Department of Biological Sciences

B.Sc. (Hons.) Integrative Biology
Curriculum and Syllabus

(Applicable to the students admitted during AY: 2022-23)

School of Engineering and Sciences
SRM University *AP*, Andhra Pradesh

Department Vision

To integrate innovative teaching, cutting-edge research and creating an environment that inspires both learning and discovery. To emerge as a global leader in value-based education, interdisciplinary research and new ventures in the field of biological sciences.

Department Mission

1. Empower students with skills, knowledge, and ethics for success in the dynamic field of biological sciences, enabling them to address societal challenges.
2. Advancing the frontier of biological sciences through groundbreaking research and fostering pedagogical innovations to create interactive learning experiences.
3. Integrate academic excellence with entrepreneurial spirit to evolve into an interdisciplinary centre.

Program Educational Objectives (PEO)

1. Enhance understanding of biology fundamentals with a focus on key areas in modern biology.
2. Develop core competencies in critical thinking, hypothesis formation, and effective problem-solving.
3. Provide comprehensive training in the design, execution, and critical analysis of biological experiments.
4. Enhance students' employability and empower them to explore new realms within the field of biological sciences.

Mission of the Department to Program Educational Objectives (PEO) Mapping

	PEO 1	PEO 2	PEO 3	PEO 4
Mission Statement 1	3	3	2	3
Mission Statement 2	2	3	3	2
Mission Statement 3	1	2	2	3

Program Specific Outcomes (PSO)

1. Apply foundational principles of biological concepts into practical applications.
2. Design and conduct experiments to address biological questions effectively.
3. Enhance career opportunities in industries, research, and teaching within the field of biological sciences.

Mapping Program Educational Objectives (PEO) to Program Learning Outcomes (PLO)

Program Learning Outcomes (PLO)															
PEOs	POs												PSOs		
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
PEO 1	3	2	1	2	1	1	2	1	1	1	1	2	3	2	2
PEO 2	2	3	3	2	2	2	1	2	3	2	2	2	2	3	2
PEO 3	3	3	2	3	3	2	2	1	2	2	2	2	2	3	2
PEO 4	2	2	1	2	1	3	2	3	3	3	3	3	2	2	3

Category Wise Credit Distribution			
Course Sub-Category	**Sub-Category Credits**	**Category Credits**	**Learning Hours**
Ability Enhancement Courses (AEC)		2	60
University AEC	0		
School AEC	2		
Value Added Courses (VAC)		4	120
University VAC	4		
School VAC	0		
Skill Enhancement Courses (SEC)		14	420
School SEC	6		
Department SEC	2		
SEC Elective	6		
Foundation / Interdisciplinary courses (FIC)		28	840
School FIC	28		
Department FIC	0		
Core + Core Elective including Specialization (CC)		85	2550
Core	73		
Core Elective (Inc Specialization)	12		
Minor (MC) + Open Elective (OE)	15	15	450
Research / Design / Internship/ Project (RDIP)		12	360
Internship / Design Project / Startup / NGO	0		
Internship / Research / Thesis	12		
Total		**160**	**4800**

Semester wise Course Credit Distribution Under Various Categories										
Category	**Semester**									
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**	**%**
Ability Enhancement Courses - AEC	0	0	2	0	0	0	0	0	2	1
Value Added Courses - VAC	0	0	0	0	0	4	0	0	4	3
Skill Enhancement Courses - SEC	1	3	2	2	3	3	0	0	14	9
Foundation / Interdisciplinary Courses - FIC	20	8	0	0	0	0	0	0	28	18
CC / SE / CE / TE / DE / HSS	0	12	12	12	16	16	17	0	85	53
Minor / Open Elective - OE	0	0	3	3	3	3	3	0	15	9
(Research / Design / Industrial Practice / Project / Thesis / Internship) - RDIP	0	0	0	0	0	0	0	12	12	8
Grand Total	**21**	**23**	**19**	**17**	**22**	**26**	**20**	**12**	**160**	**100**

Note: L-T/D-P/Pr and the class allocation is as follows.

a) Learning Hours : 30 learning hours are equal to 1 credit.

b) Lecture/Tutorial : 15 contact hours (60 minutes each) per semester are equal to 1 credit.

c) Discussion : 30 contact hours (60 minutes each) per semester are equal to 1 credit.

d) Practical : 30 contact hours (60 minutes each) per semester are equal to 1 credit.

e) Project : 30 project hours (60 minutes each) per semester are equal to 1 credit.

SEMESTER - I								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	FIC	S FIC	BIO 114	A Primer to Biology	3	0	0	3
2	FIC	S FIC	BIO 114L	Practical Biology	0	0	1	1
3	FIC	S FIC	CHE 115	Introduction to Chemistry	3	1	0	4
4	FIC	S FIC	CSC 108	Introduction to Computer Science and Programming Using C	3	0	0	3
5	FIC	S FIC	CSC 108L	Introduction to Computer Science and Programming Using C Lab	0	0	1	1
6	SEC	S SEC	ISES 101	Industry Specific Employability Skills-I	**0**	0	1	1
7	FIC	S FIC	MAT 104	Introduction to Mathematics	4	0	0	4
8	FIC	S FIC	PHY 103	Introduction to Physics	3	0	0	3
9	FIC	S FIC	PHY 103L	Introduction to Physics Lab	0	0	1	1
				Semester Total	**17**	**1**	**3**	**21**

SEMESTER - II								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	Core	CC	BIO 215	Biomolecules	3	0	0	3
2	Core	CC	BIO 216	Basic concepts in Microbiology	3	0	0	3
3	Core	CC	BIO 216L	Microbiology Lab	0	0	2	2
4	Core	CE	BIOE 006	Evolutionary Biology	4	0	0	4
5	FIC	S FIC	EGL 100	Introduction to Communicative English	4	0	0	4
6	SEC	S SEC	ENTR 100	Exploratory Learning and Discovery	0	0	1	1
7	FIC	S FIC	ENV 100	Introduction to Environmental Science	4	0	0	4
8	SEC	S SEC	ISES 102	Industry Specific Employability Skills-II	0	0	1	1
9	SEC	S SEC	RM 100	Introduction to Research	1	0	0	1
				Semester Total	**20**	**0**	**3**	**23**

SEMESTER - III								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	AEC	S AEC	AEC 106	Analytical Skills for Sciences	1	0	1	2
2	VAC	U VAC	VAC 103	Co-Curricular Activities	0	0	2	2*
3	VAC	U VAC	VAC 104	Community Service and Social Responsibility	0	0	2	2*
4	SEC	S SEC	SEC 102	Digital Literacy	1	0	1	2
5	Core	CC	BIO 201	Metabolism of Biomolecules	3	0	1	4
6	Core	CC	BIO 202	Cell Biology	3	0	1	4
7	Core	CC	BIO 203	Concepts of Genetics	3	0	1	4
8	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**14**	**0**	**9**	**19**

SEMESTER - IV								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	VAC	U VAC	VAC 103	Co-Curricular Activities	0	0	2	2*
2	VAC	U VAC	VAC 104	Community Service and Social Responsibility	0	0	2	2*
3	SEC	D SEC	SEC 106	Leadership for Professionals	2	0	0	2
4	Core	CC	BIO 204	Concepts of Molecular Biology	3	0	1	4
5	Core	CC	BIO 205	Experimental Methods of Biology	3	0	1	4
6	Core	CC	BIO 206	Introductory Biophysics	3	1	0	4
7	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**14**	**1**	**6**	**17**

SEMESTER - V								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	VAC	U VAC	VAC 103	Co-Curricular Activities	0	0	2	2*
2	VAC	U VAC	VAC 104	Community Service and Social Responsibility	0	0	2	2*
3	SEC	E SEC		Career Skills - I	3	0	0	3
4	Core	CC	BIO 301	Introduction to Developmental Biology	3	1	0	4
5	Core	CC	BIO 302	Genetic Engineering	2	1	0	3
6	Core	CC	BIO 303	Immunobiology	2	1	0	3
7	Core	CC	BIO 304	Genetic Engineering Lab	0	0	2	2
8	Core	CC	BIO 305	Plant and Animal Physiology	3	1	0	4
9	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**16**	**4**	**6**	**22**

SEMESTER - VI								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	VAC	U VAC	VAC 103	Co-Curricular Activities	0	0	2	2
2	VAC	U VAC	VAC 104	Community Service and Social Responsibility	0	0	2	2
3	SEC	E SEC		Career Skills - II	3	0	0	3
4	Core	CC	BIO 306	Introduction to Biotechnology	2	1	0	3
5	Core	CC	BIO 307	Fundamentals of Bioinformatics	2	1	0	3
6	Core	CC	BIO 308	Neurobiology	3	1	0	4
7	Core	CC	BIO 309	Introduction to Disease Biology	3	1	0	4
8	Core	CC	BIO 310	Bioinformatics Lab	0	0	2	2
9	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**16**	**4**	**6**	**26**

SEMESTER - VII								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	Core	CC	BIO 401	Minor Research Project	0	0	5	5
2	Elective	CE	CE	Core Elective				4
3	Elective	CE	CE	Core Elective				4
4	Elective	CE	CE	Core Elective				4
5	Elective	OE		Open Elective / Minor	3	0	0	3
				Semester Total	**12**	**0**	**5**	**20**

SEMESTER - VIII								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	RDIP	RDIP	BIO 405	Research Degree Project	0	0	12	12
				Semester Total	**0**	**0**	**12**	**12**

Specialization								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	Elective	CE	BIO 421	Signal transduction	3	0	1	4
2	Elective	CE	BIO 422	Introduction to Omics	3	0	1	4
3	Elective	CE	BIO 423	Cancer and stem cell biology	3	0	1	4
4	Elective	CE	BIO 424	Enzymology	3	0	1	4
5	Elective	CE	BIO 425	Biostatistics	3	0	1	4
6	Elective	CE	BIO 426	Ecology	3	0	1	4
7	Elective	CE	BIO 427	Population Genetics	3	0	1	4
8	Elective	CE	BIO 428	Proteomics	3	0	1	4
9	Elective	CE	BIO 429	Computational Biology	3	0	1	4
10	Elective	CE	BIO 430	Bio nanotechnology	3	0	1	4

Open Electives								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	OE	OE	BIO 241	Biochemical foundation of life	3	0	0	3
2	OE	OE	BIO 247	Cell Biology	3	0	0	3
3	OE	OE	BIO 248	Basic Microbiology	3	0	0	3
4	OE	OE	BIO 243	Human Physiology	3	0	0	3
5	OE	OE	BIO 244	Molecular Biology	3	0	0	3
6	OE	OE	BIO 245	Bioinformatics	3	0	0	3
7	OE	OE	BIO 242	Introductory Biology	3	0	0	3

Carrer Skill Courses								
S. No	**Category**	**Sub-Category**	**Course Code**	**Course Title**	**L**	**T/D**	**P/Pr**	**C**
1	SEC	E SEC	SEC 130	Career Exploration in Life Sciences	3	0	0	3
2	SEC	E SEC			3	0	0	3

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

A Primer to Biology

Course Code	BIO 114	**Course Category**	CC	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Department of Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Understanding the importance of studying biology and the evolution of complex biomolecules and life on Earth provides a foundation for science students to appreciate the biological principles and systems that utilise many fundamental processes from other branches of natural sciences.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Explain the importance of studying biology and the evolution of complex biomolecules and life on Earth.	2	80%	75%
Outcome 2	Explain the structure and functions of prokaryotic and eukaryotic cells, including organelles, and recognize the diversity of life.	2	80%	70%
Outcome 3	Describe membrane transport processes, cellular respiration, energy generation, photosynthesis, enzymes, vitamins, and hormones.	2	80%	70%
Outcome 4	Describe the structure and organization of DNA and chromosomes, and comprehend the central dogma of DNA replication, transcription, and translation.	2	75%	70%
Outcome 5	Explain the principles and applications of genomics, transcriptomics, proteomics, and metabolomics.	2	75%	70%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1		1							3			3	1	2
Outcome 2	2	3								3			3	3	2
Outcome 3	2	3	2	2					1				3	2	3
Outcome 4	2	3	2	2						3		2	3	2	2
Outcome 5	2	3		3	1	2			1			3	3	2	3
Course Average	**1.8**	**3**	**1.7**	**2.3**	**1**	**2**			**1**	**3**		**2.5**	**3**	**2**	**2.4**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
Unit 1	**Life: Origin, composition and chemistry**	**5**		
	Origin of complex Biomolecules and primitive cells	1	1	1, 2
	Chemical basis of life	1	1	1, 2
	Importance of carbon - synthesis by polymerization; importance of self assembly;	1	1	1, 2
	Importance of Water- synthesis by polymerization; importance of self assembly;	1	1	1, 2
	Selectively permeable membranes	1	1	1, 2
Unit 2	**Cell Biology**	**12**		
	Prokaryotes and eukaryotes (cell structures and organelles);	2	1, 2	1, 2
	Virus- lysogenic and lytic cycles;	3	2	1, 2
	Bacteria- typical bacterial cells, bacterial gene transfer- conjugation, transformation, and transduction	3	2	1, 2
	Antibiotic resistance- an emerging threat; Microbiome	3	2	1, 2
	Cell cycle- mitosis and meiosis.	1	2	1, 2
Unit 3	**Energy harvesting reactions by life forms**	**10**		
	The importance of energy in biological systems; Gibbs free energy ($\triangle$ G);	2	1,3	1, 2
	Biological reactions: Enzymes and their equilibrium constants (Keq);	2	3	1, 2
	Energy harvesting: Chemotrophic, Phototrophic;	2	3	1, 2
	Metabolism: Glycolysis, anaerobic and aerobic cellular respiration.	2	3	1, 2
	Fate of food in cellular energy cycle.	2	3	1, 2
Unit 4	**Molecular Biology**	**9**		
	Structure of DNA and organization of chromosomes;	2	4	1, 2
	Central dogma- replication, transcription, and translation in prokaryotes.	3	4	1, 2
	Mutations, cancer and hereditary diseases.	2	4	1, 2
	Introduction to genetic manipulation- concepts of restriction digestion, cloning	2	4	1, 2
Unit 5	**Bioinformatics**	**9**		
	Biological sequences and evolution of sequencing technologies.	3	5	3
	Utilization of sequence information in personalized medicine and disease detection.	3	5	3
	Structural Biology: Biomolecular structures and their databases.	3	5	3
Total Contact Hours		**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)				End Semester Exam (50%)
		CLA-1 (10%)	Mid-1 (15%)	CLA-2 (10%)	CLA-3 (15%)	
		Th	Th	Th	Th	Th
Level 1	Remember	100%	100%	100%	100%	100%
	Understand					
Level 2	Apply					
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Becker's World of the Cell, Global Edition, 9th Edition (2017). Jeff Hardin, Gregory Paul Lewis J. Kleinsmith. Pearson
2. Life: The Science of Biology, 11th Edition (2017). David Sadava, David M. Hillis, H. Craig Heller, Sally D. Hacker. SINAUER ASSOCIATES MACMILLAN.
3. Introduction to Bioinformatics (Chapman & Hall/CRC Computational Biology Series) (2006) by Anna Tramontano.

Other Resources

Course Designers

1. All Faculty Members, Department of Biological Sciences, SRM University – AP.

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Practical Biology

Course Code	BIO 114L	**Course Category**	CC	**L**	**T**	**P**	**C**
				0	0	1	1
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Understand and implement lab safety rules and proficiently handle micropipettes and pH meters for secure laboratory practices.
2. Develop skills in buffer preparation and gain familiarity with basic laboratory instruments, including microscopes, autoclaves, spectrophotometers, centrifuges, incubators, and laminar air-flow cabinets.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Demonstrate a thorough understanding of lab safety protocols and proficiently handle essential laboratory equipment, ensuring a secure working environment.	3	80%	75%
Outcome 2	Develop precision in using micropipettes and pH meters, successfully prepare buffers and growth media, and acquire skills in observing mitosis stages in onion root tips and thin plant specimens under a microscope.	3	70%	65%
Outcome 3	Gain competence in the operation and safety procedures of fundamental laboratory instruments, including microscopes, autoclaves, spectrophotometers, centrifuges, incubators, and laminar air-flow cabinets.	3	70%	65%
Outcome 4	Acquire practical expertise in culturing microorganisms from various sources (air, soil, coins, and skin), observe the preparation of growth media and plates through a demonstration, and master cell counting using a hemocytometer.	3	70%	60%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	3	3		1		3	3			3	1	3
Outcome 2	3	2	3	3	3		1	1	3				3	3	2
Outcome 3	3	3	3	3	3		1		3	3			3	3	3
Outcome 4	3	2	3	3	3		1	1	3	3			3	3	2
Average	**3**	**2.3**	**3**	**3**	**3**		**1**	**1**	**3**	**3**			**3**	**2.5**	**2.5**

Course Unitization Plan

Exp No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1.	Lab safety introduction Handling micropipettes and pH meter	5	1	1
2.	Preparation of buffers; Introduction to basic instrumentation: microscope, autoclave, spectrophotometer, centrifuge, incubators, and laminar air-flow cabinets	5	2	1
3.	Observing stages of mitosis in onion root tip. Observing thin specimens of plant samples under the microscope	5	3,4	1
4.	Preparation of growth media and plates (demonstration)	5		
5.	Culturing microorganisms from air, soil, coins, and skin	5	3,4	1
6.	Cell counting using hemocytometer	5	3,4	1
Total Contact Hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)			End Semester Exam (50%)
		Experiments (20%)	Record / Observation Note (10%)	Viva + Model (20%)	
Level 1	Remember	50%		50%	50%
	Understand				
Level 2	Apply	50%	100%	50%	50%
	Analyse				
Level 3	Evaluate				
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Practical Manual of Biochemistry. Sattanathan, Padmapriya, Balamuralikrishnan.

Other Resources

1. https://amrita.edu/course/biochemistry-practical/

Course Designers

1. Dr. Anil K Suresh, Associate Professor, Department of Biological Sciences, SRM University – AP.

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Introduction to Chemistry

Course Code	CHE 115	**Course Category**	FIC	**L**	**T**	**P**	**C**
				3	1	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Chemistry	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To distinguish the types of bonding and predict the shape of the molecules using the valence shell electron pair (VSEPR) model and molecular orbital (MO) theory.
2. To classify the states of matter and discuss their behavior and properties.
3. To explain the redox reactions and demonstrate their applications in the electrochemical cells
4. To explain the classification, nomenclature, and electronic properties of organic compounds.
5. To describe the different types of organic reactions and their purification techniques.
6. To discuss the structures and the properties of carbohydrates, amino acids, proteins and vitamins, and nucleic acids and list the toxicity of the metals

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Distinguish the types of bonding and predict the shape of the molecules using the valence shell electron pair (VSEPR) model and molecular orbital (MO) theory.	2	80%	85%
Outcome 2	Classify the states of matter and their behavior and properties	2	80%	80%
Outcome 3	Explain the redox reactions and demonstrate their application in the electrochemical cells.	3	80%	75%
Outcome 4	Classify electronic properties of organic compounds and reactions.	2	80%	70%
Outcome 5	Discuss the structures and the properties of carbohydrates, amino acids, proteins and vitamins, nucleic acids and can list the toxicity of the metals.	2	80%	75%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	2	2		2	2	1	3	2	2	2	2	2	2
Outcome 2	2	2	2	1		2	2	1	1	3	2	2	2	2	2
Outcome 3	2	2	1	1		2	3	3	3	3	2	1	2	2	1
Outcome 4	2	3	2	2		2	2	1	3	2	2	1	2	2	3
Outcome 5	2	2	1	1		2	3	3	2	2	2	1	2	2	2
Average	**2**	**2**	**2**	**1**		**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Chemical Bonding and Molecular Structure**	**8**		
	Importance and scope of chemistry (Central Science)	1	1	2
	Valence electrons, ionic bond, covalent bond, Hydrogen bond	1	1	2
	Valence bond theory	1	1	2
	The geometry of covalent molecules	1	1	
	VSEPR theory	1	1	2
	The concept of hybridization involving *s, p,* and *d* orbitals	1	1	2
	Shapes of some simple molecules	1	1	2
	Molecular orbital theory of homonuclear diatomic molecules (qualitative idea only)	1	1	2
	Tutorial 1	3	1	2
Unit 2	**States of Matter**	**12**		
	Three states of matter, intermolecular interactions Gases: The behavior of gases, changes in the volume of a gas with pressure; Boyle's law	1	2	1
	Change in volume of a gas with temperature; Charles's law	1	2	1
	Gay Lussac's law, Avogadro's law, Ideal gas law	1	2	1
	Empirical derivation of gas equation, Kinetic molecular theory	1	2	1
	Deviation from ideal gas law.	1	2	1
	Liquids – Liquid State – Vapour pressure, viscosity, and surface tension	1	2	1
	Introduction to solutions, different types of solutions	1	2	1
	Raoult's Law (change of state),	1	2	1
	Constant boiling mixtures (azeotropic mixtures (distillation)	1	2	1
	Nature and different types of solids including covalent, non-covalent ionic, and metallic solids	1	2	1
	Solids and their bonding, Band theory	1	2	1
	Application of crystalline materials in electronic devices.	1	2	1
	Tutorial 2	3	1	1
Unit 3	**Redox Reactions**	**8**		
	Concept of oxidation and reduction, redox reactions	1	3	2
	redox reactions	1	3	2
	Oxidation number, balancing redox reactions in terms of loss and gain of electron and change in oxidation numbers	1	3	2
	Applications of redox reactions	1	3	2
	Nomenclature applicable to electrochemical cells, viz., electromotive force, electrochemical series.	2	3	2
	Evolution of electrochemical cells: from voltaic cells to Li-ion battery	2	3	2
	Tutorial 3	3	3	2
Unit 4	**Basic Principles of Organic Chemistry**	**12**		
	General introduction, classification	1	4	3,4
	IUPAC nomenclature of organic compounds.	2	4	3,4
	Electronic displacements in a covalent bond	1	4	3,4
	Inductive effect, electrometric effect, resonance, and hyperconjugation	2	4	3,4
	Homolytic and heterolytic fission of a covalent bond	1	4	3,4
	Free radicals, carbocations, carbanions	1	4	3,4
	Electrophiles and nucleophiles	1	4	3,4
	Types of organic reactions	1	4	3,4
	Purification methods: Qualitative and quantitative analysis	2	4	3,4
	Tutorial 4	3	4	3,4
Unit 5	**Chemistry of Life**	**5**		
	Carbohydrates, Amino acids, peptide bonds	1	5	3,4
	Secondary and tertiary structures of proteins, enzymes, vitamins, Nucleic acids, bioinorganic chemistry	2	5	3,4
	Toxicity of heavy metals (Cu, Fe, As, Pb, Hg, Co, Cr, Cd, etc.),	2	5	3,4
	Tutorial 5	3	5	3,4
	Total Contact Hours	**60**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)				End Semester Exam (50%)
		CLA-1 (10%)	Mid-1 (15%)	CLA-2 (15%)	CLA-3 (10%)	
Level 1	Remember	40%	60%	40%	60%	30%
	Understand					
Level 2	Apply	60%	40%	60%	40%	70%
	Analyse					
Level 3	Evaluate					
	Create					
Total		100%	100%	100%	100%	100%

Recommended Resources

1. Peter Atkins, & Paula, J. de. Elements of Physical Chemistry 7th Ed., Oxford University Press (2014).
2. Concise Inorganic Chemistry: J.D. Lee (1999) 5th edition, Blackwell Science.
3. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press.

