

VIDYASAGAR UNIVERSITY

Midnapore, West Bengal



PROPOSED CURRICULUM&SYLLABUS (DRAFT) OF

B. Sc. (HONOURS/ HONOURS WITH RESEARCH)
MAJOR IN BIOTECHNOLOGY

4-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2023-2024)

Based on

Curriculum & Credit Framework for Undergraduate Programmes
(CCFUP), 2023& NEP, 2020

VIDYASAGAR UNIVERSITY
BACHELOR OF SCIENCE (HONOURS/ HONOURS WITH RESEARCH) MAJOR IN BIOTECHNOLOGY
(under CCFUP, 2023)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks				
								CA	ESE	TOTAL		
B.Sc. (Hons./ Hons. with Research)	4 th	VII	SEMESTER-VII									
			Major-14	BITHMJ14	T: Biostatistics and Bioinformatics; P: Practical			4	3-0-1	15	60	75
			Major-15	BITHMJ15	T: Reproductive Biology; P: Practical			4	3-0-1	15	60	75
			CRM	BITHCRM	T: Research Methodology and Ethics;			4	3-1-0	15	60	75
			Major Elective-03	BITHDSE03	Plant Biotechnology OR Plant Diversity II			4	3-0-1	15	60	75
			Minor-07 (Disc.-I)	BITMIN07	T: Biostatistics and Bioinformatics; P: Practical (To be taken by the other Discipline)			4	3-0-1	15	60	75
		Semester-VII Total					20				375	
		VIII	SEMESTER-VIII									
			Major-16	BITHMJ16	T:; Genomics & Proteomics; P: Practical			4	3-0-1	15	60	75
			Major Elective-04	BITHDSE04	T: Animal Diversity-II OR Immunotechniques P: Practical			4	3-0-1	15	60	75
			Major Elective-05	BITHDSE05	T: Green Biotechnology; P: Practical	FOR HONOURS STUDENTS	4	3-0-1	15	60	75	
			Major Elective-06	BITHDSE06	T: Biotechnology Start-Up & IPR P: Practical		4	3-0-1	15	60	75	
			Research	BITHRD	DISSERTATION:	FOR HONOURS WITH RESEARCH STUDENTS	8	0-0-8	-	150	150	
			Minor-8 (Disc.-II)	BITMIN08	T: Entrepreneurship Development; P: Practical (To be taken by the other Discipline)			4	3-0-1	15	60	75
		Semester-VIII Total					20				375	
		YEAR-4					40				750	
		To be awarded Bachelor of Science (Honours / Honours with Research) Major in Biotechnology					166	Marks (Year: I+II+III+IV)			3075	

MJ = Major, MI = Minor Course, DSE = Discipline Specific Elective Course, CRM= Compulsory Research Methodology, CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical

SEMESTER-VII

MAJOR (MJ)

MJ-14: Biostatistics and Bioinformatics

Credits 04 (Full Marks:75)

MJ-14T: Biostatistics and Bioinformatics (Theory)

Credits 03 (45 hrs.)

Course Objectives (COBs):

- *Introduce statistical methods and their applications in biological sciences.*
- *Train students in hypothesis testing, correlation, regression, and data interpretation.*
- *Familiarize students with bioinformatics databases, sequence analysis, phylogeny, and molecular docking.*

Course Outcomes (COs):

- *Explain descriptive and inferential statistical tools and apply them to biological data.*
- *Use bioinformatics databases and algorithms (FASTA, BLAST) for sequence analysis.*
- *Analyze evolutionary relationships and ligand–protein interactions using computational approaches.*

Course Content:

Unit 1- Introduction to Biostatistics: Importance of statistical methods in biological sciences; Concept of sample and population; Variables- discrete and continuous; Frequency distribution and its graphical representation (Histogram, Frequency polygon, Ogive).

Unit 2 - Descriptive Statistics: Measures of central tendency (Mean, Median, Mode); Measures of dispersion (Range, Variance, Standard deviation); Coefficient of variation (CV); Standard error of biological data.

Unit 3- Inferential Statistics: Concept of hypothesis testing; t-test (paired and unpaired); Chi-square test for goodness- of-fit; Simple correlation (Karl Pearson's method); Linear regression analysis and its applications biological research.

