Programme Structure for Bachelor of Science in Biotechnology

First Year B. Sc. Programme Semester I: Teaching Scheme

Course code	Course name	Teaching scheme (Hrs/week)			Credits assigned			Total credits
		Th	Pr	Tu	Th	Pr	Tu	
U40PC101	Fundamentals of Biotechnology	3	-	-	3	-	-	3
U21PC103	General Chemistry	3	-	-	3	-	-	3
U40IK101	Generic Indian Knowledge System	2	-	-	2	-	-	2
U03AE002	English	2	-	-	2	-	-	2
U03VE001	Constitution of India	2	-	-	2	-	-	2
UXXOE01X	Open Elective-I	2	-	-	2	-	-	2
U40PC103	Fundamentals of Biotechnology Lab	-	2	-	-	1	-	1
U21PC104	General Chemistry Lab	-	2	-	-	1	-	1
U40VS101	Plant Science Lab	-	4	-	-	2	-	2
U40SE101	Methods in Biological Sciences	-	4	-	-	2	-	2
U04CC0XX	Co-Curricular Courses I	-	4	-	-	2	-	2
U03VE002	Universal Human Values-I [#]	-	-	-	-	-	-	Audit Course
	Total	**14**	**16**	**-**	**14**	**08**	**-**	**22**

[#]During the Induction program, students would get an initial exposure to human values through Universal Human Values- I

Programme Structure for Bachelor of Science in Biotechnology

First Year B. Sc. Programme Semester I: Evaluation Scheme

Course Code	Course Name	Theory Marks				Practical / Tutorial Marks			Total
		Internal Assessment*				ESE*	Term work*/ Tutorial	Practical * Oral / POE	
		T1	T2	FET	Total				
U40PC101	Fundamentals of Biotechnology	10	10	5	25	50	-	-	75
U21PC103	General Chemistry	10	10	5	25	50	-	-	75
U40IK101	Evolution of Science and Technology in India and Rest of World	-	10	5	15	35	-	-	50
U03AE002	English	-	10	5	15	35	-	-	50
U03VE001	Constitution of India	-	10	5	15	35		-	50
UXXOE01X	Open Elective-I	-	10	5	15	35	-	-	50
U40PC103	Fundamentals of Biotechnology Lab	-	-	-	-	-	25	-	25
U21PC104	General Chemistry Lab	-	-	-	-	-	25	-	25
U40VS101	Plant Science Lab	-	-	-	-	-	25	25	50
U40SE101	Methods in Biological Sciences	-	-	-	-	-	25	25	50
U04CC0XX	Co-Curricular Courses I	-	-	-	-	-	50	-	50
U03VE002	Universal Human Values-I #	-	-	-	-	-	-	-	Audit Cours

*Minimum passing is 40% for all courses and evaluation head mentioned above. FET – Faculty evaluation for Theory, T1, T2, Continuous Assessment Test, Term Work, ESE - End Semester Examination, P/F – Pass/ Fail Course, AU – Audit Course.

Programme Structure for Bachelor of Science in Biotechnology

First Year B. Sc. Programme Semester II: Teaching Scheme

Course code	Course name	Teaching scheme (Hrs/week)			Credits assigned			Total credits
		Th	Pr	Tu	Th	Pr	Tu	
U40PC201	Fundamentals of Microbiology	3	-	-	3	-	-	3
U21PC203	Chemistry for Biologist	3	-	-	3	-	-	3
UXXMM0XX	Multidisciplinary Minor-I	2	-	-	2	-	-	2
UXXOE02X	Open Elective-II	2	-	-	2	-	-	2
U03AE001	Professional Communication	2	-	-	2	-	-	2
U01VE003	Environment Science	2	-	-	2	-	-	2
U40PC203	Fundamentals of Microbiology Lab	-	2	-	-	1	-	1
U21PC204	Chemistry for Biologist Lab	-	2	-	-	1	-	1
U40VS202	Animal Science Lab	-	4	-	-	2	-	2
U40SE202	Introduction to Biostatistics	-	4	-	-	2	-	2
U04CC0XX	Co-curricular courses II	-	4	-	-	2	-	2
	Total	**14**	**16**	**-**	**14**	**08**	**-**	**22**

Programme Structure for Bachelor of Science in Biotechnology

First Year B. Sc. Programme Semester II: Evaluation Scheme

Course Code	Course Name	Theory Marks					Practical / Tutorial Marks		Total
		Internal Assessment*				ESE*	Term work */ Tutori	Practical* Oral/ POE	
		T1	T2	FET	Total				
U40PC201	Fundamentals of Microbiology	10	10	5	25	50	-	-	75
U21PC203	Chemistry for Biologist	10	10	5	25	50	-	-	75
UXXMM0XX	Multidisciplinary Minor-I	10	-	5	15	35	-	-	50
UXXOE02X	Open Elective-II	10	-	5	15	35	-	-	50
U03AE001	Professional Communication	10	-	5	15	35	-	-	50
U01VE003	Environment Science	10	-	5	15	35	-	-	50
U40PC203	Fundamentals of Microbiology Lab	-	-	-	-	-	25		25
U21PC204	Chemistry for Biologist Lab	-	-	-	-	-	25	-	25
U40VS202	Animal Science Lab	-	-	-	-	-	25	25	50
U40SE202	Introduction to Biostatistics	-	-	-	-	-	25	25	50
U04CC0XX	Co-curricular courses II	-	-	-	-	-	50	-	50