Other Resources

Course Designers

1. Dr. Mahesh Kumar Ravva, Asst. Professor, Dept. of Chemistry, SRM University – AP.
2. Dr. Pardha Saradhi Maram, Assoc. Professor, Dept. of Chemistry, SRM University – AP.

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Introduction to Computer Science and Programming Using C

Course Code	CSC 108	**Course Category**	CC	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CSE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Gain basic knowledge in C programming language.
2. Acquire knowledge on Decision making and functions in C.
3. Learn arrays, strings and pointers concept in C.
4. Understand the basics concepts of Structures, Union and File handling techniques using C Programming.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe C structures, enumerators, keywords, header files and operators	2	75 %	70%
Outcome 2	Illustrate Decision-Making statements and Functions.	3	70 %	65%
Outcome 3	Interpret arrays, strings, and pointers programming in C	3	70 %	65%
Outcome 4	Apply Structures, unions, File handling operations on different scenarios	3	70 %	65%
Outcome 5	Solve given projects based on C concepts	4	70 %	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	2	1									2	2	3
Outcome 2	3	3	2	1									3	2	3
Outcome 3	3	3	2	2									3	2	3
Outcome 4	3	3	2	2									3	2	3
Outcome 5	3	3	2	2								2	3	2	2
Average	**3**	**3**	**2**	**2**								**2**	**3**	**2**	**3**

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**INTRODUCTION TO COMPUTER SCIENCE**	**9**	1	1
	Fundamentals of Computing, Historical perspective, Early computers	2	1	1,2
	Computing machine. Basic organization of a computer: ALU, input-output units, memory, program counter - variables and addresses - instructions: store, arithmetic, input and output	2	1	1,2
	Problem solving: Algorithm / Pseudo code, flowchart, program development steps	2	1	1,2
	Computer languages: Machine, symbolic and high-level langua Level languages	1	1	1,2
	Creating and Running Programs: Writing, editing (any editor), compiling (gcc)	1	1	1,2
	linking, and executing in Linux environment	1	1	1,2
Unit 2	**C PROGRAMMING BASICS**	**9**		
	Structure of a C program, identifiers Basic data types and sizes. Constan Variables	1	1	1,2
	Arithmetic, relational and logical operators, increment and decrement operator's	1	1	1,2
	Conditional operator, assignment operator, expressions Type conversion	1	1	1,2
	Conditional Expressions Precedence and order of evaluation, Sample Programs.	1	1	1,2
	SELECTION & DECISION MAKING: if-else, null else, nested if, examp multi-way selection: switch, else-if, examples.	2	1	1,2
	ITERATION: Loops - while, do-while and for, break, continue,	1	1	1,2
	initialization and updating, event and counter controlled loops and examples.	2	1,2	1,2
Unit 3	**FUNCTIONS AND ARRAYS**	**10**		
	User defined functions, standard library functions	1	2,3	1,2
	Passing 1-D arrays, 2-D arrays to functions.	1	2,3	1,2
	Recursive functions - Recursive solutions for Fibonacci series, towers of Hanoi.	2	2,3	1,2
	C Pre-processor and header files	1	2,3	1,2
	Concepts, declaration, definition, storing and accessing elements	1	2,3	1,2
	one dimensional, two dimensional and multidimensional arrays	2	2,3	1,2
	array operations and examples, Character arrays and string manipulations	2	2,3	1,2
Unit 4	**POINTERS**	**10**		
	Concepts, initialization of pointer variables	1	3,4	1,2
	pointers as function arguments, passing by address, dangling memory, address arithmetic	2	3,4	1,2
	character pointers and functions, pointers to pointers	2	3,4	1,2
	pointers and multi-dimensional arrays, dynamic memory management functions	2	3,4	1,2
	command line arguments	1	3,4	1,2
Unit 5	**ENUMERATED, STRUCTURE AND UNION TYPES**	**7**		
	Structures - Declaration, definition, and initialization of structures, accessing structures	1	5	2, 3, 4
	nested structures, arrays of structures, structures and functions, pointers to structures,	1	5	2, 3, 4
	self-referential structures. Unions, typedef, bit-fields, program applications	2	5	2, 3, 4
	Bit-wise operators: logical, shift, rotation, masks.	1	5	2, 3, 4
	FILE HANDLING: Concept of a file, text files and binary files, formatted I/O, file I/O operations and example programs.	2	5	2, 3, 4
	Total Contact Hours	**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 50%				End Semester Exam 50%
		CLA-1 10%	Mid-1 20%	CLA-2 10%	CLA-3 10%	
Level 1	Remember	70%	60%	50%	40%	30%
	Understand					
Level 2	Apply	30%	40%	50%	60%	70%
	Analyse					
Level 3	Evaluate					
	Create					
Total		100%	100%	100%	100%	100%

Recommended Resources

1. The C programming Language by Brian Kernighan and Dennis Richie.
2. Programming in C, Pradip Dey and Manas Ghosh, Second Edition, OXFORD Higher Education, 2011.
3. Problem Solving and Program Design in C, Hanly, Koffman, 7th edition, PEARSON 2013.
4. Programming with C by R S Bichkar, Universities Press, 2012.

Other Resources

1. "Programming with C", Byron Gottfried, Mcgraw hill Education, Fourteenth reprint,2016

Course Designers

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Introduction to Computer Science and Programming using C Lab

Course Code	CSE 108 L	**Course Category**	CC	**L**	**T**	**P**	**C**
				0	**0**	1	**1**
Pre-Requisite Course(s)		**Co-Requisite Course(s)**	**CSC 108**	**Progressive Course(s)**			
Course Offering Department	CSE	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Learn and understand C programming basics and paradigm.
2. Acquire knowledge on decision making and functions in C.
3. Acquire knowledge on decision making, loop concept, control statements, arrays, string and functions using C.
4. Learn basics of Structures, Union, and File handling concepts in C.

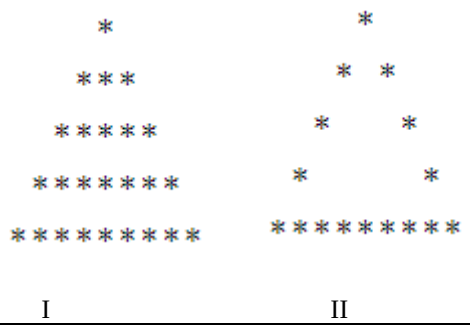
Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe fundamentals in C, enumerators, datatypes, vakeywords, header files and operators	2	75 %	70%
Outcome 2	Illustrate Decision-Making statements and Functions.	3	70 %	65%
Outcome 3	Interpret arrays, strings, and pointers programming in C	3	70 %	65%
Outcome 4	Apply Structures, unions, File handling operations on different scenarios	3	70 %	65%
Outcome 5	Solve given projects based on C concepts	4	70 %	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	3	3	3	2				2				3	2	
Outcome 2	2	2	3	3	2				2				2	2	
Outcome 3	2	3	3	2	2				2				2	2	
Outcome 4	3	3	3	3	2				3				2	3	
Outcome 5	2	3	3	3	3				3				2	2	
Average	**2**	**3**	**3**	**3**	**2**				**2**				**2**	**2**	

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**INTRODUCTION TO COMPUTER SCIENCE**	**4**		
	Lab Experiment 1: GCC Compiler using Linux, various Linux commands used to edit, compile and executing	2	1	1,2
	Lab Experiment 2: a) Calculation of the area of the triangle. b) Swap two numbers without using a temporary variable. c) Find the roots of a quadratic equation	2	1	1,2
Unit 2	**C PROGRAMMING BASICS**	**6**		
	Lab Experiment 3: a) Find the sum of individual digits of a positive integer and find the reverse of the given number. b) Generate the first n terms of Fibonacci sequence. c) Generate all the prime numbers between 1 and n, where n is a value supplied by the user.	2	1,2	1,2
	Lab Experiment 4: a) Print the multiplication table of a given number n up to a given value, where n is entered by the user. b) Decimal number to binary conversion. c) Check whether a given number is the Armstrong number or not.	2	1,2	1,2
	Lab Experiment 5: Triangle star patterns  I II	2	1,2	1,2
Unit 3	**FUNCTIONS AND ARRAYS**	**9**		
	Lab Experiment 6: **a)** (nCr) and (nPr) of the given numbers $1+x+x^2\2+x^3\3!+x^4\4!+\ldots\ldots\ldots X^n\n!$	2	2,3	1,2
	Lab Experiment 7: a) Interchange the largest and smallest numbers in the array. b. Searching an element in an array b. Sorting array elements.	2	2,3	1,2
	Lab Experiment 8: a. Transpose of a matrix. b.Addition and multiplication of 2 matrices.	2	2,3	1,2
	Lab Experiment 9: a. Function to find both the largest and smallest number of an array of integers. b. Liner search. c. Replace a character of string either from beginning or ending or at a specified location.	2	2,3	1,2
	Lab Experiment 10: Pre-processor directives a. If Def b. Undef c. Pragma	1	2,3	1,2

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 4	**POINTERS**	**6**		
	Lab Experiment 10: a. Illustrate call by value and call by reference. b. Reverse a string using pointers Compare two arrays using pointers	2	3, 4	1,2,3
	Lab Experiment 11: a. Array of Int and Char Pointers. Array with Malloc(), calloc() and realloc().	2	3, 4	1,2,3
	Lab Experiment 12: a. To find the factorial of a given integer. b. To find the GCD (greatest common divisor) of two given integers. c. Towers of Hanoi	2	3, 4	1,2,3
Unit 5	**ENUMERATED, STRUCTURE AND UNION TYPES**	**4**		
	Lab Experiment 13: a. Reading a complex number b. Writing a complex number. c. Addition of two complex numbers Multiplication of two complex numbers	2	5	2, 3, 4
	Lab Experiment 14: a. File copy b. Word, line and character count in a file.	2	5	2, 3, 4
Total Hours		**29**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)		End Semester Exam (50%)	
		Lab Record (20%)	Projects Presentations (30%)	Lab Record (20%)	Projects Presentations (30%)
Level 1	Remember	70%	60%	30%	40%
	Understand				
Level 2	Apply	30%	40%	70%	60%
	Analyse				
Level 3	Evaluate				
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. The C programming Language by Brian Kernighan and Dennis Richie.
2. Programming in C, Pradip Dey and Manas Ghosh, Second Edition, OXFORD Higher Education, 2011.
3. Problem Solving and Program Design in C, Hanly, Koffman, 7th edition, PEARSON 2013.
4. Programming with C by R S Bichkar, Universities Press, 2012.

Other Resources

1. Programming with C", Byron Gottfried, Mcgraw hill Education, Fourteenth reprint,2016

Course Designers

Biomolecules

Course Code	BIO 215	**Course Category**	DC	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Equip students with a foundational understanding of bioenergetic principles and the structure-function relationships of key biomolecules. This knowledge is crucial for understanding metabolic pathways, cellular processes, and the molecular basis of life, forming a cornerstone for advanced studies in biological sciences.
2. Develop the ability to integrate knowledge of biomolecules such as carbohydrates, lipids, proteins, and nucleic acids into the context of cellular function and organismal biology. This integration is essential for comprehending complex biological systems and for pursuing specialized fields such as molecular biology, biochemistry, and physiology within a Biological Science BSc program.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe knowledge of biomolecules and bioenergetic principles.	1	80%	75%
Outcome 2	Classify carbohydrates, lipids, amino acids, and proteins with structure-function correlation.	2	75%	70%
Outcome 3	Describe the structure and functions of nucleic acids (DNA, RNA) and their different forms.	1	80%	75%
Outcome 4	Relate acquired knowledge to solve biochemical problems, critically analyze data, and communicate effectively in both written and oral formats.	3	70%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	1	2	1	1		1	2	3		2	2	1	3
Outcome 2	3	3	2	3	2	2		1	2	3		2	3	2	3
Outcome 3	3	2	2	2	2	3	2	2	2	3		2	2	3	3
Outcome 4	3	3	3	3	3	3	2	1	3	3		3	3	3	3
Course Average	**3**	**2.5**	**2**	**2.5**	**2**	**2.3**	**2**	**1.3**	**2.3**	**3**		**2.3**	**2.5**	**2.3**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
1	UNIT I: Bioenergetics	**9**		
	Biomolecules: water- structure and properties, buffers, and their biological importance	3	1,4	**1,2,3**
	Principles of bioenergetics- laws of thermodynamics, entropy and enthalpy, standard free energy changes,	3	1,4	**1,2,3**
	standard reduction potentials,	2	1,4	**1,2,3**
	thermodynamics of coupled reactions.	1	1,4	**1,2,3**
2	UNIT II: Carbohydrates	**9**		
	Carbohydrates: definition and functions,	3	2,4	**1,2,3**
	classification, properties, monosaccharides,	3	2,4	**1,2,3**
	disaccharides, oligosaccharides,	2	2,4	**1,2,3**
	polysaccharides- homo- and hetero-polysaccharides.	1	2,4	**1,2,3**
3	UNIT III: Lipids	**9**		
	Lipids: Classification,	2	2,4	**1,2,3**
	structure and properties,	2	2,4	**1,2,3**
	phospholipids,	1	2,4	**1,2,3**
	glycolipids,	1	2,4	**1,2,3**
	sphingolipids,	1	2,4	**1,2,3**
	cholesterol,	1	2,4	**1,2,3**
	fatty acids- saturated and unsaturated fatty acids.	1	2,4	**1,2,3**
4	UNIT IV: Amino acids and Proteins	**9**		
	Amino Acids: Classification and properties,	2	2,4	**1,2,3**
	structure and properties of amino acids,	2	2,4	**1,2,3**
	essential and nonessential amino acids,	2	2,4	**1,2,3**
	proteins-classification and functions,	1	2,4	**1,2,3**
	levels of protein structure,	1	2,4	**1,2,3**
	haemoglobin,and myoglobin.	1	2,4	**1,2,3**
5	UNIT V: Nucleic Acids	**9**	3,4	
	Nucleic acids: Structure,	3	3,4	**1,2,3**
	purine and pyrimidine bases structure,	2	3,4	**1,2,3**
	properties and functions of nucleic acids (DNA, RNA)	2	3,4	**1,2,3**
	Different forms of DNA and RNA.	2	3,4	**1,2,3**
	Total	**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		CLA-3 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	80%		70%		70%		60%		50%	
	Understand										
Level 2	Apply	20%		30%		30%		40%		50%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Harper's Illustrated Biochemistry, V. W. Rodwell, D. Bender, K.M. Botham, P.J. Kennelly and P.A. Weil (2018) 31st edition, McGraw Hill-Medical.
2. Lehninger Principles of Biochemistry, D. L. Nelson and M. M. Cox, (2017) 7th edition, W.H. Freeman & Company.
3. Biochemistry: D. Voet and J.G. Voet (2011), 4th edition, Wiley.

Other Resources

1. No data given

Course Designers

1. Prof. Jayaseelan Murugaiyan, Professor, Dept. Of Biological Sciences. SRM University – AP
2. Dr. Writoban Basu Ball, Dept. Of Biological Sciences. SRM University - AP
3. Dr. Sutharsan Govindrajan, Dept. Of Biological Sciences. SRM University - AP

SRM University *AP*, Andhra Pradesh
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Basic concepts in Microbiology

Course Code	BIO 216	**Course Category**	CC	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Develop a foundational knowledge of microbial diversity, structure, and function, encompassing bacteria, archaea, and viruses. This understanding is essential for exploring the roles of microorganisms in various biological processes, ecosystems, and their impact on human health. It prepares students for advanced studies in microbial physiology, genetics, and ecology.
2. Equip students with theoretical knowledge of microbiological methods, including sterilization, disinfection, culturing, and microbial taxonomy. These skills are critical for conducting research, diagnosing infectious diseases, and applying microbiological principles in industrial, clinical, and environmental settings. This objective emphasizes the practical applications of microbiology, aligning with the broader goals to produce proficient and versatile biologists.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe the fundamental concepts and historical developments in microbiology.	1	80%	70%
Outcome 2	Interpret various methods for studying microbes and maintaining cultures, while assessing factors influencing microbial growth.	2	75%	65%
Outcome 3	Explain the processes of microbial genetic exchange and the basic structure and function of different microbial cells.	1	80%	70%
Outcome 4	Summarize the classification, structure, and pathogenic mechanisms of viruses and other molecular pathogens.	2	75%	65%
Outcome 5	Summarize the mechanisms of microbial diseases and the basic principles of antimicrobial agents, as well as their applications.	2	75%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	1	1	1	1		3	3	1	2		1	2	2	3
Outcome 2	3	2	1	1	3	1	3	3	2	2		2	2	3	3
Outcome 3	3	1	1	1	1	1	3	3	2	2		2	3	1	2
Outcome 4	3	1	1	2	2	1	3	3	2	3		3	3	2	3
Outcome 5	3	2	3	2	3	2	3	3	2	3		3	3	3	3
Course Average	**3**	**1.4**	**1.4**	**1.4**	**2.5**	**1.25**	**3**	**3**	**1.8**	**2.4**		**2.2**	**2.6**	**2.2**	**2.8**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction to microbiology**	**8**		
	History of microbiology	2	1	1,2
	Methods to study microbes. sterilization and disinfection; Growth media types - selective and differential media; Maintenance and preservation of bacterial cultures; Growth phases and kinetics, influence of environmental factors for microbial growth	3	1	1,2
	Cell division, transformation, transduction and conjugation.	3	1	1,2
Unit 2	**Microbial Cells - Types, Structure and Function**	**12**		
	Classification and molecular taxonomy of microorganisms	4	2	1,2
	Ultrastructure of the archaea and bacterial cell	4	2	1,2
	Gram positive and gram-negative bacteria; Mycobacteria.	4	2	1,2
Unit 3	**Molecular pathogens**	**11**		
	Viral structure and classification	4	3	2,3
	Bacteriophage and its life cycle	3	3	2,3
	Viral pathogenesis; Acute, chronic and latent viral infections; Viroid, prions, plasmids and transposable elements	4	3	2,3
Unit 4	**Microbial disease and antimicrobial agents**	**8**		
	Microbial pathogens; Quorum sensing and biofilm	4	4	2,3
	Antimicrobials and Antibiotics: types, mechanism of action and resistance.	4	4	2,3
Unit 5	**Applied microbiology**	**6**		
	Applications of microorganisms in industrial use; Food microbiology	3	5	2,3
	Environmental microbiology: Bioremediation, bioleaching, microbial degradation of textile waste.	3	5	2,3
Total Contact Hours		**45**		

Learning Assessment

Question Difficulty	Bloom's Level of Cognitive Task	Continuous Learning Assessments (50%)				End Semester Exam (50%)
		CLA-1 (10%)	Mid-1 (15%)	CLA-2 (10%)	CLA-3 (15%)	
Level 1	Remember	100%	100%	100%	100%	100%
	Understand					
Level 2	Apply					
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Microbe, 3rd Edition (2022), Michele S. Swanson, Elizabeth A Joyce, Rachel Horak. ASM Press.
2. Prescotts Microbiology, 12th edition, Dorothy Wood , Joanne Willey, Kathleen Sandman.
3. McGraw Hill International.
4. A & P's Textbook of Microbiology, 12th Edition, R Ananthanarayan , CK Jayaram Paniker , Reba
5. Kanungo, Sonal Saxena. Universities Press.

Other Resources

Course Designers

1. Dr. Sutharsan Govindarajan, Dept. Of Biological Sciences. SRM University – AP

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Microbiology Lab

Course Code	BIO 216L	**Course Category**	Core Course (CC)	**L**	**T**	**P**	**C**
				0	0	2	2
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Understand and apply various sterilization techniques, including physical and chemical methods, and the preparation of solid and liquid media.
2. Demonstrate proficiency in isolating, staining, enumerating, and culturing microorganisms, as well as in preserving and maintaining microbial cultures using different methods.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Explain and perform the sterilization methods/protocols in microbiology	3	80%	70%
Outcome 2	Isolate microorganism and identify its growth kinetics	3	80%	70%
Outcome 3	Describe and perform staining of microbes	3	80%	70%
Outcome 4	Explain and demonstrate the techniques involved in in maintenance and preservation of microbes	3	70%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	3	3	3	1	1	1	3	1		2	2	3	2
Outcome 2	3	3	3	3	3	1	3	2	2			2	2	3	3
Outcome 3	3	3	3	3	3	1	2	1	3	1		3	3	3	2
Outcome 4	3	3	3	3	3	1	3	1	3	2		3	3	2	3
Course Average	**3**	**3**	**3**	**3**	**3**	**1**	**2.3**	**1.3**	**2.3**	**1.3**		**2.5**	**2.5**	**2.8**	**2.5**
Outcome 1	3	3	3	3	3	1	1	1	3	1		2	2	3	2

Course Unitization Plan - Lab

Exp No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1.	Sterilization techniques- physical and chemical methods	8	1	1, 2
2.	Preparation of media: Solid and Liquid media	8	2	1, 2
3.	Isolation of microorganisms from different sources	10	2	1, 2
4.	Staining methods: simple staining, Gram staining, negative staining and hanging drop.	8	3	1, 2
5.	Enumeration of microorganism - total & viable count	8	3	1, 2
6.	Microbial culture, growth curve and plating	10	2,4	1, 2
7.	Preservation and maintenance of microbial cultures (slant, slab and cryo)	8	4	1, 2
Total Contact Hours		**60**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)			End Semester Exam (50%)
		Experiments (20%)	Record / Observation Note (10%)	Viva + Model (20%)	
Level 1	Remember	50%		25%	25%
	Understand				
Level 2	Apply	50%	100%	75%	75%
	Analyse				
Level 3	Evaluate				
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Dubey RC, Maheshwari DK. Practical Microbiology, 4/e. S. Chand Publishing; 2002.
2. Sharma K. Manual of Microbiology. Ane Books Pvt Ltd; 2007.

