



॥ तमसो मा ज्योतिर्गमय ॥

VISION

To provide equal opportunities for value based global education for creating an Enlightened Society

MISSION

To establish and facilitate educational institutions in the region for providing affordable value based global education to all who aspire to study and to create opportunities to educators, social workers and philanthropists to serve society



**SARVAJANIK
UNIVERSITY**

INCLUSIVE | INTEGRATED | INNOVATIVE

creating an enlightened society...

UNIVERSITY OFFICE

Dr. R. K. Desai Marg, Athwalines,
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CURRICULUM FOR

**“BACHELOR OF
SCIENCE (HONS)” /
“BACHELOR OF
SCIENCE (HONS
WITH RESEARCH)”**

B.Sc. (Hons) (Biotechnology)

**B.Sc. (Hons with Research)
(Biotechnology)**

SEM – 7

SEM – 8

w.e.f. Academic Year 2026-27

Constituent Institute:

**Shree Ramkrishna Institute of
Computer Education and Applied
Sciences (SRKI)**



Course Curriculum

BACHELOR OF SCIENCE (Hons) / BACHELOR OF SCIENCE (Hons with Research) (BIOTECHNOLOGY) Sem-7 and 8

The Course Curriculum of Bachelor of Science (Biotechnology) was proposed and drafted by **Academic and Curriculum Committee of Biotechnology** under the Faculty of Science in the meeting held on **24-06-2026** and recommended to '**BOARD OF STUDIES**' for approval.

Dr. Jay Bergi
**Chairman, Academic
& Curriculum Committee
Science**

Place of the meeting
Sarvajani University Office


Sign

The proposed Course Curriculum was approved by **Board of Studies; Science** under the Faculty of Science in the meeting held on **21-08-2026** and was recommended to the '**FACULTY**' for approval.

Dr. Jay Bergi
**Chairman,
Board of Studies- Science**

Place of the meeting
Sarvajani University Office


Sign

The Course Curriculum approved by the **Faculty of Science** in the meeting held on **21-08-2026** and was recommended to '**ACADEMIC COUNCIL**' for approval.

Dr. Jay Bergi
**Chairman & Dean,
Faculty of Science**

Place of the meeting
Sarvajani University Office


Sign

The Course Curriculum approved by the '**Academic Council of Sarvajani University**' in the meeting held on **16-09-2026**.

Mr. Ashish Desai
**Member Secretary,
Academic Council
& I/c. Registrar,
Sarvajani University**

Place of the meeting
Sarvajani University Office


Sign

- *The approved curriculum of Bachelor of Science (Hons) / Bachelor of Science (Hons with Research) (Biotechnology) Sem-7 and 8 is with effect from the Academic year 2026-27*



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DETAILED CURRICULUM
(W.E.F. 2026-27)



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Credit Framework for Four Years Undergraduate Program (As per KCG SOP)
 Faculty of Science, Sarvajani University

Semester	Major						Minor		Skill Enhancement		Ability Enhancement		Multidiscipline		Value Added		Total Credits
	Major No. of Papers	Theory		Lab		Total Major Credits	No. of Papers	Credits	No. of Papers	Credits	No. of Papers	Credits	No. of Papers	Credits	No. of Papers	Credits	
		Theory Hours	Theory Credits	Lab Hrs	Lab Credits												
1	2	3+3	3+3	2+2	1+1	8	1	4	1	2	1	2	1	4	1	2	22
2	2	3+3	3+3	2+2	1+1	8	1	4	1	2	1	2	1	4	1	2	22
3	3	3+3+3	3+3+3	2+2+2	1+1+1	12	0	0	1	2	1	2	1	4	1	2	22
4	3	3+3+3	3+3+3	2+2+2	1+1+1	12	1	4	1	2	1	2	1		1	2	22
5	3	3+3+3	3+3+3	2+2+2	1+1+1	12	2	8	1	2							22
6	3	3+3+3	3+3+3	2+2+2	1+1+1	12	1	4	Internship	4	1	2					22
Total after 3y	16					64	6	24	5+1	10+4	5	10	3	12	4	8	132
7 (Honors)	4	3+3+3+3	3+3+3+3	2+2+2+2	1+1+1+1	16	1	4	1	2							22
8 (Honors)	4	3+3+3+3	3+3+3+3	2+2+2+2	1+1+1+1	16	1	4	1	2							22
7 (Research)	3	3+3+3	3+3+3	2+2+2	1+1+1	12	1	4	RP	6							22
8 (Research)	3	3+3+3	3+3+3	2+2+2	1+1+1	12	1	4	RP	6							22
Total after 4y	24/22					96/88	8	32	7+1	18/26	5	10	3	12	4	8	176



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Teaching Scheme for B.Sc. (Hons) / B.Sc. (Hons with Research) Semester – I to VIII						
Semester	Course Category	Credits	Theory (Hrs/Week)	Theory (Total)	Laboratory (Hrs/Week)	Laboratory (Total)
B.Sc. (Hons) / B.Sc. (Hons with Research)						
I	Major	4	3	45	2	30
	Major	4	3	45	2	30
	Minor	4	3	45	2	30
	Skill Enhancement Courses	2	2	30	0	0
	Ability Enhancement Courses	2	2	30	0	0
	Value Added Courses	2	2	30	0	0
	Multidisciplinary	4	4	60	0	0
	Total	22	19	285	6	90
II	Major	4	3	45	2	30
	Major	4	3	45	2	30
	Minor	4	3	45	2	30
	Skill Enhancement Courses	2	2	30	0	0
	Ability Enhancement Courses	2	2	30	0	0
	Value Added Courses	2	2	30	0	0
	Multidisciplinary	4	4	60	0	0
	Total	22	19	285	6	90
III	Major	4	3	45	2	30
	Major	4	3	45	2	30
	Major	4	3	45	2	30
	Skill Enhancement Courses	2	2	30	0	0
	Ability Enhancement Courses	2	2	30	0	0
	Value Added Courses	2	2	30	0	0
	Multidisciplinary	4	4	60	0	0
	Total	22	19	285	6	90
IV	Major	4	3	45	2	30
	Major	4	3	45	2	30
	Major	4	3	45	2	30
	Minor	4	3	45	2	30
	Skill Enhancement Courses	2	2	30	0	0
	Ability Enhancement Courses	2	2	30	0	0
	Value Added Courses	2	2	30	0	0
	Total	22	18	270	8	120



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Teaching Scheme for B.Sc. (Hons) Semester – I to VIII						
Semester	Course Category	Credits	Theory (Hrs/Week)	Theory (Total)	Laboratory (Hrs/Week)	Laboratory (Total)
B.Sc. (Hons) / B.Sc. (Hons with Research)						
V	Major	4	3	45	2	30
	Major	4	3	45	2	30
	Major	4	3	45	2	30
	Minor	4	3	45	2	30
	Minor	4	3	45	2	30
	Skill Enhancement Courses	2	2	30	0	0
	Total	22	17	255	10	150
VI	Major	4	3	45	2	30
	Major	4	3	45	2	30
	Major	4	3	45	2	30
	Minor	4	3	45	2	30
	Skill Enhancement Courses	4	-	-	12	180
	Ability Enhancement Courses	2	2	30	0	0
	Total	22	14	210	20	300
VII	Major	4	3	45	2	30
	Major	4	3	45	2	30
	Major	4	3	45	2	30
	Minor	4	3	45	2	30
	Skill Enhancement Courses	2	2	30	0	0
	Total	18	14	210	8	120
VIII	Major	4	3	45	2	30
	Major	4	3	45	2	30
	Major	4	3	45	2	30
	Minor	4	3	45	2	30
	Skill Enhancement Courses	2	2	30	0	0
	Total	18	14	210	8	120
Semester	Course Category	Credits	Theory (Hrs/Week)	Theory (Total)	Laboratory (Hrs/Week)	Laboratory (Total)
B.Sc. (Hons with Research)						
VII	Research Project	6	2	30	8	120
VIII	Research Project	6	2	30	8	120



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Evaluation Scheme for B.Sc. (Hons) Semester I to VIII							
Semester	Course Category	Continuous and Comprehensive Evaluation (CCE)			Total CCE	Semester End Examination (SEE)	Grand Total
		CCE	Assignment	Attendance			
B.Sc. (Hons) / B.Sc. (Hons with Research)							
I	Major	30	10	10	50	50	100
	Major	30	10	10	50	50	100
	Minor	30	10	10	50	50	100
	Skill Enhancement Courses	15	5	5	25	25	50
	Ability Enhancement Courses	15	5	5	25	25	50
	Value Added Courses	15	5	5	25	25	50
	Multidisciplinary	30	10	10	50	50	100
II	Major	30	10	10	50	50	100
	Major	30	10	10	50	50	100
	Minor	30	10	10	50	50	100
	Skill Enhancement Courses	15	5	5	25	25	50
	Ability Enhancement Courses	15	5	5	25	25	50
	Value Added Courses	15	5	5	25	25	50
III	Major	30	10	10	50	50	100
	Major	30	10	10	50	50	100
	Major	30	10	10	50	50	100
	Skill Enhancement Courses	15	5	5	25	25	50
	Ability Enhancement Courses	15	5	5	25	25	50
	Value Added Courses	15	5	5	25	25	50
	Multidisciplinary	30	10	10	50	50	100
IV	Major	30	10	10	50	50	100
	Major	30	10	10	50	50	100
	Major	30	10	10	50	50	100
	Minor	30	10	10	50	50	100
	Skill Enhancement Courses	15	5	5	25	25	50
	Ability Enhancement Courses	15	5	5	25	25	50
	Value Added Courses	15	5	5	25	25	50



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Evaluation Scheme for B.Sc. (Hons) Semester I to VIII							
Semester	Course Category	Continuous and Comprehensive Evaluation (CCE)			Total CCE	Semester End Examination (SEE)	Grand Total
		CCE	Assignment	Attendance			
B.Sc. (Hons) / B.Sc. (Hons with Research)							
V	Major	30	10	10	50	50	100
	Major	30	10	10	50	50	100
	Major	30	10	10	50	50	100
	Minor	30	10	10	50	50	100
	Minor	30	10	10	50	50	100
	Skill Enhancement Courses	15	5	5	25	25	50
VI	Major	30	10	10	50	50	100
	Major	30	10	10	50	50	100
	Major	30	10	10	50	50	100
	Minor	30	10	10	50	50	100
	Skill Enhancement Courses	-	-	-	50	50	100
	Ability Enhancement Courses	15	5	5	25	25	50
VII	Major	30	10	10	50	50	100
	Major	30	10	10	50	50	100
	Major	30	10	10	50	50	100
	Minor	30	10	10	50	50	100
	Skill Enhancement Courses	15	5	5	25	25	50
VIII	Major	30	10	10	50	50	100
	Major	30	10	10	50	50	100
	Major	30	10	10	50	50	100
	Minor	30	10	10	50	50	100
	Skill Enhancement Courses	15	5	5	25	25	50
Semester	Course Category	Continuous and Comprehensive Evaluation (CCE)			Total CCE	Semester End Examination (SEE)	Grand Total
		CCE	Assignment	Attendance			
B.Sc. (Hons with Research)							
VII	Research Project	30	10	10	50	50	100
VIII	Research Project	30	10	10	50	50	100



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SEM - 7

DETAILED CURRICULUM
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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons.) / (Hons. with Research) Biotechnology		
Course Type	Major		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSBT11701	Course Name	Genomics, Proteomics and Other Omics (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
3	3 hrs	0	0	40	35	75

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons.) / (Hons. with Research) Biotechnology		
Course Type	Major		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSBT11702	Course Name	Genomics, Proteomics and Other Omics (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
1	0	0	2 hrs	10	15	25



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Name of faculty: Science	Department: Biotechnology
Program: B.Sc. Honours / Honors with Research	Type: Theory
Subject: Genomics, Proteomics and Other Omics	Semester-7
Credit: 04	Total learning hours: 45 hrs
Course description: This course provides a comprehensive understanding of genomics and related omics technologies, including genome organization, sequencing methods, functional genomics, comparative genomics, proteomics, metabolomics, and protein interaction studies. It enables students to understand the principles and applications of modern DNA sequencing technologies and gene annotation approaches. The course also develops knowledge of gene expression analysis, protein function, metabolic profiling, and evolutionary relationships among organisms. Students are trained to apply and analyze omics data for understanding biological systems and solving research problems. Overall, it equips learners with theoretical knowledge and analytical skills required for careers in biotechnology, biomedical research, and bioinformatics-driven industries.	
Student learning outcome: 1. Explain key concepts of genomics, genome organization, and omics technologies. 2. Compare DNA sequencing technologies and genome analysis methods. 3. Apply omics tools for gene expression and functional studies. 4. Analyze genomic and proteomic data for biological interpretation. 5. Evaluate applications and limitations of omics technologies. 6. Design basic experimental approaches using omics tools.	

UNIT I: Introduction to Genomics and Structural genomics (07 hrs)

- 1.1 Definition and scope of genomics
- 1.2 Organization of prokaryotic and eukaryotic genomes, coding and non-coding DNA, repetitive DNA sequences
- 1.3 Genome size and complexity (C-value paradox)
- 1.4 Structural genomics: genome mapping, sequencing, assembly and annotation

Unit II DNA Sequencing technologies and Application (08 hrs)

- 2.1 First-generation sequencing: Sanger sequencing, Maxam-Gilbert sequencing
- 2.2 Second-generation sequencing (NGS): Roche 454 sequencing, Illumina sequencing
- 2.3 Third-generation sequencing technologies: Ion torrent, Nanopore sequencing
- 2.4 Assembly of Genomic Information. Prediction of Genes: Extrinsic and Intrinsic method

UNIT III: Functional Genomics (07 hrs)

- 3.1 Introduction and principles of Functional Genomics
- 3.2 Gene expression analysis: DNA microarrays and transcriptome analysis
- 3.3 Epigenetic regulation: DNA methylation, histone modifications and epigenetic control of gene expression
- 3.4 Forward versus Reverse genetics, Gene function analysis using gene knockout, RNAi, and mutagenesis



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UNIT IV: Comparative Genomics

(08 hrs)

- 4.1 Introduction to Comparative Genomics, genome comparison, orthologs and paralogs, evolutionary relationships.
- 4.2 Comparative genomics of bacteria
- 4.3 Comparative genomics of Eukaryotes
- 4.4 Applications of Comparative Genomics

UNIT V: Proteomics and Metabolomics

(08 hrs)

- 5.1 Introduction to proteomics and proteome complexity
- 5.2 Structural and functional proteomics
- 5.3 Protein separation techniques: two-dimensional gel electrophoresis
- 5.4 Protein identification and analysis: mass spectrometry and protein microarrays
- 5.5 Introduction to metabolomics and metabolic profiling

Unit VI: Protein Interaction and Omics Applications

(07 hrs)

- 6.1 Yeast two-hybrid system, phage display, immunoprecipitation
- 6.2 Protein Engineering and Applications
- 6.3 Recombinant proteins and therapeutic proteins
- 6.4 Applications and future prospects of omics technologies

References

1. Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th ed, Blackwell, 2006 6. ISBN 978-1405135443
2. Danial C. Liebler, Introduction to proteomics-Tools for new biology, Humana press, <https://doi.org/10.1007/978-1-59259-130-5>
3. Wilson & Walker's, Principles and Techniques of Biochemistry and Molecular Biology, Eighth Edition, ISBN 978-1-108-71698-7
4. Peter J. Russell, Reed College, iGenetics: A Molecular Approach, 3rd Edition, Pearson Publishers, ISBN 9780321569769
5. Jolls. O and Jornvali H (eds) 2000: Proteomics in functional genomics, Birkhauser verilog, Basel, Switzerland. ISBN 978-3034884587
6. Pennington, S. and Dunn M. Proteomics from protein sequence to function. New Delhi: Viva Books Private Limited; 2002. ISBN 978-8176492904

PRACTICALS

Practical 1: Isolation and quantification of genomic DNA.

