ShikshanHaach Dharma
S.A.P.D. Jain Pathashala's
(Jain Minority Institute)

Walchand College of Arts & Science, Solapur
(Autonomous College)

(Affiliated to P.A.H. Solapur University, Solapur)

॥ शिक्षण हाच धर्म ॥

Walchand College of Arts and Science, Solapur
Autonomous
Estd. 1962

Name of Faculty: Science & Technology

New Choice Based Credit System (CBCS)
(According to NEP 2020)

M.Sc. Part-I

Subject: Genetics

w.e.f. 2023-24

Walchand College of Arts & Science, Solapur

(Autonomous)

About National Education Policy (NEP) - 2020

With the directions and guidelines issued by **Government of Maharashtra resolution dated 20th April 2023 and 16th May, 2023** regarding the implementation of NEP at UG and PG level, the Walchand College of Arts & Science (Autonomous), Solapur has taken decision to implement NEP 2020 with Choice Based Credit System (CBCS) at Undergraduate level and Post Graduate level. This has been done to achieve the goals and objectives set in NEP-2020 such as- worldwide recognition, acceptability, horizontal as well as vertical mobility for students completing undergraduate and post-graduate degree.

The CBCS provides an opportunity for the students to select from the prescribed courses comprising core, elective/minor or skill based. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations.

Outline of NEP:

The structure of the Three/Four-year bachelor's degree programme allows the opportunity to the students to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per their choices and the feasibility of exploring learning in different institutions. The structure allows students to learn various components like:

(a) Major (Core) Subject (DSC): This comprises of Mandatory and Elective Courses that require students to achieve:

- Minimum 50% of total credits corresponding to Three/Four - year UG Degree- Mandatory Courses are offered in all four years;
- 2 credit course on Major Specific IKS shall be included under Major;
- Elective courses of Major will be offered in the third and/or final year;
- Vocational Skill Courses, Internship/ Apprenticeship, Field Projects, Research Projects are related to Major

(b) Minor Subject (18-20 Credits)

- The Minor subjects may be from the different disciplines of the same faculty of DSC Major (Core) or they can be from different faculty altogether;
- The credits of Minor subjects shall be completed in the first three years of UG Programme

(c) Generic/ Open Elective Courses (OE) (10-12 credits)

- GE/OE are to be offered in I and/or II year;
- Faculty-wise baskets of OE shall be prepared by Autonomous College.
- OE/GE is to be chosen compulsorily from faculty other than that of the Major or as per the directions issued by NEP-Steering Committee

(d) Vocational and Skill Enhancement Courses (VSEC)

i) Vocational Skill Courses (VSC): (8-10 credits): Includes Hands on Training corresponding to the Major and/or Minor Subjects:

- To be offered in first three years;
- Wherever applicable vocational courses will include skills based on advanced laboratory practicals' of Major

ii) Skill Enhancement Courses (SEC): (06 credits)

- To be offered in I and II year;
- To be selected from the basket of Skill Courses approved by Autonomous College

(e) Ability Enhancement Courses (AEC), Indian Knowledge System (IKS) and Value Education Courses (VEC): (14 Credits)

i) AEC: (08 credits)

- To be offered in I and II year
- English: 04 Credits
- Modern Indian Language: 04 credits
- To be offered from the Basket approved by Autonomous College;

The focus for both languages should be on linguistic and communication skills.

ii) IKS: (2 Credits)

- To be offered in I Year
- Courses on IKS to be selected from the basket of IKS courses approved by Autonomous College

iii) VEC: 04 Credits

- To be offered in I year
- Value Education Courses (VEC) such as Understanding India, Environmental Science/Education, and Digital and Technological Solutions.

(f) Field Projects/ Internship/ Apprenticeship/ Community Engagement and Service corresponding to the Major (Core) Subject, Co-curricular Courses (CC) and Research Project

- Internship/Apprenticeship corresponding to the Major (Core) Subject: (8 Credits)
- Field Projects/Community Engagement and Service (CEP) corresponding to the Major (Core) Subject (minimum 4-6 credits)
  -To be offered in II and III years of UG Degree Programmes.
- Co-curricular Courses (CC) such as Health and Wellness, Yoga education, sports and fitness, Cultural Activities, NSS/NCC and Fine/ Applied/Visual/ Performing Arts: (8 credits)
  -To be offered in I and/or II year
- Research Projects: (12 credits)
  -To be offered in the final year for 4 year Honours with Research UG Degree

➢ **CREDIT:**

- Credit is a numerical value that indicates students work load (Lectures, Lab work, Seminar, Tutorials, Field work etc.) to complete a course unit. The contact hours are transformed into credits. Moreover, the grading system of evaluation is introduced for B.Sc. course wherein process of Continuous Internal Evaluation is ensured.
- **Theory: '**15 contact hours' for theory course constitute 'one credit'
- **Practical/Tutorial: '**30 contact hours' for practical course constitute 'one credit'.
- **Workshop based activities/Skill based activities:** Minimum 30 contact hours per credit in a semester is required
- **Internship/On-Job Training: '**30 contact hours' per credit in a semester is required (1 credit/week)
- **Community Engagement and Service-CEP/Field Project:'**30 contact hours' per credit in a semester is required

➢ **Credit Framework under Three/Four Years UG Programme with Multiple Entry and Multiple Exit Options:**

The minimum and maximum credit structure for different levels under three or four year UG programme with multiple entry and multiple exit options are as given below:

Levels	Code	Qualification Titles	Credit Requirements		Semester	Year
			Minimum	Maximum		
4.5	100-199	UG Certificate	40	44	2	1
5.0	200-299	UG Diploma	80	88	4	2
5.5	300-399	Three Year Bachelor's Degree	120	132	6	3
6.0	400-499	Bachelor's Degree Honours **OR** Bachelor's Degree-Honours with Research	160	176	8	4
	500-599	First Year PG & or PG Diploma	40	44	2	1
6.5	600-699	PG Degree	80	88	4	2
8.0	700-799	Ph.D.	16+ Ph.D. Work		-	-

Multiple Exit Options

Year	Exit Option	Re entry
First Year	Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF course/Internship OR Continue with Major and Minor	Students opting for exits at any level 'will have the option to reenter' the programme from where they had left off, in the same or in different higher educational institution 'within three years of exits' and complete the degree program within the stipulated maximum period of 07 years from the date admission of first year of UG.
Second Year	Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQF Course/Internship OR Continue with Major and Minor	
Third Year	Award of UG Degree in Major with 120-132 credits OR Continue with Major and Minor	
Fourth Year Honours	Four Year UG Honours Degree in Major and Minor with160-176 credits	
Fourth Year Honours with Research	Four Year UG Honours with Research Degree in Major and Minor with160-176 credits	
Post-Graduation Degree		
Post-Graduation: First Year	PGDiploma(44Credits)after ThreeYear UGDegree	Reentry to complete the PG degree after taking exit option will be permissible

		up to 5 years from the date admission to PG programme

- **Academic Bank of Credit (ABC):**

It is mandatory for all admitted students to get enrolled on ABC Portal and create ABC ID and share ABC-ID with academic institutions where they are enrolled. Credits earned by the students will be reflected in the students ABC account. This will allow students smooth transition during multiple entry and exit.

