

# MAHARAJA SURAJMAL BRIJ UNIVERSITY

BHARATPUR  
Rajasthan



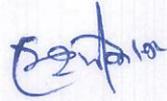
**Programme Brochure**

(As Per NEP 2020)

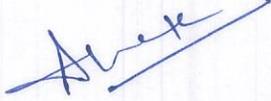
**MASTER OF SCIENCE  
(Biotechnology)  
(Semester Scheme)**

**III & IV Semester Examination 2025-26**

(University Campus)

  
प्रभारी अकादमिक प्रथम  
(Dr. Anshika Singh)

  
(Dr. Anand Kumar)

  
(Dr. Anok Sharma)

## M.Sc. BIOTECHNOLOGY (NEP 2020) Two-Year Programme

### About the Programme

M.Sc. Biotechnology offered by Maharaja Surajmal Brij University, Bharatpur (Raj.) is a two years duration programme with optional exit after completion of one-year with PG diploma in Biotechnology. The programme is research oriented and structured as per UGC NEP 2020 recommendations following the semester system along with choice-based credit system (CBCS). The various papers of programme are designed to include classroom teaching and lecture, project work, assignments, workshops, conferences participation/presentation and field trips. The overall course structure is designed in such a way to cover all the topics to fulfil need of various competitive exams such as CSIR, DBT, ICAR, ICMR etc.

Each paper divided in three categories: Core paper (mandatory), Elective Courses (student must opt one of three Elective Courses by his/her choice in each semester offered by the Department), and research project in the last semester (student can conduct research work either within the Department/or other Department/Institute/Laboratory/ Faculty of Interdisciplinary and Applied Sciences). The Core Courses are of four credits and include classroom as well as laboratory courses (practicals) with two credit each. A separate research-based course that leads to a dissertation in the fourth semester is also one of the Core Courses (mandatory). The Elective Courses (theory) are also of four credit and include two credit laboratory course (practical). The student is required to accumulate minimum credits in each semester, to fulfill the requirements for a Master of Science degree in Biotechnology.

The classrooms are equipped with the advanced interactive board/panels for high tech classes. The departmental laboratory equipped with modern instruments offers student a vibrant in-house facility for learning while doing experiment in order to understand biological reactions in *In-vitro* and *In-vivo* system. A central instrument facility with sophisticated instrument to do cutting-edge research is proposed for construction soon.

Currently Department of Biotechnology enriched with well qualified faculties, Arvind Kumar (Ph.D., Awards: DSKPDF, NPDP, winner CV Raman Prize-2025) (Asst. Professor & Coordinator), and Dr. Alok Sharma (Asst. Professor), and other inter-departmental/visiting faculties.

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(Dr. Alok Sharma)

**Abbreviations:** used in the text are

CW: Class work <sup>#</sup>	VAC: Value Added Course
DSC: Discipline Specific Course	L: Lecture;
DSE: Discipline Specific Elective	T: Tutorial;
EoSE: End of the Semester Exam	P: Practical;
ETE: End Term Exam	S: Self Study
MTE: Mid Term Exam	<sup>#</sup> include attendance, assignment, class
DIS: Dissertation/Project	test/quiz, power point presentation, play
SEM: Seminar	learn by fun activities, etc.

**Programme Structure**

(2-year PG course with exit option as PG diploma in Biotechnology after one-year):

The M.Sc. Biotechnology programme is a two-year course divided into four-semesters. A student is required to Secure 52 credits for PG Diploma in Biotechnology (if willing to exit) and/or 100 credits (52+48) for PG degree in Biotechnology.

**Semester/year and Exit points**

First Year (Previous Year)		Second Year (Final Year)	
Semester-I	Semester-II	Semester-III	Semester-IV
Diploma in Biotechnology		P.G. Degree in Biotechnology	

\* A student can exit with PG Diploma in Biotechnology after one year (semester I and II).

\*\*A student will be eligible for PG degree in Biotechnology on successful completion of all four semesters (Condition: if he/she admitted in the P.G Biotechnology course after his/her 3-year graduation programme).

**Internal assessment, Examination Scheme, and minimum Credits to earn diploma and degree in Biotechnology:**

1. The medium of instruction and examination shall be English only.
2. Assessment of students' performance shall consist of:
  - i. One credit is equivalent to 25 marks. Thus, four credit theory course will carry 100 marks, of which 30% marks shall be reserved for Internal Assessment [IA= (CW+MTE)] based on internal theory and practical exams, seminar/presentation, mid-term exam, and assignment and 70% for external assessment at the end of the semester. The IA of every course will include at least two of the above components, and the weightage given to each of the components shall be decided by the individual teacher responsible for the course. Any student who fails to participate in the Internal Assessment exercises will be debarred from appearing in the end

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- semester examination (EoSE) in the specific course and no Internal Assessment marks will be awarded. His/her Internal Assessment marks will be awarded in the next applicable semester only. No special classes will be conducted for him/her during other semesters.
- ii. Each six credit (2 credit/paper) laboratory course (based on core theory paper) will be of 150 marks of which 30% marks will be reserved for IA. IA will be based on performance of experiments, maintenance of records of data and results obtained, and viva voce. A two credit laboratory course based on elective will be of 50 marks, of which 30% marks will be reserved for IA and 70% for external. IA will be based on performance of experiments, maintenance of records of data and results obtained, and viva-voce.
- In theory 15hr teaching is equivalent to 1 credit and in practical, 45 hrs equals to 2 credits.
- iii. Student have options to select one elective course from the given elective papers in semester first, second and third to earn maximum credits as per their choice.
  - iv. Each theory paper at end of the semester shall carry 100 [30 (internal exam) + 70 (external exam)] marks. 40% marks will be the minimum to avail degree or diploma course. The duration of exam shall be 3 hours. Each theory paper shall contain Part A and Part B.
  - v. Part "A" of theory paper shall contain 10 Short Answer Questions of 10 marks based on knowledge, understanding and applications of the topics/ texts covered in the syllabus. Each question will carry one marks for the correct answer.
  - vi. Part "B" of paper will consist of four questions with internal choice (except in case where a different scheme is specified in the syllabus) of 15 marks each.
  - vii. Each Laboratory EoSE will be of six-hour duration and involve laboratory experiments/exercises.

