KURUKSHETRA UNIVERSITY KURUKSHETRA

Scheme of Examination and Syllabus for

Under-Graduate Programme

(Subject: Genetics with Scheme 'A' only)

Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020 w.e.f. 2023-24 (in phased manner)

DEPARTMENT OF BOTANY, KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme of Examination for Under-Graduate Programme
Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020 w.e.f. 2023-24
(in phased manner)
Subject : Genetics

SEMESTER-1									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External MarksB 23-GEN-101**	**Total Marks**	**Exam Duration**
Scheme A	**CC-1 MCC-1 4 credits**	B23-GEN-101	INTRODUCTION TO GENETICS	3	3	20	50	70	3 hrs.
			PRACTICAL	1	2	10	20	30	4 hrs.
	CC-M1 2 credits	B23-GEN-102	GENETICS TO MANKIND	1	1	10	20	30	3 hrs.
			PRACTICAL	1	2	5	15	20	4 hrs.
	MDC-1 3 credits	B23-GEN-103	CYTOGENETICS	2	2	15	35	50	3 hrs.
			PRACTICAL	1	2	5	20	25	4 hrs.
	CC-M1 4 credit	From Available CC-M1 of 4 credits as per NEP							
	AEC-1 2 credit	From Available AEC-1 of two credits as per NEP							
	SEC-1 3 credit	From Available SEC-1 of three credits as per NEP							
	VAC-1 2 credit	From Available VAC-1 of two credits as per NEP							

SEMESTER-2									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A	**CC-2 MCC-3 4 credits**	B23-GEN-201	MOLECULAR CYTOGENETICS	3	3	20	50	70	3 hrs.
			PRACTICAL	1	2	10	20	30	4 hrs.
	CC-M2 2 credits	B23-GEN-202	BASIC HUMAN GENETICS	1	1	10	20	30	3 hrs.
			PRACTICAL	1	2	5	15	20	4 hrs.
	MDC-2 3 credits	B23-GEN-203	PLANT BREEDING	2	2	15	35	50	3 hrs.
			PRACTICAL	1	2	5	20	25	4 hrs.
	CC-M2 4 credits	From Available CC-M2 of 4 credits as per NEP							
	AEC-2 2 credits	From Available AEC-2 of two credits as per NEP							
	SEC-2 3 credits	From Available SEC-2 of three credits as per NEP							
	VAC-2 2 credits	From Available VAC-2 of two credits as per NEP							
Internship of 4 credits of 4-6 weeks duration after 2nd Semester									

SEMESTER-3									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A	**CC-3 MCC-4 4 credits**	B23-GEN-301	MICROBIAL GENETICS	3	3	20	50	70	3 hrs.
			PRACTICAL	1	2	10	20	30	4 hrs.
	MDC-3 3 credits	B23-GEN-302	TRANSGENICS IN BIOLOGY	2	2	15	35	50	3 hrs.
			PRACTICAL	1	2	5	20	25	4 hrs.
	CC-M3 4 credits	From Available CC-M3 of 4 credits as per NEP							
	CC-M3 (V) 4 credits	From Available CC-M3(V) of 4 credits as per NEP							
	AEC-3 2 credit	From Available AEC-3 of two credits as per NEP							
	SEC-3 3 credit	From Available SEC-3 of three credits as per NEP							
SEMESTER-4									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A	**CC-4 MCC-6 4 credits**	B23-GEN-401	MOLECULAR GENETICS	3	3	20	50	70	3 hrs.
			PRACTICAL	1	2	10	20	30	4 hrs.
	CC-M4 (V) 4 credits	From Available CC-M4(V) of 4 credits as per NEP							
	AEC-4 2 credits	From Available AEC-3 of two credits as per NEP							
	VAC-3 2 credits	From Available VAC-3 of two credits as per NEP							
Internship of 4 credits of 4-6 weeks duration after 4th Semester (if not done after second semester)									