Practical 2: PCR and agarose gel electrophoresis.

Practical 3: Restriction digestion and agarose gel electrophoresis.

Practical 4: Protein estimation and SDS-PAGE analysis.

Practical 5: GMO detection and screening using qPCR

Explanation of sequencing technique using chromatogram interpretation.



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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons.) / (Hons. with Research) Biotechnology		
Course Type	Major		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSBT11703	Course Name	Principles of Bioprocess Technology (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
3	3 hrs	0	0	40	35	75

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons.) / (Hons. with Research) Biotechnology		
Course Type	Major		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSBT11704	Course Name	Principles of Bioprocess Technology (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
1	0	0	2 hrs	10	15	25



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Name of Faculty: Science	Department: Biotechnology
Program: B.Sc. Biotechnology (Hons.) / (Hons. with Research)	Type: Major
Subject: Principle of Bioprocess Technology	Semester: B.Sc. Sem-7
Credit: 03+01	Total learning hours: 45 (Th)+ 30 (Pr)
Course description: This course introduces the fundamentals of industrial bioprocessing from upstream to downstream operations, focusing on application-oriented engineering principles in biological systems. It emphasizes process monitoring, control, validation, and modern trends such as PAT, QbD, and Industry 4.0 to prepare students for real-world biopharmaceutical applications.	
Student Learning Outcome: 1. Explain industrial bioprocess workflows and unit operations. 2. Analyze factors affecting fermentation and product yield. 3. Apply principles of mass and heat transfer in bioprocess systems. 4. Interpret process control strategies and instrumentation data. 5. Understand downstream processing techniques and cost implications. 6. Evaluate validation, regulatory, and quality requirements in biopharma industries.	

UNIT 1: Fundamentals of Bioprocess and Sterilization

(7 hrs)

1.1 Historical Development of Bioprocess Technology, Interdisciplinary Approach to Bioprocessing. Outlines of Integrated Bioprocess, Unit Operations in Bioprocess

1.2 Sterilization of Process Equipments: Equipment Sterilization: Vessel, Air filters, Medium Filters, Valve and Pippings, Elimination of Condensate

1.3 Monitoring and validation of sterilization, Batch Sterilization, Continuous Sterilization, degradation of Heat labile components

1.4 Trouble shooting/ Problem Solving, Sterility Audit, Automation

UNIT 2: Mass Transfer in Bioprocess Systems

(8 hrs)

2.1 Mass Transfer by Diffusion

2.2 Theories of Diffusional Mass Transfer: Penetration Theory, Surface Renewal Theory

2.3 Mass Transfer by Convection: Gas-Liquid Mass Transfer, Measurement of kLa



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2.4 Oxygen Transfer Methodology in Fermenters: Specific Oxygen Uptake Rate, Critical Oxygen Concentration

2.5 Factor affecting Oxygen Transfer Rate: Bubble Size, Gas Hold-up, Gas Velocity, Types of Gas Sparger, Types of Agitator, Power Input to Agitators, Temperature, Pressure, Antifoaming Agents, Cells, Surface Active Solutes

UNIT 3: Heat Transfer in Bioprocesses

(8 hrs)

3.1 Importance of Heat Transfer in Biological Reactors

3.2 Heat transfer mechanisms: Conduction, convection, Heat Transfer by Radiation

3.3 Heat Transfer Equipments: Process Equipment for Heat Transfer, Double Pipe Heat Exchanger, Shell and Tube Heat Exchanger, Condenser

3.4 Case study: Cooling failure in industrial fermenter

UNIT 4: Instrumentation and Control of Bioprocess

(7 hrs)

4.1 Fundamentals of process control: Basic Control System

4.2 Control Loops: Open, Close and Additional Forms of Control

4.3 Measurement Elements: Temperature, Pressure, Level, Flow, pH, DO, CO₂, NADH, Cell Density, Viscosity

4.4 Analytical Instrumentation: Microprocessor Based Control System. SCADA systems and real-time monitoring, PAT tools and data integrity (ALCOA+)

UNIT 5: Cleaning of Process Equipment: Design and Practice

(8 hrs)

5.1 Hygienic Plant Design, Cleaning Reagents, Cleaning Methods, CIP

5.2 Pharmaceutical Water: Grade Water, Dead legs, Slope

5.3 Pharmaceutical Water Treatment System: Treatment Equipment. Softeners, Deionizer

5.4 Plant Steam Systems, Clean Steam Systems, Chilled Water Systems. Cooling Towers



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UNIT 6: Validation and Bioprocess Economics

(7 hrs)

6.1 Validation: Team, Time line, Criteria, Protocols

6.2 Installation Qualification, Operation Qualification, Performance Qualification

6.3 Plant Design and Economics, Cost of Production, Break-Even Analysis

6.4 Project Economics, Depreciation, Case Study: Project Economics for Citric Acid Manufacturer

Practicals:

1. Determination of Oxygen Transfer Rate (OTR) in a model system.
2. Determination of Thermal Death Point (TDP) and Thermal Death Time (TDT).
3. Calibration and performance analysis of bioprocess sensors (pH/DO).
4. Study of microbial growth kinetics in batch culture.
5. Study of the components and function of laboratory scale Bioreactor.

References:

1. Bailey, J. E. & Ollis, D. F. *Biochemical Engineering Fundamentals* (2nd ed.). McGraw-Hill.
2. Bhatia, S. C.. *Biochemical Engineering*. Lotus Press.
3. Lydersen, B. K., D'Elia, N. A., & Nelson, K. L. (Eds.). *Bioprocess Engineering: Systems, Equipment and Facilities*. John Wiley & Sons.
4. Rao, D. G. *Introduction to Biochemical Engineering*. Tata McGraw-Hill.
5. Shuler, M. L. & Kargi, F. *Bioprocess Engineering: Basic Concepts* (3rd ed.). Prentice Hall.



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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons.) / (Hons. with Research) Biotechnology		
Course Type	Major		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSBT11705	Course Name	IVF, ART and Stem Cells (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
3	3 hrs	0	0	40	35	75

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons.) / (Hons. with Research) Biotechnology		
Course Type	Major		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSBT11706	Course Name	IVF, ART and Stem Cells (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
1	0	0	2 hrs	10	15	25



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Name of faculty: Science	Department: Biotechnology
Program: B.Sc. Biotechnology (Hons)	Type: Theory + Practical
Subject: IVF, ART and Stem Cells	Semester: 7
Credits: 03 + 01	Total learning hours: 45
Course Description: The course is designed to introduce students to the set up of the Assisted Reproductive Technology Centers, the basic requirements for establishing the center, the documentation and management systems for smooth functioning at the center. The course also deals with the basic techniques for handling gametes. This course will make students aware & scientifically informed about fundamental concepts of Stem cell biology till molecular levels. It will provide adequate knowledge about recent strategies & applications in the field of treatment of cancers & about stem cell therapies.	
Student Learning Outcome: Students will: 1. Define ART, IVF and Stem cells technology. 2. Understand the need and criteria for the ART-IVF center set up. 3. Apply knowledge of handling and aseptic technique for embryo culture, sperm processing, cryopreservation and other relevant techniques related to IVF. 4. Evaluate the need and applications of IVF and stem cells. 5. Analyze the challenges and complications in IVF. 6. Compare conventional and recent trends in IVF and Stem Cells.	

Unit 1: Introduction to Assisted Reproductive Technologies (ART)

(05 Hours)

- 1.1 Significance and Historical Background of Art and IVF
- 1.2 Reproductive Biology and Human Fertility
- 1.3 Causes and Types of Infertility
- 1.4 Overview of Assisted Reproductive Technologies
- 1.5 Fertility Assessment and Patient Evaluation

Unit-2 Emerging ART Techniques and Fertility Preservation

(06 Hours)

- 2.1 Artificial Insemination and Intrauterine Insemination (IUI)
- 2.2 Fertility Preservation Techniques
- 2.3 Donor Programs in Assisted Reproduction
- 2.4 Cryopreservation of Gametes, Embryos and Reproductive Tissues
- 2.5 Genetic Screening and Reproductive Decision-Making

Unit-3 Fundamentals of In Vitro Fertilization (IVF)

(08 Hours)

- 3.1 IVF Laboratory Infrastructure and Equipment
- 3.2 Media and Reagents for IVF Laboratories
- 3.3 Ovarian Stimulation and Oocyte Retrieval



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- 3.4 Sperm Preparation and Fertilization Techniques
- 3.5 Embryo Culture and Development
- 3.6 Embryo Transfer and Treatment Outcomes

Unit-4 Advanced IVF Practices and Clinical Applications (08 Hours)

- 4.1 Intracytoplasmic Sperm Injection (ICSI)
- 4.2 Blastocyst Culture and Embryo Selection
- 4.3 Quality Control and Quality Assurance in IVF Laboratories
- 4.4 Challenges and Complications in IVF
- 4.5 Assisted Reproductive Technology Act, 2021 with ART Rules, 2022

Unit-5 Introduction to Stem Cells (10 Hours)

- 5.1 Stem Cells: Definition, Properties
- 5.2 Stem Cells Niches
- 5.3 Signal Transduction in Stem Cells
- 5.4 Model Organisms in Stem Cell Research (*Arabidopsis Thaliana*, *Platyhelminthes*, Zebrafish, Deer Antler Stem Cells)

Unit-6 Culture of Stem Cells (08 Hours)

- 6.1 Embryonic Stem Cells and Extraembryonic Stem Cells
- 6.2 Derivation and Culture of Embryonic Stem Cells (mESC And hESC)
- 6.3 Culture of Amniocytes
- 6.4 Induced Pluripotent Stem Cells
- 6.5 Applications of Stem Cells

Practicals:

1. Demonstration of Stem cell Expansion.
2. Visit to IVF Center/ Stem Cell Bank
3. Demonstration of Sperm Preparation
4. Case study/ Review Article on ART/Stem Cell.

References:

1. Textbook Of Assisted Reproductive Techniques Volume 1: Lab Perspectives By David Gardner, Ariel Weissman, Colin M Howles, Zeev Shoham, CRC Press, 5th Edition ISBN: 9781498740098
2. Textbook Of Assisted Reproductive Techniques Volume 2: Clinical Perspectives by David Gardner, Ariel Weissman, Colin M Howles, Zeev Shoham, CRC Press, 5th Edition ISBN:978-1498740180
3. Talwar, Lt Pankaj. Step by Step: Protocols in Clinical Embryology and ART. JP Medical Ltd, 2012. ISBN: 9789350257654
4. IVF Techniques For the Beginners – Kuldeep Jain & Pankal Talwar, Jaypee Brothers Medical Pub.ISBN: 978-9350903599
5. A Practical Guide To Setting Up An Ivf Lab, Embryo Culture Systems & Running The Unit – Alex C Varghese, Peter Sjoblom & K Jayaprakasan, Jaypee brothers' medical Pub ISBN:9789350905166
6. Calegari, F., & Waskow, C. (Eds.). (2014). *Stem Cells: From Basic Research to Therapy. Volume 1: Basic Stem Cell Biology. Tissue Formation during Development, and Model Organisms*. CRC Press. ISBN 978-1-4822-0776-7
7. Calegari, F., & Waskow, C. (Eds.). (2014). *Stem Cells: From Basic Research to Therapy. Volume Two: Tissue Homeostasis and Regeneration during Adulthood, Applications, Legislation and Ethics* (Vol. 1144). CRC Press. ISBN: 978-1-4822-1984-5
8. Lanza, R., Gearhart, J., Hogan, B., Melton, D., Pedersen, R., Thomas, E. D., & Thomson, J. A. (Eds.). (2005). *Essentials of stem cell biology*. Elsevier. ISBN: 978-0-12-374729-7



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9. Sell, S. (Ed.). (2004). *Stem cells handbook* (Vol. 1). Totowa, NJ: Humana Press. E-ISBN 1-59259-411-5

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Faculty	Science		Program	B.Sc. (Hons.) Biotechnology		
Course Type	Major		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSBT11707	Course Name	Dairy and Food Technology (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
3	3 hrs	0	0	40	35	75

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons.) Biotechnology		
Course Type	Major		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSBT11708	Course Name	Dairy and Food Technology (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
1	0	0	2 hrs	10	15	25



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Dairy and Food Technology

Unit 1: Introduction to food microbiology and food spoilage (08 hours)

- 1.1 Food as a substrate for microorganisms
- 1.2 Contamination and Spoilage of food:
 - 1.2.1 Bread
 - 1.2.2 Vegetables and fruits
 - 1.2.3 Heated canned foods
- 1.3 Food borne disease outbreaks
- 1.4 Detection of food-borne pathogens

Unit 2: Preservation of food (08 hours)

- 2.1 Asepsis
- 2.2 Removal of microorganisms
- 2.3 Heat treatments employed in processing foods
- 2.4 Temperatures employed in low-temperature storage
- 2.5 Methods of drying
- 2.6 Added preservatives
- 2.7 Developed preservatives
- 2.8 Preservation by radiation

Unit 3: Dairy Microbiology (07 hours)

- 3.1 Kinds of milk
- 3.2 Composition and structure of milk
- 3.3 Methods of testing and grading of milk
- 3.4 Source of microorganisms in milk
- 3.5 Contamination and Spoilage of milk and milk products
- 3.6 Preservation of milk and milk products

Unit 4: Dairy technology (08 hours)

- 4.1 Basic steps in milk processing
- 4.2 Manufacturing of fluid milk products
- 4.3 Concentrated fat products
- 4.4 Condensed fluid milk products
- 4.5 Dry milk products
- 4.6 Fermented / Cultured dairy products
- 4.7 Cheese and cheese products
- 4.8 Ice cream and frozen desserts

Unit 5: Fermented food and microorganisms as food (07 hours)

- 5.1 List of fermented foods
- 5.2 Production of breads
- 5.3 Production of alcoholic beverages
- 5.4 Single cell protein
- 5.5 Microorganisms as food and food amendments
- 5.6 Mushroom Culture



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Unit 6: Testing of food and dairy

(07 hours)

- 6.1 Types of samples
- 6.2 Best methods of sampling
- 6.3 Testing of raw and pasteurised milk
- 6.4 Testing for APC
- 6.5 Testing for *coliforms*
- 6.6 Qualitative assays for *Salmonella* and *Listeria*
- 6.7 Testing methods for *S. aureus*

References:

1. Frazier, W. C., and Westhoff, D. C., (2006). Food Microbiology, 4Ed., Tata Mc-Graw Hill, India.
2. Wiley, J., Sherwood, L. and Woolverton, C.J. (2014). Prescott's Microbiology, 9th Ed., McGraw-Hill.
3. Chandan, R. C. (2015). Dairy processing and quality assurance: an overview. Blackwell.
4. Pelczar, M. J., Chan, E. C. S. and Kreig, N. (1998). Microbiology, 5th Ed., Tata-McGraw-Hill.
5. Purohit, S. S., (2006). Microbiology: Fundamentals and Applications, 7Ed., Agrobios(India).
6. Dubey, R.C. (2010). Textbook of Biotechnology, S. Chand.