Other Resources

Course Designers

1. Dr. Sutharsan Govindarajan – Assistant Professor- Department of Biological Sciences

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Evolutionary Biology

Course Code	BIOE 006	**Course Category**	CC	**L**	**T**	**P**	**C**
				4	0	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To understand and explore the methods involved in gauging diversification of life and adapt phylogenetic analysis in deciphering the complexities of biological evolution and its directions.
2. To understand the evolution of humans and explore the same in the perspective of diseases.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Define the origin and diversity of life and its evolution	1	70%	60%
Outcome 2	Summarize the principles of evolution, its properties and intricacies involved.	2	65%	60%
Outcome 3	Relate the direction of evolution and methods involved in exploring the evolutionary mechanisms	3	65%	55%
Outcome 4	Articulate the evolution of humans and underpin the reasons for variations and diseases	3	65%	55%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	1	2	2	1	1	2				2	2	3	2
Outcome 2	3	2	1	2	1	1	1	3				3	2	3	3
Outcome 3	3	3	2	3	1	3	1	2	1	2		2	3	3	1
Outcome 4	3	3	3	3	2	3	2	3	2	3		3	3	2	3
Course Average	**3**	**2.5**	**1.8**	**2.5**	**1.5**	**2**	**1.3**	**2.5**	**1.5**	**2.5**		**2.5**	**2.5**	**2.8**	**2.3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
Unit 1	**Origin of Life and Evolution**	**12**		
	Concept of evolution; Importance and potential applications of evolution in real life;	3	1	1, 2
	Origin of Life: Fitness and Darwin's theory;	3	1, 2	1, 2
	Selection: Artificial, natural and sexual; Mutations and their role in evolution;	4	1, 2	1, 2
	Introduction to phenotype and genotype.	2	1	1, 2
Unit 2	**Species and Speciation**	**12**		
	Concept of species; Causes of speciation and properties of species	3	1, 2	1, 2
	Asexual speciation; Orthologs, paralogs, homologs;	3	1, 2	1, 2
	Methods of classification;	3	1, 2	1, 2
	Ancestral lineage; Inheritance	3	2, 3	1, 2, 3
Unit 3	**Phylogeny**	**12**		
	Gene Genealogy: gene Tree, species tree, gene transfer, xenology;	3	1,3,4	4, 5
	Phylogenetic trees: basic concepts of trees: Rooted and un-rooted trees;	3	1,3,4	4, 5
	Networks and their biological nature;	3	1,3,4	4, 5
	The concept of phyla: monphylatic, polyphylatic and paraphylatic groups.	3	1,3,4	4, 5
Unit 4	**Direction of evolution**	**12**		
	Evolutionary rate and distances; Units of evolution, evolutionary and adaptive landscapes;	3	1, 4	3, 4, 5
	Convergent, Parallel and Divergent evolutions;	3	1, 4	3, 4, 5
	Coevolution; Adaptive diversification of coevolutionary systems;	3	1, 4	3, 4, 5
	Role of microbiome and parasites in evolution of hosts; Living fossils and extinction.	3	1, 4	3, 4, 5
Unit 5	**Human Evolution**	**12**		
	Theories of human evolution	3	1, 2, 4	5, 6
	Phenotypic and genotypic variations;	3	1, 2, 4	5, 6
	Classic markers and DNA markers in human variation;	3	1, 2, 4	5, 6
	Evolution of human growth; Diseases in evolutionary perspective.	3	1, 2, 4	5, 6, 7
Total Contact Hours		**60**		

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (50%)**				**End Semester Exam (50%)**
		CLA-1 (10%)	**Mid-1 (15%)**	**CLA-2 (10%)**	**Mid-2 (15%)**	
		Th	**Th**	**Th**	**Th**	**Th**
Level 1	Remember	40%	60%	40%	60%	30%
	Understand					
Level 2	Apply	60%	40%	60%	40%	70%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. The Evolutionary Biology of Species (2019) by Timothy G. Barraclough, Oxford University Press.
2. Introduction to Evolutionary Genomics 2nd edition (2018) by Naruya Saitou, Springer publishers
3. Phylogenetic Trees Made Easy 5th edition (2018), Barry G. Hall. Oxford University Press.
4. Human evolutionary biology (2010) Michael P. Meuhlenbein, Cambridge University Press.
5. Evolutionary Analysis: S. Freeman and J.C. Herron. Prentice Hall
6. Evolution: D.J. Futuyma. Sinauer Associates
7. Ecology: from individuals to ecosystems: M. Begon, C.R. Townsend, Blackwell Publishing

Other Resources

Course Designers

1. Dr. Naga Bhushana Rao Karampudi, Assistant Professor, Department of Biological Sciences, SRM University – AP.
2. Dr. Writoban Basu Ball, Assistant Professor, Department of Biological Sciences, SRM University – AP.

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Introduction to Communicative English

Course Code	EGL 100	**Course Category**	FIC	**L**	**T**	**P**	**C**
				4	0	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	English	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To Introduce the Principles and Practices of Effective Communication Skills in various contexts.
2. To understand the purpose and differentiate various types of audience.
3. To encourage self-evaluation while collaborating with peers during learning.
4. To prepare the students to produce Language in various contexts be it Oral or Written form.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Employ all four skills (listening/speaking/ reading/writing) to express themselves using production skills (Speak and Write)	3	90%	90%
Outcome 2	Illustrate views using Power Point and Word.	3	70%	80%
Outcome 3	Express with proper grammar.	2	60%	50%
Outcome 4	Apply listening skills to practice.	3	80%	80%
Outcome 5	Employ reading skills to read the given text.	4	60%	50%
Outcome 6	Demonstrate the forms of writings	3	70%	70%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1			2	2	3			3	3	3		3			
Outcome 2					3	3		3	3	3		3			
Outcome 3								3	2	3		3			
Outcome 4										3		3			
Outcome 5								2	3	3		3			
Outcome 6								3	3	3		3			
Average			**2**	**2**	**3**	**3**		**2.8**	**2.8**	**3**		**3**			

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	COs Addressed	References Used
Unit No. 1		**7**		
	Course Introduction and Overview	1	**1,2,3**	
	Parts of Speech	1		**1,2**
	Tenses	1		**1,2**
	Vocabulary (Etymology, Prefixes, Suffix)	2		**1,2**
	Capitalization & Punctuations	1		**1,2**
	Principles of Sentence Structure & Paragraph Writing (*S+V+O*)	1		**1,2,3**
Unit No. 2		**6**		
	The Fundamentals of Speech (*Ethos, Pathos & Logos*)	1	**1,2**	**1,2**
	How to give a good Speech? (*Rhetoric & Speech Delivery*)	1		**1,2**
	Verbal Communication (Turn taking strategies, Questioning, Types of Qs)	2		**1,2**
	Nonverbal Communication (Cultural Contexts, Importance and Types)	1		**1,2**
	Fundamentals of Personal, Informative, and Scientific Speech	1		**1,2**
Unit No. 3		**10**		
	Listening Skills: Definition, Barriers, Steps to Overcome	2	**4**	**2**
	Listening Comprehension	3		**2**
	Listening to Influence, Negotiate	2		**2**
	Listening to Specific Information	1		**2**
	Note taking & Making while Listening	2		**2**
Unit No. 4		**10**		
	Read to Skim, and Scan	2	**5**	**1,2**
	Read to Comprehend (Predict, Answer Questions & Summarize)	2		**1,2**
	Read to Appreciate, Compose and Present	3		**1,2**
	Read to Understand Referencing Skills for Academic Report Writing and Plagiarism (APA 6th Ed)	3		**1,2**
Unit No. 5		**12**		
	Write to Interpret Data (Flow charts, Bar Diagrams)	2	**6**	**4**
	Write to Inform (News, Emails, Notice, Agenda & Minutes)	2		**4**
	Write to Define (Definitions & Essays)	2		**4**
	Resume and Cover Letter	2		**4**
	Write an Effective Abstract and a Comprehensive Summary	2		**4**
	Write Project Proposal	2		**4**
Total Contact Hours		**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50 %)								End Semester Exam (50 %)	
		CLA-1 (10 %)		CLA-2 (15 %)		CLA-3 (10%)		Mid Term (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%		50%		30%		40%		50%	
	Understand										
Level 2	Apply	60%		50%		70%		60%		50%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Shoba, Lourdes. (2017). Communicative English: A Workbook. U.K: Cambridge University Press.
2. Steven, Susan, Diana. (2015). Communication: Principles for a Life Time. U.S.A: Pearson 6th Ed.
3. Publication Manual of the American Psychological Association, (2010). 6th Ed.
4. Kosslyn, S.M. "Understanding Charts and Graphs", Applied Cognitive Psychology, vol. 3, pp. 185-226, 1989.

Other Resources

Course Designers

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Introduction to Environmental Science

Course Code	ENV 100	**Course Category**	FIC	**L**	**T**	**P**	**C**
				4	0	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Environmental Science	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To study the scope of Environmental Science and the idea of sustainability.
2. To acquire basic knowledge of environmental ethics, critical environmental laws, and policies.
3. To explore various sources and challenges in the renewable energy sector in replacing conventional energy.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Recognise the scope and purview of Environmental Science, the Idea of sustainability, environmental ethics, and global efforts to overcome the hindrance for sustainability.	2	80%	70%
Outcome 2	Interpret the environmental laws and policies.	3	80%	70%
Outcome 3	Investigate climate change, the way it affects life at different scales (global, regional, and local scales), and various mitigation strategies.	2	70%	60%
Outcome 4	Analyse the extent of environmental pollution and pollution reduction strategies through and resource optimization, renewable energy, and waste management.	3	70%	60%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1	-	-	-	1	-	3	1	1	-	1	1	-	-	-
Outcome 2	1	-	1	-	1	-	3	-	1	-	1	1	-	-	-
Outcome 3	1	-	-	-	1	-	3	-	1	-	1	1	-	-	-
Outcome 4	1	-	-	-	1	-	3	-	1	-	1	1	-	-	-
Average	**1**	**-**	**1**	**-**	**1**	**-**	**3**	**1**	**1**	**-**	**1**	**1**	-	-	-

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	**Fundamental Concepts in Environmental Science**	**12**	1	1, 2, 3, 4, 5, 6, 7, 8, 10
	Human population and environment	1		
	Environmental education and awareness Environmental ethics Evolution of Environmental ethics – Leopold's land ethics, Silent Spring	2		
	Population growth, Ecological overshoot, and Ecological Footprint	2		
	Defining global sustainability, Garret Hardin's "Tragedy of the Commons', Brundtland commission report, Principles of sustainable development, Sustainable Development Goals (SDGs), Triple bottom line of sustainable development	2		
	Technology and Society: Information Technology - Human health & Environmental health, Environmental misconception	2		
	Sustainable ethics: Overcoming the obstacles of sustainability Individualizing Responsibility for a sustainable future - Consumption and its impact on sustainable development	3		
Unit No. 2	**Social issues and Environment**	**10**	4	1, 3, 9
	Fronterism, Biological Imperialism, and Natural rights, Significance of Human rights; Human rights and environment	3		
	Wastewater reclamation, Water conservation, Rainwater harvesting, Watershed management, Urban problems related to energy, Nuclear accidents	3		
	Global Environmental Policy, Environmental acts and laws, Water Act 1974, Environmental Protection Act 1986	4		
Unit No. 3	**Global Climate Change**	**14**	3	10, 3
	Differentiating Climate and Weather, Interconnection of Earth systems (Hydrosphere, Geosphere, Cryosphere, Atmosphere, and Biosphere)	2		
	Climate change through data (global temperature, and CO_2 – Mauna Lao Earth observatory)	3		
	Climate change: Impacts - Extreme weather events, Sea-level rise, Food and water security, and Human health & well-being, Biodiversity loss	4		
	Climate change: Adaptation – local to global scales, Synthesis	2		
	Disaster management – landslides, Tsunamis floods, earthquakes, anthropogenic disasters, Bhopal tragedy	2		
	Communicating climate change	1		
Unit No. 4	**Energy and Environment**	**8**	4	3, 4
	Renewable Energy: Global Status and trends	2		
	Global Renewable Energy Applications	2		
	Technical Issues, Challenges & Opportunities Solar, tidal, hydropower, Bioenergy, nuclear	2		
	Renewable Energy Markets	2		
Unit No. 5	**Environmental Pollution and Management**	**16**	2, 4	3, 11
	Pollution: Air pollution, Noise pollution, Water pollution, Soil pollution	4		
	Solid waste management: Collection, Handling, and solid waste management rules	4		
	E-waste and hazardous waste management, biomedical waste management	4		
	Wastewater treatment systems: Industrial and sewage treatment	4		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		Mid-2 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	70%		70%		30%		30%		70%	
	Understand										
Level 2	Apply	30%		30%		70%		70%		30%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Daniel D. Chiras (2012), Environmental Science 9th Edition. Jones & Barlet Publishers
2. Carson, R. (2002). Silent spring. Houghton Mifflin Harcourt.
3. Rajagopalan, R (2015). Environmental Science – from crisis to cure, 3rd Edition. Oxford Higher Education.
4. Walter K Dodds (2018). Humanity's Footprint: Momentum, Impact, and Our Global Environment. Columbia University Press
5. Hayley Stevenson (2018). Global Environmental Politics Problems, Policy and Practice. Cambridge University Press
6. Garette Hardin (1968). The Tragedy of the Commons. Science 162 (3859), 1243-1248. DOI: 10.1126/science.162.3859.1243
7. Brutland Commission Report, 1987. Oxford University Press
8. TRANSFORMING OUR WORLD: The 2030 Agenda for Sustainable Development
9. Shastri, S.C. (2015) Environmental Law by 5th edition, EBC Publications.
10. Intergovernmental Panel on Climate Change (IPCC) Synthesis Report, 2014.
11. C.S. Rao (2018) Environmental Pollution Control Engineering, New Age International Publishers.

Other Resources

1. W. Cunningham, M. Cunningham (2016). Principles of Environmental Science (8th Edition), McGraw-Hill
2. Divan Shyam (2002). Environmental Law and Policy in India, OUP India
3. Jonathan Cowie, (2002). Climate change: Biological and Human Aspects, 2nd Edition. Cambridge University Press
4. Hanjalic, Kemo, Roel Van de Krol, and Alija Lekic, eds. (2017). Sustainable energy technologies: options and prospects. Springer Science & Business Media

Course Designers

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Industry Standard Employability Skills -II

Course Code	ISES 102	**Course Category**	Ability Enhancement Course (AEC)	**L**	**T**	**P**	**C**
				0	0	1	1
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CDC	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Develop interpersonal skills to be a good team player.
2. Develop socialization skills, positive attitude, and behavioural skills
3. Eliminate the barriers of communication and make conscious efforts to improve skill sets.
4. Recognise practice and acquire the skills necessary to deliver effective presentation with clarity and impact.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Recognise the intrinsic motivating factors.	1	70%	60%
Outcome 2	Demonstrate the ability to conceptualize an original idea.	3	80%	70%
Outcome 3	Solve the given problems using lateral thinking techniques	3	70%	60%
Outcome 4	Apply interpersonal skills to be a team player	3	90%	80%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1					1			2		2		1			
Outcome 2		2			3			3	3						
Outcome 3		3							2			2			
Outcome 4								2	3			2			
Average		2.5			2			2.3	2.7	2		1.7			

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	COs Addressed	References Used
Unit No. 1	**Motivation**	**9**		
	Soldiers' walk (Activity on factors of motivation)	3	1,4	1,4
	The Japanese fan (An activity on factors 1of motivation)	3	1,4	1,4
	Steps to ward off demotivation.	3	1,4	1,4
Unit No. 2	**Creativity and innovation**	**9**		
	Short film: (Students are encouraged to make a ten-minute documentary on various topics to enhance the power of aesthetics and precision)	3	1,2	1,4
	Creative short film (This activity is aimed at creating an interest on research and think out of the box)	3	1,2	1,4
Unit No. 3	**Critical and lateral thinking**	3		
	Fill me up, stimulating lateral thinking	**9**	1,2	2,4
	The curious case of Mary and Kevin (Activity triggering the different types of thinking)	3	2,3	2,4
	The creative college	3	2	2,4
Unit No. 4	**Team dynamics**	3		
	Story boarding, Frenzy, come to my island.	**9**	1,2,3	2,3
	Striking cars	3	1,2	2,3
	Defend the egg, tallest tower (Activities on the different stages of team building, team communication, coordination, and collaboration.	3	1,2,3	2,3
Unit No. 5	**Mini project**	3		
	Concept 1: Mini project presentation	**9**	1,2,3,4	1,4
	Concept 2: Mini project presentation	3	1,2,3,4	1,4
	Concept 3: Mini project presentation	3	1,2,3,4	1,4
Total Contact Hours		**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		Mid-2 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%		50%		40%		50%		50%	
	Understand										
Level 2	Apply	60%		50%		60%		50%		50%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Personality development and soft skills – Braun K. Mitra
2. Key to success in workplace and life – Meenakshi Roman, Shalini Upadhyay.
3. Mastering soft skills – Julian Vyner
4. The Accidental Creative – How to be brilliant at a moment's notice – Todd

Other Resources

Course Designers

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Introduction to Research

Course Code	RM 100	**Course Category**	FIC		**L**	**T**	**P**	**C**
					1	0	0	1
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**				
Course Offering Department	Chemistry	**Professional / Licensing Standards**						

Course Objectives / Course Learning Rationales (CLRs)

1. To facilitate the students in understanding the basics of research
2. To educate the young researchers on methods of research
3. To prepare the students to apply research in scientific problems

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Illustrate the importance of research	2	85%	80%
Outcome 2	Demonstrate research acumen in the research process	3	80%	75%
Outcome 3	Apply the research method in given scenarios	5	80%	75%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	2	1		1	2	3	3	2		3	1	2
Outcome 2	2	3	2	1	3		3	3	2	3	3		2	3	3
Outcome 3	1	3	1	3	2		2	1	2	2	1		1	2	1
Average	**2.0**	**2.7**	**2.0**	**2.0**	**2.0**		**2.0**	**2.0**	**2.3**	**2.7**	**2.0**		**2.0**	**2.0**	**2.0**

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	**Introduction to Scientific Research**	**7**	**1**	**1,2**
	Importance of Research	2		
	Objectives of Research	2		
	Types of Research	3		
Unit No. 2	**Introduction to Research Articles**	**8**	**2**	**1,3**
	Literature survey	2		
	Tools to collect research articles	2		
	Identifying research problem	1		
	Understanding research articles	1		
	Different components in a research article	1		
	Review articles and book chapters, report writing	1		
Unit No. 3	**Scientific Conduct**	**8**	3	**1,2,3**
	Ethics with respect to science and research	2		
	Intellectual honesty and research integrity	2		
	Scientific misconducts: falsification, fabrication, and plagiarism	2		
	Redundant publications: duplicate and overlapping publications	2		
Unit No. 4	**Research Management and Collaboration**	**7**	3	**1**
	Google scholar, ResearchGate	3		
	Citations, h-index, i10 index	2		
	Bibliography, reference manager (Mendeley)	2		
Total Contact Hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50 %)								End Semester Exam (50 %)	
		CLA-1 (15 %)		CLA-2 (15 %)		CLA-3 (__%)		Mid Term (20 %)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	60%		40%				40%		30%	
	Understand										
Level 2	Apply	40%		60%				60%		70%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**				**100%**		**100%**	

Recommended Resources

1. Bordens K.S. and Abbott, B.b.: Research Design and Methods, Mc Graw Hill, 2008
2. Kothari C.K., Research Methodology- Methods and Techniques (New Age International, New Delhi), 2004
3. Catherine Dawson, Introduction to Research Methods, 2005

Other Resources

Course Designers

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Analytical Skills For Sciences

Course Code	AEC 106	**Course Category**	AEC	**L**	**T**	**P**	**C**
				1	0	1	2
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Mathematics	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To categorize, apply and use thought process to distinguish between concepts of quantitative methods.
2. To prepare and explain the fundamentals related to various possibilities.
3. To critically evaluate numerous possibilities related to puzzles.
4. Explore and apply key concepts in logical thinking to business problems.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Use logical thinking and analytical abilities to solve quantitative aptitude questions from company specific and other competitive tests.	1	70%	60%
Outcome 2	Solve questions related to Aptitude from company specific and other competitive tests.	3	80%	70%
Outcome 3	Understand and solve puzzle questions from specific and other competitive tests	1	70%	60%
Outcome 4	Make sound arguments based on mathematical reasoning and careful analysis of data.	1	90%	80%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1					1			2		2		1			
Outcome 2		2			3			3	3						
Outcome 3		3							2			2			
Outcome 4								2	3			2			
Average		2.5			2			2.3	2.3	2		1.6			

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	**Quantitative Aptitude**			
	Data interpretation – Introduction and basics to solve data interpretation	4	1,4	1,4
	Data interpretation line graphs, Data interpretation bar graph.	6	1,4	1,4
Unit No. 2	**Quants**			
	Data interpretation – Pie charts,	2	1,4	1,4
	Data interpretation – Tabular, Data interpretation – case lets.	2	1,4	1,4
Unit No. 3	Statistics	6	1,2	2,3
Unit No. 4	Functions and graphs	3	1,2	1,2
	graph theory with respect to coding	2	1,2	1,2
	math graph theory and coding problems	2	2,3	2,3
	discrete planar theory and coding problems.	3	1,2	2,4
Total Contact Hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		Mid-2 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%		50%		40%		50%		50%	
	Understand										
Level 2	Apply	60%		50%		60%		50%		50%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Arun Sharma – How to prepare for Quantitative Aptitude, Tata Mcgraw Hill.
2. R.S. Agarwal – Reasoning. Reasoning for competitive exams – Agarwal.
3. Objective Quantitative Aptitude – Oswaal books.
4. Test of reasoning and numerical ability, quantitative aptitude book – Sahitya bhavan.
5. Radian's Quantitative Aptitude.
6. Quantitative Aptitude and Reasoning – Shyam Saraf / Abhilasha Swarup.
7. Fast track objective Arithmetic – Rajesh Verma.

