

FACULTY OF LIFE SCIENCES

Syllabus

For

B.Sc. (HONS. SCHOOL) HUMAN GENETICS
(Credit Based Evaluation & Grading System)

(FOR OLD STUDENTS)

(SEMESTER: III - VI)

Examinations: 2019-20



Guru Nanak Dev University
Amritsar

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B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER SYSTEM)
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Credit Structure of B.Sc. (Hons. School) in Human Genetics

III	20	3	-	23
IV	17	3	4	24
Total Credits	37	6	4	47
V	16	3	4	23
VI	11	1.5	4	16.5
Total Credits	27	4.5	8	39.5

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NOTE : ALL THEORY PAPERS HAVING MID SEMESTER MARKS : 20 & END SEMESTER MARKS : 80. TOTAL MARKS WILL BE 100.

SCHEME

Semester-III

Course No.	C/E/I	Course Title	L	T	P	Total Credits
Core Courses (20 Credits)						
HGL-201	C	Fundamentals of Human Anatomy	3	0	0	3
HGL-204	C	Principles of Molecular Genetics	3	0	0	3
HGL-205	C	Metabolism of Biomolecules	3	0	0	3
MTL-261	C	Biostatistics	3	1	0	4
*ESL-220	C	Environmental Studies (Compulsory)	4	0	0	4
HGP-201	C	Fundamentals of Human Anatomy Practical	0	0	1.5	1.5
HGP-204	C	Lab Techniques in Molecular Genetics	0	0	1.5	1.5
Elective Courses (3 Credits)						
HGL-292	E	Human Embryology	3	0	0	3
HGL-282	E	Introduction to Microscopy	3	0	0	3
Total Credits			19	1	3	23

***Note : Credits will not be included in the total.**

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Semester-IV

Course No.	C/E/I	Course Title	L	T	P	Total Credits
Core Courses (17 Credits)						
HGL-251	C	Fundamentals of Human Physiology	3	0	0	3
HGL-253	C	Concepts of DNA Technology	3	0	0	3
HGL-254	C	Human Evolution and Primatology	3	0	0	3
CYL-291	C	Physical Chemistry	3	1	0	4
HGP-251	C	Lab Exercises in Human Physiology	0	0	1.5	1.5
HGP-273	C	Lab Exercises in Biochemistry and Molecular Genetics	0	0	1.5	1.5
CYP-293	C	Physical Chemistry Lab	0	0	1	1
Elective Course (3 Credits)						
HGL-281	E	Biochemical Basis of Human Diseases	3	0	0	3
HGL-293	E	Fundamentals of Genetic Engineering	3	0	0	3
Interdisciplinary/Optional Course (4 Credits)						
–	I	To be taken from outside the department	4	0	0	4
Total Credits			19	1	4	24

Note:

1. The students are required to opt for one 'Elective' paper.
2. The students are also required to take one paper (Interdisciplinary/Optional) of 4 credits of their choice from any other department of Guru Nanak Dev University Campus, Amritsar.

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Semester-V

Course No.	C/E/I	Course Title	L	T	P	Total Credits
Core Courses (16 Credits)						
HGL-301	C	Human Genetics and Cytogenetics-I	2	1	0	3
HGL-303	C	Population Genetics	3	1	0	4
HGL-304	C	Human Growth, Physique and Body Composition	3	0	0	3
HGL-405	C	Computer Applications	3	0	0	3
HGP-301	C	Human Genetics and Cytogenetics Practical	0	0	1.5	1.5
HGP-304	C	Human Growth, Physique and Body Composition Practical	0	0	1.5	1.5
Elective Course (3 Credits)						
HGL-282	E	Introduction to Microscopy	3	0	0	3
HGL-292	E	Human Embryology	3	0	0	3
Interdisciplinary/Optional Course (4 Credits)						
–	I	To be taken from outside the department	4	0	0	4
Total Credits			18	2	3	23

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Semester-VI

Course No.	C/E/I	Course Title	L	T	P	Total Credits
Core Courses (11 Credits)						
HGL-351	C	Human Genetics and Cytogenetics-II	2	1	0	3
HGL-354	C	Applied DNA Technology	3	0	0	3
HGL-356	C	Immunology and Immunogenetics	2	1	0	3
HGP-371	C	Human Genetics and Molecular Genetics Practical	0	0	2	2
Elective Course (1.5 Credits)						
HGP-394	E	Lab Exercises in Tissue Culture and Microscopy	0	0	1.5	1.5
HGP-395	E	Lab Exercises in Biochemical Genetics and Immunogenetics	0	0	1.5	1.5
Interdisciplinary/Optional Course (4 Credits)						
–	I	To be taken from outside the department	4	0	0	4
Total Credits			11	2	3.5	16.5

Note:

1. The students are required to opt for one 'Elective' paper.
2. The students are also required to take one paper (Interdisciplinary/Optional) of 4 credits of their choice from any other department of Guru Nanak Dev University Campus, Amritsar.

**B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-III)
(Credit Based Evaluation & Grading System)**

HGL-201 FUNDAMENTALS OF HUMAN ANATOMY

Time: 3 Hours

Credits: 3-0-0

Marks: 75

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Fields of anatomy, Skeletal system — Classification of bones, Ossification and growth of bone, Histology of bone, Fracture and repair, Types of joints. Muscular system — Classification of muscles, Structure of smooth, cardiac, skeletal muscle, neuromuscular junction.

Section-B

Circulatory system — Blood composition, Structure of heart and blood vessels, Types of blood vessels, Brief description of arterial, venous system and lymphatic system. Respiratory system — Brief description of anatomy of constituent parts, olfactory receptors.

Section-C

Nervous system — Gross anatomy of brain and spinal cord, Ascending and descending tracts of neurons, Autonomic nervous system, Special senses — Eye, ear, Integumentary system — Skin, hair, nail, touch receptors. Endocrine system — Brief anatomy of endocrine glands,

Section-D

Digestive system — Brief description of gross anatomy and histology of constituent parts. Urinary system — Brief anatomical description of constituent parts, Reproductive system — Brief anatomical description of male and female reproductive organs.

Books Recommended

1. Drake, R., Vogl, W. and Mitchell, A. (2015). Gray's Anatomy for Students. Churchill Livingstone, USA.
2. Marieb, E.N. (2004). Human Anatomy and Physiology. Dorling Kindersley (India) Pvt. Ltd., 6thed.
3. Ross and Willson (2010). Anatomy and Physiology. ELBS Publication.
4. Standring, S. (2008). Gray's Anatomy. Churchill Livingstone, USA. 40thed.
5. Tortora, G.J. and Grabowski, S.R. (2002). Principles of Anatomy and Physiology. Harper Collins College Publishers.
6. Tortora, G.J. and Henderson, S.R. (2012). Principles of Anatomy and Physiology. Harper Collins College Publishers.

**B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-III)
(Credit Based Evaluation & Grading System)**

HGL-204 PRINCIPLES OF MOLECULAR GENETICS

Time: 3 Hours

Credits: 3-0-0

Marks: 75

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

An overview of molecules involved in the flow of genetic information, Central dogma of life, Composition of nucleic acids, Double helical structure of DNA, Different forms of DNA, DNA denaturation and renaturation, Factors affecting DNA stability, Structure of gene, Gene families.

Section-B

Mechanisms of DNA replication in prokaryotes and eukaryotes, Different types of DNA polymerases in prokaryotes and eukaryotes, The Messelson-Stahl experiment, Topoisomerases and their role.

Section-C

Different types of RNA, their structure and role, Transcription process, Prokaryotic and eukaryotic RNA polymerases, Transcription factors, Reverse transcription, Post-transcriptional processing of RNA, RNA splicing, Capping and tailing of mRNA, processing of rRNA and tRNA, Genetic code.