Faculty of Science: Choice Based Credit System (CBCS)
(w. e. f. 2023-24)

Preamble: This course provides a broad overview of Genetics and to produces expert hands that would have sufficient knowledge and expertise to solve the urgent problems of the region by using Genetics. The course structure is technology-centric where students basically learn technology and are taught necessary fundamental and applied subjects for that purpose.

Objectives of the course: The objectives of M. Sc.-I Genetics course are:

- To provide an intensive and in-depth learning to the students in field of Genetics.
- Beyond simulating, learning, understanding the techniques, the course also addresses the underlying• recurring problems of disciplines in today scientific and changing business world.
- To develop awareness& knowledge of different organization requirement and subject knowledge through varied subjects and training methodology in students.
- To train the students to take up wide variety of roles like researchers, scientists, consultants, entrepreneurs, academicians, industry leaders and policy.

Eligibility and Admission:
A Candidate passing Bachelor Degree with Any Life Sciences such as Biotechnology/Biochemistry/Chemistry/ Microbiology/Botany/Zoology/B. Pharmacy/MBBS/B. Sc. Agri, B.S.cEntrepreneurship, BAMS, Paramedical and who have passed the entrance examination conducted by the Walchand College of Arts and Science, Solapur (Autonomous) (WCAS) shall be held eligible for admission to M. Sc. Course in Genetics. Students from other University with B.Sc. General Degree and who have passed the entrance examination conducted by the WCAS, Solapur are also eligible. Merit list based on average of B. Sc. aggregate and entrance exam conducted by Walchand College of Arts and Science, Solapur (Autonomous).

Duration:
The duration of the M.Sc.-I course is of 1 year (comprising 02 semesters) and the duration for this program is of 2 years with semester pattern (04 Semesters)

Medium of Instruction: English

Pattern of the Course: The autonomous college follows semester pattern.

Walchand College of Arts & Science (Autonomous), Solapur

NEP Structure: M. Sc. Genetics
w.e.f.2023-24

M.Sc. (Genetics)				
Semester-I				
Subject	**Paper Title**	**Credits**	**Hours/week**	**Total Contact Hours**
Genetics (Mandatory)	Concepts of Genetics	4	4	60
Genetics (Mandatory)	Cell and Molecular biology	4	4	60
Genetics (Mandatory)	Biostatistics and Population Genetics	2	2	30
Genetics (Mandatory)	Practical-I: Concepts of Genetics and Biostatistics	2	4 (hours/week/batch)	60
Genetics (Mandatory)	Practical-II: Cell and Molecular biology and Population Genetics	2	4 (hours/week/batch)	60
Genetics-Elective-I	Elective-I: Cytogenetics and Genome organization	2	2	30
	Elective-I : Clinical bioinformatics			
	Practical Elective-I:	2	4 (hours/week/batch)	60
Genetics-RM	RM: Research methodology& Intellectual Property Rights	4	4	60
M.Sc.				
Semester-II				
Genetics (Mandatory)	Plant breeding and tissue culture	4	4	60
Genetics (Mandatory)	Concepts of Biochemistry	4	4	60
Genetics (Mandatory)	Regulation of Gene Expression And Developmental Genetics	2	2	30
Genetics (Mandatory)	Practical-III Plant breeding and tissue culture and Regulation of Gene Expression	2	4 (hours/week/batch)	60
Genetics (Mandatory)	Practical IV Concepts of Biochemistry and Developmental Genetics	2	4 (hours/week/batch)	60
Genetics-Elective-II	Elective-II: Advanced Microbial Genetics	2	2	30

	Elective-II: Computational structure biology and drug designing			
	Practical Elective-II	2	4 (hours/week/batch)	60
Genetics-OJT/FP	OJT/FP: Industry training orfield project	4	4	120
M.Sc.				
Semester-III				
Genetics (Mandatory)	Immunology and Immunotechnology	4	4	60
Genetics(Mandatory)	Genetic Engineering	4	4	60
Genetics (Mandatory)	Cancer genetics and Stem cell research	2	2	30
Genetics (Mandatory)	Practical-V:	2	4 (hours/week/batch)	60
Genetics (Mandatory)	Practical-VI:	2	4 (hours/week/batch)	60
Genetics-Elective-III	Elective-III: Molecular Medicine	2	2	30
	Elective-III: Industrial biotechnology and Bioinformatics			
	Practical Elective-III:	2	4 (hours/week/batch)	60
Genetics-RP	RP: Genetics Based Research Project	4	8	120
M.Sc.				
Semester-IV				
Genetics (Mandatory)	Medical Biotechnology and Bionanotechnology	4	4	60
Genetics (Mandatory)	Analytical Instruments	4	4	60
Genetics(Mandatory)	Practical-VII: Medical Biotechnology and Bionanotechnology	2	4 (hours/week/batch)	60
Genetics (Mandatory)	Practical-VIII: Analytical Instruments	2	4 (hours/week/batch)	60
Genetics-Elective-IV	Elective-IV: Agricultural science seed technology	2	2	30

	Elective-IV: Animal tissue culture			
	Practical Elective-IV:	2	4 (hours/week/batch)	60
Genetics-RP	RP: Genetics Based Research Project	6	12	180

Outline of Examination

THEORY

1) Internal Evaluation (IE): Internal evaluation will consist of **40 % marks** per semester per paper. It may be held as **per the following scheme** per semester **(Annexure: I& II)**

Credits	Marks for Attendance	Classroom Test	Home Assignment	Marks for Presentation/Group Discussion/ Participation/Field work/Study visit	Total Marks
02	05	10	05	---	20
04	05	20	05	10	40

2) End Semester Examination (ESE): The detailed question paper pattern (**60% marks per paper)** is given as in **Annexure- IV; Annexure- V**

PRACTICAL

1) Internal Evaluation (IE): Internal evaluation will carry **40 % marks** and may consist of:

Credits	Marks for Attendance	Internal Practical Exam	Journal	Total Marks
02	05	10	05	20

2) **End Semester Examination (ESE):** Practical examination **60 % marks** shall be conducted at the end of each semester. **Annexure- VI**