Other Resources

Course Designers

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Digital Literacy

Course Code	SEC 102	**Course Category**	SEC	**L**	**T**	**P**	**C**
				1	0	1	2
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	ITKM	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Introduce basic digital skills that are needed in today's 21st century work environment.
2. develop the skills that they need to effectively integrate technology into their respective professional practices.
3. Learn practical-oriented and will have a lot of hands-on exercises.
4. Understand basic and practical digital skills.
5. learn and use software and hardware systems, including the basic troubleshooting.
6. Learn issues pertaining to emerging technologies and creating digital identity in various platforms.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Discuss the importance of Digital Literacy	2	75%	80%
Outcome 2	Compare and Contrast collaborative features in digital platforms	3	70%	70%
Outcome 3	Create digital identity profile on LinkedIn	3	75%	75%
Outcome 4	Demonstrate best practices of digitally managed workspace on MS office 365 and G Suite	3	70%	75%
Outcome 5	Identify relevant information from authentic data sources	3	70%	75%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1					3	3		1	2	3		3			
Outcome 2					3	3		1	2	3		3			
Outcome 3					3	3		1	2	3		3			
Outcome 4					3	3		1	2	3		3			
Average					3	3		1	2	3		3			

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	COs Addressed	References Used
Unit No. 1	**Introduction - Digital Literacy**	**2**	**1**	1,2,3
	About Digital Literacy	0.5	1	1,2,3
	Importance of digital literacy	0.5	1	1,2,3
	Overview of Computing Systems and Platforms	0.5	1	1,2,3
	Digital Proficiency for Career prospects and Everyday living	0.5	1	1,2,3
Unit No. 2	**Know your computer**	**3**	**1**	1,2,3
	Types of computing	0.5	1	1,2,3
	Accessories & peripherals	0.5	1	1,2,3
	System upkeep & maintenance	0.5	1	1,2,3
	Basic Troubleshooting	0.5	1	1,2,3
	Operating Systems	1	1	1,2,3
Unit No. 3	**Microsoft Office Automation software**	**5**	4	1,2,3
	Word Processing	1	4	1,2,3
	Excel - Data Analysis	1	4	1,2,3
	PowerPoint Presentations	1	4	1,2,3
	Digital software tools	1	4	1,2,3
	Best practices	1	4	1,2,3
Unit No. 4	**Google Automation Software**	**3.5**	4	1,2,3
	Word Processing	1	4	1,2,3
	Spreadsheet	1	4	1,2,3
	Presentations	1	4	1,2,3
	Best practices	0.5	4	1,2,3
Unit 5	**Digital Communication tools**	**4**	2	1,2,3
	Emails Systems - Gmail, MS Outlook, Zimbra, etc	0.5	2	1,2,3
	Calendar Functionality	0.5	2	1,2,3
	Drive - Access Permissions - Best practices	1	2	1,2,3
	Chat functionality and Use	1	2	1,2,3
	Zoom, MS Teams, Google meet, Jiomeet,	1	2	1,2,3
Unit No. 6	**Network and Internet**	**3**	1	1,2,3
	Basics of Network	1	1	1,2,3
	Types of browsers, Safety measures, bookmarks	1	1	1,2,3
	Search engines	1	1	1,2,3
Unit No. 7	**Digital Identity for Professional Connect activities**	**5**	3	1,2,3
	Social media	1	3	1,2,3
	Dos and Don’ts handling Social Media Accounts	2	3	1,2,3
	Digital Profile	3	3	1,2,3
Unit No. 8	**Cybersecurity**	**1.5**	1	1,2,3
	Introduction to Cybersecurity	0.5	1	1,2,3
	Strategies to project the personal and professional data	0.5	1	1,2,3
	Awareness on various Cyber Attacks	0.5	1	1,2,3
	Security measures for Email, Personal computing systems		1	1,2,3
Unit No. 9	**Information and Data Literacy**	**4**	5	1,2,3
	Information & Data Mining Strategies	1	5	1,2,3
	Online resources	2	5	1,2,3
	Understanding on Plagiarism	1	5	1,2,3
Total Contact Hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (60%)				End Semester Exam (40%)
		CLA-1 (10%)	Mid-1 (15%)	CLA-2 (10%)	CLA-3 (15%)	
Level 1	Remember	70%	40%	30%	30%	30%
	Understand					
Level 2	Apply	30%	60%	70%	70%	70%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Digital Literacy (20210401) Kindle Edition by Mandy Reininger (Author), Darrel Karbginsky (Author) Format: Kindle Edition
2. Digital Literacies: Concepts, Policies and Practices (New Literacies and Digital Epistemologies) New Edition by Colin Lankshear (Editor), Michele Knobel (Editor
3. Read the World: Rethinking Literacy for Empathy and Action in a Digital Age Illustrated Edition by Kristin Ziemke (Author), Katie Muhtaris (Author)

Other Resources

Course Designers

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Metabolism of Biomolecules

Course Code	BIO 201	**Course Category**	CC	**L**	**T**	**P**	**C**
				3	0	1	4
Pre-Requisite Course(s)	BIO 215	**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Understand fundamental metabolic concepts, including anabolism, catabolism, oxidation/reduction, and dehydration/hydrolysis.
2. Explore cellular respiration components, covering glycolysis, citric acid cycle, electron transport chain, oxidative phosphorylation, anaerobic respiration, and the Cori cycle.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Relate knowledge of metabolic concepts to analyze cellular processes and explain their interconnectedness.	3	70%	60%
Outcome 2	Summarize disorders related to lipid, amino acid, and nucleic acid metabolism.	2	80%	65%
Outcome 3	Demonstrate an understanding of regulatory mechanisms controlling metabolic pathways.	3	70%	60%
Outcome 4	Demonstrate the principles learned to comprehend the role of hormones and growth factors in metabolic regulation.	3	70%	60%
Outcome 5	Demonstrate laboratory skills related to identification and quantification of biomolecules	3	80%	75%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	1	2	1	1	1					2	2	3	2
Outcome 2	3	2	3	3	1	1		2				2	3	2	3
Outcome 3	3	3	3	3	2	1			1	2		3	3	3	2
Outcome 4	3	3	3	3	3	1	2	1	1	2		3	3	2	3
Outcome 5	3	3	2	3	3	2	3	3	3	3	2	2	3	3	2
Course Average	**3**	**2.8**	**2.4**	**2.8**	**2**	**1.2**	**2**	**2**	**1.7**	**2.3**	**2**	**2.4**	**2.8**	**2.6**	**2.4**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
1	UNIT I: Concepts of Metabolism and Carbohydrate Metabolism Anabolism and catabolism	**12**		
	Metabolic reactions: oxidation/reduction, dehydration/hydrolysis, addition/subtraction/exchange, ligation	2	1	1,2,3
	The concept of cellular respiration: Glycolysis, citric acid cycle, electron transport chain and oxidative phosphorylation	2	1	1,2,3
	Anaerobic respiration and production of lactic acid	2	1	1,2,3
	Cori cycle	1	1	1,2,3
	Pentose phosphate pathway	1	1	1,2,3
	Gluconeogenesis	1	1	1,2,3
	Glycogen metabolism	1	1	1,2,3
	Role of hormones in sugar metabolism	1	1,3	1,2,3
	Brief introduction to metabolic disorders	1	1,2	1,2,3
2	UNIT II: Lipid Metabolism	**12**		
	Lipid Metabolism- Lipolysis and β-oxidation	2	1	1,2,3
	ketogenesis and causes of ketosis	2	1	1,2,3
	Lipogenesis	2	1	1,2,3
	Phospholipid biosynthesis	2	1	1,2,3
	Cholesterol biosynthesis and regulation	2	1,3	1,2,3
	Disorders of lipid metabolism.	2	1,2	1,2,3
3	UNIT III: Metabolism of Amino Acids and Proteins	**8**		
	Amino acid metabolism	2	1	1,2,3
	Transamination	1	1	1,2,3
	Glucose-Alanine cycle	1	1	1,2,3
	Urea cycle and disorders	1	1	1,2,3
	Brief introduction to nitrogen cycle	1	1	1,2,3
	Biosynthesis of aromatic amino acids	1	1	1,2,3
	Inborn errors of amino acid metabolism.	1	1,3	1,2,3
4	UNIT IV: Metabolism of Nucleic acids	**4**		
	Introduction to synthesis and degradation of nucleic acids- de novo and salvage pathway of purine and pyrimidine biosynthesis	2	1	1,2,3
	Catabolism of purines and pyrimidines	2	1	1,2,3
5	UNIT V: Intermediary metabolism	**9**		
	Integration of carbohydrate, lipid and amino acid metabolism	2	1	1,2,3
	Basic concepts of metabolic regulation	2	1,2	1,2,3
	regulatory enzymes	2	1	1,2,3
	intrinsic control and allosteric regulation	1	1	1,2,3
	Hormone and growth factors controlling metabolism	1	1,4	1,2,3
	Brief introduction to xenobiotic metabolism.	1	1	1,2,3
6	Practical	**30**		
	Preparation of Buffers.	2	1,3	5
	Quantitative analysis of carbohydrates.	4	1,3	6
	Quantitative estimation of Proteins.	4	1,3	7
	Quantitative estimation of Nucleic Acids.	4	1,3	8
	Separation of amino acids by TLC.	4	1,3	9
	Separation of leaf pigments by paper chromatography.	4	1,3	10
	Determination of enzyme activity of salivary amylase.	4	1,3	11
	Factors influencing enzyme activity.	4	1,3	11
	Total	**75**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		CLA-3 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	20%		40%		20%		40%		10%	
	Understand										
Level 2	Apply	80%		40%	20%	60%	20%	40%	20%	60%	30%
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Harper's Illustrated Biochemistry, V. W. Rodwell, D. Bender, K.M. Botham, P.J. Kennelly and P.A. Weil (2018) 31st edition, McGraw Hill-Medical.
2. Lehninger Principles of Biochemistry, D. L. Nelson and M. M. Cox, (2017) 7th edition, W.H. Freeman & Company.
3. Biochemistry: D. Voet and J.G. Voet (2011), 4th edition, Wiley
4. Biochemistry, Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto Jr., Lubert Stryer (2019), 8th edition, W.H. Freeman & Company.
5. https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/BI501%20Advanced%20Biochemistry%20and%20Immunology.pdf
6. https://amrita.olabs.edu.in/?sub=73&brch=8&sim=209&cnt=1
7. https://egyankosh.ac.in/bitstream/123456789/68738/1/Exercise%2010.pdf
8. https://egyankosh.ac.in/bitstream/123456789/81189/1/EXPERIMENT%203.pdf
9. https://www.iitg.ac.in/biotech/BTechProtocols/Thin%20Layer%20Chromatography%20Protocol.pdf
10. https://egyankosh.ac.in/bitstream/123456789/16433/1/Unit-3.pdf
11. https://egyankosh.ac.in/bitstream/123456789/68739/1/Exercise%2011.pdf

Other Resources

Course Designers

1. Prof. Jayaseelan Murugaiyan, Dept. Of Biological Sciences. SRM University – AP

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Cell Biology

Course Code	BIO 202	Course Category	CC	L	T	P	C
				3	0	1	4
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Biological Sciences	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. Understand cell theory, origin of cells and about the different cellular forms of life.
2. Understand and learn the structure and functions of the different cell membranes and cellular organelles.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Explain cell theory, origin of cells and describe the properties of prokaryotes, eukaryotes and virus.	2	70%	65%
Outcome 2	Describe and differentiate the cell membranes and various cell organelles.	2	70%	65%
Outcome 3	Describe bacterial binary fission, eukaryotic cell division (cell cycle, mitosis, cytokinesis, meiosis), and cytoskeleton functions.	2	70%	65%
Outcome 4	Explain necrosis, senescence, apoptosis and oncogenes.	2	70%	65%
Outcome 5	Demonstrate basic principles of cell staining, viewing, and identification of division stages	3	80%	70%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	1		1								2	2	3	2
Outcome 2	3	1		1								2	2	3	2
Outcome 3	3	1	1	1	1				1			3	2	3	2
Outcome 4	3	2	2	2	1				1			2	3	3	3
Outcome 5	3	3	3	3	3	2	3	2	3	2	2	3	3	3	3
Course Average	**3**	**1.6**	**2**	**1.6**	**1.7**	**2**	**3**	**2**	**1.7**	**2**	**2**	**2.4**	**2.4**	**3**	**2.4**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction to Cell biology**	**11**		
	History of Cell biology	1	1	1, 2, 3
	Cell theory; Origin and Evolution of cells	1	1	1, 2, 3
	Basic properties of cells; Prokaryotic cells and types (bacteria and archaea)	3	1	1, 2, 3
	Eukaryotic cells and types (unicellular and multicellular eukaryotes)	3	1	1, 2, 3
	Cellular organization of prokaryotes vs eukaryotes	3	1	1, 2, 3
Unit 2	**Cell structure and function**	**12**		
	Animal, plant and yeast cells	3	2	1, 2, 3
	Cell Membrane architecture, and models of membrane structure and function	3	2	1, 2, 3
	Cytoskeleton	3	2	1, 2, 3
	Transport across membranes: Passive and Active transport	3	2	1, 2, 3
Unit 3	**Structure and Function of Cellular Organelles**	**12**		
	Nucleus	2	2	1, 2, 3
	endoplasmic reticulum, Golgi apparatus, lysosomes	2	2	1, 2, 3
	Mitochondria – structure and origin	2	2	1, 2, 3
	Chloroplast – structure and origin	2	2	1, 2, 3
	vacuoles, peroxisomes, glyoxysomes	2	2	1, 2, 3
	Membraneless organelles: ribosomes, nucleolus, stress granules	2	2	1, 2, 3
Unit 4	**Cell division**	**6**		
	Cell division in bacteria: Binary fission	2	3	1, 2, 3
	Eukaryotic cell division: Cell cycle and regulation	2	3	1, 2, 3
	Meiosis	2	3	1, 2, 3
Unit 5	**Cell death**	**4**		
	Necrosis	1	4	1, 2, 3
	Senescence	1	4	1, 2, 3
	Apoptosis, Programmed cell death and their mechanisms.	2	4	1, 2, 3
Unit 6	**Practicals**	**30**		
	The light microscope	4		
	Observation of plant and animal cells under the microscope	4		
	Basics of cell culture -practice	6		
	Nuclei staining in HeLa Cells	4		
	Observation of mitosis in onion root tip cells	4		
	Cell counting and viability	4		
	Blood smear preparation	4		
Total Contact Hours		**75**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		CLA-3 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%		40%		40%		20%		20%	
	Understand										
Level 2	Apply	30%	30%	40%	20%	30%	30%	50%	30%	30%	50%
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, Hidde Ploegh, Paul Matsudaira, Molecular Cell Biology, W. H. Freeman; 6th edition, 2007.
2. Bruce Alberts, Molecular Biology of the Cell, Garland Science, 5th edition, 2008
3. Cooper, G. M., & Hausman, R. E. (2004). The cell: Molecular approach. Medicinska naklada.

Other Resources

Course Designers

1. Dr. Anil K Suresh, Associate Professor, Dept. Of Biological Sciences. SRM University – AP

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Concepts of Genetics

Course Code	BIO 203	**Course Category**	CC	**L**	**T**	**P**	**C**
				3	0	1	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Explain the fundamental principles of genetics, including inheritance patterns, gene structure, and function.
2. Apply genetic techniques such as Punnett squares, pedigree analysis, and molecular tools to solve problems and analyze genetic data.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe key genetic concepts, including pre-Mendelian ideas and Mendel's principles	5	80%	75%
Outcome 2	Explain the molecular basis of mutations, distinguishing between induced and spontaneous mutations	3	80%	75%
Outcome 3	Compare and contrast bacterial genetics, bacterial transposons, horizontal and vertical gene transfer, and principles of phage genetics	4	60%	60%
Outcome 4	Apply advanced chromosomal techniques, such as FISH, karyotyping, SKY, and chromosome painting	3	70%	65%
Outcome 5	Assess the impact of natural selection and genetic drift in population genetics, while also interpreting data related to speciation, pedigree analysis, and genetic model organisms using various statistical methods	5	60%	60%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	2	3	1	1	2		2			2	3	2	2
Outcome 2	3	2	3	3	2	1			1			2	3	2	3
Outcome 3	3	2	3	3	3	1	3	2	1			2	3	3	3
Outcome 4	3	3	3	3	3	1		2	2			2	3	3	2
Outcome 5	3	3	3	3	3	3	2	2	2	3		3	3	2	3
Course Average	**3**	**2.4**	**2.8**	**3**	**2.4**	**1.4**	**2.3**	**2**	**1.6**	**3**		**2.2**	**3**	**2.4**	**2.6**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
Unit 1	**Introduction to genetics**	**9**		
	Introduction to genetics and historical context. Scope of genetics.	1.5	1	1,2,3
	Pre-Mendelian Genetics: Key concepts and developments.	1.5	1	1,3
	Mendel's Work: Principles and experiments.	1.5	1	1,3
	Genetic Variation: Barbara McClintock's contributions. Non-Mendelian genetics.	1.5	1	1,3
	Principles of Inheritance: Principles and applications.	1.5	1	1,3
	Alleles and Inheritance Mechanisms: Concept and basics of alleles. Multiple alleles, lethal alleles, linkage, and crossing over.	1.5	1	1,3
Unit 2	**Mutations**	**9**		
	Chromosomal Mutations: Overview and types.	1.5	2	1,2,3
	Gene Mutations: Types and distinctions.	1.5	2	1,2,3
	Molecular Basis of Mutations: Relation to UV light and chemical mutagens.	1.5	2	1,2,3
	Mutations Comparison: Comparative analysis.	1.5	2	
	Induced vs. Spontaneous Mutations: Differences and significance.	1.5	2	
	Back vs. Suppressor Mutations: Analysis and implications.	1.5	2	1,2,3
Unit 3	**Bacterial and phage genetics**	**9**		
	Phage Genetics: Overview and applications.	1.5	3	1, 2
	Fine Structure of Gene in Bacteriophage T4: Benzer's fine structure, plaque formation, and mapping.	1.5	3	
	Bacterial Genetics: Genetics of bacteria.	1.5	3	
	Gene Transfer in Bacteria: Bacterial transposons, vertical and horizontal gene transfer.	1.5	3	1, 2
	Bacterial Transformation: Mechanisms and applications.	1.5	3	1, 2
	Bacterial Conjugation: Understanding the process.	1.5	3	1, 2
Unit 4	**Chromosomal basis of inheritance**	**9**		
	Chromosome Structure: Basics and implications.	1.5	4	1,2,4
	Cytogenetics: Techniques and applications.	1.5	4	1,2,3,4
	Chromosomal Staining and Banding Patterns: Techniques and interpretation.	1.5	4	1,2,3,4
	Fluorescent in-situ Hybridizations (FISH): Principles and applications.	1.5	4	1,2,3,4
	Advanced Chromosome Biology: • Karyotyping and Spectral Karyotyping (SKY).	1.5	4	1,2,3,4
	Chromosome Painting: Significance and applications.	1.5	4	1,2,3,4
Unit 5	**Population genetics and model organism**	**9**		
	Allele and Genotype Frequencies: Understanding and calculations.	1.5	1,5	1,2,3,4

	Hardy-Weinberg Law: Principles and applications.	1.5		
	Natural Selection: Role in population genetics.	1.5	1,5	1,2,3,4
	Genetic Drift: Understanding its impact.	1.5	1,5	1,2,3,4
	Speciation: Principles and examples.	1.5	1,5	1,2,3,4
	Pedigree Analysis and Model Organisms: Techniques and introduction to model organisms.	1.5	1,5	1,2,3,4
Unit 6	**Foundations of Probability and Statistics**	**30**		
	Introduction to Probability Basic probability concepts and probability distributions	3	5	5,6,7
	Descriptive Statistics Measures of central tendency. Measures of dispersion.	3	5	5,6,7
	Inferential Statistics Hypothesis testing. Confidence intervals.	3	2,4,5	5,6,7
	Multivariate Statistics Multivariate distributions. Covariance and correlation.	3	1,2,3,4,5	5,6,7
	Regression Analysis Simple and multiple regression. Regression diagnostics.	3	1,3,4	5,6,7
	Binomial and Poisson Distributions Application in genetics.	3	1,4,5	5,6,7
	Normal Distribution and Central Limit Theorem Role in statistical genetics.	3	1,2,3	5,6,7
	Genetic Drift and Natural Selection Statistics Population dynamics. Evolutionary statistics.	3	1,3,5	2,5,6,7
	Quantitative Genetics Statistics Heritability. Polygenic traits.	3	1,2,5	1,5,6,7
	Genome-Wide Association Studies Statistical methods in GWAS.	3	1,2,3,4,5	1,5,6,7
Total Contact Hours		**75**		

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (50%)**								**End Semester Exam (50%)**	
		CLA-1 (10%)		**Mid-1 (15%)**		**CLA-2 (10%)**		**Mid-2 (15%)**			
		Th	**Prac**	**Th**	**Prac**	**Th**	**Prac**	**Th**	**Prac**	**Th**	**Prac**
Level 1	Remember Understand	40%		50%		40%		50%		30%	
Level 2	Apply Analyse	50%		35%		40%		30%		30%	
Level 3	Evaluate Create	5%	5%	5%	10%	10%	10%	10%	10%	20%	20%
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Introduction to Genetic Analysis: A.J. Griffiths et al. (2008) 9 edition, W.H. Freeman.
2. iGenetics: A Molecular Approach by Peter J Russell, 3rd edition, Pearson International Edition.
3. Genetics: A Conceptual Approach by Benjamin A Pierce, 5th edition. W.H. Freeman.
4. Concepts of Genetics by Klug, Cummings, Spencer, Palladino, 11th edition. Pearson
5. Foundations of Mathematical Genetics by Anthony Edwards, 2nd edition. Cambridge University Press.
6. Mathematical Genetics by Andrey Volobuev, Nova Science Publishers.
7. Introduction to Probability and Statistics for Engineers and Scientists by Sheldon M Ross, 3rd edition. Elsevier Academic Press.