**Course Credits: Discipline-wise**

Semester	DSC**			DSE*			VAC**			Total Credits
	No. of papers	Credits (L+T+P)	Total Credits	No. of papers	Credits (L+T+P)	Total Credits	No. of papers	Credits (L+T+P)	Total Credits	
I	3	12+0+6	18	1	4+0+2	6	2	2+0+0	2	26
II	3	12+0+6	18	1	4+0+2	6	2	2+0+0	2	26
III	3	12+0+6	18	1	3+1+2	6	-	-	-	24
IV	3	4+8+12	24	-	-	-	-	-	-	24
<b>Total</b>		<b>78</b>			<b>18</b>			<b>4</b>		<b>100</b>

L: Lecture, T: Tutorial, P: Practical class credit wise

\* Student have choice to opt any one of the provided electives.

\*\*Compulsory course

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**SEMESTER-WISE DETAILS OF M.Sc. BIOTECHNOLOGY COURSE  
(Final Year; Total Credits: 48)**

Semester-III											
Sl. No	Paper code	Course name	Discipline category	Credit	Contact hours Per week			Weightage (%)			Max Marks
					L	T	P	CW	MTE	ETE	
1.	BTT 301	Animal Biotechnology	DSC	4	4	0	0	10	20	70	100
2.	BTT 302	Plant Biotechnology	DSC	4	4	0	0	10	20	70	100
3.	BTT 303	Genetic Engineering	DSC	4	4	0	0	10	20	70	100
4.	BTT 304	Entrepreneurship & Ethics <sup>#</sup>	DSE	4	4	0	0	10	20	70	100
5.	BTT 305	Protein Engineering <sup>#</sup>	DSE	4	4	0	0	10	20	70	100
6.	BTT 306	Proteomics & Genomics <sup>#</sup>	DSE	4	4	0	0	10	20	70	100
7.	BTT 307	Nanobiotechnology <sup>#</sup>	DSE	4	4	0	0	10	20	70	100
8.	BTP 311	Practical based on BTT 301, 302 & 303	-	6	0	0	9	15	30	105	150
9.	BTP 312	Practical based on BTT 304/305/306/307	-	2	0	0	3	5	10	35	50
<b>Total credits</b>				<b>24</b>							<b>600</b>
# Elective papers: Student must opt any "one" of the given electives											
Semester-IV											Max Marks
Sl. No	Paper code	Course name	Discipline	Credit	Contact hours Per week			Weightage (%)			
					L	T	P	CW	MTE	ETE	
1.	BTT 401	Review paper writing*	DSC	4	0	4	0	0	30	70	100
2.	BTT 402	Industrial Training/ Hands-on-training/ workshop	DSC	8	0	0	20	0	60	140	200
3.	BTT 403	Dissertation	DSC	12	0	0	40	0	90	210	300
<b>Total credits</b>				<b>24</b>							<b>600</b>
Student secured 100 credits shall be eligible for Postgraduate Degree in Biotechnology											

\* Review paper should be based on recent research from reputed journals.

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**Course-Wise Content Details for M.Sc. (Biotechnology) Program**

**SEMESTER-III**

DSC Course

**BTT 301: Animal Biotechnology**

(Credit: 4; Hours: 60)

Theory Paper

Exam Duration: 03 hours

**Content:**

**UNIT-I (15hrs): Tools and Culture Media**

1. Equipment and materials for animal cell culture technology.
2. Constituents of culture media: chemical, physical and metabolic roles.
3. Role of CO<sub>2</sub>, serum, supplements and defined serum-free media and their applications.
4. Primary and secondary cell line cultures, cell characterization and growth measurement.

**UNIT-II (15hrs): Techniques of Cell Culture**

1. Basic techniques of mammalian cell culture In vitro: disaggregation of tissue, primary culture, maintenance and separation of cell culture.
2. Scaling-up, measurement of viability, cytotoxicity and cell synchronization.
3. Cell cloning, micromanipulation, stem cell culture and applications.
4. Measurement of cell death, apoptosis and 3D culture.

**UNIT- III (15hrs): Mammalian Cell Transformation**

1. Immortal cell line establishment, transfection, selectable markers and gene amplification for protein expression.
2. Specialized methods to transfer difficult cell type.
3. Gene transfer methods using viral vectors (Vaccinia, baculovirus, retro-virus).
4. Impact of recombinant DNA on human genetics: disease gene mapping, positional cloning, in situ hybridization and RFLP.

**UNIT-IV (15hrs) Applications of Animal Cell and Recombinant DNA Technology**

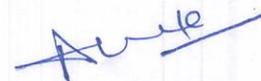
1. Cell culture-based vaccines, somatic cell genetics, and organ and histotypic cultures.
2. Transgenic animal development (mice, cattle, sheep, goat, pigs, birds, fish) and their uses.
3. DNA-based diagnosis of genetic diseases and human somatic cell gene therapy for single gene disorder.



