DEPARTMENT OF GENETICS
(Choice Based Credit System)
Examination Scheme of M.Sc. Genetics (Semester system) w.e.f. the academic Session 2011-2012

FIRST SEMESTER							
Paper No.	**Nomenclature of Paper**	**L**	**P**	**Credits**	**Max. Marks**	**Internal assessment**	**Total**
GENET-101	Concepts of Genetics	4	-	4	80	20	100
GENET-102	Chromosomes ,Genes and Genomics	4	-	4	80	20	100
GENET-103	Cell and Molecular Biology	4	-	4	80	20	100
GENET-104	Methods in Genetics	4	-	4	80	20	100
GENET-105(OE)	Biostatistics and Computers	4	-	4	80	20	100
GENET-106	Lab course-I	0	-	8	100	-	100
Total Credits for Semester-I				**28**			**600**

Open Elective (OE) - Biostatistics and Computers

There will be one common and compulsory paper for the students listed as Open Elective (OE).

SECOND SEMESTER							
Paper No.	**Nomenclature of Paper**	**L**	**P**	**Credits**	**Max. Marks**	**Internal assessment**	**Total**
GENET-201	Genetics of Bacteria and Viruses	4	-	4	80	20	100
GENET-202	Human Genetics	4	-	4	80	20	100
GENET-203	Biostatistics and Population Genetics	4	-	4	80	20	100
GENET-204	Recombinant DNA Technology	4	-	4	80	20	100
GENET-205PE (i) Or GENET-205PE(ii)	Medical Genomics or Plant Genetic Engineering	4	-	4	80	20	100
GENET-206	Lab course-II	0	-	10	100	-	100
Total Credits for Semester-II				**30**			**600**

THIRD SEMESTER							
Paper No.	**Nomenclature of Paper**	**L**	**P**	**Credits**	**Max. Marks**	**Internal assessment**	**Total**
GENET-301	Developmental Genetics	4	-	4	80	20	100
GENET-302	Conservation Biology	4	-	4	80	20	100
GENET-303	Gene Expression and Regulation	4	-	4	80	20	100
GENET-304	Immunogenetics	4	-	4	80	20	100
GENET-305 PE(iii) or GENET-305 PE(iv)	Medicinal and Aromatic Plants in Human Health Care or Advanced Human Molecular Genetics	4	-	4	80	20	100
GENET-306	Student Seminar	-	-	4	100	-	100
GENET-307	Lab course-III	-	-	10	100	-	100
Total Credits for Semester-III				**34**			**700**

Student Seminar:

Student would deliver a seminar on any general topic of Genetics. Evaluation of the seminar would be done by the concerned faculty members.

FOURTH SEMESTER							
Paper No.	**Nomenclature of Paper**	**L**	**P**	**Credits**	**Max. Marks**	**Internal assessment**	**Total**
GENET-401	Intellectual Property Right and Biosafety	4	-	4	80	20	100
GENET-402	Bioinformatics	4	-	4	80	20	100
GENET-403 PE (v) or GENET-403 PE (vi)	RNAi Biology and its Applications or Drosophila Genetics	4	-	4	80	20	100
GENET-404	Self Study Paper	-	-	-	-	-	-
GENET-405	Dissertation/Project Work	-	-	20	200	-	200
Total Credits for Semester-IV				**32**			**500**

Grand total of the credits for the all Semesters I (28) + II (30) +III (34) +IV (32) = 124 (2400)

NOTE: Semester-IV

Dissertation:

Each student would submit a special report of the dissertation work carried out on the selected problem either in the departmental laboratory or any other laboratory or both. The report would be evaluated in terms of quality of written work, experimental work and performance in the viva-voce as well. Both internal and external examiners would evaluate dissertation work.

Self Study paper: Student would also take a discipline centric elective paper to acquire knowledge as a supplement to the project work. Student would study this paper on his/her own with an advisory support by the concerned teacher.

ORDINANCE

MASTER OF SCIENCES

IN

Genetics
&
Forensic Science

Department of Genetics
Maharshi Dayanand University
Rohtak-124001 Haryana

ORDINANCE

TWO YEAR MASTER OF SCIENCES
IN
Genetics & Forensic Science

1. i) The duration of the course leading to the degree Master of Sciences in Genetics, Forensic Science shall be of two academic years. Each year shall be divided into two semesters. The Examination for the first and the third semesters shall ordinarily be held in the month of December/January and for the second and the fourth semesters in the month of May/June or on such dates as may be fixed by the University.

   ii) A supplementary examination for the first and the third semester shall be held along with their regular first and third semester examinations in December/January and for the second and fourth semester examinations along with their regular second and fourth semester examinations which will be held ordinarily during the month of May/June.

   iii) A special examination may be held in the month of December/January for candidates who have failed/or failed to appear in fourth semester examination held in May/June.

2. The date of Commencement of examination as well as last date for the receipt of examination forms & fee as fixed by the University, shall be notified by the COE/Registrar at least two weeks before the commencement of the examination in each semester.

3. Examination forms shall be forwarded to the Registrar as per the schedule of the examination to be notified by the COE /Registrar.

4. Admission eligibility in first semester will be as below:

(A) Genetics

a) B.Sc. (Hons.) in any of the subjects' i.e. Botany/ Environmental Science/Genetics/ Zoology/Biochemistry/Microbiology/Biotechnology/Biosciences/Food Technology / Forensic Science with atleast 50% marks in aggregate.

OR

b) B.Sc. (Pass) with 50% marks in aggregate with any three of the subjects viz. Botany, Chemistry, Biotechnology, Anthropology, Fisheries, Genetics, Zoology, Industrial Microbiology,

Bio- Medical Engineering, Medical-Biochemistry, Immunology, Haematology & Industrial Chemistry, Microbiology, Fermentation, Microbial Technology and Food Processing Technology, Forensic Science.

OR

c) Bachelor Degree with 50% marks in aggregate in Pharmacy/Home Science/Agriculture Science/Veterinary Science/B.E./B.Tech. Bio-Technology/Bioinformatics/Food Technology /Nursing/BDS/ Forensic Science

OR

d) An equivalent examination recognized by this university.

(B) Forensic Science

a) B.Sc. (Hons.) in any of the subjects' i.e. Forensic Science/Botany/ Environmental Science/Genetics/Zoology/Biochemistry/Microbiology/Biotechnology/Biosciences/Food Technology with atleast 50% marks in aggregate.

OR

b) B.Sc. (Pass) with 50% marks in aggregate with any three of the subjects viz. Anthropology, Biochemistry,Bioinformatics,Biophysics,Biotechnology,Botany, Chemistry,Computer Science, Genetics,Mathematics, Microbiology, Physics, Statistics, Zoology, Forensic Science, Fisheries Industrial Microbiology, Bio- Medical Engineering, Medical-Biochemistry, Immunology, Haematology & Industrial Chemistry, Microbiology, Fermentation, Microbial Technology and Food Processing Technology.

OR

c) Bachelor Degree with 50% marks in aggregate in MBBS/BDS/B.Pharm./Home Sc./ Agriculture Science/ Veterinary Science/B.E./ B. Tech. Biotechnology/Bioinformatics /Nursing/BDS/ Forensic Science

OR

d) Graduates in Science disciplines of this university or any other university recognized as equivalent. Candidate should have scored at least 50% marks at Graduate level.

5. (i) There shall be 80% marks for theory and 20% marks for Internal Assessment.

The Internal assessment marks will be distributed as according to the following guidelines:

1) One Class Test/Assignment and Presentation	10 marks
2) Students conduct, Behavior & Sincerity	5 marks
3) Attendance	5 marks
Less than 65%	0 marks
65% to 70%	2 marks
71% to 75%	3 marks
76% to 80%	4 marks
Above 80%	5 marks

If the candidate is awarded Internal Assessment of more than 80% or less than 45%, in both cases, the concerned teacher will give specific justification for the same, which shall be considered by a committee chaired by the concerned Head of the University Teaching Department.

(ii) The Schedule of class test and presentation of the assignments etc. will be finalized by teacher concerned and shall be notified to the students with intimation of Head of the Department. However, Internal Assessment shall be made by the teacher teaching the subject. A student who fails to appear in the class test or present the assignment on the scheduled date due to some emergency one more chance may be given to such students.

