SEMESTER – III								
S. No	**Course**	**Code**	**Title of the Course**	**H/W**	**C**	**SEE**	**IA**	**Total Marks**
1	CC	BTE 301	Core course – 7 Animal Biotechnology	4	4	70	30	100
2		BTE 302	Core Course – 8(A) Plant and Agriculture Biotechnology Core Course – 8(B) Stem Cell Technology and Regenerative Medicine	4	3	50	25	75
3		BTE 303	Core Course – 9(A) Environmental Biotechnology Core Course – 9(B) Solid Waste Management	4	3	50	25	75
4	P	BTE 304	Practical V (related to CC 8 & 9)	6	2	35	15	50
5	SOC	BTE 305	Skill Oriented Course – 5(A) Food and Industrial Biotechnology Skill Oriented Course – 5(B) Medical Biotechnology and Vaccinology	4	3	50	25	75
6		BTE 306	Skill Oriented Course – 6(A) IPR, Biosafety Bioethics & Bioentrepreneurship Skill Oriented Course – 6(B) Basics of Organic Farming and Bioentrpreneurship	4	3	40	25	75
7	P	BTE 307	Practical VI (related to SOC 5 & 6)	6	2	35	15	50
8	OOTC	BTE 308	Open Online Transdisciplinary Course – 2	-	2+2	-	100	100
OR								
	Open Elective	BTE 308	Bioethics	4	4	70	30	100
*	Seminar/tutorials/ remedial classes and Quiz as part of internal assessment			-	-	-	-	-
			Total	**36**	**22**	**340**	**260**	**600**

Programme : **M. Sc. Biotechnology**
Type of Course : **Open Elective**
Course Code : **BTE 308**
Open Elective : **Bioethics**
Semester : **III**

Programme : **M. Sc. Biotechnology**
Type of Course : **Open Elective**
Course Code : **BTE 308**
Open Elective : **Bioethics**
Semester : **III**

Course Objectives:

1. To impart knowledge about intellectual property rights
2. To make the student to learn about legal and ethical aspects of Biotechnology
3. To educate the student about Social and Moral aspects of Biotechnology
4. To train students on Environmental risk assessment and food and feed safety assessment.

Course outcomes:

The student will be able to

CO Nos	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Acquire the knowledge on IPR and procedures for patent filing	K1
CO2	Understand the Legal and Ethical aspects of gene therapy - cloning - Manipulation of human genome -Technology transfer.	K3
CO3	Learn role of Government, Industries and society in promoting, accepting and regulating the rDNA research	K5
CO4	Develop understanding on Environmental and Health aspects of Biotechnology	K6

UNIT-I

Intellectual property rights - Definition - types -patents - copy rights-trademarks: essential requirements for IPR, procedures of filing patents-provisional and complete specifications-Pan-Co-operation treaty (PCT)-application: GATT and IPR: WTO Act - Global and Indian Biodiversity Act- Indian Patent Act and their revised versions.

UNIT-II

Legal and Ethical aspects of Biotechnology -Prenatal diagnosis - Genetic screening - Surrogate mothers and exploitation of women - designing of plants and animals- gene therapy - cloning - Manipulation of human genome -Technology transfer.

UNIT-III

Social and Moral aspects of Biotechnology -Biotechnology and International trade - Privatization and patenting of Biotechnology products - Role of Government, Industries and society in promoting, accepting and regulating the rDNA research.

UNIT-IV

Environmental and Health aspects of Biotechnology - Generally engineered organisms - Introduction of novel species and natural equilibrium - Environmental security and safety - Precautionary measures - Genetically modified foods - health safety.

Reference Books

1. Gene Cloning – Brown.
2. Concepts in Biotechnology- Balasubramanyam. D.
3. Basic Biotechnology - Colin Rotledge and Kristainsen.
4. Gene Biotechnology – Jogdand.
5. From Genes to Clones, Introduction to Gene Technology-Winnacker, Ernst.L.
6. Safety, Moral, Social and Ethical issues related to genetically modified foods - Smith J.E.
7. Molecular Biology and Biotechnology - Meyer R.A.
8. Environmental Biotechnology- Forster and wase.
9. Biotechnological Innovations in Environmental Management - Leach and Van Dam-mieras.
10. Industrial Microbiology and Biotechnology- Demain and Solomon.

