

Department of Biological Sciences

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

(Applicable to the students admitted from AY: 2023 onwards)



**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)		8	240
University AEC	4		
School AEC	4		
Value Added Courses (VAC)		8	240
University VAC	8		
School VAC	0		
Skill Enhancement Courses (SEC)		15	450
School SEC	7		
Department SEC	2		
SEC Elective	6		
Foundation/ Interdisciplinary courses (FIC)		17	510
School FIC	17		
Department FIC	0		
Core + Core Elective including Specialization (CC)		80	2400
Core	68		
Core Elective (Inc Specialization)	12		
Minor (MC) + Open Elective (OE)	15	15	450
Research / Design / Internship/ Project (RDIP)		17	510
Internship / Design Project / Startup / NGO	5		
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)	2	2	2	2	0	0	0	0	8	5
Value Added Courses (VAC)	2	2	0	0	0	4	0	0	8	5
Skill Enhancement Courses	3	2	2	2	3	3	0	0	15	9
Multidisciplinary / Interdisciplinary /Foundation Core (MIC/FIC)	11	6	0	0	0	0	0	0	17	11
Major Core + Specialization (CC)	0	8	16	12	16	16	12	0	80	50
Minor (MC)/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	5	12	17	11
Grand Total	18	20	23	19	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	AEC	U AEC	AEC 101	Art of Listening, Speaking and Reading Skills	1	0	1	2
2	VAC	U VAC	VAC 101	Environmental Science	2	0	0	2
3	SEC	S SEC	SEC 101	Analytical Reasoning and Aptitude Skills	1	1	1	3
4	FIC	S FIC	FIC 101	Emerging Technologies	2	0	0	2
5	FIC	S FIC	FIC 111	Chemical Basis of Life	2	0	1	3
6	FIC	S FIC	FIC 112	Mathematics for the Physical World	2	1	0	3
7	FIC	S FIC	FIC 113	Fundamentals of Computing	2	0	1	3
Semester Total					12	2	4	18

SEMESTER - II								
S. No	Category	Sub-Category	Course Code	Course Title	L	T/D	P/Pr	C
1	AEC	U AEC	AEC 107	Effective Writing and Presentation Skills	2	0	0	2
2	VAC	U VAC	VAC 102	Universal Human Values and Ethics	2	0	0	2
3	SEC	S SEC	SEC 103	Entrepreneurial Mindset	2	0	0	2
4	FIC	S FIC	FIC 107	Principles of Management	3	0	0	3
5	FIC	S FIC	FIC 124	Psychology for Everyday Living	3	0	0	3
6	Core	DE	BIO 101	Biomolecules	3	1	0	4
7	Core	DE	BIO 102	Basic Concepts in Microbiology	3	0	1	4
Semester Total					18	0	2	20

SEMESTER - III								
S. No	Category	Sub-Category	Course Code	Course Title	L	T/D	P/Pr	C
1	AEC	S AEC	AEC 108	Problem Solving Skills	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	1	0	2
5	Core	DE	BIO 201	Metabolism of Biomolecules	2	1	0	3
6	Core	DE	BIO 202	Cell Biology	2	1	0	3
7	Core	DE	BIO 203	Concepts of Genetics	3	1	0	4
8	Core	DE	BIO 204	Evolutionary Biology	3	1	0	4
9	Core	CC	BIO 208	Biochemistry Lab	0	0	2	2
10	Elective	OE		Open Elective / Minor	3	0	0	3
Semester Total					17	1	9	23

SEMESTER - IV								
S. No	Category	Sub-Category	Course Code	Course Title	L	T/D	P/Pr	C
1	AEC	S AEC	AEC 104	Creativity and Critical thinking Skills	2	0	0	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	D SEC	SEC 106	Leadership for Professionals	2	0	0	2
5	Core	CC	BIO 205	Concepts of Molecular Biology	2	1	0	3
6	Core	CC	BIO 206	Experimental Methods of Biology	3	1	0	4
7	Core	CC	BIO 207	Introductory Biophysics	2	1	0	3
8	Core	CC	BIO 209	Molecular Biology Lab	0	0	2	2
9	Elective	OE		Open Elective / Minor	3	0	0	3
Semester Total					16	3	6	19

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 Skill-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					18	0	8	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 Skill-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					21	0	9	26

SEMESTER - VII								
S. No	Category	Sub-Category	Course Code	Course Title	L	T/D	P/Pr	C
1	Elective	CE	CE	Core Elective				4
2	Elective	CE	CE	Core Elective				4
3	Elective	CE	CE	Core Elective				4
4	RDIP	RDIP	BIO 401	Mini Project	0	0	5	5
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	Core	RDIP	BIO 405	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	1	0	4
2	Elective	CE	BIO 422	Introduction to Omics	3	1	0	4
3	Elective	CE	BIO 423	Cancer and stem cell biology	3	1	0	4
4	Elective	CE	BIO 424	Enzymology	3	1	0	4
5	Elective	CE	BIO 425	Biostatistics	3	1	0	4
6	Elective	CE	BIO 426	Ecology	3	1	0	4
7	Elective	CE	BIO 427	Population Genetics	3	1	0	4
8	Elective	CE	BIO 428	Proteomics	3	1	0	4
9	Elective	CE	BIO 429	Computational Biology	3	1	0	4
10	Elective	CE	BIO 430	Bio nanotechnology	3	1	0	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 - I	3	0	0	3
2	SEC	E SEC		Career Exploration in Life Sciences - II	3	0	0	3

The Art of Listening, Speaking and Reading Skills

Course Code	AEC 101	Course Category					L	T	P	C
							1	0	1	2
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)						
Course Offering Department	Literature and Languages	Professional / Licensing Standards								

Course Objectives / Course Learning Rationales (CLRs)

- To develop and enhance students' proficiency in listening, speaking, and reading skills,
- To help the participants understand the purpose and differentiate various types of audience.
- 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	Develop advanced listening skills, to comprehend and respond to a wide range of spoken language varieties, accents, and contexts with increased accuracy and fluency.	2	90%	90%
Outcome 2	Articulate ideas and thoughts clearly and effectively in both informal and formal settings, utilizing appropriate vocabulary, grammar, and speech delivery techniques.	3	90%	90%
Outcome 3	Enhance their reading comprehension and critical analysis abilities, enabling them to understand complex texts, extract key information, and critically evaluate the content within various genres and subjects.	3	70%	70%
Outcome 4	Engage in effective and meaningful conversations, demonstrating improved listening skills, oral communication abilities, and comprehension of written texts, thereby enhancing their overall language proficiency and communication competence	2	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					1	1		3	2	3		3			
Outcome 2					1	1			1	3		3			
Outcome 3					1	1			1	3		2			
Average					1	1			1	3	3	3			

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	Augmenting Listening skills	9		
	Course introduction and objectives: Importance of LSRW	1	1	1 a
	Listening - Barriers to active listening and steps to Overcome	2	1	1 b
	Listening Comprehension How to take/ make notes (different ways)	2	1	1b, 2a, 2c
	Listening practice: Identifying main ideas, supporting details, and inferences and summarizing key points	2	1	1b, 2a, 2c
	Practice sessions: memory games, Chinese whisper	2	1	NA
Unit 2	Developing Speaking Skills	9		
	Strategies for good speech, Basics of grammatically correct speech	1	2	1a, 2 a, b, c
	Basics of phonetics and intonation	2	2	1a
	Oral presentations: do's and don'ts	1	2	1a
	Speaking Practice: Just a minute/ Impromptu, Story-telling/ Story starters Group discussions,	5	2	NA
Unit 3	Communication and Persuasion	9		
	Verbal Communication and Nonverbal Communication	2	2, 3	1a
	The art of persuasive communication (Ethos, pathos, Logos)	2	2, 3	1a
	Practice sessions (Convince the other Role plays, Self-introduction, Pitching, extempore, public speaking)	5	2, 3	NA
Unit 4	Reading	9		
	Reading strategies (Skimming and scanning, extensive and intensive)	2	2	1c
	Reading and analyzing various texts, including articles, essays, and academic papers	3	2	1c
	Reading Comprehension Practice	4	2	1c, 2a
Unit 5	Integrated Skills and Real-World Application	9		
	Engaging in discussions and debates on current issues	2	3	NA
	Real-world application of language skills (e.g., job interviews, social interactions)	2	3	NA
	Pitching Presentation	5	3	NA
	Total contact hours	45		
	Notional hours	15		
	Total Learning Hours	60		

Learning Assessment

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

Recommended Resources

1a. Shoba, L. (2017). Communicative English: A Workbook. U.K: CambridgeUniversity Press.

1b. Leonardo, N. (2020) Active Listening Techniques: 30 Practical Tools to Hone Your Communication Skills. Rockridge Press

1c. Williams, A.J. (2014) Reading Comprehension: How To Drastically Improve Your Reading Comprehension and Speed Reading Fast! (Reading Skills, Speed Reading)

2a. <https://learnenglishteens.britishcouncil.org/>

2b. <https://www.bbc.co.uk/learningenglish/>

2c. <https://www.ted.com/?geo=hi>

Other Resources

1. -

Course Designers

1. -

Environmental Science

Course Code	VAC 101	Course Category	VAC	L	T	P	C
				2	0	0	2
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Environmental Science and Engineering	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. To describe the environmental concepts from ecology and earth science to address real-world problems.
2. To interpret the complex interactions within and between environmental systems and to evaluate evolving environmental 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	Comprehend the environmental challenges that need attention.	1	80%	70%
Outcome 2	Summarize the types of environmental pollutions and possible effects to society	2	80%	70%
Outcome 3	Classify the natural environmental resources, present state, rate of depletion and future perspectives	2	80%	70%
Outcome 4	Articulate a project-based learning on existing local to global environmental issues	2	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 Life Long Learning	PSO 1	PSO 2	PSO 3
Outcome 1	1	-	1	1	-	1	1	1	2	1	-	1	-	-	-
Outcome 2	1	-	1	1	-	1	2	1	2	1	-	1	-	-	-
Outcome 3	1	-	1	2	1	1	3	2	2	1	-	1	-	-	-
Outcome 4	1	-	1	2	2	1	3	3	2	2	1	1	-	-	-
Average	1	-	1	1.5	1.5	1	2.25	1.75	2	1.25	1	1	-	-	-

