge et al.,Gene cloning,Taylor and Francis.
14. Rastogi,Genetic Engineering,Oxford.

MOB C 303: Genomics and Bioinformatics

60 Hours **4 Credits**

1. The Human genome: Organization of genes and related sequences – pseudo genes and microsatellites.
2. Organellar genomes: Special features of yeast mitochondria and human mitochondrial genome – petite mutants of yeast.
3. Mapping genomes: Genetic mapping – physical mapping – restriction mapping – Fluorescent *in situ* hybridization (FISH) – sequence tagged site (STS) mapping.
4. Sequencing genomes: chain termination sequencing – assembly of contiguous DNA sequence – sequence assembly by shot gun approach – sequence assembly by clone contig approach – whole genome shot gun sequence – Human genome project – sequencing the human genome – future of the human genome project.
5. Understanding a genome sequence: Locating the genes in a genome sequence – determining the function of individual genes – computer analysis of gene function – assigning gene function by experimental analysis.
6. Pharmacogenomics and its applications: Historical perspectives and current status – Genetic polymorphism – SNPs – personalized medicine.
7. Genome evolution and phylogenetics: Origin of genome – acquisition of new genes – non coding DNA – genome evolution -phylogenetic tree as a tool in the study of human prehistory – origin and migration of modern human.

8. **Bioinformatics**: Introduction – genomics – transcriptome – proteome.
9. Biological databases: Generalized and specialized databases – DNA, protein and carbohydrate databases – nucleic acid sequence databases – premier institutes for databases – nucleic acid codes used in database formats; Collection and down loading of information from databases – literature search.
10. Sequence alignment and its evolutionary basis: Simple alignment and multiple sequence alignment - searching the database for sequence similarity – search programmes with special reference to FASTA, BLAST, CLUSTAL W. Application of bioinformatics in phylogenetic analysis.

Reference:

1. Dale J W and Schantz M V, From Genes to Genome. Wiley.
2. Brown T A, Gene Cloning and DNA Analysis. Blackwell Science.
3. Winnacker E L, From Genes to Clones: Introduction to Gene Technology. Panima.
4. Benjamin Lewin, Genes IX. Jones and Bartlett.
5. Daniel L Hartl and Elizabath W Jones, Gentics: Analysis of Genes and Genome. Jones and Bartlett
6. Young, Computerized Data Acquisition and Analysis For Life Sciences. Cambridge
   University Press.
7. Xiong, Essential Bioinformatics. Cambridge University Press.
8. Marketa J Zvelebil, Understanding Bioinformatics. Garland Science.
9. Shui Quing Ye, Bioinformatics: A practical Approach.
10. Anna Tramontano, Introduction to Bioinformatics
11. David W Mount, Bioinformatics. CBS
12. Mani K and Vijayaraj N, Bioinformatics. Kalaikathir Achchagam.
13. Augen Jeff, Bioinformatics in the post genomic era. Addison Wesley.
14. Cohen Nadine, Pharmacogenomics and personalized medicine
15. Lesk,Introduction to Genomics,Oxford
16. Ruvinsky et al.,Mammalian Genomics,Oxford
17. Faridi,Genetics and Genomics,Pearson
18. Bosu et al,Bioinformatics,Oxford
19. Rastogi et al,.Bioinformatics,Oxford.

MOB P 304: Lab in Molecular Biology – 2 & Genetic Engineering and Biotechnology

4 Credits

1. Isolation of genomic DNA.
2. Isolation of plasmid DNA from *E.coli* – Separation by agarose gel

electrophoresis.

3. Restriction digestion of plasmid – single, double digestion – determination of molecular weight – physical mapping.
4. Cloning of fragment in p BR 322 /pUC – insertional inactivation - Bluewhite selection.
5. Re-isolation of plasmid from recombinant clone – restriction digestion and agarose gel electrophoresis – confirmation of size of insert.
6. PCR amplification of DNA, RFLP – gel electrophoresis – analysis of fragments.
7. Genomic and cDNA library construction.
8. Blotting technique – Southern, Northern and Western blotting.
9. DNA sequencing.

MOB P 305: Lab in Genomics and Bioinformatics

2 Credits

1. Internet search for literature.
2. Genome Database services – Search against genes and genomes (BLAST / FASTA) – Gene annotation; DNA–Protein interactions, protein-protein interactions, similarity searches.
3. Use of software for sequence alignment (BLAST , FASTA , CLUSTAL W)
4. Phylogenetic analysis using bioinformatics software.
5. Alignment of protein sequence using Bioinformatics software

ELECTIVE COURSES

.

