Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2022
'B^{++}' Grade (CGPA 2.96)

Name of the Faculty: Science &Technology

(As per New Education Policy 2020)

Syllabus: Biotechnology

Name of the Course: M. Sc. II (Sem. III & IV)

(Syllabus to be implemented from June 2024)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science & Technology
Nep 2020 Compliant Curriculum

M.Sc. (Biotechnology)
Program Preamble

Master of Science (M.Sc.) in Biotechnology is a comprehensive program that provides a broad overview of biotechnology and can produce expert hands with knowledge and expertise to deal with the several issues, problems, opportunities and challenges in life sciences and their numerous applications. The course structure is technology-centric where students learn about the advances in Biotechnology along with the necessary fundamental knowledge of subjects in life sciences. Aligned with the vision of the National Education Policy (NEP) 2020, the program offers a flexible, multidisciplinary, and learner-centric curriculum that encourages critical thinking, innovation, and holistic development. This programme allows the opportunity to the students to experience holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per their choices. Each year of the curriculum offers progressively advanced learning and is designed to build a strong foundation in Biotechnology. The curriculum is structured around several key components:

1. **Major Courses:**These core courses form the backbone of the program, providing in-depth knowledge and understanding of essential Biotechnology concepts, theories, and methodologies.
2. **Minor Courses:** Students have the opportunity to choose minor courses from related or distinct disciplines, promoting an interdisciplinary approach to learning.
3. **Open Electives/General Electives:** The program encourages intellectual exploration beyond the core discipline by offering a wide range of elective courses. These electives enable students to pursue their interests in diverse subjects, fostering creativity, critical thinking, and a well-rounded educational experience.
4. **Vocational and Skill Enhancement Courses:** Practical skills and technical proficiency are integral to the program, with vocational and skill enhancement courses providing hands-on experience in Biotechnology areas. These courses are designed to prepare students for immediate employment and equip them with the tools necessary for career advancement in various scientific and technological fields.
5. **Ability Enhancement Courses (AEC), Indian Knowledge System (IKS), and Value Education Courses (VEC):** In alignment with NEP 2020, the program integrates courses that emphasize the Indian Knowledge System, ethical values, and life skills. These courses foster a deep appreciation for India's rich cultural heritage, while also developing essential communication and ethical decision-making skills that are vital for personal and professional growth.
6. **Field Projects/Internships/Apprenticeships/Community Engagement Projects/On-Job Training:** To bridge the gap between theoretical knowledge and real-world applications, the program includes opportunities for field projects, internships, apprenticeships, and community engagement. These experiences provide students with practical insights, problem-solving abilities, and exposure to professional environments, enhancing their readiness for careers in Biotechnology and related fields.

7. **Research Methodology and Research Projects:** Research is a critical component of the M.Sc Biotechnology program, with students acquiring skills in research methodology, data collection, analysis, and scientific inquiry. By engaging in independent research projects, students are encouraged to develop innovative solutions to complex scientific problems, preparing them for advanced studies and research-oriented careers.

Multiple Entry and Multiple Exit Options:

In accordance with the NEP 2020, the M.Sc Biotechnology program incorporates a Multiple Entry and Multiple Exit framework, offering students the flexibility to enter or exit the program at various stages. This approach ensures that students can tailor their educational journey according to their personal and professional goals, with options to earn certificates, diplomas, or degrees based on the duration of study completed.

- Post-Graduation: First Year : PG Diploma (44 Credits)
- Post-Graduation: Second Year: Masters Degree (44 Credits)

Eligibility for <u>M.Sc. I Biotechnology</u>:

- A Candidate possessing Bachelor Degree with Biotechnology/Biochemistry/Chemistry/ Microbiology/Botany/Zoology/B. Pharm/MBBS/BAMS/BHMS/BUMS/BDS/B. E./B. Sc. Agri. OR Concerned subjects to life sciences from recognized university, and **who have passed the entrance examination conducted by the PAH Solapur University** shall be eligible for admission to the M. Sc. Programme in Biotechnology.
- **Admission:** Merit list based on average of B. Sc. aggregate and an Entrance Exam conducted by PAH Solapur University.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science & Technology
Nep 2020 Compliant Curriculum

M.Sc. (Biotechnology)
Program Outcomes (PO)

Students with post graduation from the Master of Science in Biotechnology program will be able to:

Major Courses:

- PO1: Have an intensive and in-depth learning and are acquainted with fundamental and advanced knowledge of science in their specialization area.
- PO2: Have a scientific temperament and a basic research aptitude to address the underlying recurring issues and new opportunities.
- PO3: Have an awareness about professional and ethical responsibilities required for their work field.
- PO4: Have developed an awareness, skill & knowledge as per the requirements of career opportunities in the field of specialization to take up a wide variety of roles.

Minor Courses:

- PO5: Acquire complementary knowledge and skills from a related or distinct discipline, enhancing interdisciplinary understanding and versatility.

Open Electives/General Electives:

- PO6 Explore diverse subjects beyond the core discipline, fostering a broad-based education and cultivating critical thinking and creativity.

Field Projects/Internship/Apprenticeship/Community Engagement Projects/ On Job Training/ Internship/Apprenticeship:

- PO7: Apply theoretical knowledge to real-world situations through field projects, internships, community engagement and On job Training for gaining practical experience and problem-solving skills.

Research Methodology and Research Project:

- PO8: Acquire research skills, including data collection, analysis, and interpretation, fostering a scientific approach to problem-solving to develop independent research projects handling capabilities.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science & Technology
Nep 2020 Compliant Curriculum

M.Sc. (Biotechnology)
Program Specific Outcomes (PO)

PO 01 Students have a basic as well as in depth understanding about the fundamentals and advances in the core subjects of biotechnology.

PO 02 Students have acquired practical and theoretical knowledge in subjects of biotechnology.

PO 03 Students become skilled with techniques in biotechnology and are able to critically think about application of these skills as per requirement.

PO 04 Students have developed a research and logical aptitude and are able to interpret and communicate the biological data.

PO 05 Students can identify the contemporary technical and professional requirements in Biotechnology and are competent to take up a wide variety of roles.

M. Sc. II- BIOTECHNOLOGY (As per NEP 2020 - w.e.f. June 2024-25)

General Structure of the Course:

Sem.	Code	Title of the paper	Semester Examination			Hrs/ Week	Credit
		MAJOR	**UA**	**CA**	**Total**		
SEM-III	2311301	DSC 5: Industrial and Environmental Biotechnology	60	40	100	4	4
	2311302	DSC 6: Genetic Engineering	60	40	100	4	4
		ELECTIVE (Any One)					
	2311306	DSE 3A: Plant Biotechnology	60	40	100	4	4
	2311307	DSE 3B: Molecular Diagnostics					
	2311308	DSE 3C: Advanced Pharmaceuticals					
		PRACTICALS					
	2311304	Practical I: Industrial and Environmental Biotechnology	30	20	50	4	2
	2311305	Practical II: Genetic Engineering)	30	20	50	4	2
	2311309	Practical III (Based on DSE 3A) /	30	20	50	4	2
	2311310	Practicals III (Based on DSE 3B) /					
	2311311	Practical III (Based on DSE 3C)					
		RESEARCH PROJECT					
	2311303	Research Project	60	40	100	8	4
		Total for semester III	**330**	**220**	**550**		**22**
SEM-IV		**MAJOR**					
	2311401	DSC 7: Advanced Analytical Techniques	60	40	100	4	4
	2311402	DSC 8: Bionanotechnology	60	40	100	4	4
		ELECTIVE (Any One)					
	2311405	DSE 4A: Animal Biotechnology	60	40	100	4	4
	2311406	DSC 4B: Medical Biotechnology					
	2311407	DSE 4C: Advanced Pharmacognosy					
		PRACTICALS					
	2311404	Practical I: Advanced Analytical Techniques	30	20	50	4	2
	2311408	Practical II: (Based on DSE-4A) /	30	20	50	4	2
	2311409	Practical II: (Based on DSE-4B) /					
	2311410	Practical II: (Based on DSE-4C)					
		RESEARCH PROJECT					
	2311403	Research Project	90	60	150	12	6
		Total for semester IV	**330**	**220**	**550**		**22**

Nature of Examination:

Each semester will have theory external assessment examination of 60 marks each (2.5 hrs. duration) and 40 marks college assessment. The practical examination of Semesters III to IV will be conducted at the end of the each Semester. Duly certified copy of laboratory record must be produced at the time of examination.