Unit 4 - Introduction to Bioinformatics: Definition, scope and applications; Interdisciplinary nature; Bioinformatics tools in modern biology

Unit 5 - Biological Databases: Nucleotide databases (GenBank, EMBL, DDBJ); Protein databases (UniProt, PDB); Database formats and accession numbers.

Unit 6 - Sequence Alignment and Comparison: Pairwise sequence alignment; Multiple sequence alignment (MSA); Scoring and mutation matrices (PAM and BLOSUM); FASTA and BLAST algorithms and applications; Database searching strategies

Unit 7 - Molecular Phylogeny: Concepts of phylogenetic trees and its construction methods (UPGMA, Neighbor- Joining); Bootstrapping and tree reliability; Evolutionary relationships and cladistics.

Unit 8 - Ligand-Protein Interaction: Basics of molecular docking; Drug design and virtual screening; Examples of ligand-binding proteins

MJ-14P: Biostatistics and Bioinformatics (Practical)

Credits 01 (30 hrs)

Course Outline:

1. Preparation of graph of experimental data using MS Excel/software.
2. Computation of mean, median, mode, SD, SE, correlation coefficient, regression and ANOVA using available software.
3. Use of Public Domain Interfaces for downloading different DNA and Protein sequences from authenticated databases (Using NCBI, SWISS-SPROT).
4. Performing BLAST and interpretation of the results.
5. Identification of consensus sequence through multiple sequence alignment.
6. Analysis of regional conservation by MSA, primer designing and restriction site analysis.
7. *In vitro* amplification of DNA by PCR.
8. Construction of phylogenetic tree using multiple sequence alignment.
9. Tertiary structure prediction using homology modelling.

MJ-I 5: Reproductive Biology**Credits 04 (Full Marks:75)***MJ-I 5T: Reproductive Biology (Theory)**Credits 03 (45 hrs.)***Course Content:**

1. Novel features of plant development
2. Shoot apical meristem (SAM) and Root apical meristem (RAM) Apical basal and Radial pattern formation in *Arabidopsis thaliana*
3. Genes in development of embryo from zygotic cell division in *Arabidopsis thaliana*, Hormonal regulation of polarity, endosperm development in plants
4. *Phy* gene- Types, mechanism of action, Genetic analysis of phytochrome function
5. Floral meristem and Floral organ development: Organization of floral organ, modification of floral organ, Role of Homeotic gene in determination of floral organ in *Arabidopsis thaliana*, ABC and ABCDE model, MADS- box.
6. Early embryonic development in Animals: Cleavage –Types and mechanism, Gastrulation- Movements involved; Cell specification with respect to amphibian and chick
7. Zygotic genes (gap gene, pair rule gene & segment polarity gene) in pattern formation; antero-posterior embryogenesis in *Drosophila*; homeotic genes in *Drosophila*, Hox gene in mammals.
8. Gametogenesis: spermatogenesis & Oogenesis with hormonal regulations by FSH, LH and Gonads

*MJ-I 5P: Reproductive Biology (Practical)**Credits 01 (30 hrs.)*

1. Study of different stages of meiosis in Onion flower buds, *Rhoeo discolor*, and Grasshopper
2. Study pollen germination by dissecting flowers, dusting pollens on water drops and observing under microscope.
3. Use of Leishman's stain for isolating rat macrophages from peritoneum or lymphocyte from blood for identification
4. Study on different phases of Chick embryo development

COMPULSORY RESEARCH METHODOLOGY (CRM)

[for both Hons. and Hons. with Research students]

CRM: Research Methodology and Ethics

CRM (T): Research Methodology and Ethics (Theory)

Credits 04

Course Content:

Course Objectives (COBs):

- *To provide a foundation in the principles, process, and design of scientific research, including formulation of research problems, hypotheses, and objectives.*
- *To develop proficiency in literature review, data collection, analysis, and interpretation using appropriate statistical and experimental approaches.*
- *To inculcate skills in scientific writing, reporting, and adherence to research ethics, ensuring integrity and responsible conduct of research.*

Course Outcomes (COs):

- *Explain the theoretical basis, structure, and methodology of scientific research and distinguish among various research approaches.*
- *Design and execute research projects through proper problem identification, data handling, statistical analysis, and result interpretation.*
- *Demonstrate competence in preparing scientific reports and publications while maintaining ethical standards and integrity in research practices.*

Course Content:

Unit 1 - Foundation of Research: Definition, objectives and significance of research; scientific research and theory; conceptual and theoretical models; research process; problem definition; research questions; research design and approaches; role of reasoning in research.