* Minimum passing is 40% for all courses and evaluation head mentioned above. FET – Faculty evaluation for Theory, T1, T2, Continuous Assessment Test, Term Work, ESE - End Semester Examination, P/F – Pass/ Fail Course, AU – Audit Course.

Programme Structure for Bachelor of Science in Biotechnology

Second Year B. Sc. Programme Semester III: Teaching Scheme

Course code	Course name	Teaching scheme (Hrs/week)			Credits assigned			Total credits
		Th	Pr	Tu	Th	Pr	Tu	
U40PC301	Cell Biology	3	-	-	3	-	-	3
U40PC302	Molecular Biology	2	-	-	2	-	-	2
U40PC303	Plant biotechnology	2	-	-	2	-	-	2
UXXMM0XX	Multidisciplinary Minor-II	3	-	-	3	-	-	3
UXXOE03X	Open Elective-III	2	-	-	2	-	-	2
U03AE003 U03AE004 U03AE005	Modern Indian Language: Hindi OR Modern Indian Language: Sanskrit OR Modern Indian Language: Marathi	2	-	-	2	-	-	2
U40PC304	Genetics Lab	-	2	-	-	1	-	1
U40SE303	Molecular Biology Lab	-	4	-	-	2	-	2
UXXMM0XX	Multidisciplinary Minor-II Lab	-	2	-	-	1	-	1
U36FP301	Field Project / Plant biotechnology Lab	-	4	-	-	2	-	2
U04CC0XX	Co-curricular courses III	-	4	-	-	2	-	2
	Total	**14**	**16**	**-**	**14**	**08**	**-**	**22**

Programme Structure for Bachelor of Science in Biotechnology

Second Year B. Sc. Programme Semester III: Evaluation Scheme

Course Code	Course Name	Theory Marks					Practical / Tutorial Marks		Total
		Internal Assessment*				ESE*	Term work*/ Tutorial	Practical* Oral/ POE	
		T1	T2	FET	Total				
U40PC301	Cell Biology	10	10	5	25	50	-	-	75
U40PC302	Molecular Biology	10	-	5	15	35	-	-	50
U40PC303	Plant biotechnology	10	-	5	15	35	-	-	50
UXXMM0XX	Multidisciplinary Minor-II	10	10	5	25	50	-	-	75
UXXOE03X	Open Elective-III	10	-	5	15	35	-	-	50
U03AE003 U03AE004 U03AE005	Modern Indian Language: Hindi OR Modern Indian Language: Sanskrit OR Modern Indian Language: Marathi	10	-	5	15	35	-	-	50
U40PC304	Genetics Lab	-	-	-	-	-	25	-	25
U40SE303	Molecular Biology Lab	-	-	-	-	-	25	25	50
UXXMM0XX	Multidisciplinary Minor-II Lab	-	-	-	-	-	25	-	25
U40FP301	Field Project / Plant biotechnology Lab	-	-	-	-	-	50	-	50
U04CC0XX	Co-curricular courses III	-	-	-	-	-	50	-	50

* Minimum passing is 40% for all courses and evaluation head mentioned above. FET – Faculty evaluation for Theory, T1, T2, Continuous Assessment Test, Term Work, ESE - End Semester Examination, P/F – Pass/ Fail Course, AU – Audit Course.

Programme Structure for Bachelor of Science in Biotechnology

Second Year B. Sc. Programme Semester IV: Teaching Scheme

Course code	Course name	Teaching scheme (Hrs/week)			Credits assigned			Total credits
		Th	Pr	Tu	Th	Pr	Tu	
U40PC401	Genetics	3	-	-	3	-	-	3
U40PC402	Biostatistics	2	-	-	2	-	-	2
U25PC403	Animal Biotechnology	3	-	-	3	-	-	3
UXXMM0XX	Multidisciplinary Minor-III	3	-	-	3	-	-	3
U03AE003 U03AE004 U03AE005	Modern Indian Language: Hindi OR Modern Indian Language: Sanskrit OR Modern Indian Language: Marathi	2	-	-	2	-	-	2
UXXOE04X	Open Elective-IV	2	-	-	2	-	-	2
U40PC404	Genetics Lab	-	2	-	-	1	-	1
U40PC405	Biostatistics Lab	-	2	-	-	1	-	1
UXXMM0XX	Multidisciplinary Minor-III Lab	-	2	-	-	1	-	1
U40SE404	Food Microbiology	-	4	-	-	2	-	2
U04CC0X	Co-curricular courses IV	-	4	-	-	2	-	2
U03VE002	Universal Human Values II	-	-	-	-	-	-	Audit Course
	Total	**14**	**16**	**-**	**14**	**08**	**-**	**22**

