General Scheme of Examination of B.Sc.–Semester System (2011-12)

Subject : Genetics

Semester – I	
Paper-I Cell Biology – I	40 + 10*
Paper-II Genetics – I	40 + 10*
Semester – II	
Paper-III Cytogenetics	40 + 10*
Paper-IV Genetics – II	40 + 10*
Practical (Semester I & II)	80 + 20*
Semester – III	
Paper-V Molecular Genetics – I	40 + 10*
Paper-VI Population Genetics – I	40 + 10*
Semester – IV	
Paper-VII Molecular Genetics – II	40 + 10*
Paper-VIII Population Genetics – II	40 + 10*
Practical (Semester III & IV)	90 + 10*
Semester – V	
Paper-IX Genetics & Crop Improvement – I	40 + 10*
Paper-X Genetics & Animal Improvement– I	40 + 10*
Semester – VI	
Paper-XI Genetics & Crop Improvement – II	40 + 10*
Paper-XII Genetics & Animal Improvement– II	40 + 10*
Practical (Semester V & VI)	80 + 20*
Total marks	**900**

***** *indicates marks of internal assessment*

B.Sc. Genetics

Semester – I

Paper – I Cell Biology-I

Max. Marks : 40+10
Time : 3 Hours

Note : Question one will be compulsory and will have 8 short answer type covering entire syllabus. Four questions will be set from each section. Candidates will answer two questions from each section. All questions will carry equal marks.

SECTION –A

I **Cell :**
Cell as a unit of structure and function. Organization of prokaryotic and eukaryotic cells; plant and animal cells.

II **Cell wall:**
Structure, functions and synthesis.

III **Cell Membrane:**
Ultrastructure, models and functions of cell membrane.

IV **Cell Organelles:**
Detailed structure and functions of endoplasmic reticulum, mitochondria, chloroplast, golgi bodies, lysosomes and ribosomes.

V **Cytoskeleton:**
microtubules, microfilaments, cilia and flagella.

SECTION-B

VI **Nucleus:**
Shape, size, structure, nuclear envelope, nucleoplasm, nucleolus, euchromatin and heterochromatin, sex chromatin (Barr body).

VII **Chromosomes:**
Structure and morphology of chromosomes, chemical organization, karyotype study.

VIII **Cell Cycle & Cell Division:**
Definition, different phases of cell cycle, mitosis, meiosis, regulation of cell cycle.

B.Sc. Genetics

Semester – I

Paper – II Genetics – I

Max. Marks : 40+10
Time : 3 Hours

Note : Question one will be compulsory and will have 8 short answer type covering entire syllabus. Four questions will be set from each section. Candidates will answer two questions from each section. All questions will carry equal marks.

SECTION –A

I Background and Scope:
Introduction, historical background, epigenesis, preformation and germplasm theories of heredity, applications for human welfare.

II Eugenics and Euphenics:
Historical background, positive and negative eugenic measures for the betterment of human race.

III Mendel's Laws of Inheritance:
Principles of segregation and independent assortment, expressivity and penetrance; numerical problems based on Mendelism.

IV Interaction of Genes:
Incomplete inheritance and co-dominance, pleotropism, modification of $\mathbf{F_2}$ ratios: epistasis, complementary genes, supplementary genes, inhibitory genes, duplicate genes, lethality and collaborators genes.

SECTION-B

V Multiple Allelism:
Introduction, characteristics, examples in *Drosophila*, rabbit and humans, concept of isoalleles and pseudoalleles.

VI Blood Group Inheritance in Human:
Blood antigens, antigen-antibody reaction, inheritance of A, B, AB, & O blood types. Rh factor and its inheritance, M-N blood group type and its inheritance, numerical problems based on ABO blood group.

VII Quantitative Inheritance:
Characteristics of polygenes, examples: skin colour in humans, kernel colour in wheat, cob length in maize and grain yield; effect of environment on quantitative inheritance.

B.Sc. Genetics

Semester – II

Paper – III Cytogenetics

Max. Marks : 40+10
Time : 3 Hours

Note : Question one will be compulsory and will have 8 short answer type covering entire syllabus. Four questions will be set from each section and candidates will answer two questions from each section. All questions will carry equal marks.

SECTION –A

I Special Chromosomes:
Polytene chromosomes, lampbrush chromosome, accessory or B-chromosomes.

II Linkage:
History, coupling and repulsion hypothesis, chromosomal theory of linkage, complete and incomplete linkage, linkage groups and significance of linkage.

III Crossing Over:
Introduction, mechanism of meiotic crossing over, types of crossing over, interference and coincidence, theories regarding mechanism, factors affecting it and its significance.

IV Recombination in Fungi:
Tetrad analysis in *Neurospora*, somatic crossing over in *Aspergillus*, a brief account of gene conversion.