Unit 2 - Review of Literature: Purpose and significance of literature review; selection and organization of literature; sources and search tools; note-taking and referencing; role of libraries, indexing, abstracting and citation databases.

Unit 3 - Research Formulation and Design: Selection and formulation of research problems; hypothesis development; measurement and variable identification; types and

structure of research design.

Unit 4 - Experimental Research: Cause–effect relationships; hypothesis testing; measurement system analysis; error propagation; experimental validity; statistical design of experiments.

Unit 5 - Data Collection Methods: Types and sources of data; primary and secondary data; methods of data collection—survey, observation, simulation, and questionnaire techniques.

Unit 6 - Data Processing and Analysis: Editing, classification, coding, transcription and tabulation; graphical and numerical data analysis; sampling methods, sample size determination; sampling errors; descriptive and inferential statistics; data interpretation.

Unit 7 - Research Writing and Reporting: Structure and format of dissertation and research papers; principles of scientific writing; preparation of abstract, introduction, methodology, results, discussion, and conclusion; tables and illustrations; referencing and citation styles; journal types (Q1–Q4).

Unit 8 - Research Ethics and Integrity: Concept and importance of research ethics; intellectual honesty; research misconduct—plagiarism, fabrication, falsification, redundancy; authorship and contributorship; ethical committees and approvals; biomedical and animal research ethics; data ownership and privacy; environmental ethics.

MAJOR ELECTIVE (DSE)

Major Elective – 03:
(Plant Biotechnology OR Plant Diversity II)

MJDSE-03: Plant Biotechnology

Credits 04 (Full Marks:75)

MJDSE-03T: Plant Biotechnology (Theory)

Credits 03 (45 hrs)

Course Content:

UNIT I

Introduction, Cryo and organogenic differentiation, Types of culture: Seed , Embryo, Callus, Organs, Cell and Protoplast culture. Micropopagation Axillary bud proliferation, Meristem and shoot tip culture, cud culture, organogenesis, embryogenesis, advantages and disadvantages of micropropagation.

UNIT- II

In vitro haploid production Androgenic methods: Anther culture, Microspore culture androgenesis Sgnificance and use of haploids, Ploidy level and chromosome doubling, diploidization, Gynogenic haploids, factors effecting gynogenesis, chromosome elimination techniques for production of haploids in cereals.

UNIT - III

Protoplast Isolation and fusion Methods of protoplast isolation, Protoplast development, Somatic hybridization, identification and selection of hybrid cells, Cybrids, Potential of somatic hybridization limitations.

Somaclonal variation

Nomenclature, methods, applications basis and disadvantages.

UNIT - IV

Plant Growth Promoting bacteria.

Nitrogen fixation, Nitrogenase, Hydrogenase, Nodulation, Biocontrol of pathogens, Growth promotion by free-living bacteria.

MJDSE-03P: Plant Biotechnology (Practical)

Credits 01 (30 hrs)

Practical:

1. Preparation of simple growth nutrient (knop's medium), full strength, half strength, solid and liquid.

2. Preparation of complex nutrient medium (Murashige & Skoog's medium)
3. To selection, Prune, sterilize and prepare an explant for culture.
4. Significance of growth hormones in culture medium.
5. To demonstrate various steps of Micropropagation.

Suggested Readings:

1. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.
2. Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication.
3. Gardner, E.J. Simmonns, M.J. Snustad, D.P. 2008 8th edition Principles of Genetics.
1. Wiley India.
4. Raven, P.H., Johnson, GB., Losos, J.B. and Singer, S.R. 2005 Biology. Tata MC Graw
2. Hill.
5. Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue
and Organ Culture. Narosa Publishing House.
6. Russell, P.J. 2009 Genetics – A Molecular Approach. 3rd edition. Benjamin Co.
7. Sambrook & Russel. Molecular Cloning: A laboratory manual. (3rd edition) Slater, A.,
Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation of
Plants, Oxford University Press.