Programme Structure for Bachelor of Science in Biotechnology

Second Year B. Sc. Programme Semester IV: Evaluation Scheme

Course Code	Course Name	Theory Marks					Practical / Tutorial Marks		Total
		Internal Assessment*				ESE*	Term work*/ Tutorial	Practical* Oral/ POE	
		T1	T2	FET	Total				
U40PC401	Genetics	10	10	5	25	50	-	-	75
U40PC402	Biostatistics	10	-	5	15	35	-	-	50
U25PC403	Animal Biotechnology	10	10	5	25	50	-	-	75
UXXMM0XX	Multidisciplinary Minor-III	10	10	5	25	50	-	-	75
U03AE003 U03AE004 U03AE005	Modern Indian Language: Hindi OR Modern Indian Language: Sanskrit OR Modern Indian Language: Marathi	10	-	5	15	35	-	-	50
UXXOE04X	Open Elective-IV	10	-	5	15	35	-	-	50
U36PC404	Genetics Lab	-	-	-	-	-	25	-	25
U36PC405	Biostatistics Lab	-	-	-	-	-	25	-	25
UXXMM0XX	Multidisciplinary Minor-III Lab	-	-	-	-	-	25	-	25
U40SE404	Food Microbiology	-	-	-	-	-	25	25	50
U04CC0X	Co-curricular courses IV	-	-	-	-	-	25	-	25
U03VE002	Universal Human Values II	-	-	-	-	-	-	-	Audit Course

* Minimum passing is 40% for all courses and evaluation head mentioned above. FET – Faculty evaluation for Theory, T1, T2, Continuous Assessment Test, Term Work, ESE - End Semester Examination, P/F – Pass/ Fail Course, AU – Audit Course.

Programme Structure for Bachelor of Science in Biotechnology

Third Year Semester V: Teaching Scheme

Course code	Course name	Teaching scheme (Hrs/week)			Credits assigned			Total credits
		Th	Pr	Tu	Th	Pr	Tu	
U40PC501	Immunology	3	-	-	3	-	-	3
U40PC502	Animal Cell Cultures	3	-	-	3	-	-	3
U40PE501	Applied Genetics	3	-	-	3	-	-	3
U40VS503	Forensics	3	-	-	3	-	-	3
UXXMM0XX	Multidisciplinary Minor-IV	3	-	-	3	-	-	3
U40PC503	Immunology-I Lab	-	2	-	-	1	-	1
U40PC504	Animal Cell Cultures Lab	-	2	-	-	1	-	1
U40PE502	Applied Genetics Lab	-	2	-	-	1	-	1
UXXMM0XX	Multidisciplinary Minor-IV Lab	-	2	-	-	1	-	1
U40VS504	Nanobiotechnology	-	2	-	-	1	-	1
U40CE501	Pharmaceutical Biotechnology	2	-	-	2	-	-	2
	Total	**17**	**10**	**-**	**17**	**5**	**-**	**22**

Programme Structure for Bachelor of Science in Biotechnology

Third Year Semester V: Evaluation Scheme

Course Code	Course Name	Theory Marks					Practical / Tutorial Marks		Total
		Internal Assessment*				ESE *	Term work*/ Tutorial	Practical* Oral/ POE	
		T1	T2	FET	Total				
U40PC501	Immunology	10	10	5	25	50	-	-	75
U40PC502	Animal Cell Cultures	10	10	5	25	50	-	-	75
U40PE501	Applied Genetics	10	10	5	25	50	-	-	75
U40VS503	Forensics	10	10	5	25	50	-	-	75
UXXMM0XX	Multidisciplinary Minor-IV	10	10	5	25	50	-	-	75
U40PC503	Immunology-I Lab	-	-	-	-	-	25	-	25
U40PC504	Animal Cell Cultures Lab	-	-	-	-	-	25	-	25
U40PE502	Applied Genetics Lab	-	-	-	-	-	25	-	25
UXXMM0XX	Multidisciplinary Minor-IV Lab	-	-	-	-	-	25	-	25
U40VS504	Nanobiotechnology	-	-	-	-	-	25	-	25
U40CE501	Pharmaceutical Biotechnology	10	-	5	15	35	-	-	50

* Minimum passing is 40% for all courses and evaluation head mentioned above. FET – Faculty evaluation for Theory, T1, T2, Continuous Assessment Test, Term Work, ESE - End Semester Examination, P/F – Pass/ Fail Course, AU – Audit Course.