SECTION-B

V Structural changes in chromosomes:: Deficiencies, duplications, inversions and translocations; their consequences and role in evolution.

VI Numerical changes in chromosomes: Aneuploidy, euploidy , their types and role in evolution; haploids and their applications.

VII Genetic Mapping:
Construction of gene maps, determination of map distance, usage of genetic maps, genetic maps versus physical maps.

VIII Brief account of the contributions of :

1. T.H. Morgan
2. H.J. Mueller
3. G.W. Beadle and E.L. Tatum
4. A.H. Sturtevant
5. W. Bateson and R.C. Punnet

B.Sc. Genetics

Semester – II

Paper – IV Genetics - II

Max. Marks : 40+10
Time : 3 Hours

Note : Question one will be compulsory and will have 8 short answer type covering entire syllabus. Four questions will be set from each section. Candidates will answer two questions from each section. All questions will carry equal marks.

SECTION –A

I Sex Determination:
Sex determination in animals, humans and plants: hormonal and environmental control of sex; gene dosage compensation.

II Sex Linkage:
Sex-linked characters and their inheritance in *Drosophila*, humans and plants. Sex limited and sex influenced traits.

III Extranuclear Inheritance:
Basis of extranuclear inheritance in eukaryotes, A brief account of plastid and mitochondrial DNA; plastid inheritance, mitochondrial inheritance, shell coiling in snails, kappa particles in *Paramecium*.

SECTION-B

V Human Cytogenetics:
Human chromosomes, karyotype, autosomal and sex chromosomal abnormalities and common genetic disorders: Down syndrome, Klinefelter syndrome, Turner syndrome, Cri-du-chat syndrome, Haemophilia, Alkaptonuria

VI Cytogenetics and Cancer:
Characteristics of cancer cells, origin, types and cure of cancer, tumour suppressor genes. oncogenes

VII Somatic Cell Genetics:
Cell cultures and genetic analysis of cultured somatic cells, somatic cell hybrids.

B.Sc. Genetics

Practical Examination

(Based on Semester – I & II)

Max. Marks : 80+20
Time : 6 Hours
(Two sessions of 3 hours each)

1.	Numerical problems on Mendelism and on modified F2 ratios: Complementary, inhibitory, epistatic, duplicate, supplementary and lethal gene interactions.	10
2	Spotting – Cytogenetical and genetical topics	15
3.	Squash preparations for studying mitotic and C-mitotic cell divisions in *Allium* and *Vicia*.	15
4.	Study of polytene chromosomes from permanent slides.	10
5.	Detection of sex chromatin bodies: Barr bodies and drumsticks of human beings	10
6.	Karyotype studies of Human and some plants from micro photographs and preparation of idiograms.	10
7.	Practical Record	10
8.	Viva	10

Note : Students must be taken to visit the institution /higher centers engaged in research activities in genetics and related fields.

B.Sc. GENETICS

Part-II

SEMESTER-III

Paper-V : Molecular Genetics-I **Max.Marks-** 40+10*

Time – 3 Hrs.

Note: Question 1 will be compulsory and short answer type covering entire syllabi. Four questions will be set from each section. Candidates have to answer five questions in all selecting two from each section.

Section – A

I. GENETIC MATERIAL:
Evidence to prove that DNA is the genetic material, its structure, properties and replication.

II. RECOMBINATION IN BATERIA:
Transformation, transduction, conjugation, F-mediated seduction. Plasmids and episomes.

III. TRANSPOSABLE GENETIC ELEMENTS:
Genetic instability and discovery of transposable elements, their genetic and evolutionary significance.

Section- B

IV PROTEIN SYNTHESIS:
Process of transcription, translation and concept of introns and exons.

V. GENETIC CODE :
Characteristics, colinearity of gene and polypeptide and evolution of the genetic code.

VI GENE MUTATIONS:
Types, induced and spontaneous, molecular basis of Mutations.

B.Sc. GENETICS

Part-II

SEMESTER-III

Paper-VI: Population Genetics and Biometrics-I **Max. Marks-** 40+10*

Time – 3 Hrs.

Note: Question 1 will be compulsory and short answer type covering entire syllabi. Four questions will be set from each section. Candidates have to answer five questions in all selecting two from each section.

Section – A

I. GENE FREQUENCIES AND EQUILIBRIUM:
An introduction to gene frequencies and gene pool. Conservation of gene frequencies.

II. ESTIMATION OF EQUILIBRIUM FREQUENCIES IN NATURAL POPULATIONS:
Codominance, dominance and sex linkage in natural populations.

III. CHANGES IN GENE FREQUENCEIES :
Mutation selection, fitness, gametic and zygotic selection. Migration and random genetic drift.

Section – B

IV ESTIMATION OF CENTRAL TENDENCIES :
Computation of mean, mode median, standard deviation and standard error, t-test and its application.

