



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Syllabus for B. Sc. IV Biotechnology (Honours with Research)

**Under
Faculty of Science and Technology**

(As per NEP 2020)

With Effect From Academic Year 2026 – 2027

Syllabus for Bachelor of Science (B.Sc.) Part – IV (Honours with Research) Biotechnology

As per the NEP 2020 guidelines this updated syllabus is prepared for first year undergraduate students of Biotechnology. At this level, to develop their interest towards Biotechnology as applied science and also to prepare them for the academic and research simultaneously. Introduction of life science subjects will help to form a basic foundation of research concepts for students. The interdisciplinary approach with vigor and depth is compatible to the syllabi of other universities, at the same time is not rigid for the students at first year of their graduation. The units in the syllabus are well defined with scope and the number of lectures. The Reference books are mentioned with relevance.

GENERAL OBJECTIVES

1. Construction and redesigning of the courses to suite local needs
2. More emphasis on applied aspects of biotechnology
3. To develop aptitude of students in the field of research
4. Enrichment of applied knowledge in areas of Biotechnology

GENERAL OUTCOMES

1. Graduate with proficiency in the biotechnology
2. Eligible to continue higher studies in the subject
3. Eligible to peruse post graduate study in abroad
4. Eligible to appear for the examination for a job in the research in government sector.

PROGRAM SPECIFIC OBJECTIVES

1. The students are expected to understand the fundamentals, principles, concept and recent developments in Biotechnology.
2. The practical course is framed in relevance with theory courses to improve understanding of various concepts in biotechnology.
3. It is expected to inspire and boost interest of students in Biotechnology.
4. To enrich students' knowledge and train them in various branches of Biotechnology.

PROGRAM SPECIFIC OUTCOMES

1. Develop the ability to apply the knowledge acquired in classroom and laboratories to specific problems in theoretical and experimental biotechnology.
2. Identify the area of interest in the academic research and development.

3. Perform job in various fields like food, pharmaceutical, agriculture, healthcare, public services and business etc.
4. Be an entrepreneur with precision, analytical mind, innovative thinking, and clarity of thought, expression and systematic approach.

DURATION: One year

PATTERN: Semester wise

MEDIUM OF INSTRUCTION: English

ELIGIBILITY OF STUDENTS: Bachelor of Science with Biotechnology with CGPA above 7.5 or equivalent

NO. OF STUDENTS: A batch shall consists of 40 students and additional 20% of seats will be allotted as per Karmaveer Bhaurao Patil University, Satara norms.

ELIGIBILITY OF CORE FACULTY: The eligibility of faculty shall be as per the University Grant Commission (UGC) regulations and guidelines

ELIGIBILITY FOR PROFESSOR OF PRACTISE OR PROFESSIONAL TRAINER:
Any other eligibility as per the Guidelines and Regulations Passed by the Board of Concerned Studies, Academic Council of the College / University and Rules and Regulations of Karmaveer Bhaurao Patil University, Satara, Government of Maharashtra, and UGC norms

SEMESTER, CREDIT FRAMEWORK NSQF LEVEL AND EXIT POINTS

Sr. No	Semester	Year	Year	Credits	Level	Exit Points &Award
1	Sem. I & II	2026-27	1 Year	44	4.5	UG Certificate (Biotechnology)
2	Sem. III & IV	2027-28	2 Year	44	5.0	UG Diploma (Biotechnology)
3	Sem. V & VI	2028-29	3 Year	44	5.5	UG Degree (Biotechnology)
4	Sem VII & VIII	2029-30	4 Year	44	6.0	UG Honours Degree/ Honours with research (Biotechnology)
				Total 176		Bachelor of Science (Biotechnology)

STRUCTURE OF COURSE: CREDIT DISTRIBUTION

Sem (Level)	Courses			O E	VSC/ SEC	AE C/ VE C/ IKS	OJT/ FP/ CEP/ CC/ RP	Total Credi ts	Degree/ Cum. Cr. MEME
	Course I Major Mandatory	Course II Major Electiv e	Course III						
Sem VII (6.0)	Major XVII(4) Major XVIII(4) Major (P) VII (2)	Major XIX (4) RM (4)	RM I (2) RM (P) I (2)	-	-	-	RP (4)	22	UG HONO URS WITH Researc h Degree: 176
Sem VIII (6.0)	Major XX(4) Major XXI(4) Major (P) VIII (2)	Major XXII (4)	-	-	-	-	RP (8)	22	
Credit s	20	08	04	-	-	-	12	44	
Total	100		16	08	14	16	22	176	

STRUCTURE OF COURSE B.Sc. IV AS PER NEP-2020 (1.0)

Semester VII				
Sr. No	Components	Course code	Course Title	Credits
1.	Major	BBTT 471	Advances in Cell Biology	4
2.	Major	BBTT 472	Advances in Molecular Biology	4
3.	Elective	BBTT 473	Advances in Biological Chemistry	4
4.	Elective	BBTT 474	Clinical Research & Data management	4
5.	RM	BBTT 475	Research Methodology	2
6.	Major Lab	BBTP 476	Practical based on BBTT 471 and BBTT 472	2
7.	RM	BBTPRM 477	Practical based on BBTT475	2
8.	RP	BBTP 478	Research Project in Biotechnology I	4
Total				22

Semester VIII				
Sr. No	Components	Course code	Course Title	Credits
1.	Major	BBTT 481	Advances in Genetics	4
2.	Major	BBTT 482	Advances in Immunology and Virology	4
3.	Elective	BBTT 483	Advances in Food Biotechnology	4
4.	Elective	BBTT 484	Animal Tissue Culture	4
5.	Major Lab	BBTP 485	Practical based on BBTT 481 and BBTT 482	2
6.	RP	BBTP 486	Research Project in Biotechnology II	8
Total				22

EVALUATION STRUCTURE

Semester VII

Course	Course Category	Course Code		Internal Evaluation (Best of two CCE)			ESE	Total Marks	Credits
			CCE-I	CCE-II	CCE-III	Total			
Major	T	BBTT 471	20	20	20	40	60	100	04
Major	T	BBTT 472	20	20	20	40	60	100	04
Elective	T	BBTT 473	20	20	20	40	60	100	04
	T	BBTT 474	20	20	20	40	60	100	04
RM	T	BBTT 475	10	10	10	20	30	50	02
Practical's		Internal evaluation (student performance, attendance, journal, viva)					ESE	Total	Credits
Major Lab	P	BBTP 476	20				30	50	02
RM	P	BBTPRM 477	20				30	50	02
RP	P	BBTP 478	40				60	100	04
								550	22

Semester VIII

Course	Course Category	Course Code		Internal Evaluation (Best of two CCE)			ESE	Total Marks	Credits
			CCE-I	CCE-II	CCE-III	Total			
Major	T	BBTT 481	20	20	20	40	60	100	04
Major	T	BBTT 482	20	20	20	40	60	100	04
Elective	T	BBTT 483	20	20	20	40	60	100	04
	T	BBTT 484	20	20	20	40	60	100	04
Practical's		Internal evaluation (student performance, attendance, journal, viva)					ESE	Total	credits
Major Lab	P	BBTP 485	20				30	50	02
RP	P	BBTP 486	80				120	200	08
								550	22

RP: Research Project; T: Theory; P: Practical; RM: Research Methodology.