Practical Examination of M. Sc. II

The practical examination will be of 3 days for each semester.

Semester III:

Practical courses each	: 30 (UA)+ 20 (CA)
Research Project work	: 60 (UA) + 40 (CA)

Semester IV:

Practical courses each	: 30 (UA)+ 20 (CA)
Research Project work	: 90 (UA) + 60 (CA)

** The evaluation of Research Project will be done by both external and internal examiners at the time of examination

M. Sc. - BIOTECHNOLOGY SEMESTER-III

Semester	Code	Title of the paper	Semester Examination			Hrs/ Week	Credit
	MAJOR		**UA**	**CA**	**Total**		
SEM-III	**2311301**	DSC 5: Industrial and Environmental Biotechnology	60	40	100	4	4
	2311302	DSC 6: Genetic Engineering	60	40	100	4	4
	ELECTIVE (Any One)						
	2311306	DSE 3A: Plant Biotechnology	60	40	100	4	4
	2311307	DSE 3B: Molecular Diagnostics					
	2311308	DSE 3C: Advanced Pharmaceuticals					
	PRACTICALS						
	2311304	Practical I: Industrial and Environmental Biotechnology	30	20	50	4	2
	2311305	Practical II: Genetic Engineering)	30	20	50	4	2
	2311309	Practical III (Based on DSE 3A) /	30	20	50	4	2
	2311310	Practicals III (Based on DSE 3B) /					
	2311311	Practical III (Based on DSE 3C)					
	RESEARCH PROJECT						
	2311303	Research Project	60	40	100	8	4
	Total for semester III		**330**	**220**	**550**		**22**

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Second Year MSc (Biotechnology) Semester-III
Vertical : DSC-5
Course Code: 2311301
Course Name: Industrial and Environmental Biotechnology

*Teaching Scheme:	*Examination Scheme
Lectures - 04 Hrs/Week, 04 Credits	UA:60 Marks CA: 40 Marks

Course Preamble:
Industrial and Environmental Biotechnology utilizes the biochemical potential of microorganisms and plants for the preservation and restoration of the environment. It promotes sustainable and efficient use of natural resources like fungi, plants, algae, and bacteria in the industrial processes. Our biological systems have the capability to absorb and control pollutants like free carbon sources from our environment and keep our surroundings clean and green. Integrated with the industrial processes, it helps in forming a balanced industrial framework that has better efficiency, makes better use of natural resources, and also keeps our environment green. Green manufacturing technologies and sustainable development are the key issues that environmental biotechnology addresses.

Course Objectives:
During this course, the student is expected to:

- To obtain knowledge on wide-ranging topics related to applications of biotechnology in industries.
- To learn about bioprocess technology and its applications
- To learn the relevance of biotechnology for environmental monitoring and pollution abatement.

Course Outcomes:
At the end of this course:

- Scientific industrial biotechnology and applications of microbes and enzymes used in industry.
- Awareness about Environment protection regulations and source of environmental pollution.
- Environmental pollution and its remediation measure The capability to apply avalanched discipline in wastewater management.

DSC T5 INDUSTRIAL AND ENVIRONMENTAL BIOTECHNOLOGY (4 Credits - 60L)

Unit I	Fermentation Biotechnology	No. of Lectures: 15	Weightage (UA): 15-23 Marks
General requirements of the fermentation, Bioreactors: design, types (Air lift, Bubble column, Packed bed, fluidized bed, Photobioreactor), Types of fermentation processes: (Batch, fed batch, continuous, submerged, Aerobic and Anaerobic) Upstream Processing: Isolation and preservation of industrially important microorganisms, Strain improvement, Scale up, Microbial growth kinetics Downstream processing: Solid liquid separation (flotation, flocculation, sedimentation, filtration and centrifugation), Cell lysis (physical, chemical and biological methods), Concentration (Evaporation, solvent extraction, membrane filtration, precipitation and adsorption), Purification by chromatography, Formulation (dehydration, crystallization and use of stabilizing agents). ,			
Unit II	**Products of Industrial Biotechnology**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Primary Metabolites: Vitamins (B12 and Riboflavin) Amino acid - Glutamic acid, Lysine, Organic acids (Citric acid, Vinegar and Lactic acid), Secondary metabolites: Ethanol and alcoholic Beverages (Beer and Wine), Antibiotics (Penicillin and Streptomycin) , Milk products: Cheese and Yogurt,			
Unit III	**Environmental Biotechnology**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Distillery and pharmaceutical industrial Effluent treatment (Physical, chemical and biological methods), Concept of Bioremediation, Environmental monitoring in industry. Energy sources (Conventional & Non-conventional). Environment protection Acts: Environmental laws, Environmental policies, Environmental ethics. UN declaration. Environmental protection and conservation. Environmental Impact Assessment			
Unit IV	**Industrial management**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Human Resource Management, Research and Development, Process design and Scale up, Production, Quality Control, Quality Assurance, Packaging and Storage, Transport and shelf life, Marketing and Sales, SOPs, industrial safety, Regulatory affairs, Industrial Ethics			

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Second Year MSc (Biotechnology) Semester-III

Vertical : DSC-5 P

Course Code: 2311304

Course Name:

Practical (DSC-5 P) - INDUSTRIAL AND ENVIRONMENTAL BIOTECHNOLOGY

*Teaching Scheme:	*Examination Scheme
Practicals - 2 Credits	UA:30 Marks CA: 20 Marks

Practical (DSC-5 P) - INDUSTRIAL AND ENVIRONMENTAL BIOTECHNOLOGY 02 Credits

1. Necessity and procedure of writing SOPs for instruments/equipments to be used in scale up and/or large scale production.
2. Culturing and characterization of microorganisms used in Dairy and Bakery.
3. Culturing and characterization of fungi/actinomycetes used in pharmaceutical industry.
4. Production and estimation of organic solvents: Ethanol/Acetone/Butanol/Glycerol.
5. Production and estimation of Alcoholic beverages: Beer/Wine.
6. Production and estimation of Phenylalanine/L-lysine/ Vitamin B12.
7. Preservation of industrial microorganisms (short term and long term).
8. Determination of COD for the given effluent sample.
9. Determination of BOD for the given effluent sample.
10. Visit to a Dairy / Fermentation industry / Agriculture college/ Pharmacy college and preparation of visit report

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Second Year MSc (Biotechnology) Semester-III

Course Name: INDUSTRIAL AND ENVIRONMENTAL BIOTECHNOLOGY

References:

1. Sullia S. B & Shantharam S: (1998) General Microbiology, Oxford & IBH Publishing Co. Pvt. Ltd.
2. Glaser A.N &Nilaido. H (1995) Microbial Biotechnology,W.H Freeman & Co. 3. Prescott & Dunn (1987) Industrial Microbiology 4th Edition, CBS Publishers& Distributors. 4. Prescott & Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers. 5. Crueger W. & Crueger A. (2000) A text of Industrial Microbiology, 2nd Edition, Panima Publishing Corp.
6. Stanbury P.F, Ehitaker H, Hall S.J (1997) Priciples of Fermentation Technology., Aditya Books (P) Ltd. S.N.Jogdan (2006) Industrial Biotechnology, Himalaya Publishing House 7. Amann, R.I. Stromley, J. Stahl : Applied & Environmental Microbiology 8. Dash : Concepts of Ecology
9. Chattergy : Environmental Biotechnology
10. Varma & Agarwal : Environmental Biology
11. B.K. Sharma : Environmental Chemistry
12. Peavy & Rowe : Environmental Pollution
13. Asthana & Asthana : Environment Problems & Solutions

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Second Year MSc (Biotechnology) Semester-III

Vertical : DSC-6

Course Code: 2311302

Course Name: Genetic Engineering

*Teaching Scheme:	*Examination Scheme
Lectures - 04 Hrs/Week, 04 Credits	UA:60 Marks CA: 40 Marks

Course Preamble:

Genetic Engineering plays a pivotal role in numerous fields, including medicine, agriculture, environmental science, and industrial biotechnology. This course combines theoretical knowledge with practical skills, including laboratory work and critical analysis of current research. student will gain hands-on experience and develop a critical understanding of the potential, limitations, and future directions of genetic engineering. The field of genetic engineering is not just about altering genes; it's about shaping the future and solving some of the world's most pressing challenges.