OR

MJDSE-03: Plant Diversity-II

Credits 04 (Full Marks:75)

MJDSE-03T: Plant Diversity-II (Theory)

Credits 03 (45 hrs)

Course Content:

UNIT I: Pteridophytes

General characters of pteridophytes, affinities with bryophytes & gymnosperms, classification, economic importance, study of life histories of fossil Pteridophytes – *Rhynia*.

UNIT- II: Pteridophytes: Type studies

Life histories of *Selaginella*- (Heterospory and seed habit), *Equisetum*, *Pteris*, *Lycopodium*.

UNIT – III: Gymnosperms

General characters, classification, geological time scale, theories of fossil formation, types of fossils, fossil gymnosperms- *Williamsonia* & *Glossopteris*, telome and stele concept.

UNIT – IV: Gymnosperms: Type studies

Life histories of *Cycas* & *Pinus*, economic importance of gymnosperms.

MJDSE-03P: Plant Diversity-II (Practical)

Credits 01 (30 hrs)

Practical:

1. Examination of morphology and anatomy of vegetative and reproductive parts of *Selaginella*, *Equisetum* & *Pteris*.
2. Examination of morphology and anatomy of vegetative & reproductive parts of – *Cycas* & *Pinus*
3. Plant collection (pteridophytes & gymnosperms)

Suggested Readings:

1. Bhatnager, S.P. and Moitra, A. 1996 Gymnosperms. New Age International (P) Ltd. Publishers, New Delhi.
2. Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes. Central, Book Depot, Allahabad.
3. Sambamurty 2008 A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. IK International Publishers.
4. Wickens, G.E. 2004 Economic Botany: Principles and Practices, Springer. Kuwer Publishers, Dordrecht, The Netherlands

MINOR (MI)

Minor (MI)-07: Biostatistics and Bioinformatics

Credits 04 (Full Marks:75)

MI-07T: Biostatistics and Bioinformatics (Theory)

Credits 03 (45 hrs.)

Course Content:

Unit 1- Introduction to Biostatistics: Importance of statistical methods in biological sciences; Concept of sample and population; Variables- discrete and continuous; Frequency distribution and its graphical representation (Histogram, Frequency polygon, Ogive).

Unit 2 - Descriptive Statistics: Measures of central tendency (Mean, Median, Mode); Measures of dispersion (Range, Variance, Standard deviation); Coefficient of variation (CV); Standard error of biological data.

Unit 3- Inferential Statistics: Concept of hypothesis testing; t-test (paired and unpaired); Chi-square test for goodness- of-fit; Simple correlation (Karl Pearson's method); Linear regression analysis and its applications biological research.

Unit 4 - Introduction to Bioinformatics: Definition, scope and applications; Interdisciplinary nature; Bioinformatics tools in modern biology

Unit 5 - Biological Databases: Nucleotide databases (GenBank, EMBL, DDBJ); Protein databases (UniProt, PDB); Database formats and accession numbers.

MI-07P: Biostatistics and Bioinformatics (Practical)

Credits 01 (30 hrs)

Course Outline:

1. Preparation of graph of experimental data using MS Excel/software.
2. Computation of mean, median, mode, SD, SE, correlation coefficient, regression and ANOVA using available software.
3. Use of Public Domain Interfaces for downloading different DNA and Protein sequences from authenticated databases (Using NCBI, SWISS-SPROT).

SEMESTER-VIII

MAJOR (MJ)

MJ-16: Genomics & Proteomics

Credits 04 (Full Marks:75)

MJ-16T: Genomics & Proteomics (Theory)

Credits 03 (45 hrs.)

Course Content:

UNIT I

(16 L)

Introduction to Genomics, DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clone contig) methods, Computer tools for sequencing projects: Genome sequence assembly software.

UNIT II

(13 L)

Managing and Distributing Genome Data: Molecular marks and their applications. Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases.

UNIT III

(16 L)

Introduction to Proteomics, Analysis of proteomes SDS-PAGE; Native PAGE, 2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE. Mass spectrometry based methods for protein identification. De novo sequencing using mass spectrometric data.

MJ-16P: Genomics & Proteomics (Practical)

Credits 01 (30 hrs.)