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***Suggested Laboratory Exercises: -***

1. Preparation of tissue culture medium.
2. Preparation of single cell suspension from spleen and thymus.
3. Cell counting and cell viability.
4. Macrophage monolayer from PEC and measurement of pathogenicity activity.
6. Cryopreservation and thawing.
7. Measurement of doubling time.
8. Role of serum in cell culture.
9. MTT assay for cell viability and growth.
10. Cell fusion with PEG.
11. Any other practical based on theory syllabus

***Suggested Readings:***

1. Watson, JD., Gilman, M., Witkowski, J and Zollar, M. (1992). Recombinant DNA (Sec. Ed.). Scientific American Books, New York.
2. Glick, BR. And Pasternak, JJ. (1994). Molecular Biotechnology Principles and applications of Recombinant DNA. Panima Publishing Corp, New Delhi.
3. Froshney, RI. Culture of Animal Cells, (3rd Edition), Wiley-Liss. Mesters, JRW. (Ed) Animal Cell Culture-Practical Approach, Oxford.
4. Basega, R. (Ed), Celi Growth and Division:A Practical Approach, IRL Press.
5. Butler, M. & Dawson, M. (Eds) Cell Culture Lab Fax.Eds., Bios Scientific Publications Ltd. Oxford.
6. Martin Clynes. M. (Ed). Animal Cell Culture Techniques. Springer.
7. Jenni, Mathur P. and Barnes, D (Eds). Methods in Cell Biology, Vol.57, Animal Cell Culture Methods. Academic Press.
8. Glick, BR. And Pasternak, JJ. (1994). Molecular Biotechnology Principles and Applications of Recombinant DNA. Panima Publishing Corp, New Delhi.
9. Watson, JD., Gilmar., Ni., Witkowski, J and Zoiar, M. (1992). Recombinant DNA (Sec. Ed.). Scientific American Books, New York.
10. Kumar, HD. (1998). Modern Concept of Biotechnology, Vikas Publishing House, New Delhi



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## BTT 302- Plant Biotechnology

(Credit: 4; Hours: 60)

Theory Paper

Exam Duration: 03 hours

### Content:

#### UNIT-I (15hrs): Plant Tissue Culture (PTC) – Concepts and Applications

1. Concept, history, principles of PTC, cellular totipotency, Different media components and it's preparation, sterilization and aseptic culture technique.
2. PTC technologies – Micro propagation, in vitro propagation, shoot morphogenesis, organogenesis, rooting, hardening and field transfer.
3. Callus, suspension and single-cell cultures; ovary, anther, and microspore culture for haploid plant production and virus-free plants.
4. Somatic embryogenesis, synthetic seeds, somaclonal variations and applications of plant tissue culture.

#### UNIT-II (15hrs): Protoplast and Plant Transformation Technologies

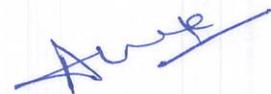
1. Protoplast isolation, purification, viability tests, plating efficiency, culture, somatic cell hybridization, hybrid and cybrid selection and regeneration.
2. Tools and techniques of plant transformation; vectors and their characteristics.
3. Agrobacterium features, basis of tumor and hairy root formation.
4. Vector characteristics and it's types – co-integrated, binary vectors, Ti and Ri plasmids, 35S promoters and terminators, reporter genes and ori-c/ ori-i.

#### UNIT-III (15hrs): Plant Transformation Methods and Plant Breeding

1. Agrobacterium-mediated plant transformation (AMPT): gene cloning, integration, T-DNA transfer mechanism and integration into the plant genome.
2. Selection of transformed tissues, gene expression in plants and applications of AMPT.
3. Direct gene transfer methods – particle bombardment, electroporation, microinjection; transgene incorporation, stability, expression and gene silencing.
4. Cryopreservation, gene banks and plant breeding methods – character identification, selection, variety release and role of molecular markers.



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**UNIT-IV (15hrs): Transgenic Approaches and Industrial Applications**

1. Transgenic approaches for resistance to biotic and abiotic stress.
2. Crop yield and quality improvement – golden rice and related developments.
3. Industrial applications of PTC.
4. Green house and green-home technologies.

***Suggested Laboratory Exercises: -***

1. Preparation of Stock solutions for MS medium.
2. Preparation of medium.
3. Micro propagation technique
4. Surface sterilization and Organ culture.
5. Callus induction, propagation and differentiation
6. Organogenesis- Shoot and root formation and their organic connection.
7. Hardening and transfer of plants to soil.
8. Study of somatic embryogenesis.
9. Anther culture and production of Haploids.
10. Preparation of synthetic seeds.
11. Protoplast isolation and culture.
12. Demonstration of protoplast fusion employing PEG.
13. Cytological examination of regenerated plants.
14. Isolation & Identification of Sec. Metabolite from Plant Cell Cultures.
15. Any other practical based on theory syllabus

***Suggested Readings:***

1. Bhojwani, S.S. and Razdan, M.K. (1996). Plant Tissue Culture : Theory and Practice (a revised edition). Elsevier Science Publishers, New York. USA.
2. Slater A, Scott N, Fowler M (2010). Plant biotechnology: the genetic manipulation of plants. Oxford: Oxford University Press.
3. Hammond, J. McGarvey P. and Yusibov V. (Eds.) (2000). Plant Biotechnology. Springer Verlag. Germany.
4. Fu, T-J., Singh, G. and Curtis, WR. (Eds) (1999). Plant Cell and Tissue Culture for the Production of Food ingredients. Kluwer Academic/Plenum Press.
5. Chawla, HS. (1998). Biotechnology in Crop improvement. International Book Distributing Company.
6. Henry, RJ. (1997). Practical Application of plant Molecular Biology. Chapman and hall.
7. Butenko, RG. (2000). Plant Cell Culture, University Press of Pacific.