(iii) The candidate will have to pass in theory papers and Internal Assessment separately.

(iv) The Internal Assessment awards of a candidate who fails in any semester/paper(s) shall be carried forward to the next examination.

(v) Candidate(s) who has not obtained pass marks in the Internal Assessment in any paper(s) will be provided an opportunity to appear before the Committee of Examiners, to be constituted by the Head of the concerned Department, to re-assess performance of the candidate (within three months of the declaration of result and receipt of the request of the candidate concerned), corresponding to schedule given for supplementary examinations and the Internal Assessment given by the committee shall be final.

(vi) The HOD shall forward the Internal Assessment marks awarded to the students to the Controller of Examinations at least one week before the commencement of the semester examination.

(vii) The HOD will preserve the records on the basis of which the, Internal Assessment awards have been prepared for inspection, if needed by the University up to one month from the date of declaration of the semester examination results.

6. The candidate will be allowed to appear in the first and second semester examination if he/she meets the following requirements:

(i) Bears a good character.

(ii) has been on the rolls of the Department during the first semester;

(iii) has attended **not less than 75% of lectures** delivered in theory as well as in practicals. Relaxation in shortage of lectures upto 20% will be allowed by Head of department on genuine grounds.

(iv) has obtained **pass marks in the internal assessment** in each paper of the semester.

7. The third and fourth semester examinations, of the concerned Programme, shall be open to a regular student who:

(i) has been on the rolls of the department during the semester preceding the respective semester examination;

(ii) has attended not less than 75% of lectures of each paper/course (individually) in the respective semester; failing which he/she will be not be allowed to appear in the paper(s)/course(s) concerned. Relaxation in shortage of lectures upto 20% will be allowed by Head of department on genuine grounds

(iii) has obtained at least 45% marks in the internal assessment in the papers of the relevant semester of which he/she is a candidate;

(iv) has passed at least 50% of the papers in the preceding semester (semester 1 and 2) examination;

(v) has not taken any other course during proceeding/setup Semester, if any.

NOTE:

(i) The HOD of the concerned department will submit a list of students who fulfill the requirements of Clause 6/8 of the Ordinance immediately after the dispersal of classes to the Controller of Examinations, M.D.University, Rohtak, indicating the names, Roll Nos. of candidates and paper(s) in which they are short of attendance.

(ii) The candidate(s) who fall short of attendance till the dispersal of classes in any paper(s) and he/she appears in those paper(s) will be declared fail in such paper(s).

8. A candidate who has been admitted to any semester but **fails to attend classes in any paper/course continuously for 15 days** will be treated as absent and his/her name will

be treated as struck off automatically. He/she will be allowed re-admission by the Vice-Chancellor on the recommendation of the Head of the Department on payment of Rs.1000.00 as re-admission fee.

9. The medium of instruction and examination for all the above mentioned programmes shall be English.

10. The minimum percentage of marks to pass the examination in each semester shall be :-

a) 45% in each written paper and internal assessment/ practicals separately.

b) 45% in Dissertation and Viva-Voce separately.

c) 45% in the total of each semester examination.

11. The amount of examination fee to be paid by the candidate for each semester shall be as per the decision of the University from time to time.

12. (i) A candidate shall be promoted to the next higher semester if he/she passes at least 50% of the papers prescribed in each of the preceding semester examination.

OR

2/3 of the papers of preceding semester examinations taken together.

Provided that a candidate shall not be allowed to attend classes in any semester unless he has fulfilled the above requirements of the previous semester (S).

Provided further that a candidate who has paid dues for the higher class and is dropped for want of fulfillment of any of the above conditions shall not be required to pay the dues again on re-admission after fulfillment of above conditions.

EXPLANATION: **50% of five papers will be taken as two** and that of seven papers as three and that of nine papers as four under this Clause.

(ii) A candidate shall have to pass all the four semester examinations within a maximum period of five years of his/her admission to the first semester of 2-Year M.Sc.

Biochemistry/Clinical Biochemistry program failing which he/she will be deemed to be unfit for the programme, and however if the candidate has taken admission in any other course during intervening period , he/she shall not be eligible for admission in next semester.

13. A candidate, who having passed the second semester examination discontinues his studies, for legitimate and justified reasons may be permitted to join third semester within two years of his passing the second semester examination, however he or she has to file an affidavit that he/she has not taken admission in any other course.

14. (i) The Internal Assessment awards of a candidate who fails in any semester examination shall be carried forward to the next examination.

(ii) A candidate who has not obtained pass marks in the Internal Assessment for any paper(s) will not be allowed to take examination in the said paper(s) in the relevant semester unless he repeats the course in paper(s) concerned and obtains the minimum pass marks in the Internal Assessment.

15. (i) The topic of the dissertation report and the faculty under which a student will have to complete the **dissertation/project work shall be decided by completely random lottery draw system**. This draw should be held within the first month of the third semester itself.

(ii) The candidate shall be required to submit two copies of his/her dissertation report. The last date for receipt of dissertation report in the office of the Controller of Examinations shall be 15th April. Provided that in exceptional cases, the Vice Chancellor may, on the recommendation of the Head of department of Biochemistry, extend the last date of receipt of the Dissertation report with late fee, as prescribed by the University from time to time.

(iii) The written part of Dissertation/project report shall account for 70% of marks and the viva-voce to be conducted by a duly constituted Board of Examiners for the remaining 30% of marks, as specified in the Scheme of Examinations.

Dissertation /project Report written part evaluation criteria

Performance Evaluation Parameter	Score

Writing Quality	15%
Novelity/Scientific Significance of Aim	15%
Project Design	15%
Publication Potential	15%
Aim-Results Concurrence	10%

(iv) The Viva-voce of the Dissertation/project report shall be conducted by the following board of examiners:

a) HOD of the concerned department or internal faculty member as its nominee

b) One external examiner (to be appointed by the Vice-Chancellor out of the panel approved by the PGBOS)

(vi) The marks obtained by the candidate for the dissertation report shall be taken into account when he appears in any future examination under re-appear clause.

16. (a) The viva-voce, wherever specified in the scheme of examinations shall be conducted by a Board of Examiners to be appointed by the Vice-Chancellor on the recommendation of the PG Board of Studies in the department consisting of the three members; -

(I) HOD of the concerned department or internal faculty member as his/her nominee.

(II) An External Examiner from the Academic field.

(b) The marks obtained by the candidate for the viva-voce shall be taken into account when he appears in any future examination under re-appear clause.

17. The practical examination(s) of the courses specified in the scheme of examination shall be conducted by the following Board of Examiners, consisting of two members, to be appointed by the Vice-Chancellor on the recommendation of the PG Board of Studies of the department..

(i) One internal faculty member (to be appointed by the HOD and

(ii) One External Examiner

18. As soon as possible, after the termination of the examination the Controller of Examination shall publish a list of candidates who have passed the Semester Examination.

19. Each successful candidate shall receive a copy of the detailed marks card on having passed the Semester Examination.

20. The list of successful candidates after the fourth semester examination shall be arranged as under in two divisions on the basis of the aggregate marks obtained in the first, second, third and fourth semester examinations taken together, and the division obtained by the candidate will be stated in his degree.

DIVISION:

a) Those who obtain 50% marks but less than 60% marks-**SECOND DIVISION**;

b) Those who obtain 60% marks or more marks-**FIRST DIVISION**;

c) Those that obtain a score between 75% and 85% in the aggregate shall be declared to have passed with **DISTINCTION**

d) Those that obtain a score above 85% in the aggregate shall be declared to have passed with **OUTSTANDING PERFORMANCE**

21. There will be no improvement facilities available to M.Sc. students. However, grace marks will be allowed as per University rules.

22. The students enrolled in the department will have the option to select any open elective/program elective paper either in same or in any other department of life science.

23. Not withstanding the integrated nature of this course which is spread over more than one academic year and the Ordinance in force at time a student joins the course shall hold good only for the examination held during or at the end of the academic year and nothing in this Ordinance shall be deemed to debar the University from amending the Ordinance and the amended Ordinance, if any shall apply to all the students whether old or new.