Course Objectives:

During this course, the student is expected to:

- The students will have knowledge of tools and strategies used in genetic engineering.
- Understanding of applications of recombinant DNA technology and genetic engineering. from academic and industrial perspective.
- Can use and apply the knowledge of genetic engineering in problem solving and in practice

Course Outcomes:

At the end of this course:

- Students will understand the basic steps of gene manipulations.
- Students will acquire the knowledge of the role of enzymes and vectors responsible for gene manipulation, transformation and genetic engineering.
- Students will acquire detailed knowledge of gene transfer methods and identifying suitable hosts for cloning.

DSC T6 GENETIC ENGINEERING (4 Credits - 60L)

Unit I	**Enzymes and Vectors in Genetic Engineering**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Exonucleases, Endonucleases, Restriction endonucleases–classification & properties; DNA manipulating enzymes - nucleases, DNA polymerases, RNA polymerases,and reverse transcriptase; nucleic acid modifying enzymes- ligases, alkaline phosphatases, terminal transferases and kinases. Properties & structure of plasmids, cosmids, phagemids, BAC, YAC, Bacteriophages (λ and M13), Yeast vector, animal and plant viruses, Baculovirus, Mammalian and shuttle vectors.			
Unit II	**Construction, screening and Isolation of r DNA Molecules**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Construction of r DNA Molecules - Isolation of Vector and donor DNA and its purification; Assembly of gene of interest and vector DNA; Introduction to genomic library: Construction and screening of Genomic library and c DNA library. Screening of Recombinant Cell – Direct Screening, Indirect Screening, Colony hybridization, Immuno-Screening. Molecular Probes- Genomic DNA probes, c DNA probes, synthetic oligonucleiotide probes, and RNA probes, methods of labeling probes.			
Unit III	**Molecular Markers and Transformation Methods**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Techniques in Genetic Engineering: Introduction; Commonly used techniques: Chromosome walking, Molecular markers: Restricted Fragment Length Polymorphism (RFLP), Random Amplified Polymorphic DNA (RAPD), Amplified Fragment Length Polymorphism (AFLP), Microarray (DNA and protein). DNA sequencing: Maxam's and Gilbert's method, Sanger's dideoxy method, Automated method. PCR and its types (Inverse, Real time and Reverse transcription). Transformation methods: Methods of direct transformation - Microinjection, particle bombardment, Electroporation, PEG and CaCl2**.**			
Unit IV	**Applications of genetic engineering**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
GE in animals - Transgenic sheep and mice. DNA fingerprinting, Production of recombinant products: insulin and HGH; Hepatitis-B recombinant vaccine, Synthesis of Human Interferon Gene therapy- *ex vivo, in vivo,*. GE in Plants**:** Insect- resistant plants, Herbicide-resistant plants, salt stress tolerant plants, edible vaccines, Modification of food plants taste (Sweetness); DNA marker technology in plants, , Detection and Diagnosis of Genetic diseases (sickle-cell anaemia, Thalasemia, Haemophilia and Cystic fibrosis) and infectious diseases (Malaria and TB)			

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Second Year MSc (Biotechnology) Semester-III

Vertical : DSC-6 P

Course Code: 2311305

Course Name: PRACTICAL (DSC-6 P): GENETIC ENGINEERING

*Teaching Scheme:	*Examination Scheme
Practicals - 2 Credits	UA:30 Marks CA: 20 Marks

PRACTICAL (DSC-6 P): GENETIC ENGINEERING - 02 Credits
1. Isolation of Genomic DNA from blood/hair.
2. Isolation of Ti plasmid DNA.
3. Transformation of *E. coli*
4. Restriction Fragment Length Polymorphism (RFLP)
5. Random Amplified polymorphic DNA (RAPD)
6. *In vitro* DNA ligation
7. Southern blotting and hybridization
8. DNA amplification by PCR.
9. Demonstration of Reverse transcriptase PCR
10. Isolation of bacteriophage from given sample
11. Any suitable practicals conducted by the department with respect to the concerned course (maximum two practicals)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Second Year MSc (Biotechnology) Semester-III

Course Name: Genetic Engineering

References

1) Genes VIII: Benjamin Lewin
2) Molecular Biology of Gene: Watson et al.
3) Cell & Molecular Biology: Lodish et al.
4) An Introduction to Genetic Engineering By Desmond S. T. Nicholl.
5) Principles of Gene Manipulation and Genomics by Sandy Primrose
6) Gene and Genome Technology: Principles and Applications of Recombinant DNA and Genomics by Sandy Primrose
7) An Introduction to Genetic Engineering, Des Nicholl.1994
8) Molecular Cloning, VolumeI, II, &III, Sambrook and Russell (CSHLPress)
9) Eugene W. Nester: Agrobacterium: nature's genetic engineer .
10) Frontiers in Plant sciences. 2014 .
11) Brown,T.A.(2006).Genomes(3rded.).New York: Garland Science Pub.
12) Methods in Enzymology Guide to Molecular Cloning Techniques, Vol. 152 S.L. Berger and A.R. Kimmel, Academic Press Inc, San Diego, 1996
13) Methods in Enzymology Gene Expression Technology, Vol. 185D. V. Goedel, Academic Press Inc, San Diego, 1990
14) Molecular Biotechnology, 2nd Ed. S. B. Primrose, Blackwell Scientific publishers, Oxford, 1994
15) Milestones in Biotechnology, Classic Papers on Genetic Engineering, J. A. Davis and W. S.Reznikoff, Butterworth-Heinemann Boston 1992
16) Genetic Engineering: An Introduction to Gene Analysis and Exploitation in Eukaryotes, S.M. Kingsman, Blackwell Scientific Publications, Oxford, 1998.

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Second Year MSc (Biotechnology) Semester-III

Vertical : DSE-3A

Course Code: 2311306

Course Name: Plant Biotechnology

*Teaching Scheme:	*Examination Scheme
Lectures - 04 Hrs/Week, 04 Credits	UA:60 Marks CA: 40 Marks

Course Preamble:

The purpose of this course is to educate students about the fundamental concepts of plant cell system, plant transformation, genetic engineering, plant tissue culture and their related applications, thus preparing them to meet the challenges of the new and emerging areas of the plant biotechnology industry. Plant tissue culture enhances skills for large scale and quality plants; plant transformation and genetic engineering in plants ignites new ideas for development of novel transgenic plants of desired characters.

Course Objectives:
During this course, the student is expected to:

- To learn about basic techniques in plant tissue culture, Micro propagation and other type of hybridization techniques
- To know about genetic transformation in plant and techniques about gene delivery.
- To know about applications of plant biotechnology in molecular farming.

Course Outcomes:
At the end of this course:

- To learn about basic techniques in plant tissue culture, Micro propagation and other type of hybridization techniques
- To know about genetic transformation in plant and techniques about gene delivery.
- To know about applications of plant biotechnology in molecular farming.

DSE 3A: PLANT BIOTECHNOLOGY (4 Credits - 60L)

Unit I	**Plant physiology and basic techniques in plant tissue culture**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Plant Nutrition: Microelements and micronutrients in plant metabolism, Functions & Deficiency diseases. Plant Hormones: Types & Mechanism of Action. Role of Hormones in growth of Plants. Lab setup of Plant Tissue Culture laboratory, Tissue culture Media, Initiation and Maintenance of callus & Suspension culture, single cell clones.			
Unit II	**Tissue culture technology**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Micropropagation: Organogenesis, Somatic Embryogenesis, Synthetic seeds. Shoot tip culture/Auxiliary bud culture, Rapid clonal propagation. Embryo Culture & Embryo Rescue. Acclimatization of Plants. Somaclonal Variations/*In vitro* mutagenesis **Protoplast culture, Haploid culture and cryopreservation:** Protoplast Isolation, Culture, Fusion, Selection of Hybrid Cells and Regeneration of Hybrid Plants, Production of Haploid Plants and Homozygous lines. Cryopreservation, Slow growth & DNA Banking for germ plasma Conservation.			
Unit III	**Plant transformation technology**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Basics of Tumor formation, Hairy root, features of Ti & Ri Plasmid and their uses, Mechanism of DNA transfer role of Virulence gene, Binary vectors, Use of 35s & other promoters, genetic markers, viral vectors & their applications, Multiple gene transfers: vector less or direct DNA transfer, Use of reporter gene, Particle bombardment, electroporation, Microinjection, transformation in monocots, Transgene stability & gene silencing in Plant transformation.			
Unit IV	**Applications of plant biotechnology**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Commercial micro propagation. Metabolic engineering & Industrial products, Plant secondary metabolites, Industrial enzymes, Biodegradable plastics, Therapeutic proteins: lysozomal enzymes, Antibodies and edible vaccines. Purification strategies, oleosin partitioning technology. Agriculture Diseases resistant plants, Biotic & Abiotic stress resistant plants, Enhancement of nutritional value of crop Plants & molecular farming, Applications in Biodiversity conservation.			