Practicals:

1. Determination of microbial quality of milk by RRT
2. Determination of pasteurization of milk by phosphatase test
3. Characterization for the presence of *Listeria*
4. Determination of the presence of fecal coliforms in milk



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Faculty	Science		Program	B.Sc(Hons.) / (Hons. with Research) All		
Course Type	Minor		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSSES12701	Course Name	Agriculture Management (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
3	3 hrs	0	0 hrs	50	50	100

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc(Hons.) / (Hons. with Research) All		
Course Type	Minor		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSSES12702	Course Name	Agriculture Management (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
1	0 hrs	0	2 hrs	50	50	100



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Subject code: Minor	Department: Environmental Science
Program: B. Sc.	Type of Subject: Theory
Subject: Agriculture Management	
Semester-7	
Course Description: This course aims to provide a basic understanding of principles and scope of agriculture management. It also explores different crops, their management, and economic importance. 1. Develop a comprehensive understanding of agricultural management principles and sustainable farming systems. 2. Familiarize students with planning, organization, resource utilization, and decision-making in agriculture. 3. Introduce modern agricultural technologies, precision farming, and climate-smart agriculture. 4. Enhance knowledge of agricultural marketing, value chains, agribusiness, and entrepreneurship. 5. Promote scientific management of soil, water, crops, and farm resources for sustainable development. 6. Equip students with practical skills for farm planning, record keeping, and agricultural enterprise management.	
Student Learning Outcomes (SLOs): At the end of the course, students will be able to: Explain the principles and scope of agricultural management. 1. Prepare farm plans and efficiently manage agricultural resources. 2. Apply sustainable farming practices and precision agriculture technologies. 3. Analyze agricultural markets, supply chains, and farm economics. 4. Evaluate government policies, agricultural schemes, and risk management strategies. 5. Develop entrepreneurial skills for successful agricultural enterprises.	

Reference:

1. Brady, N. C. & Weil, R. R. *The Nature and Properties of Soils*. Pearson.
2. Pandey, M. M. *Agricultural Engineering*. CBS Publishers.
3. Reddy, S. R. *Principles of Crop Production*. Kalyani Publishers.
4. Tandon, P. K. & Dhandyal, S. P. *Principles and Methods of Farm Management*. Kalyani Publishers.
5. Lekhi, R. K. & Singh, J. *Agricultural Economics*. Kalyani Publishers.
6. Palaniappan, S. P. & Sivaraman, K. *Cropping Systems in the Tropics*. New Age International.
7. Sharma, A. K. *Biofertilizers for Sustainable Agriculture*. Agrobios.
8. Singh, B. D. *Agricultural Biotechnology*. Kalyani Publishers.
9. National Institute of Agricultural Extension Management (MANAGE). *Agribusiness and Agricultural Extension Study Materials*.
10. ICAR. *Handbook of Agriculture*. Indian Council of Agricultural Research.
11. FAO. *Climate Smart Agriculture Sourcebook*.
12. Government of India. *National Mission on Sustainable Agriculture Guidelines*.



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Unit 1: Introduction to Agriculture Management (7 Hours)

- 1.1 Concept, scope, objectives and importance of agriculture management
- 1.2 Indian agriculture: characteristics, challenges and opportunities
- 1.3 Types of farming systems: subsistence, commercial, mixed, organic and integrated farming
- 1.4 Role of agriculture in sustainable development and food security

Unit 2: Farm Resource Management (8 Hours)

- 2.1 Management of land, soil, water and farm inputs
- 2.2 Cropping systems, crop planning and crop rotation
- 2.3 Farm machinery, mechanization and resource optimization
- 2.4 Farm records, budgeting, cost analysis and farm accounting

Unit 3: Sustainable Agriculture and Climate Smart Farming (7 Hours)

- 3.1 Principles of sustainable agriculture and natural resource conservation
- 3.2 Organic farming, integrated nutrient management (INM) and integrated pest management (IPM)
- 3.3 Climate-smart agriculture and adaptation strategies
- 3.4 Precision agriculture: GPS, GIS, drones, sensors and smart irrigation

Unit 4: Agricultural Economics and Agribusiness Management (8 Hours)

- 4.1 Agricultural production economics and resource allocation
- 4.2 Agricultural marketing systems and value chain management
- 4.3 Supply chain management, contract farming and Farmer Producer Organizations (FPOs)
- 4.4 Agricultural entrepreneurship, start-ups and agri-business models

Unit 5: Sustainable Agricultural Resource Management (7 Hours)

- 5.1 Soil health management: soil fertility, nutrient management and soil conservation techniques
- 5.2 Water resource management: irrigation methods, rainwater harvesting, watershed management and water-use efficiency
- 5.3 Integrated Farming Systems (IFS), integrated nutrient management (INM) and integrated pest management (IPM)
- 5.4 Climate-smart agriculture, carbon farming and sustainable agricultural practices

Unit 6: Modern Agriculture, Agribusiness and Entrepreneurship (8 Hours)

- 6.1 Precision agriculture: GPS, GIS, drones, sensors and Internet of Things (IoT) in farming
- 6.2 Post-harvest management, storage, value addition and food processing
- 6.3 Agricultural marketing, Farmer Producer Organizations (FPOs), e-NAM and agricultural supply chains
- 6.4 Agricultural entrepreneurship, Agri-tech start-ups, circular agriculture and future trends in Agriculture 4.0

Practicals:

1. Determination of seed germination percentage and seed vigour index.
2. Isolation of microorganisms commonly used as biofertilizers (Rhizobium, Azotobacter, PSB).
3. Determination of soil properties from agriculture soil samples (Soil pH, Electrical Conductivity (EC), Moisture content, Organic carbon (Walkley–Black method).
4. Detection and estimation of IAA from agricultural important plants/microorganisms.



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5. Study of Weather and Weather forecasting.
6. Determination of leaf area index (LAI)
7. Estimation of chlorophyll content using leaf samples (chlorophyll extraction method).



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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc(Hons.) / (Hons. with Research) All		
Course Type	Minor		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSMB12701	Course Name	Bioprocess Engineering-I (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
3	3 hrs	0	0 hrs	50	50	100

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc(Hons.) / (Hons. with Research) All		
Course Type	Minor		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSMB12702	Course Name	Bioprocess Engineering-I (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
1	0 hrs	0	2 hrs	50	50	100



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Name of faculty: Science	Department: Microbiology
Program: B.Sc. (Hons.) Sem-7	Type: Minor (IFT)
Subject: Bioprocess Engineering-I	
Credit: 04	Total learning hours: 45 hr
Course description: This course provides a comprehensive foundation in bioprocess engineering. Student will explore the concepts of thermodynamics, and basics of Engineering principles. The curriculum emphasizes practical behaviour of fluids in the bioreactor. Learners will evaluate commercial production of commercially high-value metabolites.	
Student Learning outcomes: (SLOs) • After completion of this course, students will be able to design, analyse, and optimize industrial fermentation processes. • Students will able to design thermodynamically stable fermentation process. • Students will also able to understand the concepts of Newtonian and non-Newtonian fluid rheology in fermentation broths. • Ultimately, this course prepares students to understand the commercial fermentation operations for industrial metabolites, including organic acids, biofuels and exopolysaccharides.	

References:

Crueger, W., & Crueger, A. (1990). *Biotechnology: A textbook of industrial microbiology*. Sinauer Associates. ISBN: 978-0-87893-131-6

Doran, P. M. (1995). *Bioprocess engineering principles*. Academic Press. ISBN: 978-0-12-220851-5

Waites, M. J., Morgan, N. L., Rockey, J. S., & Higon, G. (Eds.). (2002). *Industrial microbiology: An introduction*. Blackwell Science. ISBN: 978-0-632-05307-0

Nelson, D. L., Cox, M. M., & Hoskins, A. A. (2021). *Lehninger principles of biochemistry* (8th ed.). W. H. Freeman. ISBN: 978-1319381493

Unit: 1: Fundamentals of Bioprocess Engineering

(07 Hrs.)

- 1.1 What is Bioprocess Engineering?
- 1.2 Steps in Bioprocess Development
- 1.3 Basic calculations in Engineering
 - 1.3.1 Physical Variables
 - 1.3.2 Dimensions
 - 1.3.3 Units
 - 1.3.4 Force and Weight
 - 1.3.5 Measurement Conventions



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1.3.6 Standard Conditions and Ideal Gases

- 1.4 Thermodynamic Preliminaries: System and Process
- 1.5 First and Second Law of thermodynamics
- 1.6 Concept of Work, Entropy, Free Energy and Enthalpy

Unit: 2: Material Balance

(08 Hrs.)

- 2.1. Steady State and Equilibrium
- 2.2. Law of Conservation of Mass
 - 2.2.1. General Mass Balance Equation
 - 2.2.2. Types of Material Balance
 - 2.2.3. Simplification of the General Mass Balance Equation
- 2.3. General Procedure for Material Balance Calculation
- 2.4. Material Balance Examples
 - 2.4.1. Continuous Filtration
 - 2.4.2. Batch Mixing
- 2.5. Material Balance with Recycle, Bypass, and Purge streams

Unit: 3: Energy Balance

(07 Hrs.)

- 3.1. Basic Concepts of Energy
- 3.2. Energy Balance Equation
 - 3.2.1. General Energy Balance Equation
 - 3.2.2. Steady-state flow process Energy Balance Equation
 - 3.2.3. Energy Balance Equation for Adiabatic process
- 3.3. Calculation of Enthalpy and Enthalpy Change Non-reactive process
- 3.4. General Procedure for Energy Balance Calculation
- 3.5. Energy Balance Examples

Unit: 4: Fluid Rheology

(08 Hrs.)

- 4.1. Classification of fluids and Fluids in motion
- 4.2. Viscosity & its measurement
- 4.3. Momentum Transfer
- 4.4. Non-Newtonian fluids
- 4.5. Rheological properties of fermentation broths

Unit: 5: Bioproduction of Commercially Important Products-I

(07 Hrs.)

- 5.1. Bioproduction of Organic Acid
 - 5.1.1. Citric Acid
 - 5.1.2. Acetic Acid
 - 5.1.3. Lactic Acid
- 5.2. Bioproduction of industrial alcohols

Unit: 6 : Bioproduction and Biotransformation of Commercially Important Products (08 Hrs.)

- 6.1. Microbial Production of polysaccharides:
 - 6.1.1. Xanthan



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- 6.1.2.Dextran
- 6.1.3.Alginate
- 6.2. Microbial production of beverages
 - 6.2.1.Production of Beer
 - 6.2.2.Production of Wine
- 6.3. Microbial Transformation of Steroids and sterols

List of Practical

1. Bioproduction of Alcohol
2. Bioproduction of Citric Acid



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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc(Hons.) / (Hons. with Research) All		
Course Type	Minor		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSBT12701	Course Name	Forensic Toxicology (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
3	3 hrs	0	0 hrs	50	50	100

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc(Hons.) / (Hons. with Research) All		
Course Type	Minor		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSBT12702	Course Name	Forensic Toxicology (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
1	0 hrs	0	2 hrs	50	50	100



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Forensic Toxicology

Unit 1: Introduction to toxicology (07 hours)

- 1.1 Definition and general account
- 1.2 History of toxicology
- 1.3 Forensic medicine in India
- 1.4 Disciplines of toxicology
- 1.5 Toxicants and their classification
- 1.6 Classification of toxicants based on organs

Unit 2: Medical toxicology (07 hours)

- 2.1 Maximum acceptable concentration
- 2.2 Toxic effects
- 2.3 Laws related to poisons
- 2.4 Features of poisoning in the living and dead
- 2.5 General principles of treatment of poisoning

Unit 3: Forensic aspects of some poisons-1 (07 hours)

- 3.1 Corrosive poisoning
- 3.2 Inorganic acid poisoning
- 3.3 Organic acid poisoning
- 3.4 Halogen poisoning
- 3.5 Alkalies

Unit 4: Forensic aspects of some poisons-2 (08 hours)

- 4.1 Irritant Poisons
- 4.2 Vegetable irritants
- 4.3 Non-metallic
- 4.4 Metallic
- 4.5 Animal irritants
- 4.6 Mechanical irritants

Unit 5: Forensic aspects of some poisons-3 (08 hours)

- 5.1 Neurotic poisons
- 5.2 Cerebral poisons
- 5.3 Deliriant poisons
- 5.4 Spinal poisons
- 5.5 Cardiac poisons



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Unit 6: Miscellaneous poisons and Clinical practice of Forensic toxicology (08 hours)

- 6.1 Asphyxiants
- 6.2 Food poisoning
- 6.3 Legal procedure
- 6.4 Post-mortem examination
- 6.5 Collection and Preservation of Viscera and Biological Sample in Poisoning Cases
- 6.6 Viscera management system

References:

1. Sharma, RK. *Concise textbook of forensic medicine and toxicology*. Global Education Consultants, 2011.
2. Pandey, K, Shukla JP and Trivedi, SP. *Fundamentals of toxicology*. Central, 2009.
3. Sharma, PD. *Toxicology*. Rastogi Publications, 2010.