Section-D

Prokaryotic and eukaryotic ribosomes, Translation process in prokaryotic and eukaryotes: initiation, elongation, termination of polypeptide chain, Composition of polypeptides, Post-translation modifications of polypeptides, inhibitors of protein synthesis.

Books Recommended

1. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D. (2007). Molecular Biology of the Cell. Garland Press, USA, 3rded.
2. Brown, T.A. (2005). Genetics: A Molecular Approach. Bios Scientific Publishers Ltd., Oxford, 3rded.
3. Brown, T.A. (2006). Genomes 3. Bios Scientific Publishers Ltd., Oxford, 3rd ed.
4. Brown, T.A. (2016). Gene Cloning and DNA Analysis: An Introduction. Blackwell Publishing Co., Oxford, 7thed.
5. Hartl, D.L. and Jones, E.W. (2012). Genetics: Analysis of Genes and Genomes. Jones and Bartlett Publishers, 8thed.
6. Korf, B.R. (2007). Human Genetics and Genomics. Blackwell Scientific Publications, USA, 3rded.
7. Lewin, B. (2008). Genes-IX. Jones and Barlett Publishers, Inc., USA.
8. Lodish, H., Baltimore, D., Berk, A., Zipursky, S.L., Matsudaira, P. and Daniell, J. (2007). Molecular Cell Biology. W.H. Freeman and Co., San Fransisco.
9. Strachan, T. and Read, A. (2010). Human Molecular Genetics. Garland Publishers, London. 4thed.
10. Weaver, R.F. (2002). Molecular Biology. McGraw Hill, New Delhi.

**B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-III)
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HGL-205 METABOLISM OF BIOMOLECULES

Credits: 3-0-0

Time: 3 Hours

Marks: 75

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Overview & Types of metabolic pathways, Basic principles of bioenergetics, Free energy of Phosphoanhydride, Acyl Phosphate, Enolphosphate, Guanidine phosphate & Thioester bonds, Carbohydrate Metabolism: Glycolysis and gluconeogenesis, Regulation, Cori cycle, TCA cycle, Oxidative phosphorylation, Pentose phosphate pathway, Glycogen metabolism and regulation.

Section-B

Overview of Nitrogen metabolism, Nitrogen cycle, Reactions of amino acids metabolism i.e. transamination, deamination, decarboxylation, Urea cycle, Biosynthesis and degradation of amino acids, Regulation, Structure of Heme precursors, Porphyrins (Copro, Uro and Protoporphyrins), Heme biosynthesis and regulation, Catabolism of heme bilirubin: its conjugation and secretion.

Section-C

Lipid Metabolism: Hydrolysis of tri-acylglycerols, oxidation of fatty acids, Oxidation of fatty acids, Oxidation of odd numbered fatty acids, Ketone bodies significance and synthesis, Synthesis of fatty acids, Synthesis of triacylglycerols, phosphoglycerides, Cholesterol biosynthesis and regulation.

Section-D

Nucleic Acid Metabolism: Degradation of purines and pyrimidines, Salvage and denovo pathways of biosynthesis of purine and pyrimidine nucleotides, Biosynthesis of deoxyribonucleotides, Role of ribonucleotide reductase, Regulation of nucleotide biosynthesis.

Recommended Books:

1. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2010). Biochemistry. W.H. Freeman and Co., New York, 7th ed.
2. Garrett, R.H., Grisham, C.M. (2013) Biochemistry. Brook/Cole Cengage Learning, Belmont, CA, USA, 6th Ed.
3. Murray, R.K., Bender, D.A., Botham, K.M., Kenelly, P.J., Rodwell, V.W. and Mayes, P.A. (2012). Harper's Illustrated Biochemistry. McGraw-Hill, California, 29th ed.
4. Nelson, D.L. and Cox, M.M. (2013). Lehninger's Principles of Biochemistry. W.H. Freeman and Co., New York, 6th ed.
5. Voet, D., Voet, J.G. and Pratt, C.W. (2012). Fundamentals of Biochemistry: Life at the Molecular Level. John Wiley and Sons, New York.

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MTL-261 BIOSTATISTICS

Credits: 3-1-0

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note:- The scope of this paper is restricted only to the applications of various statistical techniques. The mathematical derivations of various results are excluded.

Section-A

Statistical Methods — Collection of data, Frequency distribution and, Measures of Central Tendency, Dispersion.

Correlation and Regression — Relationship between variables, Covariance, Karl-Pearson's Correlation Coefficient, Spearman's rank Correlation Coefficient, Least square technique for regression lines (without proof), Regression Coefficients, Relationship between Correlation analysis and Regression Analysis.

Section-B

Probability — Mathematical definition of probability of an event, Use of permutations and combinations in calculations of Probability, Conditional probability, Additive and Multiplication law of Probability, Random Variables and its pmf, pdf, cdf, Mathematical expectation and variances, Theoretical Distributions: Binomial, Poisson and normal, Properties of these distributions (applications only).

Section-C

Hypothesis Testing — Sample, Population, Statistics and Parameters, Null Hypothesis, Level of significance, Definitions of Chi-square, 't' and 'F' variates and their pdfs only, Applications of these distributions in testing of hypothesis.

Section-D

Large sample test- Testing of significance of proportion in single population, Testing of equality of proportions in two populations, Testing of significance of mean in single population, Testing of equality of means in two populations.

Analysis of Variance — Meaning of analysis variance with linear models, Analysis of variance for one-way classified data, Analysis of variance for two-way classified data with one observation for cell.

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Text Books

1. Fowler, J., Cohen, L. and Jarvis, P. (1998). Practical Statistics for Field Biology. John Wiley and Sons, 2nd ed. [Chapters: 4,5,6,7,(7.1–7.6), 9 (9.1–9.4), 12 (12.1–12.7), 13 (13.1–13.4, 13.6,13.7), 14 (14.1–14.5, 14.7), 15 (15.3–15.8, 15.10–15.11), 16 (16.9–16.13), 17 (17–17.3, 17.5,17.6,17.8)].
2. Raghavarao, D. (1983). Statistical Techniques in Agricultural and Biological Research Oxford and IBH Publishing Co. [Chapters: 2,3,4,5,7,8,9 and 10].

Reference Books:

1. Bland, M. (2006). An Introduction to Medical Statistics. Oxford University Press, 3rd ed.
2. Finney, D.J. (1980). Statistics for Biologists. Chapman and Hall Ltd.
3. Hoel, P.G. (1971). Elementary Statistics. John Wiley and Sons, 3rd ed.
4. Ross, S.M. (2005). Introductory Statistics. Academic Press, 2nd ed.
5. Wayne, W, Daniel (1999). Biostatistics: A Foundation for Analysis in Health Sciences. John Wiley and Sons, 7th ed.
6. Woodworth, G. (2004). Biostatistics: A Bayesian Introduction. John Wiley and Sons.

**B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-III)
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ESL-220 : ENVIRONMENTAL STUDIES (COMPULSORY)

Credits: 4-0-0

Teaching Methodologies

The Core Module Syllabus for Environmental Studies includes class room teaching and field work. The syllabus is divided into 8 Units [Unit-1 to Unit-VII] covering 45 lectures + 5 hours for field work [Unit-VIII]. The first 7 Units will cover 45 lectures which are class room based to enhance knowledge skills and attitude to environment. Unit-VIII comprises of 5 hours field work to be submitted by each candidate to the Teacher in-charge for evaluation latest by 15 December, 2019.