Other Resources

Course Designers

1. Dr. Writoban Basu Ball, Assistant Professor, Dept. Of Biological Sciences. SRM University – AP

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Leadership for Professionals

Course Code	SEC 106	**Course Category**	SEC	**L**	**T**	**P**	**C**
				2	**0**	**0**	**2**
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Management	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To understand different leadership styles and their applications.
2. To develop effective communication and interpersonal skills for leadership.
3. To learn strategies for building and leading high-performing teams.
4. To acquire techniques for problem-solving and decision-making in leadership roles.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Analyse and apply appropriate leadership styles in various contexts.	4	60%	80%
Outcome 2	Summarize and interpret effective communication strategies for team members and stakeholders	2	80%	70%
Outcome 3	Evaluate and devise strategies to lead teams in achieving goals and objectives efficiently	5	70%	50%
Outcome 4	Synthesize and implement problem-solving techniques to address challenges in leadership roles	5	80%	70%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)													
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	3	1	2		1			3	3	2	2
Outcome 2	3	2	2	1		3	1	2	3	3	3	2	3	3
Outcome 3	3	2	3	2	2	3	3	3	1	2	3	3	3	3
Outcome 4	3	2	3	1	3		2	2	2	1	3	3	3	3
Average	3	2	3	2	2	3	3	2	2	2	3	3	3	3

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**The Evolution of Leadership**	**6**		
	Historical Perspectives on Leadership, Leadership during the industrial revolution, Contemporary Leadership Theories and Models	2	1,2	1, 2
	Trait theory: identifying key traits of effective leaders, Behavioural theory: exploring leadership behaviours and styles, Situational theory: adapting leadership styles to different situations,	2		
	Leadership in the Digital Age: Challenges and Opportunities, Leading virtual teams and remote workforces, Harnessing technology for effective leadership communication, Addressing ethical considerations in the digital era.	2		
Unit 2	**Emotional Intelligence and Leadership**	**6**		
	Understanding Emotional Intelligence (EQ), Definition and components of emotional intelligence, Importance of EQ in leadership effectiveness, Developing Self-Awareness and Empathy as a Leader	2	2,3	1,2
	Techniques for self-reflection and self-awareness, Practicing empathy and perspective-taking in leadership roles, Utilizing Emotional Intelligence to Enhance Team Performance	2		
	Building rapport and trust within teams, Managing emotions in challenging situations, Resolving conflicts through emotional intelligence.	2		
Unit 3	**Transformational Leadership**	**6**		
	Characteristics and Principles of Transformational Leadership, Inspiring vision and purpose, Intellectual stimulation and innovation, Individualized consideration and mentorship	2	2,3	1
	Inspiring and Motivating Teams Towards a Shared Vision, Communicating a compelling vision for the future, Empowering and motivating team members to achieve goals, Creating a Culture of Trust and Empowerment Within Organizations	2		
	Building trust through transparency and integrity, Delegating authority and fostering autonomy, Celebrating successes and learning from failures.	2		
Unit 4	**Leading with Purpose and Authenticity**	**6**		
	Discovering Personal Values and Aligning Them with Leadership Goals, Identifying core values and principles, Aligning personal values with organizational mission and vision	2	2,3,4	1
	Authentic Leadership: Being True to Oneself While Leading Others	2		
	Building Credibility and Trust Through Authentic Leadership Practices	1		1,2
	Leading by example and modelling desired behaviours	1		1,2
Unit 5	**Leading Through Adversity and Crisis**	**6**	3.4	
	Strategies for Leading During Times of Uncertainty and Crisis, Remaining calm and composed under pressure, Making tough decisions with limited information	2		1
	Crisis Communication and Decision-Making in Leadership Roles, Communicating effectively with stakeholders during crises, Implementing crisis management plans and protocols	2		1
	Building Resilience and Fostering Organizational Agility, Encouraging adaptability and flexibility within teams, Cultivating a culture of resilience and innovation.	2		
Total Contact Hours		**30**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		CLA-3 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Project	Th	Prac
Level 1	Remember	60%		60%		60%			100%	60%	
	Understand										
Level 2	Apply	40%		40%		40%				40%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**			**100%**	**100%**	

Recommended Resources

1.Yukl, G. (2020). Leadership in Organizations (9th ed.). Pearson Education, Inc

2.Maxwell, J. C. (2007). The 21 Irrefutable Laws of Leadership: Follow Them and People Will Follow You (10th Anniversary ed.). Thomas Nelson.

Other Resources

1. Collins, J. (2001). Good to Great: Why Some Companies Make the Leap… and Others Don't. HarperBusiness.
2. Sinek, S. (2009). Start with Why: How Great Leaders Inspire Everyone to Take Action. Portfolio.
3. Sinek, S. (2014). Leaders Eat Last: Why Some Teams Pull Together and Others Don't. Portfolio.
4. Sandberg, S. (2013). Lean In: Women, Work, and the Will to Lead. Knopf.
5. Bennis, W. (2009). On Becoming a Leader (4th ed.). Basic Books.
6. Tzu, S. (2002). The Art of War. Shambhala.
7. Wooden, J., & Jamison, S. (2005). Wooden on Leadership: How to Create a Winning Organization. McGraw-Hill.
8. Goleman, D., Boyatzis, R., & McKee, A. (2013). Primal Leadership: Unleashing the Power of Emotional Intelligence (10th Anniversary ed.). Harvard Business Review Press.
9. Covey, S. R. (2004). The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change (25th Anniversary ed.). Free Press.

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Concepts of Molecular Biology

Course Code	BIO 204	**Course Category**	CC	**L**	**T**	**P**	**C**
				3	0	1	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Describe the structure and function of key biomolecules, including nucleic acids, proteins, and lipids, and their roles in cellular processes.
2. Apply molecular biology techniques such as PCR, gel electrophoresis, and recombinant DNA technology to analyze and manipulate genetic material.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe the intricacies of gene transcription and the intricate realm of RNA processing.	2	80%	75%
Outcome 2	Describe the intricate landscape of post-transcriptional processing and the diverse realm of modifications that shape cellular processes.	2	80%	70%
Outcome 3	Explain genetic code to protein synthesis machinery.	2	80%	70%
Outcome 4	Explain chromatin dynamics and multilayered gene regulation.	2	70%	65%
Outcome 5	Describe the molecular mechanisms underlying repair of DNA.	2	70%	65%
Outcome 6	Demonstrate the Molecular Techniques by experiments: Gel Electrophoresis, DNA Purification, Restriction Digestion, Plasmid DNA Transformation, and PCR Amplification	3	75%	80%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	3	1	1	3	3	3	3		2	3	1	2
Outcome 2	3	2	3	3	2	1	3		1			2	3	2	2
Outcome 3	3	2	3	3	3	1	3		1			2	3	2	2
Outcome 4	3	2	3	3	3	1	3		1			2	3	2	2
Outcome 5	3	2	3	3	3	3	2		2			3	3	2	3
Outcome 6	3	3	3	3	3	2	3					2	3	3	3
Course Average	**3**	**2.2**	**3**	**3**	**2.5**	**1.5**	**2.8**	**3**	**1.6**	**3**		**2.2**	**3**	**2**	**2.3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
Unit 1	**Gene Expression: Transcription and RNA Processing**	**10**		
	RNA world; Origin of DNA and classical experiments proving DNA as genetic material	1	1	1,3,4
	Complexity of definition of a gene,	1	1	1,2,3
	Prokaryotic and eukaryotic gene structure;	1	1	1,2,3
	Types of genes; Prokaryotic and eukaryotic promoters,	1	1	3,4
	Mechanism of transcription	2	1	3,4
	Types of RNAs	1	1	1,2,4
	prokaryotes and eukaryotes structure of rRNA,	1	1	1,2,4
	prokaryotes and eukaryotes structure of tRNA,	1	1	1,2,4
	prokaryotes and eukaryotes structure of mRNA	1	1	1,2,4
Unit 2	**Gene Expression: Post-Transcriptional Processing and Modifications**	**8**		
	Processing ribosomal RNAs	1	1	1,2,3
	biogenesis and assembly of ribosomal subunits in the nucleolus;	2	1	1,2,3
	tRNA processing and modifications	2	2	1,2,4
	mRNA-splicing,	1	2	1,2,4
	mRNA- modification;	1	2	1,2,4
	RNA transport	1	2	1,2,4
Unit 3	**Gene Expression: Translation and Post-Translational Modifications**	**8**		
	Genetic code, degeneracy and codon bias.	1	3	1,2,3
	Ribosome; Structure and Function of the protein synthesis machinery:	2	3	1,2,3
	The Ribozyme; Prokaryotic translation:	1	3	1,2,3
	coupled transcription and translation;	1	3	1,2,3
	Eukaryotic translation: translational factors, steps in translation:	2	3	1,2,3
	Initiation, elongation and termination; Post-translational modification of proteins and protein transport.	1	3	1,2,3
Unit 4	**Gene Regulation**	**9**		
	Chromatin structure and function; Gene regulation at multiple levels;	2	4	2,4
	Transcriptional regulation: activators and repressors,	2	4	2,4
	Transcriptional factors and basic transcriptional machinery in eukaryotes;	1	4	2,4
	Post-transcriptional regulation of gene expression, Translational & post-translational regulation of gene expression;	1	4	2,4
	Regulation of gene expression in prokaryotes using lac operon as a model.	3	4	2,4

Unit 5	DNA Replication and Repair	10		
	Meselson and Stahl experiment: Semi-conservative nature of DNA replication.	2	5	2,3
	The mechanism of DNA replication:	2	5	2,3
	Replication fork, leading and lagging strands, enzymes and proteins involved in replication;	2	5	2,3
	The replication process: Initiation, elongation and termination,	1	5	2,3
	Proof reading; Replication in prokaryotes and eukaryotes,	1	5	2,3
	DNA damage and repair mechanisms,	1	5	2,3
	Recombination and repair mechanisms, SOS system	1	5	2,3
Total Contact Hours		**45**		

Unit 6	Practical	30		
	Agarose gel electrophoresis.	3	6	5,6
	Isolation of bacterial genomic DNA	2	6	5,6
	Isolation of Plasmid DNA by Alkali-Lysis method.	2	6	5,6
	Determination of melting temperature (Tm) of DNA.	2	6	5,6
	Determination of purity of DNA.	2	6	5,6
	Restriction digestion of DNA.	4	6	5,6
	Ligation of DNA by T4 DNA ligase.	2	6	5,6
	Preparation of competent cells by Calcium chloride method and transformation	3	6	5,6
	Polymerase chain reaction.	5	6	5,6
	SDS-PAGE.	5	6	5,6
Total Contact Hours		**30**		

Learning Assessment Theory

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (15%)		CLA-3 (10%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	100%		80%		80%		80%		80%	
	Understand										
Level 2	Apply			20%		20%		20%		20%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Learning Assessment (Practical)

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)			End Semester Exam (50%)
		Experiments (20%)	Record / Observation Note (10%)	Viva + Model (20%)	
Level 1	Remember	50%		50%	50%
	Understand				
Level 2	Apply	50%	100%	50%	50%
	Analyse				
Level 3	Evaluate				
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Molecular Biology of the Cell: B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts and P. Walter 2014. 6 th edition, Garland Science.
2. Genes VIII. Benjamin Lewin. 8th edition, Pearson.
3. Molecular Biology of the Gene: J.D. Watson, T.A. Baker, S.P. Bell, A.A.F. Gann, M. Levine and R.M. Losick (2007). 7th edition. Benjamin Cummings.
4. Molecular Cell Biology: H. Lodish, A. Berk, C.A. Kaiser et al (2007) 6th edition. W.H. Freeman
5. Book: Introduction to Biotechnology; Orange County Biotechnology Education Collaborative (ASCCC Open Educational Resources Initiative).
6. Molecular Biology: Principles and Practice" by Michael M. Cox and Jennifer Doudna:

Other Resources

Course Designers

1. Dr Pulak Kar Assistant Professor, Dept. Of Biological Sciences. SRM University – AP

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Experimental Methods of Biology

Course Code	BIO 205	**Course Category**	CC	**L**	**T**	**P**	**C**
				3	1	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Gain a thorough knowledge of the principles underlying various microscopy and centrifugation techniques.
2. Comprehend the principles of various separation and quantification techniques which have application in structural biology and biophysics.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe the principles of various microscopy techniques, including Light, Fluorescence, Confocal, and Super-resolution microscopy, centrifugation and demonstrate how to use a light microscope	2	70%	65%
Outcome 2	Illustrate the principles underlying various chromatography techniques.	3	70%	65%
Outcome 3	Describe immunological techniques such as Immunodiffusion, Immunoelectrophoresis, ELISA, along with blotting techniques	2	70%	65%
Outcome 4	Explain the principle & techniques involved in biophysics & Structural biology.	2	80%	75%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	3	2	1	1		3	2		2	3	1	2
Outcome 2	3	3	3	3	2	1	1		1	2		2	3	3	2
Outcome 3	3	3	3	3	3	2	1		1	2		2	3	3	3
Outcome 4	3	3	3	3	3	3	1		1	2		2	3	3	3
Average	**3**	**3**	**3**	**3**	**2.5**	**1.4**	**1**		**1.5**	**2**		**2**	**3**	**2.5**	**2.5**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
Unit 1	**Microscopy**	**10**		
	Principles of microscopy	2	1	1,2,5
	Light, Fluorescence, Confocal, and Super-resolution microscopy	3	1	1,2,5
	Fluorochromes and their applications	2	1	1,2,5
	Transmission and Scanning electron microscopy and sample preparation for light and electron microscopy.	3	1	1,2,5
Unit 2	**Centrifugation**	**10**		
	Principles of Centrifugation	2	1	1,2
	Sedimentation	2	1	1,2
	Types of rotors	2	1	1,2
	Preparative and analytical centrifuges	2	1	1,2
	Methods: Differential, Zonal and Density gradient.	2	1	1,2
Unit 3	**Chromatography Techniques**	**10**		
	Principles of Chromatography	2	2	2,4
	Paper, TLC	2	2	2,4
	Gel filtration, Ion exchange, Affinity	2	2	2,4
	Gas-Liquid Chromatography	2	2	2,4
	High performance Liquid Chromatography (HPLC)	2	2	2,4
Unit 4	**Electrophoretic and Immunological Techniques**	**15**		
	Principles and applications of electrophoresis	2	3	2,3,4
	Poly-Acrylamide Gel Electrophoresis (PAGE); Agarose gel electrophoresis	3	3	2,3,4
	Two dimensional (2D) electrophoresis; Iso-electric focusing	2	3	2,3,4
	Immunodiffusion, Immunoelectrophoresis	3	3	2,3,4
	ELISA, and Radio-Immune Assay (RIA)	2	3	2,3,4
	Blotting techniques: Southern, Northern and Western	2	3	2,3,4
	Immunohistochemistry	1	3	2,3,4
Unit 5	**Spectroscopic Techniques**	**15**		
	Principles of spectroscopy and its applications in biological research	3	4	2
	Theory and Application of UV and Visible Spectroscopy	3	4	2
	Fluorescence Spectroscopy	3	4	2
	Atomic Absorption Spectroscopy (AAS)	3	4	2
	Mass Spectrometry (MS)	3	4	2
Total Contact Hours		60		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		Mid-2 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	80%		70%		80%		70%		60%	
	Understand										
Level 2	Apply	20%		30%		20%		30%		40%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		100%		100%		100%		100%		100%	

Recommended Resources

1. Wilson and Walker's principles and techniques of biochemistry and molecular biology. 2018.
2. Hofmann, A., & Clokie, S. (Eds.). Cambridge University Press. 8th edition
3. Biophysics and Bioinstrumentation. 2015. N Arumugam, V Kumaresan. Saras Publications
4. Bioinstrumentation. 2018. Reilly N J. CBS
5. Biochemical Techniques and Instrumentation. 2020. S Felix F Parthiban. Daya Publishing House
6. Fundamentals of Light Microscopy and Digital Imaging. (2012). Murphy DB, Wiley-Liss, New York.

Other Resources

Course Designers

1. Dr. Writoban Basu Ball, Dept. Of Biological Sciences. SRM University - AP
2. Dr. Sutharsan Govindrajan, Dept. Of Biological Sciences. SRM University - AP

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Introductory Biophysics

Course Code	BIO 206	**Course Category**	CC	**L**	**T**	**P**	**C**
				3	1	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	**Biological Sciences**	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Gain a thorough knowledge of the principles underlying various microscopy and centrifugation techniques.
2. Comprehend the principles of various separation and quantification techniques which have application in structural biology and biophysics.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe the principles of various microscopy techniques, including Light, Fluorescence, Confocal, and Super-resolution microscopy, centrifugation and demonstrate how to use a light microscope	2	70%	65%
Outcome 2	Illustrate the principles underlying various chromatography techniques.	3	70%	65%
Outcome 3	Describe immunological techniques such as Immunodiffusion, Immunoelectrophoresis, ELISA, along with blotting techniques	2	70%	65%
Outcome 4	Explain the principle & techniques involved in biophysics & Structural biology.	2	80%	75%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	3	2	1	1		3	2		2	3	1	2
Outcome 2	3	3	3	3	2	1	1		1	2		2	3	3	2
Outcome 3	3	3	3	3	3	2	1		1	2		2	3	3	3
Outcome 4	3	3	3	3	3	3	1		1	2		2	3	3	3
Course Average	**3**	**3**	**3**	**3**	**2.5**	**1.4**	**1**		**1.5**	**2**		**2**	**3**	**2.5**	**2.5**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
Unit 1	**Microscopy**	**10**		
	Principles of microscopy	2	1	1,2,5
	Light, Fluorescence, Confocal, and Super-resolution microscopy	3	1	1,2,5
	Fluorochromes and their applications	2	1	1,2,5
	Transmission and Scanning electron microscopy and sample preparation for light and electron microscopy.	3	1	1,2,5
Unit 2	**Centrifugation**	**10**		
	Principles of Centrifugation	2	1	1,2
	Sedimentation	2	1	1,2
	Types of rotors	2	1	1,2
	Preparative and analytical centrifuges	2	1	1,2
	Methods: Differential, Zonal and Density gradient.	2	1	1,2
Unit 3	**Chromatography Techniques**	**10**		
	Principles of Chromatography	2	2	2,4
	Paper, TLC	2	2	2,4
	Gel filtration, Ion exchange, Affinity	2	2	2,4
	Gas-Liquid Chromatography	2	2	2,4
	High performance Liquid Chromatography (HPLC)	2	2	2,4
Unit 4	**Electrophoretic and Immunological Techniques**	**15**		
	Principles and applications of electrophoresis	2	3	2,3,4
	Poly-Acrylamide Gel Electrophoresis (PAGE); Agarose gel electrophoresis	3	3	2,3,4
	Two dimensional (2D) electrophoresis; Iso-electric focusing	2	3	2,3,4
	Immunodiffusion, Immunoelectrophoresis	3	3	2,3,4
	ELISA, and Radio-Immune Assay (RIA)	2	3	2,3,4
	Blotting techniques: Southern, Northern and Western	2	3	2,3,4
	Immunohistochemistry	1	3	2,3,4
Unit 5	**Spectroscopic Techniques**	**15**		
	Principles of spectroscopy and its applications in biological research	3	4	2
	Theory and Application of UV and Visible Spectroscopy	3	4	2
	Fluorescence Spectroscopy	3	4	2
	Atomic Absorption Spectroscopy (AAS)	3	4	2
	Mass Spectrometry (MS)	3	4	2
Total Contact Hours		60		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		Mid-2 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	80%		70%		80%		70%		60%	
	Understand										
Level 2	Apply	20%		30%		20%		30%		40%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Wilson and Walker's principles and techniques of biochemistry and molecular biology. 2018.
2. Hofmann, A., & Clokie, S. (Eds.). Cambridge University Press. 8th edition
3. Biophysics and Bioinstrumentation. 2015. N Arumugam, V Kumaresan. Saras Publications
4. Bioinstrumentation. 2018. Reilly N J. CBS
5. Biochemical Techniques and Instrumentation. 2020. S Felix F Parthiban. Daya Publishing House
6. Fundamentals of Light Microscopy and Digital Imaging. (2012). Murphy DB, Wiley-Liss, New York.