M. Sc. Previous Genetics, Semester – I

GENET 101 CONCEPTS OF GENETICS

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit -I

Model systems in Genetic Analysis: Bacteriophage, E. coli, Neurospora crassa, yeast, Arabidopsis, maize, Drosophila, C. elegans, Zebra fish, Homo sapiens - General outline of life cycle, importance in Genetic analysis. Laws of inheritance: Mendel's Laws, concept of dominance, segregation, independent assortment; Chromosome theory of inheritance.

Unit -II

Allelic and non-allelic interactions: Concept of alleles, types of dominance, lethal alleles, multiple alleles, test of allelism, Gene interaction: complementation, Epistasis, pleiotropy.

Unit III

Linkage: Concepts, recombination, gene mapping in prokaryotes and eukaryotes, fine structure mapping. Sex-linked inheritance: Conceptual basis, sex influenced traits, mechanism of sex determination. Quantitative inheritance: Concept, Genes and Environment: heritability, Penetrance and expressivity.

Unit IV

Cytoplasmic inheritance: Basis and mechanism, role of organellar genes. Mutation: Classification, mechanism, repair, role in genetic analysis and evolution. Changes in Chromosome number and structure: Polyploidy, aneuploidy, chromosomal rearrangements: deletion, duplication, inversion, and translocation. Meiotic consequences in structural heterozygote, role in speciation and evolution.

Suggested readings:

1. Concepts of Genetics (1999) - Klug W. S. and Cummings, M. R Prentice-Hall
2. Genetics (2008) -A Conceptual Approach, Pierce B. A., Freeman
3. Genetics- Analysis of Genes and Genomes (1998) - Hartle D. L. and Jones E. W, Jones & Bartlett
4. An Introduction to Genetic Analysis (2004) - Griffith A. F. et al, Freeman
5. Principles of Genetics (1997) -Snustad D. P. and Simmons M. J, John Wiley & Sons.
6. Genetics (2005) - Strickberger M. W., Prentice-Hall

M. Sc. Previous Genetics, Semester – I

GENET 102 CHROMOSOMES, GENES AND GENOMICS

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

UNIT-I

Chromatin structure: Histones, DNA, nucleosome morphology and higher level organization; Functional states of chromatin and alterations in chromatin organization. Chromosome organization: Metaphase chromosomes: centromere and kinetochore, telomere and its maintenance; Holocentric chromosomes; Heterochromatin and euchromatin, position effect variegation; Chromosomal domains (matrix, loop domains) and their functional significance.

Unit-II

Giant chromosomes: Polytene and lampbrush chromosomes. Cytogenetic aspects of cell division: Chromosome labeling and cell cycle analysis, Overview of mitosis and meiosis, sister chromatid cohesion remodeling, regulation of exit from metaphase, chromosome movement at anaphase. Genetic control of meiosis with examples from yeast. Chromosomal anomalies: Numerical and structural alterations induced chromosomal aberrations in somatic cells.

Unit-III

Techniques in the study of chromosomes and their applications: Short term (lymphocyte) and long term (fibroblast) cultures, Chromosome preparations, karyotyping, banding, chromosome labeling, *in situ* hybridization, chromosome painting, Comparative genome hybridization (CGH), somatic cell hybrids and gene mapping, premature chromosome condensation. Genome organization in viruses, prokaryotes and eukaryotes: Organization of nuclear and organellar genomes; C-value paradox, Repetitive DNA-satellite DNAs and interspersed repeated DNAs, Transposable elements, LINES, SINES, Alu family and their application in genome mapping.

Unit -IV

Concept of gene: Conventional and modern views. Fine structure of gene, split genes, pseudogenes, non-coding genes, overlapping genes and multi-gene families. Genome mapping: Physical maps -an overview and approaches.

Suggested readings:

1. Essential Cell Biology (2009) 3rd. ed. - Alberts B. et al. Garland
2. Molecular Biology of the Cell (1994) - Alberts B et al., Garland
3. The Eukaryotic Chromosome -TB stock C. J. & Summer A. T.T, Elsevier
4 The Chromosome (1993) - Hamsew and Flavell, Bios
5. Advanced Genetic Analysis (2003) - Hawley & Walker, Blackwell
6. Structure & Function of Eukaryotic Chromosomes (1987) - Hennig , Springer
7. Genes IX (2009) - Lewin B., Pearson
8. Molecular Cell Biology (2000) 4th ed. - Lodish, H. et al., Freeman
9. Cell and Molecular Biology (1995) - De Robertis & De Robertis Lippincott & Wilkins

Genome.Brown T. A. ,Garland

M. Sc. Previous Genetics, Semester – I

GENET 103 CELL AND MOLECULAR BIOLOGY

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit-I

Origin of life: Origin of biomolecules, primitive life forms, RNA world, biological evolution, Tree of life: rRNA as a chronological marker, Woese's concept of molecular taxonomy.

Unit-II

Cellular organization: An overview, endosymbiotic origin of mitochondria and chloroplast. Bimolecular: Chemical bonds, building blocks: carbohydrates, lipids, fats, proteins, nucleic acids.

Unit-III

Informational molecules: DNA as genetic material, DNA structure and replication, RNA as genetic material, types of RNA, role of RNA in information transfer, concept of central dogma, Genetic code, codon usage, protein structure: primary, secondary and tertiary, processing, and transport; versatility of the proteins in biological processes.

Unit-IV

Enzymes: As biocatalysts, specificity and kinetics, assay and inhibition of enzyme activity, mechanism of action, regulation of enzyme activity, Allosteric enzymes. Cellular energetics: Energy rich compounds, ATP synthesis, thermodynamics of cellular reactions, metabolic networks-an overview. Cell cycle and its regulation. Cell signaling.

Suggested readings:

1. Principles of Biochemistry (2005) - Lehninger et al., Freeman

2. Biochemistry (2002) - Devlin, T.M., Wiley-Liss

3. Biochemical Calculation (1976) 2nd ed. - Sehgal I. H., Wiley

4 Fundamentals of Enzymology (2002) - T Price N. C. and Lewis S.T, Oxford University Press

5. Biochemistry (2002) - T Berg, J. M. Tymoczko, J. L and Strider L.T W. H., Freeman

6. Molecular Biology of the Gene (2004) - Watson, J. et al. Benjamin Cummings

7. Molecular Cell Biology (2000) 4th ed. - Lodish, H. et al. W. H., Freeman

8. The World of the Cell (2010)-, Becker, W.M. et al. Benjamin Cummings

M. Sc. Previous Genetics, Semester – I

GENET 104 METHODS IN GENETICS

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit-I

Principles and techniques of nucleic acid hybridization and cot curves; sequencing of nucleic acids; Southern, Northern and South -Western blotting techniques; Polymerase
Chain reaction, Methods for measuring nucleic acid and protein interaction.

Unit - II

Biophysical methods**:** Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy, structure determination using X-ray diffraction and NMR; analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.

Unit - III

Principle & application of gel filtration, ion exchange & affinity chromatography; thin layer chromatography ; gas chromatography; High pressure liquid chromatography (HPLC), Electrophoresis (starch, agarose, page); Electrofocussing, Ultracentrifugation (Velocity and buoyant density).

Unit – IV

Radio labeling techniques: Properties of different types of radioisotopes normally used in biology, their detection and measurement; incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines, Computational methods: Nucleic acid and protein sequence databases; data mining methods for sequence analysis, web-based tools for sequence searches, motif analysis and presentation.

Suggested readings:

1. Molecular cloning A Laboratory Manual 3rd edition Vol. 1, 2, 3- Sambrook and Russell, Churchill press, 2007
2. Principals and Techniques of Biochemistry and Molecular Biology (2010)- Edited by Keith Wilson and John Walker, Sixth Edition, Cambridge University Press.

M. Sc. Previous Genetics, Semester – I

GENET 105 (OE) BIOSTATISTICS & COMPUTERS

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit-I

Introduction of computer: Characteristics, classification of computer; block diagram of computer and overview of working, Number system: Non-positional vs. positional number, binary, octal, decimal, hexa-decimal conversion of number system.