8. Collin, H.A. and Edwards, S. (1998). Plant Cell Culture. Bios Scientific Publishers. Oxford, UK.
9. Dixon, RA. (Ed.) (1987). Plant Cell Culture :Practical Approach. IRL Press, Oxford.
10. George, EF. (1993). Plant Propagation by Tissue Culture. Part 1. The Technology, 2nd edition. Exegetics Ltd., Edington, UK.
11. Hall, RD. (Ed.) (1999). Plant Cell Culture Protocols. Humana Press, Inc., New Jersey, USA.
12. Shaw, CH. (Ed.) (1988). Plant Molecular Biology: A Practical Approach, IRI. Press, Oxford.
13. Smith, RH. (2000). Plant Tissue Culture: Techniques and Experiments. academic press, New York.
14. Kumar, A. and Roy. S. (2006). Plant Biotechnology & is applications in Tissue Culture. I.K. International Pvt. Ltd.
15. Kumar, A. and Roy, S. (2011). Plant Tissue Culture and Applied Biotechnology, Aavishkar Publishers, Jaipur.
16. Mascarenhas, AF. (1991). Handbook of Plant Tissue Culture, ICAR, New Deihi. Ramawat, KG. (2000). Plant Biotechnology, S. Chand & Co. Ltd. New Delhi.
17. Rajdan, MK. (1993). An Introduction to Piant Cell Culture. Oxford & IBH Publishing Co. Pvt. Ltd. New Deihi.
18. Narayanaswamy, S. (1994). Plant Cell and Tissue Culture. Tata McGraw-Hill Pub. Com. Ltd. New Delhi.
19. Ammirato, PV, Evans, DA, Sharp, WR. Anu Yamada, Y. (1984). Hand Book Of Plant Cell Culture, Vol. 1-3, Macmillan Pub. Co. NY & Collier Macmillan Pub. London.
20. Gupta, PK. (2010). Plant biotechnology, Rastogi Pub. Meerut.
21. Natesh, S. Chopra, VL. and Ramachandran,. (1987). Bio techniques in Agriculture. Oxford & IBH Publishing Co. Pvt. Lid. New Delhi.

## BTT 303: Genetic Engineering

(Credit: 4; Hours: 60)

Theory Paper

Exam Duration: 03 hours

Content: -

### UNIT-I (15 hrs): Genetic engineering tools and their applications

1. Restriction-modification systems, modification enzymes, DNA/RNA markers and cloning vectors (plasmids, bacteriophages, phagemids, cosmids, artificial chromosomes, SV40, MI3 and retroviral vectors).
2. Nucleic acid sequencing: Maxim & Gilbert, Sanger, shotgun sequencing and automated methods.
3. Nucleic acid purification and PCR techniques: types, principles and applications.
4. Recombinant DNA technology and applications of molecular tools in gene analysis.

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**UNIT-II (15 hrs): Gene Manipulation**

1. c-DNA synthesis, cloning, primers, linkers, adaptors and library construction/screening.
2. Gene cloning strategies: expression vectors, gene regulation and DNA microarrays.
3. Analysis of gene expression: transfection, primer extension, reporter assays and blotting techniques.
4. Chromosome walking, DNA fingerprinting and fluorescence in situ hybridization (FISH).

**UNIT-III (15 hrs): Mutagenesis, Protein Engineering & Recombinant Protein Processing**

1. Directed and random mutagenesis using oligonucleotides and M13 DNA.
2. Protein engineering: disulfide bond addition, modification of sulfhydryl residues and enzymatic activity alteration.
3. Recombinant protein processing: purification, refolding, characterization and stabilization.
4. Gene tagging, transgenic technology, gene knockout and chromosome engineering.

**UNIT-IV (15 hrs): Expression Strategies & Applications**

1. Expression strategies for heterologous proteins: vector/host engineering, in vitro transcription/translation, expression in bacteria, plants and mammalian cells.
2. Gene therapy: vector engineering, delivery strategies, gene replacement/augmentation, gene editing, regulation and silencing.
3. Applications of genetic engineering: transgenic plants/animals, recombinant pharmaceuticals and disease diagnostics.
4. Integration of molecular tools for research, biotechnology and therapeutic applications.

**Suggested Laboratory Exercises: -**

1. Bacterial culture and preparation of antibiotic selection media.
2. Growth curve and growth characteristics of E. coli using plating and/or turbidimetric methods.
3. Isolation of plasmid from E. coli by alkaline lysis method and its Quantification by spectrophotometer.
4. Amplification of DNA by PCR.
5. Restriction enzyme digestion of genomic DNA and plasmid DNA from E. coli and estimation of size of DNA fragments after electrophoresis using DNA markers.

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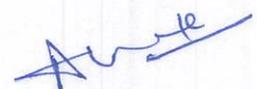
6. RFLP and RAPD analysis.
7. Demonstration of DNA fingerprinting.
8. Restriction digestion of the plasmid and estimation of the size of various DNA fragments & Construction of Restriction digestion map.
9. Cloning of DNA fragment in a plasmid vector.
10. Any other practical based on theory syllabus.