OTHER FEATURES:

A) LIBRARY:

Reference books, Textbooks, journals, and Periodicals are available in Institute and Departmental Library. (Separate reference lists are attached along with the respective course syllabus)

B) LABORATORY EQUIPMENT:

a) Computer, LCD projector, visualizer, smart board

b) Laboratory Equipment:

1. Atomic Absorption Spectrometer

2. Autoclave Vertical
3. Bacteriological Incubator
4. Binocular Research Microscope CX 21i
5. BOD Incubator
6. Centrifuge Remi R-4C
7. COD refluxing unit
8. Colorimeter
9. Combined pH and Conductivity Meter
10. Compound Microscope
11. Conductivity Meter
12. Deep freezer
13. Dissection microscope
14. Distillation assembly
15. Flame Photometer
16. Hemocytometer
17. Horizontal Electrophoresis unit
18. Horizontal Laminar Airflow
19. Hot Plate
20. Lux Meter
21. Microcentrifuge
22. Microscope camera device
23. Microwave Oven
24. MiniCentrifuge Remi
25. Mixer
26. pH Meter
27. Refractometer
28. Refrigerator
29. Rotary Shaker
30. Sonicator Waterbath

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology		
	Yashavantrao Chavan Institute of Science, Satara		
	Board of Studies in Biotechnology		
	Programme: B.Sc.	Semester - VII	
	Type : Major	Marks: 100	
	Credits : 4	From: A. Y. 2025-26	
	Name of the Course: BBT 471 Advances in Cell Biology		
Course Objectives: Students should be able to... 1) learn cell structure with respect to plant, animal and bacteria 2) study transport of cell membrane 3) understand cell division theory 4) learn characteristic of normal and cancerous cell			
Course Outcomes: Students will be able to... 1) explain cell structure with respect to plant, animal and bacteria 2) determine different types of transport systems across the plasma membrane 3) discuss protein targeting and vesicular transport 4) describe and differentiate cancerous and noncancerous cells			
Module	Title and Contents	Hrs	
Module -1:	Cell structure and cytoplasmic membrane system 1.1 Structure and functions of organelles (mitochondria, chloroplast, vacuoles, peroxisomes and lysosomes, nucleus and its components) 1.2 Cell membrane – Plasma membrane types (animal, plant and bacterial) 1.3 Cell cytoplasmic membrane system- structural and functional organization	15	
Module -2:	Cellular Transport 2.1 Transport across plasma membrane and intra-cellular transport (vesicular and membrane transport) at molecular level, Transepithelial transport 2.2 Voltage-gated ion channels and the propagation of action potentials in nerve cells, ion channels and aquaporins. 2.3 Structure of Plant Cell, Plant cell wall - primary and secondary, 2.4 Plamodesmata structure and function 2.5 Plastids - Structure and types	15	
Module -3:	Cell Signaling 3.1 Communication between cells and environment 3.2 Cytoskeleton- Structure- assembly and disassembly of cytoskeletal elements (microtubule, microfilament IF), role in cell division 3.3 Extracellular matrix and cell junctions- relevance to tissue structure and function 3.4 Signaling at cell surface, signaling molecules, hormones and receptors signaling pathways that control gene activity 3.5 Signal transduction and secondary messengers plant cell communication	15	

Module -4:	Cell Differentiation 4.1 Cell Cycle and its regulation, Cell differentiation 4.2 Cell death, phenomenon of apoptosis, necrosis, cell transformation 4.3 Cell differentiation in plants and animals including terminal cell differentiation 4.4 Role of hormones and growth factors	15
	Reference Books:- 1. Alberts, Bruce, Alexander Johnson, Rebecca Heald, David Morgan, Martin Raff, Keith Roberts, and Peter Walter. <i>Molecular Biology of the Cell</i>. 7th ed. New York: W. W. Norton & Company, 2022. 2. Dashek, William V. <i>Plant Cell Biology</i>. Boca Raton, FL: CRC Press, 2017. 3. Pollard, Thomas D., William C. Earnshaw, and Jennifer Lippincott-Schwartz. <i>Cell Biology</i>. 3rd ed. Philadelphia: Elsevier, 2016. 4. Stahl, Philip D., and Ralph A. Bradshaw, eds. <i>Encyclopedia of Cell Biology</i>. Amsterdam: Elsevier, 2015. 5. Plopper, George. <i>Principles of Cell Biology</i>. 2nd ed. Burlington, MA: Jones & Bartlett Learning, 2014. 6. Cooper, Geoffrey M., and Robert E. Hausman. <i>The Cell: A Molecular Approach</i>. 6th ed. Sunderland, MA: Sinauer Associates, 2013. 7. Lodish, Harvey, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher, Hidde Ploegh, Angelika Amon, and Matthew P. Scott. <i>Molecular Cell Biology</i>. 7th ed. New York: W. H. Freeman and Company, 2012. 8. Karp, Gerald. <i>Cell and Molecular Biology: Concepts and Experiments</i>. 6th ed. Hoboken, NJ: John Wiley & Sons, 2010. 9. Wilson, John H. <i>Molecular Biology of the Cell: Problems Book</i>. New York: Garland Science, 2008. 10. Alberts, Bruce, James Lewis, Martin Raff, Keith Roberts, and Peter Walter. <i>Molecular Biology of the Cell</i>. 4th ed. New York: Garland Science, 2006.	
Evaluation Pattern:60:40		
Total Marks: 100		
Internal Continuous Evaluation: 40 Marks CCE I- 20 Marks: Home Assignment CCE II -20 marks: Short and long answer questions Test/Seminar/Open Book Test/Quiz/Case study/Book Review/Field work/ Industry Visit CCE III -20 Marks: Compulsory MCQ test (Best of two CCE marks will be considered)		End Semester Examination: 60 Marks Question -1 12 Marks (Compulsory) (Six questions of 2 marks) Question -2 to Question 7- 12Marks each (Any 4 from Q 2 to Q 7)

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	Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Biotechnology	
	Programme: B.Sc.	Semester - VII
	Type : Major	Marks: 100
	Credits : 4	From: A. Y. 2025-26
Name of the Course: BBT 472 Advances in Molecular Biology		
Course Objectives: Students should be able to... 1) learn various advance concepts of genomic organization. 2) know role of gene expression and regulation. 3) study protein synthesis process 4) understand molecular biology in relevance to biotechnology.		
Course Outcomes: Students will be able to... 1) explain advance concepts of genomic organization 2) describe fundamentals of central dogma of life. 3) elaborate concepts of dna mutation and gene expression 4) discuss process of synthesis of proteins		
Module	Title and Contents	Hrs
Module -1:	Genome Structure and Organization 1.1 Organization of prokaryotic and eukaryotic genomes, Structure of chromatin, nucleosome, chromatin organization and remodeling, 1.2 DNA re-association kinetics (Cot curves), repetitive and unique sequences, DNA melting and buoyant density, C value paradox and genome size, satellite DNA,. Gene families, clusters, Pseudogenes, superfamilies, Organelle genomes 1.3 Mobile DNA elements: Transposable elements in bacteria, IS elements, composite transposons, replicative and non-replicative transposons, Mu transposition, p-elements, Controlling elements in TnA and Tn 10 transposition. SINES and LINES, retrotransposons	15
Module -2:	Mutations, DNA damage and Repair 2.1 Mutation: Nonsense, missense and point mutations, intragenic and intergenic suppression, frameshift mutations, physical, chemical and biological mutagens. 2.2 DNA damage and its types 2.3 DNA repair mechanisms- nucleotide excision repair, base excision repair, mismatch repair, recombination repair, double strand break repair, transcriptional coupled repair. 2.4 Recombination repair: Homologous and site-specific recombination, models for homologous recombination- Holliday junction, NHEJ Proteins involved in recombination- RecA, RuvA, B, C, Gene conversion	15
Module -3:	DNA Replication, Transcription and Regulation 3.1 Introduction and significance of replication 3.2 Enzymes and accessory proteins involved in DNA replication in prokaryotes and eukaryotes	15