Walchand College of Arts and Science (Autonomous), Solapur

(CBCS)Theory Syllabus

M.Sc. I-Genetics (Semester-I)

w. e. f. 2023-24

SEMESTER I

Genetics (Mandatory) CONCEPTS **OF GENETICS**

Marks 100	**4 Credits**	**Contact Hrs-60**
UNIT	**CONTENT**	**Hrs**
1	**History of genetics. Laws of Inheritance:** Mendel's Law of Dominance, segregation and Independent assortment. Test cross, Back cross, Co-dominance, Incomplete dominance, Allelic Interaction, multiple allele, Linkage and Crossing Over with suitable examples, Complementation test.	15
2	**Sex linked Inheritance:**Structure of Sex Chromosomes, Complete and incompletely sex-linked genes. Inheritance of XY linked genes, Y linked genes, X linked genes, Sex limited and Sex influence gene. **Quantitative inheritance:** Concept, Genes and Environment: heritability, Penetrance and expressivity.	15
3	**DNA Damage:** Mutation; Types - Spontaneous and Induced Mutations, Chemical and Physical Mutagenic agents, Mechanism of action of Mutagenic agents, Transposon mediated mutagenesis. Changes in Chromosome number and Structure. **DNA Repair:** Base excision repair (BER), Nucleotide excision repair (NER), Mismatch repair (MMR), Homologous recombination (HR), Nonhomologous end joining (NHEJ), Photo reactivation and Dark repair.	15
4	**Genetic Counselling:** Overview of genetic counseling, components of genetic counseling, information gathering and construction of pedigrees and their interpretation. Psychological counseling, Patient education, Risk communication and decision making, Understanding genetic testing, Medical documentation.	15

REFERENCE BOOKS:

1. Concepts of Genetics- Klug W. S. And Cummings M. R Prentice-Hall
2. Genetics-a Conceptual Approach Pierce B. A. Freeman
3. Genetics- Analysis of Genes and Genomes Hartle D. L. And Jones E. W. Jones & Bartlett
4. An Introduction to Genetic Analysis- Griffith A. F. et al Freeman
5. Principles of Genetics -Snustad D. P. And Simmons M. J. John Wiley & Sons.
6. Genetics- Strickberger M. W. Prentice-Hall
7. Genetics - B.D.Singh
8. Genetics - Verma&Agrawal
9. Genetics - P.K.Gupta
10. Peter Snustad and Michael J Simmons (2009). Principles of Human Genetics. Fifth Edition. John Wiley & Sons, Inc.
11. Strachan T and Read A 2010 Human Molecular Genetics, Fourth Edition. Taylor and Francis
12. Ricki Lewis (2009) Human Genetics-Concepts and Application. Ninth Edition.

McGraw-Hill College Publishers
About the course The course deals with study of Genetics. Overall genetic study is must for a Genetics core course as they are fundamental to understand genome of important organisms, Mendelian genetics, non-mendelian genetics, mutation study, DNA Repair and Genetic counselling. **Learning outcomes** After successfully completing the course, • The students will be able to understanding fundamental ideas of genetics, while exploring modern techniques and recent applications of genetic analysis. • It will also provide explanation of complex analytical topics covering the areas of ethics towards society and case study.

Genetics (Mandatory) CELL AND MOLECULAR BIOLOGY

Marks 100	**4 Credits**	**Contact Hrs-60**
UNIT	**CONTENT**	**Hrs**

1	**Cell structure and components:** Prokaryotic and eukaryotic cell structure, Cell division, Cell Cycle Phases, Cytoskeletal proteins, Motor proteins, Inhibitors and activators of cytoskeleton, Cytoplasmic Membrane: Chemical Composition of Membrane, Models of Plasma membrane, Movement of substances across cell membrane –Passive transport and Active transport.	15
2	**Cell-cell interaction and Signal Transduction**: Cell-Cell Adhesion: Extra-cellular space, Desmosomes, Hemidesmosomes, Integrins, Selectins, Cadherins, Tight Junction, Gap Junction.G protein coupled receptor, Tyrosine Kinase receptor - Ras- MAP Kinase pathway, Hedgehog pathway, WNT signaling pathway, Notch Pathway, Nf-κB, JAK-STAT Pathway. Cell death: Apoptosis and necrosis.	15
3	**DNA replication in prokaryotes and eukaryotes** - i) Initiation of replication process: Origin of replication ii) Elongation: coordinated synthesis of Leading and Lagging strands. iii) Termination: End of replication. Types of DNA Polymerases, Mechanism of Transcription in Prokaryote and Eukaryotes -Initiation, Elongation and Termination, RNA Polymerases.	15
4	**Translation and membrane trafficking:**Genetic code and its properties, Eukaryotic and Prokaryotic Translation. Membrane Trafficking: Vesicular transport from Endoplasmic reticulum to Golgi Apparatus **Gene editing and silencing:** Antisense, RNAi, Micro RNA - Mechanism and Examples, Ribozyme Tailor made for gene silencing.CRISPR-, Discovery, CRISPR Knockout Basics CRISPR Editing in Animal Models (Knockout and Knockin Strategies in Mice).	15

REFERENCE BOOKS:

1. Molecular Cell Biology, Lodish et al. Scientific American Books (1995)
2. The World of the Cell Becker, W.M. et al. Benjamin Cummings (2004)
3. Cell and Molecular Biology, Karp G, John Wiley and Sons. (1999).
4. Molecular Biology of Cell, Alberts B et al. Garland Publishers, (2001)
5. Principles of cell and Molecular Biology, Kleinsmith LJ & Kish VM,Harper Collins College Publishers(1995)

About the course

This course helps to understand molecular basis of cells as well as its work in healthy and diseased states. The study of this course increases knowledge a better understanding of different molecular events take place in the cells.

Learning outcomes

After successfully completing the course,

- The students will be able to gain in depth knowledge of biological and/or medicinal

processes through the investigation of the underlying processes that occur in and between cells and able to explain processes and their meaning for the characteristics of living organisms.