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1.	Human, Environmental Issues, and Climate Change	6	1	1,2,3
	The man-environment interaction	1	1	1,2,3
	Environmental issues and scales	1	1	1,2,3
	Land use and Land cover change	2	1	1,2,3
	Ozone layer depletion	1	1	1,2,3
	Understanding climate change and adaptation	1	1	1,2,3
Unit No. 2	Environmental Pollution and Health	7	2	1,2,3
	Understanding pollution; Definitions, sources, impacts on human health and ecosystem	2	2	1,2,3
	Air pollution	1	2	1,2,3
	Water pollution	1.5	2	1,2,3
	Soil pollution	1	2	1,2,3
	Solid waste	1.5	2	1,2,3
Unit No. 3	Ecosystems, Biodiversity Conservation, and Sustainable Development	9	3	1,2,3
	Ecosystems and ecosystem services	1	3	1,2,3
	Biodiversity and its distribution	1	3	1,2,3
	Threats to biodiversity and ecosystems	1	3	1,2,3
	Overview of natural resources	1	3	1,2,3
	Biotic resources	1	3	1,2,3
	Water resources; Soil and Energy resources	2	3	1,2,3
	Introduction to Sustainable Development Goals (SDGs)- targets and indicators	2	3	1,2,3
Unit No. 4	Environmental Management, Treaties and Legislation	8	4	1,2,3
	Introduction to environmental laws and regulation	2	4	1,2,3
	Environmental management system	2	4	1,2,3
	Pollution control and management	2	4	1,2,3
	Major International Environmental Agreements; Major Indian Environmental Legislations	2	4	1,2,3
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. Bharucha, E. (2004). Textbook for Environmental Studies for Undergraduate Courses. University Grant Commission, New Delhi.
2. R. Rajagopalan (2016). Environmental Studies (3rd edition), Oxford University Press

Other Resources

1. Sharma, P. D., Sharma, P. D. (2018) Ecology and environment. Rastogi Publications.
2. Lane, M., Marcantonio, R. (2022) Environmental Management: Concepts and Practical Skills. Cambridge University Press.
3. Kohli, K., Menon, M. (2021) Development of Environment Laws in India, Cambridge University Press.

Course Designers

Analytical Reasoning and Aptitude Skills

Course Code	SEC 101	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	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 Time and Distance and Time and work from company specific and other competitive tests.	3	65%	70%
Outcome 3	Understand and solve puzzle questions from specific and other competitive tests	1	60%	60%
Outcome 4	Make sound arguments based on mathematical reasoning and careful analysis of data.	1	65%	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	2	2					2						
Outcome 2		3	2	2					1						
Outcome 3		3	2	1					2						
Outcome 4		3	1	2					2						
Average		3	2	2					2						

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	Quantitative Aptitude	14		
	Time, speed and distance	5	1,4	1,4
	Time and work, Pipes and cisterns	9	1,4	1,4
Unit II	Numbers, LCM and HCF.	2	1,4	1,4
	P and C	4	1,4	1,4
	Probability, progressions	4	1,4	1,4
Unit III	Geometry, Mensuration	5	1,2	2,3
	Clocks and calendars	4	1,3	1,4
Unit IV	Linear equation and special equations	5	1,2	1,2
	Quadratic equations	2	1,2	1,2
	Inequalities	2	2,3	2,3
	Sets and Venn diagrams	3	1,2	2,4
Total Contact Hours		45		

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%		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.

Emerging Technologies

Course Code	FIC 101	Course Category	FIC			
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)		
Course Offering Department	ECE	Professional / Licensing Standards				

Course Objectives / Course Learning Rationales (CLRs)

1. Foster a comprehensive grasp of diverse emerging technologies and their transformative impacts on society and industries.
2. Cultivate critical thinking skills to analyze challenges, opportunities, and applications within each technological domain.
3. Develop practical skills through hands-on experiences and assignments, translating theoretical concepts into real-world applications.
4. Raise awareness of ethical considerations, particularly in the context of Artificial Intelligence, and Machine Learning, IoT, Electric Vehicles, and Semiconductor Technology.

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	Exhibit a thorough understanding of quantum computing principles, including superposition, entanglement, and interference.	1	80%	90%
Outcome 2	Illustrate understanding by explaining the history, synthesis, and applications of nanomaterial and green hydrogen.	1	80%	90%
Outcome 3	Understand and classify 3D printing technologies.	2	75%	85%
Outcome 4	Demonstrate understanding of the evolution, classification, and applications of UAVs.	2	75%	85%
Outcome 5	Apply knowledge of Artificial Intelligence and Machine Learning, IoT, Electric Vehicles, and Semiconductor Technology.	2	75%	85%

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	2	3	2	2	2	1	2	2	1	1	1	1
Outcome 2	2	1	1	2	3	1	2	2	2	2	2	1	1	1	1
Outcome 3	2	2	2	3	3	3	1	1	3	2	2	1	1	2	2
Outcome 4	2	2	2	2	3	3	2	2	3	2	2	1	2	2	1
Outcome 5	3	2	3	2	2	3	3	2	3	2	2	1	2	2	1
Average	2	2	2	2	3	2	2	2	2	2	2	1	2	2	1

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	Quantum Computer and early ideas, classical and quantum computing approaches, superposition, entanglement, and interference in quantum computing.	1	1	1
	QUBITS and their types; representation of data in quantum mechanics.	1	1	1
	Shor's Algorithm, Grover's search algorithm.	1	1	1
	Quantum programming languages; Obstacles in building quantum computers.	1	1	1
	Applications of quantum computers; Opportunities in the field of quantum computing.	1	1	1
	Introduction of quantum communication pillars, quantum network, Heisenberg's uncertainty principle and QKD.	1	1	1
	Challenges in QKD, National Quantum Mission, Future perspectives.	1	1	1
Unit No. 2	Introduction to the nanometer scale. history of nanomaterials	1	2	2
	Synthesis of nanomaterials: Bottom-up and Top-down approach	1	2	2
	Tools & techniques to characterize nanomaterials. Applications of nanomaterials.	1	2	2
	Green Technology: Definition, types of Green Technologies, Green Hydrogen production.	1	2	2
	Challenges involved in the storage of Green Hydrogen produced from PEM based electrolysis.	1	2	2
	Applications of Green Hydrogen.	1	2	2
Unit No. 3	Introduction to 3D printing and additive manufacturing	1	3	3
	Capabilities of 3D printing	1	3	3
	Applications of 3D printing	1	3	3
	Classification based on ASTM	1	3	3
	Working principles of 3D printing technologies	1	3	3
Unit No. 4	Introduction to the evolution of drones	1	4	4
	Classification of drones	1	4	4
	Basic components of drones	1	4	4
	Principles of flight	1	4	4
	Applications of drones	1	4	4
	Drones rules in India, Challenges and future scope.	1	4	4
Unit No. 5	Introduction to Artificial Intelligence, Machine Learning, and Deep learning; applications	1	5	5
	Introduction to the Internet of Things (IoT)	1	5	6
	Applications of IoT	1	5	6
	Basic architecture of the Electric Vehicles (EVs)	1	5	7
	Trends and challenges in EVs	1	5	7
	Introduction to semiconductor mission and chip fabrication	1	5	8

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (100%)				
		CLA-1 20%	CLA-2 20%	CLA-3 20%	CLA-4 20%	CLA-5 20%
Level 1	Remember	90 %	90 %	80 %	75 %	85 %
	Understand					
Level 2	Apply	10 %	10 %	20 %	25 %	15 %
	Analyse					
Level 3	Evaluate	0%	0%	0%	0%	0%
	Create					
Total		100%	100%	100%	100%	100%

Recommended Resources

1. Quantum Computation and Quantum Information by Michael A. Nielsen, Isaac L. Chuang, 2010.
2. Nanotechnologies: Principles, Applications, Implications and Hands-on Activities – A compendium for educators by Luisa Filippini and Duncan Sutherland, European Commission Research and Innovation, 2013.
3. Additive manufacturing: Principles, Technologies and applications by C.P. Paul and A.N. Jinoop, 2021.
4. Make: Getting Started with Drones - Build And Customize Your Own Quadcopter by Terry Kilby and Belinda Kilby, 2016.
5. Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig, 2010.
6. Fundamentals of Internet of Things: For Students and Professionals by F. John Dian, 2022.
7. Electric Vehicle Engineering by Per Enge, Nick Enge, and Stephen Zoepf, 2021.
8. Fundamentals of Semiconductor Manufacturing and Process Control by Gary S. May and Costas J. Spanos, 2006.

Course Designers

1. Dr. Sunil Chinnadurai, Associate Professor, ECE Department.
2. Dr. Pardha Saradhi Maram, Associate Professor, Chemistry Department.
3. Dr. Sangjukta Devi, Assistant Professor, Mechanical Engineering Department.
4. Dr. Harish Puppala, Assistant Professor, Civil Engineering Department.
5. Dr. Pranav RT Peddinti, Assistant Professor, Civil Engineering Department.
6. Dr. Ravi Kumar, Assistant Professor, Physics Department.
7. Dr. Sujith Kalluri, Associate Professor, ECE Department.