	3.3 Replication in prokaryotes and eukaryotes 3.4 DNA replication models, connection of replication to cell cycle. 3.5 Gene Expression and Regulation in Prokaryotes and Eukaryotes: 3.6 Transcription: Basic mechanism in prokaryotes and eukaryotes, RNA Polymerases, Chromatin remodeling in relation to gene expression, DNase hypersensitivity, DNA methylation. 3.7 Regulation of transcription including transcription factors. Post-transcriptional processing and transport of RNA. 3.8 Non coding RNAs	
Module -4:	Protein Synthesis and Regulation 4.1 Components of protein synthesis, Genetic code, degeneracy of codons, wobble hypothesis codon usage, 4.2 Mechanism of protein synthesis (initiation, elongation and termination, Co- and post-translational Modifications), 4.3 Regulation of protein synthesis, 4.4 protein turnover and degradation.	15
	Reference Books:- 1. Nadeem, A., F. Hassan, and M. Javed. <i>Introduction to Molecular Genomics</i>. Bentham Science Publishers, 2021. 2. Craig, Nancy L., Rachel Green, Carol Greider, Orna Cohen-Fix, et al. <i>Molecular Biology: Principles of Genome Function</i>. 2nd ed. Oxford: Oxford University Press, 2014. 3. Lewin, Benjamin. <i>Genes XI</i>. 11th ed. Burlington, MA: Jones & Bartlett Learning, 2012. 4. Tropp, Burton E. <i>Molecular Biology: Genes to Proteins</i>. 4th ed. Burlington, MA: Jones & Bartlett Learning, 2011. 5. Weaver, Robert F. <i>Molecular Biology</i>. 5th ed. New York: McGraw-Hill Science, 2011. 6. Wilson, Keith, and John Walker, eds. <i>Principles and Techniques of Biochemistry and Molecular Biology</i>. 7th ed. Cambridge: Cambridge University Press, 2010. 7. Pal, J. K., and S. Ghaskadbi. <i>Fundamentals of Molecular Biology</i>. New Delhi: Oxford University Press, 2009. 8. Watson, James D., Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, and Richard Losick. <i>Molecular Biology of the Gene</i>. 6th ed. San Francisco: Pearson Education, 2008. 9. Twyman, Richard M., and W. Wisden. <i>Advanced Molecular Biology: A Concise Reference</i>. Oxford: BIOS Scientific Publishers, 1998. 10. Brown, T. A. <i>Essential Molecular Biology: A Practical Approach</i>. Vol. 1. Oxford: IRL Press, 1995.	
Evaluation Pattern: 60:40		
Total Marks: 100		
Internal Continuous Evaluation: 40 Marks CCE I- 20 Marks: Home Assignment CCE II -20 marks: Short and long answer questions Test/Seminar/Open Book Test/Quiz/Case study/Book Review/Field work/ Industry Visit CCE III -20 Marks: Compulsory MCQ test (Best of two CCE marks will be considered)		End Semester Examination: 60 Marks Question -1 12 Marks (Compulsory) (Six questions of 2 marks) Question -2 to Question 7- 12Marks each (Any 4 from Q 2 to Q 7)



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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc.

Semester - VII

Type : Elective

Marks: 100

Credits : 4

From: A. Y. 2026-27

Name of the Course: BBT 473 Advances in Biological Chemistry

Course Objectives: Student should be able to...

- 1) learn basic concepts of protein biochemistry.
- 2) know vitamins and their role as coenzymes
- 3) understand the role of enzymes in industry and diagnostics
- 4) acquire the knowledge about enzymes their structure, function and kinetics.

Course Outcomes: Students will be able to...

- 1) correlate functional relationship of proteins & misfolding diseases.
- 2) determine structure function relations of enzymes and coenzymes.
- 3) perform applications of immobilization of enzymes in industries.
- 4) apply gained knowledge in clinical disease diagnosis.

Module	Title and Contents	Hrs
Module -1:	Protein Biochemistry 1.1 Biomolecules of life, Structure of Proteins (Primary, Secondary, Tertiary, quaternary), 1.2 Protein folding mechanisms - Molten globule, energy funnel, chaperon, Protein misfolding and misfolding diseases, Protein Processing Proteolytic cleavage (Pre, Pro, removal)	15
Module -2:	Enzymes & Coenzymes 2.1 IUB system, rationale, overview and specific example 2.2 Concept of prosthetic group, apoenzyme, holoenzyme, Coenzymes: Vitamins as coenzymes and deficiency symptoms of water soluble vitamins. 2.3 Structure and biochemical role, Cofactors: Role of trace elements, their bound .	15
Module -3:	Enzymology 3.1 Characteristics of enzymes, enzyme substrate complex. Concept of active center, binding sites, and ES complex formation. 3.2 Enzyme kinetics, MichaelisMenten equation, 3.3 Effect of temperature, pH and substrate concentration on reaction rate 3.4 Activation energy. Transition state theory. Enzyme activity, international units, specific activity, turnover number, factors affecting catalytic efficiency 3.5 Chemical modification, Isoenzymes and multiple forms of enzymes	15

Module -4:	Purification & Immobilization of Enzymes 4.1 Purification- salting out-salting in, Ammonium sulfate precipitation, Dialysis, Gel filtration, IEC, Affinity chromatography, Isoelectric focussing, 4.2 Immobilization: Various methods of immobilization of enzymes - ionic bonding, adsorption, covalent bonding, encapsulation and gel entrapment. Immobilized multi enzyme complex systems.	15
	Reference Books:- 1. Berg, Jeremy M., John L. Tymoczko, Lubert Stryer, Gregory J. Gatto Jr., and David L. Gatto. <i>Biochemistry</i>. 7th ed. New York: W. H. Freeman and Company, 2012. 2. Conn, Eric E., and Paul K. Stumpf. <i>Outlines of Biochemistry</i>. 5th ed. New York: John Wiley & Sons, 2009. 3. Price, Nicholas C. <i>Fundamentals of Enzymology: Cell and Molecular Biology of Catalytic Proteins</i>. 3rd ed. Oxford: Oxford University Press, 2009. 4. Nelson, David L., and Michael M. Cox. <i>Lehninger Principles of Biochemistry</i>. 5th ed. New York: W. H. Freeman and Company, 2008. 5. Voet, Donald, and Judith G. Voet. <i>Fundamentals of Biochemistry: Life at the Molecular Level</i>. 3rd ed. Hoboken, NJ: John Wiley & Sons, 2008. 6. Satyanarayana, U., and U. Chakrapani. <i>Biochemistry</i>. 3rd ed. New Delhi: Uppala Author Publishers, 2007. 7. Reymond, Jean-Louis. <i>Enzyme Assays and Enzyme Profiling: High-Throughput Screening, Genetic Selection and Fingerprinting</i>. Weinheim: Wiley-VCH, 2005. 8. Plummer, David T. <i>An Introduction to Practical Biochemistry</i>. 3rd ed. New Delhi: Tata McGraw-Hill Education, 2001. 9. Walsh, Gary. <i>Proteins: Biochemistry and Biotechnology</i>. 2nd ed. Chichester: Wiley-Blackwell, 2001. 10. Price, Nicholas C., and Lewis Stevens. <i>Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins</i>. 3rd ed. New York: Oxford University Press, 2000.	
Evaluation Pattern:60:40		
Total Marks: 100		
Internal Continuous Evaluation: 40 Marks CCE I- 20 Marks: Home Assignment CCE II -20 marks: Short and long answer questions Test/Seminar/Open Book Test/Quiz/Case study/Book Review/Field work/ Industry Visit CCE III -20 Marks: Compulsory MCQ test (Best of two CCE marks will be considered)		End Semester Examination: 60 Marks Question -1 12 Marks (Compulsory) (Six questions of 2 marks) Question -2 to Question 7- 12Marks each (Any 4 from Q 2 to Q 7)



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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc.

Semester - VII

Type : Elective

Marks: 100

Credits : 4

From: A. Y. 2026-27

Name of the Course: BBTT 474 Clinical Research & Data management

Course Objectives: Students should be able to...

- 1) understand the principles involved in the ethical, legal, and regulatory issues in clinical human subjects research, including the role of irbs.
- 2) understand the infrastructure required in performing clinical research and to have
- 3) know the steps involved in developing and funding research studies.
- 4) familiar with the basic biostatistical and epidemiologic methods involved in clinical research

Course Outcomes: Students will be able to...