SEMESTER-5									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A	**CC-5 MCC-9 4 credits**	B23-GEN-501	POPULATION AND EVOLUTIONARY GENETICS	3	3	20	50	70	3 hrs.
			PRACTICAL	1	2	10	20	30	4 hrs.
	CC-M5 (V) 4 credits	From Available CC-M5(V) of 4 credits as per NEP							
	Internship 4 credits	Internship#4 credit after 4th semester							
SEMESTER-6									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A	**CC-6 MCC-11 4 credit**	B23-GEN-601	AGRICULTURAL GENETICS	3	3	20	50	70	3 hrs.
			PRACTICAL	1	2	10	20	30	4 hrs.
	CC-M6 4 credits	From Available CC-M6 of 4 credits as per NEP							
	CC-M7(V) 4 credits	From Available CC-M7(V) of 4 credits as per NEP							

Session: 2023-24			
Part A - Introduction			
Subject	**GENETICS**		
Semester	**SEMESTER-I**		
Name of the Course	**INTRODUCTION TO GENETICS**		
Course Code	**B23-GEN-101**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**CC-1/MCC-1**		
Level of the course (As per Annexure-I)	**100-109**		
Pre-requisite for the course (if any)	**Nil**		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Theory Max. Marks: 70 Internal Assessment Marks: 20 End Term Exam Marks: 50	Duration of Exam: 3 hours		
Practical Max. Marks: 30 Internal Assessment Marks: 10 End Term Exam Marks: 20	Duration of Exam: 4 hours		

Part B- Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit . The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topics	Contact Hours
I	**Background and Scope:** Introduction, historical background, epigenesis, preformation and germplasm theories of heredity, applications for human	11

	welfare. **Mendel's Laws of Inheritance:** Principles of segregation and independent assortment, expressivity and penetrance; numerical problems based on Mendelism **Interaction of Genes:** Incomplete inheritance and co-dominance, pleiotropism, modification of F2 ratios: epistasis, complementary genes, supplementary genes, inhibitory genes, duplicate genes, lethality and collaborators genes.	
II	**Linkage:** History, coupling and repulsion hypothesis, chromosomal theory of linkage, complete and incomplete linkage, linkage groups and significance of linkage. **Crossing Over:** Introduction, mechanism of meiotic crossing over, types of crossing over, interference and coincidence, theories regarding mechanism, factors affecting it and its significance.	11
III	**Sex Determination:** Sex determination in animals, humans and plants: hormonal and environmental control of sex; gene dosage compensation**.** **Sex Linkage:** Sex-linked characters and their inheritance in *Drosophila*, humans and plants. Sex limited and sex influenced traits. **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.	12
IV	**Multiple Allelism:** Introduction, characteristics, examples in *Drosophila*, rabbit and humans. **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. **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.	11
V*	**PRACTICAL** 1. To study the structure and functioning of a compound microscope. 2. Numerical problems on Mendelism and on modified F2 ratios: Complementary inhibitory, epistatic, duplicate, supplementary and lethal gene interactions and multiple alleles. 3. Study of polytene chromosomes and lampbrush chromosomes from permanent slides. 4. Detection of sex chromatin bodies: Barr bodies and drumsticks of human beings 5. Study of ABO groups & Rh factor. 6. Meiosis through temporary squash preparation. 7. To study the karyotype using a given metaphase chromosome picture	30

	(*Allium cepa*).	

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory** ·Class Participation: ·Seminar/presentation/assignment/quiz/class test etc.: ·Mid-Term Exam: ➢ **Practicum** ·Class Participation: ·Seminar/Demonstration/Viva-voce/Lab records etc.: ·Mid-Term Exam:	**End Term Examination:**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th Ed. Sinauer Associates, Inc. • Publishers Sunderland, Massachusetts U.S.A.
- De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia
- Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
- Lewin, B. 2018. Genes XII, Oxford University Press, Oxford, UK
- Alberts, B.Bray, D.Lewis, J., Raff, M.., Roberts, K. and Watson J.D. 1999. Molecular Biology of Cell. Garland Publishing Co., Inc., New York, USA.
- Gupta, P.K. 1999. A textbook of Cell and Molecular Biology. Rastogi Publications, Meerut, India.
- Kleinsmith, L. J and Kish, V.M. 1995. Principles of Cell and Molecular Biology (2nd edition) Harper Collins College Publishers, New York, USA.
- Lodish, H., Berk, A., Zipursky, S.L., Matsudaria, P., Baltimoe, D. and Darnell, J. 2000. Molecular, Cell Biology, W.H. Freeman and Co., New York., USA.