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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc(Hons.) / (Hons. with Research) All		
Course Type	Minor		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSES12703	Course Name	Industrial Disaster and Safety Measures (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
3	3 hrs	0	0 hrs	50	50	100

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc(Hons.) / (Hons. with Research) All		
Course Type	Minor		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSES12704	Course Name	Industrial Disaster and Safety Measures (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
1	0 hrs	0	2 hrs	50	50	100



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Subject code: Minor	Department: Environmental Science
Program: B. Sc.	Type of Subject: Theory + Practical
Subject: Industrial Disaster and Safety Measures	
Semester-7	
Course Description: 1. The course is designed to develop a scientific understanding of industrial disasters, occupational and process safety, hazardous materials, emergency preparedness, and disaster-management systems. 2. It introduces students to the causes and consequences of industrial accidents involving fire, explosion, toxic releases, chemical spills, structural failures, and other technological hazards. 3. The course emphasizes hazard identification, risk assessment, preventive engineering, personal protection, emergency response, industrial hygiene, environmental monitoring, and post-disaster management. 4. It also develops awareness of Indian industrial safety legislation, institutional responsibilities, and the role of workers, industries, local authorities, and communities in reducing disaster risk.	
Student Learning Outcomes (SLOs): At the end of the course, students will be able to: 1. Explain the causes, types, characteristics, and environmental consequences of industrial disasters. 2. Identify industrial hazards associated with chemicals, machinery, fire, explosions, electricity, storage systems, and industrial processes. 3. Apply basic principles of hazard identification, risk assessment, safety auditing, and emergency planning.. 4. Explain fire prevention, chemical safety, occupational health, personal protective equipment, and industrial hygiene practices.	

References and Textbooks:

1. Environmental Hazards: Assessing risk and reducing disaster, Keith Smith, 6th Edition, 2013, Routledge, Taylor and Francis group.
2. Environmental Health, Assessing Risk and Reduction Disaster, Smith, K. 3rd Edition, 2001, Routledge.
3. Handbook of Disaster Risk Reduction & Management, Christian N Madu and Chu-Hua Kuei, 1st Edition, 2017, World Scientific.
4. World Famous Disasters, Narendra Malhotra, 1st Edition, 2004, Jain Book Depot.
Natural Disasters, R.K. Sharma and Gagandeep Sharma, 1st Edition, 2005, Jain Book Depot.
5. Environmental Pollution and Control in Chemical Process Industries, S.C. Bhatia, 2nd Edition, 3rd Reprint, 2014, Khanna Publishers.
6. Industrial Wastewater Treatment, A.D. Patwardhan, 1st Edition, 2nd Reprint, 2009, PHI Learning Private Limited.
7. Mistry K.U (2012): Fundamentals of Industrial Safety & Health – I, Siddharth Prakashan, Ahmedabad.
8. Mistry K.U (2012): Fundamentals of Industrial Safety & Health – II, Siddharth Prakashan, Ahmedabad.



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Unit 1: Introduction to Industrial Disasters and Industrial Safety (08 Hours)

- 1.1 Concept and classification of industrial disasters
- 1.2 Causes of industrial disasters
- 1.3 Types of industrial disasters
- 1.4 Consequences of industrial disasters

Unit 2: Industrial Hazards and Risk Assessment (08 Hours)

- 2.1 Chemical and physical hazards
- 2.2 Hazard identification
- 2.3 Risk assessment
- 2.4 Risk-analysis techniques

Unit 3: Fire, Explosion and Chemical Safety (08 Hours)

- 3.1 Fundamentals of fire
- 3.2 Fire prevention and protection
- 3.3 Industrial explosions
- 3.4 Chemical safety

Unit 4: Occupational Health, Industrial Hygiene and Personal Safety (07 Hours)

- 4.1 Occupational health and industrial hygiene
- 4.2 Physical and biological hazards
- 4.3 Personal Protective Equipment
- 4.4 Safe work practices

Unit 5: Industrial Emergency Preparedness and Disaster Management (07 Hours)

- 5.1 Emergency preparedness
- 5.2 Emergency response
- 5.3 Disaster management cycle
- 5.4 Community and institutional preparedness

Unit 6: Industrial Safety Audit, Legislation and Case Studies (07 Hours)

- 6.1 Industrial safety audit
- 6.2 Industrial safety legislation in India
- 6.3 Major industrial disaster case studies
- 6.4 Contemporary approaches to industrial safety

Practical's:

1. Case studies of Bhopal Gas Tragedy (1984), Visakhapatnam LG Polymers Gas Leak (2020), Jaipur IOC Oil Depot Fire (2009).
2. Seminar on KoI-Dam Hydropower Project of Himachal Pradesh, India.
3. Measurement of Noise in various environments.



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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons.) / (Hons. with Research)		
Year	2026		Version	1.0		
Semester	VII		Effective From	June, 2026		
Course Code	BSCH12701	Course Name	Minor: Advanced Analytical Chemistry (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CCE)	Semester end examinations (SEE)	Total
3	3	-	-	40	35	75

Purpose of Course	To Teach the students about different spectroscopy techniques, solvent extraction and ion exclusion chromatography techniques.
Course Objective	To teach about Principle, Instrumentation and Applications of IR-NMR and Advanced Spectroscopy, On-line Analyzers, Solvent Extraction Techniques and Ion Exclusion Chromatography.
Pre-requisite	Basic knowledge of analytical chemistry, instrumental analysis, spectroscopy, and fundamental concepts of organic and inorganic chemistry.
Course Out come	At the end of the course students will be able to learn about • The History, origin, laws, principles, theories, instrumental set up, its' working mechanism, various components and it's working pattern, procedure of analysis and applications in the various field of analysis about: • IR Spectroscopy • NMR Spectroscopy • Florescence, Phosphorescence, Chemiluminescence, Turbidimetry and Nephelometry • Solvent Extraction • Ion Exclusion Chromatography



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Course Content	Unit-1: Infra-Red Spectroscopy (07 Hrs) 1.1 Introduction and classification of IR region 1.2 Information provided by IR Spectroscopy 1.3 Instrumentation of IR Spectrophotometer - Single and Double Beam 1.4 Differences between IR and UV Spectrum 1.5 Applications of IR Spectroscopy Unit-2: NMR Spectroscopy (06 Hrs) 2.1 Introduction and Basis of NMR Spectroscopy 2.2 NMR Spectroscopy - Classification, Principle and Working 2.3 Chemical Shift in NMR Spectroscopy 2.4 Instrumentation and Techniques of NMR Spectroscopy 2.5 Applications of NMR Spectroscopy Unit-3: Advanced Spectroscopy Techniques (06 Hrs) 3.1 Principle, Instrumental set up & Applications of 3.1.1 Florescence 3.1.2 Phosphorescence 3.1.3 Chemiluminescence 3.1.4 Turbidimetry 3.1.5 Naphelometry Unit-4: On-Line Analyzers (12 Hrs) 4.1 Water quality monitoring: purpose of water quality measurement, sampling system, different sensors and analyzers 4.2 Online pH analyzers: principle, types of different pH electrodes, application 4.3 Online DO analyzers: principle, types of different cells and sensors, application 4.4 ORP measurement: principle, equipment, application, ORP control 4.5 Online FRC analyzers: principle, types of FRC sensors, applications 4.6 On-line Turbidity, Sludge and Suspended Solid measurement: turbidity units, forward scattering transmission types, dual beam design, laser type suspended solid and sludge density sensors, scattered light detectors, backscatter turbidity analyzers Unit-5: Solvent Extraction Techniques (08 Hrs) 5.1.1 Principle and Rules 5.1.2 Classification of extraction methods 5.1.2.1 Chelation 5.1.2.2 Solvation 5.1.2.3 Ion pair formation 5.1.2.4 Synergic extraction 5.1.3 Methods of Extraction 5.1.4 Factors influencing the Extraction Efficiency
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	Unit-6: Ion Exclusion Chromatography (06 Hrs) 6.1 Principle, working procedure and applications of IEC 6.1.1 Gel Permeation Chromatography 6.1.2 Ion Exclusion Technique 6.1.3 Inorganic Molecular Sieves
Practical	-
Reference Books	• Chemistry for Environmental Engineering and Science, C. N. Sawyer and P. L. McCarty, G.F. Parkin, 5th Edition, 21st Reprint, 2015, McGraw Hill Education (India) Private Limited. • Quantitative Analysis, R.A Day, A.L Underwood, 6th Edition, 1991, Prentice-Hall. • Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, 9th Edition, Reprint 2014, Cengage Learning. • Quantitative Analysis, R.A Day, A.L Underwood, 6th Edition, 1991, Prentice-Hall. • 5. Basic Concepts of Analytical Chemistry, S.M. Khopkar, 3rd Edition, Reprint 2009, New Age International (P) Limited, Publishers. • Theory and Practicals of Engineering Chemistry, Shashi Chawla, 5th Edition, 2008, Dhanpat Rai & Co. Pvt. Ltd. • 7. Engineering Chemistry, P.C. Jain & Monica Jain, 17th Edition, Reprint 2011, Dhanpatrai Publishing Company (P) Ltd. • 8. Handbook of Analytical Instrument, R.S. Khandpur, 2nd Edition, Reprint 2009, Tata McGraw Hill Publishers. • 9. Instrumental Methods of Chemical Analysis (Analytical Chemistry), H. Kaur, 8th Edition, 2012, Pragati Prakashan. • 10. Analytical Instrumentation Handbook, Ewing's, Edited by Jack Cazes, 3rd Edition, 2005, Marcel Dekker Publisher. • 11. Instrumental Methods of Analysis, H.H. Willard, L.L. Meritt, J.A. Dean and F.A. Settle, 7th Edition, 1986, CBS Publishers. • 12. Instrumental methods of analysis, B.K. Sharma, 24th Edition, 2005, Goel Publishing House. • 13. Instrumental Analysis, D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, 11th Edition, Reprint 2012, Cengage Learning. • 14. Operation and Maintenance manuals for water, sewage and Effluent treatment plants. • 15. BIOS-Instant Notes-Analytical Chemistry, D. Kealey, P.J. Haines, 2002, Viva Books (P) Ltd. • Analytical Instrumentation, Bela G. Liptak, 1st Edition, 1994, 1st Indian Reprint, 2012, Chilton Book Company. • Theory and Practicals of Engineering Chemistry, Shashi Chawla, 5th Edition, 2008, Dhanpat Rai & Co. Pvt. Ltd.



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Faculty	Science		Program	B.Sc. (Hons.) / (Hons. with Research)		
Year	2026		Version	1.0		
Semester	VII		Effective From	June, 2026		
Course Code	BSCH12702	Course Name	Minor: Advanced Analytical Chemistry (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CCE)	Semester end examinations (SEE)	Total
1	-	-	2	10	15	25

Purpose of Course	To provide hands on training for IR-NMR, Advanced Spectroscopy, Water Quality Analyzers, Solvent Extraction Techniques and Ion Exclusion Chromatography Technique.
Course Objective	To Train the students about experimentation in laboratory regarding different parameters of Spectroscopy, On-line Analyzers, Solvent Extraction and Chromatography.
Prerequisite	Basic knowledge of analytical chemistry, water quality parameters, volumetric analysis, laboratory safety, preparation of standard solutions, and operation of common analytical instruments.
Course Out come	At the end of this course, students will be able to determine Turbidity, Suspended Solids of water sample, different water quality parameters like Free Residual Chlorine, Dissolved Oxygen, IR-NMR and Chromatography related hands on training, etc.
Course Content	---
Practical	Any three Determination of Turbidity in water sample. Determination of Suspended Solids in water sample. Determination of Free Residual Chlorine in water sample. Determination of Dissolved Oxygen in water sample.
Reference Books	Standard Methods for Examination of Water & Wastewater, Andrew D. Eaton, Lenore S. Clesceri, Eugene W. Rice, Arnold Greenberg, 23 rd Edition, 2017, published by APHA, AWWA, WEF. Official Methods of Analysis, Dr. William Horwitz, Dr. George W Latimer, 18 th Edition, 2005, published by Association of Officiating Analytical



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Chemists (AOAC). Analytical Chemistry, H. Kaur, 1st Edition, 2013, Pragati Prakashan. Operation and Maintenance manuals for water, sewage and Effluent treatment plants. S.K.Bhasin, Sudha Rani, Laboratory Manual on Engineering Chemistry; 3rd Edition, 2011, Dhanpatrai Publishing Company. Theory and Practicals of Engineering Chemistry, Shashi Chawla, 5th Edition, 2008, Dhanpat Rai & Co. Pvt. Ltd.
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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc(Hons.) / (Hons. with Research) All		
Course Type	Minor		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSMB12703	Course Name	Molecular Diagnosis and Cytogenetics (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
3	3 hrs	0	0 hrs	50	50	100

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc(Hons.) / (Hons. with Research) All		
Course Type	Minor		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSMB12704	Course Name	Molecular Diagnosis and Cytogenetics (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
1	0 hrs	0	2 hrs	50	50	100



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Name of faculty: Science	Department: Microbiology
Program: B. Sc. (Hons.) Sem-7	Type: Minor (MLT)
Subject: Molecular Diagnosis and Cytogenetics	
Credit: 4	Total learning hours: 45
Course description: The main aim of the subject is to inform the knowledge about isolation, amplification, and analysis of nucleic acids (DNA and RNA) to identify infectious agents, genetic mutations, and oncology markers. Also focuses on the structure, function, and abnormalities of human chromosomes utilizing classical cell-culturing and high-resolution imaging technologies.	
Student learning outcome: At the end of the course, the students will get knowledge of • Basics of molecular biology • Principles, mechanics, and diagnostic limitations of nucleic acid analysis • Practical application & Quality control in PCR • Fundamental components & use of cell culture for cytogenetic studies • Basic aspects of clinical cytogenetics • Patterns of Inheritance & Autosomal Disorders • Laboratory diagnosis of inborn error of metabolism • Clinical Cytogenetic testing	