- 1) explain principles involved in the ethical, legal, and regulatory issues in clinical human subject's research, including the role of irb
- 2) analyze infrastructure required in performing clinical research
- 3) determine steps involved in developing and funding research studies.
- 4) explain data management system

Module	Title and Contents	Hrs
Module -1:	Introduction to Clinical Research 1.1 Brief History of Clinical Research: Sulphanilamide Tragedy, Thalidomide Disaster, Nazi Experiments, Tuskegee Study, Belmont report, Nuremberg code, Declaration of Helsinki. 1.2 Clinical Research: An Overview, Historical guidelines in Clinical Research. Different types of Clinical Research. 1.3 Clinical Pharmacology: Pharmacokinetics, Pharmacodynamics 1.4 Drug Development Process: Preclinical trail, Human Pharmacology (Phase-I to phase IV) 1.5 Guidelines in Clinical Research-International Conference on Harmonization (ICH), Guidelines for Good Clinical Practice, ICMR guidelines for Biomedical Research on Human Subjects.	15
Module -2:	Regulation and Ethics in Clinical Research 2.1 Regulation in Clinical Research- Drug and cosmetic act, FDA, Schedule-Y- Ethics Committee and their responsibilities. 2.2 Clinical Research Regulatory Submission & approval Process- IND, NDA and ANDA submission Procedure. DCGI submission procedure. Other Regulatory authorities- EMEA, MHRA, PhRMA.	15
Module -3:	Clinical Trial Management 3.1 Concept of Clinical Trail Management, Stake holders in Clinical Trail project. Responsibility of Sponsors, Study Preparation, Study feasibility, Vendors/Service provider selection, Investigator selection, Budgeting in Clinical trial, Agreement (CTA), Regulatory submission and approval,	15

	adverse event and safety reporting. 3.2 Service provider- Contract Research Organization (CRO), Site Management Organization (SMO), Central Lab, Clinical Data Management Organization (CDMO), Medical Writing Organization, Pharmacovigilance Organization. 3.3 Clinical Research Operation, Monitoring and Clinical Evaluation: Protocol in Clinical Research, Informed Consent, Case Report Form, Investigator's Brochure (IB), Inclusion and exclusion criteria, Randomization, Blinding.	
Module -4:	CDM Systems and Clinical Data Management Process 4.1 Clinical data management systems, , Electronic data capture systems, Implementing new systems, System validation, Test procedures, Coding dictionaries, Migrating and archiving Legacy Data. 4.2 Clinical Data Management process- Data management Plan, CRF design considerations, Database design considerations, Collecting Adverse Event Data, Coding Reported terms, Creating report and Transferring data, , SAS in Clinical data analysis, Standard operating procedures and guidelines for data management.	15
	Reference Books:- 1. Kubben, Peter, Michel Dumontier, and André Dekker. <i>Fundamentals of Clinical Data Science</i>. Cham: Springer International Publishing, 2018. 2. Elsley, Mary. <i>A Guide to GCP for Clinical Data Management</i>. Canterbury: Canary Publications, 2017. 3. Friedman, Lawrence M., Curt D. Furberg, and David L. DeMets. <i>Fundamentals of Clinical Trials</i>. 5th ed. Cham: Springer, 2015. 4. Hulley, Stephen B., Steven R. Cummings, Warren S. Browner, Deborah G. Grady, and Thomas B. Newman. <i>Designing Clinical Research</i>. 4th ed. Philadelphia: Lippincott Williams & Wilkins, 2013. 5. Gallin, John I., and Frederick P. Ognibene, eds. <i>Principles and Practice of Clinical Research</i>. 2nd ed. Amsterdam: Elsevier, 2011. 6. National Research Council, Panel on Handling Missing Data in Clinical Trials, and Committee on National Statistics. <i>The Prevention and Treatment of Missing Data in Clinical Trials</i>. Washington, DC: National Academies Press, 2010. 7. Gupta, S. K. <i>Basic Principles of Clinical Research and Methodology</i>. 1st ed. New Delhi: Jaypee Brothers Medical Publishers, 2007. 8. Machin, David, Stephen Day, and Susie Green. <i>Textbook of Clinical Trials</i>. Chichester: John Wiley & Sons, 2007. 9. Di Giovanna, Giovanna, and Graham Hayes. <i>Principles of Clinical Research</i>. Braintree, UK: Wrightson Biomedical Publishing, 2001. 10. Rondel, Robert K., Sheila A. Varley, and Colin F. Webb. <i>Clinical Data Management</i>. 2nd ed. Chichester: John Wiley & Sons, 2000.	
Evaluation Pattern:60:40		
Total Marks: 100		
Internal Continuous Evaluation: 40 Marks CCE I- 20 Marks: Home Assignment CCE II -20 marks: Short and long answer questions Test/Seminar/Open Book Test/Quiz/Case study/Book Review/Field work/ Industry Visit CCE III -20 Marks: Compulsory MCQ test (Best of two CCE marks will be considered)		End Semester Examination: 60 Marks Question -1 12 Marks (Compulsory) (Six questions of 2 marks) Question -2 to Question 7- 12Marks each (Any 4 from Q 2 to Q 7)



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Faculty of Science and Technology

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Board of Studies in Biotechnology

Programme: B.Sc.

Semester - VII

Type : RM

Marks: 50

Credits : 2

From: A. Y. 2026-27

Name of the Course: BBT 475 Research Methodology

Course Objectives: Students should be able to...

- 1) know the basics of research.
- 2) learn the philosophy behind the research.
- 3) understand how define research problem.
- 4) learn tools required while doing research.

Course Outcomes: Students will be able to...

- 1) discuss the philosophy behind the research.
- 2) define research problems.
- 3) discuss the importance of knowing how research is done.
- 4) use different tools required while doing research.

Module	Title and Contents	Hrs
Module -1:	Introduction of Research 1.1 Introduction: Meaning of Research, Objectives of Research, Types of Research, Research Approaches, 1.2 Significance of Research, Research Methodology, 1.3 Research and Scientific Method Defining the Research Problem: What is a Research Problem, Selecting the Problem, Necessity of Defining the Problem, 1.4 Technique Involved in Defining a Problem.	7
Module -2:	Scientific Writing 2.1 Definition and kinds of scientific documents – research paper, review paper, book reviews, theses, conference and project reports (for the scientific community and for funding agencies). 2.2 Components of a research paper–the IMRAD system, title, authors and addresses, abstract, acknowledgements, references, tables and illustrations. 2.3 Dealing with publishers–submission of manuscript, ordering reprints. Oral and poster presentation of research papers in conferences/symposia.	8
Module -3:	Ethics in Biological Science Research 3.1 Originality, Integrity, Intellectual Property Rights, Patents and Plagiarism in research. Ethical issues and bio-safety regulation: DBT Guidelines for Bio-safety, Institutional Bio-safety committee and its functioning. 3.2 Ethics in use of Experimental animals: Institutional Animal ethics committee, and Institutional ethical committee, CCSEA and CPCEA guidelines for animal experimentation, ICMR guidelines for experiments involving humans.	7

	3.3 Biodiversity laws: Guidelines and regulations of Bioresources utilization for commercial and research purpose. 3.4 The Biological Diversity Act, Wildlife (Protection) Act, Forest (Conservation) Conservation Act.	
Module -4:	Biostatistics in Research 4.1 Processing of data: Classification and tabulation. 4.2 Data Analysis: Descriptive- Central measures (mean, medium, mode). 4.3 Dispersion measures (range, standard deviation), probability co- relation and regression, Binomial position and normal distribution, parametric and non parametric tests t- test, chi-square test, ANOVA. 4.4 Introduction to computer programs used for biostatistics: MS-Excel, SPSS, STATISTICA, PRIMER etc.	8
	Reference Books:- 1. Gupta B. N., and N. Gupta. <i>Research Methodology</i>. SBPD Publications, 2022. 2. Devi, P. Saravanavel. <i>Research Methodology: A Handbook for Beginners</i>. Notion Press, 2017. 3. Mishra, Shanti Bhushan, and Alok S. Mishra. <i>Handbook of Research Methodology: A Compendium for Scholars and Researchers</i>. Educreation Publishing, 2017. 4. Tan, Wee Liang. <i>Research Methods: A Practical Guide for Students and Researchers</i>. Singapore: World Scientific Publishing, 2017. 5. Goyal, R. C. <i>Research Methodology for Health Professionals</i>. New Delhi: Jaypee Brothers Medical Publishers, 2010. 6. Kothari, C. R. <i>Research Methodology: Methods and Techniques</i>. 2nd rev. ed. New Delhi: New Age International Publishers, 2009. 7. Mathur, U. C. <i>Product and Brand Management</i>. New Delhi: Macmillan India, 2007. 8. Trochim, William M. K. <i>Research Methods: The Concise Knowledge Base</i>. Mason, OH: Atomic Dog Publishing, 2005. 9. Garg, B. L., R. Karadia, F. Agrawal, and U. K. Agrawal. <i>An Introduction to Research Methodology</i>. Jaipur: RBSA Publishers, 2002. 10. Sinha, S. C., and A. K. Dhiman. <i>Research Methodology</i>. 2 vols. New Delhi: EssEss Publications, 2002. 11. Wadehra, B. L. <i>Law Relating to Patents, Trade Marks, Copyright, Designs and Geographical Indications</i>. New Delhi: Universal Law Publishing, 2000.	
Evaluation Pattern:60:40		
Total Marks: 50		
Internal Continuous Evaluation: 20 Marks CCE I- 10 Marks: Home Assignment CCE II -10 marks: Short and long answer questions Test/Seminar/Open Book Test/Quiz/Case study/Book Review/Field work/ Industry Visit CCE III -10 Marks: Compulsory MCQ test (Best of two CCE marks will be considered)		End Semester Examination: 30 Marks Question -1 10 Marks Question -2 to question 5- 10 Marks each (Any 2 from Q 2 to Q 5)



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc.