V CONCEPT OF SIMPLE CORRELATION :
Computation of bivariate correlation and regression coefficient.

B.Sc. GENETICS

Part-II

SEMESTER-IV

Paper-VII : Molecular Genetics-II **Max.Marks-** 40+10*

Time – 3 Hrs.

Note: Question 1 will be compulsory and short answer type covering syllabi. Four questions will be set from each section. Candidates have to answer five questions in all selecting two from each section.

Section – A

I. GENE STRUCTURE AND ORGANIZATION :
Fine structure of gene, concept of cistron, muton and recon, structure of eukaryotic gene. Benzer's experiment, repeated DNA, multigene families, split genes.

II. REGULATION OF GENE E XPRESSION :
Lac. And Trp. Operons, summary of types of control of gene expression.

III. ONCOGENES AND PROTONCOGENES :
A brief account of viral oncogenes, proto-oncogenes and cellular oncogenes.

Section – B

IV. DNA TRANSFER:
A brief account of electroporation and microprojectile guns. Microinjection of DNA into fertilized eggs, Ti-plasmids in Agrobacterium. Transgenic plants, animals and micro-organisms.

V. RECOMBINANT DNA TECHNOLOGY
Isolation and cloning of genes, restriction endonucleases and vectors. (Plasmids, phages and cosmids).

VI. DNA REPAIR :
DNA Damage, DNA Repair mechanisms.

B.Sc. GENETICS

Part-II

SEMESTER-IV

Paper-VIII : Population Genetics and Bimetrics-II **Max.Marks-** 40+10

Time – 3 Hrs.

Note: Question 1 will be compulsory and short answer type covering entire syllabi. Four questions will be set from each section. Candidates have to answer five questions in all selecting two from each section.

Section – A

I. GENETIC STRUCTURE OF POPULATION
Canalization, genetic homeostasis, genetic load and genetic death.

II. SPECIATION:
Concept of the species and ; modes of speciation

III. MOLECULAR EVOLUTION :
A brief account of molecular evolution in the test tube, evolution of genetic system. Regulatory gene and some evolutionary consequences.

Section – B

IV. PROBABILITY :
Introduction, fundamentals, addition theorem and multiplication theorem of probability.

V. CHI-SQUARE (X^2) TEST :
Introduction, degree of freedom, X^2 test for goodness of fit and its genetic application, Contingency Chi-square

B.Sc. GENETICS

Part-II

(Based on SEMESTER-III-IV)

GENETICS PRACTICAL EXAMINATION

Max.Marks- 80+20

Time – 4 Hrs.

1. Computation of statistical constants viz.: mean, standard deviation and standard error from the date provided.
2. Squash preparation from testis to study meiotic cell divisions of grass hopper.
3. Study of male meiosis in *Allium* and*Vioia* or *Pisum*
4. Study of mitosis from bone marrow of mouse/rat.
5. Testing of blood groups and Rh factors in human beings.
6. Testing of colour blindness in human beings and numerical problems based on it.
7. Application t-test on the basis of given exercise.
8. Practical Record = 6 marks
9. Viva = 6 marks

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Semester – V

B.Sc. Genetics

Paper –IX (Genetics & Crop Improvement – I) Max. Marks: 40+10

Time : 3 Hours

Note : Question one will be compulsory and will have 8 short answer type covering entire syllabus. Four questions will be set from each section. Candidates will answer two questions from each section. All questions will carry equal marks.

SECTION –A

I Introduction to Plant Breeding:
History, Objectives and major achievements in crop improvement

II Plant Domestication:
Introduction, Changes in Plant species under domestication, Genetic erosion, Germ- Plasm conservation: Insitu and Exsitu

III Plant Inroduction:
Introduction, History, Purpose, Mertis, Demerits and major achievements in crop improvement

IV Self incompatibility:
Introduction, mechanism of Heteromorphic and Homomorphic systems, Elimination and applications of self incompatibility in crop plants

SECTION-B

V Male Sterility:
Introduction, Phenotypic expression, Genetic, Cytoplasmic and gene-cytoplasmic male sterility, their utilization in plant breeding

VI Hybridization:
Techniques, Procedure objectives and consequences of hybridization, Limitations of distant hybridization, Merits, Demerits and main achievements of hybridization

VII Heterosis and inbreeding depression:
Introduction, Manifestations, Genetic basis and Molecular basis of Heterosis, Commercial utilization, Effects of inbreeding

VIII Mutations in Crop Improvements:
Spontaneous and induced mutations, Physical and Chemicals mutagens, Gamma-Garden, application, limitations and major achievements of mutation breeding

Semester – V

B.Sc. Genetics

Paper –X (Genetics & Animal Improvement – II) Max. Marks: 40+10

Time : 3 Hours

Note : Question one will be compulsory and will have 8 short answer type covering entire syllabus. Four questions will be set from each section. Candidates will answer two questions from each section. All questions will carry equal marks.