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Second Year MSc (Biotechnology) Semester-III

Vertical : DSE-3A P

Course Code: 2311309

Course Name: Practical of DSE-3A P Plant Biotechnology

***Teaching Scheme:**	***Examination Scheme**
Practicals - 2 Credits	**UA:30 Marks** **CA: 20 Marks**

PRACTICAL (DSE-3A P): PLANT BIOTECHNOLOGY – 02 **Credits**

1. Aseptic culture techniques for establishment and maintenance of cultures.
2. Preparation of solutions and media in plant tissue culture laboratory.
3. Surface sterilization of different types of explants
4. Callus induction and culture
5. Anther and ovule culture.
6. Embryo culture
7. Protoplast isolation and culture.
8. Protoplast fusion techniques
9. *In vitro* rooting and acclimatization.
10. Synthetic seed preparation
11. Any suitable practicals conducted by the department with respect to the concerned course (maximum two practicals)

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Second Year MSc (Biotechnology) Semester-III

Course Name: Plant Biotechnology

References

1. An introduction to Plant Tissue Culture 2nd edn. Razdan, M. K, Science Publishers, USA.
2. Textbook of plant biotechnology, Chawala P.K.2002, Oxford & IBH, New Delhi.
3. Bhojwani, S. S. and M. K. Razdan 1996.Plant Tissue Culture:Theory and Practice, Elsevier Pub.
4. Chrispeels, M. J. 2002. Plant Tissue Culture: Genetical Aspects. Jones and Bortlett Publishers, International.
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7. Chawla HC (2004) – Introduction to plant biotechnology (Science Publ)
8. Davies K (Ed) (2004) – Plant pigments and their manipulation – Annual plant revies, vol 14 Blackwell Publ)
9. Altman A, Hasegawa PM (Ed) (2012) – Plant Biotechnology and agriculture. Prospects for the 21st century (Academic press).
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Second Year MSc (Biotechnology) Semester-III

Vertical : DSE-3 B

Course Code: 2311307

Course Name: Molecular Diagnostics

*Teaching Scheme:	*Examination Scheme
Lectures - 04 Hrs/Week, 04 Credits	UA:60 Marks CA: 40 Marks

Course Preamble:

The purpose of this course is to educate students about the fundamental concepts of Microbiology, Molecular Biology, Serology and their related diagnostic applications, thus preparing them to meet the challenges of the new and emerging areas of the diagnostic industry. Microbial techniques enhance skills for handling of microbes including pathogens; serological tests and molecular methods practiced by students could create skillful manpower in the Diagnostic industry.

Course Objectives:
During this course, the student is expected to:

- To learn about common diagnostic methods used in clinical science.
- To understand the principle and working of common diagnostic methods.
- To understand the clinical significance of diagnostic methods.

Course Outcomes:
At the end of this course:

- Students learn about common diagnostic methods used in clinical science.
- Students can understand the principles and working of common diagnostic methods.
- Students can understand the clinical significance of diagnostic methods.

DSE 3B: MOLECULAR DIAGNOSTICS (4 Credits - 60L)

Unit I	**Molecular Assays:**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Assessment of biochemical constituents (proteins, sugars, lipids, enzymes, hormones etc.) using molecular estimations, Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays. Enzyme immunoassays after immuno blotting. Enzyme immuno histochemical techniques. Use of polyclonal or monoclonal antibodies in enzymes immuno assays. Applications of enzyme immunoassays in diagnostic microbiology.			
Unit II	**Molecular methods in clinical microbiology**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Applications of PCR, Molecular markers (RFLP, RAPD, AFLP etc.), Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology Laboratory tests in chemotherapy: Susceptibility tests: Micro-dilution and macro-dilution broth procedures. Susceptibility tests:Diffusion test procedures. Susceptibility tests: Tests for bactericidal activity. Automated procedures for antimicrobial susceptibility tests.			
Unit III	**Advances in diagnostics**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies. Concepts and methods in idiotypes. Antiidiotypes and molecular mimicry and receptors. Epitope design and applications. Immunodiagnostic tests. Immuno florescence. Radioimmunoassay.			
Unit IV	**Standards of diagnostic laboratory**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Handling of Instruments and Laboratory Management: Safety regulation, Good Lab Practices, Quality control methods and maintenance of laboratory records, First aid, Correct practices for handling and disposal of biological, Queuing & Maintaining of Lab material & Instruments., Lab Standard.			

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Second Year MSc (Biotechnology) Semester-III

Vertical : DSE-3B P

Course Code: 2311310

Course Name: Practical of DSE-3B P Molecular Diagnostics

*Teaching Scheme:	*Examination Scheme
Practicals - 2 Credits	UA:30 Marks CA: 20 Marks

PRACTICAL (DSE-3B P): MOLECULAR DIAGNOSTICS – 02 Credits

1. Measurement of Blood glucose concentration and its diagnostic importance.
2. Measurement of abnormal constituents in urine and its diagnostic importance.
3. Measurement of cholesterol in serum and its diagnostic importance.
4. Perform/demonstrate RFLP and its analysis
5. Kirby-Bauyer method (disc-diffusion method) to study antibiotic sensitivity of a bacterial culture
6. A kit-basd detection of a microbial infection (Widal test)
7. Perform any one immuno diagnostic test (Typhoid, Malaria, Dengue)
8. Isolation of genomic DNA from pathogenic bacteria
9. Case Study of any molecular diagnosis report.

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Second Year MSc (Biotechnology) Semester-III

Course Name: Molecular Diagnostics

References

1. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
2. Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe,Kluwer Academic
3. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.
4. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
5. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
6. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
7. Microscopic Techniques in Biotechnology, Michael Hoppert

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Second Year MSc (Biotechnology) Semester-III

Vertical : DSE-3C

Course Code: 2311308

Course Name: ADVANCED PHARMACEUTICALS

*Teaching Scheme:	*Examination Scheme
Lectures - 04 Hrs/Week, 04 Credits	UA:60 Marks CA: 40 Marks

Course Preamble:
This course is designed to impart a fundamental knowledge on the preparatory pharmacy with arts and science of preparing the different conventional dosage forms.

Course Objectives:
During this course, the student is expected to:

- To study Physical pharmaceutics
- To understand the concepts of Dissolution.
- To study Surfactant System.
- To study Polymer science.
- To be aware of Stability studies.

Course Outcomes:
At the end of this course:

- Students can understand Physical pharmaceutics
- Students will understand concepts of Dissolution.
- Students can be enriched with knowledge of Surfactant Systems.
- Students can become acquainted with Polymer science and Stability studies.

DSE 3C: ADVANCED PHARMACEUTICALS (4 Credits - 60L)

Unit I	**Physical pharmaceutics**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Introduction to Advance Pharmaceuticals, Solids: Particle characterization by size, shape and surface of individual particles and for contacted particles. Handling of solids, pharmaceutical granulation, compression and compaction properties of binary mixtures, lubricant sensitivity, characterization of granules and compacts. Types and characterization of polymers.			
Unit II	**Dissolution**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Theory of dissolution, concept of drug release. Dissolution test apparatus: different designs, factors affecting dissolution rate. Dissolution of different dosage forms: solids, suspensions, topicals, suppositories and controlled release systems. Enhancement of dissolution rate. Solid dispersions: Types, methods of preparation, selection of carrier, characterization and applications.			
Unit III	**Surfactant System**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Phase behavior of surfactant in binary and ternary systems. Factors affecting phase behavior; Micellization; micelle structure, shape, size factors affecting CMC and micelle size, thermodynamics and kinetics of micelle formation. Pharmaceutical aspects of Solubilization, Solubilization in non-aqueous system, interactions with polymers and oppositely charged species. Hydrotrophy in pharmaceuticals, surfactants in emulsions and suspensions. Biological implications of surfactants; Effect on: dissolution of drugs, permeability of membranes, drug absorption, antibacterial activity. Cyclodextrin inclusion complexes and co-solvents.			
Unit IV	**Stability studies**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Kinetics activation energy calculations, accelerated stability studies, factors responsible for destabilization of pharmaceutical products and techniques to improve, shelf life calculations. Physical testing of solution, suspension, emulsion, aerosol, powder, tablet and sustained release products.			