**Suggested Readings:-**

1. Sambrook, J., Fritsch, EF. And Maniatis, I. (2000). Molecular Cloning: A Laboratory Manual Cold Spring Harbor Laboratory Press, New York.
2. Glover, DM. and Hames, BD. (1995). DNA Cloning: a practical Approaches IRL Press Oxford
3. Kaufman, PB., Wu, W., Kim, D. and Cseke, LJ. (1995). Molecular and cellular: Methods in Biology and Medicine CRC Press. Florida.
4. Berger, SL. and Kimmel, AR. (1998). Guide to Molecular Cloning Techniques, Academic press Inc. San Dlogo.
5. Gooddol, DV. (1990). Gene. Expression Technology Academic Press Inc., San Diego, 1990.
6. Mickloss, DA. and Greyer, GA. (1990). DNA Science A First Course in Recombinant Technology, Cold Spring Harbor Laboratory Press, New York.
7. Primorso, SB. (1994). Molecular Biotechnology (2nd Edn.), Blackwell Scientific Publishers, Oxford.
8. Davies, JA. And Roznikolf, WS. (1992). Milestones in Biotechnology. Classic Papers on genetic Engineering Butterworth-Helnemann, Boston.
9. Walker, MR. and Repley, R. (1997). Route Maps in Gene Technology. Blackwell Science Ltd. Oxford.
10. Kingsman, SM. and Kingsman, AJ. (1998). Genetic Engineering: An Introduction to gene analysis and exploitation in eukaryotes. Blackwell Scientific publications. Oxford, 1998.
11. Glick BR. and Thompson, JE. (1993). Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
12. Glover, D.M. and Hames, B.D. (Eds.) (1995). DNA Cloning 1: A Practical Approach, Core Techniques, 2nd edition. PAS, IRL Press at Oxford University Press, Oxford.
13. Hackett, T'B., Fuchs, JA. And Meesing, JW. (1988). An Introduction to Recombinant DNA Techniques: Basic Experiments in Gene Manipulation. Benjamin/Cummings Publishing Co., Inc. Menlo Park, California.
14. Glick, BR. And Pasternak, JJ. (1994). Molecular Biotechnology Principles and Applications of Recombinant DNA. Panima Publishing Corp. New Delhi.
15. Watson, JD., Gilman, M., Witkowski, J and Zollar, M. (1992). Recombinant DNA (Sec. Ed.). Scientific American Books, New York.



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Discipline Specific Elective (DSE)

**BTT 304: Entrepreneurship & Ethics**

(Credit: 4; Hours: 60)

Theory Paper

Exam Duration: 03 hours

**Content:**

**UNIT-I (15hrs): Entrepreneurship & Project Management**

1. Entrepreneurship- concept, definition, structure and theories.
2. Types of start-ups and entrepreneurship.
3. Process of entrepreneurial development, entrepreneurial leadership and product planning.
4. Project management- Concept, identification, formulation, design and network analysis, project report creation and appraisal.

**UNIT-II (15hrs): Entrepreneurship in Biotechnology**

1. Integration of Science, technology and business: This point highlights how entrepreneurial success in biotechnology depends on combining scientific knowledge with business strategy.
2. Basic Principles and Practices of Management: definition, concepts and application.
3. Organization and Decision Making: Organization types, coordination, control and decision making in management
4. Conceptual Framework for a Bio-entrepreneur: It outlines the specific skills and characteristics needed to be a successful entrepreneur in the biotech industry.

**UNIT-III (15hrs): Business Development in biotechnology**

1. Factors Affecting Biotech Business and Core concept of Market: This point examines the various factors that influence a biotech business and the process of identifying and evaluating market potential of various bio-entrepreneur sectors.
2. Government and Financial Support: It discusses the crucial role of government schemes and financial institutions in fostering bio-entrepreneurship.
3. Essential Skills in Bio-entrepreneurship: This covers the necessary soft skills, including personality, attitude and Organizational behaviour and entrepreneur leadership.
4. Principles of effective communication- Body language, presentation and communication skills like public speaking and writing business proposals.

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**UNIT-IV (15hrs): Ethical & Legal Issues**

1. Introduction to Ethical Issues: ethics in a professional context and explores the causes of unethical acts such as personal gain, ignorance of law, codes, policies and procedures.
2. Professional Ethics and Conduct: importance of professional behavior and the need to instill ethical values in scientists.
3. Good Practices & Lab Accreditation: This covers key practices such as Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP), as well as the significance of laboratory accreditation.
4. Intellectual Property Rights (IPR): its various forms, which are essential for protecting innovations in the biotechnology sector.

***Suggested Laboratory Exercises: -***

1. Innovation and Entrepreneurship
2. Development of Networking
3. Business Communication
4. Forms of IPR
5. Industrial visit (Report)
6. Success stories of Entrepreneurs
7. Support & start up schemes in India.

***Suggested Readings:***

1. Alvaro Cuervo, Domingo Ribeiro and Salvador Koig, 2007, Entrepreneurship Concepts, Theory and Perspective. Part II, 155-170
2. Hannafey, FT. (2004). Entrepreneurship and Ethics: A. Literature Review. J. of Business Ethics. Volume 46, Number 2, 99-110 Faj (Tai)
3. Hassan., Yaqub, O., Diepeveen, D. (2010). Intellectual Property and Developing Countries: A review of the literature, the RAND Corporation, 1776 Main Street, P.O. Box 2138, Santa Monica C.A 90407-2138
4. Krattiger et al (2007) "Intellectual Property Management in Health and Agricultural Innovation: A Handbook of Best Practices", Managing Innovation for a Better World
5. Hahn, RW. (2005). Intellectual Property Rights in Frontier Industries: Software and Biotechnology, AEI Press.
6. Miller, Raphael, A. and Michael HD. (2000) Intellectual Property: Patents, Trademarks and Copyright. 3rd ed. New York: West/Wadsworth.
7. Creswell, J. (1998). Qualitative inquiry and research design: Choosing among five traditions. Thousand Oaks, California: Sage Publications.