- Explain the growth, development, and behaviour of organisms are activated through the expression of genetic information in context. Students will learn about CRISPR and how it is applications

Genetics (Mandatory)BIOSTATISTICS AND POPULATION GENETICS

Marks 502 Credits	**Contact Hrs-30**	
UNIT	**CONTENT**	**Hrs**
1	**Fundamentals of Biostatistics:** Introduction to Biostatistics,Population, Sample, Sample size, sampling methods, variable, classification of data, Frequency Distribution, tabulation, graphical and diagrammatic representation of data. Measures of central tendency- mean, mode & median, Measures of dispersion- range, variance, standard deviation, and	15

	coefficient of variation. Probability-theory, types, conditional & unconditional, Correlation- types, Scatter diagram, correlation coefficient (r), Regression- linear & multiple linear, coefficient of determination. Hypothesis testing-types, critical region, and type I & II error, t-test, Z-test, f-test, Chi-square test, P- value of the statistic, ANOVA.	
2	**Population Genetics:**Introduction to population genetics, Genetic polymorphism, Hardy-Weinberg genetic Equilibrium with example **QTL mapping** strategies; Statistical methods for mapping QTL in experimental cross populations (experimental design, linkage map construction, single-marker analysis, interval mapping and multiple interval mapping), Estimation of breeding values and genetic variances in general pedigrees, association mapping, genomic selection, direct and associative models of general group and kin selection, genotype by environment interaction models.	15

REFERENCE BOOKS:

1. DNA markers Protocols, applications and overviews- Anolles G. C. &Gresshoff P. Wiley-Liss
2. Molecular markers in Plant Genetics and Biotechnology -Vienne De. D. Science Publishers
3. Genetics of Population- Hedrick P.W. Jones & Bartlett
4. Principle of Population Genetics -Hartl D. L. and Clark A.G Sinauer Associates
5. Biostatistics- Danial, W. W Wiley
6. Statistical methods in Biology- Bailey, N.T.J Cambridge Univ.Press
7. Statistical Genetics: Linkage, Mapping and QTL analysis, Ben Hui Liu – CRC Press
8. Statistical Genetics: Gene Mapping Through Linkage and Association, ed. By B Neale, M Ferreira, S Medland, D Posthuma – Taylor Francis
9. The Fundamentals of Modern Statistical Genetics NM Lairdand, C Lange - Springer
10. Computational Molecular Evolution, Z Yang, 2006, Oxford University Press.
11. Cell Biology, Genetics, Molecular Biology,Evolution And Ecologys, P.S. Verma and V.K. Agarwal, Chand & Company Ltd. Ram Nagar, New Delhi-110 055,

About the course

The course deals with study of biostatistics and population genetics. This course, recognize the importance of data collection and its role in determining scope of inference. The portion of population genetics, aims to introduce the study of the Hardy-Weinberg genetic Equilibrium and Quantitative Trait Locus (QTL) Mapping.

Learning outcomes

After successfully completing the course,

- The students will be able to define biostatistics and its relation with other subjects, restate the principal concepts about biostatistics and Data analysis.
- The students will explain population genetics and QTL mapping strategies.

Genetics (Elective I) CYTOGENETICS AND GENOME ORGANIZATION

Marks 502 Credits	**Contact Hrs-30**	
UNIT	**CONTENT**	**Hrs**
1	**Chromosome :**History, Chromosome structure and types based on centromere, Chromatin structure, heterochromatin and euchromatin, telomere and its maintenance, Special types of chromosomes, Chromosome banding, painting and karyotyping, FISH and GISH, Extra chromosomal inheritance: Mitochondrial, chloroplast and plasmids, Mechanism of sex determination in plants, animals and *Drosophila*	15

2	**Gene and Genomics :**Fine structure of gene, Genome organization in Prokaryotes and eukaryotes, organization of nuclear and organelle genomes, genome mapping: physical maps and functional genomics, repetitive DNA satellites and its significance, LINES and SINES, Transposable elements in prokaryotes and eukaryotes, Alu family, Multigene families, C value paradox	15

REFERENCE BOOKS:

1. Essential Cell Biology -Alberts B. et al. Garland
2. Molecular Biology of The Cell- Alberts B et al. Garland
3. The Eukaryotic Chromosome- TBostock C. J. & Summer A. T.T Elsevier
4. The Chromosome- Hamsew and Flavell Bios
5. Advanced Genetic Analysis- Hawley & Walker Blackwell
6. Structure & Function of Eukaryotic Chromosomes- Hennig Springer
7. Genes IX- Lewin B. Pearson
8. Molecular Cell Biology -Lodish, H. et al. Freeman
9. Cell and Molecular Biology- De Robertis& De Robertis Lippincott & Wilkins
10. Genome 3 -Brown T. A. Garland

About the course:

The purpose of the course is to provide a working knowledge of cytogenetics, the preparation of materials for study, and the importance of chromosomal variations in structure and number in such fields as plant and animal breeding and the medical sciences.

Learning outcomes

After successfully completing the course,

- The students will be able to acquire knowledge regarding genetic analysis and heredity.
- Advantage of genetics mapping to identify the relative position of genes based on their phenotypic effect.
- Genetics can help to identify certain conditions in peoples using various techniques to minimize the risk in future

Genetics (Elective I) CLINICAL BIOINFORMATICS

Marks 502 Credits	**Contact Hrs-30**	
UNIT	**CONTENT**	**Hrs**
1	**Next Generation Sequencing :** Introduction, Process, Application, NGS Platforms & Techniques, NGS Tools: Data & Data Formats, and QC tools PrinSek, BAM Stats FASTX Toolkit Fast QC, HTQC, Pyro cleaner and QPLOT, NGS Methods: Reference Based Genome Assembly, DeNovo Genome Assembly, Transcriptomics, Epigenomics, Genome Mapping, Microarray Data Analysis, RNA Sequence Analysis and NGS Data Annotation	15
2	**Genome sequencing projects and applications:**	15

	HumanGenomeProject:Introduction,Applications,Challenges of HGP,Introduction to various genome sequencing projects (Name of genome organism) and their implications in human health and diseases, Comparative genome analysis, Genome data visualization using Ensemble and Map viewer.	

REFERENCE BOOKS:

1. Zentralblatt Math 2014:Next-generation Sequencing: Current Technologies and ApplicationsJianpingXuMcMaster University, Ontario, Canada, Caister Academic Press- I SBN: 978-1-908230-33-1.
2. Thakur, Nirja and Shirkot, Poonam, Pradesh, Himachal, Pandey, India and Rachappanavar, Kanika and Pandey, Himanshu and Thakur, Kanika and Kumar, Vinay. (2018). Next generation sequencing -Techniques and its applications. 1316-1320.
3. Liu L, Li Y, Li S, Hu N, He Y, Pong R. *et al.,* Comparison of next-generation sequencing systems. Bio Med Research International, 2012.
4. Gardy JL, Loman NJ. Towards a genomics-informed, real-time, globalpathogen surveillance system. Nature Reviews Genetics. 2018; 19(1):9.
5. BentleyDR,BalasubramanianS,SwerdlowHP,etal.,Accuratewholehumangenomesequencingusing reversibleterminatorchemistry.Nature.2008; 456:53-59.
6. Pareek, Chandra &Smoczynski, Rafal&Tretyn, Andrzej. (2011). Sequencing technologies and genome sequencing. Journal of applied genetics. 52. 413-435. 10.1007/s13353-011-0057-x.