Semester - VII

Type : Major

Marks: 50

Credits : 2

From: A. Y. 2026-27

Name of the Course: BBTP 476 Practical's based on BBTT 471 & BBTT 472

Course Objectives: Student should be able to...

- 1) become aware of basic techniques in biological chemistry
- 2) gain hands on skill for handling of chromatography techniques
- 3) perform skill of measuring the microscopic objects
- 4) get the practical skills of protein extraction, purification and characterization

Course Outcomes: Students will be able to..

- 1) apply advanced techniques in biochemistry
- 2) perform skillful handling of chromatography techniques
- 3) perform measuring the microscopic objects
- 4) demonstrate techniques in isolation of different kinds of microorganisms or discuss the clinical data and collection strategy.

Sr. No.	Name of the Practical	Hrs
1.	Effect of organic solvents, temperature on membrane permeability.	60
2.	Isolation of chloroplasts from plant cells	
3.	Micrometry: determination of different cell sizes: Bacterial,	
4.	Micrometry: determination of different cell sizes: Fungal,	
5.	Micrometry: determination of different cell sizes: Animal, plant cell	
6.	Estimation of amount of chlorophyll present in the leaf tissue	
7.	Isolation of nuclei from plant cell.	
8.	Lab safety regulations for molecular Biology laboratory	
9.	Preparation of chemicals, buffers for molecular biology	
10.	Isolation of Eukaryotic DNA from - Plant Material	
11.	Isolation of Eukaryotic DNA from - Blood sample	
12.	Isolation of bacterial genomic DNA	
13.	Isolation of RNA from animal tissue	
14.	Isolation of RNA from plant tissue	
15.	Restriction digestion of DNA /Plasmid	

Reference Books:-

1. Krebs, Jocelyn E., Elliott S. Goldstein, and Stephen T. Kilpatrick. *Lewin's Genes XII*. 12th ed. Burlington, MA: Jones & Bartlett Learning, 2017.
2. Lodish, Harvey, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher, Hidde Ploegh, Angelika Amon, and Kelsey C. Martin. *Molecular Cell Biology*. 8th ed. New York: W. H. Freeman and Company, 2016.
3. Alberts, Bruce, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter. *Molecular Biology of the Cell*. 6th ed. New York: Garland Science, 2014.
4. Karp, Gerald. *Cell and Molecular Biology: Concepts and Experiments*. 7th ed. Hoboken, NJ: John Wiley & Sons, 2013.
5. Weaver, Robert F. *Molecular Biology*. 5th ed. New York: McGraw-Hill, 2011.

6. Wilson, Keith, and John Walker, eds. *Principles and Techniques of Biochemistry and Molecular Biology*. 7th ed. Cambridge: Cambridge University Press, 2010.
7. Prescott, Lansing M., John P. Harley, and Donald A. Klein. *Microbiology*. 6th ed. Boston: McGraw-Hill, 2005.
8. Ausubel, Frederick M., ed. *Current Protocols in Molecular Biology*. New York: John Wiley & Sons, 2003.
9. Tortora, Gerard J., Berdell R. Funke, and Christine L. Case. *Microbiology: An Introduction*. 5th ed. Redwood City, CA: Benjamin/Cummings Publishing Company, 1992.
10. Davis, Bernard D., Renato Dulbecco, Herman N. Eisen, Harold S. Ginsberg, and Wolfgang K. Joklik. *Microbiology*. 4th ed. Philadelphia: J. B. Lippincott Company, 1990.

Evaluation Pattern: 60:40

Total Marks: 50

Internal Continuous Evaluation: 20 Marks

Student Performance & Attendance: 10 Marks
Journal & Viva: 10 Marks

End Semester Examination: 30 Marks

Question -1 : 10 Marks
Question -2 : 10 Marks
Question -3 : 10 Marks



Karmaveer Bhaurao Patil University, Satara

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc.

Semester - VII

Type : RM

Marks: 50

Credits : 2

From: A. Y. 2026-27

Name of the Course: BBTPRM 477 Practical's based on BBTT 475

Course Objectives: Student should be able to...

- 1) become aware writing mini research article
- 2) gain the knowledge about the t-test analysis
- 3) know the one way and two way annova for significance analysis
- 4) get the knowledge about writing research article

Course Outcomes: Students will be able to..

- 1) apply the knowledge for writing research article
- 2) prepare and publish the research article in journal
- 3) prepare a poster for presentation
- 4) use statistical analysis tools like mean, mode & median

Sr. No.	Name of the Practical	Hrs
1.	Designing a basic experimental layout	60
2.	Framing a research problem and hypothesis	
3.	Literature review and problem selection	
4.	Review of Institutional Biosafety Guidelines (IBSC)	
5.	Writing a mini research article using IMRAD format	
6.	Intellectual property rights and patent search exercise	
7.	Creating scientific tables and figures	
8.	Preparing a poster presentation for a scientific study	
9.	Referencing and citation management using Zotero/Mendeley	
10.	Preparing an abstract from a full research paper	
11.	Study of design research proposal	
12.	Identification of sampling and experimental units	
13.	Case study on research misconduct and plagiarism	
14.	Data visualization: Creating graphs and plots	
15.	Descriptive statistical analysis (Mean, Median, SD)	

Reference Books:-

1. Kubben, Peter, Michel Dumontier, and André Dekker. *Fundamentals of Clinical Data Science*. Cham: Springer International Publishing, 2018.
2. Elsley, Mary. *A Guide to GCP for Clinical Data Management*. Canterbury: Canary Publications, 2017.
3. Friedman, Lawrence M., Curt D. Furberg, and David L. DeMets. *Fundamentals of Clinical Trials*. 5th ed. Cham: Springer, 2015.
4. Hulley, Stephen B., Steven R. Cummings, Warren S. Browner, Deborah G. Grady, and Thomas B. Newman. *Designing Clinical Research*. 4th ed. Philadelphia: Lippincott Williams & Wilkins, 2013.
5. Gallin, John I., and Frederick P. Ognibene, eds. *Principles and Practice of Clinical Research*. 2nd ed. Amsterdam: Elsevier, 2011.

6. National Research Council, Panel on Handling Missing Data in Clinical Trials, and Committee on National Statistics. *The Prevention and Treatment of Missing Data in Clinical Trials*. Washington, DC: National Academies Press, 2010.
7. Gupta, S. K. *Basic Principles of Clinical Research and Methodology*. 1st ed. New Delhi: Jaypee Brothers Medical Publishers, 2007.
8. Machin, David, Stephen Day, and Susie Green. *Textbook of Clinical Trials*. Chichester: John Wiley & Sons, 2007.
9. Di Giovanna, Giovanna, and Graham Hayes. *Principles of Clinical Research*. Braintree, UK: Wrightson Biomedical Publishing, 2001.
10. Rondel, Robert K., Sheila A. Varley, and Colin F. Webb. *Clinical Data Management*. 2nd ed. Chichester: John Wiley & Sons, 2000.

Evaluation Pattern: 60:40

Total Marks: 50

Internal Continuous Evaluation: 20 Marks

Student Performance & Attendance: 10 Marks

Journal & Viva: 10 Marks

End Semester Examination: 30 Marks

Question -1 : 10 Marks

Question -2 : 10 Marks

Question -3 : 10 Marks



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc.

Semester - VII

Type : RP

Marks: 100

Credits : 4

From: A. Y. 2026-27

Name of the Course: BBTT 478 Research Project in Biotechnology I

Course Objectives: Student should be able to...