Programme Structure for Bachelor of Science in Biotechnology

Third Year Semester VI: Teaching Scheme

Course code	Course name	Teaching scheme (Hrs/week)			Credits assigned			Total credits
		Th	Pr	Tu	Th	Pr	Tu	
U40PC601	Medical Biotechnology	3	-	-	3	-	-	3
U40PC602	Industrial Biotechnology	3	-	-	3	-	-	3
U40PE603	Genomics and Proteomics	3	-	-	3	-	-	3
UXXMM0XX	Multidisciplinary Minor-V	3	-	-	3	-	-	3
UXXOE05X	Open Elective-V	2	-	-	2	-	-	2
U40PC603	Medical Biotechnology Lab	-	2	-	-	1	-	1
U40PC604	Industrial Biotechnology Lab	-	2	-	-	1	-	1
U40PE604	Genomics and Proteomics Lab	-	2	-	-	1	-	1
UXXMM0XX	Multidisciplinary Minor-V Lab	-	2	-	-	1	-	1
U40OT601	Internship	-	8	-	-	4	-	4
	Total	**14**	**16**	**-**	**14**	**08**	**-**	**22**

Programme Structure for Bachelor of Science in Biotechnology

Third Year Semester VI: Evaluation Scheme

Course Code	Course Name	Theory Marks					Practical / Tutorial		Total
		Internal Assessment*				ESE *	Term work*/ Tuto	Practical * Oral /	
		T1	T2	FET	Total				
U40PC601	Medical Biotechnology	10	10	5	25	50	-	-	75
U40PC602	Industrial Biotechnology	10	10	5	25	50	-	-	75
U40PE603	Genomics and Proteomics	10	10	5	25	50	-	-	75
UXXMM0XX	Multidisciplinary Minor-V	10	10	5	25	50	-	-	75
UXXOE05X	Open Elective-V	10	-	5	15	35	-	-	50
U40PC603	Medical Biotechnology Lab	-	-	-	-	-	25	-	25
U40PC604	Industrial Biotechnology Lab	-	-	-	-	-	25	-	25
U40PE604	Genomics and Proteomics Lab	-	-	-	-	-	25	-	25
UXXMM0XX	Multidisciplinary Minor-V Lab	-	-	-	-	-	25	-	25
U40OT601	Internship	-	-	-	-	-	50	50	100

* Minimum passing is 40% for all courses and evaluation head mentioned above. FET – Faculty evaluation for Theory, T1, T2, Continuous Assessment Test, Term Work, ESE - End Semester Examination, P/F – Pass/ Fail Course, AU – Audit Course.

Programme Structure for Bachelor of Science in Biotechnology

Fourth Year Semester VII: Teaching Scheme

(UG Honors with research)

Course code	Course name	Teaching scheme (Hrs/week)			Credits assigned			Total credits
		Th	Pr	Tu	Th	Pr	Tu	
U40PC701	Recombinant DNA technology	3	-	-	3	-	-	3
U40PC702	I.P.R. Entrepreneurship Bio ethics & Bio safety	3	-	-	3	-	-	3
U40PE705	Structural Biology and Molecular Biophysics	3	-	-	3	-	-	3
U40PC703	Genetic Engineering Lab	-	2	-	-	1	-	1
U40PC704	Stem Cell Technology Lab	-	2	-	-	1	-	1
U40PE706	Biophysics and Instrumentation Lab	-	2	-	-	1	-	1
U40RM001	Research Methodology	3	-	1	3	-	1	4
U40PR701	Research Project	-	8	-	-	4	-	4
	Total	**13**	**14**	**1**	**13**	**07**	**1**	**20**

Programme Structure for Bachelor of Science in Biotechnology

Fourth Year Semester VII: Evaluation Scheme

(Honors with research)

Course Code	Course Name	Theory Marks					Practical / Tutorial		Total
		Internal Assessment*				ESE*	Term work	Practical *	
		T1	T2	FET	Total				
U40PC701	Recombinant DNA technology	10	10	5	25	50	-	-	75
U40PC702	I.P.R. Entrepreneurship Bio ethics & Bio safety	10	10	5	25	50	-	-	75
U40PE705	Structural Biology and Molecular Biophysics	10	10	5	25	50	-	-	75
U40PC703	Genetic Engineering Lab	10	10	5	25	50	-	-	75
U40PC704	Stem Cell Technology Lab	-	-	-	-	-	25	-	25
U40PE706	Biophysics and	-	-	-	-	-	25	-	25
U40RM001	Research Methodology	10	10	5	25	50	25	-	100
U40PR701	Research Project	-	-	-	-	-	50	50	100

* Minimum passing is 40% for all courses and evaluation head mentioned above. FET – Faculty evaluation for Theory, T1, T2, Continuous Assessment Test, Term Work, ESE - End Semester Examination, P/F – Pass/ Fail Course, AU – Audit Course.