About the Course:

The course provides the extended knowledge of Next Generation sequencing genome and its storage in file formats also handling the data with bioinformatics tools. Handling the genome data, pharmacogenomics and medical informatics develop the understanding and applications in bioinformatics

Learning Outcomes:

After successfully completing the course,

- The students will be able to: Apply the knowledge in the use of NGS and its platforms.
- Enhance the understanding of medical, clinical and systems biology.
- Apply the sequencing projects for analysis of data.

M. SC. - I - GENETICS (SEMESTER –I)

GENETICS (Mandatory) PRACTICAL I: CONCEPTS OF GENETICS AND BIOSTATISTICS

50 marks **2 CreditContact Hours-60**

1. Interspecific study of mitosis in*Alliumcepa* and *Alliumsativum*
2. Interspecific study of meiosis.
3. Problems on Mendelian Genetics: one factor & two factor with examples.
4. Problems on non-Mendelian genetics.
5. Problem on gene mapping.
6. To Study the effect of mutagens on germination, seedling growth and on mitosis.
7. Spontaneous mutation: Fluctuation test – StrR.
8. Spontaneous mutation: Replica plate method-StrR
9. Measures of Central Tendency and Dispersion on Excel
10. Statistical Analysis using EXCEL (Diagrammatic and graphical presentation)

GENETICS (Mandatory) PRACTICAL II: **CELL AND MOLECULAR BIOLOGY AND POPULATION GENETICS**

50 marks **2 Credit** **Contact Hours-60**

1. Genomic DNA isolation from plants.
2. Genomic DNA quantificationfrom Plant.
3. Restriction digestion of total DNA

4. Ligation of restricted DNA.
5. Isolation of organelle DNA.
6. Problems on t-test, Z test, & chi square test.
7. Examples based on pedigree analysis.
8. Examples based on Hardy Weinberg Equilibrium

Practical Elective I CYTOGENETICS AND GENOME ORGANIZATION
50 marks **2 Credit** **Contact Hours-60**

1. Preparation of polytene chromosome
2. *Drosophila* genetic crosses
3. Study of different morphology of nucleus
4. Identification of inactivated X chromosome as Barr body
5. Karyotyping analysis
6. Chromosome preparation from human blood lymphocytes.
7. Qualitative analysis of DNA melting temperature.
8. Problems on extrachromosomal inheritance.

Practical Elective I CLINICAL BIOINFORMATICS

50 marks **2 Credit** **Contact Hours-60**

1. Genomedatavisualization by usingEnsembleandMapviewer.
2. GenomeanalysisandcomparisonusingUCSCbrowser.
3. Genome Mapping using NGS Technology.
4. Different tools used for NGS data mapping – BWA, Bowtie.
5. Understand and analyze the different file formats - SAM, BAM.
6. Visualize the mapped data using the tool IGV.
7. Study online Next Generation sequencing resources and databases.
8. Study of PrinSek, BAMStats FASTX Toolkit FastQC, HTQC, Pyrocleaner and QPLOTtools.

RESEARCH RM: RESEARCH METHODOLOGY& INTELLECTUAL PROPERTY RIGHTS

Marks 1004 Credit	**Contact Hours-60**	
UNIT	**CONTENT**	**Hrs**
1	**Research:** Definition, Importance and Meaning of Research, Objectives, Characteristics, Types of Research. Steps in Research; Identification, Selection and Formulation of Research Problem, Research Design, Formulation of Hypothesis. **Thesis and Manuscript writing:** Abstract, Introduction, Review of literature, Materials and Methods, Results and Discussion, Summary and Conclusion, References.	15
2	**Manuscript writing:** citation index, h-index, i10-index, ISSN and ISBN. Author instructions, criteria for publication. Preparation & presentation of Oral and Poster for conferences. Concept of plagiarism, Scientific proposal writing for funding agencies (UGC, CSIR, DBT, DST, ICMR and DRDO).Use of tools in Research report writing- Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism.	15
3	**IPR and Patents:** Intellectual property, Protection of Intellectual property, WIPO, Forms of protection- patent, copyright, trademark, trade secrets, geographical indications. Criteria for patent and procedure of patenting-India and PCT. Patenting of biological materials with examples and case studies, IP Infringement.	15
4	**Plant breeder's right**: Traditional knowledge, Biopiracy, International Union for the Protection of New Varieties of Plants (UPOV), Breeders exemption, Plant variety protection in India. Farmer's right, advantages and disadvantages of PBR**.** Technology transfer- Introduction, types of technology transfer and Indian scenario.	15

REFERENCE BOOKS:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Publications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
5. Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.
6. Text book of Biotechnology, P K Gupta
7. Text book of Biotechnology, B D Singh

About the course:

The course covers all the conceptual and methodological issues that go into successful conduction of research. That includes philosophy of science, the methodological issues in measurement, proposing and testing hypotheses, scientific communication and the ethical issues in the practice of science.

Learning outcomes:

After completely this paper students will learn following knowledge:

- Students will get useful information about Steps in Research and Sampling Techniques
- Students will be able to learn about Thesis and Manuscript writing.
- Students will know the importance of patents and IPR in processing their innovations

M. SC. GENETICS (SEMESTER –II)

GENETICS (Mandatory) PLANT BREEDING AND TISSUE CULTURE

Marks 1004 Credit	**Contact Hours-60**	
UNIT	**CONTENT**	**Hrs**
1	**Plant Breeding:**History of plant breeding, Definition, Objectives, disciplines to be known by breeder (Botany of the crop, Cytogenetics, agronomy, physiology, pathology, entomology, biochemistry, bacteriology, statistics, plant biotechnology),Mode of reproduction in crop plants.Diversity and origin of crop plants, Law of Homologous variation, Plant genetic resources. Breeding methods for self-pollinated, cross pollinated and clonally propagated crops (Recombinational and transgressive breeding)	15
2	**Single seed descent.**Populationsimprovement methods and maintenance, heterosis breeding and hybrid development, genetic basis of heterosis. Ideotype breeding. Mutation breeding. Plant Breeding for Stress Resistance and Nutritional Quality, Breeding for vertical and horizontal resistance to diseases. Role of molecular markers in stress resistance breeding: MAS, MARS and MABB.	15
3	**Plant regeneration pathways** - Organogenesis and Somatic embryogenesis; Somaclonal Variation, Endosperm culture and triploid production; Anther and pollen culture, and production of haploid and doubled haploid plants; Protoplast culture and fusion, Somatic hybrids, Micropropagation, Virus-free plants by meristem culture; Use of somaclonal and gametoclonal variation for crop improvement Cryopreservation -Principle and types;	15
4	***In vitro* mutagenesis and mutant selection**. metabolic engineering for production of secondary metabolites, Hairy root culture**,** Transgenic crops for resistance against biotic and abiotic stresses; Transgenic plants-Edible vaccine, Golden rice; Engineering crops for male sterility	15

	and modification of flower colour, flowering, fruit ripening and senescence; GM crops for nutritional quality and quantity; Molecular pharming; Other applications; Global status and biosafety of transgenic plants.	