- 1) design and execute an independent research project within their discipline under supervision.
- 2) select and apply appropriate qualitative, quantitative, or mixed research methods relevant to their research problem.
- 3) critically evaluate research findings in the context of existing literature and theoretical frameworks.
- 4) prepare a well-structured research thesis/report following academic standards and referencing styles.

Course Outcomes: Students will be able to..

- 1) identify, define, and justify a research problem based on gaps in existing literature.
- 2) develop a comprehensive research plan including objectives, hypotheses (if applicable), methodology, tools, and ethical considerations.
- 3) systematically collect, organize, and manage qualitative or quantitative data using appropriate tools and techniques.
- 4) critically compare results with existing studies and draw logical, evidence-based conclusions.

Sr. No.	Name of the Practical	Hrs
1	Research project work (literature review, experimental work, data analysis, synopsis writing, dissertation preparation)	120
Evaluation Pattern: 60:40		
Total Marks: 100		
Internal Continuous Evaluation: 40 Marks		End Semester Examination: 60 Marks
Attendance: 15 Marks		Project report: 30 Marks
Viva: 15 Marks		Presentation : 30 Marks
Spiral research paper: 10 Marks		



Karmaveer Bhaurao Patil University, Satara

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc.

Semester - VIII

Type : Major

Marks: 100

Credits : 4

From: A. Y. 2026-27

Name of the Course: BBTT 481 Advances in Genetics

Course Objectives: Students should be able to...

- 1) understand the basics of genetics.
- 2) learn principles of mendelian and microbial genetics.
- 3) know the concept of cytogenetics, human and population genetics.
- 4) study the effect of environment on genetics.

Course Outcomes: Students will be able to...

- 1) explain cell structure with respect to plant, animal and bacteria
- 2) determine different types of transport systems across the plasma membrane
- 3) discuss protein targeting and vesicular transport
- 4) describe and differentiate cancerous and noncancerous cells

Module	Title and Contents	Hrs
Module -1:	Mendelian Genetics and Extra Chromosomal Inheritance 1.1 Mendelian principles: Dominance, segregation, independent assortment. 1.2 Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests. 1.3 Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy. 1.4 Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.	15
Module -2:	Cytogenetics 2.1 Linkage and crossing over: Linkage – Definition, coupling and repulsion hypothesis, linkage groups. Crossing over- Mechanism and theory. 2.2 Gene mapping methods : Linkage maps, tetrad analysis, mapping with molecular markers. 2.3 Chromosomal Aberrations and Syndromes: Changes in chromosomal number: Euploidy, Aneuploidy. Changes in chromosomal structure: Translocation, inversion, deletion and duplication. 2.4 Autosomal and sex linked disorders. 2.5 Abnormal karyotype and its implications.	15
Module -3:	Human and Population Genetics 3.1 Pedigree Analysis in Humans: Symbols, construction of pedigree, molecular genetic data, significance of pedigrees. 3.2 Karyotyping: Classical karyotyping (banding techniques). Molecular karyotyping (FISH, M-FISH, SKY, QF-PCR and mBAND). Various karyotyping symbols used	15

	in human genetics. 3.3 Quantitative genetics: Human Population and gene pool concepts, modes of speciation, genotype and allele frequencies, variation. 3.4 Hardy Weinberg's Law, genetic equilibrium. inheritance, heritability and its measurements, QTL mapping.	
Module -4:	Microbial Genetics and Environment 4.1 Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction and sex-duction. 4.2 Recombination: Homologous and non- homologous recombination including transposition. 4.3 Environment and the Genome: (a) Imprinting and Epigenetics (b) Genetics of Cancer (Oncogenes and tumor suppressor genes) (c) Genetics of Ageing.	15
	Reference Books:- 1. Strickberger, Monroe W. <i>Genetics</i>. New Delhi: Prentice Hall of India, 2006. 2. Gardner, Eldon J., Michael J. Simmons, and D. Peter Snustad. <i>Principles of Genetics</i>. 8th ed. Hoboken, NJ: John Wiley & Sons, 2006. 3. Hartl, Daniel L., and Elizabeth W. Jones. <i>Genetics: Analysis of Genes and Genomes</i>. Sudbury, MA: Jones & Bartlett Publishers, 2004. 4. Pasternak, Jack J. <i>An Introduction to Human Molecular Genetics</i>. Fitzgerald Science Press, 2000. 5. Gersen, Steven L., and Martha B. Keagle, eds. <i>The Principles of Clinical Cytogenetics</i>. Totowa, NJ: Humana Press, 1999. 6. Strachan, Tom, and Andrew P. Read. <i>Human Molecular Genetics</i>. New York: Wiley, 1999. 7. Maloy, Stanley R., John E. Cronan Jr., and David Freifelder. <i>Microbial Genetics</i>. 2nd ed. Boston: Jones & Bartlett Publishers, 1994. 8. Stanier, Roger Y., John L. Ingraham, Mark L. Wheelis, and Page R. Gunasalus. <i>General Microbiology</i>. 5th ed. London: Macmillan Publications, 1992. 9. Gupta, P. K. <i>Genetics: A Textbook for University Students</i>. 2nd ed. Meerut: Rastogi Publications, 1990. 10. Sarin, C. <i>Genetics</i>. New Delhi: Tata McGraw-Hill Publications, 1985..	
Evaluation Pattern:60:40		
Total Marks: 100		
Internal Continuous Evaluation: 40 Marks CCE I- 20 Marks: Home Assignment CCE II -20 marks: Short and long answer questions Test/Seminar/Open Book Test/Quiz/Case study/Book Review/Field work/ Industry Visit CCE III -20 Marks: Compulsory MCQ test (Best of two CCE marks will be considered)		End Semester Examination: 60 Marks Question -1 12 Marks (Compulsory) (Six questions of 2 marks) Question -2 to Question 7- 12Marks each (Any 4 from Q 2 to Q 7)



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc.

Semester - VIII

Type : Major

Marks: 100

Credits : 4

From: A. Y. 2026-27

Name of the Course: BBTT 482 Advances in Immunology and Virology

Course Objectives: Students should be able to...

- 1) learn human immune system.
- 2) understand transplantation technology to cure diseases.
- 3) know experimental model organism for research.
- 4) understand properties of viruses.

Course Outcomes: Students will be able to...

- 1) discuss antigen antibody reactions.
- 2) describe techniques used in clinical transplantation.
- 3) identify autoimmunity and strategies for treating autoimmune diseases.
- 4) describe different types of viruses

Module	Title and Contents	Hrs
Module - 1:	Study of Immunological Principles 1.1 Fundamentals and anatomy of immune system, Immunity – Innate and acquired immunity. Components of innate and acquired immunity. 1.2 Antigen, Haptens, adjuvants, mitogens. Antibodies – structure, functions. Regulation of immune response – Humoral and Cell mediated response. Immunity to infection, Antigen processing and presentation, MHC, complement system. 1.3 Vaccines – Active and passive immunization, DNA vaccines, multivalent subunit vaccines, synthetic peptide vaccine.	15
Module - 2:	Advanced Immunology 2.1 Hypersensitivity: Type I, II, III, and IV reactions. 2.2 Autoimmunity – organ specific and systemic autoimmune diseases, Treatment of autoimmune diseases, molecular mimicry, autoimmune therapy 2.3 Monoclonal antibodies – Hybridoma technology and various cellular technologies. 2.4 Transplant immunology: Classification of Grafts, Immunological basis of acceptance of autografts and rejection of allograft, Acute, Hyper-acute and Chronic rejections of transplant, Xenotransplantation and its clinical future, GVHD and Immunosuppressive therapy 2.5 Animal Models: Nude mouse, SCID mouse, NOD mouse, Knock – out mouse etc.	15
Module - 3:	Introduction to viruses 3.1 General properties of viruses, Morphology and ultrastructure of Viruses Classification of viruses: ICTV system, Baltimore system	