Session: 2023-24			
Part A - Introduction			
Subject	**GENETICS**		
Semester	**SEMESTER-I**		
Name of the Course	**GENETICS TO MANKIND**		
Course Code	**B23-GEN-102**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**CC-M1**		
Level of the course (As per Annexure-I)	**100-109**		
Pre-requisite for the course (if any)	Nil		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
Theory Max. Marks: 50 Internal Assessment Marks: 15 End Term Exam Marks: 35	Duration of Exam: 3 hours		
Practical Max. Marks: 20 Internal Assessment Marks: 5 End Term Exam Marks: 15	Duration of Exam: 4 hours		

Part B- Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit . The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topics	Contact Hours

I	**HISTORY AND IMPACT OF GENETICS IN MEDICINE AND SOCIETY**: The history of Genetics to Medicine and Society, Medical Genetics, Heredity and environment (twin studies), Eugenics, Euthenics and Euphenics.	7
II	**GENETIC MODIFICATIONS AND DISORDERS:** Cross breeding and genetic modifications in plants and animals Genetic diseases and disorders, Genetic Testing (Prenatal & Postnatal)	8
III	**HUMAN GENOME PROJECT:** Project, Beginning and Organization of the HGP, Sequencing of the Human Genome, Promises and Achievements.	8
IV	**GENE THERAPY:** Stem cells- Properties, types and sources. A brief account on Cord blood banking and Stem cell therapy	7
V*	**PRACTICAL** 1. Karyotype studies of Normal male and female Human from micro photographs 2. Preparation of Idiograms 3. Identification of chromosomal disorders with the help of karyotype. 4. Project report on Genetic Disorders 5. Meiosis through temporary squash preparation. 6. To study the karyotype using a given metaphase chromosome picture (A*llium cepa*). 7. Problems on Genetics based on dihybrid crosses, sex-linked inheritance and blood Groups. 8. Study of various human genetic traits. Genetic disorders	30

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory** ·Class Participation: ·Seminar/presentation/assignment/quiz/class test etc.: ·Mid-Term Exam: ➢ **Practicum** ·Class Participation: ·Seminar/Demonstration/Viva-voce/Lab records etc.: ·Mid-Term Exam:	**End Term Examination:**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Introduction to Genetics, A Molecular Approach, T. Brown, Garland Science, 2012
- Genome Duplication, Concepts, Mechanism, Evolution and Disease, M.L. De Pamphilis and S.D. Bell, Garland Science, 2011.
- Human Molecular Genetics, 4th ed., T.Strachan and A.Read, Garland Science, Taylor and Francis Group, 2011.
- A Guide to Genetic Counseling, 2nd ed., W.R.Uhlmann, J.L.Schuette and B.M.Yashar, Wiley, Blackwell, 2009.

Session: 2023-24			
Part A - Introduction			
Subject	**GENETICS**		
Semester	**SEMESTER-I**		
Name of the Course	**CYTOGENETICS**		
Course Code	**B23-GEN-103**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**MDC-1**		
Level of the course (As per Annexure-I)	**100-109**		
Pre-requisite for the course (if any)	Nil		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
Theory Max. Marks: 50 Internal Assessment Marks: 15 End Term Exam Marks: 35	Duration of Exam: 3 hours		
Practical Max. Marks: 25 Internal Assessment Marks: 5 End Term Exam Marks: 20	Duration of Exam: 4 hours		

Part B- Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit . The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topics	Contact Hours
I	**Cell:** Cell as a unit of structure and function. Organization of plant and animal cells. **Nucleus:** Structure, nuclear pore complex, nucleolus, sex chromatin (Barr body).	8
II	**Chromosomes:** Structure and morphology of chromosomes, chemical organization, karyotype study. **Cell Cycle:** Different Phases of Cell cycle, Brief account of Mitosis and Meiosis	8
III	**Linkage:** History, coupling and repulsion hypothesis, chromosomal theory of linkage, linkage groups and significance of linkage. **Crossing Over:** Introduction, mechanism and its significance.	7
IV	**Structural changes in chromosomes:** Deficiencies, duplications, inversions and translocations; their consequences. **Numerical changes in chromosomes:** Aneuploidy, euploidy, their types and applications.	7
V*	**PRACTICAL** 1.To study the structure and functioning of a compound microscope. 2. Karyotype studies of Normal male and female Human from micro photographs 3. Preparation of Idiograms 4. Identification of chromosomal disorders with the help of karyotype. 5. Study of different stages of mitosis and meiosis from permanent slides. 6. To study different mitotic stages in root tips of *Allium cepa*. 7. To work out the genetics of a cross from the given F_{-2} harvest.	30