Exam Pattern: **End Semester Examination- 75 marks**
 Project Report/Field Study- 25 marks [based on submitted report]
 Total Marks- 100

The structure of the question paper being:

Part-A, Short answer pattern with inbuilt choice – 25 marks

Attempt any five questions out of seven distributed equally from Unit-1 to Unit-VII. Each question carries 5 marks. Answer to each question should not exceed 2 pages.

Part-B, Essay type with inbuilt choice – 50 marks

Attempt any five questions out of eight distributed equally from Unit-1 to Unit-VII. Each question carries 10 marks. Answer to each question should not exceed 5 pages.

Project Report / Internal Assessment:

Part-C, Field work – 25 marks [Field work equal to 5 lecture hours]

The candidate will submit a hand written field work report showing photographs, sketches, observations, perspective of any topic related to Environment or Ecosystem. The exhaustive list for project report/area of study are given just for reference:

1. Visit to a local area to document environmental assets: River / Forest/ Grassland / Hill / Mountain / Water body / Pond / Lake / Solid Waste Disposal / Water Treatment Plant / Wastewater Treatment Facility etc.
2. Visit to a local polluted site – Urban / Rural / Industrial / Agricultural
3. Study of common plants, insects, birds
4. Study of tree in your areas with their botanical names and soil types
5. Study of birds and their nesting habits
6. Study of local pond in terms of wastewater inflow and water quality
7. Study of industrial units in your area. Name of industry, type of industry, Size (Large, Medium or small scale)
8. Study of common disease in the village and basic data from community health centre
9. Adopt any five young plants and photograph its growth
10. Analyze the Total dissolved solids of ground water samples in your area.
11. Study of Particulate Matter (PM_{2.5} or PM₁₀) data from Sameer website. Download from Play store.
12. Perspective on any field on Environmental Studies with secondary data taken from Central Pollution Control Board, State Pollution Control Board, State Science & Technology Council etc.

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Unit-I

The multidisciplinary nature of environmental studies

Definition, scope and importance, Need for public awareness

(2 lectures)

Unit-II

Natural Resources: Renewable and non-renewable resources:

Natural resources and associated problems.

- (a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
- (b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
- (c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
- (d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
- (e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies.
- (f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
 - Role of an individual in conservation of natural resources.
 - Equitable use of resources for sustainable lifestyles.

(8 Lectures)

Unit-III

Ecosystems

- Concept of an ecosystem
- Structure and function of an ecosystem
- Producers, consumers and decomposers
- Energy flow in the ecosystem
- Ecological succession
- Food chains, food webs and ecological pyramids
- Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, ocean estuaries)

(6 Lectures)

Unit-IV

Biodiversity and its conservation

- Introduction – Definition: genetic, species and ecosystem diversity
- Biogeographical classification of India
- Value of biodiversity: consumptive use, productive use, social, ethical aesthetic and option values
- Biodiversity at global, national and local levels
- India as a mega-diversity nation
- Hot-spots of biodiversity
- Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts
- Endangered and endemic species of India
- Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity

(8 Lectures)

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Unit-V

Environmental Pollution

Definition

- Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear pollution
- Solid waste management: Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution
- Pollution case studies
- Disaster management: floods, earthquake, cyclone and landslides

(8 Lectures)

Unit-VI

Social Issues and the Environment

- From unsustainable to sustainable development
- Urban problems and related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people; its problems and concerns. Case studies.
- Environmental ethics: Issues and possible solutions
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- Wasteland reclamation
- Consumerism and waste products
- Environmental Protection Act, 1986
- Air (Prevention and Control of Pollution) Act, 1981
- Water (Prevention and control of Pollution) Act, 1974
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation
- Public awareness

(7 Lectures)

Unit-VII

Human Population and the Environment

- Population growth, variation among nations
- Population explosion – Family Welfare Programmes
- Environment and human health
- Human Rights
- Value Education
- HIV / AIDS
- Women and Child Welfare
- Role of Information Technology in Environment and Human Health
- Case Studies

(6 Lectures)

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Unit-VIII

Field Work

- Visit to a local area to document environmental assets river/forest/grassland/hill/mountain
- Visit to a local polluted site – Urban / Rural / Industrial / Agricultural
- Study of common plants, insects, birds
- Study of simple ecosystems-pond, river, hill slopes, etc

(Field work equal to 5 lecture hours)

References:

1. Bharucha, E. 2005. Textbook of Environmental Studies, Universities Press, Hyderabad.
2. Down to Earth, Centre for Science and Environment, New Delhi.
3. Heywood, V.H. & Waston, R.T. 1995. Global Biodiversity Assessment, Cambridge House, Delhi.
4. Joseph, K. & Nagendran, R. 2004. Essentials of Environmental Studies, Pearson Education (Singapore) Pte. Ltd., Delhi.
5. Kaushik, A. & Kaushik, C.P. 2004. Perspective in Environmental Studies, New Age International (P) Ltd, New Delhi.
6. Rajagopalan, R. 2011. Environmental Studies from Crisis to Cure. Oxford University Press, New Delhi.
7. Sharma, J. P., Sharma. N.K. & Yadav, N.S. 2005. Comprehensive Environmental Studies, Laxmi Publications, New Delhi.
8. Sharma, P. D. 2009. Ecology and Environment, Rastogi Publications, Meerut.
9. State of India's Environment 2018 by Centre for Sciences and Environment, New Delhi
10. Subramanian, V. 2002. A Text Book in Environmental Sciences, Narosa Publishing House, New Delhi.

**B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-III)
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HGP-201 FUNDAMENTALS OF HUMAN ANATOMY PRACTICAL

Credits: 0-0-1.5

Anatomical positions — Superior, Inferior, Anterior, Medial, Posterior, Lateral, Proximal, Distal, External, Internal, Parietal, Visceral, Cavities and planes of human body. Classification of bones, Skull – different views, Vertebrae, Sternum, Scapula, Bones of upper and lower limbs, Innominate, Clavicle, Sex differentiation in skull, innominate, sacrum.

B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-III)
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HGP-204 LAB TECHNIQUES IN MOLECULAR GENETICS

Credits: 0-0-1.5

Washing and sterilization of glassware and plasticware, Calculations for preparing stock solutions, Preparation of stock solutions and adjustment of pH, Preparation of working solutions from stock solutions, Genomic DNA extraction from blood using inorganic method, Quality and quantity checking of DNA using agarose gel electrophoresis.

B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-III)
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HGL-292 HUMAN EMBRYOLOGY
(Elective Paper)

Time: 3 Hours

Credits: 3-0-0

Marks: 75

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Fertilization, Cleavage, Blastocyst formation, Bilaminar disc, Gastrulation, Three-germ layer, Notochord formation, Establishing body axes, fate map during gastrulation, Derivative of three- germ layers, Placentation.

Section-B

Central nervous system and eye ,Head and neck region, Ear,Respiratory system,

Section-C

Overview of development of limbs, skeletal system, Muscular system, Body cavities, Integumentary system.

Section-D

Overview of development of cardiovascular system, Digestive system, Urogenital system.

Books Recommended:

1. Gilbert, S.F. (2016). Developmental Biology. Sinauer Associates, Inc., Sunderland, MA.
2. Sadler, T.W. (2014). Langman's Medical Embryology. Lippincot Williams and Wilkins, USA, 13thed.
3. Singh, I. and Paul, G.P. (2014). Human Embryology. McMillan Co., New Delhi.

**B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-III)
(Credit Based Evaluation & Grading System)**

**HGL-282 INTRODUCTION TO MICROSCOPY
(Elective Paper)**

Time: 3 Hours

Credits: 3-0-0

Marks: 75

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Simple microscope: Lenses, lens aberration, objective lens, light source, stage, light path, Compound microscope, resolution, magnification. Methods of specimen preparation for bioimaging: Fixation, dehydration, infiltration, staining.