Chemical Basis of Life

Course Code	FIC 111	Course Category	FIC	L	T	P	C
				3	0	0	3
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Biological Sciences/ Chemistry	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

- To learn the origin and composition of complex biomolecules and primitive cells, focusing on the chemical reactions that drive the force of life
- To gain foundational knowledge in chemical thermodynamics, covering the basic principles of energy, work, and heat, and understanding the first and second laws of thermodynamics, entropy, spontaneity, reversibility, disorder, and the calculation of Gibbs free 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	List and describe biomolecules and cellular structures	2	70%	65%
Outcome 2	Compare different chemical bonding concepts	2	70%	65%
Outcome 3	Analyze and explain cellular processes and structures	4	50%	50%
Outcome 4	Apply thermodynamic principles to chemical systems	3	70%	65%
Outcome 5	Interpret and evaluate energy harvesting reactions in life	6	50%	50%

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	1	2
Outcome 2	3	3	3	3	1	1			1			3	3	3	2
Outcome 3	3	3	3	2	1	1			1			2	3	2	3
Outcome 4	3	2	3	3	1	1			1			3	3	3	3
Outcome 5	3	3	3	3	1	1			2	3		3	3	2	3
Average	3	2.6	3	2.8	1	1			1.3	3		2.8	3	2.2	2.6

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	Life: Origin, composition, and chemistry	9		
	Origin of complex biomolecules and primitive cells	1.5	1	1, 2
	Chemical basis of life- Importance of carbon & water	1.5	1	1, 2
	Synthesis by polymerization; importance of self-assembly; Selectively permeable membranes	1.5	1	1, 2
	Concepts of acids, bases, and buffers	1.5	1	3
	Concepts and numerical problems on pH, K_a , K_b , K_w	1.5		2, 3
	Henderson-Hasselbalch equation	1.5	1	1, 2, 3
Unit 2	Chemical bonding	9		
	Definition and importance; Valence electrons and their role in bond formation	1.5	2	3
	Introduction of Lewis dot structure; Covalent bonds- single, double, and triple bonds	1.5		
	Electronegativity and polarity in covalent bonds; Ionic bonds- transfer of electrons, cations and anions	1.5	2	3
	An elementary idea of lattice structure	1.5		3
	Weak intermolecular associations. Coordinate bonds.	1.5	2	3
	Comparison of bond strengths of different bonds with special relation to biological systems.	1.5	2	3
Unit 3	Life forms and processes	9		
	Prokaryotes and eukaryotes (cell structures and organelles); Virus- lysogenic and lytic cycles	1.5	3	1, 2
	Bacteria- typical bacterial cells, bacterial gene transfer- conjugation, transformation, and transduction	1.5	3	1, 2
	Antibiotic resistance- an emerging threat; Microbiome; Cell cycle- mitosis and meiosis	1.5	3	1, 2
	Structure of DNA and organization of chromosomes	1.5	3	1, 2
	Central dogma- replication in prokaryotes	1.5	3	1, 2
	Central dogma- transcription, and translation in prokaryotes	1.5	3	1, 2
Unit 4	Chemical thermodynamics	9		
	Introduction to energy, work and heat in chemical systems; Differentiating between open, closed, and isolated systems	1.5	4	3
	First law of thermodynamics: conservation of energy, calculation of internal energy changes, concept of enthalpy	1.5	4	3
	Second law of thermodynamics: definition, concept of entropy, calculation and interpretation of entropy changes	1.5	4	3
	Spontaneity, reversibility, and disorder	1.5	4	3
	Gibbs free energy: calculation, predicting feasibility of reaction	1.5	4	2, 3
	Concept of chemical equilibrium	1.5	4	1, 2, 3
Unit 5	Energy harvesting reactions by life forms	9		
	Biological reactions: Enzymes	1.5	5	1, 2
	Equilibrium constants (K_{eq}) of enzymes	1.5	5	1, 2
	Metabolism: Glycolysis	1.5	5	1, 2
	Anaerobic respiration	1.5	5	1, 2
	Aerobic cellular respiration	1.5	5	1, 2
	Fate of food in cellular energy cycle.	1.5	5	1, 2
Total Contact Hours		45		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (70%)								End Semester Exam (30%)	
		CLA-1 (20%)		Mid-1		CLA-2 (25%)		CLA-3 (25%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	40%				40%		40%		30%	
	Understand										
Level 2	Apply	60%				40%		40%		45%	
	Analyse										
Level 3	Evaluate					20%		20%		25%	
	Create										
Total		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. ISBN-13: 978-1292177694.
2. Life: The Science of Biology, 11th Edition (2017). David Sadava, David M. Hillis, H. Craig Heller, Sally D. Hacker. Sinauer Associates Inc. ISBN-13: 978-1319121078.
3. Chemistry, 12th Edition (2015). Raymond Chang, Kenneth A. Goldsby. McGraw-Hill Education. ISBN-13: 978-0078021510.

Other Resources

Course Designers

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

Mathematics for Physical World

Course Code	FIC 112	Course Category	FIC	L	T	P	C
				2	1	0	3
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 enable students from the very beginning of their undergraduate course to know what Mathematics is about.
2. To consolidate and improve students' understanding of mathematics by studying core mathematical topics in more depth.
3. To understand the usefulness, power, and beauty of mathematics

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	Interpret mathematical concepts of set theory to solve appropriate problems in both familiar and unfamiliar situations including those in real-life contexts.	2	80%	70%
Outcome 2	Demonstrate basic matrix operations and apply the concepts to real-world applications.	3	80%	70%
Outcome 3	Express derivative as a limit and apply these techniques to graph sketching and optimization problems.	3	70%	65%
Outcome 4	Illustrate the process of integration as anti-differentiation and utilize it to solve several real-world problems.	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	3	3	3					1			2	3	1	2
Outcome 2	3	3	3	2	1				2			2	3	2	2
Outcome 3	3	3	3	3	1				2			2	3	2	2
Outcome 4	3	3	3	3	3				3			2	3	2	2
Average	3	3	3	3	2				2			2	3	2	2

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact hours	CLOs Addressed	Reference Used
Unit No. 1	High School Mathematics and its Applications	6		
	Set Theory	1	1	1
	Tutorial-I	1	1	1
	Permutation	1	1	1
	Tutorial -II	1	1	1
	Combination	1	1	1
	Tutorial-III	1	1	1
Unit No. 2	Matrices and System of Linear Equations	10		
	Introduction to Matrices	1	2	3
	Matrix Operations and Algebraic Properties of Matrices	2	2	3
	Tutorial-I	1	2	3
	Determinant and inverse of matrices	2	2	3
	Tutorial-II	1	2	3
	System of Linear Equations and their solutions	2	2	3
	Tutorial-III	1	2	3
Unit No. 3	Differential Calculus	9	3	
	Functions and their graph	2	3	1,2
	Tutorial-I	1	3	1,2
	Limit and Continuity of a function	2	3	1,2
	Derivative of a function and various rules	2	3	1,2
	Increasing and Decreasing functions	1	3	1,2
	Tutorial-II	1	3	1,2
Unit No. 4	Integral Calculus	8		
	Indefinite Integrals	2	4	1,2
	Tutorial-I	1	4	1,2
	Definite Integrals	2	4	1,2
	Tutorial-II	1	4	1,2
	Fundamental Theorem of Calculus	1	4	1,2
	Tutorial-III	1	4	1,2
Unit No. 5	Applications	12		
	Applications of Permutations and Combinations: Formation of molecules	1	1	1,2
	Generation of ON/OFF signals in computing	1	1	
	Tutorial-I	1	1	1,2
	Applications of Matrices: Cryptography by Matrices	1	2	1,2
	Electrical circuit problem	1	2	1,2
	Tutorial-II	1	2	
	Applications of Differential Calculus: Work done and Electric field	1	3	1,2
	Energy behaviour of physical system and computation of Area and volume	1	3	1,2
	Tutorial-III	1	3	1,2
	Applications of Integral Calculus: Kinematics of one-dimensional system	1	4	1,2
	Concept of Slope and analysis of its real-life applications	1	4	1,2
	Blood flow and Cardiac Output	1	4	1,2
	Total Contact Hours	45		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (ds60%)				End Semester Assessments (40%)
		CLA-1 (15%)	Mid-1 (25%)	CLA-2 (10%)	CLA-3 (10%)	
Level 1	Remember	30%	20%	25%	25%	20%
	Understand	20%	30%	30%	25%	30%
Level 2	Apply	25%	30%	25%	25%	25%
	Analyse	25%	20%	20%	25%	25%
Level 3	Evaluate					
	Create					
Total		100%	100%	100%	100%	100%

Recommended Resources

1. Rosen, K. H. (2012). Discrete Mathematics and Applications (7th ed.). New Delhi: Tata McGraw-Hill.
2. Hass, J. R., Heil, C. E., & Weir, M. D. (2018). Thomas' Calculus (14th ed.). Place of publication: Publisher Name.
3. Hill, D., & Kolman, B. (2019). Elementary Linear Algebra with Applications (9th ed.). Place of publication: Pearson.

Other Resources

Course Designers

Fundamentals of Computing

Course Code	FIC 113	Course Category	FIC	L	T	P	C
				2	0	1	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 Computer Science and problem solving.
2. Gain basic knowledge in C programming language.
3. Acquire knowledge on Decision making and functions in C.
4. Learn arrays, strings and pointers concept 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 basics of Computing and problem solving	2	75 %	70%
Outcome 2	Describe C structures, enumerators, keywords, header files and operators	3	70 %	65%
Outcome 3	Illustrate Decision-Making statements and Functions.	3	70 %	65%
Outcome 4	Interpret arrays, strings, and pointers programming in C	3	70 %	65%
Outcome 5	Apply Structures, unions, File handling operations on different scenarios	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 No. 1	INTRODUCTION TO COMPUTING	10	1	1
	Fundamentals of Computing, Historical perspective, Early computers	2	1	1,2
	Computing machine. Basic organization of a computer.	2	1	1,2
	ALU, input-output units, and addresses - instructions	2	1	1,2
	Computer Memory	2	1	1,2
	Program counter - variables	1	1	1,2
	Store, arithmetic, input and output	1	1	1,2
Unit No. 2	INTRODUCTION TO PROBLEM SOLVING	10		
	Problem solving: Algorithm / Pseudo code, flowchart, program development steps	2	1	1,2
	Computer languages: Machine, symbolic and high-level language	2	1	1,2
	Creating and Running Programs: Writing, editing (any editor),	1	1	1,2
	linking, and executing in Linux environment	1	1	1,2
	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 No. 3	C PROGRAMMING BASICS	15		
	Structure of a C program, identifiers Basic data types and sizes. Constants, 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, Type Conversions,	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, examples, 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
	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	2	1, 2	1,2

	<pre> * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * </pre> <p>I II</p>			
Unit No. 4	FUNCTIONS AND ARRAYS	19		
	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
	Lab Experiment 6: a) <u>(nCr) and (nPr) of the given numbers</u> b) $1+x+x^2/2+x^3/3!+x^4/4!+.....X^n/n!$	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 c) 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. 5	POINTERS	14		
	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

	Lab Experiment 10: a. Illustrate call by value and call by reference. b. Reverse a string using pointers c. Compare two arrays using pointers	2	3, 4	1,2,3
	Lab Experiment 11: a. Array of Int and Char Pointers. b. 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
	Lab Experiment 14: a. File copy b. Word, line and character count in a file.	2	5	2, 3, 4
Total Hours		68		

Learning Assessment

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

Effective Writing and Presentation Skills

Course Code	AEC 107	Course Category				L	T	P	C
						1	0	1	2
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)					
Course Offering Department	Literature and Languages	Professional / Licensing Standards							

Course Objectives / Course Learning Rationales (CLRs)

- Demonstrate proficiency in written communication, including the ability to compose clear, grammatically structured and organized written documents, as well as deliver well-structured and engaging presentations
- Critically analyse and synthesize information from various sources, conduct research, and effectively use evidence to support their arguments in both written assignments and oral presentations, that will enhance their critical thinking and research skills
- Through a combination of theoretical knowledge and practical exercises, the course aims to enhance students' ability to express ideas clearly, engage an audience, and deliver persuasive and impactful messages in both written and spoken formats.