Unit-II

Hardware and software: Input, output, and secondary storage devices, central processing unit; types of software; meaning, functions and types of operating system; computer languages, Understanding computer networks: Types; topologies for LANS, transmission media; analog and digital signals; network security.

Unit-III

Working with software packages: An introduction to PC-software packages; word processor-working with text, tables, checking spelling and grammar, printing a document; spreadsheet software-working with worksheet, formulas and functions, inserting charts; PowerPoint presentation-working with different views and designing presentation; window XP-working with files and folders, windows explorer.

Unit-IV

Methods of data collection, sampling and sampling methods, measurement of central tendency, mean, median, mode, standard deviation, standard error, variance. Correlation & regression analysis, analysis of variance (ANOVA), tests of significance, t-test, z-test.

Suggested readings:

- Elements of Biostatistics in Health Science (2005) 8th ed. - W. Daniell.

- Statistical Methods for Research- S. Singh et al (1988), Central Publishing Ludhiana.
- Fundamental of Statistics – D. N. Enhance.
- Statistical Methods (1996) - S.P. Gupta. S. ,Chand Publication
- Fundamentals of Biostatistics- Khan and Khanna, Ukaz Publication

M. Sc. Previous Genetics, Semester – I

GENET 106 LAB COURSE 1

M. Marks: 100

Time-6 hours

M. Sc. Previous Genetics, Semester – II

GENET 201 GENETICS OF BACTERIA AND VIRUSES

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit-I

Bacteria as model systems in genetic analysis: Mutation, recombination, test of allelism, gene mapping. Methods of gene transfer in bacteria, Conjugation: Discovery, nature of donor strains and compatibility, interrupted mating and temporal mapping, Hfr, F', map of F plasmid, mechanism of chromosome transfer, molecular pathway of recombination. Chromosome transfer in other bacteria.

Unit-II

Transformation: Natural transformation systems, Biology and mechanism of transformation, transformation and gene mapping, Chemical-mediated and electro transformation, Transduction: Discovery generalized and specialized or restricted transduction, Phage P1 and P22-mediated transduction, mechanism of generalized transduction, abortive transduction. Temperate phage lambda and mechanism of specialized transduction, gene mapping, fine structure mapping.

Unit-III

Techniques for studying bacteriophages**:** Virulent phage (TB4B) and Temperate phage (phage lambda). Important aspects of lytic cycle, phage-host relationships, immunity and repression. Site specific recombination (lambda and P1).

Unit-IV

Transposable phage (phage Mu): Genetic organization, and transposition, Mu as a genetic tool, Plasmids: Types, detection, replication, incompatibility, partitioning, copy-number control and

transfer. Properties of some known plasmids. Genetic rearrangements and their evolutionary significance: Phase variation in *Salmonella*.

Suggested readings:

1. Microbial Genetics (1994) - Maloy S., Cronan J., Freifelder D, Jones and Bertlett
2. Fundamental Bacterial Genetics (2004) - Trun N and Trempy J, Blackwell Publ.
3. Modern Microbial Genetics (2002)-Streips U. N. and Yasbin R.E., Wiley-Liss
4 Molecular Genetics of Bacteria (2003) -Sneider L. and Champness W. ASM Publishers
5. Genetics of Bacteria -Scaife J., Academic Press
6. Genetics of Bacteria and Viruses (2006)- Birge E. A., Springer
7. Molecular Genetics of Bacteria -Dale J.W. and Park S, Wiley

M. Sc. Previous Genetics, Semester – II

GENET 202 HUMAN GENETICS

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

UNIT-I

Introduction to Human Genetics: Early perception, development and documentation; Study tools in Human Genetics: pedigree- gathering family history symbols, construction of pedigree, pedigree analysis in monogenetic traits; Autosomal dominant and recessive inheritance; sex linked dominant and recessive inheritance; consanguinity and its effects; Sex linked anomalies: Haemophilia, Colour blindness; Sex linked and sex influenced traits, sex determination in Man, TDF & SRY, testicular feminization syndrome; Single active X hypothesis, Sex chromatin and drum sticks, Genetic mosaics.

UNIT-II

Human Karyotypes: Banding, Nomenclature of banding, Nomenclature of aberrant karyotypes; Human genome mapping methods: Physical mapping. Introduction to physical map markers-Chromosomal, G/Q banding, radiation hybrid; Fluorescence in situ hybridization; Comparative genome hybridization, long range restriction mapping; High resolution mapping-STS/EST/MS/SNP/sequencing; Genetic mapping: Linkage analysis (RFLP/MS/SNP).

UNIT III

Human Health and Disease: Chromosomal disorders: Structural and Numerical; Mechanisms-mitotic/meiotic non-disjunction/ chromosomal rearrangements; Some examples (Klinefilter, Down's, Turner, Achondroplasia); Single gene and diseases: Beadle and tatum experiment, Inborn errors of metabolism (PKU, Alkaptonuria, Albinism, Galactosemia); Haemoglobinopathies: ABO blood group system, Rh blood group, Thalassemia syndromes; Multifactorial disorders: Diabetes, Schizophrenia, Huntington disease.

UNIT IV

Ethical, legal and social issues in Human genetics: Human genome project: History and concepts, gateways, goals, role of sequencing, distribution of GC content, CPG islands, main conclusions, current activities; Prenatal/adult (individual/family/population) screening of mutation/risk factor for genetic diseases, Confidentiality/privacy, Discrimination, Ethical dilemma, Human rights, Surrogate mothers; Human cloning and eugenics.

Suggested readings:

1. Human Genetics: Problems and Approaches (1997) - T Vogel F. and. Motulsky A. GT, Springer Verlag
2. Human Molecular Genetics (2003) 3rd ed. - Strachan T & Read A, Garland Science
3. An Introduction to Human Molecular Genetics (1999) - Mechanism of Inherited Diseases Pasternak J Fitzgerald, Science Press

4 Chromosome Structural analysis (1999) - A Practical Approach (Ed.) W.A. Bickmore, Oxford University Press

5. The AGT Cytogenetics Lab Manual (1997) 3rd ed. -, Barch, Knutsen and Spurbeck, Lippincott Raven publ
6. Human Cytogenetics-Constitutional analysis (1995) (Ed) D.E. Rooney, Oxford University Press.
7. Recombinant DNA (1992) - J.D. Watson Gillman, Scientific American books, W.H, freeman company N.Y.
8. Human Genetics (1993) - The molecular revolution McConkey, Edwin H, Jones & Bartlett publishers.

M. Sc. Previous Genetics, Semester – II

GENET 203 BIOSTATISTICS AND POPULATION GENETICS

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit-1

Principles and applications of statistical methods in biological research: Basic statistics: Samples and populations, experimental design, Data analysis, Graphs, Average. Coefficient distributions (chi-square, Binomial, Poisson and Normal), Tests of statistical significance – t-test, z-test, F-test, U-test and others. Regression and correlation, Analysis of variance.

Unit-II

General background: Variation at the genetic level: DNA markers -VNTR, STR, microsatellite, SNP and their detection techniques - RFLP, genotyping, RAPD, AFLP etc. Organization and measure of genetic variation: Random mating population, Hardy-Weinberg principle, complications of dominance, special cases of random mating – multiple alleles, different frequencies between sexes (autosomal and X-linked).

Unit- III

Linkage and linkage disequilibrium. Sources responsible for changes in gene frequencies: Mutation, selection, migration and isolation; random genetic drift; insights into human migration, natural selection and evolution.

Unit-IV

Population substructure: Hierarchical population, isolate breaking, Inbreeding, Assortative mating. Quantitative Genetics: Johannsen pure-line theory, multiple factor hypothesis, types of quantitative traits, components of phenotypic variation and genetic models for quantitative traits, concept of heritability, artificial selection and realized heritability.