1. Use of SNP databases at NCBI and other sites
2. Use of OMIM database
3. Detection of Open Reading Frames using ORF Finder
4. Proteomics 2D PAGE database
5. Softwares for Protein localization.
6. Hydropathy plots
7. Native PAGE 8. SDS-PAGE

Suggested Readings:

1. Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA. Clark DP and Pazdernik NJ. (2009)
2. Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K. Primrose SB and Twyman RM. (2006)
3. Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education. Wiley JM, Sherwood LM and Woolverton CJ. (2008).
4. Genomes-3. Garland Science Publishers. Brown TA. (2007).
5. Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K. Primrose SB and Twyman RM. (2008).

MAJOR ELECTIVE (DSE)

Major Elective – 04:
(Animal Diversity-II OR Immunotechniques)

MJDSE-04: Animal Diversity-II

Credits 04 (Full Marks:75)

MJDSE-04T: Animal Diversity-II (Theory)

Credits 03 (45 hrs)

Course Content:

UNIT I: Proto-chordates, Pisces and Ambhibia

Proto-chordates: Outline of classification, General features and important characters of *Herdmania*, *Branchiostoma*

Origin of Chordates

Pisces: Migration in Pisces, Outline of classification

Amphibia: Classification, Origin, Parental care, Paedogenesis

UNIT II: Reptilia, Aves and Mammalia

Reptelia: Classification, Origin

Aves: Classification, Origin, flight- adaptations, migration

Mammalia: Classification, Origin, dentition

UNIT III: Comparative anatomy of vertebrates I

Comparative anatomy of various systems of vertebrates: Integumentary, digestive respiratory systems.

UNIT IV: Comparative anatomy of vertebrates II

Comparative Anatomy of vertebrates – Heart, Aortic arches, Kidney & urinogenital system, Brain, Eye, Ear.

Autonomic Nervous system in Mammals

MJDSE-04P Animal Diversity-II (Practical)

Credits 01 (30 hrs)

1. Identification & Classification upto order of the following: Proto-chordata: *Salpa*, *Doliolum*, *Herdmania*, *Branchiostoma*
Cyclostomata: *Myxine*, *Petromyzon*
Chondrichthyes: *Scoliodon*, *Zygnea*, *Pristis*, *Trygon*, *Raja*, *Chimaera*
Ostiechthyes: *Labeo*, *Mystus*, *Catla*, *Hippocampus*, *Anabas*, *Echeneis*, *Lophius*, *Polypeterus*

Amphibia: *Rana*, *Hyla*, *Amblystoma*, *Necturus*, *Proteus*.

Reptiles: *Hemidactylus*, *Calotes*, *Draco*, *Phrynosoma*, *Naja Vipera*, *Bungarus*

Aves: *Columba*, *Alcedo*, *Passer*

Mammalia: *Ornithorhynchus*, *Macropus*, *Didelphes*, *Dasypus*

2. An Ecological Note on any one of the specimens in Experiment 1
3. Identification of the following slides Mammalian Histology: Liver, Lung, Intestine, Kidney, Ovary, Testes Slides of *Salpa*, *Doliolum*, Spicules of *Herdmania*, Tadpole of Frog
4. Preparation of a permanent mount of *Salpa*, Placoid scales, spicules of *Herdmania*, Pharynx of *Amphioxus*, Tadpole Larva of frog
5. Identification of endoskeletons of frog and rabbit.

Suggested Readings:

1. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
2. Kardong, K.V. (2005) Vertebrates Comparative Anatomy, Function and evolution. IV Edition. McGraw-Hill Higher Education.
3. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
4. Weichert, C.K. (1970). Anatomy of Chordate. McGraw Hill.
5. Young, J.Z. (2004). The life of vertebrates. III Edition. Oxford university press.

OR

MJDSE-04: Immunotechniques**Credits 04 (Full Marks: 75)***MJDSE-04T: Immunotechniques (Theory)**Credits 03 (45 hrs)***Course Content:****Unit-I:**

Immunotechniques: Blood grouping, Antigen-antibody Reaction: Agglutination, precipitation, immunoelectrophoresis, immune fluorescence microscopy, immuno precipitation, immune affinity chromatography, immune electron microscopy, Coomb's test

Unit-II:

ELISA, RIA, Monoclonal Antibody Production hybridoma technique. Purification of antibody, raising antibody in laboratory animals.