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination:**
➢ **Theory** ·Class Participation: ·Seminar/presentation/assignment/quiz/class test etc.: ·Mid-Term Exam: ➢ **Practicum** ·Class Participation: ·Seminar/Demonstration/Viva-voce/Lab records etc.: ·Mid-Term Exam:	

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th Ed. Sinauer Associates, Inc. • Publishers Sunderland, Massachusetts U.S.A.
- De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia
- Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons In.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cumming
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetic Analysis. IX Edition. W. H. Freeman and Co.
- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India

Session: 2023-24			
Part A - Introduction			
Subject	**GENETICS**		
Semester	**SEMESTER - II**		
Name of the Course	**MOLECULAR CYTOGENETICS**		
Course Code	**B23-GEN-201**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**CC-2/MCC-3**		
Level of the course (As per Annexure-I)	**100-109**		
Pre-requisite for the course (if any)	Nil		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Theory Max. Marks: 70 Internal Assessment Marks: 20 End Term Exam Marks: 50	Duration of Exam: 3 hours		
Practical Max. Marks: 30 Internal Assessment Marks: 10 End Term Exam Marks: 20	Duration of Exam: 4 hours		

Part B- Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit . The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topics	Contact Hours
I	**Genome Organization:** Hierarchy in genome organization, Mobile DNA. Brief account of Epigenetics.	11

	Somatic Cell Genetics: Agents and mechanism of cell fusion, Heterokaryon – selection of hybrids and chromosome segregation	
II	**Mutation:** Basic features of mutation, Phenotypic effects of mutations, Molecular basis of gene mutation, Mutations induced by chemicals, radiation, Mutations caused by the DNA replication machinery, Detection of mutation- The Ames Test. **DNA repair mechanisms:** DNA repair mechanisms; Diseases resulting from defects in DNA repair mechanisms	11
III	**Molecular Cytogenetic Techniques:** DNA fingerprinting: Principle, procedure and applications, Flow cytometry, Chromosome painting, Polymerase chain reaction (PCR), Fluorescence in situ hybridization (FISH). **Mitochondrial DNA and human diseases:** Structure of mitochondrial DNA and human diseases.	12
IV	**Genetics of cancer:** Properties of cancer cells, metastasis, Oncogenes, Tumor suppressor genes. **Drosophila Genetics:** Introduction to *Drosophila* genetics, advantages of *Drosophila* as a model organism for genetic studies. Polytene chromosomes.	11
V*	**PRACTICAL** 1. Demonstration of Barr bodies in leucocytes of human female 2. Demonstration of salivary gland chromosomes from Chironomus /Drosophila Larvae 3. Study of meiosis from Grasshopper / Rat testes using smear method 4. Histological demonstration of meiosis in Rat testis 5. Preparation of human karyotypes by using photograph/picture 6. Problems on Genetics based on dihybrid crosses, sex-linked inheritance and blood Groups. 7. Study of various human genetic traits. Genetic disorders 8. Study of mDNA disorders through Photographic slides	30