MOB E 206: Biometrics

45 Hours **3 Credits**

1. Nature and scope of Biometry and its applications in biology: Discrete and continuous variables – collection and classification and tabulation of data frequency table – diagrammatic and graphic presentation of data – bar diagram - pie diagram – histogram – frequency polygon and frequency curve
2. Measures of central tendency: Arithmetic mean – median – mode.
3. Measures of dispersion: Range – quartile deviation – mean deviation and standard deviation.
4. Probability theory: Basic concepts and definition of probability – relative frequency definition – probability distributions – binomial, Poisson and normal distributions and their applications.
5. Testing hypothesis; level of significance – critical region , type 1 and type 11

error – tests based on normal distribution – t-test, F-test, Z-transformation and chi-square test.

6. Correlation and regression analysis: positive correlation – negative correlation coefficient of correlation, regression equation and its application in computing X or Y.
7. Analysis of variance: ANOVA – one way and two way classification.
8. Applications of computer in biometry.

Reference:

1. Jasra P K & Raj G, Biostatistics. Krishna Prakasan Media Pvt. Ltd.
2. Dixon W J & Massey F J Jr, Introduction to Statistical Analysis.
3. Khan I A & Khanum a, Fundamentals of Biostatistics. Ukaaz Publicaations.
4. Sokal R R & Rohif F J, Introduction to Biostatistics. W H Freeman & Co.
5. Lewis A I, Biostatistics. Reinhold Publications.
6. Snedecor G W & Cochran W G, Statistical Methods. Oxford & IBH.
7. Zar, Jerrold H, Biostatistical Analysis. Morgan Kaufman.
8. Hannagan T J, Mastering Statistics. Mac Millan Master Series.
9. Milton Susan J, Statistical Methods in the Biology and Health Sciences. McGraw Hill.
10. Arora P N, Biostatistics. Himalaya Publishing House.

MOB E 207: Ecology and Biodiversity

45 Hours **3 Credits**

1. Concept of ecosystem: Introduction – Various components of ecosystem – functions –Concept of habitat and niche– energy in ecosystem – nutrient cycling.
2. Population growth – Characteristics – population growth curves- r and k selection-dispersion – dynamics – species diversity indices – species and the individual in ecosystem.
3. Ecological Succession: Types-Mechanisms-changes involved in succession-concept of climax.
4. Biogeography;Major terrestrial biomes-Theory of Island biogeography-biogeographical zones in India.
5. Concept and Scope of Biodiversity – species loss – social concept – biodiversity conservation in protected area – biodiversity and agriculture – grazing – forestry – human dimension of biodiversity.
6. Hotspots – conservation strategies – challenges to the preservation of biodiversity

– conservation and management – Indian case studies on conservation (Project Tiger/Bioshere reserves).

Reference:

1. Eugene P Odum, Fundamentals of Ecology. W B Saunders.
2. Subramanyam N S & Sambamurthy AVSS, Ecology. Narosa.
3. Wilson E O, Biodiversity. National Academy Press.
4. Jeffrey A, McNeely & R Miller, Conserving the Worlds Biological Biodiversity.
5. Vitousek P M & DV Hooper, Biodiversity and Ecosystem Function.
6. Cain et al,.Ecology,Sinauer.
7. Dr.V.K.Gupta,Animal diversity,natural history and conservation vol.1.,Daya publications.

MOB E 306: Developmental Biology

45 hours **3 Credits**

1. Basic concepts of development: Potency-commitment,specification,induction-competence-determination and differentiation-morphogenetic gradients-cell fate and cell lineages-stem cells.
2. Gametogenesis, fertilization and early development:Production of gamates-cell surface molecules in sperm egg recognition in animals-Embryo sac development and double fertilization in plants-zygote formation-clevage-blastula formation-embryonic fields-gastrulation and formation of germ layers in animals-Embryogenesis.
3. Morphogenesis and organogenesis in animals:Cell aggregation and differentiation in Dictyostelium-Axes and pattern formation in Amphibia and chick-vulva formation in Caenorhabditis elegans,eye lens induction,limb development and regeneration in vertebrates-Post embryonic development-larval formation-metamorphosis-sex determination
4. Morphogenesis and organogenesis in plants:Organization of shoot and root apical meristem-Shoot and root development-leaf development and phyllotaxy-Transition to flowering.