Programme Structure for Bachelor of Science in Biotechnology

Fourth Year Semester VIII: Teaching Scheme

(Honors with research)

Course code	Course name	Teaching scheme (Hrs/week)			Credits assigned			Total credits
		Th	Pr	Tu	Th	Pr	Tu	
U40PC801	Bioinformatics	3	-	-	3	-	-	3
U40PC802	Bioanalytical tools	3	-	-	3	-	-	3
U40PE807	Biotechnology Entrepreneurship	3	-	-	3	-	-	3
U40PC803	Bioinformatics Lab	-	2	-	-	1	-	1
U40PC804	Research Ethics Lab	-	2	-	-	1	-	1
U40PE808	Biotechnology Entrepreneurship Lab	-	2	-	-	1	-	1
U40PR802	Research Project	-	16	-	-	8	-	8
	Total	**09**	**22**	**-**	**09**	**11**	**-**	**20**

Programme Structure for Bachelor of Science in Biotechnology

Fourth Year Semester VIII: Evaluation Scheme

(Honors with research)

Course Code	Course Name	Theory Marks					Practical / Tutorial Marks		Total
		Internal Assessment*				ESE*	Term work*/ Tutorial	Practical* Oral/ POE	
		T1	T2	FET	Total				
U40PC801	Bioinformatics	10	10	5	25	50	-	-	75
U40PC802	Bioanalytical tools	10	10	5	25	50	-	-	75
U40PE807	Biotechnology Entrepreneurship	10	10	5	25	50	-	-	75
U40PC803	Bioinformatics Lab	-	-	-	-	-	25	-	25
U40PC804	Bioanalytical tools Lab	-	-	-	-	-	25	-	25
U40PE808	Biotechnology Entrepreneurship Lab	-	-	-	-	-	25	-	25
U40PR802	Research Project	-	-	-	-	-	50	150	200

* Minimum passing is 40% for all courses and evaluation head mentioned above. FET – Faculty evaluation for Theory, T1, T2, Continuous Assessment Test, Term Work, ESE - End Semester Examination, P/F – Pass/ Fail Course, AU – Audit Course.

Programme Structure for Bachelor of Science in Biotechnology

Fourth Year Semester VII: Teaching Scheme

(UG Honors)

Course code	Course name	Teaching scheme (Hrs/week)			Credits assigned			Total credits
		Th	Pr	Tu	Th	Pr	Tu	
U40PC701	Recombinant DNA technology	3	-	-	3	-	-	3
U40PC702	I.P.R. Entrepreneurship Bio ethics & Bio safety	3	-	-	3	-	-	3
U40PC703	Industrial Microbiology	3	-	-	3	-	-	3
U40PE705	Structural Biology and Molecular Biophysics	3	-	-	3	-	-	3
U40PC704	Genetic Engineering Lab	-	2	-	-	1	-	1
U40PC705	Stem Cell Technology Lab	-	2	-	-	1	-	1
U40PC706	Genomics Lab	-	2	-	-	1	-	1
U40PE706	Biophysics and Instrumentation Lab	-	2	-	-	1	-	1
U40RM001	Research Methodology	3	-	1	3	-	1	4
	Total	**15**	**8**	**1**	**15**	**04**	**1**	**20**

Programme Structure for Bachelor of Science in Biotechnology

Fourth Year Semester VII: Evaluation Scheme

(UG Honors)

Course Code	Course Name	Theory Marks					Practical / Tutorial		Total
		Internal Assessment*				ESE*	Term work	Practical *	
		T1	T2	FET	Total				
U40PC701	Recombinant DNA technology	10	10	5	25	50	-	-	75
U40PC702	I.P.R. Entrepreneurship Bio ethics & Bio safety	10	10	5	25	50	-	-	75
U40PC703	Industrial Microbiology	10	10	5	25	50	-	-	75
U40PE705	Structural Biology and	10	10	5	25	50	-	-	75
U40PC704	Genetic Engineering Lab	10	10	5	25	50	-	-	75
U40PC705	Stem Cell Technology Lab	-	-	-	-	-	25	-	25
U40PC706	Genomics Lab	-	-	-	-	-	25	-	25
U40PE706	Biophysics and Instrumentation Lab	-	-	-	-	-	25	-	25
U40RM001	Research Methodology	10	10	5	25	50	25	-	100

* Minimum passing is 40% for all courses and evaluation head mentioned above. FET – Faculty evaluation for Theory, T1, T2, Continuous Assessment Test, Term Work, ESE - End Semester Examination, P/F – Pass/ Fail Course, AU – Audit Course.