M. Sc. Biotechnology :: Model Question paper

Semester III-BTE 308

Time 3 Hrs **Max marks 70**

Attempt any five from part A (5 x 4=20 marks) and all from part B (4 x 12.5=50 marks)

PART A (5 x 4=20 marks)

1. Unit 1
2. Unit 1
3. Unit 2
4. Unit 2
5. Unit 3
6. Unit 3
7. Unit 4
8. Unit 4

PART B (4 x 12.5=50 marks)

9. Unit 1 A or B
10. Unit 2 A or B
11. Unit 3 A or B
12. Unit 4 A or B

SEMESTER – IV								
S. No	**Course**	**Code**	**Title of the Course**	**H/W**	**C**	**SEE**	**IA**	**Total Marks**
1	OOSD C	BTE 401	Open Online Skill Development Courses	-	8	-	200	200
OR								
2	SDC	BTE 401 a	Emerging technologies in Biotechnology	4	4	70	30	100
3	SDC	BTE 401 b	Pharmaceutical Biotechnology	4	4	70	30	100
4	PW	BTE 402	Project Work - Orientation Classes	24	12	300	0	300
*	Conducting classes for competitive exams, communication skills UGC/CSIR and NET/ SLET examinations			4	-	-	-	-
			Total	**36**	**20**	**300/ 440**	**200/ 60**	**500**
Total Semesters				**144**	**84**	**1320**	**880**	**2200**

Programme : M. Sc. Biotechnology
Type of Course : Open Online Skill Development Course's (MOOCS / SWAYAM)
Course Code : BTE 401
Semester : IV

OR

Programme : M. Sc. Biotechnology
Type of Course : Skill Oriented Course
Course Code : BTE 401 a
Skill Development Course 7(A) : Emerging technologies in Biotechnology
Semester : IV

&

Programme : M. Sc. Biotechnology
Type of Course : Skill Development Course's
Course Code : BTE 401 b
Skill Development Course 7(B) : Pharmaceutical Biotechnology
Semester : IV

Programme : M. Sc. Biotechnology
Type of Course : Skill Oriented Course
Course Code : BTE 401 a
Skill Development Course 7(A) : Emerging technologies in Biotechnology
Semester : IV

Course Objectives:

1. To impart knowledge about role of stem cells and its importance.
2. To make the student to learn about nanoscience and applications in different fields
3. To educate the student about applications of biosensors
4. To familiarize with RNAi Technology

Course Outcomes:

After the successful completion of the course, students will be able to:

CO Nos	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Acquire the knowledge about recent trends in stem cell technology and medical applications of stem cells	K1
CO2	Understand the Biosynthesis of nanomaterials and biomedical applications of nanomaterials	K3
CO3	Learn role of antibodies in biosensing and applications of Nano biosensors in medicine, food industry and environmental monitoring.	K5
CO4	Develop understanding on RNAi Technology and its technological applications	K6

UNIT - I

Stem cell technology: Unique properties of stem cells, embryonic stem cells, Adult stem cells: occurrence and functions, tests, cell differentiation and stem cell plasticity and transdifferntiation, medical applications of stem cells, Advantages and disadvantages of stem cell technology, Recent trends in stem cell technology.

UNIT - II

Introduction to Nanoscience: Definition of Nanoscience and its applications, Nanotechnology – History – Kinds of nanomatter, Biosynthesis of nanomaterials. Safety aspect of Nanobiotechnology. Nano biochips and devices. Biomedical applications of Nanomaterials. Nanoparticles in food and cosmetic application.

UNIT – III

The role of transducer and its applicability. Role of antibodies in biosensing; Nano biosensors applications of biosensors in medicine, food industry and environmental monitoring.

UNIT – IV

RNAi Technology: History and discovery, Cellular mechanism- dsRNA cleavage, micro RNA, RNA induced silencing complex (RISC), activation and catalysis, transcriptional silencing, variation among organisms, biological functions, technological applications- gene knock down, functional genomics, medicine, and biotechnology

REFERENCE BOOK

1. Sasidhara R, Animal Biotechnology, MJP Publishers, Chennai, 2006.
2. M.M. Ranga, Animal Biotehnology, Student Edition, Chennai.
3. Geoferey M. Cooper, The Cell, A molecular approach, 3rd Edition, ASM press, Washington, D.C. 2004.
4. Gregory J. Hannon, RNAi – A guide to gene silencing, Cold Spring Harbor Press,

2003.