SECTION –A

I Historical Aspect:

Ancient Animal Husbandry, 18th century animal husbandry, laying the foundation of pure breeds, Development of breed association

II Domestication of Animals:

Centers of domestication, Effects of domestication, Domestication of cattle, Buffalo, Sheep & Goats, Poultry

III Qualitative Genetics in Animal Breeding:

Lethal and genetic abnormalities, Genetic differences in disease and parasite resistance

SECTION-B

IV Inbreeding and Relationship:

Introduction, Effectiveness, Degree of inbreeding, Relationship, Genetic effects of inbreeding, Usefulness of inbreeding

V Out Breeding:

Introduction, Out- Crossing, Cross breeding, Grading, Crossing inbred lines for commercial production, Species hybridization

VI Principal of Selection:

Introduction, Effectiveness of selection, Individual, Pedigree selection, Progeny and selection, Family selection, Results of selection

Semester – VI

B.Sc. Genetics

Paper – XI (Genetics & Crop Improvement–I) Max. Marks: 40+10

Time : 3 Hours

Note : Question one will be compulsory and will have 8 short answer type covering entire syllabus. Four questions will be set from each section. Candidates will answer two questions from each section. All questions will carry equal marks.

SECTION –A

I Polyploidyin Plant Breeding:
Autopolyploidy and allopolyploidy, their application in crop improvement and origin of crop plants, Colchicine induced polyploidy and limitation of polyploidy

II New Approach to Breeding of Self Pollinated Crops:
Multi-line varietics, their merits, demerits and achievements, Population approach, Its merits and demerits.

III Biotechnology in Crop Improvements:
A brief account of plant tissue culture-technique, embryo culture, meristem culture, another culture, somatic hybridization, achievements and future prospects

SECTION-B

IV Varietal Release and Seed Production:
Evaluation: Station trial, Multilocation trial, Disease and Insect Tests, Quality Test and identification of entries for release

V Certified Seed:
Introduction, Requirement for certified seed, Certified Seed Production in Some Crops, Self-Pollinated Crops: Hybrid Maize, Hybrid Jawar, Hybrid Bajra and potato.

VI Brief account of the following: Research Centers:
Intcrnational Rice Research Institute(IRRI), Sugarcane Breeding Institute(SBI), Central Potato/Research Institute(CPRI), Central Institute of Cotton Research(CICR), Inernational Centre for Improvments of Maize and Wheat(CIMMYT).

VII Plant Breeder's Rights (PBR):

Historical, Requirments of PBR, Farmer's Right, need for PBR, Benefits from PBR, Disadvantages from PBR.

Semester – VI

B.Sc. Genetics

Paper – XII (Genetics & Animal Improvement–II) Max. Marks : 40+10

Time : 3 Hours

Note : Question one will be compulsory and will have 8 short answer type covering entire syllabus. Four questions will be set from each section. Candidates will answer two questions from each section. All questions will carry equal marks.

SECTION –A

I Breeds of Live Stock:
A brief account of important indigenous and exotic breeds of dairy cattle, Sheep, Goat, Swine and poultry

II Animal Genetics Resources:
Live Stock, Poultry and fish genetic resources in India and their conservation strategies

III Sire Evaluation:
Introduction, Sire indexing, Daughter average index, Correlated daughter average index, Contemporary daughter average index

SECTION-B

IV Biotechnology for the improvement of animals:
Frozen semen and artificial insemination, Embryo manipulation, Gene targeting and transgenesis, Sex selection

V Exsitu Cryopreservation of Animal Genetic Resources:
Cryopreservation of embryos, Insemination and flushing of embryos, Cryopreservation of ovaries, Conservation of genetic material

VI Brief account of the following: Animal Research Centers:
National Bureau of Animal Genetic Resources (NBAGR), National Diary Research Institute (NDRI), Indian Veterinary Research Institute (IVRI)

VII Intellectual Property Right (IPRs) and Patents:
Introduction, Process Patent, Product patent, non patentable inventions, Animal patents- classical cases

Semester – V & VI

B.Sc. Genetics

Practical Examination

Max. Marks : 80+20*
Time : 6 Hours
(Two sessions of 3 hours each)

1. Estimation of DNA
2. Estimation of RNA
3. To study emasculation and cross pollination techniques in rice, wheat and pea
4. To study selfing technique in maize.
5. Study of Pollen viability using staining test
6. To test seed by viability using Tetrazolium test method.
7. Study of human pedigrees and their possible genetic explanation
8. Construction of Sire index from the given data.
9. Practical Record 12 Marks
10. Viva-Voce 12 Marks

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