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 coherent and well-structured written communication by generating clear and concise written content with logical organization, appropriate grammar	2	90%	90%
Outcome 2	Recognize and analyse the expectations of specific target audiences by adjusting tone, language and style to suit the intended purpose of the audience of written communication and tailoring written content to various formats such as reports, essays, emails, and professional correspondence.	3	90%	90%
Outcome 3	Demonstrate confident Public Speaking with the ability to deliver structured, well-organized, and persuasive presentations by employing visual and interactive aids, storytelling techniques.	3	70%	70%
Outcome 4	Develop strong critical thinking and research skills, enabling them to evaluate information critically, synthesize sources effectively, and provide well-reasoned arguments in their written work and presentations.	2	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					1	1		3	2	3		3			
Outcome 2					1	1			1	3		3			
Outcome 3					1	1			1	3		2			
Outcome 4					1	1			1	3	3	3			
Average					1	1		3	1	3	3	3			

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	Basics of Grammatically correct writing	9	1	
	SVO	1	1	1a, 2a,b
	Punctuation	3	1	1a, 2a,b
	Articles and Preposition	2	1	1a, 2a, b
	Tense and Apostrophe	1	1	1a, 2a, b
	Subject-Verb-Agreement	2	1	1a, 2a, b
Unit 2	Categories of Writing	9		
	Emails – different types (Official mails : Requesting Leave/ Enquiring vacancy/ Resigning from job/ requesting internship etc.)	3	1, 2	1b, c
	Notice and Agenda,	2	1, 2	1b, c
	Minutes of Meeting	2	1, 2	1b, c
	Paragraph writing	2	1, 2	1b, c
Unit 3	Advanced Writing	9		
	Writing Cover Letters	3	1, 2	1e
	Resume writing	2	1, 2	1d
	SOP, Abstract	2	1, 2	1g
	Project Report Writing	2	1, 2	2, d
Unit 4	Effective Presentation Techniques	9		
	Understanding the elements of successful presentations – Non-verbal communication in presentaions	3	2,3, 4	1f, 2c
	Creating engaging PPTs	2	2,3, 4	1f, 2c
	Structuring presentations for clarity and impact - Logical flow of topics and connected writing in line with storyboard	2	2, 3, 4	1f, 2c
	Handling Questions and Answers	2	2, 3, 4	1f, 2c
Unit 5	Project Based Learning	15		
	Community Based Project	15	1, 2, 3, 4	NA
	Total Learning Hours	60		

Learning Assessment

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

Recommended Resources

- 1a) Swan, M. (2005). Practical English usage (Vol. 688). Oxford: Oxford university press.
- 1b) Fenning, C. (2023). Effective Emails: The secret to straightforward communication at work: 1 (Business CommunicationSkills): Sanage Publishing University Press.
- 1c) Talbot, F. (2009). How to Write Effective Business English: The Essential Toolkit for Composing Powerful Letters, Emails and More, for Today's Business Needs. Kogan Page Publishers
- 1d) Yate, M. (2016). Knock'em Dead Resumes: A Killer Resume Gets More Job Interviews! Simon and Schuster.
- 1e) Yate, M. J. (2018). Ultimate Cover Letters: Master the Art of Writing the Perfect Cover Letter to Boost Your Employability (Vol. 5). Kogan Page Publishers.
- 1f) Carnegie, D. (2013). The Art of Public Speaking. Wyatt North Publishing, LLC.
- 2a. <https://learnenglishteens.britishcouncil.org/>
- 2b. <https://www.bbc.co.uk/learningenglish/>
- 2c. <https://www.ted.com/?geo=hi>
- 2d. https://www.tifr.res.in/~cccf/data/InternDocs/How_to_write_a_structured_Project_Report.pdf

Other Resources

Course Designers

Universal Human Values and Ethics

Course Code	VAC 102	Course Category	VAC		L	T	P	C
					2	0	0	2
Pre-Requisite Course(s)	NA	Co-Requisite Course(s)	NA	Progressive Course(s)	NA			
Course Offering Department	Psychology Department	Professional / Licensing Standards	NA					

Course Objectives / Course Learning Rationales (CLRs)

- To cultivate deep understanding of human values by teaching students the core principles of universal human values and their significance.
- To promote ethical decision-making skills by equipping the students with the ability to make ethical choices in life, work, and society.
- To foster a diverse and inclusive ethical perspective by sensitizing the students to diversity, equity, inclusion, gender, and cultural differences.
- To highlight the relevance of ethics in society and professions by showcasing the practical importance of ethics in personal, societal, and professional contexts.
- To address common challenges by preparing the students to overcome obstacles to ethical behaviour, fostering a commitment to universal values.

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	Evaluate the significance of value inputs in formal education and start applying them in their life and profession	1	70%	80%
Outcome 2	Students will foster diverse and inclusive perspectives, contributing to more equitable and harmonious communities and workplaces	2	70%	70%
Outcome 3	Students will be able to apply ethical principles effectively in their personal and professional lives, leading to improved relationships and ethical practices in society	3	60%	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		2		2	3	3	1	1	3			
Outcome 2			3		2		1	3	3	1	1	3			
Outcome 3			3		2		2	3	3	1	1	3			
Average			3		2		1.6	3	3	1	1	3			

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit 1	Fundamentals of Human Values and Ethics	7	1	1, 2, 3, 4, 5
	Introduction to human values and ethics.	1		
	Theory of wellbeing	2		
	Purpose and relevance of human values	4		
Unit 2	Culture and Ethical Principles	5	2	1, 2, 3, 4, 5
	Culture and ethics.	2		
	Ethics in the community and society	3		
Unit 3	Ethics and Inclusivity	6	2	1, 2, 3, 4, 5
	Ethics and diversity & inclusion	3		
	Equity, equality, and addressing violence	3		
Unit 4	Ethics in various life spheres	6	3	1, 2, 3, 4, 5
	Ethics in family, society, and workplace	4		
	Ethics in IPR and plagiarism	2		
Unit 5	Overcoming ethical challenges	6	3	1, 2, 3, 4, 5
	Identifying common challenges	3		
	Strategies to overcome challenges	3		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (50%)		
		CLA-1 (10%)	CLA 2 (20%)	CLA-3 (20%)
		Theory	Theory	Theory
Level 1	Remember	50%	50%	50%
	Understand			
Level 2	Apply	50%	50%	50%
	Analyse			
Level 3	Evaluate			
	Create			
Total		100%	100%	100%

Recommended Resources

1. Landau, RS. (2019). Living Ethics. New York: Oxford University Press.
2. Nagarajan, R.S. (2022). A Text book on Professional Ethics and Human Values. New Delhi: New Age International Publisher.
3. Rachels, J., & Rachels, S. (2012). The elements of moral philosophy 7e. McGraw Hill.
4. Singer, P. (1986). Applied Ethics. Oxford: Oxford University Press.
5. Gensler, H., Spurgin, E., & Swindal, J. (2004). Ethics: contemporary readings. Routledge.

Course Designers

1. Department of Psychology, SLASS, SRM University-AP

Entrepreneurial Mindset

Course Code	SEC 103	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 develop the Entrepreneurial Mindset of Students.
2. To provide tools and techniques for navigating the uncertain path of entrepreneurship

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 key entrepreneurship and innovation concepts	1	80%	80%
Outcome 2	Explain concepts of Startup Funding and Pitching	1	80%	80%
Outcome 3	Identify Entrepreneurial Opportunity and ideate solutions	2	80%	70%
Outcome 4	Articulate innovative business plans with sound entrepreneurial concepts.	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				1								
Outcome 2			2						3		3				
Outcome 3		3	3		2				3	2	3	3			
Outcome 4		3	3		2				3		3	3			
Average		1.5	2.5		1		0.25		2.25	0.5	2.25	1.5			

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
UNIT-1	Introduction to Entrepreneurship	2		
	What and Why of Entrepreneurship		1	1,2
	Need of Entrepreneurship		1	1,2
	Entrepreneurship at SRM-AP		1	1,2
UNIT-2	Entrepreneurial Orientation	4		
	Characteristics of successful entrepreneurs		1,2	1,2
	Mindset shifts: from an employee to an entrepreneur		1,2	1,2
	Overcoming challenges and dealing with failures		1,2	1,2
UNIT-3	Entrepreneurial Skills	4		
	Skillsets of an Entrepreneur		1,2	1,2
	Design Thinking, Growth Mindset		1,2	1,2
	Design Thinking		1,2	1,2
UNIT-4	Entrepreneurial Opportunity & Ideation	2		
	Difference between idea and opportunity		1,2	1,2
	Opportunities in Vibrant Indian Entrepreneurial Ecosystem		1,2	1,2
	Opportunity Recognition (Sources of Opportunity)		1,2	1,2
	Idea Generation		1,2	1,2
UNIT-5	Business Model Canvas	2		
	Why BMC		3	1,2
	Value Proposition		3	1,2
	Customer Discovery		3	1,2
	Customer Relationship		3	1,2
	Channels		3	1,2
	Key Partners		3	1,2
	Key Activities		3	1,2
	Key Resources		3	1,2
	Revenue Structure		3	1,2
	Cost Structure		3	1,2
UNIT-6	Startup Financing & Pitching	2		
	Stages of Fundraising		4	1,2
	Mode of Investment		4	1,2
	Startup Valuation		4	1,2
	From Pitch to Hitch (Pitch Deck)		4	1,2
UNIT-7	Growth Mindset and Sales Ability	2		
	Importance of Sales skill for Entrepreneur		3	1,2
	Sales Techniques		3	1,2
	Developing Growth Mindset		3	1,2
UNIT-8	Developing the Business Plan	12	3,4	1,2
	Total Hours	30		