8. Creswell, J. (2003). Research Design: Qualitative, Quantitative, and Mixed, Methods Approaches. Thousand Oaks, California: Sage Publications.
9. John W. Creswell, 2009, Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, Third Edition, www.sagepub.com ISBN: 978-1-4129-6557-6
10. Dahlia K. Remler, Gregg G., Van Ryzin, R. (2011). Research Methods in Practice, Strategies for Description and Causation., www.sagepub.com, ISBN: 978-1-4129-6467-
11. Glenn, MacDonald, L. (2011). Ethical Issues in Genetic Engineering and Transgenics
12. McGee, G. "Primer on Ethics and Human Cloning"  
<http://www.actionbioscience.org/biotech/mcgee.html>
13. "Primer on Ethics and Crossing Species Boundaries"  
[http://www.actionbioscience.org/biotech/baylis\\_robert.html](http://www.actionbioscience.org/biotech/baylis_robert.html)
14. Grey, ST. "Genetic Engineering and Xenotransplantation"  
<http://www.actionbioscience.org/biotech/grey.html>
15. Kolehmainen, S.M. "The Dangerous Promise of Gene Therapy"  
<http://www.actionbioscience.org/biotech/kolehmainen.html>
16. Sherlock, R. and Morrey, JD. (2002). -Ethical issues in biotechnology, Rowman & Littlefield Publishers, Inc., Maryland.
17. Paul B. Thompson (2007). Food biotechnology in ethical perspective, TheSpringer, 2<sup>TM</sup> Ed., The Netherlands
18. Krishna R. Dronamraju, (2008). Emerging consequences of biotechnology: Biodiversity loss and IPR issues. World Sc. Publ. Co. Pvt. Lid., Singapore.

## BTT 305: Protein Engineering

(Credit: 4; Hours:60)

Theory Paper

Exam Duration: 03 hours

Content:

### UNIT-I (15hrs): Structure of Proteins and Prediction

1. Overview of protein structures: primary, secondary, tertiary and quaternary structures.
2. Structure-based classification, visualization tools and structure alignment techniques.
3. Prediction and determination of motifs, profiles, patterns and super-secondary structures.
4. Introduction to protein engineering: definition, principles and engineerable features.

### UNIT-II (15hrs): Methods for Protein Engineering

1. Rational design, directed mutagenesis, random mutagenesis, DNA shuffling, and evolutionary methods.
2. Homology modelling and de novo enzyme engineering strategies.

3. Case studies: addition of disulfide bonds (T4 Lysozyme, Human pancreatic Ribonuclease), altering asparagine residues, reducing free sulfhydryl residues.
4. Approaches for increasing enzyme activity and stability.

**UNIT-III (15hrs): Computational Approaches to Protein Engineering**

1. Sequence and 3D structure analysis for protein engineering.
2. Bioinformatics tools, data mining and Ramachandran maps for protein study.
3. Mechanisms of protein stabilization in psychrophiles, thermophiles and mesophiles.
4. Computational protein design strategies for engineering novel proteins.

**UNIT-IV (15hrs): Applications of Protein Engineering**

1. Industrial applications: food, detergent, biopolymer production and environmental challenges.
2. Therapeutic protein production, antibody modelling and redox enzyme applications.
3. Role in gene regulation and industrially important enzymes.
4. Applications in Nano biotechnology and protein-based innovations.

**Suggested Laboratory Exercises: -**

1. Isolation and purification of protein.
2. SDS – PAGE.
3. Demonstration of Mass spectroscopy.
4. Gel filtrations chromatography.
5. To find out capacity & nature of the given ion exchange resin.
6. Effect of pH, temperature on activity or stability of protein.
7. Protein structure prediction by bioinformatics.
8. Protein structure prediction and classification.
9. Application of Bioinformatics tools in support of protein research.
10. Protein structure visualization.
11. Secondary structure prediction.
12. Any other exercise based on theory paper content

**Suggested Readings:**

1. Carl Brandon & John Tooze, "Introduction to Protein Structure," "2nd Edition" Garland Publishing, 1999
2. Paul R. Carey, "Protein Engineering and Design," Academic Press, 1996.

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3. Daniel C. Liebler, "Introduction to Proteomics - Tools for the New Biology," Humana Press.
4. C. Branden, I. Tooze. 1999. Introduction to Protein Structure (2nd Ed.), Garland Science, Taylor and Francis Group, New York, USA.
5. T.E. Creighton. 2002. Proteins: Structures and Molecular Properties (3rd Ed.), W.H. Freeman and Company, New York, USA
6. R. H. Pain. 2000. Mechanisms of Protein Folding, Oxford University Press, Oxford, England. S. J. Cavanagh, W.J. Fairbrother, A.G. Palmer III, M. Rance, N. J. Skelton. 2007.
7. S. Lutz, U. T. Bornscheuer. 2008. Protein Engineering Handbook, Wiley-VCH, Weinheim, Germany.
8. D. W. Mount. 2004. Bioinformatics: Sequence and Genome Analysis, Cold, Spring Harbor Laboratory, Plainview, New York, USA.
9. V. N. Uversky, A.L. Fink. 2006. Protein Misfolding, Aggregation and Conformational Diseases: Part A: Protein Aggregation and Conformational Diseases (Protein Reviews), Springer, New York, USA.
10. M. Zvelebil, J.O. Baum. 2007. Understanding Bioinformatics (1st Ed.), Garland Science, Taylor and Francis Group, New York, USA.