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Second Year MSc (Biotechnology) Semester-III

Vertical : DSE-3C P

Course Code: 2311311

Course Name: PRACTICAL DSE-3C P ADVANCED PHARMACEUTICALS

*Teaching Scheme:	*Examination Scheme
Practicals - 2 Credits	UA:30 Marks CA: 20 Marks

PRACTICAL (DSE-3C P): ADVANCED PHARMACEUTICALS – 02 Credits
1. To determine solubility of a given drug sample at room temperature. 2. To determine the density of a given liquid sample. 3. To determine surface tension of a given liquid sample. 4. To determine CMC of given liquid surfactant. 5. To determine particle size and size distribution by using optical microscopy/microscopy method. 6. To determine rheological properties for liquid samples. 7. To demonstrate accelerated stability studies of a formulation. 8. Isolation, purification and characterization of natural products. 9. To visit the drug manufacturing/characterization unit. 10. Any suitable practicals conducted by the department with respect to the concerned course (maximum two practicals)

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Second Year MSc (Biotechnology) Semester-III
Vertical : DSE-3C
Course Code: 2311311
Course Name: ADVANCED PHARMACEUTICALS

References

1. Kitahard and A. Watanabe; Electrical Phenomena at Interfaces; Marcel Dekker.
2. Martin, P. Bustamante and A. H. Chun; Physical Pharmacy; Waverly.
3. D. M. Parikh; Handbook of Pharmaceutical Granulation Technology; Marcel Dekker. 4. G. Alderborn and C. Nystrom; Pharmaceutical Powder Compaction Technology; Marcel Dekker.
5. H. G. Brittain; Physical Characterization of Pharmaceutical solids; Marcel Dekker.
6. J. T. Cartensen; Drug Stability; Marcel Dekker.
7. James J. Wells; Pharmaceutical Preformulation, Ellis Harwood Ltd.
8. Lieberman, Rieser and Banker; Pharmaceutical Dosage Forms; Disperse system; Marcel Dekker.
9. M. N. Rubinstein; Pharmaceutical Technology, Drug stability, John Wiley and sons.
10. Martin Rhodes; Principles of Powder Technology, John Wiley and sons.
11. N. G. Stanley – Wooed; Enlargement and compaction of particle solids; Butterworths.
12. P. H. List and P. C. Schmidt; Pharmaceutical Technology, CRS Press.
13. P. J. Tarcha; Polymer for Controlled Drug Delivery, CRC Press.
14. Robinson; Novel Drug Delivery Systems, Marcel Dekker.
15. Kitahard and A. Watanabe; Electrical Phenomena at Interfaces; Marcel Dekker.
16. Martin, P. Bustamante and A. H. Chun; Physical Pharmacy; Waverly.
17. D. M. Parikh; Handbook of Pharmaceutical Granulation Technology; Marcel Dekker.
18. H. G. Brittain; Physical Characterization of Pharmaceutical solids; Marcel Dekker. 19. J. T. Cartensen; Drug Stability; Marcel Dekker.
20. James J. Wells; Pharmaceutical Preformulation, Ellis Harwood Ltd.
21. Rieser and Banker; Pharmaceutical Dosage Forms; Disperse system; Marcel Dekker.
22. M. N. Rubinstein; Pharmaceutical Technology, Drug stability, John Wiley and sons.
23. Martin Rhodes; Principles of Powder Technology, John Wiley and sons.
24. N. G. Stanley – Wooed; Enlargement and compaction of particle solids; Butterworths.
25. P. H. List and P. C. Schmidt; Pharmaceutical Technology, CRS Press.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Second Year MSc (Biotechnology) Semester-III

Vertical : RM

Course Code: 2311303

Course Name: RESEARCH PROJECT

*Teaching Scheme:	*Examination Scheme
Practical - 04 Hrs/Week, 02 Credits	UA:30 Marks CA: 20 Marks

SEM III - RESEARCH PROJECT

The project work should be carried out in a group of **minimum 2 to maximum 4 students**. The coordinator will guide the students in selecting the topic of the project, working on experiments, results of the same and writing the report. The report should be signed by the coordinator and submitted to the University at the time of the University Practical examination.

COLLEGE ASSESSMENT (40 Marks)

- The research project work should be continuously assessed by the respective project guides. Students must be asked to keep a continuous record of their project work. Team members of the project group should be equally assigned the tasks from time to time. College assessment of the project should be based on:
  - Synopsis of the project : 10 M
  - Primary Introduction write-up : 10 M
  - Primary Literature review report : 10 M
  - Work Record book : 10 M

UNIVERSITY ASSESSMENT (60 Marks)

Project Progress Report	**60 Marks**
The project progress report should be presented as a Power-Point including Abstract, Objectives, Introduction, Ongoing Literature review, proposed schedule and progress of the project work.	

M. Sc. - BIOTECHNOLOGY SEMESTER-IV

Semester	Code	Title of the paper	Semester Examination			Hrs/ Week	Credit
		MAJOR	**UA**	**CA**	**Total**		
SEM-IV	2311401	DSC 7: Advanced Analytical Techniques	60	40	100	4	4
	2311402	DSC 8: Bionanotechnology	60	40	100	4	4
		ELECTIVE (Any One)					
	2311405	DSE 4A: Animal Biotechnology	60	40	100	4	4
	2311406	DSC 4B: Medical Biotechnology					
	2311407	DSE 4C: Advanced Pharmacognosy					
		PRACTICALS					
	2311404	Practical I: Advanced Analytical Techniques	30	20	50	4	2
	2311408	Practical II: (Based on DSE-4A) /	30	20	50	4	2
	2311409	Practical II: (Based on DSE-4B) /					
	2311410	Practical II: (Based on DSE-4C)					
		RESEARCH PROJECT					
	2311403	Research Project	90	60	150	12	6
		Total for semester IV	**330**	**220**	**550**		**22**

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Second Year MSc (Biotechnology) Semester-IV

Vertical : DSC-7

Course Code: 2311401

Course Name: Advanced Analytical Techniques

*Teaching Scheme:	*Examination Scheme
Lectures - 04 Hrs/Week, 04 Credits	UA:60 Marks CA: 40 Marks

Course Preamble:

The present course is proposed as a core course in M.Sc. Biotechnology program to develop a strong background in analytical techniques that are required in the various other core and elective courses in the program. The courses, which will benefit from the course on analytical techniques include, but are not limited to Microbiology, Fermentation technology, Research Project etc.

Course Objectives:
During this course, the student is expected to:

- To provide an adequate knowledge of the principles, instrumentation and applications of common analytical techniques.
- To provide scientific understanding of analytical techniques and detail interpretation of results

Course Outcomes:
At the end of this course:

- Upon successful completion, students will have the knowledge and skills to: Explain the theoretical aspects of key analytical techniques and instruments used in different biological areas.
- To understand the strength and limitations of techniques and creative use of techniques for problem solving

DSC T7A: ADVANCED ANALYTICAL TECHNIQUES (4 Credits - 60L)

Unit I	Centrifugation and Chromatography	No. of Lectures: 15	Weightage (UA): 15-23 Marks

Centrifugation: Small bench top centrifuges, large capacity refrigerated centrifuges, High speed refrigerated centrifuges, preparative and analytical ultracentrifuge.

Chromatography: Introduction and types of chromatography, Plane-Paper and TLC, Column Chromatography- Principle, procedure and applications of Adsorption, Affinity, Gel Permeation, Ion Exchange, Gas Liquid chromatography (GLC), Fast Protein Liquid Chromatography (FPLC), High Performance Liquid Chromatography (HPLC), Gas Chromatography-Mass Spectrometry (GCMS), Liquid Chromatography-Mass Spectrometry (LCMS). Chromatofocusing.

Unit II	Electrophoresis and Blotting Techniques	No. of Lectures: 15	Weightage (UA): 15-23 Marks

Electrophoresis: Basic principle of electrophoresis; Factors affecting electrophoretic mobility; Support Media. **Types of electrophoresis -** Theory & Applications of Paper, Starch gel, Agarose, Cellulose Acetate, Native PAGE, SDS-PAGE, Isoelectric focusing, 2-D gel electrophoresis (2-D PAGE), High Voltage, Pulse field gel electrophoresis (PFGE), Capillary Electrophoresis; Blotting Techniques: Southern, Northern, Western and Southwestern blotting.