Learning Assessment

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

Recommended Resources

1. Bruce R. Barringer, R. Duane Ireland. Entrepreneurship Successfully Launching New Ventures, Pearson; 2020
2. Robert D. Hasrich, Dean A. Shepherd, Michael P. Peters, Entrepreneurship, McGraw Hill, 2021

Other Resources

1. Best business courses online (n.d.). Coursera. <https://www.coursera.org/browse/business/entrepreneurship>

Course Designers

1. Dr Aftab Alam, Assistant Professor, Paari School of Business, SRM University-AP
2. Mr Udayan Bakshi, Associate Director, Directorate of Entrepreneurship, SRM University-AP

Principles of Management

Course Code	FIC 107	Course Category	FIC			L	T	P	C
						3	0	0	3
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. Understand the basic principles and theories of management.
2. Analyse the roles and functions of managers within organizations.
3. Apply management principles to real-world scenarios.
4. Develop critical thinking and problem-solving skills in management contexts

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 comprehension of key management theories and concepts.	2	80%	75%
Outcome 2	Evaluate the effectiveness of management practices in different organizational settings.	5	80%	75%
Outcome 3	Apply management principles to solve complex problems and make informed decisions.	4	75%	75%
Outcome 4	Communicate effectively and collaborate with others in managerial roles.	5	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	2	3	3	3	1	3	2	3	2	3	3	2	3
Outcome 2		3	3	3	3	2	1	3	2	2	3	3	3	3	3
Outcome 3		3	3	3	3	3	1	3	3	3	3	3	3	2	3
Outcome 4		3	3	3	3	3	1	3	3	3	3	3	3	2	2
Average		3	3	3	3	3	1	3	3	3	3	3	3	2	3

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	Introduction to Management			
	Definition and nature of management: Understanding what management entails and its significance in achieving organizational goals. Evolution of management theories: Exploring the historical development of management theories from classical to modern approaches. Functions of management: Introduction to the four primary functions of management – planning, organizing, leading, and controlling. Roles and responsibilities of managers: Analysing the various roles managers undertake, including interpersonal, informational, and decisional roles.	12	1	1,3,5,11
Unit No. 2	Planning and Decision-Making Importance of planning in management: Understanding the role of planning in setting organizational objectives and guiding future actions. Types of plans: Strategic, tactical, and operational plans and their relevance at different organizational levels. Decision-making process and techniques: Exploring the steps involved in decision making and different decision-making techniques such as rational, intuitive, and bounded rationality. Setting goals and objectives: Learning how to establish SMART (Specific, Measurable, Achievable, Relevant, Time-bound) goals and objectives to facilitate effective planning.	12	1, 2	1,2,3,5,12
Unit No. 3	Organizational Structure and Design Organizational structure and its types: Understanding the different types of organizational structures, including functional, divisional, matrix, and network structures. Departmentalization and span of control: Examining how organizations group activities into departments and the implications of span of control on managerial effectiveness. Authority, responsibility, and delegation: Understanding the concepts of authority, responsibility, and delegation in organizational settings and their impact on managerial decision making. Factors influencing organizational design: Analysing internal and external factors that influence organizational design, such as strategy, environment, technology, and size.	12	3	4,5,8,9,11

Unit No. 4	Theories of leadership: Exploring various leadership theories, including trait theory, behavioural theory, contingency theory, and transformational leadership. Leadership styles and their effectiveness: Understanding different leadership styles such as autocratic, democratic, laissez-faire, and their impact on employee motivation and performance. Motivation theories: Examining motivational theories such as Maslows hierarchy of needs, Herzberg two-factor theory, and expectancy theory, and their implications for managerial practice. Techniques for motivating employees: Exploring practical techniques and strategies for motivating employees, including recognition, rewards, job enrichment, and empowerment.	12	1, 3	2,3,8,11,13
Unit No. 5	Process of control: Understanding the control process, including establishing standards, measuring performance, comparing results, and taking corrective action. Types of control: Exploring different types of control mechanisms, including feedforward, concurrent, and feedback control, and their applications in organizational settings. Performance appraisal methods: Analysing various performance appraisal methods such as graphic rating scales, behaviourally anchored rating scales (BARS), and 360-degree feedback. Continuous improvement and quality management: Understanding the concepts of continuous improvement and quality management, including Total Quality Management (TQM).	12	4	1,7,12
Total Contact Hours		60		

Learning Assessment

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

Recommended Resources

1. Prasad, L.M. (2021), Principles and Practices of Management, Sultan Chand Publisher, New Delhi.

Other Resources

1. Vasishth, N. & Vasishth, V. (2022), Taxmann's Principles of Management, Taxmann publications.
2. Tripathi, P.C. & Reddy, P.N. (2021), Principles of Management, McGraw Hill
3. Jayashankar, J. (2009) Principles of Management, Margham Publications
4. Mintzberg, H. (2009). Managing. San Francisco, Berrett-Koehler Publishers. P. 26-28.
5. Hannaway, J. (1989). Managers Managing: The Workings of an Administrative System. New York: Oxford University Press, P. 391.
6. Eccles, R. G. & Nohria, N. (1992). Beyond the Hype: Rediscovering the Essence of Management. Boston: The Harvard Business School Press, p. 471.
7. Kotter, J. P. (1982). The General Managers. New York: The Free Press
8. Mintzberg, H. (1973). The Nature of Managerial Work. New York: Harper; Row. P. 371.
9. Kotter, J. P. (1999). "What Effective General Managers Really Do," Harvard Business Review, March–April 1999, pp. 145–159.
10. Sproull, L. S. (1984). "The Nature of Managerial Attention," in L. S. Sproull (ed.)
11. Advances in Information Processing in Organizations. Greenwich, CT: JAI Press.
12. Stewart, R. (1967). Managers and Their Jobs. London: Macmillan.
13. Pondy, L. R. (1978). "Leadership Is a Language Game," in M. W. McCall, Jr. and M.
14. M. Lombardo (eds.), Leadership: Where Else Can We Go? Durham, NC: Duke University Press.
15. Mintzberg, H. (2009). Managing. San Francisco, Berrett-Koehler Publishers. P. 26-281.
16. McGregor, J. (2008). "Bezos: How Frugality Drives Innovation," BusinessWeek,
17. April 28, 2008, pp. 64–66. Katz, Robert L., (1974). "Skills of an Effective Administrator." Harvard Business Review, September–October 1974.

Course Designers

Psychology for Everyday Living

Course Code	FIC 124	Course Category	FIC	L	T	P	C
				3	0	0	3
Pre-Requisite Course(s)		Co-Requisite Course(s)		Progressive Course(s)			
Course Offering Department	Psychology	Professional / Licensing Standards					

Course Objectives / Course Learning Rationales (CLRs)

1. To understand the fundamental psychological processes in everyday living.
2. To apply knowledge of psychology in improving self and others.
3. To apply knowledge of psychology in enhancing quality of life.

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 fundamental psychological processes in everyday living	2	80%	70%
Outcome 2	Describe important theories in psychology in the areas of sensation, perception, personality and learning	2	75%	70%
Outcome 3	Illustrate personal, professional and social applications of psychology	4	75%	60%
Outcome 4	Interpret results from certain personality tests	5	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	2							1				1			
Outcome 2	1			1					2	1					
Outcome 3	1	1	1				1	1	2	2		2			
Outcome 4	2		2		1			2	1	1		1			
Average	2	1	2	1	1		1	1	2	1		1			

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References
Unit No. 1	Myths and Misconceptions in Psychology	12	1	1
	Definition, nature and goals of psychology	4		
	Common myths and misconceptions about psychology	4		
	Schools of psychology; Basic and applied areas of psychology	4		
Unit No. 2	The Role of Perception and Attitude towards Understanding the World	12	2, 3	2
	Perception: Understanding perception, Gestalt laws of organization, common illusions	3		
	Perceptual constancy - depth perception, size perception, perception of movement	3		
	Attitude formation	3		
	Attitude change	3		
Unit No. 3	Intelligence and Learning	12	2, 3	2
	Definitions and nature of intelligence	3		
	Emotional and social intelligence; Measuring IQ, EQ and SQ	3		
	Fundamentals of learning and its applications	3		
	Memory techniques	3		
Unit No. 4	Understanding the Self	12	2, 4	1
	Definition; Approaches to personality – trait and type	4		
	Psychoanalytical and humanistic theory, Tests of personality – MBTI and NEO-PI	4		
	Identity; Self-concept, self-esteem and self-efficacy	4		
Unit No. 5	Stress, Coping and Quality of Life	12	2, 3	1
	Nature, sources of stress and its reactions	3		
	Factors influencing stress	3		
	Coping with and managing stress - cognitive and behavioural techniques	3		
	Improving quality of life	3		

Learning Assessment

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

Recommended Resources

1. Baron, R. A. (2001). Psychology. New Delhi: Pearson Education India.
2. Nolen-Hoeksema, S., Fredrickson, B.L. & Loftus, G.R. (2014). Atkinson & Hilgard's Introduction to Psychology. 16th Ed. United Kingdom: Cengage Learning.