Programme : M. Sc. Biotechnology
Type of Course : Skill Development Course's
Course Code : BTE 401 b
Skill Development Course 7(B) : Pharmaceutical Biotechnology
Semester : IV
Course Objectives:

1. To impart knowledge on production of pharmaceutical products by biotechnological applications
2. Provide training in clinical testing of pharmaceutical products
3. Give insight on the drug designing and development
4. Explain the comprehensive overview on the conventional and recombinant vaccines and bioethical issues

Course Outcomes:
After the successful completion of the course, students will be able to:

CO Nos	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Acquire the knowledge about recent trends in stem cell technology and medical applications of stem cells	K1
CO2	Understand the Biosynthesis of nanomaterials and biomedical applications of nanomaterials	K3
CO3	Learn role of antibodies in biosensing and applications of Nano biosensors in medicine, food industry and environmental monitoring.	K5
CO4	Develop understanding on RNAi Technology and its technological applications	K6

Course outcomes:
The student will be able to
1. Gain knowledge on preparation and formulations of different drugs
2. Develop skill on commercial production of pharmaceutical products for human welfare
3. Learn the techniques of drug validation and vaccine production
4. Understand the bioethical principle, values, concepts and social and judicial implications of pharmaceutical biotechnology

UNIT-I
Definition - History of development of Pharmaceutical Products by biotechnological methods like genetic recombinant vaccines, microbial and non-microbial products - scope of biotech products and biochemical in pharmaceutical industry. Need to design a drug, drug receptor interactions

UNIT-II
Methods of testing products for anti-microbial potentials, pharmacological activities and biopesticidal properties - conventional and rapid enzyme inhibitor techniques; in vivo methods - use of animals models for confirmation of in vitro properties – Clinical trials - definition - design - specific objectives - types of clinical trials -phase I, II & II

UNIT-III
Biotech products as medicines and pharmaceutical products: Biochemical's - enzymes like proteases - chemical like ethanol, vinegar, citric acid and glutamic acid; vitamins like B12; drugs for infection and metabolic, immunomodulatory -insulin - interferon's, B-cell growth factors, Tissue plasminagen activator.

UNIT-IV

Vaccines - cell culture-based vaccines - genetic recombinant vaccines - recombinant vector-based vaccines -live and subunit - their production model - fermentation technology - expression systems – guideline for the production of genetic recombinant vaccines - Eg. Hepatitis B vaccine, HIV vaccine and other vaccines in pipeline. Application of biotechnology to Animal health and disease diagnosis, Development of kits and their application in disease diagnosis.

Reference Books

1. Biopharmaceuticals- Walsh, John Willey and Sons, New York 1998 Pharmaceutical Biotechnology- Daan J.A. Crommelin, RobestD. Sindelar, Daan JACrommelinAmazon.
2. Physical Methods to characterize Pharmaceutical Proteins- James. N.Herron, Wim Jiskoor and Daan J.A.Crommelin Amazon. Wm From clone to clinic (Developments in Biotherapy)-Daan J.A.Crommelin and H.Schellekom Amazon.Wm.
3. Hand Book of Pharmaceutical Biotechnology- Jay P.Rho, Starlonie the Haworth press.
4. Alice Sr. Bringhamtpn, NY13904 US Drug discovery, Tamas bartifai, Harold L.Dorn's The Scientific world Ltd., Newburry, U.K.

M. Sc. Biotechnology :: Model Question paper

Semester IV- BTE 401a & 401 b

Time 3 Hrs **Max marks 70**

Attempt any five from part A (5 x 4=20 marks) and all from part B (4 x 12.5=50 marks)

PART A (5 x 4=20 marks)

1. Unit 1
2. Unit 1
3. Unit 2
4. Unit 2
5. Unit 3
6. Unit 3
7. Unit 4
8. Unit 4

PART B (4 x 12.5=50 marks)

9. Unit 1 A or B
10. Unit 2 A or B
11. Unit 3 A or B
12. Unit 4 A or B