Programme Structure for Bachelor of Science in Biotechnology

Fourth Year Semester VIII: Teaching Scheme

(UG Honors)

Course code	Course name	Teaching scheme (Hrs/week)			Credits assigned			Total credits
		Th	Pr	Tu	Th	Pr	Tu	
U40PC801	Bioinformatics	3	-	-	3	-	-	3
U40PC802	Bioanalytical tools	3	-	-	3	-	-	3
U40PC803	Advanced Biotechnology Techniques	3	-	-	3	-	-	3
U40PE807	Biotechnology Entrepreneurship	3	-	-	3	-	-	3
U40PC804	Bioinformatics Lab	-	2	-	-	1	-	1
U40PC805	Bioanalytical tools Lab	-	2	-	-	1	-	1
U40PC806	Advanced Biotechnology Techniques Lab	-	2	-	-	1	-	1
U40PE808	Biotechnology Entrepreneurship Lab	-	2	-	-	1	-	1
U40OT802	Internship	-	8	-	-	4	-	4
	Total	**12**	**16**	**-**	**12**	**8**	**-**	**20**

Programme Structure for Bachelor of Science in Biotechnology

Fourth Year Semester VIII: Evaluation Scheme

(UG Honors)

Course Code	Course Name	Theory Marks					Practical / Tutorial Marks		Total
		Internal Assessment*				ESE*	Term work*/ Tutorial	Practical* Oral/ POE	
		T1	T2	FET	Total				
U40PC801	Bioinformatics	10	10	5	25	50	-	-	75
U40PC802	Bioanalytical tools	10	10	5	25	50	-	-	75
U40PC803	Advanced Biotechnology Techniques	10	10	5	25	50	-	-	75
U40PE807	Biotechnology Entrepreneurship	10	10	5	25	50	-	-	75
U40PC804	Bioinformatics Lab	-	-	-	-	-	25	-	25
U40PC805	Bioanalytical tools Lab	-	-	-	-	-	25	-	25
U40PC806	Advanced Biotechnology Techniques Lab	-	-	-	-	-	25	-	25
U40PE808	Biotechnology Entrepreneurship Lab	-	-	-	-	-	25	-	25
U40OT802	Internship	-	-	-	-	-	50	150	200

* Minimum passing is 40% for all courses and evaluation head mentioned above. FET – Faculty evaluation for Theory, T1, T2, Continuous Assessment Test, Term Work, ESE - End Semester Examination, P/F – Pass/ Fail Course, AU – Audit Course.

SEMESTER-I

Theory course

Course code	Course name	Teaching scheme (Hr/week)			Credits assigned		
U40PC101	**Fundamentals of biotechnology**	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		03	-	-	03	-	-

Evaluation scheme

Course code	Course name	Evaluation scheme (In semester)					End semester exam (ESE)		
U40PC101	**Fundamentals of biotechnology**	T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
		10	10	5	25	40%	50	40%	75

Course description: This course provides a comprehensive introduction to the field of Biotechnology and it is designed to provide a strong foundation in biotechnology principles and practices, preparing students for advanced studies and careers in the field. With this course students will get aware and introduced to different areas of Biotechnology and the important role of Biotechnology in Human welfare.

Course outcomes: after the end of this course students will able to

CO1 **Understand** basic principles of Biotechnology

CO2 **Explain** the importance of diverse fields of Biotechnology

CO3 **Describe** the advantages and disadvantages of Biotechnology

CO4 **Apply** the knowledge of Biotechnology in various fields like medicine, Agriculture and Environment

Course contents

Module	Unit	Description	Hours
1.0		**Introduction to biotechnology:**	
1	1.1	Introduction, milestones in the history of biotechnology, traditional and modern biotechnology, red, green, white, blue areas of biotechnology, commercial potential of biotechnology.	9
	1.2	Scope of biotechnology in India, agencies and renounced biotechnology institutes.	
2.0		**Agricultural biotechnology:**	
2	2.1	Introduction, plant tissue culture, genetically modified crops, GMOs in agriculture, plant-based vaccines.	9
	2.2	Biofertilizer - Definition, types with examples. Biopesticide – Definition, types with examples.	
3.0		**Biotechnology and healthcare:**	
3	3.1	Disease diagnosis, detection of genetic diseases, disease treatment, stem cell therapy.	9
	3.2	Role of biotechnology in pandemics, gene therapy - concept, advantages and disadvantages.	
4.0		**Vaccines**	
4	4.1	Vaccines- concept, inventions and classification with examples vaccination, uses of vaccination. Immunization- concept and process.	9
	4.2	Pandemic diseases- definition, examples with causal organism, study of current pandemic COVID-19.	
5.0		**Food biotechnology:**	
5	5.1	Biotechnological applications in enhancement of food quality, food safety, food products, microbial role in food products.	9
	5.2	Yeast, bacterial and other microorganisms-based process and products, modern biotechnological regulatory aspects in food industries, biotechnology and food - Social Appraisal.	