Unit III	Spectroscopic techniques:	No. of Lectures: 15	Weightage (UA): 15-23 Marks

Introduction; Properties of electromagnetic radiation. Instrumentation & Applications of Colorimetry, Nephelometry, VIS & UV Spectroscopy, Atomic Absorption Spectroscopy, Atomic Emission Spectroscopy, X-ray spectroscopy, IR Spectroscopy, Raman Spectroscopy, Nuclear Magnetic Resonance Spectroscopy, Mass Spectroscopy, Circular dichorism spectroscopy, MALDI TOF, Spectro-fluorimetry, Gamma ray spectroscopy.

Unit IV	Microscopy and Radioisotope techniques	No. of Lectures: 15	Weightage (UA): 15-23 Marks

Microscopy: Introduction, Optical principles of Microscopy, Types of Microscopes - simple and compound, Inverted, Phase-contrast, Bright field, Dark field, Fluorescence microscope, Advanced Microscopy- Scanning electron Microscopy, Transmission electron Microscopy and Confocal Microscopy.

Nature of Radioactivity (atomic structure, stability and radiation, types of radioactive decay, radioactive decay energy, rate of radioactive decay, units of radioactive decay,

Detection & Measurement of Radioactivity -

A) **Methods Based on Gas Ionization**- Ionization Chamber, Proportional Counters, GM Counters.

B) Methods Based on Excitation- Solid and Liquid Scintillation counting. Applications of Radioisotopes in Biology, Safety measures.

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Second Year MSc (Biotechnology) Semester-IV

Vertical : DSC-7 P

Course Code: 2311404

Course Name:

PRACTICAL (DSC-7 P): ADVANCED ANALYTICAL TECHNIQUES

*Teaching Scheme:	*Examination Scheme
Practical - 04 Hrs/Week, 02 Credits	UA:30 Marks CA: 20 Marks

PRACTICAL (DSC-7 P): ADVANCED ANALYTICAL TECHNIQUES - 02 Credits

1) Flame photometric analysis of an ionic solution.
2) Spectrophotometric analysis of a biological sample.
3) Column chromatography experiment of biological sample by - Gel filtration/ Ion Exchange/ Affinity
4) Separation of DNA/RNA sample by Agarose gel electrophoresis.
5) Separation of protein sample by Polyacrylamide Gel electrophoresis.
6) Preparation and staining of biological sample by - Bright field/ Dark field/ Fluorescence method.
7) Study of blotting technique - Southern, Northern and Western.
8) Demonstration of HPLC and Gas Chromatography.
9) Study of an Electron micrograph of a biological sample/specimen.
10) Visit to an analytical instrumentation laboratory.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Second Year MSc (Biotechnology) Semester-IV

Course Name: Advanced Analytical Techniques

References

1. Keith Wilson and John Walker. Practical Biochemistry- principles and techniques; Cambridge University press, London, UK.
2. David T Plummer, Tata McGraw- Hill publishing company limited, McGraw office, New Delhi.
3. Kothari C.R., 2nd Edition, 2004. Research methodology- methods and techniques. New Age International (P) limited publishers, New Delhi.
4. P.K. Sharma-Instrumental methods of chemical analysis
5. Upadhyay. Upadhyay and Nath- Biophysical chemistry, Himalaya publication.
6. Brigan L. Williams- A Biologist's guide to principle and techniques of practical biochemistry.
7. Khandpur R.S-Handbook of Biomedical Instrumentation, Tata McGraw Hill.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Second Year MSc (Biotechnology) Semester-IV
Vertical : DSC-8
Course Code: 2311402
Course Name: BIONANOTECHNOLOGY

*Teaching Scheme:	*Examination Scheme
Lectures - 04 Hrs/Week, 04 Credits	UA:60 Marks CA: 40 Marks

Course Preamble:
The aim of this course is to give an introduction to different nanomaterials and their sensing and biomedical applications. The fundamental concepts of the unique properties of nanomaterials compared to those of bulk materials will be discussed in detail. Since nanotechnology allures students from different backgrounds, the course will enable them to understand the nano-bio interface and how nanotechnology can be useful in several biotechnological applications. The course will essentially serve as a platform to interlink students from non-biology backgrounds at all levels.

Course Objectives:
During this course, the student is expected to:

- To understand the fundamental science behind nanotechnology
- To integrate knowledge of synthesis and characterization of nanomaterials.
- To gain knowledge about diverse applications of nanotechnology especially in biological sciences.

Course Outcomes:
At the end of this course:

- Students can understand the fundamental science behind nanotechnology
- Students can integrate knowledge of synthesis and characterization of nanomaterials.
- Students know about diverse applications of nanotechnology especially in biological sciences.

DSC T8: BIONANOTECHNOLOGY (4 Credits - 60L)

Unit I	**Nanotechnology**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Introduction, Size of Matter, fundamental science behind nanotechnology (electron, atoms and ions, molecules, metals, other materials, biosystem, molecular recognition, electrical conduction, optics, quantum mechanics and quantum idea), Milestones in nanotechnology			
Unit II	**Synthesis of Nanomaterials**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Chemical methods: colloids and colloids in solutions, colloids in vacuum, colloids in medium, synthesis of colloids, growth of nanoparticles, synthesis of metal nanoparticles, synthesis of semiconductor nanoparticles, langmuir-blodgett method, micro emulsions, sol-gel method Biological synthesis: synthesis using microorganisms, synthesis using plant extracts, synthesis using proteins and DNA template			
Unit III	**Characterization Methods**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Optical Microscopy – Scanning Electron Microscopy – Transmission Electron Microscopy - Atomic Force Microscopy – Scanning Tunneling Microscopy – Optical Absorption and Emission Spectroscopy – Thermo gravimetric Analysis – Differential Scanning Calorimetry – Thermo mechanical Analysis- X-Ray Diffraction			
Unit IV	**Application of Bionanotechnology**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Applications in Biosensors as Precursors of Bioelectronics, Fictionalization of Sensing Substrates, Biochip, Nanosensors-Miniaturization of Biosensors, Nanomaterial Based Biosensors. Electron Transfer of Biomolecules, Nanoparticle-Biomaterial Hybrid Systems for Sensing and Electronic Devices, Effect of Biosensor in biological and physicochemical techniques. Drug, drug delivery, photodynamic therapy, neuro-electronic interference, cleaning environment (for heavy metal & Bioremediation)			

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Second Year MSc (Biotechnology) Semester-IV

Course Name: BIONANOTECHNOLOGY

References

1. D.E. Reisner, bionanotechnology: Global Prospects, CRC Press, Boca Raton, FL 2008
2. Mark Ratner, Daniel Ratner, “Nanotechnology, A Gentle introduction to the next big idea”, Pearson Publication
3. Charles P. et al., “Introduction to Nanotechnology”, Willey Interscience, A John Willey & Sons, INC., Publication.
4. Sulbha Kulkarni, “Nanotechnology: Principles and Practices”
5. Hari Singh Nalwa, “Encyclopedia of Nanotechnology”, USA 2011 2.
6. James A. Schwarz, Cristian I. Contescu, Karol Putyera, “Dekker encyclopedia of nanoscience and nanotechnology” CRC Press, 2004. 3.
7. Introduction to Nanoscience and Nanotechnology, CRC Press, G. L. Hornyak, H. F. Tibbals, J. Dutta, J. J. Moore

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Second Year MSc (Biotechnology) Semester-IV
Vertical : DSE-4A
Course Code: 2311405
Course Name: ANIMAL BIOTECHNOLOGY

*Teaching Scheme:	*Examination Scheme
Lectures - 04 Hrs/Week, 04 Credits	UA:60 Marks CA: 40 Marks

Course Preamble:
The purpose of this course is to educate students about the fundamental concepts of animal cell system, transformation, genetic engineering, animal cell culture and their related applications, thus preparing them to meet the challenges of the new and emerging areas of the animal biotechnology industry. Cell culture technology enhances skills for large scale and quality animal products; transgenics in animals ignites new ideas for development of novel transgenic animals of desired characters.

Course Objectives:
During this course, the student is expected to:

- To introduce students to the principles, practices and applications of animal and stem culture technology.
- To introduce students, the knowledge and importance of cell lines, transgenic animals and stem cells in animal biotechnology.
- Providing knowledge about advanced techniques in animal biotechnology.