Reference Book:

- P.B. Godkar, (2014), Textbook of Medical Laboratory Technology, 3rd ed., Bhalani Publishing House, Mumbai, India. (ISBN: 9789381496190)
- Mahabal Ram (2010), Fundamentals of Cytogenetics and Genetics, PHI Pub, India. (ISBN: 9788120340336)
- Roger L.Miesfeld,(2013),APPLIED MOLECULAR GENETICS,Wiley pub. (ISBN: 9788126538355)
- Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (2010),,7th ed.,Cambridge Uni. Press (ISBN:9780521178747)
- Susan Carson, Heather B. Miller, D. Scott Witherow, (2012),Molecular Biology Techniques A Classroom Laboratory Manual, 3rd ed. Academic Press (ISBN:9780123855442)
- Mukharjee K.L. (1999), Medical Laboratory Technology, 2nd ed., Tata MacGraw Hill. (ISBN: 9789352606818)



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Unit-1: Molecular Pathology (07 Hrs)

- 1.1 Introduction
- 1.2 Nucleic Acid Analysis
- 1.3 Blotting techniques: Southern, Northern & Western Blotting
- 1.4 Diagnostic application of DNA probes

Unit-2: Polymerase Chain Reaction (PCR) & Advanced Amplification (08 Hrs)

- 2.1 Sources of DNA for PCR
- 2.2 PCR: Components and Protocol
- 2.3 Practical applications & Quality control in PCR
- 2.4 Variations of the PCR: Nested PCR, RT PCR, Real time, Multiplex PCR
- 2.5 Gene Cloning- Methodology, Synthesis of cDNA

Unit-3: Rapid Diagnostics Technology (08 Hrs)

- 3.1 Sequencing
- 3.2 Microarrays
- 3.3 NGS diagnostics

Unit-4: Basics of Clinical Cytogenetics (07 Hrs)

- 4.1 Important definitions & normal chromosome structure
- 4.2 Fundamental components & use of cell culture for cytogenetic studies
- 4.3 Tissue Culture Laboratory
- 4.4 Constitutional Chromosome Patterns analysis

Unit-5: Chromosomal Abnormalities (08 Hrs)

- 5.1 Patterns of Inheritance & Autosomal Disorders
- 5.2 Laboratory diagnosis of inborn error of metabolism
- 5.3 Clinical Cytogenetic testing (CCT)
- 5.4 Prenatal cytogenetics
- 5.5 Chromosomal Aneuploidy syndromes

Unit-6: Diagnosis of Various diseases using Molecular Techniques (07 Hrs)

- 6.1 Hemetopoietic neoplasm & Lymphomas
- 6.2 Genetic diseases & Familial cancers
- 6.3 Use of FISH technique in cancer genetics
- 6.4 Forensic identity and Parentage testing

List of Practical

- 1. Determination of Plasma HIV RNA (Viral load)
- 2. Cytogenetics- Various case studies should be carried out.



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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons.) Biotechnology		
Course Type	SEC		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSBT15701	Course Name	Research Methodology - I			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
2	2 hrs	0	0 hrs	25	25	50



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Faculty: Science	Department: Env. Sc. and Biotech.
Program: B.Sc.	Type: SEC
Subject: Research Methodology - I	Credits: 2
Semester: VII	

References:

1. Ghosh, B. N. (1982). *Scientific method and social research*. Sterling Publishers.
2. Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International.

Unit 1: Conceptual Foundation

(06 hours)

- 1.1 Constituents and theoretical perspectives
- 1.2 Approaches to inquiry
- 1.3 Strategies and process
- 1.4 Hypothesis: its types and sources
- 1.5 Nature, sources and types of data
- 1.6 Measurement scales of variables

Unit 2: Philosophy of Scientific research

(08 hours)

- 2.1 Positivist philosophy of science and its criticism
- 2.2 Karl Popper and Thomas Kuhn's philosophy of science
- 2.3 Definition, need and purpose of research
- 2.4 Conceptual framework of research
- 2.5 Basic and applied research
- 2.6 General characteristics of modern research
- 2.7 Criteria for selecting a topic and Scientific method

Unit 3: Planning of research

(08 hours)

- 3.1 Criteria of scientific research
- 3.2 Purpose and development of theory
- 3.3 Scope of research in biology
- 3.4 Stages and process of research
- 3.5 Sources of data
- 3.6 Sample design
- 3.7 Survey research
- 3.8 Experimental research



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Unit 4: Methods of research

(08 hours)

- 4.1 Planning and process of observation
- 4.2 Types of observation
- 4.3 Questionnaire method
- 4.4 Pre-testing and distribution of questionnaires
- 4.5 Interviewing method
- 4.6 Parts and planning of experimental research
- 4.7 Laboratory vs Field experiment
- 4.8 Experiment design



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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons with Research) Biotechnology		
Course Type	Research Project		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSBT18701	Course Name	Research Project - I (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
2	2 hrs	0	0 hrs	25	25	50

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons with Research) Biotechnology		
Course Type	Research Project		Version	1.0		
Semester	07		Effective From	June, 2026		
Course Code	BSBT18702	Course Name	Research Project - I (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
4	0	0	8 hrs	40	60	100



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Faculty: Science	Department: Env. Sc. and Biotech.
Program: B.Sc.	Type: SEC
Subject: Research Project - 1	Credits: 2
Semester: VII	

References:

1. Ghosh, B. N. (1982). *Scientific method and social research*. Sterling Publishers.
2. Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International.

Unit 1: Conceptual Foundation

(06 hours)

- 1.1 Constituents and theoretical perspectives
- 1.2 Approaches to inquiry
- 1.3 Strategies and process
- 1.4 Hypothesis: its types and sources
- 1.5 Nature, sources and types of data
- 1.6 Measurement scales of variables

Unit 2: Philosophy of Scientific research

(08 hours)

- 2.1 Positivist philosophy of science and its criticism
- 2.2 Karl Popper and Thomas Kuhn's philosophy of science
- 2.3 Definition, need and purpose of research
- 2.4 Conceptual framework of research
- 2.5 Basic and applied research
- 2.6 General characteristics of modern research
- 2.7 Criteria for selecting a topic and Scientific method

Unit 3: Planning of research

(08 hours)

- 3.1 Criteria of scientific research
- 3.2 Purpose and development of theory
- 3.3 Scope of research in biology
- 3.4 Stages and process of research
- 3.5 Sources of data
- 3.6 Sample design
- 3.7 Survey research
- 3.8 Experimental research



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Unit 4: Methods of research

(08 hours)

- 4.1 Planning and process of observation
- 4.2 Types of observation
- 4.3 Questionnaire method
- 4.4 Pre-testing and distribution of questionnaires
- 4.5 Interviewing method
- 4.6 Parts and planning of experimental research
- 4.7 Laboratory vs Field experiment
- 4.8 Experiment design



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SEM - 8

DETAILED CURRICULUM
(W.E.F. 2026-27)

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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons.) / (Hons. with Research) Biotechnology		
Course Type	Major		Version	1.0		
Semester	08		Effective From	June, 2026		
Course Code	BSBT11801	Course Name	CRO and CMDO (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
3	3 hrs	0	0	40	35	75

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons.) / (Hons. with Research) Biotechnology		
Course Type	Major		Version	1.0		
Semester	08		Effective From	June, 2026		
Course Code	BSBT11802	Course Name	CRO and CMDO (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
1	0	0	2 hrs	10	15	25



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CRO and CDMO

Name of Faculty: Science	Department: Biotechnology
Program: B.Sc. Biotechnology (Hons.) / (Hons. with Research)	Type: Major
Subject: CRO and CDMO	Semester: B.Sc. Sem-8
Credit: 03+01	Total learning hours: 45(Th)+30 (Pr)
Course description: The course provides students with a comprehensive understanding of the rapidly growing Contract Research Organization (CRO) and Contract Development and Manufacturing Organization (CDMO) sectors within the biotechnology and biopharmaceutical industry. The course explores the business models, operational frameworks, regulatory requirements, and strategic importance of outsourcing in modern biotechnology enterprises.	
Student Learning Outcome: 1. Explain CRO and CDMO business models and global market dynamics. 2. Analyze outsourcing strategies and sponsor-partner relationships. 3. Understand operational workflows in research, development, and manufacturing services. 4. Interpret regulatory requirements and quality systems in outsourced environments. 5. Apply business development, contract, and project management principles. 6. Evaluate emerging trends and career opportunities in the CRO/CDMO sector.	

Unit 1: CRO Industry Overview, Market Drivers and Research Outsourcing (7 hrs)

- 1.1 Introduction to pharmaceutical biotechnology and biopharmaceutical products, CRO industry as a component of the pharmaceutical and biotechnology ecosystem
- 1.2 Market Drivers: Increasing R&D expenditure worldwide, Growing number of clinical trials worldwide, Growing outsourcing of R&D activities
- 1.3 Rising technological advancement
- 1.4 Porter 5 forces Analysis of Indian CRO Sector

Unit 2: CRO Service Areas, Drug Development Support and Emerging Research Technologies (8 hrs)

- 2.1 CRO service areas and service type trends, Discovery and chemical research services in CRO sector
- 2.2 Clinical development services and clinical trial management services, Clinical CRO services, Bioequivalence and bioavailability CRO services
- 2.3 Genomics, proteomics, pharmacogenomics, toxicogenomics, glycomics, and chemical genomics in drug discovery and development



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2.4 Role of bioinformatics, next-generation sequencing, molecular profiling, and biomarker identification in modern drug development

Unit 3: CRO Growth Restraints, Regulatory Complexity, and Biosimilar Development (7 hrs)

- 3.1 Industry–academia collaboration gap in CRO sector, Regulatory complexity and approval delays
- 3.2 Data integrity issues in CRO operations, Historical perception of clinical trials in India, Patient Recruitment and Retention, Guinea Pig Syndrome, Patient Data Confidentiality
- 3.3 Regulatory framework for biosimilars, Biosimilars and drug product approval
- 3.4 Comparability, scale-up and post-approval changes in biopharmaceutical products

Unit 4: Contract Manufacturing Arrangements, Quality Agreements and CGMP Responsibilities (8 hrs)

- 4.1 Defining contract manufacturing in pharmaceutical and biopharmaceutical industries
- 4.2 Responsibilities of parties involved in contract manufacturing, Role of owner and contract facility
- 4.3 Quality agreements: purpose, scope, and essential elements, Documenting CGMP activities in quality agreements, CGMP responsibilities of owners and contract facilities, analytical testing laboratories
- 4.4 Case Study: Common Problem in Contract Manufacturing Arrangements

Unit 5: Assessment of Indian CDMO Market (7 hrs)

- 5.1 Overview of CDMO Services & Global CDMO Market
- 5.2 Key growth drivers for the CDMO Industry
- 5.3 Risk and Challenges for the Indian CDMO Industry
- 5.4 Overview of recent trends in Indian CDMO Industry

Unit 6: India as an Emerging Biologics CDMO Hub (8 hrs)

- 6.1 Advanced Modality Pivots and Continuous Biomanufacturing: A Case Study on Gennova Biopharmaceuticals (Pune, Maharashtra)
- 6.2 Reason for India emerging as the key player in CDMO segment
- 6.3 Overview of Competitor analysis in CDMO industry
- 6.4 Case Study: Competitive landscape of Indian CDMO Segment



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References:

1. Study on CRO Sector in India. Department of Pharmaceuticals, Government of India.
2. Contract Manufacturing Arrangements for Drugs: Quality Agreements – Guidance for Industry. U.S. Food and Drug Administration.
3. Assessment of Indian Pharmaceutical and CDMO market .CRISIL Report-May 2022
4. Crommelin DJA, Sindelar RD, Meibohm B. Pharmaceutical Biotechnology. Springer.
5. Developing Countries Vaccine Manufacturers Network (DCVMN) Industrial Profile & Process Frameworks: Gennova Biopharmaceuticals Limited (Pune Cluster).

Practicals:

1. Preparation and Presentation of a Contract Research Organization (CRO) Service Proposal.
2. Development of a Scale-Up Risk Assessment and Mitigation Plan for a Biologic Product.
3. Case Study Evaluation of CRO/CDMO Operations and Regulatory Compliance.
4. Preparation of an Audit Checklist and CAPA Plan for CRO/CDMO Facility Inspection.



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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons.) / (Hons. with Research) Biotechnology		
Course Type	Major		Version	1.0		
Semester	08		Effective From	June, 2026		
Course Code	BSBT11803	Course Name	Aquaculture and Livestock Biotechnology (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
3	3 hrs	0	0	40	35	75

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons.) / (Hons. with Research) Biotechnology		
Course Type	Major		Version	1.0		
Semester	08		Effective From	June, 2026		
Course Code	BSBT11804	Course Name	Aquaculture and Livestock Biotechnology (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
1	0	0	2 hrs	10	15	25



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Name of faculty: Science	Department: Biotechnology
Program: B.Sc. Biotechnology (Hons)	Type: Theory + Practical
Subject: Biotechnology Business: Aquaculture and Livestock Biotechnology	Semester: 8
Credits: 03 + 01	Total learning hours: 45
Course Description: The course aims to: 1. Introduce students to India's aquaculture and livestock sectors and their contribution to the bioeconomy. 2. Understand biotechnology-enabled production systems used in fisheries, dairy, poultry and livestock industries. 3. Familiarize students with commercial production technologies and value-added products. 4. To develop understanding related to nutrition, disease management and breed improvement. 5. Promote sustainable and environmentally responsible biotechnology concepts.	
Student Learning Outcome: Upon successful completion of the course, students will be able to: 1. Define and explain the structure and economic significance of aquaculture and livestock industries. 2. Understand value addition and commercialization opportunities. 3. Apply and identify career and startup opportunities in aquaculture and livestock biotechnology. 4. Compare conventional and recent trends in livestock. 5. Evaluate biotechnology applications in feed, nutrition and production management. 6. Analyze sustainability issues and environmental challenges with livestock management.	