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Career Exploration in Life Sciences

Course Code	SEC 130	**Course Category**	SEC	**L**	**T**	**P**	**C**
				3	0	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department		**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Help students identify career paths, aligning personal strengths with industry opportunities.
2. Equip students with skills in resume writing, cover letters, and interview techniques.
3. Enhance students' scientific communication, ethical understanding, and professionalism in life sciences.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Students will be able to identify various career paths in life sciences and map potential trajectories that align with their skills and interests.	**2**	**85%**	**755**
Outcome 2	Create tailored resumes and persuasive cover letters for life sciences roles.	**4**	**80%**	**70%**
Outcome 3	Apply effective interview and networking strategies for career advancement.	**3**	**75%**	**70%**
Outcome 4	Demonstrate ethical standards and professionalism in scientific settings.	**3**	**75%**	**70%**
Outcome 5	Communicate scientific ideas effectively using presentation skills and visual aid**s.**	**3**	**75%**	**70%**

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	2	1	2	1	1	2	1	2	2	1	1	3	**1**	**1**	**3**
Outcome 2	3	1	2	1	1	3		1	2	3	2	2	**1**	**1**	**3**
Outcome 3	1	1	2	1	1	2		2	3	3	2	2	**1**	**1**	**3**
Outcome 4	1	1	2	1	1	1		3	2	2	2	2	**2**	**1**	**3**
Outcome 5	1	1	2	1	1	2		1	2	3	1	2	**2**	**1**	**3**
Average	**2**	**1**	**2**	**1**	**1**	**2**	**1**	**2**	**2**	**3**	**2**	**2**	**1**	**1**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Overview of Life Sciences Careers**	**1**	1	2
	Job roles and industries	2	1	2
	Emerging trends and opportunities	2	1	2
	Career Path Mapping	1	1	2
	Identifying personal interests and strengths	1	1	2
	Researching potential career trajectories	2	1	2
Unit 2	**Resume Writing Workshop**	**2**	2	2,3
	Key elements of an effective resume tailored to life sciences	2	2	2,3
	Customizing resumes for specific roles	1	2	2,3
	Cover Letter Crafting	2	2	2,3
	Writing persuasive cover letters	1	2	2,3
	Techniques for showcasing relevant experience	1	2	2,3
Unit 3	**Interview Techniques**	**1**	3	4
	Common interview questions in life sciences	2	3	4
	Behavioral and situational interview strategies	2	3	4
	Networking Essentials	1	3	4
	Importance of networking in life sciences	**1**	3	4
	Building professional relationships and using platforms like LinkedIn	**2**	3	4
Unit 4	**Understanding Ethical Issues in Life Sciences**	**2**	4	1
	Overview of ethical guidelines and standards	2	4	1
	Case studies on ethics in research and professional practice	1	4	1
	Professional Etiquette	1	4	1
	Workplace behavior and communication	2	4	1
	Managing conflicts and professionalism in scientific interactions	1	4	1
Unit 5	**Effective Science Communication**	**1**	5	1
	Tailoring messages for different audiences (public, peers, stakeholders)	2	5	1
	Utilizing visual aids and data presentation techniques	2	5	1
	Public Speaking and Presentation Skills	1	5	1
	Structuring scientific presentations	1	5	1
	Tips for engaging an audience and handling Q&A sessions	2	5	1

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (100%)			
		CLA-1 25%	Mid-1 25%	CLA-2 25%	CLA-3 25%
Level 1	Remember	20	30	20	20
	Understand				
Level 2	Apply	80	70	80	80
	Analyse				
Level 3	Evaluate				
	Create				
Total					

Recommended Resources

1. "Scientific Writing and Communication: Papers, Proposals, and Presentations" by Angelika H. Hofmann, Oxford University Press, 2010, ISBN · 9780197613795
2. Freedman, T., 2008. Career opportunities in biotechnology and drug development. CSHL Press, 2008 ; ISBN, 0879697253
3. Indeed Career Advice (www.indeed.com/career-advice)
4. "The New Rules of Work" by Alexandra Cavoulacos and Kathryn Minshew, 2017. ISBN 9781984823168

Course Designers

1. Dr. Writoban Basu Ball, Assistant Professor, Dept. of Biological Sciences, SRM University-AP.

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Introduction to Developmental Biology

Course Code	BIO 301	**Course Category**	CC	**L**	**T**	**P**	**C**
				3	1	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Understand the fundamental aspects of development
2. Understand the general concepts of differential gene expression, cell differentiation, transcription factors and mechanisms of morphogenesis.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe the process of fertilization and early embryonic developmental stages	2	70%	65%
Outcome 2	Demonstrate the cellular differentiation pathways.	3	70%	60%
Outcome 3	Describe the process of invertebrate and vertebrate development.	2	70%	65%
Outcome 4	Explain the process of tissue regeneration and aging	3	70%	60%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	2	2	3	1				1		2	3	1	2
Outcome 2	3	2	2	3	3	1		2				2	3	2	3
Outcome 3	3	2	2	2	3	1						2	3	3	3
Outcome 4	3	2	2	3	2	1		2				2	3	3	2
Course Average	**3**	**2.3**	**2**	**2.5**	**2.8**	**1**		**2**		**1**		**2**	**3**	**2.3**	**2.5**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
Unit 1	**INTRODUCTION TO DEVELOPMENTAL BIOLOGY**	**15**		
	Animal development	4	1	1, 2
	Fertilization, gastrulation and developmental patterns	4	1	1, 2
	Plant development	4	1	1, 2
	Fundamental differences between animal and plant development.	3	1	1, 2
Unit 2	**Molecular Basis of Development**	**15**		
	Concept of differential gene expression	3	2	1, 2, 4, 5
	Cell differentiation	3	2	1, 2, 4, 5
	Transcription factors	3	2	1, 2, 4, 5
	Mechanisms of morphogenesis: Morphogen gradients	3	2	1, 2, 4, 5
	Major signaling pathways regulating development	3	2	1, 2, 4, 5
Unit 3	**Invertebrate and Vertebrate Development**	**10**		
	Drosophila development: early development and pattern formation	3	1,2,3	2, 3, 4
	Drosophila segmentation, anterior-posterior and dorsal - ventral body plan generation	3	1,2,3	2, 3, 4
	Amphibian development: early development and pattern formation	2	1,2,3	2, 3, 4
	Amphibian segmentation, anterior-posterior and dorsal - ventral body plan generation	2	1,2,3	2, 3, 4
Unit 4	**Tissue Regeneration**	**10**		
	Concept of regeneration	3	4	1, 4
	Models systems to study regeneration -hydra, planarians, zebrafish	3	4	1, 4
	Limb regeneration in axolotls, Regeneration in mammals and Regenerative medicine	4	4	1, 4
Unit 5	**Aging**	**10**		
	Concept of aging	2	4	1, 2, 5
	Hallmarks of aging	2	4	1, 2, 5
	Molecular basis of aging: insulin signalling	2	4	1, 2, 5
	Dietary restriction, and mitochondrial signalling.	2	4	1, 2, 5
Total contact hours		**60**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		Mid-2 (15%)			
		Th	**Prac**	**Th**	**Prac**	**Th**	**Prac**	**Th**	**Prac**	**Th**	**Prac**
Level 1	Remember	80%		70%		80%		80%		70%	
	Understand										
Level 2	Apply	20%		30%		20%		20%		30%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Developmental Biology (2016). 11thEdition: by Scott F. Gilbert
2. Essential Developmental Biology (2012). 3rd Edition:Jonathan M. W. Slack
3. Principles of Development (2018). 5th Edition: Martinez Arias Wolpert and Tickle
4. Mechanisms in Plant Development (2002). Ottoline Leyser and Stephen Day
5. Cell Signaling (2014). Wendell Lim and Bruce Mayer

Other Resources

1. Stem Cells: An Insiders Guide (2013). Paul Knoepfler
2. Molecular Biology of the Cell (2014). 6th Edition. Bruce Alberts

Course Designers

1. Dr. Prateek Gupta, Assistant Professor, Department of Biological Sciences. SRM University – AP
2. Dr. Pitchaiah Cherukuri, Assistant Professor, Department of Biological Sciences. SRM University – AP

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Genetic Engineering

Course Code	BIO 302	**Course Category**	CC	**L**	**T**	**P**	**C**
				2	1	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To understand basic of tools and technique used in genetic engineering
2. To understand concepts and application of rDNA technology in health, agriculture and environment

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe the role of genetic engineering in the modern world.	2	80%	75%
Outcome 2	Explain tools and methods used for genetic engineering.	2	80%	75%
Outcome 3	Explain the role of advanced techniques like sequencing methods and its application in genetic engineering.	2	70%	65%
Outcome 4	Describe organismal cloning and ethical debate on organismal cloning.	3	70%	65%
Outcome 5	Design molecular techniques to improve and generate genetically modified organisms and its importance.	3	70%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	3	1	1	3	3				2	3	1	2
Outcome 2	3	2	3	3	2	1	3	3				2	3	2	3
Outcome 3	3	2	3	3	3	1	3	3		1		2	3	3	3
Outcome 4	3	2	3	3	3	1	3	3		1		2	3	2	3
Outcome 5	3	2	3	3	3	3	2	3	1	2		3	3	3	2
Course Average	**3**	**2**	**3**	**3**	**2.4**	**1.4**	**2.8**	**3**	**1**	**1.3**		**2.2**	**3**	**2.2**	**2.6**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
Unit 1	**Genetic Engineering: Basic Concepts, Bacterial Hosts and Vectors**	**9**		
	Definition of genetic engineering	2	1	1,3
	Bacterial strains: Growth and Maintenance, Cloning and colony	2	1	1,3
	Plasmids and properties of plasmid cloning vectors	2	1,2	1,3
	Prokaryotic and eukaryotic expression plasmid vectors	2	1,2,4	1,3
	Transformation and Transfection	1	1	1,3
Unit 2	**Phage vectors, Libraries and Expression System**	**9**		
	Bacteriophages: Lambda, M13 and Phage vectors	3	2	1,2,3
	Cosmids, Yeast artificial chromosomes.	2	2,3	1,2,3
	Concepts of Genomic and cDNA libraries	2	2	1,2,3
	Inducible vectors	2	2	1,2,3
Unit 3	**Enzymes and Recombinant DNA Methodologies**	**9**		
	Enzymes used in genetic engineering: Restriction endonucleases, Polymerases, Ligases, Kinases, Endo- and Exonucleases.	3	1,3,5	1, 2
	DNA and RNA isolation and their detection, Polymerase chain reaction (qualitative and quantitative) and applications.	2	1,3,5	1, 2
	Methods of Genomic and cDNA cloning, Construction of Genomic DNA and cDNA libraries,	2	1,3,5	1, 2
	Radioactive and Non-radioactive labelling of nucleic acids and proteins. Methods of screening the libraries .	2	1,3,5	1, 2
Unit 4	**Protein Expression, Purification and Molecular Interactions**	**9**		
	Recombinant protein expression	2	4	1,2,4
	Methods of purification and characterization of tagged and untagged proteins.	2	4	1,2,3,4
	Analysis of protein-nucleic acid and protein-protein interactions.	2	4	1,2,3,4
	Site-specific and random mutagenesis	2	4	1,2,3,4
	DNA and Protein microarrays.	1	4	1,2,3,4
Unit 5	**Sequencing Methods and Applications**	**9**		
	Basics of Nucleic acid sequencing methods	2	1,5	1,2,3,4
	Antisense and RNA silencing techniques	2	1,5	1,2,3,4
	Gene Drives. Methods to generate transgenic bacteria/animals/plants.	2	1,5	1,2,3,4
	Genome Editing: Safety and Ethics	2	1,5	1,2,3,4
	Genome sequencing and genetic engineering applications in personalized Medicine and Agriculture.	1	1,5	1,2,3,4
Total Contact Hours		**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		Mid-2 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%		60%		40%		60%		30%	
	Understand										
Level 2	Apply	60%		40%		60%		40%		70%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. J. Sambrook and D. W. Russell, Molecular Cloning: A Laboratory Manual, 3rd Edn: Vol. I, II, & III, Cold Spring Harbor Laboratory Press
2. S. B. Primrose and R. M. Twyman. Principles of Gene Manipulation and Genomics, 7th Ed., Blackwell Publishing
3. Fred Ausubel and Others. Current Protocols in Molecular Biology. Wiley.
4. Gurbachan S. Miglani, Genome Editing: A Comprehensive Treatise. Alpha Science International Ltd.

Other Resources

Course Designers

1. Dr. Sutharsan Govindarajan. Assistant Professor, Dept. Of Biological Sciences. SRM University – AP
2. Prof. Jayaseelan Murugaiyan. Professor & Head. Dept. Of Biological Sciences. SRM University – AP

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Immunobiology

Course Code	BIO 303	**Course Category**	CC	**L**	**T**	**P**	**C**
				2	1	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. The students will be able to identify the cellular and molecular basis of immune responsiveness.
2. The students will be able to understand the roles of the immune system in both maintaining health and contributing to disease.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe the cell types and organs present in the innate and adaptive immunity.	2	80%	75%
Outcome 2	Summarize effector molecules and responses in immune activation.	2	70%	65%
Outcome 3	Apply the techniques of antigen-antibody interactions to demonstrate immunoassay principles.	3	70%	65%
Outcome 4	Illustrate the stages of transplantation immunology based on immune tolerance mechanisms.	2	70%	65%
Outcome 5	Describe the reasons for immunization and vaccination.	2	80%	75%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	3	1	1						2	3	1	2
Outcome 2	3	2	3	3	2	1						2	3	2	2
Outcome 3	3	2	3	3	3	1						2	3	2	3
Outcome 4	3	2	3	3	3	1		2		2		2	3	3	3
Outcome 5	3	2	3	3	3	3	1	1		2		3	3	3	3
Course Average	**3**	**2**	**3**	**3**	**2.4**	**1.4**	**1**	**1.5**		**2**		**2.2**	**3**	**2.2**	**2.6**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
Unit 1	**INTRODUCTION TO IMMUNOLOGY**	**9**		
	Overview of defense mechanisms in animals	3	1	1, 2
	Hematopoiesis	2	1	1, 2
	Cells of the immune system	2	1	1, 2
	Primary and secondary lymphoid organs and tissues	2	1	1, 2
Unit 2	**INNATE IMMUNITY**	**9**		
	Anatomical barriers and cell types of innate immunity	2	1, 2	1, 2
	Soluble molecules and membrane associated receptors (PRR)	1	1, 2	1, 2
	Connections between innate and adaptive immunity	1	1,2	1, 2
	Cell adhesion molecules and chemokines	1	2	1, 2
	Leukocyte extravasation,localized and systemic response	1	2	1, 2
	Complement activation by classical, alternate and MBL pathway	1	2	1, 2
	Biological consequences of complement activation	1	2	1, 2
	Regulation and complement deficiencies	1	2,4	1, 2
Unit 3	**ADAPTIVE IMMUNITY**	**9**		
	Antigens and haptens Factors that dictate immunogenicity B and T cell epitopes	1	1,3,4	1, 2
	Structure and distribution of classes and subclasses of immunoglobulins (Ig), Ig fold, effector functions of antibody	1	1,3,4	1, 2
	Antigenic determinants on Ig and Ig super family Generation of antibody Diversity	1	1,3,4	1, 2
	Monoclonal antibodies	1	1,3,4	1, 2
	Immunological methods- Antigen-antibody interactions	1	3	1, 2
	Histocompatibility antigens - HLA and Disease	1	3	1, 2
	T cell differentiation – Positive and Negative selection Antigen Presentation	1	3	1, 2
	Activation of T and B cells	1	3, 4, 5	1, 2
	Cytokines and Chemokines	1	2, 3, 4, 5	1, 2
Unit 4	**IMMUNE DYSFUNCTION AND DISEASE**	**9**		
	Immunological tolerance	2	4	1, 2
	Immunological disorders – Hypersensitivity and Autoimmune diseases	1.5	4	1, 2
	Immunodeficiencies	1.5	4	1, 2
	Transplantation Immunology	1.5	4	1, 2
	Immune response against major classes of pathogens	2.5	4	1, 2
Unit 5	**Vaccines**	**9**		
	Introduction to vaccines and History of the development of vaccines	2	1,5	1, 2
	Types of vaccines	2	1,5	1, 2
	Adjuvants	2	1,5	1, 2
	Immunization –routes and responses	2	1,5	1, 2
	Future of vaccine biology	1	1,5	1, 2
Total Contact Hours		**45**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		Mid-2 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%		60%		40%		40%		30%	
	Understand										
Level 2	Apply	60%		40%		60%		60%		70%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		100%		100%		100%		100%		100%	

Recommended Resources

1. Kuby Immunology (2018), 8thedition.Jenni Punt, Sharon Stranford, Patricia Jones, Judith A Owen
2. William Paul, Fundamental Immunology, 7th edition. 2013

Other Resources

1. BiteSized Immunology (https://www.immunology.org/public-information/bitesized-immunology)

Course Designers

1. Dr. Writoban Basu Ball, Assistant Professor, Department of Biological Sciences, SRM University – AP.

Genetic Engineering Lab

Course Code	BIO 304	**Course Category**	CC	**L**	**T**	**P**	**C**
				0	0	2	2
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To develop proficiency in essential molecular biology techniques, including site-directed mutagenesis, plasmid preparation, and transformation of competent E. coli, for manipulating and analyzing genetic material.
2. To gain expertise in protein analysis methods such as cell harvesting, protein extraction, SDS-PAGE, and Western blotting, complemented by bioinformatics tools for sequence analysis and comparison.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Perform site-directed mutagenesis, plasmid preparation, and E. coli transformation.	4	80%	70%
Outcome 2	Conduct cell harvesting, protein extraction, and SDS-PAGE analysis.	3	80%	70%
Outcome 3	Execute Western blotting for His-tagged proteins and interpret results.	4	80%	70%
Outcome 4	Use bioinformatics tools for sequence analysis and comparison.	4	75%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	3	3	3			2	3	1		3	2	3	3
Outcome 2	3	3	3	3	3				2	1		3	2	3	3
Outcome 3	3	3	3	3	3				3	2		3	3	3	3
Outcome 4	3	3	3	3	3	2			3	3		3	2	3	3
Course Average	**3**	**3**	**3**	**3**	**3**	**2**		**2**	**2.7**	**1.7**		**3**	**2.2**	**3**	**3**

Course Unitization Plan - Lab

Exp No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1.	Site directed mutagenesis,	10	1	1
2.	Transformation of competent E. coli	5	1	1
3.	Plasmid preparation	5	1	1
4.	Sequence analysis and comparison using bioinformatics tools.	10	4	1
5.	Cell harvesting and protein extraction	5	2	1
6.	Protein expression analysis via SDS-PAGE	15	2	1
7.	Western blotting (His-Tag protein)	10	3	1
Total Contact Hours		**60**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)			End Semester Exam (50%)
		Experiments (20%)	Record / Observation Note (10%)	Viva + Model (20%)	
Level 1	Remember	50%		35%	20%
	Understand				
Level 2	Apply	50%	100%	65%	80%
	Analyse				
Level 3	Evaluate				
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Molecular Cloning: A Laboratory Manual, 4th edition. Michael R. Green. Joseph Sambrook. CSHL Press.

Other Resources

Course Designers

1. Dr. Sudeshna Saha – Assistant Professor- Dept. Of Biological Sciences. SRM University – AP

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Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Plant and Animal Physiology

Course Code	BIO 305	**Course Category**	CC	**L**	**T**	**P**	**C**
				3	1	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To gain knowledge about plants stress response and adaptation mechanisms and their relevance to crop productivity.
2. Understand the physiology across levels, from molecular to organismal, and understand interactions between different physiological systems of animals.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe the role of plants and photosynthesis in sustaining life on earth.	2	80%	75%
Outcome 2	Discuss photosynthesis and role of photoreceptors, phytohormones, nutrients in plant development.	2	70%	65%
Outcome 3	Analyse the type of stress in plants and mitigation strategies.	4	70%	65%
Outcome 4	Illustrate the functional organization of an animal and the mechanisms of maintaining homeostasis	2	70%	65%
Outcome 5	Describe the structure, organization and function of different organ systems of the human body	2	70%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)													
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	1	2	2	1		3					2	3	1	2
Outcome 2	3	2	2	3	2	1	2					2	3	2	3
Outcome 3	3	2	1	2	1		2					2	3	3	2
Outcome 4	3	3	3	3	3	2	2					2	3	3	3
Outcome 5	3	3	3	3	3	3	2		2			3	3	3	3
Course Average	**3**	**2.2**	**2.2**	**2.6**	**2.5**	**2**	**2.3**		**2**			**2.2**	**3**	**2.4**	**2.6**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
Unit 1	**Basic Plant Physiology**	**12**		
	Transport system	2	1	1
	Micro and macro nutrients	2	1	1, 2
	Nitrogen metabolism	2	1	1, 2
	Photosynthesis, respiration and photorespiration	2	1	1
	Transpiration	2	1,3	1
	Photomorphogenesis: response to light	2	1, 3	1
Unit 2	**Plant growth regulators**	**12**		
	Plant growth regulators	1	1,3	1, 2
	Auxins and their physiological roles	2	1,3	1, 2
	Gibberellins and their physiological roles	2	1,3	1, 2
	Cytokinins and their physiological roles	2	1,3	1, 2
	Abscissic acid and their physiological roles	2	1,3	1, 2
	Ethylene and their physiological role	1	1,3	1, 2
	Practical application of plant growth regulators in crop productivity	2	1,3	1, 2
Unit 3	**Plant stress response**	**12**		
	Overview of biotic and abiotic stresses	2	3	1
	Salinity stress - physiological changes	2	3	1
	Adaptation to drought and amelioration	3	3	1
	Plant-pathogen interactions	3	3	1
	Programmed cell death, aging and senescence	2	3	1
Unit 4	**Introduction to Physiology**	**12**		
	Organization of human body	3	4,5	3
	Extracellular fluid and the internal environment	3	4	3
	Concept of Homeostasis	2	4	3
	Thermoregulation	2	4,5	3
	Osmoregulation	2	4	3
Unit 5	**Physiology of Organ Systems**	**12**		
	Skeletal and muscular systems	2	5	3
	Integumentary and nervous systems	2	5	3
	Respiratory and digestive systems	2	5	3
	Excretory and cardio-vascular systems	2	5	3
	Endocrine and lymphatic (immune) systems	2	5	3
	Reproductive systems	2	5	3
Total Contact Hours		**60**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		Mid-2 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	80%		80%		80%		70%		70%	
	Understand										
Level 2	Apply	20%		20%		20%		30%		30%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Taiz and Zeiger, Plant Physiology
2. Buchnan, B. B., Gruissem, W. and Jones, R. L., Biochemistry and molecular biology of plants
3. Barret et al. Ganong's Review of Medical Physiology. 26th edition, McGraw Hill Education.

Other Resources

Course Designers

1. Dr. Prateek Gupta, Asst. Professor. Dept. of Biological Sciences. SRM University - AP

CO-CURRICULAR ACTIVITIES

Course Code	VAC 103	**Course Category**	VAC	**L**	**T**	**P**	**C**
				0	0	2	2
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	SA	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Develop essential skills, including leadership, communication, and teamwork, among students.
2. Offer opportunities for students to apply academic concepts in practical, real-world scenarios.
3. Promote self-exploration, confidence-building, and social responsibility.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	**Bloom's Level**	**Expected Proficiency Percentage**	**Expected Attainment Percentage**
Outcome 1	Demonstrate confidence in leading group activities, communicate clearly, and collaborate effectively with diverse teams.	2	80%	75%
Outcome 2	Apply theories to practical tasks by solving problems and adapting concepts to real-life situations through cocurricular activities	2	80%	70%
Outcome 3	Develop new experiences with an open approach through guided reflection to assess personal growth, skills, and learning for holistic development.	3	80%	70%

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments 100%**			
		CLA-1 25%	**CLA-2 25%**	**CLA-3 25%**	**CLA-4 25%**
Level 1	Remember				
	Understand				
Level 2	Apply	15%	15%	15%	15%
	Analyse				
Level 3	Evaluate	10%	10%	10%	10%
	Create				
Total		**25%**	**25%**	**25%**	**25%**

SRM University *AP*, Andhra Pradesh
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Guntur District, Mangalagiri, Andhra Pradesh – 522240.