REFERENCE BOOKS:

1. Principles of Plant Breeding, Allard RW – Wiley
2. Plant Breeding Theory and Practice, Stoskopf NC, Tomes DT and Christie BR – Westview Press
3. Quantitative Genetics, Genomics and Plant Breeding, Kang MS – CABI Publishing
4. Biotechnology- H.S. Chawla
5. Plant Cells in liquid culture (1991), Payne Shuler Hanser Publishers.
6. Introduction to plant tissue culture- M.K. Razdan
7. Plant tissue culture-Theory & practice-S.S.Bhojwani& M.K. Razdan
8. Plant tissue culture-KalyankumarDey

About the course

Plant breeding techniques are used for creating variability, by breeding new plants from two different parents, or by causing mutations to occur. Plant Tissue culture is an important tool for both basic and applied aspects of plant biotechnology as well as its commercial applications. This technology exhibits several advantages over conventional propagation techniques.

Learning outcomes

After successfully completing the course,

- The students will be able to understand growth, reproduction, physiological and metabolic changes in plants.
- Able to learn about plant tissue culture in crop improvement. Know the applications various technologies in plant breeding and tissue culture

GENETICS (Mandatory) CONCEPT OF BIOCHEMISTRY

Marks1004 Credit	**Contact Hours-60**	
UNIT	**CONTENT**	**Hrs**
1	**Carbohydrates:** Carbohydrate Classification, structureand functions, Glycolysis, Gluconeogenesis, TCA, HMP Shunt, Glycogen metabolism Oxidative phosphorylation, Structure of ATPase. Photosynthesis: Light Reaction, Calvin Cycle, HSK Pathway, CAM Pathway.	15
2	**Proteins:** Protein-Classification According to its function. Classification of amino acids. The primary, secondary and tertiary and quaternary structure of proteins. Enzymes: definition, enzyme classification, active site. Mechanism of enzyme action, Michaelis-Menten Equation, Linewever-Burk plot, Eadie-Hofstee plot, inhibition of enzymes.	15
3	**Lipids:** Lipids Classification, structure, and functions of fatty acids; Storage lipids Phospholipids, sphingolipids, steroids, Biosynthesis of fatty acids, Beta oxidation of fatty acid, Reactions of amino acid metabolism– transamination, deamination, Urea Cycle, Nucleotides, Purines and Pyrimidines, Nucleotide Biosynthesis –Salvage and De NOVO	15
4	**Basics of Human Nutrition** Energy metabolism and nutritional requirements of the body. Recommended daily allowance (RDA), Basic metabolic rate (BMR). Carbohydrates: Digestion of Simple and complex carbohydrates, dietaryfibre, absorption of glucose, Diabetes. Lipids: digestion, absorption, and transport, essential fatty acids (EFA). Cholesterol role in cardiovascular disease.	15

REFERENCE BOOKS:

1. Principles of Biochemistry-Lehningeretal.Freeman
2. Biochemistry-Devlin,T.M.Wiley-Liss

3. Biochemical Calculation-Sehgal I.H.Wiley
4. 4FundamentalsofEnzymology-TPriceN.C.andLewisS.T OxfordUniversityPress
5. Biochemistry-TBerg,J.M.Tymoczko,J.LandStryerL.TW.H.Freeman
6. Text book of biochemistry for Medical students –By D. M. Vasudevan, 6th edition, A jaypee publications.

About course

The course enlighten the students to acquire aspects of chemical processes occurring inside all living systems and gives information about vitamins, requirement of vitamins, bioenergetics, law of thermodynamics, oxidative phosphorylation, Photosynthesis. It helps students to understand basic and advanced principles of biochemistry, structure and properties of biomolecules.

Learning Outcomes

After successful completion of this course

- The students will be able to understand fundamental concepts of biochemistry, structure and function of biomolecules.
- They will get knowledge about electron transport chain, structure function of ATP synthase enzyme.
- They will be able to explain clinical applications of biochemistry.

GENETICS (Mandatory) REGULATION OF GENE EXPRESSION AND DEVELOPMENTAL GENETICS

Marks 50	**2 Credit**	**Contact Hours-30**
UNIT	**CONTENT**	**Hrs**
1	**Gene regulation in prokaryotes**: Operon model of regulation (with examples of lac, trp.Control of lysis and lysogeny in Lambda phage. Gene regulation in eukaryotes: Overview of gene regulation using examples of galactose- utilization in yeast.Transcriptional control – changes in chromatin structure, epigenetics controls, Post transcriptional regulation – alternative RNA splicing, RNA editing, RNA stability, Translational regulation – RNA structure, control at initiation, codon usage, Post Translational modification.	15
2	**Basic concepts in development**: Potency, commitment, specification, induction, competence, determination and differentiation; Production of gametes, cell surface molecules in sperm egg recognition in animals; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryo sac development and double fertilization in plants; embryogenesis, establishment of symmetry in plants; seed formation and germination. leaf and flower development in *Arabidopsis thaliana*.	15

REFERENCE BOOKS:

1. Genes and Signals- Mark Ptashne and Alexander Gann CSHL Press
2.A Genetic Switch- Mark Ptashne CSHL Press
3.Gene Regulation- David S Latchman Chapman & Hall
4.Genes- Benjamin Lewin Prentice Hall
5.Molecular Cell Biology- Lodish, H. et al. W. H. Freeman
6.Principles of Developmental Genetics, -Sally A. Moody Academic Press
7.Advances in Anatomy, Embryology and Cell Biology, -Korf, H.-W., Beck, F., Clascá, F., Haines, D.E., Hirokawa, N., Putz, R., Timmermans, J.-P. Springer
8.Developmental Biology- Gilbert S. F. Sinauer
9.Development of Drosophila melanogaster (Vol I & II)- Bates and Arias CSHL Press
10.Developmental Biology, 1992 3rd edition, Browder L.W. Erickson C.A. &Williams, R.J. Saunders College, Publications, London.
11.Developmental Biology; Patterns/Principles/Problems, 1982, Saunders J. W. Collier MacMillan, Publishers, London.