Other Resources

1. Morgan, C. T., King, R. A., & Schopler, J. (2004). Introduction to Psychology. New Delhi: Tata McGraw Hill.

Course Designers

Biomolecules

Course Code	BIO 101	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. 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
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	12		
	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,	4	1,4	1,2,3
	thermodynamics of coupled reactions.	2	1,4	1,2,3
2	UNIT II: Carbohydrates	12		
	Carbohydrates: definition and functions,	4	2,4	1,2,3
	classification, properties, monosaccharides,	4	2,4	1,2,3
	disaccharides, oligosaccharides,	2	2,4	1,2,3
	polysaccharides- homo- and hetero- polysaccharides.	2	2,4	1,2,3
3	UNIT III: Lipids	12		
	Lipids: Classification,	3	2,4	1,2,3
	structure and properties,	3	2,4	1,2,3
	phospholipids,	1.5	2,4	1,2,3
	glycolipids,	1.5	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	12		
	Amino Acids: Classification and properties,	3	2,4	1,2,3
	structure and properties of amino acids,	2	2,4	1,2,3
	essential and nonessential amino acids,	3	2,4	1,2,3
	proteins-classification and functions,	1	2,4	1,2,3
	levels of protein structure,	2	2,4	1,2,3
	haemoglobin, and myoglobin.	1	2,4	1,2,3
5	UNIT V: Nucleic Acids	12	3,4	
	Nucleic acids: Structure,	3.5	3,4	1,2,3
	purine and pyrimidine bases structure,	3	3,4	1,2,3
	properties and functions of nucleic acids (DNA, RNA)	3	3,4	1,2,3
	Different forms of DNA and RNA.	2.5	3,4	1,2,3
	Total	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	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

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

Basic Concepts in Microbiology

Course Code	BIO 102	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. 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 and practical 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%
Outcome 6	Explain and perform the sterilization methods/protocols in microbiology to isolate microorganism, identify strains by staining and perform growth kinetics of the same.	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	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
Outcome 6	3	2	1	2	3		3	2	3	3			3	3	3
Average	3	1.5	1.3	1.5	2.2	1.3	3	2.8	2	2.5		2.2	2.6	2.3	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
Unit 6	Experiments	30		
	Sterilization techniques- physical and chemical methods	4	6	4
	Preparation of media: Solid and Liquid media	6	6	4
	Isolation of microorganisms from different sources	3	6	4
	Staining methods: simple staining, Gram staining, negative staining and hanging drop.	3	6	4
	Enumeration of microorganism - total & viable count	2	6	4
	Microbial culture, growth curve and plating	8	6	4
	Preservation and maintenance of microbial cultures (slant, slab and cryo)	4	6	4
Total Contact Hours		75		

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 (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. 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. McGraw Hill International.
3. A & P's Textbook of Microbiology, 12th Edition, R Ananthanarayan , CK Jayaram Paniker , Reba Kanungo , Sonal Saxena. Universities Press.
4. Dubey RC, Maheshwari DK. Practical Microbiology, 4/e. S. Chand Publishing; 2002. Sharma K. Manual of Microbiology. Ane Books Pvt Ltd; 2007

Other Resources

Course Designers

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

Problem Solving Skills

Course Code	AEC 108	Course Category	AEC		L	T	P	C
					1	0	1	2
Pre-Requisite Course(s)	SEC 101	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 Time and Distance and Time and work from company specific and other competitive tests.	3	65%	70%
Outcome 3	Understand and solve puzzle questions from specific and other competitive tests	1	60%	60%
Outcome 4	Make sound arguments based on mathematical reasoning and careful analysis of data.	1	65%	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	2	1				1						
Outcome 2		2	1	2	1										
Outcome 3		3	2	2					1						
Outcome 4		3	1	2											
Average		3	2	2	1				1						

Course Unitization Plan

Unit No.	Syllabus Topics	Required Contact Hours	CLOs Addressed	References Used
Unit No. 1	Clocks, Calendars	2	1,4	2,3
	Logical Reasoning Basics, Linear Arrangements, Circular Arrangements	3	1,4	2,3
	Logical Reasoning – Selections, Distributions, Selection decision table, Circular / Tabular arrangements	6	1,4	2,4
	Direction Sense, Blood Relations, Directions, Blood Relations, Problems based on dice and cubes	5	1,4	2,3
Unit No. 2	Data interpretation – Introduction, Line Graph	3	1,4	1,3
	Data interpretation – Bar Graph, Pie-Charts	3	1,4	1,3
	Data Interpretation – Tables, Case lets	3	1,4	1,3
Unit No. 3	Statistics: Basics, Concept Review Questions	2	1,2	4
	Mean, Median, Mode, QD, MD, SD, Advanced Problems.	3	1,2	4
	Functions Basics, Graphs Basics, Functions and Graphs-Advanced.	3	1,2	5
Unit No. 4	Geometry and Mensuration	3	1,2	1
	Venn diagram with two variables and three variables ,logical deductions	3	1,2	2,3
Unit No. 5	Coding Maths – problems based on Number System Coding Maths - Pigeon Hole Principle	3	2,3	1,5
	Coding Maths - Discrete Math Graph Theory	3	1,2	5

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	20%		25%		20%		25%		25%	
	Understand	20%		25%		20%		25%		25%	
Level 2	Apply	30%		25%		30%		25%		25%	
	Analyse	30%		25%		30%		25%		25%	
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. Logical Reasoning and Data Interpretation for CAT, By Nishit K. Sinha
4. Basic Statistics - B.L. Agarwal.
5. Graph Theory and Its Applications – Jonathan L. Gross

Other Resources

1. Geeks for Geeks
2. Indiabix.
3. M4maths.com

Course Designers

1. Mr. Naresh Adapa – Quantitative Aptitude Trainer, Department of CR&CS SRM University AP.
2. Mr. Shaik Mohammed Musa Kaleemullah, Verbal Ability Trainer, Department of CR&CS, SRM University AP.
3. Dr. Fouzul Atik – Assistant Professor, Department of Mathematics, SRM University AP.

Digital Literacy

Course Code	SEC 102	Course Category	SEC	L	T	P	C
				1	1	0	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			
Outcome 5					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 protect 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

Metabolism of Biomolecules

Course Code	BIO 201	Course Category	CC		L	T	P	C
					2	1	0	3
Pre-Requisite Course(s)	BIO 101	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%

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
Average	3	2.7	2.5	2.7	1.7	1	1.5	1.5	1	2	2	2.5	2.7	2.5	2.5

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
	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%		40%		40%		40%		60%	
	Understand										
Level 2	Apply	20%		60%		60%		60%		40%	
	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

Course Designers

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

Cell Biology

Course Code	BIO 202	Course Category	CC		L	T	P	C
					2	1	0	3
Pre-Requisite Course(s)	BIO 101, BIO 102	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.	3	70%	65%
Outcome 3	Describe bacterial binary fission, eukaryotic cell division (cell cycle, mitosis, cytokinesis, meiosis), and cytoskeleton functions.	3	70%	65%
Outcome 4	Explain necrosis, senescence, apoptosis and oncogenes.	2	70%	65%
Outcome 5	Describe stem cells	2	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	1	1	1	2	2	1	3				3	3	3	3
Course Average	3	1.6	2	1.6	1.7	2	3	2	1.7			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	8		
	Animal, plant and yeast cells	2	2	1, 2, 3
	Cell Membrane architecture, and models of membrane structure and function	2	2	1, 2, 3
	Cytoskeleton	2	2	1, 2, 3
	Transport across membranes: Passive and Active transport	2	2	1, 2, 3
Unit 3	Structure and Function of Cellular Organelles	10		
	Nucleus	1.5	2	1, 2, 3
	endoplasmic reticulum, Golgi apparatus, lysosomes	1.5	2	1, 2, 3
	Mitochondria – structure and origin	1.5	2	1, 2, 3
	Chloroplast – structure and origin	1.5	2	1, 2, 3
	vacuoles, peroxisomes, glyoxysomes	1.5	2	1, 2, 3
	Membraneless organelles: ribosomes, nucleolus, stress granules	2.5	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	Stem Cell Biology	6		
	Introduction to stem cell biology	2	5	1, 2, 3
	Stem cell potency and control	2.5	5	1, 2, 3
	Human embryonic stem cells	1.5	5	1, 2, 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	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	70%		70%		70%		70%		70%	
	Understand										
Level 2	Apply	30%		30%		30%		30%		30%	
	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
2. Dr. Pitchaiah Cherukuri, Assistant Professor, Dept. Of Biological Sciences. SRM University – AP

Concepts of Genetics

Course Code	BIO 203	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. 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	2	80%	75%
Outcome 2	Explain the molecular basis of mutations, distinguishing between induced and spontaneous mutations	2	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.	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	2	2	2	3	3	2	2	2	1		3	3	2	3
Average	3	2.2	2.6	2.8	2.4	1.4	2.3	2	1.6	1		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	12		
	Introduction to genetics and historical context. Scope of genetics.	2	1	1,2,3
	Pre-Mendelian Genetics: Key concepts and developments.	2	1	1,3
	Mendel's Work: Principles and experiments.	2	1	1,3
	Genetic Variation: Barbara McClintock's contributions. Non-Mendelian genetics.	2	1	1,3
	Principles of Inheritance: Principles and applications.	2	1	1,3
	Alleles and Inheritance Mechanisms: Concept and basics of alleles. Multiple alleles, lethal alleles, linkage, and crossing over.	2	1	1,3
Unit 2	Mutations	12		
	Chromosomal Mutations: Overview and types.	2	2	1,2,3
	Gene Mutations: Types and distinctions.	2	2	1,2,3
	Molecular Basis of Mutations: Relation to UV light and chemical mutagens.	2	2	1,2,3
	Mutations Comparison: Comparative analysis.	2	2	
	Induced vs. Spontaneous Mutations: Differences and significance.	2	2	
	Back vs. Suppressor Mutations: Analysis and implications.	2	2	1,2,3
Unit 3	Bacterial and phage genetics	12		
	Phage Genetics: Overview and applications.	2	3	1, 2
	Fine Structure of Gene in Bacteriophage T4: Benzer's fine structure, plaque formation, and mapping.	2	3	
	Bacterial Genetics: Genetics of bacteria.	2	3	
	Gene Transfer in Bacteria: Bacterial transposons, vertical and horizontal gene transfer.	2	3	1, 2
	Bacterial Transformation: Mechanisms and applications.	2	3	1, 2
	Bacterial Conjugation: Understanding the process.	2	3	1, 2
Unit 4	Chromosomal basis of inheritance	12		
	Chromosome Structure: Basics and implications.	2	4	1,2,4
	Cytogenetics: Techniques and applications.	2	4	1,2,3,4
	Chromosomal Staining and Banding Patterns: Techniques and interpretation.	2	4	1,2,3,4
	Fluorescent in-situ Hybridizations (FISH): Principles and applications.	2	4	1,2,3,4
	Advanced Chromosome Biology: <ul style="list-style-type: none"> Karyotyping and Spectral Karyotyping (SKY). 	2	4	1,2,3,4
	Chromosome Painting: Significance and applications.	2	4	1,2,3,4
Unit 5	Population genetics and model organism	12		
	Allele and Genotype Frequencies:	2	1,5	1,2,3,4

	Understanding and calculations.			
	Hardy-Weinberg Law: Principles and applications.	2		
	Natural Selection: Role in population genetics.	2	1,5	1,2,3,4
	Genetic Drift: Understanding its impact.	2	1,5	1,2,3,4
	Speciation: Principles and examples.	2	1,5	1,2,3,4
	Pedigree Analysis and Model Organisms: Techniques and introduction to model organisms.	2	1,5	1,2,3,4
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 (10%)		Mid-2 (15%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	45%		50%		40%		50%		30%	
	Understand										
Level 2	Apply	50%		45%		40%		30%		50%	
	Analyse										
Level 3	Evaluate	5%		5%		20%		20%		20%	
	Create										
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.