	3.2 Replication of viruses: DNA (ds) -Poxvirus , RNA(ss+ve)- Poliovirus, RNA (ss -ve) – Influenza virus and RNA with RT- HIV 3.3 Viral Diagnosis: Microscopy, Cultivation, Serological and Molecular methods, Infectivity assays, immunodiagnostics 3.4 Antiviral : Mode of Action of various antiviral drugs with examples and Viral Vaccines	15
Module - 4:	Epidemiology 4.1 Principles and related terminologies, Current National and Global epidemiology of viral infections (with suitable examples) 4.2 Oncogenic virus and Cancer Immunology 4.3 Emerging viral diseases: Re-emerging and new emerging viral diseases with example. (H1N1, SARS, Nipah ,Ebola , H5N1, Dengue, West Nile Zika virus etc.) 4.4 Animal and Poultry viruses: Clinical symptoms with examples (FMD, Avian Influenza, etc.), Prevention. 4.5 Plant viruses: Mode of transmission & Prevention. Replication & Symptoms of TMV.	15
	Reference Books:- 1. Flint, S. Jane, Vincent R. Racaniello, Glenn F. Rall, and Anna Marie Skalka. <i>Principles of Virology</i>. 4th ed. Hoboken, NJ: Wiley, 2015. 2. Gangal, Shubhangi, and Shubhangi Sontakke. <i>Textbook of Basic and Clinical Immunology</i>. 1st ed. New Delhi: University Press, 2013. 3. Korsman, S. N. J., Gert Van Zyl, Wolfgang Preiser, Liza Nutt, and Marc I. Andersson. <i>Virology: An Illustrated Colour Text</i>. Edinburgh: Elsevier Health Sciences, 2012. 4. Owen, Judith A., Jenni Punt, and Sharon A. Stranford. <i>Kuby Immunology</i>. 7th ed. New York: W. H. Freeman and Company, 2012. 5. Reddy, S. M., R. Reddy, and S. M. Reddy. <i>Essentials of Virology</i>. Jaipur: Scientific Publishers, 2012. 6. Roitt, Ivan M., and Peter J. Delves. <i>Roitt's Essential Immunology</i>. 12th ed. Chichester: Wiley-Blackwell, 2011. 7. Khan, F. H. <i>The Elements of Immunology</i>. New Delhi: Pearson Education, 2009. 8. David, Malcolm, and Jonathan Brostoff. <i>Immunology</i>. 7th ed. Edinburgh: Mosby, 2006. 9. Fields, Bernard N., David M. Knipe, and Peter M. Howley, eds. <i>Fields Virology</i>. 5th ed. 2 vols. Philadelphia: Lippincott Williams & Wilkins, 2006. 10. Flint, S. Jane, Vincent R. Racaniello, Glenn F. Rall, and Anna Marie Skalka. <i>Principles of Virology</i>. 3rd ed. 2 vols. Washington, DC: American Society for Microbiology Press, 1999.	
Evaluation Pattern: 60:40		
Total Marks: 100		
Internal Continuous Evaluation: 40 Marks CCE I- 20 Marks: Home Assignment CCE II -20 marks: Short and long answer questions Test/Seminar/Open Book Test/Quiz/Case study/Book Review/Field work/ Industry Visit CCE III -20 Marks: Compulsory MCQ test (Best of two CCE marks will be considered)		End Semester Examination: 60 Marks Question -1 12 Marks (Compulsory) (Six questions of 2 marks) Question -2 to Question 7- 12Marks each (Any 4 from Q 2 to Q 7)



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc.

Semester - VIII

Type : Elective

Marks: 100

Credits : 4

From: A. Y. 2026-27

Name of the Course: BBT 483 Advances in Food Biotechnology

Course Objectives: Student should be able to...

- 1) become aware about different methods of food processing
- 2) get aware about different methods of food preservation techniques
- 3) understand different quality control aspects and.
- 4) learn the food standards and laws

Course Outcomes: Students will be able to...

- 1) discuss different methods of food processing and
- 2) discuss different various food preservation techniques.
- 3) determine different quality control aspects.
- 4) describe Food laws and legislations.

Module	Title and Contents	Hrs
Module - 1:	Food processing 1.1 Starter cultures and their biochemical activities; 1.2 Food and dairy products: Cheese, bread and yogurt. 1.3 Fermented vegetables – Saurkraut; Fermented Meat – Sausages	15
Module - 2:	Food preservation 2.1 Food preservation by heating: drying, osmotic dehydration, blanching, canning, pasteurization, sterilization, extrusion cooking 2.2 Non-thermal preservation: Hydrostatic pressure, hurdle technology, retort packaging technology, Food preservation by low-temp: Refrigeration, freezing and freeze-drying.	15
Module - 3:	Quality assurance in food sector 3.1 Microbiological quality standards of food, FDA, ISI 3.2 National – Introduction of BIS/IS, Food Safety and standards – Food Safety and standard regulation, FPO, MPO, MMPO, Agmark. 3.3 International – Concept of Codex Alimentarius, HACCP, GMP, GHP, ISO	15
Module - 4:	Food laws and legislations 4.1 Prevention of food adulteration Act- specification for food products, Nutritional labeling. 4.2 Food additives and legislation; coloring matter, preservatives, poisonous metals, antioxidants and emulsifying and stabilizing agents, insecticides and pesticides.	15

	Reference Books:- 1. Archer, David B. <i>Food Biotechnology</i>. Berlin: Springer, 2008. 2. Casida, Lester E. <i>Industrial Microbiology</i>. 1st ed. New Delhi: Wiley Eastern Ltd., 2005. 3. Singh, R. Paul, and Dennis R. Heldman. <i>Introduction to Food Processing</i>. Reston, VA: Prentice Hall, 2001. 4. Frazier, William C., and Dennis C. Westhoff. <i>Food Microbiology</i>. 5th ed. New York: McGraw-Hill, 2000. 5. Fellows, Peter, and Ellis H. <i>Food Processing and Nutrition</i>. London: Academic Press, 1990. 6. Lewis, Michael J. <i>Physical Properties of Food and Food Processing Systems</i>. Cambridge: Woodhead Publishing, 1990. 7. Potter, Norman N. "Food Dehydration and Concentration." In <i>Food Science</i>. Dordrecht: Springer, 1986. 8. Jelen, Peter. <i>Food Processing Technology: Principles and Practice</i>. New York: Elsevier Applied Science, 1985. 9. Arsdel, Wallace B. Van, Michael J. Copley, and Arthur I. Morgan. <i>Food Dehydration</i>. 2nd ed. 2 vols. Westport, CT: AVI Publishing Company, 1978. 10. Krammer, A., and B. A. Twigg. <i>Quality Control in Food Industry</i>. Vols. I–II. Westport, CT: AVI Publishing Company, 1973.	
Evaluation Pattern:60:40		
Total Marks: 100		
Internal Continuous Evaluation: 40 Marks CCE I- 20 Marks: Home Assignment CCE II -20 marks: Short and long answer questions Test/Seminar/Open Book Test/Quiz/Case study/Book Review/Field work/ Industry Visit CCE III -20 Marks: Compulsory MCQ test (Best of two CCE marks will be considered)	End Semester Examination: 60 Marks Question -1 12 Marks (Compulsory) (Six questions of 2 marks) Question -2 to Question 7- 12Marks each (Any 4 from Q 2 to Q 7)	

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Biotechnology	
	Programme: B.Sc.	Semester - VIII
	Type : Elective	Marks: 100
	Credits : 4	From: A. Y. 2026-27
	Name of the Course: BBTT 484 Animal Tissue Culture	
Course Objectives: Student should be able to... 1) know about organization of animal tissue culture laboratory 2) learn the basic concepts in animal tissue culture with understanding of different physicochemical requirements. 3) understanding different types of cell cultures. 4) know applications of animal tissue culture.		
Course Outcomes: Students will be able to... 1) apply basic knowledge of animal tissue culture. 2) determine laboratory organization and safety. 3) prepare various animal tissue culture media used for culturing in laboratory. 4) discuss various applications of Animal Tissue Culture.		
Module	Title and Contents	Hrs
Module - 1:	History and Introduction of Animal Cell culture: 1.1 Requirements of Animal cell culture- substrate for cell growth, Equipment's required for animal cell culture (Laminar air flow, CO2incubator, Centrifuge, Inverted microscope), 1.2 Sterilization of Glassware's, Equipment's& culture media - Glassware sterilization, reagent and media sterilization, sterility testing. 1.3 Culture media- Natural media, synthetic media (serum containing media, serum free media, balanced salt solution, media constituent, complete culture media, physicochemical properties of Media).	15
Module - 2:	Culturing and characterization of cells 2.1 Cultured cells- Biology and Characterization- Characteristics of cultured cells, cell adhesion, cell proliferation, cell differentiation. 2.2 Characterization of cultured cells- Morphology of cells, species of origin of cells, Identification of tissue of origin, transformed cells, Identification of specific cell lines. 2.3 Measurement of growth parameters of cultured cells- Growth cycle of cultured cells, plating efficiency of cultured cells. 2.4 Cell synchronization- Cell separation by physical means, cell separation by chemical blockade	15
Module - 3:	Cell culture and scale up 3.1Basic technique of mammalian cell culture- Isolation of tissue, disaggregation of tissue, measurement of viability, primary cell culture, Cell lines, Maintenance of cell culture, Subculture.	15