Section-B

Methods of optical contrast: Dyes, phase contrast, dark field microscopy, polarization microscopy, Differential interference contrast microscopy.

Section-C

Fluorescence microscope, Confocal microscope, Scanning electron microscope, Transmission electron microscope, Videomicroscopy, Electron imaging.

Section-D

Imaging ions and intracellular messenger, Imaging of macromolecules and supramolecular complexes, Detection of molecular motions and interactions (FRET, FRAP, FCS).

Books Recommended:

1. Chandler, D.E. and Robertson, R.W. (2009). Bioimaging: Current Concepts in Light and Electron Microscopy. Jones and Barlett Publishers, USA.
2. Gersen, S.L. and Keagle, M.B. (2005). The Principles of Clinical Cytogenetics. Humana Press, USA, 2nd ed.

**B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-IV)
(Credit Based Evaluation & Grading System)**

HGL-251 FUNDAMENTALS OF HUMAN PHYSIOLOGY

Time: 3 Hours

Credits: 3-0-0

Marks: 75

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Action potential, Transmission at synapse, Neurotransmitters, Functions of brain, Autonomic nervous system, Reflex action, Special senses – Hearing, vision, pain, touch,

Section-B

Physiology of muscle contraction, Cardiac cycle, Heart and circulation, Blood pressure, Role of hemoglobin in regulation of respiration, Functions of blood and lymphatic system, Blood clotting.,

Section-C

Physiology of respiration ,physiology of olfaction,Physiology of digestion and absorption, physiology of taste

Section-D

Function of endocrine glands, Physiology and hormonal control of reproduction. Physiology of excretion and urine formation, Regulation of body fluids by kidneys.

Books Recommended

1. Guyton, A.C. and Hall, J.E. (2016). Textbook of Medical Physiology. Elsevier Publications, New York.
2. Ross and Willson (2010) Anatomy and Physiology. ELBS publication.
3. Tortora, G.J. and Grabowski, S.R. (2009). Principles of Anatomy and Physiology. Harper Collins College Publishers.
4. Tortora, G.J and Henderson S.R. (2012) Principles of Anatomy and Physiology. Harper Collins College Publishers.

**B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-IV)
(Credit Based Evaluation & Grading System)**

HGL-253 CONCEPTS OF DNA TECHNOLOGY

Credits: 3-0-0

Time: 3 Hours

Marks: 75

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Types and classification of mutagens, Types of mutations, Gene, DNA and amino acid variants nomenclature, Enzymes used in DNA technology: Restriction enzymes, Polymerases, Ligases, Kinases and Phosphatases.

Section-B

Overview of primers and nucleic acid probes, Agarose and polyacrylamide gel electrophoresis, Polymerase chain reaction (PCR), Types and applications of PCR.

Section-C

Different techniques of mutation detection – Single strand conformation polymorphism (SSCP) and Restriction fragment length polymorphism (RFLP). Overview of cloning vectors and cloning strategy.

Section-D

DNA repair mechanisms - Direct repair, Mismatch repair (MMR), Excision repair (Base excision repair and nucleotide excision repair), Recombination repair, The SOS repair system.

Books Recommended

1. Brown, T.A. (2006). Genomics 3. Bios Scientific Publishers Ltd., Oxford, 3rd ed.
2. Brown, T.A. (2010). Gene Cloning and DNA Analysis: An Introduction. Blackwell Publishing Co., Oxford, 6th ed.
3. Dieffenbach, C.W. and Dveksler, G.S. (2003). PCR Primer: A Laboratory Manual. Cold Spring Harbor Press, 2nd ed.
4. Freifelder, D.C. (2008). Molecular Biology. Narosa Publishing House, New Delhi, 2nd ed.
5. Green, M.R. and Sambrook, J (2012). Molecular Cloning: A Laboratory Manual. Cold Spring Harbor, New York, Vol. 1, 2&3. 4th ed.
6. Hartl, D.L. and Jones, E.W. (2012). Genetics: Analysis of Genes and Genomes. Jones and Barlett Publishers, Inc., USA, 8th ed.
7. Krebs J.E., Goldstein, E.S. and Kilpatrick, S.T. (2012). Genes-XI. Jones and Barlett Publishers, Inc., USA.

B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-IV)
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8. Pasternak, J.J. (2005). An Introduction to Human Molecular Genetics, Mechanisms of Inherited Diseases. John Wiley and Sons, Inc., New Jersey.
9. Pierce, B.A. (2017). Genetics: A Conceptual Approach. W.H. Freeman and Co., New York, 7th ed.
10. Strachan, T. and Read, A. (2010). Human Molecular Genetics. Garland Publishers, London, 4th ed.
11. Tropp, B.E. (2012). Molecular Biology: Genes to Proteins. Jones and Barlett Publishers, Inc., USA, 4th ed.
12. Wilson, K. and Walker, J. (2000). Practical Biochemistry: Principles and Techniques. Cambridge University Press, 5th ed.

**B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-IV)
(Credit Based Evaluation & Grading System)**

HGL-254 HUMAN EVOLUTION AND PRIMATOLOGY

Credits: 3-0-0

Time: 3 Hours

Marks: 75

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Classification and significant characteristics of primates, Primate as a mammalian heritage, Reproduction, Offspring care and social structure of primates, Physical characteristics, Distribution and social structure of gibbons, orangutans, gorillas and chimpanzees.

Section-B

Overview of human evolution, Primitive hominids and australopithecine stages, Evolutionary trends and relationship with family trees, Distributions, Physical characteristics, Brain size and cultural behaviour of pithecanthropine stage, neanderthal transition stage Distributions, Physical characteristics, Brain size and cultural behaviour of neanderthal transition stage, Neanderthal stage and modern human.

Section-C

Characteristics of modern human (*Homo sapiens*). Current models and debates such as multiregional model, African model and out of Africa model, Fossil evidence, Genetic evidence such as DNA polymorphism and chromosome evolution.

Section-D

Overview of human diversity. Resolution of gorilla/ chimpanzee/human trichotomy using DNA-DNA hybridization. Estimate of molecular date for ape/human divergence. Genetic and phenotypic difference between apes and human.

Books Recommended:

1. Balding, D.J., Bishop, M. and Cannings, C. (Eds.) (2007). Handbook of Statistical Genetics. John Wiley and Sons Ltd., England, Vol. 1 and 2, 3rd ed.
2. Hartl, D.L. and Clark, A.G. (2007). Principles of Population Genetics. Sinaur Associates, Inc., Massachusetts, 4th ed.
3. Hedrick, P.W. (2011). Genetics of Population. Jones and Bartlett Publishers, Massachusetts, 4th ed.
4. Jobling, M.A., Hurles, M. and Tyler-Smith, C. (2004). Human Evolutionary Genetics: Origin, Peoples and Diseases. Taylor and Francis Group, New York.
5. Relethford, J.H. (2007). The Human Species: An Introduction to Biological Anthropology. McGraw-Hill, USA.

**B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-IV)
(Credit Based Evaluation & Grading System)**

CYL-291: PHYSICAL CHEMISTRY

Credits: 3-1-0

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Chemical Thermodynamics

System and surroundings properties and variables of a system, laws of thermodynamics, Enthalpy of a system, heat capacity, Isothermal & adiabatic process in ideal gases, Joule-Thomson effect, Carnot cycle, thermodynamic efficiency, Thermo-Chemistry : heat of reaction at constant volume and pressure thermochemical equations, calculations of E from H & vice versa, Hess's law of heat summation, heat of formation, heats of combustion, heat of solution, heat of neutralization of acids and bases, heat of formations of ions, heat of reaction from bond enthalpies, dependence of H & E for a reaction (Kirchoff's equation). II and III law of thermodynamics : Entropy, dependence of entropy on variables of a system, Entropy change in ideal gases, entropy of mixing for ideal gases, entropy change in physical transformations, Entropy change in chemical reactions, absolute Entropies, residual entropy, thermodynamics of III Law.