Reference:

1. Scott F Gilbert,Developmental Biology,Sinauer Associates,Inc.,Sunderland.
2. Werner A Muller,Developmental Biology,Springer.
3. B.I.Balinsky&B.C.Fabian,An Introduction to Embryology
4. Abhilash Jain,Advanced Developmental Biology.
5. Geoffrey M Cooper,Robert E Hausman,The cell-A molecular Approach.
6. Elena Notarianni,Martin J Evans,Embryonicstem cells.

MOB E 307: Molecular Evolution

45 Hours **3 Credits**

1. Molecules and Origin of life: Origin of basic biomolecules - origin of organized structures

   (coacervates, microspheres); RNA world, evolution of protein synthesis, evolution of genetic code, prokaryotes and eukaryotes - evolution of eukaryotic organelle, genetic constancy and variability – chromosomal variation – gene mutation - gene duplication - evolutionary history of haemoglobin, cytochrome C, psuedogene, genetic polymorphism, evolutionary clock.
2. Speciation: Isolating mechanisms – Founder principle – bottleneck effect – genetic drift – and gene flow.
3. Microevolution – Macroevolution and punctuated equilibrium – anagenesis and cladogenesis.
4. Culture and human evolution; learning, society and culture – cultural and biological evolution – Social Darwinism, sociobiology, biological limitations, deleterious genes, eugenics.

Reference:

1. Strickberger M W, Evolution. Jones Barllett.
2. Volpe E P, Understanding Evolution. Universal Book Stall.
3. Li.W H, Molecular Evolution. Sinaur Associates.
4. Edwin H McConkey, Human Genetics: The Molecular Evolution. Jones and Bartlette.
5. Masatoshi Nei and Sudhir Kumar, Molecular Evolution and Phylogenetics. Oxford University Press.

MOB E 403: Industrial Biotechnology

45 Hours **3 Credits**

1. Fermentation Types – surface, submerged, solid state, adhesive, batch, continuous, fed batch, immobilized and anaerobic. Media sterilization; development of inocula; assay of fermentation products.
2. Bioreactor – batch, chemostat and turbidostat, mode of operation, ideal reactors, mass transfer, heat transfer and mass balance. Optimization conditions – aeration agitation, foam control, process control equipment, biosensors.
3. Bioproduct technology- production of microbial biomass, enzymes, vaccines, vitamins, microbial transformation of steroid, fermentation economics, marked potential, process cost, recovery cost future of bioprocess technology.
4. Bioproduct processing – downstream processing, concentration and finishing.

Anaerobic fermentation - Wine, beer, industrial alcohol, acetone, butanol, lactic acid and glycerol production. Aerobic fermentation – vinegar, citric acid, glucomic cid, fermanic acid, Kojic acid, amino acids and antibiotics (Pencillin and streptomycin) production.

References:

1. Michael J Waites, et al., Industrial Microbiology: An introduction.Blackwell Science.
2. EI-Mansi, E.M.T and Bryce, C.F.A. Fermentation Microbiology and Biotechnology.
3. L.E. Casida, J.R Industrial Microbiology. New international (p) Ltd. Publishers.
4. DR.Kavita,Industrial Biotechnology,AITBS publishers
5. Domain and Davies,Manual of industrial Microbiology and Biotechnology,Panima.
6. P.F.Stanburry,Principles of fermentation technology

MOB E 404: Human Genetics

45 Hours **3 Credits**

1. Human chromosomes: Karyotype and different types of banding techniques and its significance.
2. Human pedigree and various modes of inheritance: Pedigree construction, autosomal abnormalities, sex chromosomal abnormalities, autosomal recessive inheritance, X-linked inheritance, Y-linked inheritance, multifactorial inheritance.
3. Genetics of reproduction and development: prenatal development, errors in sexual development – defects of androgen target cells, congenital adrenal hyperplasia, sex reversal; genetics of embryonic development – maternal effect genes, segmentation and pattern forming genes.
4. Inborn errors of metabolism: Concept of metabolic diseases, detection of metabolic diseases in new born, taysachs disease, disorders of phenyl alanine metabolism, Lesh-Nyhan syndrome.
5. Genetic diseases and gene therapy: Types of gene therapy – germ line, zygotic and somatic cell gene therapy; treatable genetic diseases – cystic fibrosis, sickle cell anemia; future of gene therapy, early detection of genetic diseases.
6. Genetic counseling and prenatal diagnosis: Methods of genetic counseling, amniocentesis, chorionic villi sampling, footoscopy, ultrasound sonography; prenatal sexing and legislation.
7. Human population genetics: Genetic drift – gene flow – consanguineous

marriages, inbreeding, sampling, demographic analysis.