Text Books

1 A text book in Biotechnology, R.C Dubey, S.Chand and Co. Pvt. Ltd.

References

1 Biotechnology – U. Satyanarayana

2 Medical biotechnology – S. N. Jogdand

3 Advances in Biotechnology- S. N. Jogadand

4 Pharmaceutical Biotechnology – S. P. Vyas, V. K. Dixit

5 Biotechnology – B. D. Singh

6 Fundamentals of agriculture biotechnology – S. S. Purohit

7 Agriculture application of Microbiology- Neelima Raj Vaidya.

8 Food Biotechnology- Varun Mehta.

- Internal Assessment (T1, T2 and FET):
  1. T1 should be based on first two modules and T2 should be based on next two modules, for 10 marks each.
  2. Fifth module will be assessed for 5 marks separately.
- End Semester Examination:
  1. Question paper will comprise of 5 questions, each carrying 10 marks.
  2. The duration of end semester examination shall be 3 hours.
  3. The students need to solve all 5 questions.
  4. Question No.1 will be compulsory and based on entire syllabus.
  5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

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Lab course

Course code	Course name	Teaching scheme (Hr/week)			Credits assigned		
U40PC103	**Fundamentals of biotechnology lab**	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		-	02	-	-	01	-

Evaluation Scheme

Course code	Course Name	In semester evaluation		End semester exam (OE/POE)		
U40PC103	**Fundamentals of biotechnology lab**	FEP	Min pass	Marks	Min pass	Total (Marks)
		25	40%	-	-	25

Course outcomes: after the end of this course students will able to

CO1 **Understand** fundamentals of Microscopy

CO2 **Understand** the working principle of equipment's/ instruments used in Biotechnology

CO3 **Demonstrate** various separation and purification techniques

List of experiments

1	Study of microscope: light and electron microscope (SEM with photograph).
2	Principle, working, construction of pH meter and conductivity meter (Demonstration).
3	Principle, working, construction of autoclave and centrifuge (Demonstration).
4	Principle, working, construction of hot air oven and microbial Incubator (Demonstration).
5	Principle, working, construction of laminar air flow and refractometer (Demonstration).
6	Principle, working, construction of colorimeter and determination of λ max of a dye solution (Demonstration).
7	Spectrophotometric determination of nucleic acid purity and concentration.
8	Study of UV absorption spectra of macromolecules. (protein and nucleic acid).
9	Separation and identification of amino acids using TLC.

10	Separation and identification of plant pigments using Ascending paper Chromatography.

Text Book

1 Textbook of biophysical chemistry- Nath Upadhyay Nath.

Reference Books

2 Principles and techniques of Biochemistry and Molecular Biology - Wilson and walker.

3 Practical handbook of Biochemistry and Molecular Biology- Gerald D. Fasman

4 Laboratory manual of microbiology and biotechnology by K.R. Aneja

5 Bio-instrumentation – B. Nagamani

6 Bio-instrumentation – Veerakumari

7 Laboratory Experiments in microbiology by Ted R. Johnson and Christine

- Evaluation Scheme
    1. FEP assessment must be based on the overall performance of the student with every assignment graded from time to time.
    2. The grades will be converted to marks as per ‘credit and grading system’ manual and should be added and averaged.
    3. Based on above scheme grading and FEP assessment should be done.

Theory Course

Course code	Course name	Teaching scheme (Hr/week)			Credits assigned		
U21PC103	**General Chemistry**	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		3	-	-	3	-	-

Evaluation Scheme

Course code	Course name	Evaluation scheme (In semester)					End semester exam (ESE)		
U21PC103	**General Chemistry**	T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
		10	10	5	25	40%	50	40%	75

Course Description: This course is being offered to nonchemistry biology majors. This course takes an overview of concepts in chemistry and biology of everyday life.

Pre-requisites: The Students should have basic knowledge of concepts in chemistry and basic biology.

Course Objectives:

- To revisit the fundamental concepts in chemistry
- To correlate the principles of chemistry and biology.

Course Learning Outcomes: At the end of this course, students will be able to,

CO1 Recall[1] the concepts of chemistry.
CO2 Relate[3] fundamental chemistry to everyday life.
CO3 Understand[2] the principles of chemistry that are relevant to biology.
CO4 Understand[2] the concepts of organic chemistry.

Course Contents

Module	Unit	Description	Hours
1.0		**Introduction:**	
1	1.1	Introduction to Chemistry, what is Chemistry? Matter, Measurements: Numbers, Units & conversions, Significant Figures, Atoms: Review of Bohr's theory and its limitations, Dual behaviour	9