Section-B

Equilibrium

General conditions for Equilibrium and Spontaneity under constraints. Helmholtz free energy (A) for reactions. Gibbs free energy.

Chemical potential, Gibbs free energy and entropy of mixing of ideal gases. The Equilibrium constants K_p and K_c of real gases. Temperature dependence of Equilibrium constant. The Lechatelier principle.

Phase Rule

Gibbs Phase rule, derivation of phase rule, one component system, the water system, the sulphur system, two components system-simple eutectic diagram, formation of compound with congruent M.pt.

**B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-IV)
(Credit Based Evaluation & Grading System)**

Section-C

Chemical Kinetics

Measurement of reaction rate, order, molecularity of reaction, first order reactions, second order reactions, third order reactions, Methods of determination of order, effect of temperature, activation energy, catalysis, Homogeneous catalysis in gases, homogeneous catalysis in solutions.

Section-D

Electro Chemistry

Conductance and Ionic Equilibrium: Faraday's law of electrolysis, transference numbers determination of transference numbers, electrolytic conductance, variation of conductance with concentration, equivalent conductance at infinite dilution, intrinsic attraction theory of conductance. Absolute velocities of ions, degree of ionization and conductance activity & activity coefficients of strong electrolytes, determination of activity coefficients, Debye-Huckel Theory of activity coefficients, Ionization constants of weak acids, and weak bases. Ionic product of water, pH & pOH Buffer solution, hydrolysis, calculation of hydrolytic constants, solubility product, salt effect and solubility.

Electrochemical Cells

Reversible and Irreversible cells, standard cells, cell reaction & EMP. Single electrode potential and its calculation, thermodynamic and EMF, standard potential and equilibrium constants, Classification of electrodes, chemical and concentration cells, Junction potential, solubility product and EMF.

Books Recommended:

1. Physical Chemistry by Samuel H, Carl P. Putton Americ Inc. Co.
2. Physical Chemistry by Glasstone, The Macmillian Press Ltd.
3. Kinetic and Mechanism by Frost A and Pearson R.G, Wiley Eastern Pvt. Ltd.
4. Chemical Kinetic by K.J. Laidler, Harper and Row.
5. Physical Chemistry by Glberg W. Castellian Addison- Wesley publishing Comp.

B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-IV)
(Credit Based Evaluation & Grading System)

HGP-251 LAB EXERCISES IN HUMAN PHYSIOLOGY

Credits: 0-0-1.5

Movements at joints, Bleeding and clotting time, Haemoglobin concentration, RBC and WBC counts, Osmotic fragility of RBC, ESR estimation, Blood pressure and pulse rate estimation, Spirometry.

B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-IV)
(Credit Based Evaluation & Grading System)

HGP-273 LAB EXERCISES IN BIOCHEMISTRY AND MOLECULAR GENETICS

Credits: 0-0-1.5

Demonstration of Beer Lambert Law, Absorption maxima, Qualitative/Quantitative analysis of carbohydrates, lipids and proteins, Paper chromatography, Quantitative analysis of proteins to study the action of salivary amylase on starch, Isolation of casein from milk. Preparation of reagents and buffers for DNA extraction and analysis, DNA extraction from blood using organic method, Quality and quantity checking of DNA samples, Amplification of DNA samples, Demonstration of PCR-RFLP.

B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-IV)
(Credit Based Evaluation & Grading System)

CYP-293 PHYSICAL CHEMISTRY LAB

Credits: 0-0-1

1. Determination of distribution coefficient of iodine between Dichloethane and water
2. Determination of coefficient of viscosity of a given liquid by viscometer.
3. To find the mol. wt. of high polymer by using viscosity measurements.
4. Determination of surface tension of a given liquid by drop number method by stalagmometer.
5. To determine the unknown composition of a mixture of two liquids by surface tension measurements.
6. To determine the critical micelle concentration of a soap (sodium laurate) by surface tension measurements.
7. To determine refractive index of a liquid by Abbe's refractometer and hence the specific and molar refraction.
8. To determine the unknown composition of a given mixture of two liquids by refractive index measurements.
9. Determination of alkalinity & hardness of Water sample.
10. To study the adsorption of acetic acid from its aqueous solution by activated charcoal
11. Determination of distribution coefficient of benzoic acid between toluene & water

Books Recommended:

1. Findlay's Practical Physical Chemistry.
2. Advanced Practical Physical Chemistry by J.B. Jadav
3. Quantitative Organic Analysis by Vogel.

**B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-IV)
(Credit Based Evaluation & Grading System)**

HGL-281 BIOCHEMICAL BASIS OF HUMAN DISEASES

(Elective Paper)

Credits: 3-0-0

Time: 3 Hours

Marks: 75

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

An overview of carbohydrate metabolism; Disorders of carbohydrate metabolism: diabetes mellitus, Hyperinsulinism, glycogen storage diseases including von Gierke disease, Pompe disease, Forbes-Cori disease, Andersen disease, Hers disease, Tarui disease, glycosylation, metabolic basis of disease associated with altered glycosylation.

Section-B

An overview of amino acid metabolism; Disorders of amino acid metabolism including albinism, alkaptonuria, argininosuccinic, Aciduria, Citrullinemia, Homocystinuria, Maple syrup urine disease, Phenylketonuria, Tyrosinemia.

Section-C

An overview of fatty acid metabolism and transportation; Disorders of fatty acid oxidation and transport including Gaucher's disease, Tay-sachs disease, Niemann-pick disease, Fabry's disease, MCAD deficiency.

Section-D

An overview of Nucleic acid metabolism; Disorders of purine and pyrimidine metabolism including Lesch-Nyhan disease, Adenosine deaminase deficiency, Adenine phosphoribosyltransferase deficiency, Adenosuccinate lyase deficiency, Dihydropyrimidine dehydrogenase deficiency, Dihydropyrimidinase deficiency.

Books Recommended:

1. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2015). Biochemistry. W.H. Freeman and Co., New York, 5th ed.
2. Murray, R.K., Bender, D.A., Botham, K.M., Kenelly, P.J., Rodwell, V.W. and Mayes, P.A. (2012). Harper's Illustrated Biochemistry. McGraw-Hill, California.
3. Nelson, D.L. and Cox, M.M. (2017). Lehninger's Principles of Biochemistry. W.H. Freeman and Co., New York, 5th ed.
4. Voet, D., Voet, J.G. and Pratt, C.W. (2016). Fundamentals of Biochemistry: Life at the Molecular Level. John Wiley and Sons, New York.

B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-IV)
(Credit Based Evaluation & Grading System)

HGL-293 FUNDAMENTALS OF GENETIC ENGINEERING
(Elective Paper)

Time: 3 Hours

Credits: 3-0-0

Marks: 75

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Bacterial cell, Bacterial genome, Transposable elements, Methods of microbial DNA replication, transcription and translation, Genetic code, DNA damage, DNA repair mechanisms, Mutagenesis and types of mutations in bacteria, Ames test.