Course Outcomes:
At the end of this course:

- Students know the principles, practices and applications of animal culture technology.
- Students get knowledge about the importance of cell lines, transgenic animals and stem cells in animal biotechnology.
- Students learn about advanced techniques in animal biotechnology.

DSE 4A: ANIMAL BIOTECHNOLOGY(4 Credits - 60L)

Unit I	Animal and Stem Cell culture	No. of Lectures: 15	Weightage (UA): 15-23 Marks
Introduction, importance, history of cell culture development, tissue culture techniques-primary and secondary culture, suspension culture, cell lines, hybridoma technology Different types of cell culture media, growth supplements, serum free media, balanced salt solution, other cell culture reagents. Behavior of cells in culture, Mechano-chemical regulation of cell behavior, division, their growth pattern, metabolism of estimation of cell number. Types of Stem cells – Hematopoietic, Mesenchymal, Embryonic Stem Cells, Fetal, Pluripotent, Characteristics, Isolation, Culture and Characterization protocols.			
Unit II	**Cell lines and transgenic animal**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Development of cell lines, characterization and maintenance of cell lines, cryopreservation, common cell culture contaminants. Culture of cells for production of various biological products, Concepts of transgenic animal technology; strategies for the production of transgenic and knock out animals– significance in biotechnology. Stem cell cultures in production of transgenic animals.			
Unit III	**Cancer biology**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Cancer cell vs. Normal cell; Hallmarks of cancer cell Cell cycle - Regulation of Cell cycle and Tumor suppressor genes (pRb, P53, BRCA, Gene encoding CDK inhibitors); Oncogenes and Proto- Oncogenes; Factors activating proto-oncogene to oncogene (Tumor Virus; Physical and Chemical Carcinogen) Diagnosis of cancer, Treatment - Chemotherapy, Radiation Therapy, Immunotherapy- use of immunotoxins in cancer therapy, retroviral drugs, Anti- angiogenic Drug; Drugs based on Epigenetics (Acetylation of Histones and Methylation of DNA)			
Unit IV	**Tissue Engineering and Transplantation Techniques**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Immuno isolation Techniques, Extra cellular matrices morphogenesis and tissue engineering. Modes of Cell and Tissue Delivery, Regeneration of Bone and Cartilage, Islet Cell transplantation and Bioartificial Pancreas, Bioprinting of Organs and Tissues			

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Second Year MSc (Biotechnology) Semester-IV
Vertical : DSE-4A P
Course Code: 2311408
Course Name: PRACTICAL DSE-4A P ANIMAL BIOTECHNOLOGY

*Teaching Scheme:	*Examination Scheme
Practical - 04 Hrs/Week, 02 Credits	UA:30 Marks CA: 20 Marks

PRACTICAL (DSE-4A P): ANIMAL BIOTECHNOLOGY – 02 **Credits**

1. Preparation of Balanced Salt Solution and pH standards for animal cell culture.
2. Trypsinization methods in animal cell culture - Warm and Cold Trypsinization
3. Isolation of Lymphocytes from blood sample.
4. Preparation of suspension culture
5. Determination of concentration of viable cells in a suspension by Hemocytometer counting.
6. Cell characterization by Giemsa banding method.
7. Study of cell lines using permanent slides/images
8. Study of types of stem cells using microscopic images - Embryonic, Mesenchymal, Neural, Epithelial, Hematopoietic
9. Study of types of cancer and mechanism of anticancer drugs.
10. Visit to animal biotechnology laboratory and study of - animal cell culture techniques, cryopreservation, flow cytometry, DNA fingerprinting etc.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Second Year MSc (Biotechnology) Semester-IV

Course Name: ANIMAL BIOTECHNOLOGY

References

1. I.M. Butley. Anaimal Cell Culture and Technology. Second edition, Taylor and Francis
2. Freshney RI. 2005. Culture of Animal Cells. Wiley Liss.
3. Portner R. 2007. Animal Cell Biotechnology. Humana Press.
4. R. Lanza, J. Gearhart et al (Eds), Essential of Stem Cell Biology. (2009), Elsevier Academic press.
5. R. Lanza and I. Klimanskaya, Essential Stem Cells Methods. (2009), Academic Press
6. J. J. Mao, G. Vunjak-Novakovic et al (Ed): Translational Approaches in Tissue Engineering & Regenerative Medicine 2008, Artech House, INC Publications.
7. Robert Lanza et al. Principles of Tissue Engineering, 3rd Edition. Academic Press; 3 edition (August 21, 2007)
8. Stein et al. Human Stem Cell Technology and Biology: A Research Guide and Laboratory Manual.Wiley-Blackwell; 1 edition (January 4, 2011)
9. Lanza et al. Handbook of Stem Cells, Two-Volume Set: Volume 1-Embryonic Stem Cells; Volume 2- Adult & Fetal Stem Cells (v. 1).Academic Press (September 28, 2004).
10. The Biology of Cancer, Robert Weinberg, Garland Science; 2 edition;2010
11. King R.J.B., Cancer Biology, Addision Wesley Longmann Ltd, U.K., 1996.
12. Ruddon.R.W., Cancer Biology, Oxford University Press, Oxford, 1995.

13.

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ।। विद्यया संपन्नता ।। NAAC Accredited-2022 'B++' Grade (CGPA-2.96)	**Punyashlok Ahilyadevi Holkar Solapur University, Solapur** **Second Year MSc (Biotechnology) Semester-IV** **Vertical : DSE-4B** **Course Code: 2311406** **Course Name: MEDICAL BIOTECHNOLOGY**
***Teaching Scheme:** **Lectures - 04 Hrs/Week, 04 Credits**	***Examination Scheme** **UA:60 Marks** **CA: 40 Marks**

Course Preamble:
The purpose of this course is to educate students about the fundamental concepts of Pathology, Molecular Biology, Serology and their related diagnostic applications, thus preparing them to meet the challenges of the new and emerging areas of the medical industry. Microbial techniques enhance skills for handling of microbes including pathogens; laboratory diagnosis practiced by students could create skillful manpower in the Diagnostic industry.

Course Objectives:
During this course, the student is expected to:

- To understand the molecular basis of microbial Diseases.
- To demonstrate practical skills in the use of tools, technologies and methods common to microbiology, and
  apply the scientific method and hypothesis testing in the design and execution of experiments.

Course Outcomes:
At the end of this course:

- Students will come to know the molecular basis of microbial Diseases
- Students will develop practical skills in the use of tools, technologies and methods common to Medical Biotechnology

DSE 4B: MEDICAL BIOTECHNOLOGY (4 Credits - 60L)

Unit I	**Medical biotechnology**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Microbial Diseases: Normal microbial flora of human body, host-microbe interactions. Infection and infectious process, routes of transmission of microbes in the body. Epidemiology, description and pathology of human diseases caused by bacteria; Staphylococcus, E.coli, Salmonella, Pseudomonas, Klebsiella, Vibrio cholera, Clostridium, Mycobacteria, syphilis, Fungi: description and pathology of diseases Caused by Aspergillus, Candida,.Micrococcosis, Protozoa: Malaria and Ameobiosis. Viruses: pathogenesis of HSV, HIV and COVID-19.			
Unit II	**Clinical manifestations of infection**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Infections of Skin and soft tissue, Bone and joint, Meningitis and Other central nervous system, Eye, respiratory tract, Urinary tract, Genital infections, Infections in pregnancy and neonates			
Unit III	**Laboratory diagnosis**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Laboratory diagnosis of common infections and parasites, Molecular diagnosis of various diseases. Biosensors: Concept and development of biosensors- Historical perspective. Market potential and limitations, new generations of biosensors, Biosensors in medical diagnostics. Industrial applications of biosensors.			
Unit IV	**Treatment of infections**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Principles of chemotherapy, Mode of antibiotics: Penicillin, Streptomycin, Sulfonamides, and Polymyxins Antifungal drugs (Nystatin), Antiviral agents. Problems of drug resistance and drug sensitivity, Drug resistance in bacteria (MDR bacteria). Interferon Induction of interferon, types of inducers. Inactivation of viruses - Photodynamic inactivation. Vaccination for prevention of diseases, Application of phages in therapeutics.			