Unit 1: Introduction to Aquaculture

(05 Hours)

- 1.1 Objectives and Advantages of Aquaculture
- 1.2 Scope and Advantages of livestock
- 1.3 Status of Aquaculture- India and Global Scenario
- 1.4 Status of Livestock - India and Global Scenario
- 1.5 Economic Importance of Aquaculture and Livestock

Unit-2: Prawn Culture and Processing

(09 hours)

- 2.1 Prawn Culture Methods
- 2.2 Constraints in Shrimp and Prawn Culture
- 2.3 Harvesting
- 2.4 Post Harvest Technology
- 2.5 Processing for Preservation

Unit-3 Biotechnology in Aquaculture

(09 Hours)

- 3.1 Fish Genome Manipulation
- 3.2 Transgenic Fish
- 3.3 Fish Hybridization
- 3.4 Induced Breeding and Hatcheries
- 3.5 Hormonal Manipulation in Aquaculture



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Unit-4 Feed Formulation and Disease Management in Aquaculture

(07 Hours)

- 4.1 Types of Food and Feedstuffs
- 4.2 Feed Formulation Tools and Techniques
- 4.3 Food Supplements, Prebiotics, Probiotics and Synbiotics
- 4.4 Types of Diseases (Nutritional, Protozoal, Fungal, Bacterial, Viral)
- 4.5 Vaccines

Unit-5 Livestock Biology

(10 Hours)

- 5.1 Diseases and Vaccines
- 5.2 Breeds of Cattle
- 5.3 Breeds of Poultry
- 5.4 Mating Behaviour, Artificial Insemination and Embryo Transfer in Cattle
- 5.5 Feed Management in Livestock
- 5.6 Methods of Identification in Cattles
- 5.7 Genetic Conservation and Role of Biotechnology in Livestock and Cattle Industry

Unit-6 Government schemes

(05 Hours)

- 6.1 Rashtriya GOKUL Mission
- 6.2 Pradhan Mantri Formalisation of Micro Food Processing Enterprises Scheme (PMMSY)
- 6.3 National Programme for Dairy Development (NPDD)
- 6.4 Animal Husbandry Infrastructure Development Fund (AHIDF) and Dairy Processing and Infrastructure Development Fund (DIDF)
- 6.5 National Livestock Mission NLM

Practicals:

1. Visit to fish hatchery, dairy farm, poultry farm, shrimp culture farm, fish/shrimp processing unit / animal hospital
2. To perform analysis of Microbial diseases in Aquaculture.
3. To perform Proximate analysis of fish feed. (Protein, Carbohydrate, Lipid, Moisture, Ash)
4. To perform Livestock Breed identification through RT-PCR.

References & Text Books:

1. The Role of Biotechnology in Improvement of Livestock: Animal Health and Biotechnology by Muhammad Abubakar (Editor), Ali Saeed (Editor), Oqez Kul (Editor)
2. Economic importance of zoology-Dr. G. S. Shukla and Dr. V.B. Upadhyay
3. Essentials of Poultry Science Mihir Suthar

Government and Industry Resources:

- National Fisheries Development Board (NFDB)
- Department of Fisheries, Government of India
- National Dairy Development Board (NDDB)
- Department of Animal Husbandry and Dairying
- Department of Biotechnology (DBT)



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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons.) / (Hons. with Research) Biotechnology		
Course Type	Major		Version	1.0		
Semester	08		Effective From	June, 2026		
Course Code	BSBT11805	Course Name	Vaccine and MAb Manufacturing (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
3	3 hrs	0	0	40	35	75

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons.) / (Hons. with Research) Biotechnology		
Course Type	Major		Version	1.0		
Semester	08		Effective From	June, 2026		
Course Code	BSBT11806	Course Name	Vaccine and MAb Manufacturing (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
1	0	0	2 hrs	10	15	25



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Name of Faculty: Science	Department: Biotechnology
Program: B.Sc. (Hons) / B.Sc. (Hons with Research)	Type: Major
Subject: Vaccine and MAb Manufacturing	Semester: 7
Credits: 03 + 01 = 04	

Unit 1: Production Facilities

(08 hours)

- 1.1 GMP-compliant plant design
- 1.2 Basic concepts for production plants
- 1.3 Clean and plant utilities
- 1.4 Equipment cleaning
- 1.5 Clean rooms
- 1.6 Automation

Unit 2: Manufacturing Process

(07 hours)

- 2.1 Process schematic and evaluation
- 2.2 Cell Bank
- 2.3 Fermentation

Unit 3: Purification

(08 hours)

- 3.1 Basic principles
- 3.2 Technologies for cell separation and product isolation
- 3.3 Technologies for final purification
- 3.4 Overview of purification
- 3.5 Formulation and filling
- 3.6 Labelling and Packaging

Unit 4: Vaccine types and manufacturing

(09 hours)

- 4.1 Understanding Six Types of Vaccine Technologies
- 4.2 Vaccine process overview
- 4.3 Vaccine Process Technologies
- 4.4 Viral Vaccine: Process overview
- 4.5 Viral Vaccine: Influenza vaccines
- 4.6 Virus-like Particles Vaccine: Generic Process
- 4.7 Typical Polysaccharide Conjugated Vaccine Process
- 4.8 Typical Viral Vectors Process
- 4.9 mRNA Vaccine Manufacturing



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Unit 5: Advances in monoclonal antibody manufacturing

(06 hours)

- 5.1 Therapeutic antibody discovery technologies
- 5.2 NK cell-mediated antibody dependent cellular cytotoxicity (ADCC)
- 5.3 Antibodies against viral disease: COVID-19
- 5.4 Single use STR systems
- 5.5 Single use bag systems
- 5.6 Microcarrier technology for the anchorage-dependent cells

Unit 6: Case studies

(07 hours)

- 6.1 Rotavac
- 6.2 Covaxin
- 6.3 iNOVACC
- 6.4 ZYCOV-D
- 6.5 EasySix
- 6.6 CANMAb
- 6.7 Reditux

References:

1. Behme, S. (2022). *Manufacturing of pharmaceutical proteins: From technology to economy* (3rd ed.). Wiley-Blackwell.



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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons.) / (Hons. with Research) Biotechnology		
Course Type	Major		Version	1.0		
Semester	08		Effective From	June, 2026		
Course Code	BSBT11807	Course Name	Agriculture Biotechnology (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
3	3 hrs	0	0	40	35	75

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons.) / (Hons. with Research) Biotechnology		
Course Type	Major		Version	1.0		
Semester	08		Effective From	June, 2026		
Course Code	BSBT11808	Course Name	Agriculture Biotechnology (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
1	0	0	2 hrs	10	15	25



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Name of faculty: Science	Department: Biotechnology
Program: B.Sc. (Honours)	Type: Theory
Subject: Agriculture Biotechnology	Semester-8
Credit: 04	Total learning hours: 45 [Th] + 30 [PR]
Course description: This course introduces the basic principles and applications of agricultural biotechnology in modern crop improvement. It covers plant transformation, genetic engineering, molecular markers, and advanced breeding techniques used for developing improved crop varieties. Students will learn about plant responses to biotic and abiotic stresses and the molecular approaches used to enhance stress tolerance. The course also explains modern technologies such as CRISPR-Cas, RNA interference, and genetically modified crops along with biosafety regulations. It provides an overview of biofertilizers, mushroom cultivation, sustainable agricultural practices, and agricultural entrepreneurship. The course emphasizes the role of biotechnology in improving crop productivity, food security, and sustainable agriculture while developing awareness of current research systems and innovations in the agricultural sector.	
Student learning outcome: 1. Explain the basic concepts and importance of agricultural biotechnology in crop improvement and food security. 2. Describe plant transformation methods, genetic engineering techniques, and their applications in agriculture. 3. Identify molecular markers and modern breeding technologies used for crop improvement. 4. Explain the molecular mechanisms involved in plant responses to biotic and abiotic stresses. 5. Evaluate the applications of CRISPR, RNA interference, GM crops, and biosafety regulations. 6. Recognize the role of biofertilizers, mushroom cultivation, and biotechnology-based entrepreneurship in sustainable agriculture.	

UNIT I: Foundations of Agricultural Biotechnology & Research Systems

(07 hrs)

- 1.1 Evolution of Agricultural Biotechnology and Major Milestones in Crop Improvement (Green Revolution, Hybrid Crops, Transgenic Crops, Gene-Edited Crops)
- 1.2 National Agricultural Research System (NARS) in India
- 1.3 CGIAR and global agricultural research organizations
- 1.4 Role of biotechnology in food security and sustainable agriculture

UNIT II: Plant Transformation and Genetic Engineering

(08 hrs)

- 2.1 Biology of *Agrobacterium tumefaciens*, Ti plasmid, virulence (vir) operon
- 2.2 Principles of stable transformation protocols (*Agrobacterium*-mediated gene transfer vs. Biolistics/Particle bombardment).
- 2.3 Binary vectors, function of selectable markers (antibiotic/herbicide resistance) and reporter genes (GUS, GFP).



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2.4 Floral dip transformation, chloroplast transformation, marker-free transgenic generation, and transient expression via agroinfiltration

UNIT III: Crop Stress Biology and Molecular Defense Mechanisms (08 hrs)

- 3.1 Biotic Stress: Plant-pathogen interactions, Bt toxins, Pathogenesis-Related (PR) proteins, and protease inhibitors.
- 3.2 Herbicide Resistance Mechanisms: Glyphosate tolerance (EPSPS engineering) and glufosinate tolerance (Bar gene).
- 3.3 Abiotic stress: drought, salinity, temperature stress and Flooding stress: hypoxia and anoxia.
- 3.4 Delaying fruit ripening (ACC synthase/oxidase inhibition, polygalacturonase silencing), male sterility using the Barnase-Barstar system.

UNIT IV: Molecular Markers and Plant Breeding Technologies (08 hrs)

- 4.1 Overview of Molecular Markers: RFLP, RAPD, AFLP and their applications
- 4.2 PCR-based markers: SSR, ISSR, SCAR, CAPS, SNP
- 4.3 Marker-assisted selection (MAS)
- 4.4 TILLING as a Reverse genetics tool for discovering natural or induced mutations, QTL mapping

UNIT V: Modern Crop Improvement Technologies (07 hrs)

- 5.1 Applications of Genetic Engineering in Crop Improvement (Yield, Nutrition and Stress Tolerance)
- 5.2 Heterosis (hybrid vigor) and apomixis
- 5.3 CRISPR-Cas based crop improvement
- 5.4 RNA interference (RNAi) in plants
- 5.5 GM crops: environmental and food safety issues
- 5.6 Biosafety Regulations and Regulatory Framework for Agricultural Biotechnology

UNIT VI: Agricultural Entrepreneurship and Sustainable Biotechnology (07 hrs)

- 6.1 Biofertilizers: Rhizobium, Azospirillum, mycorrhizae
- 6.2 Phosphate solubilizing microbes
- 6.3 Mushroom biology: types and cultivation basics
- 6.4 Basic post-harvest handling of mushrooms
- 6.5 Sustainable agriculture and green manure
- 6.6 Agri-Biotechnology Entrepreneurship: Biofertilizer Production, Mushroom Enterprise and Agri-Startup Opportunities



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References and Textbooks:

1. Adrian Slater, Nigel Scott and Mark Fowler, Plant Biotechnology: The genetic manipulation of plants, 2nd Edition, Oxford University Press, 2003
2. Introduction to Plant Biotechnology. 2nd edition. By H. S. Chawla. Oxford & IBH publishing Co. Pvt. Ltd. New Delhi.
3. Plant Biotechnology and Genetics: Principles, Techniques and Applications, Edited by C. Neal Stewart JR. John Wiley and Sons Publications 2008
4. Marker Assisted Plant Breeding: Principles and practices, B.D Singh and A.K Singh, Springer 2015
5. Plant Biotechnology Vol-I, Plant Genetic Engineering, Edited by Don Grierson, Blackie Academic and Professional 1991
6. Salisbury, P.B. & Ross, C.W. (1992). Plant Physiology. Wadsworth Publishing, California.
7. Lincoln Taiz and Eduardo Zaiger (4th Edition), Plant Physiology, Sinauer Associates Inc. Publishers.
8. Krishnamoorthy, 1999. Hand Book of Mushroom Cultivation. TNAU Publications. Coimbatore, TN, India.
9. Biswas, S, Datta, M and Nagachan, S.V. 2012. Mushrooms- A manual for cultivation. PHI Learning Private Limited, New Delhi
10. SubbaRao, N. S., 1998, Biofertilizers in agriculture and forestry. India Book House Ltd. New Delhi.

Practicals:

1. Quantitative analysis of important phytochemicals from suitable plant source.
2. Rapid *in vitro* screening tests for abiotic stress tolerance (e.g., PEG-induced drought stress or NaCl-induced salinity stress) monitoring seed germination and viability.
3. Estimation of antioxidants and antioxidant enzymes namely Superoxide dismutase. Ascorbate peroxidase / Catalase from plant leaf.
4. Isolation of DNA from suitable plant source and quality check using gel electrophoresis.



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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc(Hons.) / (Hons. with Research) All		
Course Type	Minor		Version	1.0		
Semester	08		Effective From	June, 2026		
Course Code	BSMB12801	Course Name	Bioprocess Engineering-II (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
3	3 hrs	0	0 hrs	50	50	100

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc(Hons.) / (Hons. with Research) All		
Course Type	Minor		Version	1.0		
Semester	08		Effective From	June, 2026		
Course Code	BSMB12802	Course Name	Bioprocess Engineering-II (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
1	0 hrs	0	2 hrs	50	50	100



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Name of faculty: Science	Department: Microbiology
Program: B. Sc. (Hons.) Sem-8	Type: Minor (IFT)
Subject: Bioprocess Engineering-II	
Credit: 04	Total learning hours: 45 hr
Course description: This course provides a comprehensive concept of transport phenomena within bioreactors, focusing on mixing mechanics, heat transfer dynamics, and mass transfer. Special emphasis is placed on quantifying oxygen uptake rates and measuring volumetric mass transfer coefficients which is essential for fermenter scale-up. The curriculum bridges fundamental engineering with commercial biotechnology by study of production processes for high-value metabolites.	
Student Learning outcomes: (SLOs) After completion of this course, students will be able to; - Analyse fluid flow patterns, and impeller types for stirred-tank bioreactors. - Apply the principles of heat transfer to control the temperature in fermenter. - Evaluate and measure mass transfer and Oxygen transfer. - Formulate operational strategies for the large-scale industrial cultivation of microbial biomass, commercial vitamins, and industrial enzymes.	