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory** ·Class Participation: ·Seminar/presentation/assignment/quiz/class test etc.: ·Mid-Term Exam: ➢ **Practicum** ·Class Participation: ·Seminar/Demonstration/Viva-voce/Lab records etc.: ·Mid-Term Exam:	**End Term Examination:**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Atherly, A.G., J.R. Girton and J.F. McDonald. The Science of Genetics. Saunders College Publishing, Harcourt Brace College Publishers, NY.
- Brooker, R.J. Genetics: Analysis and Principles, Benjamin Cummings, Longman
- Fairbanks, D.J.and W.R.Anderson. Genetics – The continuity of Life. Brooks/Cole Publishing Company ITP, NY, Toronto.
- Gardner, E.J., M.J. Simmons and D.P. Snustad. Principles of Genetics. John Wiley and Sons,Inc. NY.
- Griffiths, A.J.F., J.H.Miller, D.T. Suzuki, R.C. Lewontin and W.M. Gelbart. An Introduction to genetic analysis. W.H. Freeman and Company, NewYork.
- Lewin, B. Genes. VI. Oxford University Press, Oxford, New York, Tokyo.
- Snustad, D.P. and M.J. Simmons. Principles of Genetics. John Wiley & Sons.
- Watson, J.D., N.H. Hopkins, J.W. Roberts, J.A. Steiz and A.M. Weiner, Molecular Biology of Genes. The Benjamin/Cummings Pub. Co. Inc.Tokyo
- Mange E.J.and A.P.Mange.Basic Human Genetics 2nd edn.Sinauer Associates
- Russel P. J. Genetics 5th edn.The Benjamin/Cummings Pub.Co.
- Vogel, F. and A.G.Motulsky.Human Genetics . 2nd edn.Springer-Verlog, NY
- Hartl.D.L.and E.W.Jones: Genetics-Principles and analysis.4th edn. Jones & Bartlett Pub.Boston
- Weaver R.F. & P.W.Hedrick : Genetics 3rd edn. Wm.C.Brown Pub.London
- Tollefsbol T. Handbook of Epigenetics : The New Molecular and Medical Genetics. Academic Press

Session: 2023-24			
Part A - Introduction			
Subject	**GENETICS**		
Semester	**SEMESTER-II**		
Name of the Course	**BASIC HUMAN GENETICS**		
Course Code	**B23-GEN-202**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**CC-M2**		
Level of the course (As per Annexure-I)	**100-109**		
Pre-requisite for the course (if any)	Nil		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Theory Max. Marks: 50 Internal Assessment Marks: 15 End Term Exam Marks: 35	Duration of Exam: 3 hours		
Practical Max. Marks: 20 Internal Assessment Marks: 5 End Term Exam Marks: 15	Duration of Exam: 4 hours		

Part B- Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit . The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topics	Contact Hours
I	**History and Development of Human Genetics:** Overview of historical milestones in Human genetics, Fields of Human genetics, Study tools in	11

	Human Genetics: pedigree- gathering family history symbols, construction of pedigree, pedigree analysis in monogenetic traits; Human Genome Project.	
II	**Human Cytogenetics:** Human chromosomes, Human karyotype, Nomenclature of banding, techniques in human chromosome analysis, Nomenclature of aberrant karyotypes; autosomal and sex chromosomal abnormalities and common genetic disorders: Down syndrome, Klinefelter syndrome, Turner syndrome, Cri-du-chat syndrome, Haemophilia, Alkaptonuria.	12
III	**Cancer genetics:** Cancer cells, Characteristics of cancer cells, origin, tumour suppressor genes, Oncogenes; Types and cure of cancer, Leukaemias, Lymphomes, myelomas.	11
IV	**Human genetics and Ethical, legal and social considerations:** Human cloning; Human rights, Surrogate mothers, Ethical, legal and social issues in Human Genetics, Medical ethics in India.	11
V*	**PRACTICAL** 1. Preparation of Karyotype of Normal male and female from the provided photographs of metaphase plates. 2. To prepare karyotype for the provided metaphase plates and identify the genetic condition: i. Down' syndrome ii. Turner syndrome iii. Klinefelter syndrome iv. Patau syndrome v. Fragile X syndrome 3. To study inheritance patterns by pedigree analysis. 4. Preparation of Idiograms from the provided photographs of metaphase plates.	30

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory** ·Class Participation: ·Seminar/presentation/assignment/quiz/class test etc.: ·Mid-Term Exam: ➢ **Practicum** ·Class Participation: ·Seminar/Demonstration/Viva-voce/Lab records etc.: ·Mid-Term Exam:	**End Term Examination:**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Human Heredity : Principles and Issues by Micheal R. Cummings; 11th edition, Cengage Learning, 2016.
- Essential of Human Genetics (4th edition) by S. M. Bhatnagar, M. L. Kothari and L. A. Mehta (ISBN: 81-250-1426-8).
- Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by P S Verma and V K Agraval (Multicolour/14th Edition) Published by S. Chand and company Ltd., New Delhi (ISBN: 81-219-2442-1).
- Verma, Ram S. / Babu, Arvind, Human Chromosomes, Principles and Techniques 2nd edition, Mc Graw-Hill, Inc., New York, 1995, ISBN 0-07-105432-4
- Essential of Modern Genetics by V C Shah. Nirav Prakashan, Ahmedabad
- Hema Purandare & Amit Chakravarty, Bhalani Publishing House, Mumbai. Human Cytogenetic Techniques & Clinical Applications, 2000, ISBN 81 85578 41 9
- Essentials of Human Genetics by S.M. Bhatnagar et al, 4th Edition, (1999), Orient Longman. ISBN: 81-250-1426-8
- Modern Genetic Analysis, Griffiths AJF, Gelbart WM, Miller JH et al., - Freeman
- An Introduction to Genetic Analysis, Griffiths AJF, Miller JH, Suzuki DT et al., - Freeman