Section-B

Regulation of gene expression; Positive and negative control, Repressors, Inducers, Concept of operon, lac-, ara-, trp operons, attenuation, catabolite repression, genetic Analysis with lac mutants; Structural gene mutations (LacZ-/A-/Y-), Regulatory mutants, Constitutive mutants: *LacI* and *LacO^c*, Uninducible mutations: Promoter and Super-repressor mutants (*lacI^s*), Problems on Lac model

Section-C

Plasmids; structure, classification & functions, Plasmid mobility (Tra genes), Structure of Bacteriophages, Caudovirales, Lytic (e.g T4) & Lysogenic (e.g. Lambda) cycle, Plaque assay, Viral growth curve, Horizontal gene transfer in bacteria: Conjugation, transformation and transduction (specialized & generalized), Interrupted mating experiment, Gene mapping by all these three methods; concept and problems.

Section-D

Cloning strategies in bacteria, Characteristics of vectors, plasmid based vectors (pBR322 and pUC series), Antibiotic screening and blue white screening, Insertional inactivation, Phage based vectors, Insertional vectors, Replacement vectors, Cosmids, Applications of genetic engineering.

Books Recommended

1. Birge, E.A. (2006). Bacterial and Bacteriophage Genetics. Springer Science and Business Media, Inc., USA, 5thed.
2. Dale, J. and Park, S. (2010). Molecular Genetics of Bacteria. John Wiley and Sons, Inc., New York, 5th ed.
3. Grath, S.M. and Sinderen, D. (2007). Bacteriophage: Genetics and Molecular Biology. Caister Academic Press, Nortfolk.
4. Perdew, G.H., Heuvel, J.P.V. and Peters, J.M. (2006). Regulation of Gene Expression: Molecular Mechanisms. Humana Press, Totowa, N.J.
5. Snyder, L. and Champness, W. (2007). Molecular Genetics of Bacteria. AS Press, USA, 3rded.
6. Sonenberg, N., Hershey, J.W.B. and Mathews, M.B. (2000). Translational Control of Gene Expression. Cold Spring Harbour Press, New York.
7. Trun, N.J. and Trempey, J.E. (2004). Fundamental Bacterial Genetics. John Wiley and Sons, Inc., New York.

B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-V)
(Credit Based Evaluation & Grading System)

HGL-301 HUMAN GENETICS AND CYTOGENETICS-I

Credits: 2-1-0

Time: 3 Hours

Marks: 75

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Molecular organization of the human genome, Transposable elements, Human chromosome organization and structure, Chromatin, Nucleosome, Solenoid model, Centromeres, Neocentromeres, Kinetochores, Telomeres, Human artificial chromosomes.

Section-B

Various types of mutations, Role of radiations and chemicals in inducing mutations, Effects of mutations, Mutation rates in humans, Pleiotropy.

Section-C

Animal cell culture technique — Primary culture, Secondary culture, Serum-free cultures, Cell lines. Chromosome banding techniques — G,C,R,Q,T,NOR, High-resolution banding, Molecular correlates of chromosome bands, Fragile sites, Chromosome nomenclature and cytogenetic notation for G-banded chromosomes,

Section-D

Mapping the human genome — Markers, Genetic maps, Cytological maps, Chromosome maps, Physical maps, Somatic cell hybridization in cytogenetic analysis, Applications of amniocentesis, chorionic villus sampling (CVS).

Books Recommended

1. Cummings, M.R. (2009). Human Genetics. Cenage Learning, USA.
2. Czepulkowski, B. (2004). Analysing Chromosomes. Bios Scientific Publishers Ltd., Oxford.
3. Gardner, E.J. (2008). Human Genetics. Viva Books Pvt. Ltd., India.
4. Gersen, S.L. and Keagle, M.B. (2005). The Principles of Clinical Cytogenetics. Humana Press, USA, 2nded.
5. Korf, B.R. and Irons, M.B. (2013). Human Genetics and Genomics. Wiley-Blackwell, Malaysia, 4th ed.
6. Rooney, D.E. and Czepulkowski, B.H. (1986). Human Cytogenetics: A Practical Approach. IRL Press Ltd., Oxford.
7. Schaffer, L.G., Stovak, M.L. and Campbell, L.J. (2009). ISCN-2009. Karger Publishers Germany.
8. Sumner, A.T. (2003). Chromosomes: Organization and Function. Blackwell Publishing Co., Oxford.
9. Therman, E. and Miller, O.J. (2001). Human Chromosomes. Springer-Verlag, New York, 4th ed.
10. Turnpenny, P.D. and Ellard, S. (2011). Emery's Elements of Medical Genetics. Churchill Livingstone, 14th ed.

B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-V)
(Credit Based Evaluation & Grading System)

HGL-303 Population Genetics

Time: 3 Hours

Credits: 3-1-0

Marks: 100

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Historical background and Application of Human Population Genetics. Frequencies of genes and genotypes. Dynamics and conditions of Hardy-Weinberg law and its application for autosomal locus with two and multiple alleles. Testing of Hardy-Weinberg proportion.

Section-B

Kinetics of changes of gene frequencies. Non-recurrent and recurrent mutation, Mutation pressure and estimates of mutation rates. Selection coefficient and fitness, Selection against recessive/dominant/partial dominant/overdominant genes. Heterozygous advantage, Equilibrium between mutation and selection.

Section-C

Dynamics of migration and genetic drift, Consanguinity and inbreeding, Inbreeding coefficient of a population and individual through path analysis. Biological consequences of inbreeding with genetic load and its measurements.

Section-D

Wright's 'F'-statistics. Computation of 'F' for autosomal genes. Population stratification. Classification of races through UNESCO guidelines. Admixture of races. Genetic imprint of admixture and its biological impact. Ethnic elements in Indian population. Objectives of racial classification.

Recommended Books :

1. Balding, D.J., Bishop, M. and Cannings, C.C. (Eds.) (2007). Handbook of Statistical Genetics. John Wiley and Sons, England, Vol. 1&2, 3rd ed.
2. Falconer, F.S. and MacKay, T.F.C. (1996). Introduction to Quantitative Genetics. ELBS/Longman, England, 4th ed.
3. Hamilton, M.B. (2009). Population Genetics. Wiley-Blackwell, USA.
4. Hartl, D.L. and Clark, A.G. (2007). Principles of Population Genetics. Sinaur Associates, Inc., Massachusetts, 4th ed.
5. Hedrick, P.W. (2011). Genetics of Population. Jones and Bartlett Publishers, Massachusetts, 4th ed.
6. Neale, B., Ferreira, M.A.R., Medland, S.E. and Posthuma, D. (Eds.) (2008). Statistical Genetics: Gene Mapping through Linkage and Association. Taylor and Francis Group, USA.

B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-V)
(Credit Based Evaluation & Grading System)

HGL-304 HUMAN GROWTH, PHYSIQUE AND BODY COMPOSITION

Time: 3 Hours

Credits: 3-0-0

Marks: 75

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Growth and development, Methods of studying growth, Laws of growth, Somatic changes in fetal period, childhood, puberty and ageing

Section-B

Growth charts, Growth monitoring, Secular trend, Catch-up growth, Factors influencing growth,
Skeletal maturity, Dental maturity and Sexual maturity.

Section-C

Identification of abnormal growth, Endocrine growth disorders, Chromosome aberrations and growth, Growth patterns in chronic diseases.