Suggested readings:

1. DNA markers Protocols, applications and overviews (1997)-Anolles G. C. & Gresshoff P. M.,Wiley-Liss
2. Molecular markers in Plant Genetics and Biotechnology (2003) - Vienne De. D., Science Publishers
3. Genetics of Population (2000)- Hedrick P.W., Jones & Bartlett
4. Principles of Population Genetics (1989)-Hartl D. L. and Clark A.G. ,Sinauer Associates
5. Biostatistics (2006) -Danial, W. W, Wiley
6. Statistical methods in Biology (1995) - Bailey, N.T.J, Cambridge Univ. Press

M.Sc. Previous Genetics, Semester – II

GENET 204 RECOMBINANT DNA TECHNOLOGY

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of five questions. Question No. 1 will be compulsory and shall contain four to six short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining four questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit-I

Principles of Genetic Engineering: Historical account, Components of gene cloning - Nucleic acids, DNA modifying enzymes, Cloning vectors and Cloning hosts, Gene transfer and cloning methods, Gene Screening and isolation - Strategies, DNA libraries, Probe Selection and gene screening.

UNIT II

PCR and DNA sequencing: PCR – Principle, Methodology, Types - RT-PCR, RAPD, AFLP, ISSR, inverse PCR and Real time PCR and their applications, DNA sequencing methods - Maxam and Gilbert's method, Sanger's method, Automated DNA sequencing method, Capillary gel electrophoresis for DNA sequencing.

UNIT III

Molecular markers: Type of molecular markers; Application of molecular markers in discerning polymorphism, germplasm characterisation, DNA finger printing, Gene tagging; Disease diagnostics; Marker aided selection in crop improvement. DNA Engineering techniques: Gel electrophoresis of nucleic acids, Methods of labeling of DNA, Blotting of macromolecules and hybridization, Oligonucleotide synthesis, Promoter characterization, DNA fingerprinting, Microarray technology, *In vitro* translation.

UNIT IV

Application r-DNA technology: (Production of recombinant protein, Vaccine and pharmaceutical compounds; application in agriculture, Fluorescence in situ hybridization

(FISH), Proteomics: Tools techniques, study of protein- protein interaction, protein analysis for gene identification, post translation modification.

Suggested readings:

1. Gene Cloning and DNA Analysis,-An Introduction (2001) Brown T. A., Blackwell Publishing.
2. Gene Cloning and Manipulation- Howe C., Cambridge University Press.
3. Principles of Gene Manipulation and Genomics (2001) - Primrose S. B. & Twyman R. M, Blackwell Publishing.
4. Molecular Cloning (2001) - A Laboratory Manual (3-Volume Set) Sambrook J. et al., CSHL Press
5. Calculations for Molecular Biology and Biotechnology (2003) -Stephenson F. H., Academic Press

M. Sc. Previous Genetics, Semester – II

GENET 205 (I) (PROGRAMME ELECTIVE)

MEDICAL GENOMICS

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of five questions. Question No. 1 will be compulsory and shall contain four to six short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining four questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit-I

Diagnostic genetics: Cytogenetics/ Molecular Cytogenetics /Biochemical/Molecular methods; Screening for mutation/ chromosomal anomaly - Adult/Prenatal/Newborn screening; Preimplantation screening (Assisted reproductive technology- *in vitro* fertilization and Embryo transfer); Organ banking, transplantation, Forensic testing - DNA fingerprinting, paternity testing, individual identification.

Unit-II

Treatment of genetic disorders: Methods of therapy - Drug (recombinant proteins); Diet; Gene therapy (Criteria & technical aspects), (Viral vectors, delivery methods and microinjection, germline therapy), some examples (Thalassemia, Phenylketonuria, Cystic fibrosis, DMD etc).

Unit -III

Pharmacogenetics: History, Early evidence; Clinical determinants; Molecular insights (genes involved in pharmacokinetics and pharmacodynamics of drugs); Applications in pre-prescription testing.

Unit-IV

Genetic counseling: Prenatal/adult diagnosis of genetic disorders; Medical ethics; Risks and benefits; Informed consent; Right of choice; Dilemmas faced by counselors, Case studies.

Suggested readings:

1. Human Molecular Genetics (2010) 4th ed. - Strachan T. & Read A., Garland Science

2. An introduction to Human Molecular Genetics (1999) - Mechanism of Inherited Diseases Pasternak J. Fitzgerald, Science Press
3. Thompson and Thompson Genetics in Medicine (2007) 7th ed. Robert et al. ,Saunders
4 Landmarks in Medical Genetics – (2002) Ed. Harper P. S., Oxford University Press
5. Chromosome Banding (1990) - Sumner A.T. Unwin, Hyman
6. Human Genetics: Problems and Approaches (1997) - Vogel F. and Motulsky A. G., Springer Verlag.

M. Sc. Previous Genetics, Semester – II

GENET 205 (II) (PROGRAMME ELECTIVE)

PLANT GENETIC ENGINEERING

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit-I

Plant tissue culture and somatic cell genetics: Historical Perspective; Artificial nutritive media; Role of growth-hormones in differentiation of *in vitro* plants; Plant regeneration pathways-plant regeneration, somatic embryogenesis and organogenesis; Organ culture- Shoot, Root, Embryo; Isolation and maintenance of callus and suspension culture; Hardening of tissue culture raised plants.

Unit-II

Use of *in vitro* culture technology: Micro-propagation for multiplicaion; Embryo rescue for production of hybrids; Production of haploid through anther or pollen culture; Culture and manipulation of protoplast- Somatic Hybrids, Organelle transfer and cybrids; *In vitro* screening and selection of desirable cell lines; Creation of soma-clonal variation and selection of desirable genotypes in genetic improvement; *In vitro* mutagenesis; Callus and cell culture for production secondary metabolites; Production of synthetic seed; Germplasm conservation.

Unit-III

Genetic Transformation: Plant transformation vectors- T-DNA, viral vectors, transposon elements; Genetic transformation methods: Agro-bacterium system; Direct DNA transfer by ballistic gun method, electro-proration, microinjection; Alternate in-planta methods, floral dip, silicon carbide, pollen tube pathway etc.; Marker-free and novel selection strategies; Gene silencing; RNA interference (RNAi) system; Gene knockdown.

Unit-IV

Application of technology and bio-safety: Targeted transfer of genes conferring resistance to biotic and abiotic stresses, nutritional quality, and other desirable traits, like male sterility, flowering, fruiting, ripening etc. (case study); Concerns about bio-safety of genetically modified organism (GMO) (Allergen, toxicity, impact on biodiversity etc.); Indian regulatory system for testing of GMOs in laboratory, field trials and commercial release of transgenic; Bio-confinement strategies for cultivated crops; bio-safety and ethics in generating GMOs; potential benefits of GMOs.

Suggested readings:

1. Plant Tissue Culture- Theory and Practice (1996) Bhojwani S. S. & Razdan M. K., Elsevier
2. Plant Biotechnology-The Genetic Manipulation of Plants (2003) Slater A. Scott N. & Fowler M., Oxford University Press Inc.
3. Plants, Genes and Crop Biotechnology (2003) - Chrispeels M. J. & Sadava D. E., Jones and Barlett Publishers

4 Principles of Gene Manipulation and Genomics (2001) -Primrose S. B. &Twyman R. M, Blackwell Publishing.

5. Plant Cell, Tissue and Organ Culture- Fundamental Methods (1995) (Eds). Gamborg O. L & Phillips G. C. Springer-Verlag.
6. Plant Biotechnology (2006) - B. D. Singh, Kalyani Publishers.
7. Plant Cell Culture- A practical approach - (1985) Dixon RA (ed.) IRL Press, Oxford, Washington, DC

M. Sc. Previous Genetics, Semester – II

GENET 206 LAB COURSE 1I

M. Marks: 100

Time-6 hours

M. Sc. Final Genetics, Semester – III

GENET 301 DEVELOPMENTAL GENETICS

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit-I

Basic concepts of development: Potency, commitment, specification, induction, competence, Determination and differentiation, Morphogenetic gradients, pattern formation, cell fate and cell lineages; mosaic versus regulative development .

Unit-II

Fertilization, Types of cleavage, Gastrulation; Cell movement and formation of germ layers in frog. Chick and mouse, Morhogenesis and organogenesis in animals, formation of vulva in *C. elegans*, induction of development of compound eye in *Drosophila*, limb development and regeneration in vertebrates.