Other Resources

Course Designers

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

Evolutionary Biology

Course Code	BIO 204	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 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
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: monophylatic, 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	
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.

Biochemistry Lab

Course Code	BIO 208	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)

- Students will acquire hands-on experience in preparing buffers, performing quantitative analyses of various biological molecules (such as carbohydrates, proteins, and nucleic acids), and utilizing separation techniques like thin-layer chromatography (TLC) and paper chromatography. This objective emphasizes the practical application of biochemical methods in lab settings.
- Students will learn to determine enzyme activity and investigate the factors that influence enzymatic reactions, with a specific focus on salivary amylase. They will develop the ability to design experiments, interpret results, and understand the underlying principles governing enzyme kinetics and functionality.

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 and explain the principles of preparing buffers and the methodologies for the quantitative analysis of carbohydrates, proteins, and nucleic acids.	2	80%	70%
Outcome 2	Analyze and interpret chromatograms to identify and quantify components of amino acid mixtures and leaf pigments.	4	80%	70%
Outcome 3	Evaluate the factors influencing enzyme activity and design controlled experiments to measure the activity of salivary amylase under different conditions.	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	Self-Directed and Lifelong 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		2	2			2	2	3	3
Outcome 3	3	3	3	3	3	1		1	3	3		3	3	3	3
Course Average	3	3	3	3	3	1	1	1.3	2.3	2		2.3	2.3	3	2.6

Course Unitization Plan Lab

Exp No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1.	Preparation of Buffers	8	1	1
2.	Quantitative analysis of carbohydrates.	8	1	1
3.	Quantitative estimation of Proteins.	8	1	1
4.	Quantitative estimation of Nucleic Acids.	6	1	1
5.	Separation of amino acids by TLC.	6	2	1
6.	Separation of leaf pigments by paper chromatography.	6	2	1
7.	Determination of enzyme activity of salivary amylase.	8	3	1
8.	Factors influencing enzyme activity.	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%		25%	25%
	Understand				
Level 2	Apply	50%	100%	65%	60%
	Analyse				
Level 3	Evaluate			10%	15%
	Create				
Total		100%	100%	100%	100%

Recommended Resources

1. Essentials of Practical Biochemistry. (2017) Prem Prakash Gupta. Jaypee Brothers Medical Publishers.1st Edition. (ISBN: 9386056909)

Other Resources**Course Designers**

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

Creativity and Critical Thinking Skills

Course Code	AEC 104	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	Literature & Languages	Professional / Licensing Standards						

Course Objectives / Course Learning Rationales (CLRs)

1. Identify key concepts associated with creative problem-solving and critical analysis.
2. Interpret and summarize various models and frameworks used in fostering creative and critical thinking skills
3. Apply divergent thinking methods to generate innovative solutions to multifaceted problems.
4. Assess and compare the strengths and weaknesses of various critical thinking approaches in decision-making.

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 and describe fundamental concepts and theories related to creativity and critical thinking.	1	80%	80%
Outcome 2	Explain the significance of creativity and critical thinking in problem-solving and decision-making processes.	2	80%	60%
Outcome 3	Implement critical thinking strategies to analyse and evaluate information and arguments effectively.	3	80%	70%
Outcome 4	Analyse and assess the effectiveness of specific creative thinking methods in addressing real-world problems.	4	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	3	3	3	3			3		3		3	3	3	1
Outcome 2	3	3	3	3	3			3		3		3	3	3	1
Outcome 3	3	3	3	3	3			3		3		3	3	3	1
Outcome 4	3	3	3	3	3			3		3		3	3	3	1
Average	3	3	3	3	3			3		3		3	3	3	1

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References Used
Unit 1	Introduction to Creativity and Critical Thinking	6		
	Introduction to key concepts	2	1,3	1
	Importance in personal and professional contexts	2	1,3	1,2
	Understanding the differences	1	2,3	1,4
	Real-world applications	1	1,3	1,3
Unit 2	Overcoming Mental Blocks	6		
	Identifying and addressing barriers	3	1	14
	Exercises for mental flexibility	3	4	1,2
Unit 3	Critical Thinking Skills	6		
	Recognizing common pitfalls	1	1,3	1,2
	Examples and group discussion	1	2,3	1,2
	Techniques for assessing information credibility	2	1,3	1
	Case studies and research exercises	2	1,3	3
Unit 4	Application of Creative Solutions	6		
	Practical problem-solving exercises	1	1,3	1,4
	Group projects and case studies	2	2,3	2,3
	Integrating ethics into creative and critical thinking	1	1,3	1
	Discussions on ethical dilemmas and decision-making	2	1,3	3
Unit 5	Application of Creative Solutions	6		
	Quizzes on concepts and techniques	1	1,3	1,2
	Individual and group assignments	1	2,3	1,2
	Applying creativity and critical thinking to a real-world scenario	2	1,3	1
	Presentation and peer evaluation	2	1,3	3
Total Contact Hours		30		

Learning Assessment

Bloom's Level of Cognitive Task		Continuous Learning Assessments (75%)			
		CLA-1 (20%)	CLA-2 (20%)	CLA-3 (20%)	Project Work (45%)
Level 1	Remember	30%		10%	
	Understand				
Level 2	Apply	70%	100%	90%	100%
	Analyse				
Level 3	Evaluate				
	Create				
Total		100%	100%	100%	100%

Recommended Resources

1. Creative Confidence: Unleashing the Creative Potential Within Us All by Tom Kelley and David Kelley
2. Critical Thinking: An Introduction by Alec Fisher
3. Think Like a Freak: The Authors of Freakonomics Offer to Retrain Your Brain by Steven D. Levitt and Stephen J. Dubner
4. Creative Intelligence: Harnessing the Power to Create, Connect, and Inspire by Bruce Nussbaum

Other Resources

Course Designers

1. Dr. Sayantan Thakur, Assistant Professor, Department of Literature and Languages, SRM University-AP.

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.

Concepts of Molecular Biology

Course Code	BIO 205	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)

- Describe the structure and function of key biomolecules, including nucleic acids, proteins, and lipids, and their roles in cellular processes.
- 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%

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	3
Outcome 3	3	2	3	3	3	1	3		1			2	3	3	3
Outcome 4	3	2	3	3	3	1	3		1			2	3	3	2
Outcome 5	3	2	3	3	3	3	2		2			3	3	2	3
Average	3	2	3	3	2.4	1.4	2.8	3	1.6	3		2.2	3	2.2	2.6

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	1,2,3,4
	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	2,4,5,6
	Transcriptional factors and basic transcriptional machinery in eukaryotes;	1	4	2,4,5,6
	Post-transcriptional regulation of gene expression, Translational & post-translational regulation of gene expression;	1	4	2,4,5,6
	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		

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	100%		100%		100%	100%	100%	100%	100%	
	Understand										
Level 2	Apply										
	Analyse										
Level 3	Evaluate										
	Create										
Total		100%		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
2. 2014. 6 th edition, Garland Science.
3. Genes VIII. Benjamin Lewin. 8th edition, Pearson.
4. Molecular Biology of the Gene: J.D. Watson, T.A. Baker, S.P. Bell, A.A.F. Gann, M. Levine and
5. R.M. Losick (2007). 7th edition. Benjamin Cummings.
6. Molecular Cell Biology: H. Lodish, A. Berk, C.A. Kaiser et al (2007) 6th edition. W.H. Freeman.

Other Resources

Course Designers

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

Experimental Methods of Biology

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	Recall key experimental approaches and model organisms, including the principles of flow cytometry, centrifugation, chromatography, electrophoresis, spectroscopy, and microscopy.	1	70%	65%
Outcome 2	Explain the underlying principles and applications of techniques such as centrifugation, chromatography, and electrophoresis.	2	70%	65%
Outcome 3	Apply experimental techniques like flow cytometry, differential centrifugation, HPLC, and various types of microscopy to analyze biological samples.	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	2	1	1		3	2		2	3	1	3
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
Average	3	3	3	3	2.3	1.3	1		1.6	2		2	3	2.3	2.6

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
Unit 1	Introduction to Experimental approaches and Model Organisms	10		
	Choice of samples- organism, tissue, biological fluids, cells, and cellular organisms.	2	1	1
	Whole cell analysis -flow cytometry	5	1	1
	Choice of model organisms for biological investigations: microorganisms, plants, and animal models	3	1	1
Unit 2	Centrifugation	10		
	Principles of Centrifugation	2	2	1,2
	Sedimentation	2	2	1,2
	Types of rotors	2	2	1,2
	Preparative and analytical centrifuges	2	2	1,2
	Methods: Differential, Zonal and Density gradient.	2	2	1,2
Unit 3	Chromatography Techniques	10		
	Principles of Chromatography	2	2	2,3,4
	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	10		
	Principles and applications of electrophoresis	2	2	2,3,4
	Poly-Acrylamide Gel Electrophoresis (PAGE); Agarose gel electrophoresis	1	2	2,3,4
	Two dimensional (2D) electrophoresis; Iso-electric focusing	1	2	2,3,4
	Immunodiffusion, Immunoelectrophoresis	1	2	2,3,4
	ELISA, and Radio-Immune Assay (RIA)	2	2	2,3,4
	Blotting techniques: Southern, Northern and Western	2	2	2,3,4
	Immunohistochemistry	1	2	2,3,4
Unit 5	Spectroscopic Techniques	10		
	Principles of spectroscopy and its applications in biological research	2	3	2
	Theory and Application of UV and Visible Spectroscopy	2	3	2
	Fluorescence Spectroscopy	2	3	2
	Atomic Absorption Spectroscopy (AAS)	2	3	2
	Mass Spectrometry (MS)	2	3	2
Unit 6	Microscopy	10		
	Principles of microscopy	3	3	6
	Light, Fluorescence, Confocal, and Super-resolution microscopy	3	3	6
	Fluorochromes and their applications	2	3	6
	Transmission and Scanning electron microscopy and sample preparation for light and electron microscopy.	2	3	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%)		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

Introductory Biophysics

Course Code	BIO 207	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)

- Grasp fundamental concepts of thermodynamics, including energy conservation, entropy, Gibbs free energy, and equilibrium constants, and how these principles apply to living systems.
- Explore the dynamics of biomolecules, protein structure and folding, and the role of intrinsically disordered proteins, along with techniques such as circular dichroism and X-ray crystallography for structural resolution.