Section-D

Methods of studying human physique and body composition, Gross components of human body,
Dysplasia, Gynandromorphy, Somatotyping,

Books Recommended

1. Forbes, C.B. (1987). Human Body Composition. Springer-Verlag, New York.
2. Ghai, O.P., Gupta, P. and Paul, V.K. (2004). Essential Pediatrics. CBS Publishers and Distributors, New Delhi, 6th Revised ed.
3. Gibney, M.J., Macdonald, I.A. and Rocho, H.M. (2004). Nutrition and Metabolism. Blackwell Publishing Co., Oxford.
4. Harrison, G.A. Weiner, J.S. Tanner, J.M. and Barnicot, N.A. (1990). Human Biology. Oxford University Press.
5. McArdle, W.D., Katch, F.I. and Katch, V.L. (2001). Exercise Physiology. Williams and Wilkins, Lippincott.
6. Singh, S.P. and Mehta, P. (2009). Human Body Measurements: Concepts and Applications. PHI Learning Pvt. Ltd., New Delhi.
7. Ulizaszek, S.J., Johnston, F.E. and Preece, M.A. (1998). The Cambridge Encyclopedia of Human Growth and Development. Cambridge University Press.

B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-V)
(Credit Based Evaluation & Grading System)

HGL-405 COMPUTER APPLICATIONS

Time: 3 Hours

Credits: 3-0-0

Marks: 75

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Computer fundamentals, Internet basics and MS-Office 2003, Introduction to digital computers, Organization, Number system, I/O devices, Storage devices, Introduction to internet and its applications – www, email, ftp. MS-Windows basics, MS-Word – Meaning of Word–Processing, Creating, Saving, Printing documents, Formatting, Spell-Check, Adding page numbers, Header and Footer, Macros, Creating tables, Converting table to text and vice-versa, Mail Merge.

Section-B

MS-Excel – Spreadsheets, Using different types of formulae, Creating graphs and charts, Exporting charts to MS-Word, MS-PowerPoint – Creating presentations, Formatting, Adding effects and timings. Types of errors and level of significance, Tests of significance (F and t-test), Chi-square tests,

Section-C

Data analysis and database – Brief description and tabulation of data, Measure of central tendency and dispersion – Mean, Median, Mode, Range, Standard Deviation, Variance and Correlation coefficient using SPSS. Introduction to Data, Information, Database, DBMS (Advantages and disadvantages), Introduction to SQL (Data retrieval).

Section-D

Virtual library and some useful sites on Internet – Searching MEDLINE on the Pubmed system from National Centre for Biotechnology and Information. Assessing full text journals on the internet and printing articles using EndNote.

Books Recommended:

- 1 Sinha, P.K. (1992). Computer Fundamentals.
- 2 Peter Norton's Introduction to Computers, 6th ed.
- 3 Windows Based Computer Courses, Sumit Kumar, JBD Publishers.
- 4 Gupta, S.C. (2004). Fundamentals of Statistics. Himalaya Publishing House.

B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-V)
(Credit Based Evaluation & Grading System)

Website Links

Databases (Genes Bank), search tools and software at

<http://www.ncbi.nlm.nih.gov>.

Restriction enzyme site digestion webcutter2.0 at

<http://www.firsmarket.com/cutter/cut2.html>.

PCR and multiplex PCR guide and troubleshooting at

<http://www.med.yale.edu/genetics/ward/tavi/Trblesht.html>

Image analysis program at

<http://www.scioncorp.com>.

B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-V)
(Credit Based Evaluation & Grading System)

HGP-301 HUMAN GENETICS AND CYTOGENETICS (PRACTICAL)

Credits: 0-0-1.5

Demonstration of short-term blood lymphocyte culture — Washing and sterilization of glassware and plasticware, Preparation of chemical solutions and culture medium, Harvesting the culture, Staining, Banding and Scoring of prepared slides, Demonstration of photomicrography, Developing and printing of photographs, Karyotyping of solid-stained and G-banded chromosome preparations, Identification of structural and numerical chromosomal aberrations from photographs, Sister chromatid exchange analysis from peripheral blood lymphocyte culture, Numericals on chromosome nomenclature.

B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-V)
(Credit Based Evaluation & Grading System)

HGP-304 HUMAN GROWTH, PHYSIQUE AND BODY COMPOSITION
PRACTICAL

Credits: 0-0-1.5

Landmarks, Somatometric measurements, Assessment of nutritional status from anthropometric measurements, Heath and Carter method of somatotyping, Body composition assessment from skinfolds, and Demonstration of Bioelectrical impedance analysis (BIA).

B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-V)
(Credit Based Evaluation & Grading System)

HGL-282 INTRODUCTION TO MICROSCOPY
(Elective Paper)

Time: 3 Hours

Credits: 3-0-0

Marks: 75

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Note to Paper Setters: There should be eight (8) questions (of equal marks; 80% of the total marks), two from each of the four sections (Sections A – D). Sub-sections (not exceeding 4) can be made for each question with appropriate marks allocated to each sub-section. The candidates have to attempt five questions in all by selecting one question from each section and the fifth question may be attempted from any section.

Section-A

Simple microscope: Lenses, lens aberration, objective lens, light source, stage, light path, Compound microscope, resolution, magnification. Methods of specimen preparation for bioimaging: Fixation, dehydration, infiltration, staining.

Section-B

Methods of optical contrast: Dyes, phase contrast, dark field microscopy, polarization microscopy, Differential interference contrast microscopy.

Section-C

Fluorescence microscope, Confocal microscope, Scanning electron microscope, Transmission electron microscope, Videomicroscopy, Electron imaging.

Section-D

Imaging ions and intracellular messenger, Imaging of macromolecules and supramolecular complexes, Detection of molecular motions and interactions (FRET, FRAP, FCS).

Books Recommended:

1. Chandler, D.E. and Robertson, R.W. (2009). Bioimaging: Current Concepts in Light and Electron Microscopy. Jones and Barlett Publishers, USA.
2. Gersen, S.L. and Keagle, M.B. (2005). The Principles of Clinical Cytogenetics. Humana Press, USA, 2nd ed.

B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-V)
(Credit Based Evaluation & Grading System)

HGL-292 HUMAN EMBRYOLOGY
(Elective Paper)

Time: 3 Hours

Credits: 3-0-0

Marks: 75

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Fertilization, Cleavage, Blastocyst formation, Bilaminar disc, Gastrulation, Three-germ layer, Notochord formation, Establishing body axes, fate map during gastrulation, Derivative of three- germ layers, Placentation

Section-B

Development of Central nervous system and eye , Head and neck, Ear. Integumentary system development.

Section-C

Overview of development of limbs, skeletal system, Muscular system, Body cavities, Overview of development of cardiovascular system,

Section- D

Overview of development of Respiratory system, Digestive system, Urogenital system.

Books Recommended:

1. Gilbert, S.F. (2011). Developmental Biology. Sinauer Associates, Inc., Sunderland, MA.
2. Sadler, T.W. (2010). Langman's Medical Embryology. Williams and Wilkins, USA, 11thed.
3. Singh, I. and Paul, G.P. (2011). Human Embryology. McMillan Co., New Delhi.

**B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-VI)
(Credit Based Evaluation & Grading System)**

HGL-351 HUMAN GENETICS AND CYTOGENETICS-II

Time: 3 Hours

Credits: 2-1-0

Marks: 75

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Cell-cycle progression and check points, Chromosome dynamics in M-phase, Role of SMC and non-SMC proteins in regulation of cell cycle.

Section-B

Modes of inheritance in humans, Mendelian and Non-Mendelian inheritance, Multifactorial inheritance and quantitative traits, Threshold model and recurrence risks, Genetics of sex determination, Sex-linked, sex-limited and sex-influenced traits, Manifesting Heterozygotes, Mosaics and chimeras, True- and pseudo-hermaphrodites, Sex ratio.

Section-C

Introduction to light, fluorescent and confocal microscopy, FISH, CGH technique, Genetic basis of cancer — Proto-oncogenes, oncogenes and tumour-suppressor genes, Marker chromosomes, Chromosomal basis of neoplasia.