COMMUNITY SERVICE AND SOCIAL RESPONSIBILITY

Course Code	VAC 104	**Course Category**	VAC	**L**	**T**	**P**	**C**
				0	0	2	2
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	CEL	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Encourage initiatives that address local needs, foster self-sufficiency, and promote environmental sustainability within the community.
2. Equip participants with a deeper understanding of social issues and a sense of responsibility towards marginalized communities.
3. Inspire active participation in community service programs and foster a culture of giving back among individuals and organizations.
4. Develop and implement programs that contribute to skill development, economic empowerment, and equal opportunities for underprivileged sections of society.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Develop effective strategies for identifying and addressing community needs.	3	80%	80%
Outcome 2	Demonstrate empathy and cultural sensitivity when engaging with diverse community groups.	4	80%	75%
Outcome 3	Implement sustainable solutions and evaluate their impact on social well-being.	5	90%	85%
Outcome 4	Collaborate effectively within teams to design and lead community service projects.	6	90%	80%

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments 50%				End Semester Exam 50%
		CLA-1 20%	Mid-1 20%	CLA-2 20%	CLA-3 20%	
Level 1	Remember	10%	10%			20%
	Understand					
Level 2	Apply		10%	10%		20%
	Analyse					
Level 3	Evaluate				10%	10%
	Create					
Total		**10%**	**20%**	**10%**	**10%**	**50%**

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Introduction to Biotechnology

Course Code	BIO 306	**Course Category**	CC	**L**	**T**	**P**	**C**
				2	1	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Understand the history, significance, and commonly utilized materials, such as plasmids and vectors, in the field of biotechnology.
2. Learn the principles and techniques of gene and genome editing, including CRISPR-Cas9 and other emerging technologies.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe the importance and basics of biotechnology and historical breakthrough in the field.	1	70%	65%
Outcome 2	Expalin the principles of gene and genome editing.	2	70%	65%
Outcome 3	Describe the importance of microorganisms, plants, and animal systems in various industrial processes, involving genetic engineering strategies.	2	70%	65%
Outcome 4	Explain the regulatory aspects and ethical considerations in animal and medical biotechnology.	2	70%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	1	1	1	1	1	1		2			1	3	3	2
Outcome 2	3	2	2	2	1	1	1		1			1	3	3	3
Outcome 3	3	2	1	2	1	1	2		1			1	3	3	3
Outcome 4	3	1	2	1	1	1	2	3	1	1		1	3	2	3
Course Average	**3**	**1.5**	**1.5**	**1.5**	**1**	**1**	**1.5**	**3**	**1.3**	**1**		**1**	**3**	**2.8**	**2.8**

Course Unitization Plan - Theory

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction to Biotechnology**	**7**		
	Biotechnology: Scope and Importance; History of biotechnology	2	1	4
	Types of vectors: Plasmid vectors, Bacteriophage lambda and M13 based vectors	2	1	1,2
	Cosmids, Shuttle vectors, Expression vectors, Baculovirus-based vectors, Ti based vectors (Binary and Cointegrated vectors).	3	1	
Unit 2	**Genome Editing and Gene Delivery Methods**	**14**		
	The process of Genetic Engineering; Protoplast and cell fusion technologies;	2	2	1,2
	Genome engineering tools – Conventional methods (Mutagenesis, Knock-in, Knock-out, conditional knock-outs),	4	2	1,2
	Modern methods using engineered Nucleases (Zinc finger nucleases (ZFN), Transcription activator-like effector nucleases (TALENs), Clustered regularly interspaced short palindromic repeats (CRISPR))	5	2	1,2
	Gene delivery techniques: Microinjection, biolistic method (gene gun), liposome and viral-mediated delivery, Agrobacterium-mediated delivery.	3	2	1,2
Unit 3	**Microbial Biotechnology**	**9**		
	Methods of fermentation; Industrial Bioprocesses: Ethanol, Lactic acid production – Citric acid, acetic acid,	4	3	4
	Streptomycin, beer, Amylase and protease, vitamin B12, PHA, biofertilizers, vermicompost, biopesticides; Bacillus thuringiensis, recombinant insulin and hepatitis B;	4	3	4
	Waste water management by microbes	1	3	4
Unit 4	**Plant and Algal Biotechnology**	**10**		
	Engineering of insect resistant plants and disease resistant crops. Genetically modified food products; BT crops: Transgenics rice, Cotton, Brinjal;	4	3	3
	Biofuels from algae: Biodiesel, biohydrogen, methanol and electricity generation.	3	3	3
	Nanoscience and technology for the production of bioproducts from algae. Bioremediation and Phycoremediation.	3	3	3
Unit 5	**Animal and Medical Biotechnology**	**5**		
	Basic principles of organismal cloning and challenges. Cloned animals: Carp the fish, Dolly the sheep. Dehorning of calves.	3	4	5
	Sickle cell therapy, CRISPR babies, Ethical debate on organismal cloning.	2	4	5
Total Contact Hours		**45**		

Learning Assessment

Question Difficulty	Bloom's Level of Cognitive Task	Continuous Learning Assessments (50%)				End Semester Exam (50%)
		CLA-1 (10%)	Mid-1 (15%)	CLA-2 (10%)	CLA-3 (15%)	
Level 1	Remember	100%	100%	100%	100%	100%
	Understand					
Level 2	Apply					
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Gene Cloning and DNA Analysis: An Introduction. 8th edition (2020). T. A. Brown. WileyBlackwell.
2. Principles Of Gene Manipulation And Genomics, 7th edition (2014). Primrose S.B. WileyBlackwell.
3. Introduction to Biotechnology: International Edition, 2nd edition (2008). William J. Thieman, Michael A. Palladino. Pearson International.
4. Textbook of Biotechnology, 5th edition (2017). H.K. Das. Wiley.
5. Textbook of Animal Biotechnology, (2016). Carlos Wyatt. Syrawood Publishing house.

Other Resources

Course Designers

1. Dr. Sutharsan Govindarajan, Dept. Of Biological Sciences. SRM University – AP

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Fundamentals of Bioinformatics

Course Code	BIO 307	**Course Category**	CE	**L**	**T**	**P**	**C**
				2	1	0	3
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To explain the bioinformatics data analysis and available databases and their objectives and applications.
2. To explore the bioinformatics methods available for sequence and structural analysis of genes, genomes and proteins using databases and softwares.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe the fundamentals of bioinformatics	1	80%	75%
Outcome 2	Demonstrate usage of available databases and interpret results	2	85%	80%
Outcome 3	Explain bioinformatics algorithms, methods and softwares.	3	70%	60%
Outcome 4	Describe and adapt the bioinformatics tools to perform phylogenetic and evolutionary analysis.	3	70%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	3	2	3	1		3	2	3		3	2	1	3
Outcome 2	3	2	3	3	3	1	1	2	3			3	3	2	3
Outcome 3	3	3	3	3	3	3		2	2			3	3	3	2
Outcome 4	3	3	3	3	3	3	1	2	2			3	2	3	2
Course Average	**3**	**2.8**	**3**	**2.8**	**3**	**2**	**1**	**2.3**	**2.3**	**3**		**3**	**2.5**	**2.3**	**2.5**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
Unit 1	**Introduction to Bioinformatics**	**10**		
	Concept of omics	2	1	1, 2
	Genomics, transcriptomics, proteomic and metabolomics	3	1	1, 2
	Instrumental methods of biological sequence analysis and large scale metabolite analysis	3	1	1, 2
	DNA, RNA and Protein sequences, Ontology	2	1	1, 2
Unit 2	**Nucleic Acids**	**10**		
	Primary and Secondary databases. Database formats and file formats. FASTA format.	2	1, 2	2, 3
	Public databases and repositories: NCBI, EBI, GenBank, DDBJ, EMBL, PIR and Uniprot.	3	1, 2	2, 3
	Specialized databases: NCBI, Pubmed, OMIM, Medical databases, KEGG and EST databases.	3	1, 2	2, 3
	Gene Ontology (GO), Gene Ontology Annotation (GOA) databases.	2	1, 2, 3	2, 3, 5
Unit 3	**Proteins**	**10**		
	Databases: SwissProt, PRF, Protein Data Bank, DisProt, SCOP, CATH	3	1, 2	3
	File formats: .pdb, .mmcf, .cif; Protein Ontology (PRO)	2	1, 3	2, 3
	Structure prediction, Homology modelling.	3	1, 2, 3	2, 3, 4
	Docking, Fundamentals of Biomolecular simulations	2	1, 2	1, 2
Unit 4	**Database Searches and Sequence Alignment**	**8**		
	Introduction, Evolutionary basis of sequence alignment, Modular nature of proteins	2	1, 3, 4	2, 3
	Substitution scores, Substitution matrices, Gap penalties, Statistical significance of Alignments	3	1, 3, 4	2, 4
	Database similarity searching, FASTA, BLAST. Pairwise and Multiple Sequence Alignment, Motifs and Patterns.	3	1, 3, 4	3, 4
Unit 5	**Phylogenetic Analysis**	**7**		
	Introduction to Phylogenetic analysis, rooted and unrooted trees, Elements of phylogenetic Models	2	1, 3	5, 6
	Phylogenetic Data Analysis: Alignment, Substitution Model Building, Tree Building, and Tree Evaluation,	2	1, 3, 4	5, 6
	Tree: Building Methods, Distance based and character-based methods, Evaluating Trees and Data- Bootstrapping (parametric and non-parametric), Phylogenetic software	3	1, 3, 4	5, 6
Total Contact hours		**45 hours**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		Mid-2 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	60%		60%		50%		30%		20%	
	Understand										
Level 2	Apply	40%		40%		50%		70%		80%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Bioinformatics: Methods and Applications by Singh and Pathak (2021), Academic Press.
2. Applied bioinformatics by Selzer, Marhofer, Koch, 2nd edition (2018), Springer.
3. Bioinformatics Database Systems by Byron, Herbert and Wang (2016), CRC Press.
4. Biomolecular simulations in structure based drug discovery by Gervasio and Spiwok (2019), Wiley.
5. Evolutionary Bioinformatics by Forsdyke, 3rd edition (2016), Springer.
6. Bioinformatics for Evolutionary Biologists: A problems approach by Haubold and Haubold (2018), Springer.

Other Resources

Course Designers

1. Dr. Naga Bhushana Rao Karampudi, Assistant Professor, Department of Biological Sciences, SRM University – AP

Neurobiology

Course Code	BIO 308	**Course Category**	**CC**		**L**	**T**	**P**	**C**
					3	1	0	4
Pre-Requisite Course(s)	BIO 202; BIO 201; BIO 301	**Co-Requisite Course(s)**		**Progressive Course(s)**				
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**						

Course Objectives / Course Learning Rationales (CLRs)

1. To comprehend the cell types, anatomy, and organization of the nervous system, including the gross anatomy of the brain, CNS, and PNS
2. Gain understanding of neuropathology, including diseases associated with neuronal dysfunction, and degeneration – Amyotrophic Lateral Sclerosis (ALS), Alzheimer's disease, and Parkinsons disease.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe the cell types, anatomy, and organization of the nervous system, distinguishing between the structures of the brain, CNS, and PNS	2	80%	75%
Outcome 2	Describe the molecular aspects of neural development, showcasing an ability to explain neural induction, neurogenesis, neuronal specification, and axon guidance	2	75%	70%
Outcome 3	Describe neurophysiology and synaptic transmission, display an ability to explain principles of membrane excitability, resting membrane potential, action potential and apply these concepts predict ion flow across the neuronal membrane; explain the components of the pre and post synapse and principles underlying neurotransmission	3	70%	65%
Outcome 4	Describe and explain sensory (gustation, olfaction, vision, auditory, somatosensory -sensory transduction, pathway from sense organs to the brain) and motor systems (upper and lower motor neurons, neuromuscular junction, and muscle contraction)	2	75%	65%
Outcome 5	Explain the concept of neurodegenerative disorders, and describe Alzheimer's disease, Parkinsons disease and Amyotrophic lateral sclerosis (gene mutations and hypothesis leading to neuronal death)	2	75%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	3	1	1				3		2	3	1	2
Outcome 2	3	2	3	3	2	1						2	3	2	3
Outcome 3	3	3	3	3	3	1			1	3		2	3	3	2
Outcome 4	3	2	3	3	3	1			1	3		3	3	3	3
Outcome 5	3	2	3	3	2	1		2	1			2	3	2	3
Course Average	**3**	**2.2**	**3**	**3**	**2.2**	**1**		**2**	**1**	**3**		**2.2**	**3**	**2.2**	**2.6**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
Unit 1	**INTRODUCTION TO NERVOUS SYSTEM**	**12**		
	Introduction to the nervous system, concept of CNS and PNS	2.5	1	1, 2, 4, 5
	Neurons and glia	3	1	1, 2, 4, 5
	Neuroanatomy (gross structure of human brain, dorsal and ventral view, lobes of the brain, sagittal and coronal view)	3.5	1	1, 2, 4, 5
	Skull, meninges, ventricles and cerebrospinal fluid, spinal cord, cranial and spinal nerves	3	1	1, 2, 4, 5
Unit 2	**NEURAL DEVELOPMENT**	**12**		
	Introduction to the development of the nervous system – fertilization & gastrulation	2	2	1,3,4
	Neurulation, formation of brain vesicles	2	2	1,3,4
	Neural tube patterning – anteroposterior axis & dorsoventral axis, neurogenesis	2	2	1,3,4
	Neuronal migration, Dendritogenesis, axon guidance,	3	2	1,3,4
	Synapse formation, cortical histogenesis	3	2	1,3,4
Unit 3	**NEUROPHYSIOLOGY AND NEUROTRANSMISSION**	**16**		
	Introduction ton neurophysiology and neurotransmission, Membrane transport & excitability	3	3	2,5
	Resting membrane potential & action potential	3	3	2,5
	Tools to study electrical properties of neurons	2	3	2,5
	Synapses: types, pre and post-synapse: Structure and composition	3	3	2,5
	Neurotransmitter systems and principles of neurotransmission, neural code	5	3	2,5

Unit 4	**SENSORY AND MOTOR SYSTEMS**	**12**		
	Introduction to sensory and moto systems, chemical senses- gustation and olfaction	3	4	1,5
	Eye and the visual system – retinal, sensory transduction, pathway followed from eye to brain	2	4	1,5
	Auditory system – sensory transduction and path from inner ear to the brain	2	4	1,5
	Somatosensory system – sensory transduction and pathway to the brain	2	4	1,5
	Motor system – spinal motor system, neuromuscular junction, muscle contraction	3	4	1,5
Unit 5	**NEUROPATHOLOGY**	**08**		
	Diseases associated with neuronal dysfunction and degeneration	2	5	4,5,6
	Alzheimer's Disease	2	5	4,5,6
	Parkinsons Disease	2	5	4,5,6
	Amyotrophic Lateral Sclerosis	2	5	4,5,6
Total Contact Hours		**60**		

Learning Assessment

Bloom's Level of Cognitive Task		**Continuous Learning Assessments (50%)**				**End Semester Exam (50%)**
		CLA-1 (10%)	**Mid-1 (15%)**	**CLA-2 (10%)**	**CLA-3 (15%)**	
		Th	**Th**	**Th**	**Th**	**Th**
Level 1	Remember	100%	100%	80%	100%	80%
	Understand					
Level 2	Apply			20%		20%
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Neuroscience- Exploring the Brain. Mark F Bears. 2016. 4th international edition. Lww
2. Neuroscience. 2018. Dale Purves. 2018. 6th edition. OUP USA
3. Development of the Nervous system. Dan H Sanes. 2019. 4th edition. Academic Press Inc.
4. Principles of Neurobiology. Liqun Luo. 2015. Ist edition. Garland Science
5. Principles of Neural Science. Eric R. Kandel. 2012. 5th edition. McGraw Hill Education
6. Neurodegeneration, Anthony Schapira. 2017, Ist edition, Wiley

Other Resources

1. BrainFacts.org

Course Designers

1. Dr. Pitchaiah Cherukuri, Assistant Professor, Department Of Biological Sciences, SRM University – AP.

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Introduction to Disease Biology

Course Code	BIO 309	**Course Category**	CC	**L**	**T**	**P**	**C**
				3	1	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Understand the molecular bases of pathological, pathophysiological and genetic disorders.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Describe the cellular and biochemical classifications of pathogens	2	80%	75%
Outcome 2	Describe the molecular aspects of viral pathogenesis	2	75%	70%
Outcome 3	Describe neurophysiology and synaptic transmission discrepancies in neurological disorders	2	70%	65%
Outcome 4	Describe and explain the cause and prognosis of genetic disorders	2	75%	65%
Outcome 5	Explain the underlying pathogenesis of age-related diseases.	2	75%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	3	1		3	3		3		2	3	1	3
Outcome 2	3	2	3	3	2		2					2	3	2	3
Outcome 3	3	3	3	3	3					3		2	3	3	2
Outcome 4	3	2	3	3	3	1				3		3	3	3	3
Outcome 5	3	2	3	3	2			3				2	3	2	2
Course Average	**3**	**2.2**	**3**	**3**	**2.2**	**1**	**2.5**	**3**		**3**		**2.2**	**3**	**2.2**	**2.6**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
UNIT I	**INTRODUCTION TO PATHOGENS**	**9**		
	Introduction to pathogens & virulence. Types of pathogens – Prions	3	1	1,2
	Bacteria	2	1	1,2
	Virus	2	2	3
	Protozoa. Virulence factors – Defensive and offensive virulence factors.	2	1	1,2
UNIT II	**VIRUSES AND VACCINES**	**9**		
	DNA viruses and RNA viral diseases	3	2	3
	Mechanisms of replication.	3	2	3
	Retroviruses: Molecular biology of HIV	2	2	3
	Antiviral therapy. Viral vaccines strategies and antiviral drug therapy.	1	2	3
UNIT III	**NEUROLOGICAL DISORDERS**	**9**		
	Introduction to neurological disorders -Kuru	1	3	1,2
	Scrapie	1	3	1,2
	Creutzfeldt-Jakob disease	1	3	1,2
	Mad cow disease	1	3	1,2
	Alzheimer’s disease	1	3	1,2
	Multiple sclerosis	1	3	1,2
	Parkinson’s disease	1	3,5	1,2
	Huntington’s disease	1	3, 4	1,2
	Degenerative diseases of motor neurons.	1	3	1,2
UNIT IV	**GENETIC DISORDERS**	**9**		
	Introduction to Genetic disorders. Types of genetic disorders - Single gene inheritance (cystic fibrosis)	2	4, 5	1,2
	Sickle cell anemia	1	4	1,2
	Multifactorial inheritance (heart disease high blood pressure diabetes)	2	4	1,2
	Chromosome abnormalities (Down syndrome, Turner syndrome)	2	4	1,2
	Mitochondrial inheritance (myoclonic epilepsy, Leber's hereditary optic atrophy).	2	4	1,2
UNIT V	**AGING AND ASSOCIATED DISORDERS**	**9**		
	Introduction to Aging and Disease; Causes of aging – ‘wear and tear’ theories & Genome-based theories. Age related diseases- Cancer	1.5	5	1,2
	Cardiovascular Disease	1.5	5	1,2
	Diabetes Mellitus Type 2	1.5	5	1,2
	Cataracts	1.5	5	1,2
	Arthritis	1.5	5	1,2
	Parkinson’s Disease. Calorie Restriction and Aging.	1.5	4, 5	1,2
	Total	**45 hours**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)				End Semester Exam (50%)
		CLA-1 (10%)	Mid-1 (15%)	CLA-2 (10%)	CLA-3 (15%)	
		Th	Th	Th	Th	Th
Level 1	Remember	100%	100%	100%	100%	100%
	Understand					
Level 2	Apply					
	Analyse					
Level 3	Evaluate					
	Create					
Total		**100%**	**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. Ahmed, N., Dawson, M., Smith, C., & Wood, E. (2006). Biology of disease. Garland Science.
2. Crowley, L. (2011). Essentials of human disease. Jones & Bartlett Publishers.
3. Acheson, N. H. (2011). Fundamentals of molecular virology (No. Ed. 2). John Wiley & Sons, Inc.