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Second Year MSc (Biotechnology) Semester-IV

Vertical : DSE-4B P

Course Code: 2311409

Course Name: PRACTICAL DSE-4B P MEDICAL BIOTECHNOLOGY

*Teaching Scheme:	*Examination Scheme
Practical - 04 Hrs/Week, 02 Credits	UA:30 Marks CA: 20 Marks

PRACTICAL (DSE-4B P): MEDICAL BIOTECHNOLOGY – 02 **Credits**

1. Study of Normal Flora Bacteria and Morphology of Stained Bacteria;
2. Cultural and Biochemical Characteristics of common pathogens.
3. Sample collection for pathogen testing.
4. Laboratory Isolation of pathogen from patient's sample
5. Diagnosis of a bacterial infection
6. Diagnosis of a viral infection
7. Antimicrobial susceptibility testing - Kirby-Bauer disc diffusion method
8. Study of a medical biosensor device.
9. Disposal of biohazards

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Second Year MSc (Biotechnology) Semester-IV

Course Name: MEDICAL BIOTECHNOLOGY

References

1. BIOS Instant Notes in Medical Microbiology by Will Irving, Dlawer Ala'Aldeen, Tim Boswell, Publisher Taylor & Francis Group.
2. Textbook of Microbiology ;R. Ananthnarayan, C. K. J. Panicker, Orient Longman 6th Edition (2003)
3. Immunology: Introductory textbook;Nandini Shetty, New Age International pvt.Ltd. 1st Edition (2003)
4. Principles of Virology by SJ Flint, LW Enquist, RM Krug, VR Racaniello, AM Skalka ASM Press Washington 1st edition (2002)
5. An introduction to genetic engineering by ST Desmond and Nicholl CambridgeUniversity Press 2nd edition(2004)
6. General Microbiology Vol. II by Powar and Daginawala Himalaya Publ. House8th edition (2004)

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Second Year MSc (Biotechnology) Semester-IV

Vertical : DSE-4C

Course Code: 231407

Course Name: ADVANCED PHARMACOGNOSY

*Teaching Scheme:	*Examination Scheme
Lectures - 04 Hrs/Week, 04 Credits	UA:60 Marks CA: 40 Marks

Course Preamble:

The main purpose of the subject is to impart the students the knowledge of how the secondary metabolites are produced in the crude drugs, how to isolate and identify and produce them industrially. Also this subject involves the study of producing the plants and phytochemicals through plant tissue culture, drug interactions and basic principles of the traditional system of medicine.

Course Objectives:
During this course, the student is expected to:

- To study General Research Methodology for Pharmacognosy.
- To understand the Herbal drug Industry for Entrepreneurship Development.
- To study Herbal drug regulatory affairs.
- To understand Information Retrieval systems of Herbal Drugs and Literature survey.
- To study Volatile oils and Dyes of commercial value.

Course Outcomes:
At the end of this course:

- Students can acquainted with knowledge of general research methodology for Pharmacognosy as well as Information Retrieval systems of Herbal Drugs and Literature survey
- Gets knowledge about opportunities as entrepreneurship in Herbal drug Industry, Volatile oils and Dyes of commercial value
- Students can understand Regulation and dispensing of herbal drugs.

DSE 4C: ADVANCED PHARMACOGNOSY (4 Credits - 60L)

Unit I	**General Research Methodology**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Definition of research, meaning of research objective of research, types of research, Review of literature and sampling techniques			
Unit II	**Herbal drug Industry**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Infrastructure of herbal drug industry involved in production of standardized extracts and various dosage forms. Entrepreneurship Development. Project selection, project report, technical knowledge, plant design, layout and construction. Pilot plant scale–up techniques, case studies of herbal extracts. Formulation, production management.			
Unit III	**Herbal drug regulatory affairs**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Basic principles of clinical studies, Stability, Safety and toxicology of herbal drugs. Adverse drug reaction in herbal drugs. Effect of herbal medicines on clinical laboratory testing. Regulation and dispensing of herbal drugs.			
Unit IV	**Information Retrieval & Literature survey of therapeutic groups**	**No. of Lectures: 15**	**Weightage (UA): 15-23 Marks**
Immunomodulators: *Withania somnifera, Centella asiatica, Embelica officinalis, Ocimum sanctum*. **Antipeptic ulcer:** Glyceriza root, *Azadirachta indica,Gingiber officinalis* **Hepatoprotectives:***Silibum marianum,Phyllanthus niruri, Picrorrhiza kurroa, Andrographis paniculata* **Anticancer** :Taxus species, *Camptotheca acuminate* **Antifertility**: *Embelica ribes,* Azadirachta indica, Gossypium species **Nervine Tonic:** *Centella asiatica*, Acorus *calamus, Valeriana wallichi* **Anti-AIDS:** *Areca catechu, Thea sinensis*			

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Second Year MSc (Biotechnology) Semester-IV

Vertical : DSE-4C P

Course Code: 231410

Course Name: PRACTICAL DSE-4C P ADVANCED PHARMACOGNOSY

*Teaching Scheme:	*Examination Scheme
Practical - 04 Hrs/Week, 02 Credits	UA:30 Marks CA: 20 Marks

PRACTICAL (DSE-4C P): ADVANCED PHARMACOGNOSY – 02 **Credits**

1. Analysis of crude drugs by chemical tests: Agar, starch, Honey, Castor oil
2. Determination of size of starch grains, calcium oxalate crystals by eye piece micrometer
3. Determination of Fiber length and width
4. Determination of number of starch grains by Lycopodium spore method
5. Determination of Ash value
6. Determination of Extractive values of crude drugs
7. Determination of moisture content of crude drugs
8. Determination of swelling index and foaming
9. Separation of sugars by paper chromatography
10. TLC of herbal extracts

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Second Year MSc (Biotechnology) Semester-IV
Vertical : DSE-4C
Course Code: 231407
Course Name: ADVANCED PHARMACOGNOSY

References

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.
2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Text Book of Pharmacognosy by T.E. Wallis
4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
5. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
6. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.
7. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae
9. Anatomy of Crude Drugs by M.A. Iyengar

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Second Year MSc (Biotechnology) Semester-IV

Vertical : RP

Course Code: 231403

Course Name: RESEARCH PROJECT

*Teaching Scheme:	*Examination Scheme
Practicals - 2 Credits	UA:90 Marks CA: 60 Marks

SEM IV - RESEARCH PROJECT

COLLEGE ASSESSMENT (60 Marks)

- The research project work should be assessed by the respective project guides. Students must be asked to keep a continuous record of their project work. Team members of the project group should be equally assigned the tasks from time to time. College assessment of the project should be based on:
  - Final Introduction write-up : 10 M
  - Final Literature review report : 10 M
  - Methodology and results : 20 M
  - Work Completion as per the proposed schedule : 20 M

UNIVERSITY ASSESSMENT (60 Marks)

Project Thesis	**90 Marks**
The final project thesis signed by research coordinator and head of department must be submitted at the time of University assessment. The project work should be presented as a Power-Point during the university examination.	

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ॥ विद्यया संपन्नता ॥ NAAC Accredited-2022 'B++' Grade (CGPA-2.96)	**Punyashlok Ahilyadevi Holkar Solapur University, Solapur** **NATURE OF QUESTION PAPER** **Course Name: M. Sc. / M.C.A. (Part- I & II) w.e.f. AY 2023-24**

External Evaluation (UA)

Time: **Total Marks: 60**

Instructions 1. All Questions are compulsory 2. Figure to right indicate full marks.	
Q.1 A) Choose correct alternative. (MCQ)	**08 Marks**
B) Fill in the blanks OR Write true/false	**04 Marks**
Q.2. Answer the following. (Any Six) A) B) C) D) E) F) G) H)	**12 Marks** **(2+2+2+2+2+2)**
Q.3. Answer the following (Any three). A) B) C) D)	**12 Marks** **(4+4+4)**
Q.4. Answer the following (Any two). A) B) C)	**12 Marks** **(6+6)**
Q.5. Answer the following (Any two). A) B) C)	**12 Marks (6+6)**

Internal Evaluation (CA)

Time: **Total Marks: 40**

Internal Evaluation System for 40 Marks
Choose any two of the following: ➢ Home Assignment/ Unit Test/ Tutorial/ Seminar

Pattern of Examination:

External Evaluation + Internal Evaluation 60 Marks + 40 Marks =100 Marks

Passing Criteria:

1. Written Exam – 24 out of 60
2. Continuous Assessment (CA) – 16 out of 40