Reference:

1. Gardner and Simmon, Principles of Genetics. John Wiley & Sons.
2. Strickberger Genetics, Monroe W.
3. Robert J Brooker, Genetics: Analysis and Principles. Addison Wesley Longman.
4. Edwin H McConkey, Human Genetics: The Molecular Evolution. Jones and Bartlett Publishers.

MOB E 405: Ethics, Patency and Intellectual Property rights

45 Hours **3 Credits**

1. Ethical aspects of interfering in natural process – hidden dangers in altering genetic makeup.
2. Objectives of the patent system, basic principles and general requirements of patent law, technological inventions and patent law, legal development, patentable subjects and protection in biotechnology, international convention for the protection of new varieties – Strasbourg convention, UPOV convention.
3. The patentability of microorganisms – claims, characterization and repeatability – deposition in culture collections, legal protection – for plants and other higher organisms – tissue culture protocols – transfer of technology.
4. Patentability of inanimate products of nature – vectors , FDA, FPA, patent office practice – trade secrets, copyrights, infringement problems – harmonization patent laws – IPR and Plant genetic sources, GATT and TRIPS.
5. Biosafety: Objectives, definition, recombinant DNA safety – classification of pathogenic microorganisms – Biological containment (BC) and physical containment (PC) – biosafety levels.
6. Guidelines for r DNA research activities: Large scale experiments, release to the environment, import and shipment, quality control of biologicals produced by r DNA technology, mechanism of implementation.

Reference:

1. Erice Grace, Biotechnology Unzipped: Promises and realities.
2. Glick B R & Pasternak J J, Molecular Biotechnology. Panima.
3. Purohit S S & Mathur S K, Biotechnology: Fundamentals and Applications. Agrobios.

4.Brown T A, Gene Cloning and DNA Analysis. Blackwell Science.

MOB E 406: Environmental Biotechnology

45 Hours **3 Credits**

1. Introduction to Environmental Biotechnology – scope and importance.
2. Biological Treatment of waste water: Aerobic – Biological process for domestic and industrial waste water treatment ; aerobic systems – activated sludge processes – trickling filters – biological filters – rotating biological contractors (RBC) ; fluidized bed reactors (FBR) , expanded bed reactor, inverse fluidized bed biofilm reactor (IFBBR) ; sparged reaction. Anaerobic: Contact digestion - packed column reaction.
3. Bioremediation: Introduction – constraints and priorities of bioremediation ; biostimulation of naturally occurring microbial activities ; bioaugmentation ; solid phase bioremediation ; phytoremediation – composting , bioventing, biosparging; liquid phase bioremediation.
4. Mining and Metal Biotechnology: Microbial transformation – accumulation and concentration of metals – metal leaching – extraction and future prospects.
5. Biofuels: Microorganisms and energy requirements of mankind. Production of non- conventional fuels. – Methane (biogas); hydrogen, alcohols, hydrocarbon, use of microorganisms in petroleum augmentation and recovery.
6. Major pollution problems – pathogens – microbial toxins – oxygen depletion- biodeterioration - eutrophication – hazardous transformation – Management of pollution problems using microorganisms.

Reference:

1. Agarwal SK, Enviornmental Biotechnology.
2. Martin Alexander , Biodegradation and Bioremediation . Academic Press
3. Stanier R Yetal , General Microbiology. McMillan Publications
4. Foster C F. & John Ware D A, Environmental Biotechnology. Ellish Horwood Ltd.
5. Chattergy A K, Environmental Biotechnology.
6. Jogdant S N, Environmental Biotechnology, Himalaya Publications.

OPEN COURSE

MOB O : Life and Genes

45 Hours **3 Credits**

This basic course intended for those students, who are interested to know the living world around us, their diversity and finally to know they themselves through living technology.

1. Life: appearance of life – experimental studies for the origin of life – spontaneous generation, Pasteur experiment, Oparin's experiment, Miller's experiment.
2. Biodiversity: Concept and scope of biodiversity – species biodiversity, ecosystem biodiversity, genetic biodiversity – biodiversity and health.
3. Cell: General organization – Cell architecture – Biomolecules – cell cycle.
4. Genome: Genetic material – central dogma of modern biology – DNA , RNA – genetic code – gene expression and regulation – Human genome.
5. Living Technology: Biotechnology – basic steps in genetic engineering - applications – Hazards and impacts on society.