## BTT 306: Proteomics and Genomics

(Credit:4; Hour: 60)

Theory Paper

Exam Duration: 03 hours

### Content:

#### UNIT-I (15hrs): Genomics – Genome Sequencing & Gene Expression

1. Genome sequencing strategies, programs and high-throughput sequencing technologies.
2. Sequence alignment methods and gene annotation approaches.
3. Analysis of differential gene expression – ESTs, SAGE and microarrays with applications.
4. Gene tagging, promoter trapping, knockout/knockdown mutants and modulation of protein structure and function.

#### UNIT-II (15hrs): Gene Databases & Transcriptomics

1. Genome and gene databases; overview of plant genome projects – tomato, potato and rice.
2. Non-coding RNAs, Transcriptomics, RNA interference (RNAi) and gene silencing.
3. Genome imprinting and biogenesis of small RNAs.
4. Functions of small RNAs in heterochromatin formation and gene silencing.

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**UNIT-III (15hrs): Proteomics – Protein Analysis Techniques**

1. Protein analysis using Circular Dichroism, NMR, UV/Visible and fluorescence spectroscopy.
2. Protein identification and analysis using ExPASy server and other protein databases.
3. 1-D and 2-D gel electrophoresis for proteome analysis.
4. Techniques and tools for comprehensive proteome analysis and data interpretation.

**UNIT-IV (15hrs): Advanced Proteomics – Mass Spectrometry & Interactions**

1. Mass spectrometry-based protein identification – PMF (protein mass fingerprinting), LC-MS and 2D gel image analysis (data acquisition, spot detection and gel matching).
2. DIGE and alternatives to 2-DE for protein expression analysis.
3. Post-translational modifications and protein–protein interactions.
4. Protein chips and arrays, proteomics databases and future directions in proteomics research.

***Suggested Laboratory Exercise: -***

1. Demonstration and listing of sequence retrieval online tools.
2. Demonstration and listing of sequence submission online tools.
3. Listing and demonstration of Protein and DNA Sequence Databases and their utilities.
4. Demonstration of DNA and Protein Array Technology and applications.
5. Reverse transcription-PCR to examine gene expression.
6. Real-time PCR to quantify gene expression.
7. Northern and Western Blotting analysis.
8. Demonstration of Instrumentation (MALDI/TOF, LC-MS-MS, 2DGE) by visit or
9. audio-visual medium.
10. Protein separation techniques (Chromatography-Ion-Exchange, Gel Filtration, Affinity; Ultrafiltration. Recombinant protein separation techniques).
11. Comparison of Next-generation sequencing methods (by Chart/ poster preparation).
12. Any other exercises designed by course teacher as per the syllabus.

***Suggested Readings: -***

1. Buchanan B, Gruissem G, and Jones R (2000) Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, USA.
2. Hammes GD (2005) Spectroscopy for the Biological Sciences; Wiley Interscience, USA.

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3. Harlow and Lane I (Eds.) (1988) Antibodies- A Laboratory Manual; Cold Spring Harbo: Laboratory, USA.
4. Lieber DC (2006) Introduction to Proteomics: Tools for New Biology; Humana Press. NJ.
5. Pennington SR, Dunn MJ (Eds.) (2002) Proteomics: From Protein Sequence to Function, BIOS Scientific Publishers, United Kingdom.
6. Sambrook. and Russell DW (2001). Molecular Cloning - A Laboratory Manual, Vol. I - III. Cold Spring Harbor Laboratory, USA:
7. Singer M and Berg P (1991). Genes and Genomes: A Changing Perspective; University Science Books, CA, USA.

## BTT 307: Nanobiotechnology

(Credit: 4; Hours: 60)

Theory Paper

Exam Duration: 03 hours

**Content:**

### UNIT-I (15hrs): Introduction to Nano biotechnology

1. Historical background of Nano biotechnology.
2. Contributions of Michael Faraday, Richard Feynman's theories and Moore's Law.
3. Miniaturization of microprocessors.
4. Definition and concept of nano and its comparison with familiar objects.

### UNIT-II (15hrs): Nano Science and Nanomaterial's

1. Multidisciplinary nature of Nano science; Bottom-up and Top-down approaches with examples.
2. Types of nanomaterial's: One-dimensional (CNTs, its types and characteristics) and Two-dimensional (Nano films, sheets, walls).
3. Properties and types of nanomaterials and microscopy techniques for observing nanomaterials.
4. Preparation methods: Physical, Chemical and Biological.

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**UNIT-III (15hrs): Applications of Nano biotechnology**

1. Medical applications: Nano medicine, drug delivery, cancer therapy, and MRI with magnetic nanoparticles.
2. Industrial and consumer applications: Nano cosmetics, textiles, nano-sensors, and water purification.
3. Advanced technologies: Lab-on-a-chip (LOC), nano computers, and DNA computers.
4. Current trends of research directions in Nano biotechnology.

**UNIT-IV (15hrs): Nano materials in Plant Systems and Agriculture**

1. Bio-uptake, localization and transformation of nanoparticles within plants.
2. Nano-agriculture: sustainable crop production, nanoparticle-based delivery of herbicides, pesticides and fertilizers.
3. Role of nanoparticles in photosynthesis and their mode of action at the gene level.
4. Nano toxicity and its mechanisms in plants and the environment.