References:

- Crueger, W., & Crueger, A. (1990). *Biotechnology: A textbook of industrial microbiology*. Sinauer Associates. ISBN: 978-0-87893-131-6
- Doran, P. M. (1995). *Bioprocess engineering principles*. Academic Press. ISBN: 978-0-12-220851-5
- Waites, M. J., Morgan, N. L., Rockey, J. S., & Higon, G. (Eds.). (2002). *Industrial microbiology: An introduction*. Blackwell Science. ISBN: 978-0-632-05307-0
- Welty, J., Rorrer, G. L., & Foster, D. G. (2008). *Fundamentals of momentum, heat, and mass transfer* (5th ed.). John Wiley & Sons. ISBN: 978-0-470-12868-8

Further Reading

- Baltz, R. H., Demain, A. L., & Davies, J. E. (Eds.). (2010). *Manual of industrial microbiology and biotechnology*. American Society for Microbiology Press. ISBN: 978-1-55581-512-7
- Mohanty, K., & Sasmal, S. (2025). *Biochemical reaction engineering*. CRC Press. ISBN: 978-1-003-58111-6
- Okafor, N., & Okeke, B. C. (2017). *Modern industrial microbiology and biotechnology*. Science Publishers. ISBN: 978-1-57808-513-2



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Unit: 1: Mixing **(07 Hrs.)**

- 1.1. Function of Mixing
- 1.2. Mixing equipment
- 1.3. Flow Patterns in Stirred Tank
- 1.4. Impellers
- 1.5. Mechanisms of Mixing
- 1.6. Assessment of Mixing Effectiveness

Unit: 2: Heat Transfer **(07 Hrs.)**

- 2.1 Concept of heat transfer
- 2.2 Heat transfer equipment
- 2.3 Mechanisms of Heat transfer
- 2.4 Heat Conduction
- 2.5 Heat transfer between fluids

Unit: 3: Mass Transfer **(07 Hrs.)**

- 3.1 Concept of Mass transfer
- 3.2 Molecular diffusion
- 3.3 Analogy between Mass, Heat, and Momentum Transfer
- 3.4 Role of Molecular diffusion in bioprocessing
- 3.5 Film theory
- 3.6 Convective mass transfer
- 3.7 Mass Transfer Equipment

Unit: 4: Oxygen Transfer in fermenter **(08 Hrs.)**

- 4.1 Oxygen uptake in cell culture
 - 4.1.1 Factors Affecting Cellular Oxygen Demand
 - 4.1.2 Mass Oxygen transfer from Gas Bubble to Cell in fermenter
- 4.2 Factors Affecting Oxygen Transfer in Fermenter
- 4.3 Measuring DO Concentration
- 4.4 Measurement of $K_L a$
 - 4.4.1 Oxygen Balance Method
 - 4.4.2 Dynamic Method
 - 4.4.3 Sulphite Oxidation
- 4.5 Measurement of Oxygen Uptake Rate

Unit: 5: Bioproduction of Commercially Important Products: I **(08 Hrs.)**

- 5.1 Production strain and Production Process of amino acids
 - 5.1.1 L-Glutamate
 - 5.1.2 L-Lysine
 - 5.1.3 L-Threonine
- 5.2 Production strain and Production Process of amino acids
 - 5.2.1 Penicillin
 - 5.2.2 Cephalosporins
- 5.3 Microbial Production of Natural Food Preservatives



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Unit: 6: Bioproduction of Commercially Important Products: II (08 Hrs.)

6.1 Microbial Production of Vitamins

6.1.1 Vitamin B12

6.1.2 Riboflavin

6.2 Microbial Production of Enzymes

6.2.1 Amylase

6.2.2 Proteases

6.3 Microbial Biomass Production

6.3.1 Baker's Yeast

6.3.2 Single Cell Protein (SCP)

List of Practical

1. Determination of k_La
2. Microbial Production of Amylase
3. Microbiological assay of amino acid / vitamin / antibiotic.



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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc(Hons.) / (Hons. with Research) All		
Course Type	Minor		Version	1.0		
Semester	08		Effective From	June, 2026		
Course Code	BSMB12803	Course Name	Clinical Laboratory Management (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
3	3 hrs	0	0 hrs	50	50	100

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc(Hons.) / (Hons. with Research) All		
Course Type	Minor		Version	1.0		
Semester	08		Effective From	June, 2026		
Course Code	BSMB12804	Course Name	Clinical Laboratory Management (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
1	0 hrs	0	2 hrs	50	50	100



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Sem-VII and VIII

Name of faculty: Science	Department: Microbiology
Program: B. Sc. (Hons.) Sem-8	Type: Minor (MLT)
Subject: Clinical Laboratory Management	
Credit: 4	Total learning hours: 45
Course description: The main objective of this paper is to build the capacity of lab managers to enable them to manage their lab services efficiently and effectively using fundamentals of management. Also included topics like total quality management, GLP & Accreditation to enhance the knowledge in this field.	
Student learning outcome: • The students will understand various lab operations, costing, investment analysis and these will equip them with better decision-making skills in delivering good quality services. • Also know basics of service quality, efficiencies and professionalism in lab management • Understand standards of laboratory practice.	

Reference Book:

- P.B. Godkar, (2014), Textbook of Medical Laboratory Technology, 3rd ed., Bhalani Publishing House, Mumbai, India. (ISBN: 9789381496190)
- Cheesbrough Monica ,District laboratory practice in tropical countries VOL-1 & 2, Cambridge University Press.(ISBN: 9780521665476)
- Shubhangi Tambwekar (2009), Handbook of Quality Assurance in Laboratory Medicine, BI Pub. (ISBN: 9788172253158)
- WHO (2011): Laboratory quality management system: handbook (ISBN: 978924 1548274)
- Endris Mekonnen (2004), Health Laboratory Management and Quality Assurance, Ethiopia Public Health Training Initiative (EPHTI).
- Ochei J. & Kolhatkar A. (2000), *Medical Laboratory Science: Theory & Practice*, Tata McGraw Hill Pub. (ISBN: 9780074632239)

Unit-1: Introduction to Clinical Laboratory Management and Organization. (07 Hrs)

- 1.1 Definition and General Principles
- 1.2 Concepts and function of Management
- 1.3 Laboratory Structure
- 1.4 Role of Laboratory in Health Care and Training of Laboratory Personnel
- 1.5 Code of Conduct

Unit-2: Laboratory Biosafety and waste management (07 Hrs)

- 2.1 Source of Laboratory Hazards
- 2.2 Code of safe Laboratory Practice



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- 2.3 Safe Laboratory premise & personal safety measures
- 2.4 Biosafety levels & Biosafety cabinet
- 2.5 Bio medical waste management

Unit-3: Human Resource & Financial Management (07 Hrs)

- 3.1 Human Resource Management: Staff training, competency assessment and continuing medical education (CME).
- 3.2 Selection of tests & interpretation of test results
- 3.3 Financial Planning
- 3.4 Selection, procurement & care of equipment

Unit-4: Documents, Records & Information Management (07 Hrs)

- 4.1 Introduction to documents and records
- 4.2 Quality Manual
- 4.3 Storage and control of documents and records
- 4.4 Elements of information management
- 4.5 Manual & Computerized laboratory information systems

Unit-5: Quality Management Systems (QMS) (10 Hrs)

- 5.1 Introduction to QMS: Fundamentals of Quality Assurance (QA), Quality Control (QC), and Total Quality Management (TQM)
- 5.2 Analytical Variables: Accuracy and Precision; Standard and Control; Sensitivity and Specificity; Types of Error; Standard Deviation, Co-Efficient of Variation
- 5.3 Internal and External Quality Control
- 5.4 Preparation of Quality Control Charts: Levy-Jenning Chart and Gaussian Curve; Cusum Chart
- 5.5 Westgard Multirule Charts

Unit-6: Good Laboratory Practices (GLP) & Accreditation Process (07 Hrs)

- 6.1 Introduction to Basics of GLP
- 6.2 Standard Operating Procedures (SOPs)
- 6.3 Criteria, process & advantages of Accreditation
- 6.4 Audit- Internal & External
- 6.5 Accreditation & Standards: Study of national and international standards (e.g., NABL, ISO 15189, CAP, CLIA).

List of Practical

- 1. Preparation of Levy-Jenning Chart
- 2. Use of Westgard rules for internal quality control
- 3. Formulation of SOP of any one routine laboratory procedure



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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc(Hons.) / (Hons. with Research) All		
Year	2026		Version	1.0		
Semester	VIII		Effective From	June, 2026		
Course Code	BSCH12801	Course Name	Minor: Modern Instrumentation for Analysis (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CCE)	Semester end examinations (SEE)	Total
3	3	-	-	40	35	75

Purpose of Course	This course paper proposes to teach about Principle, Instrumentation and Applications of various spectroscopy and chromatographic techniques and advanced instrumentation techniques.
Course Objective	To teach the students about UV-VIS, AA, ICP-OE and Mossbauer Spectroscopy, NDIR, Elemental Analyzer, TOC, GC, HPLC and IEC Instrumentation Techniques.
Pre-requisite	12 th Science Pass/ B.Sc. Chemistry Pass
Course Out come	At the end of the course students will be able to... Learn about the History, origin, laws, principles, theories, instrumental set up, its' working mechanism, various components and it's working pattern, procedure of analysis and applications in the various field of analysis about: • UV-Visible Spectroscopy • Atomic Absorption Spectrometry • Optical Emission Spectrometry • Advanced Instrumentation Techniques • Gas Chromatography • High Performance Liquid Chromatography • Ion Exchange and Ion Exclusion Chromatography



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Course Content	Unit-1: UV-Visible Spectroscopy (11 Hrs) 1.1 Characteristics of electromagnetic spectrum 1.2 Origin of spectra and electronics transitions 1.3 Classification of electronic transition 1.4 The chromophore concepts 1.5 Absorption and intensity shifts 1.6 Laws of absorption of radiation - Lambert & Beer's law and its deviation 1.7 The Instrumentation of a spectrophotometer 1.8 Calibration curve and standard addition method - multi component analysis 1.9 Applications of UV-Visible (electronic) spectroscopy Unit-2: Atomic Absorption Spectrometry (08 Hrs) 2.1 The history & principle of atomic absorption spectroscopy 2.2 AAS – Instrumentation 2.2.1 Radiation sources: line & continuum 2.2.2 Atomization techniques: FAAS & GFAAS 2.2.3 Wavelength selector: monochromator 2.2.4 Detectors: PMT 2.2.5 Single & double beam AAS 2.5 Applications of atomic absorption spectrometry Unit-3: Optical Emission Spectrometry (07 Hrs) 3.1 Introduction and principle 3.2 Atomic spectroscopic sources 3.3 Inductively coupled plasma - the discharge 3.4 ICP-OES Instrumentation 3.4.1 Nebulizers 3.4.2 Spray Chambers 3.4.3 Sample introduction systems 3.4.4 Optics and the spectrometer Emission detectors 3.5 Applications of ICP-OES Unit-4: Modern Instrumentation Techniques (05 Hrs) 4.1 Principle, Instrumental set up & Applications of 4.2 Non dispersive IR (gas analyzer) 4.3 Modern elemental analyzer 4.4 Total organic carbon analyzer 4.5 Mossbauer Spectroscopy Unit-5: Gas Chromatography (08 Hrs) 5.1 Introduction of chromatography and principle of separation 5.2 Classification -GSC and GLC & its applications
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	5.3 Components of instruments: carrier gas, sample injection system, stationary and mobile phase 5.4 Columns - packed column and capillary column - WCOT, SCOT, PLOT 5.5 Detectors - FID, TCD, ECD, ASD 5.6 Principle and applications of GC-HS, GC-MS Unit-6: High Performance Liquid Chromatography (06 Hrs) 6.1 Introduction, principle and types of HPLC 6.2 Components of instruments: pumps 6.3 Sample injection system 6.4 Column 6.5 Detector: ultra violet light absorption, refractive index, evaporative light scattering 6.6 Selective applications in separation and estimations 6.7 Principle and applications of LC-MS
Practical	-
Reference Books	• Engineering Chemistry, P.C. Jain & Monica Jain, 17th Edition, Reprint 2011, Dhanpatrai Publishing Company (P) Ltd. • Handbook of Analytical Instrument, R.S. Khandpur, 2nd Edition, Reprint 2009, Tata McGraw Hill Publishers. • Instrumental Methods of Chemical Analysis (Analytical Chemistry), H. Kaur, 8th Edition, 2012. Pragati Prakashan. • Basic Concepts of Analytical Chemistry, S.M. Khopkar, 3rd Edition, Reprint 2009, New Age International (P) Limited, Publishers. • Analytical Instrumentation Handbook, Ewing's, Edited by Jack Cazes. - o 3rd Edition, 2005, Marcel Dekker Publisher. • Instrumental Methods of Analysis, H. H. Willard, L. L. Meritt, J.A. Dean and F.A. Settle, 7th Edition, 1986, CBS Publishers. • Instrumental methods of analysis, B.K. Sharma, 24th Edition, 2005, - o Goel Publishing House. • Instrumental Analysis, D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, 11th Edition, Reprint 2012, Cengage Learning. • 9. BIOS-Instant Notes-Analytical Chemistry, D. Kealey, P.J. Haines, 2002, Viva Books (P) Ltd. • 10. Analytical Instrumentation, Bela G. Liptak, 1st Edition, 1994, 1st Indian Reprint, 2012. Chilton Book Company. • 11. Theory and Practicals of Engineering Chemistry, Shashi Chawla, 5th Edition, 2008, Dhanpat Rai & Co. Pvt. Ltd.



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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc(Hons.) / (Hons. with Research) All		
Year	2026		Version	1.0		
Semester	VIII		Effective From	June, 2026		
Course Code	BSCH12802	Course Name	Minor: Modern Instrumentation for Analysis (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CCE)	Semester end examinations (SEE)	Total
1	-	-	2	10	15	25

Purpose of Course	To provide hands on training to students for laboratory experiments in Chemistry and Modern Instrumentation.
Course Objective	To do different analysis by using Modern Instrumentation Techniques.
Prerequisite	12 th Science Pass/ B.Sc. Chemistry Pass
Course Out come	At the end of this course the students will be able to do Chemical Analysis by using UV-Vis Double Beam spectrophotometer of various parameters and hands on training of AAS, ICP-OES, NDIR, Elemental Analyzer, TOC, GC, HPLC and IEC, etc.
Course Content	-
Practical	Any three 1. Determination of Phenol in water sample by Spectrophotometer. 2. Determination of Silica in water sample by Spectrophotometer. 3. Determination of Ni^{+2} in water sample by Spectrophotometer. 4. Determination of F^{-1} in water sample by Spectrophotometer. 5. To determine NO_3^{-1} of water sample. 6. Determination of NH_3 in water sample by Spectrophotometer.