Unit-III:

Vaccine & vaccination: adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, tumor vaccines, principles of vaccination, passive and active immunization,

*MJDSE-04P Immunotechniques (Practical)**Credits 01 (30 hrs)*

1. Antigen-Antibody reactions – Agglutination (Blood grouping testing).
2. Partial purification of Immunoglobulin by Affinity technique
3. Immuno electrophoresis (rocket IEP), Fluorescence microscopy
4. Immunodiffusion (radial, double)

Suggested reading:

1. Mark Peakman, Basic and Clinical Immunology; Churchill Livingstone. 2ndEd. 2009.
2. Talwar GP, Rao KVS and Chauhan VS, Recombinant and Synthetic Vaccines; Narosa, New Delhi. 1994.
3. Benjamini E, Coico Rand Sunskise G,;I mmunology–A short course, Wiley–Liss Publication, NY. Ed.4; 2000.
4. Kuby J, Immunology, WH Freeman and Co. NY.Ed.4; 1997.
5. ClarkWR,The Experimental Foundations of Modern Immunology; JohnWiley and Sons Inc. New York. 1991.
6. Leslie Hudson and Frank C. Hay., Practical Immunology. Wiley. Ed.3; 1989.
7. Noel R. Rose, Herman Friedman, John L. Fahey., Manual of Clinical Laboratory Immunology. ASM. Ed.3;1986.

MAJOR ELECTIVE- 05
[to be studied by Honours students only]

MJDSE-05: Green Biotechnology

Credits 04 (Full Marks: 75)

MJDSE-05T: Green Biotechnology (Theory)

Credits 03 (45 hrs)

Course Content:

UNIT-I (10 L)

Conventional fuels and their environmental impact – Firewood, plant, animal, water, Coal and gas. Modern fuels and their environmental impact – methanogenic bacteria, biogas, microbial hydrogen production, conversion of sugar to alcohol and gasohol

UNIT-II (15 L)

Bioremediation of soil & water contaminated with oil spills, heavy metals and pesticides. Degradation of lignin and cellulose using microbes. Phyto-remediation. Degradation of pesticides and other toxic chemicals by micro-organisms- degradation aromatic and chlorinated hydrocarbons and petroleum products.

UNIT-III (10 L)

Treatment of municipal waste and industrial effluents. Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Removal of toxic dyes and heavy metals from water using bio-adsorption, Bio-fertilizers: Algal, bacterial and fungal biofertilizers (VAM)

UNIT-IV (10 L)

Bioleaching, enrichment of ores by microorganisms (gold, and uranium). Environmental significance of genetically modified microbes, plants and animals.

MJDSE-05P Green Biotechnology (Practical)

Credits 01 (30 hrs)

1. Estimation of Total Dissolved Solids (TDS) of water sample.
2. Estimation of BOD & COD of water sample.
3. Bacterial Biofertilizer production.
4. Bacterial Examination of Water by MPN Method.
5. Isolation of para-nitrophenol degrading bacterial culture from agricultural field.
6. Preparation of vermi-composting.

MAJOR ELECTIVE- 06
[to be studied by Honours students only]

MJDSE-06: Biotechnology Start Up & IPR

Credits 04 (Full Marks: 75)

MJDSE-06T: Biotechnology Start Up & IPR (Theory)

Credits 03 (45 hrs)

Course Content:

UNIT I: Introduction (5L)

Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship.

UNIT II: Establishing an Enterprise (5L)

Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility.

UNIT III: Financing the Enterprise (10L)

Importance of finance / loans and repayments, Characteristics of Business finance, Fixed capital management: Sources of fixed capital, working capital its sources and how to move for loans, Inventory direct and indirect raw materials and its management.

UNIT IV: Marketing Management (10L)

Meaning and Importance, Marketing-mix, product management – Product line, Product mix, stages of product like cycle, marketing Research and Importance of survey, Physical Distribution and Stock Management, selection of a product, Selection of a market for international business, Export financing, institutional support for export.