Other Resources

Course Designers

1. Prof. Jayaseelan Murugaiyan, Department of Biological Sciences, SRM University-Andhra Pradesh

Bioinformatics Lab

Course Code	BIO 310	**Course Category**	CC	**L**	**T**	**P**	**C**
				0	0	2	2
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. To comprehend the basics of biological data base and Bioinformatics.
2. To gain expertise in UNIPROT Nucleic acid sequence databank – Gene bank, EMBL, DDBJ
3. To enable students to preform BLAST, FASTA Pair wise alignment.
4. To enable students to evaluate protein structure by Swiss PDB and visualization tools – RASMO.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Demonstrate the principle of biological database and internet resources in Bioinformatics.	3	80%	70%
Outcome 2	Explain the UNIPROT Nucleic acid sequence databank – Gene bank, EMBL, DDBJ	5	80%	70%
Outcome 3	Demonstrate the Waterman algorithms Multiple alignment-LUSTALW, CLUSTAL X and T-COFFEE.	3	80%	70%
Outcome 4	Demonstrate the protein structure by Swiss PDB viewer and visualizati tools –RASMOL and Homology modelling of a protein sequence.	3	70%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	3	3	2			3	3		2	3	3	3
Outcome 2	3	2	3	3	3	2			3			2	3	2	2
Outcome 3	3	3	3	3	3	2			3	3		1	3	3	2
Outcome 4	3	2	3	3	3	2			3	3		2	3	3	2
Course Average	**3**	**2.3**	**3**	**3**	**3**	**2**			**3**	**3**		**1.8**	**3**	**2.8**	**2.3**

Course Unitization Plan - Lab

Exp No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1.	Homology Modeling	6	1,2	1, 2, 3
2.	Molecular Docking	6	1,4	1, 2, 3
3.	Molecular Dynamics Simulations	6	1,4	1, 2, 3
4.	Molecular interaction analysis	6	1	1, 2, 3
5.	Automation of analysis pipeline	6	1	1, 2, 3
6.	SwissDock and SwissModel	6	2, 3	1, 2, 3
7.	NCBI Database	6	2, 3	1, 2, 3
8.	Genome browsers	6	2, 3	1, 2, 3
9.	Torsion angle calculation using Python programming	6	4	1, 2, 3
Total Contact Hours		**60**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)			End Semester Exam (50%)
		Experiments (20%)	Record / Observation Note (10%)	Viva + Model (20%)	
Level 1	Remember				
	Understand				
Level 2	Apply	50%	100%	50%	50%
	Analyse				
Level 3	Evaluate	50%		50%	50%
	Create				
Total		**100%**	**100%**	**100%**	**100%**

Recommended Resources

1. "Bioinformatics for Beginners: Genes, Genomes, Molecular Evolution, Databases and Analytical Tools" by Supratim Choudhuri:
2. 2. "Bioinformatics Algorithms: An Active Learning Approach" by Phillip Compeau and Pavel Pevzner:
3. 3. "Bioinformatics: Sequence and Structure Analysis" by Michael Gribskov and John Devereux:

Other Resources

Course Designers

1. Dr. Naga Bhushana Rao Karampudi, Assistant Professor, Department of Biological Sciences, SRM University-Andhra Pradesh

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Minor Research Project

Course Code	BIO 401	Course Category	RDIP	L	T	P	C
				0	0	5	5
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Biological Sciences	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. Equip students with essential research methodologies and practical experience in experimental design, data collection, analysis, and interpretation in a biological context.
2. Promote the integration of concepts from various biological disciplines to address complex biological questions and foster a holistic understanding of biology.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Design and execute a minor research project, demonstrating the ability to independently formulate hypotheses, conduct experiments, and analyze data.	3	75%	70%
Outcome 2	Analyze and interpret experimental data, using appropriate scientific methods and tools.	4	75%	70%
Outcome 3	Effectively present research findings through written reports and oral presentations, demonstrating clear and concise scientific communication skills..	4	75%	70%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	3	3	3	1			2			3	3	1	3
Outcome 2	3	3	3	3	3	2			2			3	3	2	2
Outcome 3	3	3	3	3	3	2			2			3	3	2	2
Course Average	**3**	**3**	**3**	**3**	**3**	**2**			**3**			**3**	**3**	**1.8**	**2.2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact hours	CLOs Addressed	References Used
Unit 1	Overview of research design, hypothesis formulation, and experimental planning.	10	1	1-7
Unit 2	Conducting literature review and developing a research proposal.	20	1	
Unit 3	Designing and conducting experiments, collecting data.	70	1	
Unit 4	Analyzing and interpreting data using statistical and bioinformatics tools.	20	2	
Unit 5	Applying interdisciplinary knowledge to analyze findings.	10	2	
Unit 6	Writing a detailed research report.	10	3	
Unit 7	Preparing and delivering an oral presentation, defending research findings.	10	3	
Total Contact Hours		**150**		

Learning Assessment

Bloom's Level of Cognitive Task		**Record / Observation Note (50%)**	**Presentation (50%)**
Level 1	Remember	50%	20%
	Understand		
Level 2	Apply	50%	80%
	Analyse		
Level 3	Evaluate		
	Create		
Total		**100%**	**100%**

Recommended Resources

1. As recommended by the Advisor pertaining to student research interest.
2. https://pubmed.ncbi.nlm.nih.gov/
3. https://www.sciencedirect.com/
4. www.springer.com
5. https://onlinelibrary.wiley.com/
6. Research Methodology
7. Reading assignment related to undergraduate project as guided by faculty

Other Resources

Course Designers

1. Dr. Writoban Basu Ball, Assistant Professor, Department of Biological Sciences. SRM University - AP

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Signal Transduction

Course Code	BIO 421	**Course Category**	CE	**L**	**T**	**P**	**C**
				4	0	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Equip students with knowledge of different types of signaling, receptors, and secondary messengers.
2. Provide insights into cell cycle regulation and cancer-related signaling mechanisms.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Understand the basics of cell signaling, including the types of signaling and the roles of receptors and ligands..	2	80%	75%
Outcome 2	Explain the structure and function of GPCRs and RTKs, and the modulation of their signaling pathways.	3	80%	70%
Outcome 3	Describe the role of secondary messengers and specific signaling mechanisms in bacteria and plants.	2	80%	70%
Outcome 4	Understand the function of nuclear receptors and the role of transcription factors in gene regulation.	2	70%	65%
Outcome 5	Explain the signaling pathways involved in cell cycle regulation and their implications in cancer development.	3	70%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	3	1	1	3	3	3	3		2	3	1	2
Outcome 2	3	2	3	3	2	1	3		1			2	3	2	2
Outcome 3	3	2	3	3	3	1	3		1			2	3	2	2
Outcome 4	3	2	3	3	3	1	3		1			2	3	2	2
Outcome 5	3	2	3	3	3	3	2		2			3	3	2	2
Course Average	**3**	**2**	**3**	**3**	**2.4**	**1.4**	**2.8**	**3**	**1.6**	**3**		**2.2**	**3**	**1.8**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
Unit 1	**INTRODUCTION TO SIGNAL TRANSDUCTION**	**10**		
	Overview of Cell Signalling: Definition and importance of cell signalling	1	1	1,2,3
	Types of signalling	1	1	1,2,3
	Autocrine, paracrine, endocrine, and direct cell-to-cell signalling;	1	1	1,2,3
	Molecular Components of Signalling Pathways	2	1	1,2,3
	Receptors: types, membrane-bound and intracellular receptors	1	1	1,2,3
	Ligands: hormones	1	1	1,2,3
	Growth factors, neurotransmitters.	1	1	1,2,3
	Intracellular signalling molecules	1	1	1,2,3
	Second messengers.	1	1	1,2,3
Unit 2	**CELL SURFACE RECEPTORS AND INTRACELLULAR SIGNALLING PATHWAYS**	**15**		
	G Protein-Coupled Receptors (GPCRs): Structure and function of GPCRs	2	1,2	1,2,3
	GPCR signalling cascades and their modulation. Receptor Tyrosine Kinases (RTKs)	3	1,2	1,2,3
	Structure and activation of RTKs.	2	1,2	1,2,3
	Downstream signalling pathways of RTKs.	2	1,2	1,2,3
	Crosstalk Between Signalling Pathways.	2	1,2	1,2,3
	Ion Channel Receptors: Signalling through ligand-gated ion channels	2	1,2	1,2,3
	Role of ion channels in cellular responses.	2	1,2	1,2,3
Unit 3	**SECONDARY MESSANGERs & CELL SIGNALLING IN BACTERIA & PLANTS**	**10**		
	Secondary messengers-cAMP, cGMP	2	3	1,2,3
	Metabolic pathways for the formation of inositol triphosphate from phosphatidyl inositol diphosphate	3	3	1,2,3
	Ca^{2+}, DAG and NO as signalling molecules.	2	3	1,2,3
	Cell signalling in bacteria-Two component system, Quorum sensing,	2	3	1,2,3
	Cell signalling in plants	1	3	1,2,3
Unit 4	**NUCLEAR RECEPTORS AND GENE REGULATION**	**10**		
	Nuclear Receptors: Structure and function of nuclear receptors	2	4	1,2,3
	Hormone response elements and gene regulation.	2	4	1,2,3
	Transcription Factors in Signalling:	2	4	1,2,3
	Role of transcription factors in signal transduction.	2	4	1,2,3
	Gene expression changes in response to signalling.	2	4	1,2,3
Unit 5	**SIGNALLING MECHANISM IN CELL CYCLE REGULATION & CANCER**	**15**		
	Overview of cell cycle and its regulation,	2	5	1,2,3
	Cyclin-dependent protein kinases (CDKs) phosphatases,	3	5	1,2,3
	DNA damage check points in cell cycle	2	5	1,2,3
	Cancer, signal transduction involved in tumerogenesis,	2	5	1,2,3
	Oncogenes, proto-oncogenes and tumor suppressor genes.	2	5	1,2,3
	Tumor suppressor protein	2	5	1,2,3
	p53 and its role in tumor suppression.	2	5	1,2,3
Total Contact Hours		**60**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (15%)		CLA-3 (10%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	60%		70%		70%		60%		70%	
	Understand										
Level 2	Apply	40%		30%		30%		40%		30%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Bruce Alberts, Molecular Biology of the Cell, Garland Science
2. Lehninger Principles of Biochemistry, D. L. Nelson and M. M. Cox, (2017) 7th edition, W.H. Freeman & Company.
3. Molecular Cell Biology: James E. Darnell, Harvey F. Lodish, David Baltimore:

Other Resources

Course Designers

1. Dr. Jayaseelan Murugaiyan. Professor & Head. Dept. Of Biological Sciences. SRM University – AP

SRM University *AP*, Andhra Pradesh
Neerukonda, Mangalagiri Mandal,
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Introduction to Omics

Course Code	BIO 422	**Course Category**	CE	**L**	**T**	**P**	**C**
				4	0	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Equip students with knowledge of genomics, transcriptomics, proteomics, and metabolomics, including their methodologies and applications.
2. Provide skills to analyze and interpret complex biological interactions and integrate diverse omics data.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Understand genomics concepts, sequencing methods, and the impact of the Human Genome Project.	2	70%	65%
Outcome 2	Master gene expression measurement techniques and functional enrichment analysis.	3	70%	65%
Outcome 3	Learn protein separation techniques and mass spectrometry for protein identification.	3	70%	65%
Outcome 4	Understand metabolite identification and pathway analysis using MS and NMR.	3	70%	65%
Outcome 5	Analyze biological interactions and integrate diverse omics data.	3	70%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	3	1	1	3	3	2			2	3	1	2
Outcome 2	3	2	3	3	2	1	3	3	1			2	3	2	2
Outcome 3	3	2	3	3	3	1	3	3	1			2	3	2	2
Outcome 4	3	2	3	3	3	1	3	3	2			2	3	2	2
Outcome 5	2	2	3	3	3	3	2	3	2			3	3	2	2
Course Average	**2.8**	**2**	**3**	**3**	**2.4**	**1.4**	**2.8**	**3**	**1.6**			**2.2**	**3**	**1.8**	**2**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Genomics**	**10**		
	Understand fundamental genomics concepts and their biological research applications.	2	1	1, 2
	Explore diverse sequencing methods and their applications in sequencing entire genomes	3	1	1, 2
	Gain insights into methodologies and applications of GWAS for identifying genetic variations linked to traits or diseases	2	1	1, 2
	Examine the historical context, objectives, and the transformative impact of the Human Genome Project on genomic research.	3	1	1, 2
Unit 2	**Transcriptomics**	**15**		
	Understand the definition of a transcriptome, encompassing alternative splicing, mRNA diversity, and the distinction between gene and transcript expression.	2	2	1, 2, 3
	Learn techniques such as Northern blotting, qPCR, microarray, and RNA-Sequencing for precise measurement of gene and transcript expression.	3	2	1, 2, 3
	Explore the application of differential expression analysis and its significance in understanding variations in gene and transcript expression.	4	2	1, 2 3
	Gain proficiency in functional enrichment analysis using tools like Gene Ontology (GO) and Gene Set Enrichment Analysis (GSEA) to decipher biological insights from transcriptomic data.	3	2	1, 2, 3
	Conduct Transcriptome-wide Association Studies (TWAS) to identify expressed transcripts linked to phenotypic variations, and learn to access transcriptome big data through projects like The Cancer Genome Atlas (TCGA) and Genotype-Tissue Expression (GTEx).	3	2	1, 2, 3
Unit 3	**Proteomics**	**10**		
	Understand the definition, meaning, and goals of proteomics, focusing on the comprehensive study of proteins in biological systems.	2	3	3
	Explore the fundamentals of protein and peptide separation, covering both gel-based and non-gel-based proteomic approaches.	3	3	3
	Master techniques like one-dimensional electrophoresis (SDS-PAGE), two-dimensional gel electrophoresis (2D-PAGE), and 2D Differential Gel Electrophoresis (DIGE), alongside various staining methods. Understand the basis of mass spectrometry for protein identification in proteomic studies.	2	3	3
	Learn the top-down and bottom-up approaches in proteomics, focusing on applications for both qualitative and quantitative analyses of proteins.	3	3	3
Unit 4	**Metabolomics**	**10**		
	Metabolomics - Sample processing and metabolite identification by mass spectrometry (MS)	1	4	2, 3
	nuclear magnetic resonance (NMR)	2	4	2, 3
	Data processing and interpretation for NMR	2	4	2, 3
	LC-MS	2	4	2, 3
	GC- MS	1	4	2, 3
	Pathway analysis	2	4	2, 3

Unit 5	Systems Biology	15		
	Explore the classes and biological relevance of diverse biological interactions, understanding their significance in molecular processes.	2	1-5	2, 3
	Investigate molecular interactions with a focus on databases, providing a comprehensive overview of the molecular landscape.	3	1-5	2, 3
	Understand topological analysis in the context of genetic circuits, unraveling the structural and functional aspects of genetic regulatory networks.	3	1-5	2, 3
	Explore methodologies for the seamless integration of diverse omics analyses, fostering a holistic understanding of biological systems.	3	1-5	2, 3
	Delve into interactome properties through databases and analyses, elucidating the complexities of biological networks at a systems level.	4	1-5	2, 3
	Total hours	**60**		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		Mid-2 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%		60%		40%		60%		50%	
	Understand										
Level 2	Apply	60%		40%		60%		40%		50%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		**100%**		**100%**		**100%**		**100%**		**100%**	

Recommended Resources

1. Genome, Transcriptome and Proteome Analysis by Alain Bernot. John Wiley & Sons, Ltd
2. Principles of Genome Manipulation and Genomics by S.B. Primrose and R.M. Twyman (7th edition). Blackwell Publishing.
3. Transcriptomics. Virendra Gomase. 2009. VDM Verlag
4. Proteomics: A Comprehensive Study of Proteins. Tanner Perry. 2017. Larsen and Keller Education
5. SYSTEMS BIOLOGY P VSI. Eberhard O. Voit. 2020. OUP Oxford.

Other Resources

Course Designers

1. Dr. Anil K. Suresh, Dept. Of Biological Sciences. SRM University – AP

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Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Cancer and Stem Cell Biology

Course Code	BIO 423	**Course Category**	CE	**L**	**T**	**P**	**C**
				4	0	0	4
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Equip students with foundational knowledge of cancer, including key terms, types, and contributing factors.
2. Provide insights into the molecular basis of cancer, focusing on oncogenes, tumor suppressor genes, and therapeutic strategies.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Understand cancer terms, types, and development factors.	2	70%	65%
Outcome 2	Identify oncogenes, tumor suppressor genes, and therapeutic strategies.	3	70%	65%
Outcome 3	Classify stem cells, explore cancer stem cell roles, and potential therapies.	3	70%	65%
Outcome 4	Analyze tumor microenvironment components, angiogenesis, and immunotherapy.	3	70%	65%
Outcome 5	Learn diagnostic techniques, address ethical issues, and understand social aspects of cancer care.	3	70%	65%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	2	3	3	1	1	3	3	2			2	3	1	3
Outcome 2	3	2	3	3	2	1	3	3	1			2	3	2	3
Outcome 3	3	2	3	3	3	1	3	3	1			2	3	2	3
Outcome 4	3	2	3	3	3	1	3	3	2			2	3	2	3
Outcome 5	2	2	3	3	3	3	2	3	2			3	3	2	3
Course Average	**2.8**	**2**	**3**	**3**	**2.4**	**1.4**	**2.8**	**3**	**1.6**			**2.2**	**3**	**1.8**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	**Introduction to Cancer Biology**	**10**		
	Define key terms related to cancer biology. Explain the hallmarks of cancer.	2	1	1, 2
	Summarize historical developments in cancer research.	3	1	1, 2
	Compare and contrast different types of cancer.	2	1	1, 2
	Interpret cancer statistics and epidemiological data.	2	1	1, 2
	Analyze the factors contributing to cancer development.	1	1	1, 2
Unit 2	**Cellular and Molecular Basis of Cancer**	**15**		
	Identify oncogenes and tumor suppressor genes.	2	1,2	1, 2, 3
	Describe the role of mutations in cancer.	3	1,2	1, 2 3
	The implications of genetic testing in cancer.	2	1,2	1, 2, 3
	Resistance mechanisms in cancer treatment.	3	1,2	1, 2, 3
	Crosstalk Between Signalling Pathways.	3	1,2	1, 2, 3
	Targeting signaling pathways as therapeutic strategies.	2	1,2	3
Unit 3	**Stem Cell Biology and Cancer Stem Cells**	**10**		
	Classify different types of stem cells.	2	3	3
	The influence of microenvironments on stem cell behavior.	3	3	3
	Characteristics of cancer stem cells.	2	3	3
	The role of cancer stem cells in tumor progression.	2	3	2, 3
	Potential therapeutic approaches targeting cancer stem cells.	1	3	2, 3
Unit 4	**Tumor Microenvironment and Immune Response**	**10**		
	Identify components of the tumor microenvironment.	2	4	2, 3
	Angiogenesis in the context of tumor growth.	2	4	2, 3
	Interactions between cancer cells and stroma.	2	4	2, 3
	The mechanisms of immune surveillance and evasion.	2	4	2, 3
	Potential of immunotherapies in cancer treatment.	2	4	2, 3
Unit 5	**Clinical Applications and Ethical Considerations**	**15**		
	Diagnostic techniques and imaging modalities for cancer.	2	1-5	2, 3
	Ethical challenges in clinical trials.	3	1-5	2, 3
	Social and cultural aspects of cancer care.	3	1-5	2, 3
	Ethical considerations in cancer research.	3	1-5	2,3
	Principles of ethical conduct in clinical and research settings.	4	1-5	2,3

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)								End Semester Exam (50%)	
		CLA-1 (10%)		Mid-1 (15%)		CLA-2 (10%)		Mid-2 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%		60%		40%		60%		50%	
	Understand										
Level 2	Apply	60%		40%		60%		40%		50%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		100%		100%		100%		100%		100%	

Recommended Resources

1. Bruce Alberts, Molecular Biology of the Cell, Garland Science
2. Molecular Cell Biology: James E. Darnell, Harvey F. Lodish, David Baltimore:
3. Introduction to Cancer Biology: Robin Hesketh (2023); 2nd edition, Cambridge University Press.

Other Resources

Course Designers

1. Dr. Anil K. Suresh, Dept. Of Biological Sciences. SRM University – AP

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Neerukonda, Mangalagiri Mandal,
Guntur District, Mangalagiri, Andhra Pradesh – 522240.

Research Degree Project

Course Code	BIO 405	**Course Category**	RDIP	**L**	**T**	**P**	**C**
				0	0	12	12
Pre-Requisite Course(s)		**Co-Requisite Course(s)**		**Progressive Course(s)**			
Course Offering Department	Biological Sciences	**Professional / Licensing Standards**					

Course Objectives / Course Learning Rationales (CLRs)

1. Develop students' ability to independently plan, conduct, and analyze a research project in integrative biology.
2. Encourage students to make meaningful contributions to the field of integrative biology through their research findings and conclusions.

Course Outcomes / Course Learning Outcomes (CLOs)

	At the end of the course the learner will be able to	Bloom's Level	Expected Proficiency Percentage	Expected Attainment Percentage
Outcome 1	Develop proficiency in designing and conducting research in integrative biology.	3	75%	70%
Outcome 2	Master advanced analytical techniques to interpret research data effectively.	4	75%	70%
Outcome 3	Demonstrate clear and concise scientific communication through written reports and presentations.	4	75%	70%

Course Articulation Matrix (CLO) to Program Learning Outcomes (PLO)

CLOs	Program Learning Outcomes (PLO)														
	Scientific and Disciplinary Knowledge	Analytical Reasoning and Problem Solving	Critical and Reflective Thinking	Scientific Reasoning and Design Thinking	Research Related Skills	Modern Tools and ICT Usage	Environment and Sustainability	Moral, Multicultural and Ethical Awareness	Individual and Teamwork Skills	Communication Skills	Leadership Readiness Skills	Self-Directed and Lifelong Learning	PSO 1	PSO 2	PSO 3
Outcome 1	3	3	3	3	3	1	2	1	3			3	3	3	3
Outcome 2	3	3	3	3	3	1			1	3		3	2	2	3
Outcome 3	3	3	3	3	3			2	3	3		3	3	2	3
Course Average	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**1.5**	**2.3**	**3**		**3**	**2.6**	**2.3**	**3**

Course Unitization Plan

Unit No.	Unit Name	Required Contact hours	CLOs Addressed	References Used
Unit 1	Develop research questions and objectives, and formulate a detailed proposal.	40	1	1-7
Unit 2	Supervised and independent execution of experiments and data collection.	250	2	
Unit 3	Analyze data using statistical tools, interpret results, and draw conclusions.	50	2	
Unit 4	Present findings and defend methodologies during a Q&A session.	20	3	
Total Contact Hours		**360**		

Learning Assessment

Bloom's Level of Cognitive Task		**Record / Observation Note (50%)**	**Presentation (50%)**
Level 1	Remember	50%	20%
	Understand		
Level 2	Apply	50%	80%
	Analyse		
Level 3	Evaluate		
	Create		
Total		**100%**	**100%**

Recommended Resources

1. As recommended by the Advisor pertaining to student research interest.
2. https://pubmed.ncbi.nlm.nih.gov/
3. https://www.sciencedirect.com/
4. www.springer.com
5. https://onlinelibrary.wiley.com/
6. Research Methodology
7. Reading assignment related to undergraduate project as guided by faculty

Other Resources

Course Designers

1. Dr. Writoban Basu Ball, Assistant Professor, Department of Biological Sciences. SRM University - AP