Session: 2023-24			
Part A - Introduction			
Subject	**GENETICS**		
Semester	**SEMESTER-II**		
Name of the Course	**PLANT BREEDING**		
Course Code	**B23-GEN-203**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**MDC-2**		
Level of the course (As per Annexure-I)	**100-109**		
Pre-requisite for the course (if any)	Nil		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
Theory Max. Marks: 50 Internal Assessment Marks: 15 End Term Exam Marks: 35	Duration of Exam: 3 hours		
Practical Max. Marks: 25 Internal Assessment Marks: 5 End Term Exam Marks: 20	Duration of Exam: 4 hours		

Part B- Contents of the Course

Instructions for Paper- Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No.1 will be short answer type covering the entire syllabus and will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each unit . The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

Unit	Topics	Contact Hours
I	Objectives of plant breeding; modes of reproduction in crop plants; important achievements and undesirable consequences of plant breeding	7

II	Centers of origin and domestication of crop plants; plant genetic resources; acclimatization; selection methods for self-pollinated, cross-pollinated and vegetatively propagated plants	7
III	Cytogenetic basis of plant breeding-variation in chromosome number, mutation, fertility regulation mechanism, gene recombination in plant breeding	8
IV	Inbreeding depression and heterosis; role of mutations, distant hybridization and biotechnology in crop improvement.	8
V*	**PRACTICAL** 1. To study strains and fixatives used in cytogenetics. 2. To study the karyotype using a given metaphase chromosome picture (A*llium cepa*). 3. To work out the genetics of a cross from the given F_{-2} harvest. 4. To study different tools and techniques used in plant breeding. 5. To study grafting methods and its advantages. 6. To study different methods of vegetative propagation. 7. Plant Breeder's kit, Study of germplasm of various crops 8. Study of floral structure of self-pollinated and cross pollinated crops 9. Emasculation and hybridization techniques in self pollinated crops 10. Emasculation and hybridization techniques in cross pollinated crops 11. Designs used in plant breeding experiments, analysis of Randomized Block Design 12. Methods of calculating mean, range, variance, standard deviation, heritability 13. Prediction of performance of double cross hybrids 14. Consequences of inbreeding on genetic structure of resulting populations 15. Study of male sterility system	30

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory** ·Class Participation: ·Seminar/presentation/assignment/quiz/class test etc.: ·Mid-Term Exam: ➢ **Practicum** ·Class Participation: ·Seminar/Demonstration/Viva-voce/Lab records etc.: ·Mid-Term Exam:	**End Term Examination:**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Singh, B.D. 2022. Plant Breeding: Principles and Methods. Medtech Science Press. 12th edition.
- Singh, BD. 2020. Genetics. Kalyani Publishers Delhi.
- Cummings MR, Klug WS, Spencer, CA, Palladino, MA, Killian D. 2019. Concepts of Genetics, Pearson. 12th edition.
- Chopra, V.L. 2018. Plant Breeding: Theory and Practices New India Publishing Agency-NIPA, New Delhi. 2nd edition.
- Simmonds, N.W. & Smart J. 2013. Principles of crop improvement. Wiley India Pvt Ltd. 2nd edition.
- Acquaah, G. 2012. Principles of Plant Genetics & Breeding. Willey-Blackwell Publishing. 2nd edition.
- Gardner E.J., Simmons M.J., Snustad D.P. 2012. Principles of Genetics. Wiley India. 8th edition.
- Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. 2010. Introduction to Genetic Analysis.W. H. Freeman and Co., U.S.A. 10th edition.
- Brown, J. Caligari, P. & Campos H. 2008. Plant Breeding. Willey-Blackwell Publishing. 2nd edition.