Section-D

Chromosomal instability syndromes – Ataxia telangectasia, Fanconi anemia, Bloom's Syndrome, Nijmegen breakage syndrome, Genetic toxicology.

Books Recommended

1. Cummings, M.R. (2003). Human Heredity: Principles and Issues. Thompson, Brooks/Cole, 6thed.
2. Cummings, M.R. (2009). Human Genetics. Cengage Learning, USA.
3. Farzaneh, F. and Cooper, D.N (Eds.) (1995). Functional Analysis of the Human Genome. Bios Scientific Publishers Ltd., Oxford.
4. Gardner, E.J. (2008). Human Genetics. Viva Books Pvt. Ltd., India.
5. Hancock, J.H. (2008). Molecular Genetics. Viva Books Pvt. Ltd., India.
6. Harper, P.S. (2006). First Years of Human Chromosomes. Scion, USA.
7. Korf, B.R. (2006). Human Genetics and Genomics. Blackwell Publishing Co., Oxford.
8. Sambamurty, A.V.S.S. (2006). Genetics. Narosa Publishing House, New Delhi.
9. Strachan, T. and Read, A. (2004). Human Molecular Genetics. Bios Scientific Publishers, Oxford.
10. Sumner, A.T. (2003). Chromosomes: Organization and Function. Blackwell Publishing Co., Oxford.
11. Tamarin, R.H. (2002). Principles of Genetics. Tata McGraw Hill, USA, 7thed.
12. Therman, E. and Miller, O.J. (2001). Human Chromosomes. Springer-Verlag, New York, 4thed.

B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-VI)
(Credit Based Evaluation & Grading System)

HGL-354 APPLIED DNA TECHNOLOGY

Time: 3 Hours

Credits: 3-0-0
Marks: 75

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Recombinant DNA (rDNA) technology, Cloning vectors — Plasmids, Cosmids, Phagemids, Bacteriophages, Bacterial artificial chromosome, Yeast artificial chromosome, Enzymes used in DNA technology — Restriction endonucleases, Ligases, Kinases and Phosphatases.

Section-B

Safety issues in rDNA experiments - physical contaminants, biological contaminants, Elements of contaminant, Biosafety levels for infectious agents, Applications of recombinant DNA technology: Transgenic animals and plants as bioreactors, Recombinant bacterial vaccines, Recombinant viruses as vaccines, Plants as edible vaccines, DNA vaccines.

Section-C

Linkers and adaptors, Site-directed mutagenesis, Applications of site-directed mutagenesis, Reverse transcriptase, Reverse transcription, DNA libraries; Preparation of cDNA and genomic libraries, Applications of cDNA and genomic libraries.

Section-D

Principles and applications of blotting techniques — Southern blotting, Northern blotting, Western blotting, Dot-slot blotting, Agarose gel, Polyacrylamide gel, Pulse-field gel Electrophoresis, DNA fingerprinting and its applications, DNA sequencing techniques: Sanger sequencing and Maxam and Gilbert sequencing.

Books Recommended:

1. Brown, T.A. (2010). Gene Cloning and DNA Analysis: An Introduction. Blackwell Publishing Co., Oxford, 6thed.
2. Freifelder, D.C. (2008). Molecular Biology. Narosa Publishing House, New Delhi, 2nd ed.
3. Glick, B.R.R. and Pasternak, J.J. (2002). Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press, Washington, DC.
4. Lewin, B. (2008). Genes-IX. Jones and Barlett Publishers, Inc., USA.
5. Pasternak, J.J. (2005). An introduction to Human Molecular Genetics, Mechanisms of Inherited Diseases. John Wiley and Sons, Inc., New Jersey.

**B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-VI)
(Credit Based Evaluation & Grading System)**

HGL- 356 IMMUNOLOGY AND IMMUNOGENETICS

Time: 3 Hours

**Credits: 2-1-0
Marks: 75**

**Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage**

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Section-A

Introduction: Historical Perspective of Immunology, Types of immunity: Innate and Adaptive, Active and Passive, Humoral and Cell Mediate Immunity. Features of immune response: Recognition of self and non-self, Specificity, Memory and Diversity. Pattern recognition receptors (PRRs). Brief description of Phagocytosis, inflammatory cascade and Complement cascade.

Section-B

Cells of Immune System: T-cells, B-cells, Null cells, Monocytes, Polymorphonuclear cells. Primary and secondary lymphoid organs: Thymus, Bursa of fabricius, Spleen and Lymph nodes; Mucosa associated lymphoid tissue (MALT), Gut associated lymphoid tissue (GALT).

Section-C

Antigen: Immunogenicity and Antigenicity, Factors affecting immunogenicity. Characteristic features of B- and T-cell epitopes. Adjuvants: Types and Mechanism of action.

Brief introduction to arms of adaptive immunity: Immunoglobulins: classes, structure, characteristic features, T-cell subsets and surface markers, Structure of T-cell antigen receptor (TCR).

Section-D

Major Hiotocompatibility Complex: Genomic organization of MHC, Structure of class I and II MHC, Role of MHC in antigen presentation to T cells.

Immunodiagnostic Procedures: Affinity and avidity in antigen-antibody interactions, Immunodiagnostic techniques: Immunodiffusion, Agglutination assays including Bacterial agglutination, Hemagglutination and Hemagglutination inhibition.

Books Recommended:

1. Owen, J.A., Punt, J. and Stanford, S.A. Kuby Immunology (2013). W.H. Freeman and Company, New York.
2. Roitt, I.M., Brostoff, J. and Male, D.K. (2012). Immunology. Mosby Inc, UK.
3. Murphy, K. and Weaver, C. (2017). Janeway's Immunobiology: The Immune System in Health and Disease. Garland Science, Taylor & Francis, New York, USA.

B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-VI)
(Credit Based Evaluation & Grading System)

HGP-371 HUMAN GENETICS AND MOLECULAR GENETICS

(PRACTICAL)

Credits: 0-0-2

Numericals on Mendelian and non-Mendelian inheritance in humans, Pedigree analysis, To test PTC tasting ability in a random sample and calculate gene frequencies for the taster and non-taster alleles, To study fingerball and palmar dermatoglyphics and calculate indices, To test for colour blindness using Ishihara charts, Demonstration of polymerase chain reaction (PCR), Agarose gel electrophoresis to test amplified products, Demonstration of polyacrylamide gel electrophoresis (PAGE).

B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-VI)
(Credit Based Evaluation & Grading System)

HGP-394 LAB EXERCISES IN TISSUE CULTURE AND MICROSCOPY
(Elective Paper)

Credits: 0-0-1.5

The paper is based on the current techniques in Tissue Culture and Microscopy. Lymphocytes and tissue culture techniques. Identification of cytogenetic aberration. Demonstration of various microscopic techniques Light microscopy, Phase contrast, Fluorescent, Confocal, SEM, TEM. The students will have laboratory attachments with different faculty members for varying time span and will be examined for different practical techniques that they have learnt during the semester.

**B.Sc. (HONS. SCHOOL) HUMAN GENETICS (SEMESTER-VI)
(Credit Based Evaluation & Grading System)**

**HGP-395 LAB EXERCISES IN BIOCHEMICAL GENETICS AND
IMMUNOGENETICS (Elective Paper)**

Credits: 0-0-1.5

Blood grouping from erythrocytes, blood stains and saliva stains, Estimation of serum cholesterol, triacylglycerides, HDL, LDL, blood sugar, SGOT and SGPT using semi-automated blood analyzer, Thin layer chromatography. Affinity chromatography, Enzyme-linked immunosorbent assay (ELISA), Double immunodiffusion (DID), Immunoelectrophoresis, Agglutination reactions.