	3.2 Scale up of Animal cell culture-Scale up in suspension-stirrer culture, continuous flow culture, Airlift fermenter culture Scale up in monolayer- Roller bottle culture, multi surface culture, multiarray disks, and tubes, Micro carrier culture, Immobilized cell culture	
Module - 4:	Applications of Animal Cell culture 4.1 Organ and Histotypic culture-Types and maintenance of organ culture, Histotypic culture, Stem cell cultures. 4.2 Cell storage and distribution: a. Cryopreservation b. Cell repositories. 4.3 Applications of cell culture-In transplantation, and tissue engineering, monoclonal antibodies production, ethics and morality.	15
	Reference Books:- 1. Carter, M., and J. Hunt. <i>Animal Cell Culture</i> . Ed Tech Press, 2020. 2. Aruni, A. W., and P. Ramadass. <i>Animal Tissue Culture</i> . Chennai: MJP Publisher, 2019. 3. Freshney, R. Ian. <i>Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications</i> . 7th ed. Hoboken, NJ: Wiley-Blackwell, 2015. 4. Babiuk, Lorne A., J. P. Phillips, et al. <i>Animal Biotechnology: Comprehensive Biotechnology, First Supplement</i> . Oxford: Pergamon, 2013. 5. Gangal, Sudha. <i>Principles and Practice of Animal Tissue Culture</i> . 2nd ed. New Delhi: University Press, 2007. 6. Ranga, M. M. <i>Animal Biotechnology</i> . New Delhi: University Press, 2007. 7. Masters, John R. W. <i>Animal Cell Culture: A Practical Approach</i> . 3rd ed. Oxford: Oxford University Press, 2000. 8. Masters, R. W. <i>Animal Cell Culture</i> . 3rd ed. Oxford: Oxford University Press, 2000. 9. Clynes, Martin. <i>Animal Cell Culture Techniques</i> . 2nd ed. Berlin: Springer, 1998. 10. Baserga, Renato. <i>Cell Growth and Division: A Practical Approach</i> . The Practical Approach Series, vol. 47. Oxford: Oxford University Press, 1989.	
Evaluation Pattern:60:40		
Total Marks: 100		
Internal Continuous Evaluation: 40 Marks CCE I- 20 Marks: Home Assignment CCE II -20 marks: Short and long answer questions Test/Seminar/Open Book Test/Quiz/Case study/Book Review/Field work/ Industry Visit CCE III -20 Marks: Compulsory MCQ test (Best of two CCE marks will be considered)		End Semester Examination: 60 Marks Question -1 12 Marks (Compulsory) (Six questions of 2 marks) Question -2 to Question 7- 12Marks each (Any 4 from Q 2 to Q 7)



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc.

Semester - VIII

Type : Major

Marks: 50

Credits : 2

From: A. Y. 2026-27

Name of the Course: BBTP 485 Practical based on BBTT 481 and BBTT 482

Course Objectives: Student should be able to...

- 1) understand the mendelian genetics & problems based on linkage and crossing over
- 2) study the gene transfer method conjugation
- 3) understand immuno electrophoresis, immuno diffusion techniques; rocket immuno electrophoresis
- 4) know ELISA, Western blotting

Course Outcomes: Students will be able to..

- 1) solve problems on mendelian genetics & problems based on linkage and crossing over
- 2) perform various immunological techniques
- 3) perform cultivation and biochemical analysis methods of *spirulina spp.* & *chlorella spp.*
- 4) analyse DNA by using Molecular marker-Random Amplification Polymorphic DNA

Sr. No.	Name of the Practical	Hrs
1.	Problems based on Mendelian genetics- Monohybrid cross, dihybrid cross,	60
2.	Problems based on Mendelian genetics- Test cross	
3.	Problems based on linkage and crossing over	
4.	Problem based on pedigree	
5.	Problem based gene frequency	
6.	Problem based genotypic frequency	
7.	Analysis of Karyotype of <i>Alliumcepa</i>	
8.	Conjugation	
9.	Dot ELISA	
10.	Widal Test	
11.	Immunodiffusion	
12.	Immuno-electrophoresis	
13.	Rocket immune-electrophoresis	
14.	Western blotting	
15.	Study of routes of virus inoculation in embryonated eggs	

Reference Books:-

1. Kuby, Janis, Owen Punt, Sharon Stranford, and Patricia Jones. *Kuby Immunology*. 8th ed. New York: W. H. Freeman, 2019.
2. Punia, M. S. *Plant Biotechnology and Molecular Biology: A Laboratory Manual*. Jodhpur: Scientific Publishers, 2018.
3. Jabin, P. C., and Pavan J. Kundur. *Laboratory Manual of Biotechnology*. Hubballi: Kalyan Literary Publishers, 2017.
4. Nigam, Arti, and Archana Ayyagari. *Lab Manual in Biochemistry, Immunology and Biotechnology*. New Delhi: McGraw-Hill Professional, 2011.
5. Pelczar, Michael J., E. C. S. Chan, and Noel R. Krieg. *Microbiology*. 5th ed. New Delhi: Tata McGraw-Hill, 2010.
6. Swamy, P. M. *Laboratory Manual on Biotechnology*. New Delhi: Tata McGraw-Hill, 2008.

7. Strickberger, Monroe W. *Genetics*. New Delhi: Prentice Hall of India, 2006.
8. Gardner, Eldon J., Michael J. Simmons, and D. Peter Snustad. *Principles of Genetics*. 8th ed. Hoboken, NJ: John Wiley & Sons, 2006.
9. Hartl, Daniel L., and Elizabeth W. Jones. *Genetics: Analysis of Genes and Genomes*. Sudbury, MA: Jones & Bartlett Publishers, 2004.
10. Gupta, P. K. *Genetics: A Textbook for University Students*. 2nd ed. Meerut: Rastogi Publications, 1990.

Evaluation Pattern: 60:40

Total Marks: 50

Internal Continuous Evaluation: 20 Marks

Student Performance & Attendance: 10 Marks
Journal & Viva: 10 Marks

End Semester Examination: 30 Marks

Question -1 : 10 Marks
Question -2 : 10 Marks
Question -3 : 10 Marks

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Biotechnology	
	Programme: <u>B.Sc.</u> IV	Semester - VIII
	Type : RP	Marks: 200
	Credits : 8	From: A. Y. 2026-27
	Name of the Course: BBTT 486 Research Project in Biotechnology II	
Course Objectives: Student should be able to... 1) design and execute an independent research project within their discipline under supervision. 2) select and apply appropriate qualitative, quantitative, or mixed research methods relevant to their research problem. 3) critically evaluate research findings in the context of existing literature and theoretical frameworks. 4) prepare a well-structured research thesis/report following academic standards and referencing styles.		
Course Outcomes: Student should be able to... 1) identify, define, and justify a research problem based on gaps in existing literature. 2) develop a comprehensive research plan including objectives, hypotheses (if applicable), methodology, tools, and ethical considerations. 3) systematically collect, organize, and manage qualitative or quantitative data using appropriate tools and techniques. 4) critically compare results with existing studies and draw logical, evidence-based conclusions.		
Sr. No	Title of contents	Hrs
1	Research project work (literature review, experimental work, data analysis, synopsis writing, dissertation preparation)	240
Evaluation Pattern: 60:40		
Total Marks: 200		
Internal Continuous Evaluation: 80 Marks Attendance: 30 Marks Viva: 30 Marks Spiral Research paper: 20 Marks		End Semester Examination: 120 Marks Project report: 60 marks Presentation : 60 Marks