Unit – III

Drosophila: Maternal genes and formation of body axes, Segmentation genes, and Homeotic genes function, Imaginal disc development, Genetic determination of sex in *Caenorhabditis*, *Drosophila* and mammals. Regeneration, Senescence.

Unit - IV

Embryonic stem cells and their applications. Clinical embryology: Brief account of hormonal control of reproduction, Differentiation of germ. Cells and gametogenesis, Fertilization and implen1entation Gonadal malformation and their genetic basis Reproductive failure and' infertility, Assisted reproduction.

Suggested readings:

1. Developmental Biology (2003) - Gilbert S. F, Sinauer Asso.
2. Principles of Development (2002) - Wolpert L et al., Oxford University Press
3. The Art of the Genes (1999) - How Organisms Make Themselves Coen E. Oxford University Press
4 Genetic Analysis of Animal Development (1993) 2nd ed. - Wilkins A. S., Wiley-Liss
5. Biological Physics of the Developing Embryo (2005) - Forgacs G. & Newman S. A., Cambridge University Press..

M. Sc. Final Genetics, Semester – III

GENET 302 CONSERVATION BIOLOGY

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of five questions. Question No. 1 will be compulsory and shall contain four to six short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining four questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit 1

Biodiversity: Structure and function of ecosystems; Major terrestrial biomes; Biogeographical zones- Global and Indian; Ecosystem diversity- Global and Indian; Terrestrial and aquatic biodiversity; Mega-centres of biodiversity; Biodiversity hot spots- Global and Indian; Measurement of biodiversity- species diversity; Concept of centre of origin and crop diversity; Agro-biodiversity- Definition, Global and Indian.

Unit II

Value and erosion of biodiversity: Biodiversity use: Direct- for food, fuel, health, Indirect- aesthetic, ethical, environmental services; Assessing the value of biodiversity; Factors driving the biodiversity- Environmental pollution, Global climatic change; Invasive species eroding species diversity; Factors affecting genetic erosion (crop species); Estimation of genetic diversity, population biology, concept of minimum viable population, population viability and population genetics to facilitate conservation; Assessing the loss of biodiversity- Floristic surveys and inventory; IUCN guidelines for estimating the levels of threat.

Unit III

Conservation biology: Strategies for conservation of biodiversity; *In situ* conservation- Ecosystem approach, Habitat approach, Gene management zones; *In situ*-on farm conservation; *Ex situ* conservation- Whole plant conservation/maintenance, conservation through storage of orthodox seeds at low temperatures; Conservation using *in vitro* culture methods; Conservation using cryobiology; Conservation using storage of DNA molecule;

International organisation supporting conservation; Indian organisation supporting conservation; International treaties/agreements for conservation; Indian laws for conservation.

Unit –IV

Issues and legislation related with biodiversity and access to biodiversity: International conventions and agreements on biodiversity- CBD, FAO Commission, IPCC; International agreements and national legislation regulating access to biodiversity- CBD, TRIPS, NBA; International agreements and national legislation regulating access to genetic resources- GCDT, ITPGRFA, PPV & FR; *In situ* conservation and intellectual property rights (IPR); IPR and Farmers' Rights; Agencies enforcing IPR in biodiversity, UPOV, ITPGRFA, NBA, PPV & FRA

References:

1) Krishnamurthy K. V. (2007). An Advanced Textbook on Biodiversity: Principles and Practice. Oxford & IHB Publishing Co. Pvt. Ltd. New Delhi.
2) Christian Leveque and Jean-Claude Mounolou (2003). Biodiversity. John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England.
3) Jeffries Michael J. (2006). Biodiversity and conservation, 2nd ed. Taylor and Francis Group, New York.
4) Arora RK 1991. Plant Diversity in the Indian Gene Centre. In: R.S. Paroda and R.K. Arora (eds) Plant Genetic Resources, Conservation and Management. Concept and Approaches, pp. 25-44, IBPGR, Regional Office for South and Southeast Asia, New Delhi.
5) Biodiversity Hot Spots (2005) 1919 M STREET, NW, SUITE 600, WASHINGTON, DC 20036 (202)912-1000 FAX (202)912- 1030 UPDATED 2/05 www.conservation.org.
6) Harlen, J.R. 1971. Agricultural origin: centres and non-centres. Science 174: 468-474.
7) Gadgil M and Meher-Homji VM. 1990. "Ecological diversity" In: Conservation in Developing Countries: Problems and Prospects. (eds. J.C. Daniel and J.S. Serrao), Bombay Natural History Society. Oxford University Press, Delhi. Pp.175-198.
8) Koshoo TN 1995. "Census of India's Biodiversity: task ahead. Curr. Sci. 69:14-17.

9) Ministry of Environment and Forest (1998). Implementation of article 6 of the Convention on Biological Diversity in India, National Report (interim).
10) Wilson, E.O. 1988. “The Current State of Biological Diversity”. In Biodiversity, (ed. E.O. Wilson) Washington DC: National Academy Press, p15.
11) Verma DD, Arora S and Rai RK (eds) 2006. Megadiverse Countries: Perspectives on Biodiversity- Vision for Megadiverse Countries, Ministry of Environment and Forests Government of India.

M. Sc. Final Genetics, Semester – III

GENET 303 GENE EXPRESSION AND REGULATION

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit -1

Gene expression: Basic processes: Gene as a unit of function. Transcription (prokaryotic and eukaryotic) – RNA polymerase, DNA sequences, transcription factors, process of initiation, elongation and termination.

Unit- II

Post transcriptional modifications – capping, poly-adenylation, splicing (*cis*- and *trans*-), Editing, Translation – genetic code, ribosome structure, the process of translation.

Unit-III

Gene regulation: Introduction, levels of regulation, evidences and experimental designs/methodologies, role of genetic analysis in understanding gene function and regulation. Lessons from bacteria: regulation at lac (including reading of Jacob and Monod's seminal paper), trp and ara operons; control of lysis and lysogeny in λ phage .Yeast: Gene regulation in a single celled eukaryote using a model case of GAL gene.

Unit-IV

Regulation in higher eukaryotes: a. perceiving signals. Transcriptional control – Changes in chromatin structure, epigenetic controls. Transcriptional control - DNA sequence elements and transcription factors. Post-transcriptional regulation – Alternative RNA splicing, RNA editing, RNA transport and localization, RNA stability, Regulation of translation – RNA structure, control at initiation, codon usage, Post-translational modifications. RNA-mediated control of gene regulation.

Suggested readings:

1. Genes and Signals (2002) - Mark Ptashne and Alexander Gann, CSHL Press

2. A Genetic Switch (2004) - Mark Ptashne, CSHL Press

3. Gene Regulation (1995) -David S Latchman, Chapman & Hall

4 Genes VII (2003) - Benjamin Lewin, Prentice Hall

5. Molecular Cell Biology (2000) -,Lodish, H. et al. W. H. Freeman

M. Sc. Final Genetics, Semester – III

GENET 304 IMMUNOGENETICS

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of five questions. Question No. 1 will be compulsory and shall contain four to six short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining four questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

UNIT-I

Molecular Immunology: Basic Principles and Overview of immunity: General properties of immune system, Innate and adaptive immunity; Immunological memory; Cells and organs of immune system; Hematopoiesis, Antigens (Haptens, epitopes, adjuvants) and antibodies; Immunoglobulin classes ,Cytokines, interferon, colony stimulating factor, transforming growth factor, Complement pathways

UNIT-II

Immune response: MHC complex, Class I, II, III molecules; Genetic map of H-2 complex & HLA Complex, T cell receptor complex, Subtractive hybridization; Ig gene super family;Humoral & cell mediated immune response (antigen recognition, processing and presentation),Hypersensitivity reactions (I, II, III & IV types).

UNIT-III

Immunogenetics: Organization of immuno globulin genes, Genetic control of light chains ((Lambda & Kappa), Genetic control of heavy chains; Genomic rearrangement during B lymphocyte differentiation, Somatic recombination events, Antibody class switching, allelic exclusion, Somatic mutation; Genetic control of antibody diversity.