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Reference Books	• Standard Methods for Examination of Water & Wastewater, Andrew D. Eaton, Lenore S. Clesceri, Eugene W. Rice, Arnold Greenberg, 23rd Edition, 2017, published by APHA, AWWA, WEF. • Official Methods of Analysis, Dr. William Harwitz, Dr. George W Latimer, 18th Edition, 2005, published by Association of Officiating Analytical Chemists (AOAC). • Analytical Techniques in Agriculture, Biotechnology and Environmental Engineering; A. Nag; 1st Edition, 2006, Prentice Hall of India. • Analytical Chemistry, H. Kaur, 1st Edition, 2013, Pragati Prakashan.
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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc(Hons.) / (Hons. with Research) All		
Course Type	Minor		Version	1.0		
Semester	08		Effective From	June, 2026		
Course Code	BSES12801	Course Name	Forest and Wildlife Management (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
3	3 hrs	0	0 hrs	50	50	100

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc(Hons.) / (Hons. with Research) All		
Course Type	Minor		Version	1.0		
Semester	08		Effective From	June, 2026		
Course Code	BSES12802	Course Name	Forest and Wildlife Management (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
1	0 hrs	0	2 hrs	50	50	100



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Subject code: Minor	Department: Environmental Science
Program: B. Sc.	Type of Subject: Theory
Subject: Forest and Wildlife Management	
Semester-8	
Course Description: The course is designed to: 1. Develop an understanding of forest ecosystems, biodiversity, and wildlife resources. 2. Introduce scientific principles and practices of sustainable forest and wildlife management. 3. Familiarize students with forest policies, legislation, protected area management, and community participation. 4. Explain the role of forests and wildlife in climate change mitigation, ecosystem services, and sustainable development. 5. Develop knowledge of wildlife conservation techniques, habitat restoration, and human-wildlife conflict management. 6. Promote practical skills in forest inventory, biodiversity assessment, and conservation planning using modern technologies.	
Student Learning Outcomes (SLOs): At the end of the course, students will be able to: 1. Explain the structure, composition, and ecological significance of forest ecosystems. 2. Apply principles of sustainable forest and wildlife management. 3. Assess biodiversity, forest health, and wildlife habitats using scientific methods. 4. Interpret forest policies, wildlife laws, and conservation strategies. 5. Evaluate the impacts of climate change, deforestation, and habitat fragmentation. 6. Design management strategies for conservation of forests and wildlife using geospatial and digital technologies.	

Reference:

1. Khanna, L. S. *Principles and Practice of Silviculture*. Khanna Bandhu.
2. Manikandan, K. & Prabhu, S. *Indian Forestry*. Jain Brothers.
3. Negi, S. S. *Forest Management in India*. International Book Distributors.
4. Wildlife Institute of India. *Wildlife Management Training Manuals*.
5. ICAR. *Handbook of Agriculture*.
6. FAO. *Sustainable Forest Management Toolbox*.
7. Ministry of Environment, Forest and Climate Change (MoEFCC). *National Forest Policy, Wildlife Action Plan and Forest Conservation Guidelines*.



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Unit 1: Introduction to Forests and Wildlife (7 Hours)

- 1.1 Forest ecosystem: concept, structure, functions and ecosystem services
- 1.2 Forest types of India and Gujarat; forest resources and biodiversity
- 1.3 Wildlife diversity, ecological importance and trophic interactions
- 1.4 Role of forests in climate regulation, carbon sequestration and Sustainable Development Goals (SDGs)

Unit 2: Forest Management Principles (8 Hours)

- 2.1 Concept, objectives and principles of sustainable forest management
- 2.2 Silvicultural systems, natural regeneration and artificial regeneration
- 2.3 Forest inventory, mensuration and forest resource assessment
- 2.4 Social forestry, agroforestry, joint forest management (JFM) and community participation

Unit 3: Wildlife Ecology and Conservation (7 Hours)

- 3.1 Wildlife ecology, habitat requirements and population dynamics
- 3.2 Protected area network: National Parks, Wildlife Sanctuaries, Biosphere Reserves and Conservation Reserves
- 3.3 Wildlife census and monitoring techniques
- 3.4 Endangered species conservation, captive breeding and species recovery programmes

Unit 4: Forest and Wildlife Protection (8 Hours)

- 4.1 Threats to forests and wildlife: deforestation, habitat degradation, invasive species and forest fires
- 4.2 Human-wildlife conflict: causes, impacts and mitigation measures
- 4.3 Forest health management, pest and disease control
- 4.4 Forest restoration, ecological restoration and landscape management

Unit 5: Forest Policy, Legislation and Governance (7 Hours)

- 5.1 National Forest Policy (1988 and recent developments). National Wildlife Action Plan
- 5.2 Indian Forest Act, 1927; Forest (Conservation) Act, 1980; Wildlife (Protection) Act, 1972; Biological Diversity Act, 2002
- 5.3 Forest Rights Act, 2006 and participatory forest governance
- 5.4 Role of Forest Department, National Biodiversity Authority, State Biodiversity Boards and local communities

Unit 6: Emerging Trends in Forest and Wildlife Management (8 Hours)

- 6.1 Climate change adaptation and mitigation in forestry
- 6.2 Remote sensing, GIS, GPS, drones and digital technologies in forest and wildlife management
- 6.3 Carbon forestry, REDD+, ecosystem restoration and nature-based solutions
- 6.4 Ecotourism, sustainable livelihood, non-timber forest products (NTFPs) and green entrepreneurship

Practicals

1. Measurement of tree density, frequency, abundance, basal area and Importance Value Index (IVI) using quadrat or transect methods.
2. Identification of common forest flora and fauna and preparation of a biodiversity inventory.
3. Identification of common wildlife species and indirect evidences (pugmarks, hoof marks, feathers, nests, pellets and scats) using museum specimens and photographs.
4. Preparation and analysis of wildlife census data using quadrat and line transect methods (calculation of density, abundance and population estimates from sample datasets).
5. Identification of wildlife diseases and parasites using preserved specimens, photographs and microscopic slides.



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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc(Hons.) / (Hons. with Research) All		
Course Type	Minor		Version	1.0		
Semester	08		Effective From	June, 2026		
Course Code	BSES12803	Course Name	Occupational Health and Industrial Safety (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
3	3 hrs	0	0	40	35	75

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc(Hons.) / (Hons. with Research) All		
Course Type	Minor		Version	1.0		
Semester	08		Effective From	June, 2026		
Course Code	BSES12804	Course Name	Occupational Health and Industrial Safety (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
1	0	0	2 hrs	10	15	25



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Subject code: Minor	Department: Environmental Science
Program: B. Sc.	Type of Subject: Theory + Practical
Subject: Occupational Health and Industrial Safety	
Semester-8	
Course Description: 1. This course provides a comprehensive understanding of occupational health and safety principles, workplace hazards, risk assessment, occupational diseases, industrial hygiene. 2. It develops examine ability of students impact of workers, workplace environments, industrial processes, machinery, chemicals, biological agents, and organizational practices that influence occupational health and safety. 3. The course also introduces occupational health surveillance, personal protective equipment, workplace monitoring, accident investigation, safety audits. emergency response, and relevant Indian occupational health and safety legislation.	
Student Learning Outcomes (SLOs): 1. Recognize major classes of occupational and environmental contaminants and how to apply to them the basic industrial hygiene tenets of anticipation, recognition, evaluation and control. 2. Correctly use and handle basic industrial hygiene assessment and analysis instrumentation and will understand the types and selection of Personal Protective Equipment used in practice	

References and Textbooks: (With Author, Edition, Publishers, ISBN)

1. M. H. Fulekar (I.K. International Publishing House Pvt. Ltd., New Delhi), Industrial Hygiene and Chemical Safety. ISBN: 81-88237-92-2.
2. Koren Herman and Bisesi Michael (Lewis Publishers), Handbook of Environmental Health. Volume 1 and 2. ISBN: 1-56670-536-3.
3. Gatchel Robert J. and Schultz Izabela Z. (Springer Publications) Handbook of Occupational Health and Wellness. ISBN: 978-1-4614-4838-9
4. Farzana Zahir (Bentham Books) Frontiers in occupational health and safety. Introduction to occupational health hazards. Volume 1 and 2. ISBN: 978-981-14-0690-4.

UNIT-1: Industrial Hygiene and Chemical Safety

07 Hours

- 1.1 Industrial Hygiene, principles and practices
- 1.2 Chemical agents at workplace
- 1.3 Chemical Safety
- 1.4 Occupational Safety and Health Legislations - OHSAS18001, ILO Conventions, The Factories Act, 1948, Water (Prevention & control of pollution) Act, 1974, Air (Prevention & control of pollution) Act, 1981 and Rules. Environment protection Act 1986 (Amended)



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UNIT-2: Concept of Industrial Hygiene **08 Hours**

- 2.1 Introduction
- 2.2 Industrial hygiene and Industrial hygienist
- 2.3 Recognition, Evaluation, Monitoring and Control of Industrial Hygiene
- 2.4 Physical and Chemical Classification of Airborne Contaminants

UNIT-3: Physical and Chemical Stress in Industry **07 Hours**

- 3.1 Introduction
- 3.2 Physical Stress: Noise, Vibrations, Heat and Illumination
- 3.3 Chemical Stress: Paining, Metal Coating, Electroplating
- 3.4 Basic preventive measures
- 3.5 Proposed Biological Monitoring Methods in Occupational Exposure
- 3.6 Benefits of Environmental Monitoring

UNIT-4: Occupational Diseases **08 Hours**

- 4.1 Pneumoconiosis
- 4.2 Silicosis
- 4.3 Asbestosis
- 4.4 Lead and its Compounds
- 4.5 Mercury, Chromium and its Compounds

UNIT-5: Operational Control Measures **08 Hours**

- 5.1 Introduction and Operation Control
- 5.2 Air Pollution Control Measures
- 5.3 Plant Strategies
- 5.4 Air Sampling Calibration
- 5.5 Interpretation of results

UNIT-6: Personal Protective Equipment **08 Hours**

- 6.1 Introduction, legal requirements and selection guidelines
- 6.2 Head, eye and face protection
- 6.3 Hand, leg and foot protection
- 6.4 Respirators and canisters
- 6.5 Indian Standards on Personal Protective Equipment

Practicals:

1. Assessment of air flora of different places by gravity settling technique.
2. Study of safety in industries by suggesting safety measures and PPE.
3. Prepare OHS Policy for a medium sized organization.
4. Prepare an Organisation Chart & define roles & responsibilities.
5. Conduct any two Active monitoring systems & make a report: (a) Site Inspection (b) Survey of Safe Systems (c) Health surveillance of workers.



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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons) (Biotechnology)		
Course Type	SEC		Version	1.0		
Semester	08		Effective From	June, 2026		
Course Code	BSBT15801	Course Name	Research Methodology - 2			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
2	2 hrs	0	0 hrs	25	25	50



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Faculty: Science	Department: Env. Sc. and Biotech.
Program: B.Sc. (Hons with Research)	Type: SEC
Subject: Research Methodology-2	
Semester: 8	

References:

1. Ghosh, B. N. (1982). *Scientific method and social research*. Sterling Publishers.
2. Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International.

Unit 1: Conceptual Foundation

(06 hours)

- 1.1 Constituents and theoretical perspectives
- 1.2 Approaches to inquiry
- 1.3 Strategies and process
- 1.4 Hypothesis: its types and sources
- 1.5 Nature, sources and types of data
- 1.6 Measurement scales of variables

Unit 2: Philosophy of Scientific research

(08 hours)

- 2.1 Positivist philosophy of science and its criticism
- 2.2 Karl Popper and Thomas Kuhn's philosophy of science
- 2.3 Definition, need and purpose of research
- 2.4 Conceptual framework of research
- 2.5 Basic and applied research
- 2.6 General characteristics of modern research
- 2.7 Criteria for selecting a topic and Scientific method

Unit 3: Planning of research

(08 hours)

- 3.1 Criteria of scientific research
- 3.2 Purpose and development of theory
- 3.3 Scope of research in biology
- 3.4 Stages and process of research
- 3.5 Sources of data
- 3.6 Sample design
- 3.7 Survey research
- 3.8 Experimental research

Unit 4: Methods of research

(08 hours)

- 4.1 Planning and process of observation
- 4.2 Types of observation
- 4.3 Questionnaire method
- 4.4 Pre-testing and distribution of questionnaires
- 4.5 Interviewing method
- 4.6 Parts and planning of experimental research
- 4.7 Laboratory vs Field experiment
- 4.8 Experiment design



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Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc (Hons. with Research) Biotechnology		
Course Type	Research Project		Version	1.0		
Semester	08		Effective From	June, 2026		
Course Code	BSBT18801	Course Name	Research Project - 2 (TH)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
2	2 hrs	0	0 hrs	25	25	50

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences						
Faculty	Science		Program	B.Sc. (Hons. with Research) Biotechnology		
Course Type	Research Project		Version	1.0		
Semester	08		Effective From	June, 2026		
Course Code	BSBT18802	Course Name	Research Project - 2 (PR)			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
4	0	0	8 hrs	40	60	100



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Faculty: Science	Department: Env. Sc. and Biotech.
Program: B.Sc. (Hons with Research)	Type: SEC
Subject: Research Project-2	
Semester: 8	

References:

1. Ghosh, B. N. (1982). *Scientific method and social research*. Sterling Publishers.
2. Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International.

Unit 1: Conceptual Foundation

(06 hours)

- 1.1 Constituents and theoretical perspectives
- 1.2 Approaches to inquiry
- 1.3 Strategies and process
- 1.4 Hypothesis: its types and sources
- 1.5 Nature, sources and types of data
- 1.6 Measurement scales of variables

Unit 2: Philosophy of Scientific research

(08 hours)

- 2.1 Positivist philosophy of science and its criticism
- 2.2 Karl Popper and Thomas Kuhn's philosophy of science
- 2.3 Definition, need and purpose of research
- 2.4 Conceptual framework of research
- 2.5 Basic and applied research
- 2.6 General characteristics of modern research
- 2.7 Criteria for selecting a topic and Scientific method

Unit 3: Planning of research

(08 hours)

- 3.1 Criteria of scientific research
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- 3.3 Scope of research in biology
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- 3.6 Sample design
- 3.7 Survey research
- 3.8 Experimental research

Unit 4: Methods of research

(08 hours)

- 4.1 Planning and process of observation
- 4.2 Type of observation
- 4.3 Questionnaire method
- 4.4 Pre-testing and distribution of questionnaires
- 4.5 Interviewing method
- 4.6 Parts and planning of experimental research
- 4.7 Laboratory vs Field experiment
- 4.8 Experiment design