About the course

The study of this course will help to understand the process of activation, expression and termination of gene.The course gives an introduction to basic concepts and general principles in developmental biology, which also includes evolutionary relations. Moreover, the main features of the embryonic development of important animals and plants will bedescribed to provide a basis for explaining the underlying control mechanisms.

Learning outcomes

After successfully completing the course,

- the students will able to gain subject knowledge which helpsstudents to describe two main strategies that cells used to control metabolism, able to explain adaptiveadvantage of bacterial genes grouped into an operon and distinguish between positive and negative control.
- Also able to explain differential gene expression, the characters of organism which make organism as ideal for developmental study and also able to explain developmental stages.

GENETICS (Elective II) ADVANCED MICROBIAL GENETICS

Marks 50	**2 Credit**	**Contact Hours-30**
UNIT	**CONTENT**	**Hrs**
1	**Bacterial Genetics:**Conjugation: Discovery, interrupted mating and temporal mapping, Hfr, Map of F plasmid, mechanism of chromosome transfer in bacteria. Transformation: Biology and mechanism of transformation, Competency, artificial induced competency- calcium ion induction and electroporation. Transduction: Virulent phage (T4) and Temperate phage (lambda); Lytic and lysogenic cycles, Generalized and specialized or restricted transduction, Phage P1 and P22- mediated transduction, mechanism of generalized transduction, abortive transduction.Bacterial mutagenesis: Method of isolation of auxotrophic mutants (histidine), drug resistant mutants (Streptomycin).	15
2	**Fungal Genetics and Application of Microbial genetics:**Fungal life cycle and various phases, fungi in biotechnology, Yeast Mating - Type Switching mechanism. Agricultural applications- Plant-microbe interactions (PGPB, mycorrhizal symbiosis). Microbial association for plant stress tolerance, rhizoremediation. Production and role of microbial genetics in crop improvement: bio-fertilizers, bio-insecticides, bio-pesticides, Industrial applications- Industrial production of lysine, glutamic acid.	15

REFERENCE BOOKS:

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

About the course

Microbial genetics provides powerful tools for deciphering the regulation, as well as the functional and pathway organization, of microbial cellular processes. This course introduces students the past, current and future of microbial genetics; it teaches students various techniquesused in microbial genetics; and enable students to understand the relevance of microbial geneticsin Genetics.

Learning outcomes

After successfully completing the course,

- The students will be able to presents logic and methods used in thegenetics of complex biological processes in bacteria.
- The course subject will cover various geneticapproaches to study bacterial mechanisms of metabolism, development and pathogenesis.

GENETICS (Elective-II) COMPUTATIONAL STRUCTURE BIOLOGY AND DRUG DESIGNING

Marks 50	**2 Credit**	**Contact Hours-30**
UNIT	**CONTENT**	**Hrs**
1	**Introduction to Structural and Pathway Databases:** structural data, exploring the structural databases such as Protein Data Bank (PDB) at RCSB, Catalytic Site Atlas (CSA), Homology Derived Structures of Proteins (HSSP), Protein Data Bank Europe (PDBe), PDBeChem, PDBeFold, PDBeMotiff, PDBeNMR, PDBSum, SCOP and CATH. Introduction to biological Pathway Databases. Structure Prediction Methods: Statistical methods of Chou-Fasman, Garnier- Osguthorpe-Robson method, Neural network method, Position specific scoring matrices, Motifs and domains, folds and protein folding.Homology Modeling: Introduction to homology modeling, Fold recognition and Threading, RNA structure prediction, architectures and topologies of protein and DNA using molecular visualization software, Structure validation.	15
2	**Molecular interaction:**Molecular interaction; protein-protein, protein-DNA, Protein- Lipid, Protein- Ligand, Protein-Carbohydrate, DNA-Drug interaction, Metalloproteins, Pi … Pi interactions, C-H…Pi interactions.Drug Discovery and Drug designing: Natural products, drugs, principles of drug development, Drug discovery, mutation in drug targets, automated drug design, structure based and ligand based drug design methods, combinatorial chemistry, high throughput screening (HTS), *in silico*ADMET properties, QSAR, developing lead library, DOCKING; introduction to docking method to generate new structure, tools and molecular docking programs-AUTODOCK, HEX and VLifeMD suite, virtual screening, Drug metabolism; Cytochrome p450, pharmacodynamics and pharmacokinetics, clinical trials, FDA approval.	15

REFERENCE BOOKS:

1. Wilkins, M.R., Williams, K.L., Appel, R.D., Hochstrasser, D.F. (Editors) 1997
2. Proteome Research: New Frontiers in Functional Genomics. Springer Verlag Berlin Heidelberg.
3. Baxevanis, A.D. and Francis Ouellette, B.F. 2004 Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins.Second Edition, Wiley.
4. Graur, D. and Li, W-H. 2000 Fundamentals of Molecular Evolution.SinauerAss.,USA.
5. Essential Bioinformatics, JinXiong
6. Rastogi S. C., Mendiratta. N., Rastogi. P. 2005 Bioinformatics methods and application, Genomics, Proteomics, and Drug Discovery.
7. Understanding Molecular Simulation: From Algorithms to Applications, Daan Frenkel and Berend Smit, Academic Press (2002).
8. Computer Simulation of Liquids, M. P. Allen and D. J. Tildesley, Oxford University Press (1987).
9. Ab Initio Molecular Dynamics: Basic Theory and Advanced Methods, Dominik Marx and

JürgHutter, Cambridge University Press (2009).

About the Course

Computational Structural Biology aims at establishing biomolecular sequence-structure-function relations using fundamental principles of physical sciences in theoretical models and simulations of structure and dynamics. The most fundamental goal in drug design is to predict whether a given molecule will bind to a target and if so how strongly.

Learning outcomes

After successfully completing the course,

- The students will be able to establish bimolecular sequencestructure-function relations using fundamental principles of physical sciences in theoretical models and simulations of structure and dynamics;
- Students will gain knowledge regarding the interactions between protein-protein, protein-ligand and protein-DNA interactions and their functional implications

M. SC. - I - GENETICS (SEMESTER –II)

GENETICS (Mandatory) PRACTICAL III PLANT BREEDING AND TISSUE CULTURE AND REGULATION OF GENE EXPRESSION

50 marks **2 Credit** **Contact Hours-60**

1. Induction of polyploidy using colchicines. (Root Tip)
1. Study of Pollen fertility
2. Media preparation and sterilization
3. Callus culture and Induction.
4. Isolation of protoplast by chemical and mechanical methods.
5. Synthetic seeds preparation
6. Study of Emasculation and hybridization techniques in any suitable plants.
7. Induction and assay of β- galactosidase from *E.coli*.
8. Study of Floral patterning in any suitable flower.