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 how energy conservation, entropy, enthalpy, and Gibbs free energy apply to biological systems.	2	80%	75%
Outcome 2	Explain the principles of diffusion, Brownian motion, and osmosis and their relevance to biomolecular transport.	2	80%	70%
Outcome 3	Analyze the factors influencing protein folding, stability, denaturation, and renaturation, using hemoglobin as a model.	4	70%	60%
Outcome 4	Discuss the sequence, structural features, and molecular interactions of IDPs and IDRs, highlighting examples like NFkB.	2	80%	70%
Outcome 5	Apply structural resolution techniques such as circular dichroism and X-ray crystallography to study protein-ligand interactions.	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	2	3	3	3		2	3	1	2
Outcome 2	3	2	3	3	2	1			1			2	3	2	3
Outcome 3	3	2	3	3	3	1			1			2	3	3	3
Outcome 4	3	2	3	3	3	1			1			2	3	2	3
Outcome 5	3	2	3	3	3	3	2		2			3	3	3	2
Course Average	3	2	3	3	2.4	1.4	2	3	1.6	3		2.2	3	2.2	2.6

Course Unitization Plan

Unit No.	Unit Name	Required Contact Hours	CLOs Addressed	References
Unit 1	Thermodynamics of Living System	9		
	Conservation of energy in living systems	1.5	1	1,2,3
	Entropy and Enthalpy	1.5	1	1,2,3
	Gibbs and Standard free energy	1.5	1	1,2,3
	Equilibrium constant	1.5	1	1,2,3
	Coupled reactions	1.5	1	1,2,3
	Molecular forces and Bioenergetics	1.5		
Unit 2	Dynamics of Biomolecules	9		
	Chirality of biomolecules	2	2	1,2,3
	Diffusion: Laws	2	2	1,2,3
	Brownian motion	2	2	1,2,3
	Active and Passive transport	2	2	1,2,3
	Osmosis: Osmotic pressure, Osmoregulation	1	2	1,2,3
Unit 3	Protein structure and Folding	9		
	Behavior of proteins in solution, Protein folding, Forces of protein stability	2	3	1,2,3
	Protein denaturation and renaturation	2	3	1,2,3
	Hemoglobin: structure, function, oxygen binding, Hill equation and Bohr effect	2	3	1,2,3
	Myoglobin: Structure, function.	3	3	1,2,3
Unit 4	Intrinsically Disordered Regions / Proteins (IDRs / IDPs)	9		
	Sequence and Structural features of IDPs and IDRs	2	4	1,2,3
	Molecular interactions and binding with examples (NF κ B, N _{TAIL})	3	4	1,2,3
	Case studies of IDPs as successful drug targets	4	4	1,2,3
Unit 5	Structural Resolution Techniques and Biomolecular Interactions	9		
	Circular Dichroism	2	5	1,2,3
	X-ray Crystallography	2	5	1,2,3
	NMR	2	5	1,2,3
	Biomolecular recognition and their complexes: Protein-Protein, Protein-DNA, Protein-RNA and Protein-ligand interactions and their characteristics	3	5	1,2,3
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 (15%)		CLA-3 (10%)			
		Th	Prac	Th	Prac	Th	Prac	Th	Prac	Th	Prac
Level 1	Remember	100%		80%		80%		80%		70%	
	Understand										
Level 2	Apply			20%		20%		20%		30%	
	Analyse										
Level 3	Evaluate										
	Create										
Total		100%		100%		100%		100%		100%	

Recommended Resources

1. Biophysics: A Physiological Approach" by Patrick F. Dillon. (ISBN:9781107001442, 1107001447)
2. Molecular Driving Forces: Statistical Thermodynamics in Biology, Chemistry, Physics, and Nanoscience" by Ken Dill and Sarina Bromberg. (ISBN: 9780815344308)
3. Biophysical Techniques" by Iain Campbell and John White. (ISBN:9780199642144)

Other Resources

Course Designers

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

Molecular Biology Lab

Course Code	BIO 209	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. Acquire hands-on experience with essential molecular biology techniques, including DNA isolation, electrophoresis, melting temperature determination, restriction digestion, ligation, PCR, and transformation of competent cells.

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	Identify and describe the steps and reagents used in key molecular biology techniques such as agarose gel electrophoresis, DNA isolation, and polymerase chain reaction (PCR).	2	80%	70%
Outcome 2	Explain the principles behind methods such as determining the melting temperature of DNA, assessing DNA purity, and preparing competent cells for transformation.	3	80%	70%
Outcome 3	Perform molecular biology procedures, including DNA restriction digestion, ligation with T4 DNA ligase, and PCR amplification, to analyze and manipulate DNA samples.	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	Self-Directed and Lifelong 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		2	2			2	2	3	3
Outcome 3	3	3	3	3	3	1		1	3	3		3	3	3	3
Average	3	3	3	3	3	1	1	1.3	2.3	2		2.3	2.3	3	2.6

Course Unitization Plan Lab

Exp No.	Experiment Name	Required Contact Hours	CLOs Addressed	References Used
1.	Agarose gel electrophoresis.	8	1	1
2.	Isolation of bacterial genomic DNA	7	1	1
3.	Isolation of Plasmid DNA by Alkali-Lysis method.	7	1	1
4.	Determination of melting temperature (T _m) of DNA.	5	2	1
5.	Determination of purity of DNA.	5	2	1
6.	Restriction digestion of DNA.	5	2	1
7.	Ligation of DNA by T4 DNA ligase.	8	3	1
8.	Preparation of competent cells by Calcium chloride method and transformation	10	3	1
9.	Polymerase chain reaction.	5	1,3	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%		25%	25%
	Understand				
Level 2	Apply	50%	100%	65%	60%
	Analyse				
Level 3	Evaluate			10%	15%
	Create				
Total		100%	100%	100%	100%

Recommended Resources

1. Molecular Cloning: A Laboratory Manual. (2012) Michael Green, Joseph Sambrook. CSHL Press.4th Edition.

Other Resources**Course Designers**

1. Dr. Writoban Basu Ball – Assistant Professor- Department of Biological Sciences.

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). 11th Edition: 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 Enter Data

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

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

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
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), 8th edition. 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
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

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. Buchanan, 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

1. Teaching tools in plant biology (<https://academic.oup.com/plcell/pages/teaching-tools-plant-biology>)

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%

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%

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)

- Understand the history, significance, and commonly utilized materials, such as plasmids and vectors, in the field of biotechnology.
- 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

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	1,2,3,4
	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

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
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 206; 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, 2,3, 4, 5
	Neurons and glia	3	1	1, 2,3, 4, 5
	Neuroanatomy (gross structure of human brain, dorsal and ventral view, lobes of the brain, sagittal and coronal view)	3.5	1	1, 2,3, 4, 5
	Skull, meninges, ventricles and cerebrospinal fluid, spinal cord, cranial and spinal nerves	3	1	1, 2,3, 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 to 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 motor 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	
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. 1st edition. Garland Science
5. Principles of Neural Science. Eric R. Kandel. 2012. 5th edition. McGraw Hill Education
6. Neurodegeneration, Anthony Schapira. 2017, 1st edition, Wiley

Other Resources

1. BrainFacts.org

Course Designers

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

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)

- 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	12		
	Introduction to pathogens & virulence. Types of pathogens – Prions	3	1	1,2
	Bacteria	3	1	1,2
	Virus	3	2	3
	Protozoa. Virulence factors – Defensive and offensive virulence factors.	3	1	1,2
UNIT II	VIRUSES AND VACCINES	12		
	DNA viruses and RNA viral diseases	3	2	3
	Mechanisms of replication.	3	2	3
	Retroviruses: Molecular biology of HIV	3	2	3
	Antiviral therapy. Viral vaccines strategies and antiviral drug therapy.	3	2	3
UNIT III	NEUROLOGICAL DISORDERS	12		
	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	2	3	1,2
	Parkinson's disease	1	3,5	1,2
	Huntington's disease	1	3, 4	1,2
	Degenerative diseases of motor neurons.	2	3	1,2
UNIT IV	GENETIC DISORDERS	12		
	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)	3	4	1,2
	Chromosome abnormalities (Down syndrome, Turner syndrome)	3	4	1,2
	Mitochondrial inheritance (myoclonic epilepsy, Leber's hereditary optic atrophy).	3	4	1,2
UNIT V	AGING AND ASSOCIATED DISORDERS	12		
	Introduction to Aging and Disease; Causes of aging – ‘wear and tear’ theories & Genome-based theories. Age related diseases- Cancer	2.5	5	1,2
	Cardiovascular Disease	2.5	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.	2.5	4, 5	1,2
	Total	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	
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 perform 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 visualization 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. "Bioinformatics Algorithms: An Active Learning Approach" by Phillip Compeau and Pavel Pevzner:
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

Mini 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	1-6
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. 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

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	1-6
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. 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

Introduction to Omics

Course Code	BIO 403	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	3,4
	Explore the fundamentals of protein and peptide separation, covering both gel-based and non-gel-based proteomic approaches.	3	3	3,4
	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	3,4
	Learn the top-down and bottom-up approaches in proteomics, focusing on applications for both qualitative and quantitative analyses of proteins.	3	3	3,4
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	2,3,5
	Investigate molecular interactions with a focus on databases, providing a comprehensive overview of the molecular landscape.	3	1-5	2,3,5
	Understand topological analysis in the context of genetic circuits, unraveling the structural and functional aspects of genetic regulatory networks.	3	1-5	2,3,5

	Explore methodologies for the seamless integration of diverse omics analyses, fostering a holistic understanding of biological systems.	3	1-5	2,3,5
	Delve into interactome properties through databases and analyses, elucidating the complexities of biological networks at a systems level.	4	1-5	2,3,5
	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

Signal Transduction

Course Code	BIO 402	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 MESSAGERS & 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 tumorigenesis,	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

Career Exploration in Life Sciences - I

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%	75%
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 aids.	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	1,2
	Job roles and industries	2	1	1,2
	Emerging trends and opportunities	2	1	1,2
	Career Path Mapping	1	1	1,2
	Identifying personal interests and strengths	1	1	1,2
	Researching potential career trajectories	2	1	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		100%	100%	100%	100%

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.