Reference:

1. Biology. Raven *et.al.*
2. Biodiversity: Concept, conservation and biofuture. Mandal and Nandi.
3. Ecology. Subramanyan and Sambamurthy.
4. Fundamentals of Ecology. Odum and Barrett.
5. Cell and Molecular Biology. DeRobertis and DeRobertis.
6. The thread of life. Susan Aldridge
7. Biotechnology. John.E.Smith.
8. Gene cloning and DNA Analysis. T.A.Brown
9. Molecular Biotechnology, Principles and Application of Recombinant DNA. Glick & Pasternak.
10. DNA Science. Micklos & Freger

Reg.No…….
Name…….

DEPARTMENT OF MOLECULAR BIOLOGY
KANNUR UNIVERSITY
Fourth Semester M.Sc. Degree Examination August 2017
Paper: MOB E 403 – Industrial Biotechnology

Time: 3 Hours **Total: 60 Marks**

I.Answer any **Two** of the followings

1) Give an account on the large scale production of Wine and Beer.

2) Briefly explain the downstream processing in industrial fermentation process. .

3) What are the characteristics of an ideal fermentation medium? Give a detailed account on the components of a typical production medium.

(12 x 2 = 24 marks)

II. Answer any **Two** of the followings

4. Give an account on the component parts of an ideal bioreactor
5. Describe about the large scale production of Biomass.
6. Briefly describe about the aerator systems used in a fermenter. Give an account on the factors affecting the gas transfer within the media. (8X2=16 marks)

III**.** Write short notes on any **Four** of the followings

7. Impeller.
8. Fed- Batch fermentation.
9. Process of Lactic acid production.
10. Foam sensing and control unit
11. Chemostat and Turbidostat bioreactor
12. Biological assay of fermentation products. (4 x 5= 20 Marks)

Reg.No…….
Name…….

DEPARTMENT OF MOLECULAR BIOLOGY
KANNUR UNIVERSITY
Fourth Semester M.Sc. Degree Examination August 2017
Paper: MOB E 404 – HUMAN GENETICS

Time: 3 Hours **Total: 60 Marks**

I .Answer any **two** of the following

1. Describe the role of gene therapy in the treatment of diseases.
2. Explain the karyotyping of human chromosomes with special emphasise on the significance of banding.
3. Explain population genetics. (12X2=24 marks)

II.Answer any **two** of the following

4. Give a note on human pedigree analysis.
5. Describe genetic counseling
6. Explain the concept of metabolic diseases. (8X2=16 marks)

III. Write short notes on any **four** of the following

7. Sex linked inheritance.
8. Sex reversal
9. Cystic fibrosis
10. Amniocentesis
11. Segment polarity genes
12. Footoscopy. (4 x 5= 20 Marks)

Reg.No…….
Name…….

DEPARTMENT OF MOLECULAR BIOLOGY
KANNUR UNIVERSITY
Fourth Semester M.Sc. Degree Examination August 2017
Paper: MOB E 405 – ETHICS, PATENCY&INTELLECTUAL PROPERTY RIGHTS

Time: 3 Hours **Total: 60 Marks**

I .Answer any **two** of the following

1.Write an essay on ethical issues related with genetic engineering .

2.Critically evaluate the guide lines for rDNA research and its mechanism of implementation.

3.Give an account on basic principle and general requirements of patent law.

(12X2=24 marks)

II..Answer any **two** of the following

4.Explain IPR with respect to TRIPs

5.Harmonization of patent law.

6. Give a detailed account on transfer technology.

(8X2=16 marks)

III Write short notes on any **four** of the following

7. FDA.

8. Cartagena protocol.

9. Plant variety protection.

10. Patentability of microorganisms.

11. Tissue culture protocol.

12. Infringment problems (5X4=20 marks)

Reg.No…….

Name…….

DEPARTMENT OF MOLECULAR BIOLOGY
KANNUR UNIVERSITY
Fourth Semester M.Sc. Degree Examination August 2017
Paper: MOB E 406- ENVIRONMENTAL BIOTECHNOLOGY

Time: 3 Hours **Total: 60 Marks**

I .Answer any **two** of the following

1. Discuss the various aerobic treatment processes involved in waste water treatment.
2. Explain the scope and importance of environmental biotechnology.
3. Describe the production of non- conventional biofuels.

12×2=24 marks

II. Answer any **two** of the following

4. Describe the process of microbial degradation of petroleum and other hydrocarbons.
5. Briefly explain the process of composting.
6. Explain the factors affecting anaerobic waste water treatment.

8×2=16 marks

III.Answer any **four** of the following

7.Bioaugmentation
8. Activated sludge process.
9.Bioventing
10.Liquid phase bioremediation
11.RBC
12.Microbial transformation of metals 5×4=20 marks