UNIT-IV

Immunity in health and disease: Disorders of immune system: Self tolerance & auto immunity; Thyroiditis, IDDM, SLE, Rheumatoid arthritis; Immuno suppression, Severe combined immuno deficiency (SCID), AIDS; Transplant rejection; alloantigen, vaccines Primary antigen,

antibody reaction: Radio immunoassay, Enzyme linked immunosorbant assay; Secondary antigen antibody reaction, precipitation, agglutination & Immuno electrophoresis.

Suggested readings:

1. Immunology (2000) - Kuby J. W. H., Freeman
2. Essentials of Immunology (2001) - Ivan M. Roitt, Wiley-Blackwell
3. Fundamentals of Immunology (2008) -William E. Paul Lippincott, Williams & Wilkins.`
4. Immunology Understanding Immune system (1996) –Elgert K D, John Wiley and sons.

M. Sc. Final Genetics, Semester – III

GENET 305(III) PROGRAMME ELECTIVE

MEDICINAL AND AROMATIC PLANTS IN HUMAN HEALTH CARE

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of five questions. Question No. 1 will be compulsory and shall contain four to six short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining four questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit I

History & philosophics of herbal medicine (Ayurveda, Unani), Importance and need of cultivation of medicinal and aromatic plants. Harvesting, drying, grading and storage of medicinal plants. Post harvest handling of aromatic plants. Different methods of essential oil extraction and their drying and storage.

Unit II

Active constituents and uses of important medicinal and aromatic plants: *Asparagus racemosus, Stevia rebaudiana, Aloevera, Withania somnifera, Solanum nigrumi Cassia angustifolia, Rosa damacena, Tagetes minuta, Salvadora species,Cassia tora,Cassia occidentalis,Boerhavia diffusa,Achyranthes aspera,Ncytanthus arborytis,Balanites aegyptiaca,Tridex procumbens* or any other species specific to the region.

Unit III

Active content dynamics vis-a-vis plant growth and post harvest processing for evaluation of chemical constituents. Use of thin layer chromatography during extraction and purification of phyto-phamaceuticals. Preparation of active constituent enriched extracts, Principles for assessment of biological activity of medicinal plants /essential compounds.

Unit IV

Separation and purification of phytopharmaceuticals through conventional and column chromatographic techniques. Extraction of essential oils and their evaluation for quality parameters. Preparation of concretes and absolutes from plants containing essentials oils. Organic cultivation of medicinal and aromatic herbs. Good agricultural practices (GAP) in medicinal plants. Precision farming, Principal of clinical test for assessment (application and dosage etc.).

Suggested Reading

1. Farooqi, A.A. and B.S. Sreeramu (2001). Cultivation of Medicinal and Aromatic Crops. Universities Press (India) Ltd. 3-5-819, Hyderguda, Hyderabad – 29.
2. Handa, S.S. and M.K. Kaul. (1987). Cultivation and Utilization of Medicinal Plants. RRL, Jammu.
3. Kumar, N., J.B. Md. Abdul Khadar, P. Rangaswamy and I. Irulappan. (1982).
4. Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi

M. Sc. Final Genetics, Semester – III

GENET 305(IV) PROGRAMME ELECTIVE

ADVANCED HUMAN MOLECULAR GENETICS

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of five questions. Question No. 1 will be compulsory and shall contain four to six short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining four questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit-I

Organization of genome in humans : General features of chromosomes, reiterated sequences and their detection, protein coding genes, Pseudogene; Gene mapping : Gene mapping by somatic cell hybridization, top down approach to molecular mapping, restriction maps and contig construction (the bottom up approach);Engineering chromosomes : Yeast artificial chromosome, making YACs, MACs (mammalian artificial chromosomes) and satellite DNA's artificial chromosomes (SAT ACS).

Unit –II

Multifactorial disorders: Familial forms- Linkage analysis, Candidate gene identification; Genetic polymorphism and disease susceptibility; Sporadic cases- Association studies- markers from candidate gene/pathways; whole genome association (Single nucleotide polymorphism, CNVs).

Unit-III

Functional genomics and animal models in human disease: An overview; cDNA/gene, cloning; site-directed mutagenesis; mammalian tissue culture; cell line transfections; functional assays; Use of model organisms, methods for generation of transgenic animals/ knock-in, knockout models (microinjection, ES cell transformation); E Numutagenesis; RNAi approach.

Unit-IV

Single gene disorders- conventional and contemporary methods: Pedigree analysis, Linkage mapping, Positional/structural and functional cloning; Bioinformatics analysis; Characterisation; Mutation detection, diagnosis and therapy (with examples from autosomal dominant, autosomal recessive, X-linked dominant, X-linked recessive and complex disease conditions).Study whole genome: PFGE, Automated DNA sequencing

Suggested readings:

1. Human Molecular Genetics (2011) 4thed - Strachan T. & Read A., Garland Science
2. An introduction to Human Molecular Genetics-Mechanism of Inherited Diseases (1999)- Pasternak J. Fitzgerald, Science Press
3. Genetics in Medicine 7th Ed (2007) - Thompson and Thompson, Saunders

4 Landmarks in Medical Genetics (2002) (Ed.) Harper P. S. Oxford University Press

5. Chromosome Banding (1990) -Sumner A.T., Unwin Hyman
6. Human Genetics: Problems and Approaches (1997)- Vogel F. and Motulsky A. G, Springer Verlag

M. Sc. Final Genetics, Semester – III

GENET 306 STUDENT SEMINAR

M. Marks: 100

Students will present a comprehensive seminar on topics of general interest. Topics will be selected under the guidance of the faculty members. They will also prepare a seminar report. The assessment will be based on presentation, content and the report

M. Sc. Final Genetics, Semester – III

GENET 307 LAB COURSE III

M. Marks: 100

Time-6 hours

M. Sc. Final Genetics, Semester – IV

GENET 401 INTELLECTUAL PROPERTY RIGHT AND BIOSAFETY

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of five questions. Question No. 1 will be compulsory and shall contain four to six short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining four questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit I

Introduction to Intellectual Property; Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of New GMOs; International framework for the protection of IP, IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies; Introduction to History of GATT, WTO, WIPO and TRIPS.

Unit II

Development of global and Indian IPR systems and requirement for filling applications: International framework for protection of IPR in R & D; Development of GATT, WTO, WIPO, TRIPS; WIPO treaties; Budapest treaty; Indian Patent Act 1970- Amendments; Filing of patent application, Precaution and preparation of application with disclosures and non-disclosures, fee structure, time frame; Patent Cooperation Treaty (PCT) and implications and role of country Patent Office; Procedure for filing a PCT application; International Patent requirements, procedure, cost, etc.; Status of patenting in US and Europe; Publication of patent-gazette of India; Case studies and examples.

Unit-III

Bio-safety against infectious agents/microorganism: A Historical perspective of bio-safety; Bio-safety levels for infectious agents and infected food/animals; Introduction of Biological safety Cabinets; Primary containment for biohazards; Recommended bio-safety levels; Bio-

safety levels for specific microorganisms; Bio-safety guidelines for safe food in Europe and USA, and India

Unit IV

Bio-safety issues related with GMOs: Historical perspective of bio-safety issues in GMOs; the risk of introducing genetically engineered organism to environment- ecological safety; Food safety; Socio-economic impact; Indian government bio-safety guidelines- Definitions; Role of (Review Committee on Genetic Manipulation (RCGM), Role of GEAC (Genetic Engineering Approval Committee), Role of (Institute Bio-safety Committee) IBSC in research and development of GMOs (transgenics) in food and agriculture; Guidelines for environmental release of GMOs; Risk assessment, risk management; Cartagena protocol for safe movement and exchange of transgenic material/GMOs; Restriction of Genetic Use Restriction Technology (GURT) using suitable probes/molecular markers.