UNIT V: Intellectual Property Rights (IPR) (15L)

IPR: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights, international overview on intellectual property, international - trade mark law, copy right law, international patent law.

IPR Umbrella- Patent (Foundation of patent law, patent searching process, ownership rights and transfer, WTO/TRIPS, Indian Patents Act, 1970), Trademarks (concept of trademark and trademark law), Copy rights (Fundamental of copy right law, Indian Copy right act, 1957 with its amendments), Geographical Indications

MJDSE-06P: Biotechnology Start Up & IPR (Practical)

Credits 01 (30 hrs)

1. Proxy filing of Indian Product patent
2. Proxy filing of Indian Process patent
3. Planning of establishing a hypothetical biotechnology industry in India

PROJECT / DISSERTATION (RD)

[to be undertaken by students opting for and eligible for Hons. with Research]

DISSERTATION: Credit: 8; Full Marks: 150

Structure of the dissertation

Preliminary Pages

- Title Page: Includes name of the student, university, degree, and submission date.
- Certificate/Declaration: Signed statement of originality and supervisor's approval
- Abstract: A 250-350 word summary covering research problem, methodology, and core findings.
- Acknowledgements: To supervisors and others, if any.
- Table of Contents: Clear hierarchical mapping of chapters with page number
- List of Abbreviations: Specialized terms, if any

Introduction

- Background & Context: Situates the topic in historical or theoretical context.
- Research Problem & Objectives: The specific question or gap the research is addressing.
- Thesis Statement/Hypothesis: The core argument the dissertation intends to prove.
- Scope and Significance: Why the study matters.
- Literature Review & Theoretical Framework

Literature Review: Analyzes existing scholarly works to show the gap the study fills.

- Theoretical Framework: Identifies the philosophers, critics, or schools of thought shaping the analysis in the dissertation.

Methodology

- Describes *how* the research was conducted - Anyone or a combination of textual analysis/ archival research/ conducting interviews/ ethnographic/semi-ethno-graphic research involving both textual analysis and field visit etc.
- Thematic or Analytical Chapters

The Core Body: Usually 3 to 4 chapters focusing on the core concerns of the study.

- Structure: Each chapter introduces its specific theme, analyzes primary and secondary sources, and contributes to the overarching thesis.

Conclusion

- Summary & Synthesis: Recaps your main points without simply repeating them.

Final Verdict: Answers the research questions posed in the introduction.

Future Scope: Suggests how future scholars can build upon your work.

- **Works Cited/ Reference, and/or Bibliography:** A comprehensive list of all primary and secondary sources cited as per the latest MLA style.

Appendices: Transcripts, interview logs, or raw archival data, if any.

Marks distribution-

Sl. No	Particulars	Marks
1	Research Project / Dissertation Report	70
	▪ Proposal and Abstract (along with some keywords)	10
	▪ Literature Review & Theoretical Framework	10
	▪ Methodology and Research design	10
	▪ Thematic Analysis (Chapter-wise)	20
	▪ Report Quality	20
2	Seminar Presentation	30
3	Viva-Voce	50
Total		150

MINOR (MI)

Minor (MI)-08: Entrepreneurship Development

Credits 04 (Full Marks: 75)

MI-08T: Entrepreneurship Development (Theory)

Credits 03 (45 hrs)

Course Contents-

UNIT I: Introduction

Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship.

UNIT II: Establishing an Enterprise

Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility.

UNIT III: Financing The Enterprise

Importance of finance / loans and repayments, Characteristics of Business finance, Fixed capital management: Sources of fixed capital, working capital its sources and how to move for loans, Inventory direct and indirect raw materials and its management.

UNIT IV: Marketing Management

Meaning and Importance, Marketing-mix, product management – Product line, Product mix, stages of product life cycle, marketing Research and Importance of survey, Physical Distribution and Stock Management.

UNIT V: Entrepreneurship and International Business

Meaning of International business, Selection of a product, Selection of a market for international business, Export financing, Institutional support for exports.

MI-08P: Entrepreneurship Development (Practical)

Credits 01 (30 hrs)

Practical Outline: Project Report on a selected product should be prepared and submitted

Suggested Reading:

1. Holt DH. Entrepreneurship: New Venture Creation.
2. Kaplan JM Patterns of Entrepreneurship.
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