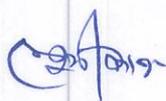
**Suggested Laboratory Exercises: -**

1. Synthesis of Nanoparticles by physical method & Chemical Method.
2. Green synthesis of Nanoparticles using Plant system from Leaves, fruit, callus etc.
3. Characterization of Nanoparticles using UV Visible Spectroscopy, XRD and FTIR.
4. Visualization of Nano materials using SEM, TEM, AFM.
5. To check the bioactivity of nanomaterial on various pathological Fungi and bacteria.
6. To check the effect of Nano materials on Plant germination parameters.

**Suggested readings:**

1. Manasi Karkare. Nanotechnology: Fundamentals and Applications.2008. I.K. International
2. K. Eric Drexler, Chris Peterson and Gayle Pergamit, Unbounding the future: The Nanotechnology Revolution. 1991. William Morrow and Company, Inc.,New York.
3. CN R Rao. Nano world: An Introduction to Nano science and Technology.2010. Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore.
4. Manzer H.Siddiqui, M.H.Al -Whabhi, F. Mohammad (Editors). Nanotechnology and Plant. Springer.
5. C.M. Niemeyer and C.A. Mirkin Nano biotechnology • 2012. Wiley-VCH
6. C.M. Niemeyer and C.A. Mirkin Nano biotechnology-II. 2012. Wiley-VCH





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## DSC Course

**BTT 401: Review paper writing**

(Credit: 4)

The Review article writing is for cultivating critical thinking, scientific literacy, and effective communication skills among students. In biotechnology, where rapid advancements and complex research are common, hence, the ability to analyze and evaluate scientific literature is essential. It will allow students to engage deeply with current research, understand experimental methodologies, and assess the validity and impact of findings, to synthesize diverse sources, identify gaps in knowledge, and propose future directions for study. Publication of review article is not mandatory. The evaluation of the review article will be done by the supervisor (departmental faculty member) and co-supervisor (if any). The review (manuscript) submitted by the candidate shall be evaluated by one external expert, Head of the department and supervisor of the candidate. The examination shall be held in the department only. The distribution of the marks will be as under:

**SCHEME: EVALUATION OF REVIEW:** Total marks: 100 (Internal: 30 & External: 70)

**Internal examination:** (Maximum marks: 30)

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|-------------------------|----------|
| a. Topic selection:     | 10 marks |
| b. Content evaluation:  | 10 marks |
| c. Citation evaluation: | 10 marks |

**External examination:** (Maximum marks: 70)

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|---|----------|
| a. Content evaluation:                  | 40 marks |
| b. Oral Presentation on written review: | 20 marks |
| c. Viva-voce:                           | 10 marks |

**BTT 402: Industrial Training/Hands-on-training / Workshop**

(Credit: 8)

The Industrial training/workshop (4-6 weeks) will involve a Hands-on experience. It is a vital component of Biotechnology course that equips students with practical experience in real-world work environments. It serves as a bridge between academic learning and industry demands, allowing

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students to apply theoretical knowledge to actual tasks and challenges. Through hands-on exposure trainees gain insights into workplace dynamics, technical processes, professional standards, enhancing their skills and boosting their confidence. This is an essential and important curriculum for students to prepares them for future employment, understand the expectations and culture of their chosen field, making them more adaptable and job-ready.

The seminars, in-plant training reports will be submitted by the candidate to the Head/ Coordinator of the Department who will submit these to the external examiner. The examination shall be held in the department and the training report etc. will NOT be required to be mailed to the external examiner. The distribution of the marks will be as under:

**SCHEME: EXAMINATION FOR WORKSHOP/INTERNSHIP /FIELD WORK**

Maximum Marks: 200 (Internal: 30% & External: 70%)

**Internal Examination:** (Maximum Marks: 60)

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|--|----------|
| a) Internship Report/Field visit report etc. | 40 marks |
| b) Demo note/Work dairy / etc                | 20 marks |

**External Examination:** (Maximum Marks: 140)

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|----------------------|-----------|
| a). Project Report   | 100 Marks |
| b) Oral Presentation | 30 Marks  |
| c) Viva-voce         | 10 marks  |

**BTT 403-Dissertation**

(Credit: 12)

Each student will undergo a 4-6 months duration research project (dry or wet lab work or both) either in department, other department or outside of university of campus. The project work will involve in depth practical work on a problem suggested by the supervisor of the candidate in or out of the departmental. The evaluation of the dissertation will be done by the external examiner. The dissertation submitted by the candidate shall be evaluated by one external expert, Head of the department and supervisor of the candidate. The seminars, in-plant training and industrial visit reports will also be





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submitted by the candidate to the Head of the Department who will submit these to the external examiner. The examination shall be held in the department and the dissertation etc. will NOT be required to be mailed to the external examiner. The distribution of the marks will be as under:

### EVALUATION & EXAMINATION FOR RESEARCH PROJECT/WORK

Maximum Marks: 300 [Internal: 30% & External: 70%]

#### INTERNAL EXAMINATION: (Maximum Marks: 90)

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| a) Report evaluation.    | 65 marks |
| b) Oral presentation etc | 25 marks |

#### EXTERNAL EXAMINATION: (Maximum Marks: 210)

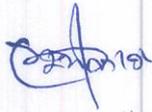
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|----------------------|-----------|
| a) Project Report    | 150 Marks |
| b) Oral Presentation | 50 Marks  |
| c) Viva-voce         | 10 Marks  |



Dr. Arvind Kumar  
(Asst. Professor & Coordinator)



Dr. Alok Sharma  
(Asst. Professor)



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Prof. Anurag Singh