Suggested Reading

1. Biological Diversity Act, 2002 and Biological Diversity Rules, National Biodiversity Authority, Chennai, 2004, pages 57.
2. Gautam PL and Singh AK 1998 Agrobiodiversity and Intellectual Property Rights (IPR) related issues. *Indian J. Pl. Genet. Resources* 11:129-153.
3. Khetarpal PL 2004. A critical appraisal of seed health certification and transboundary movements of seeds under WTO regime. *Indian Phytopathology* 57:408-427.
4. Protection of Plant Varieties and Farmers' Right Act, Ministry of Agriculture, Government of India, 2001, page 127
5. http://ipindia.nic.in/ipr/patent/patents.htm
6. http://ipindia.nic.in/tmr_new/default.htm
7. http://copyright.gov.in/
8. http://ipindia.nic.in/girindia/
9. http://ipindia.nic.in/ipr/design/designs.htm
10. http://mit.gov.in/default.aspx?id=322
11. http://www.plantauthority.gov.in/

12. Saxena Sanjeev and Anurudh K Singh 2006. Legislations for Protecting Plant Varieties and Quality Seed. In: Megadiverse Countries. In DD Verma, S Arora and RK Rai (eds) *Perspectives on Biodiversity- Vision for Megadiverse Countries*, Ministry of Environment and Forests Government of India. 64-78.

Important Links

http://www.w3.org/IPR/
http://www.wipo.int/portal/index.html.en
http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
www.patentoffice.nic.in
www.iprlawindia.org/ - 31k - Cached - Similar page
http://www.cbd.int/biosafety/background.shtml
http://www.cdc.gov/OD/ohs/symp5/jyrtext.htm

M. Sc. Final Genetics, Semester-IV

GENET 402 BIOINFORMATICS

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit-I

Introduction to computers and bioinformatics: Types of operating systems, concept of networking and remote login, basic fundamentals of working with unix. Biological databases: Overview, modes of database search, mode of data storage (Flat file format, db-tables), flat-file formats of Gene Bank, EMBL, DDBJ, PDB

Unit-II

Sequence alignment: Concept of local and global sequence alignment, Pair wise sequence alignment, scoring an alignment, substitution matrices, multiple sequence alignment. Phylogenetic analysis: Basic concept of phylogenetic analysis, rooted/unrooted trees, approaches for phylogenetic tree construction (UPGMA, Neighbor joining, Maximum parsimony, Maximum likelihood).

Unit-III

Generation and analysis of high through-put sequence data: Assembly pipeline for clustering of HTGS data, format of '.ace' file, quality assessment of genomic assemblies,

International norms for sequence data quality, Clustering of EST sequences, concept of Unigene.Annotation procedures for high through-put sequence data: Identification of various genomic elements (Protein coding genes, repeat elements, Strategies for annotation of whole genome, functional annotation of EST cluster, gene ontology (GO) consortium.

Unit-IV

Structure predictions for Nucleic acids and proteins: Approaches for prediction of RNA secondary and tertiary predictions, energy minimization and base covariance models, Basic approaches for protein structure predictions, comparative modeling, fold recognition/'threading' and *ab-initio* prediction.

Suggested readings:

1. Bioinformatics (2001) - A Practical Guide to the Analysis of Genes and Proteins Baxevanis, A. D. and Ouellette, Wiley and Sons.
2. Bioinformatics Sequence and Genome Analysis (2004) 2nd ed. - Mount, D.W, CSHL Press
3. Introduction to Bioinformatics (1995) -Tramontano, A, Chapman & Hall
4. Understanding Bioinformatics (2008) - Zvelebil, M. and Baum, J.O, Taylor and Francis.

M. Sc. Final Genetics, Semester-IV

GENET 403 (V) PROGRAMME ELECTIVE

RNAi BIOLOGY AND ITS APPLICATION

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of five questions. Question No. 1 will be compulsory and shall contain four to six short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining four questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit-I

Discovery of RNA interference (RNAi): PTGS, RNAi and related phenomena. Categories of small non-coding RNAs: dsRNAs, siRNAs, shRNAs, piRNAs and miRNAs, Detection of small RNAs, Mechanism of RNAi: Different components of RNAi pathway and their evolutionary conservation and role in gene silencing, RNAi-like pathway in bacteria,

Unit-II

Molecular basis of RNAi /siRNA /miRNA mediated gene silencing, RNAi in defense and the regulation of chromatin structure and gene expression, RNAi suppressors, Large-scale genetic analysis using RNAi: Genome-wide RNAi screens in *C. elegans*, and other systems, High-throughput small RNA profiling, RNAi microarrays, miRNAs and siRNAs: Pathways, expression and functions of microRNAs.

Unit-II

High-throughput analysis of miRNA gene expression; siRNA vectors, siRNA delivery *in vitro* and *in vivo*; RNA informatics - Computational tools for miRNA discovery, siRNA and miRNA design.

Unit-IV

Expression of dsRNA in animals and plants, and its applications: RNAi vectors and generation of transgenic animals and plants, Analysis of expression of dsRNA and gene silencing; use of

RNAi in the prevention of diseases in animal models and crop improvement; RNAi therapy; Future prospects of RNAi in biology, medicine and agriculture.

Suggested readings:

1. The RNA World – (2006) 3rd Eds. T Gesteland et al., CSHL Press
2. RNA Interference Technology- From Basic Science to Drug Development. Eds. Fire et. al. Cambridge University Press,
3. RNAi: A Guide to Gene Silencing (2003).-Ed. Gregory J. Hannon, CSHL Press

4 RNA Silencing: Methods and Protocols (2005) --Ed. Gordon G. Carmichael, CSHL Press

5. RNA Interference in Practice (2005) - Ed. Ute Schepers, Wiley-VCH GmbH & Co. KGaA.
6. Genes IX (2009) -Lewin B, Jones and Barlett Publishers.

M. Sc. Final Genetics, Semester-IV

GENET 403(VI) PROGRAMME ELECTIVE

DROSOPHILA GENETICS

M. Marks: 80

Time-3 hours

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit-I

Life cycle and advantages of *Drosophila* as a model organism for genetic analysis, *Drosophila* development: (a) Embryonic development, Maternal genes and formation of body axes, Segmentation genes, Homeotic genes and their functions, Larval stages and tissue types, Imaginal discs: development and differentiation, Pupa and metamorphosis, Adult morphology and internal organs, Spermatogenesis and oogenesis, Stem cells in *Drosophila*.

Unit-II

Polytene chromosome: Maps, puffing and utility, Basics of setting up *Drosophila* crosses Nomenclature of gene mutations, balancer chromosomes [3], Mutagenesis and isolation of new variants**:** X-ray and chemical mutagenesis, P-element and insertional mutagenesis.

Unit-III

Generation of Transgenic *Drosophila*: (a) Germ-line transformation and selection of vectors, (b) Application of P-element based vectors in transgenic generation, Advanced *Drosophila* genetics: (a) Mitotic recombination, (b) Generation and analysis of somatic clones, (c) Generation and analysis of germ-line clones, (d) Conditional and /or targeted expression/ablation of genes/transcripts (e.g. UAS/GAL4 system), (e) RNAi based screening of gene functions.

Unit-IV

Drosophila model for human genetic disorders (e.g. Parkinson's, Huntington's, Alzheimer's diseases etc.) Overview of *Drosophila* genome project: Online databases and other resources for *Drosophila* genetics

Suggested readings:

1. Developmental Biology (2003) -Gilbert S. F., Sinauer
2. Development of *Drosophila melanogaster (1991)* - (Vol I & II) Bates and Arias, CSHL Press
3. *Drosophila* Guide (1996) 10^{th} ed. - Demerec and Kaufmann, Carnegie
4. *D. melanogaster*- Practical Uses in Cell and Molecular Biology-(1994) Goldstein and Fyrberg Academic press.
5. The making of a fly-The genetics of animal design (1992)- Lawerence, Blackwell
6. *Drosophila*: Methods and Protocols -T Dahmann C.TTT Humana
7. Fly Pushing- The Theory and Practice of *Drosophila* Genetics (2004) Greenspan R. J., CSHL Press
8. *Drosophila (2000)*-A Practical Approach Roberts D. B., CSHL Press

M. Sc. Final Genetics, Semester-IV

GENET 404 SELF STUDY PAPER

M. Sc. Final Genetics, Semester-IV

GENET 405 DISSERTATION/PROJECT WORK

M. Marks: 200