GENETICS (Mandatory) PRACTICAL IV CONCEPTS OF BIOCHEMISTRY AND DEVELOPMENTAL GENETICS

50 marks **2 Credit** **Contact Hours-60**

1. Estimation of total sugar by Anthrone method
2. Estimation of protein by biuret method
3. Estimation of cholesterol by Zak's method
4. Determination of acid value, Iodine number, and saponification of fat/oil
5. Effect of Temperature on amylase enzyme activity
6. Effect of pH on amylase enzyme activity.
7. Study of Chick embryo development (preparation of whole mounts & permanent slides)
8. Observation of homeotic mutants of Drosophila

PRACTICAL ELECTIVE II ADVANCED MICROBIAL GENETICS

50 marks **2 Credit** **Contact Hours-60**

1. Study of gene transfer in bacteria by Conjugation
2. Study of gene transfer in bacteria by Transformation.
3. Ames test for detecting chemical carcinogen.
4. Isolation of vitamin B12 auxotrophic mutants.
5. Isolation and quantification of genomic DNA from bacteria.
6. Isolation and quantification of RNA from bacteria.
7. Isolation of Plasmid DNA from bacteria.

8. Isolation of Rhizobium from root nodule.

PRACTICAL ELECTIVE II COMPUTATIONAL STRUCTURE BIOLOGY AND DRUG DESIGNING

50 marks **2 Credit** **Contact Hours-60**

1. Accessing to Structural Databases and Data retrieval using RCSB PDB, CSA, PDBe, PDBeChem, PDBeFold, PDBeMotif, PdbSum.
2. Structural classification using CATH, SCOP resources.
3. Secondary structure prediction using SOPMA and GOR.
4. Homology modeling by SWISSMODEL, and Modeller 9V2 and
5. Model Validation using RAMPAGE or PROCHECK,
6. Prediction of protein-protein, protein-DNA, protein-ligand interactions and Drugbank and Chembank databases and Design of ligands using ACD lab and Chemsketch
7. Development of lead library and high throughput screening using in silicoADMET Properties.
8. Docking studies using AUTODOCK and HEX.

Walchand College of Arts and Science, Solapur

M.Sc. Genetics Part-I Syllabus (NEP) Semester-II

On Job Training/Field Project

Credits: 4 **Contact Hours: 120**

Note:

1) OJT or Internship: Credits for internship shall be one credit per one week or 120 hours of engagement. The internship shall be monitored jointly by the faculty and Industry/Organization Mentor

OR

2) Field Project: Students are expected to participate in field based learning/projects generally under the supervision of faculty. A minimum of 120 hours of learning activities/credit in a Semester is required.

Annexure: I

Walchand College of Arts and Science, (Autonomous) Solapur
M. SC. Part – I Semester I & II Genetics
(w.e.f. 2023-24)

Question Paper for Class Room Test (IE)

(02 Credit Theory Course)

Marks: 10

Q.No.1 Multiple choice questions - 04 marks.

Q.No.2 Attempt any two - 06 marks.

a)

b)

c)

Annexure: II

Walchand College of Arts and Science, (Autonomous) Solapur
M. SC. Part – I Semester I & II Genetics
(w.e.f. 2023-24)

Question Paper for Class Room Test (IE)

(<u>04 Credit</u> Theory Course)

Marks: 20

Q.No.1 Multiple choice questions - 08 marks.

Q.No.2 Attempt any two - 12 marks.

a)

b)

c)

Annexure-III

Scheme of Marking for Internal Examination (IE)
M. Sc. Part – I Semester I & II Genetics
(w.e.f. 2023-24)
(02 Credit Practical Course)

Time: 3 hours **Total Marks: 20**

Q.1. Proceed to perform _____ 10

OR

Q.1. Proceed to perform _____ 10

Q.2. Laboratory Record (Certified Journal) 05

Q.3. Attendance 05

Annexure: IV

Walchand College of Arts and Science (Autonomous), Solapur
Theory question paper Pattern for **4 credit** course as per NEP 2020 (ESE)
w. e. f. 2023-24
Examination:_____

Class: M.Sc. Semester:
Subject: Paper:
Time: 2.5 hrs Marks: 60

Instructions:
1) All questions are compulsory
2) Figures to the right indicate full marks
3) Draw neat labelled drawings wherever necessary

Q. No.1 Rewrite the following sentences by choosing correct alternative given below **08**
i)
a) b) c) d)
ii)
iii)
iv)
v)
vi)
vii)
viii)

Q. No.2 Answer the following questions (Any three) **12**
i)
ii)
iii)
iv)
v)

Q. No.3 Answer the following questions **12**
i)
ii)

OR

Q. No.3 Answer the following questions **12**
i)
ii)

Q. No.4 Answer the following questions **12**
i)
ii)

OR

Q. No.4 Answer the following questions **12**
i)
ii)

Q. No.5 Answer the following question **16**
i)
ii)

Annexure: V

Walchand College of Arts and Science (Autonomous), Solapur
Theory question paper Pattern for **2 credit** course as per NEP 2020 (ESE)
w. e. f. 2023-24
Examination:_____

Class: M.Sc. Semester:
Subject: Paper:
Time: 1.5 hrs Marks: 30

Instructions:
1) All questions are compulsory
2) Figures to the right indicate full marks
3) Draw neat labelled drawings wherever necessary

Q. No.1 Rewrite the following sentences by choosing correct alternative given below 06
i)
a) b) c) d)
ii)
iii)
iv)
v)
vi)

Q. No.2 Answer the following questions (Any three) **06**
i)
ii)
iii)
iv)

Q. No.3 Answer the following questions **06**
i)
ii)

OR

Q. No.3 Answer the following questions **06**
i)
ii)

Q. No.4 Answer the following questions **06**
i)
ii)

OR

Q. No.4 Answer the following questions **06**
i)
ii)

Q. No.5 Answer the following question **06**
i)

Annexure-VI

Scheme of Marking for End Semester Examination (ESE)
(02 Credit Practical Course)
Semester-I & II

Time: 3 hours **Total Marks: 30**

Q.1. Proceed to perform _____ 15

OR

Q.1. Proceed to perform _____ 15

OR

Q.1. Proceed to perform _____ 15

OR

Q.1. Proceed to perform _____ 15

Q.2. Write the principle of

_____ 05

OR

Q.2. Write the principle of

_____ 05

Q.3. Laboratory Record (Certified Journal) 05

Q.4. Viva Voce 05

Chairman

BoS In Genetics