		of matter and radiation, de Broglie's relation, Heisenberg uncertainty principle. Shapes of atomic orbital. Molecules, Mass of Atoms and Molecules, Ions and ionic compounds.	
	1.2	Periodic table: Historical perspectives, Period arrangements of elements and periodic trends, Periodic table for biology.	
2.0		**Stoichiometry and Chemical Reactions:**	
2	2.1	Mole concept: Determination of molecular weight by gram molecular volume relationship, Problems based on mole concept. Methods of expressing concentrations, strength, normality, molarity, molality, %w/v, %v/v, ppm, Standardization of solutions, Primary and secondary standards.	9
	2.2	Stoichiometry: Definition and balancing equations, Chemical reactions: Limiting reagents, yields and types of reactions. Chemical reactions in biological systems.	
3.0		**Gases, Energy and Chemistry, Chemical bonding:**	
3	3.1	Gases: Kinetic theory of Gases, Pressure, Gas laws, Idea gas laws. Gas mixtures, Law of conservation of Energy, Work and Heat, Enthalpy and Chemical Reactions.	9
	3.2	Chemical Bonding: Lewis dots and Ionic bonding (salts), and Covalent bonding (Vitamins and Minerals), Different aspects of covalent bonding.	
4.0		**Solids, Liquids and Solutions, Acids, Bases, Chemical Equilibrium:**	
4	4.1	Intermolecular forces, Phase transitions: Melting, Boiling and Sublimation, Properties of liquids, Solutions: Dilutions and Collegative properties, Solids: General Properties and Types.	9
	4.2	Theories of Acids and Bases, Strong and Weak acid and base, Titrations, pH and buffers, Chemical equilibrium, Equilibrium constants.	

5.0		**Oxidation and Reduction, Organic Chemistry**:	
5	5.1	Oxidation and Reduction reactions, Balancing redox reactions, redox reactions and Voltaic cell,	9
	5.2	Organic Chemistry: Hydrocarbons and functional groups, Basic Concepts in Organic chemistry. Polymers and biopolymers.	

References

1. David W Ball, The Basics of General, Organic, and Biological Chemistry, Saylor Foundation.
2. A. K. Day, Environmental Chemistry, New Edge International Ltd.
3. www.beyondbenign.com

- Internal Assessment (T1, T2 and FET):

T1 should be based on first two modules, T2 should be based on third and fourth modules, for 10 marks.

Fifth module will be assessed for 5 marks separately.

- End Semester Examination:

1. Question paper will comprise of 5 questions, each carrying 7 marks.
2. The duration of end semester examination shall be 2 hours.
3. The students need to solve all 5 questions.
4. Question No.1 will be compulsory and based on entire syllabus.
5. Remaining question (Q.2 to Q.5) will be selected from all the modules

Lab Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U21PC104	**General Chemistry Lab**	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		End Semester Exam (OE/POE)		
U21PC104	**General Chemistry Lab**	Term Work	Min pass %	Marks	Min pass %	Total (Marks)
		25	40	-	-	25

Course Description: This course is a foundation course in chemistry for non-chemistry majors. This course covers the basic laboratory skills in chemistry.

Pre-requisites: Basic knowledge of chemicals and basic laboratory equipments.

Course Outcomes: after the end of this course students will able to,

CO1 Understand[1] common laboratory techniques.
CO2 Understand[2] the purification methods for compounds.
CO3 Demonstrate[3] the basic laboratory skills of chemistry.

List of Experiments

1.	Introduction to good laboratory safety practices.
2.	Preparation of solutions. (2 examples of each) a. Normal b. Molar c.% solution
3.	To standardise NaOH solution & find the strength of given HCl solution
4.	Determination of alkalinity in given water sample.
5.	Determination of chloride content in given water sample
6.	Determination of amount of acetic acid in commercial vinegar.
7.	Determination of Physical constant. (BP, MP)
8.	To purify the given organic compound by sublimation method.
9.	Preparation of buffer solution of pH 7 and 4.

10.	Synthesis of polymer (Bakelite resin)
	Reference Books
1	Vogel's Textbook of Practical Organic Chemistry
2	Albert D. R., Chemistry Techniques and Explorations an Introductory Chemistry Laboratory Manual by PA-ADOPT.

- **Evaluation Scheme**

1. Teamwork assessment of 25 marks shall be based on the overall performance of the student with every assignment graded from time to time.
2. The grades will be converted to marks as per the ‘credit and grading system’ manual and should be added and averaged.
3. Based on the above scheme grading and Teamwork assessment should be done.

Theory Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U22IK101	**Generic Indian Knowledge System**	02	-	-	02	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					End Semester Exam (ESE)		
		T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
U22IK101	**Generic Indian Knowledge System**	-	10	5	15	40%	35	40%	50

Course Description: This course will focus on creating awareness amongst the youths about the true history and rich culture of the country. It will help in understanding the scientific value of the traditional knowledge of India. It will encourage the youths to do research in the various fields of Indian knowledge system. Additionally, this course will aid in converting the Indian wisdom into the applied aspect of the modern scientific paradigm and add career, professional and business opportunities to the youths.

Course Outcomes: after the end of this course students will able to

CO1 Understand the knowledge, art and creative practices, skills and values in ancient Indian system.

CO2 Introduce the contribution from ancient Indian system & tradition to modern science & Technology.

CO3 Understanding the fundamental principles of Indian health systems such as Ayurveda and yoga.

CO4 Apply health principles to correct the intake of food, air, water and sunlight to achieve perfect health.

Course Contents

Module	Unit	Description	Hours

1.0		**Introduction to Indian Knowledge System**	
1	1.1	Definition, Concept and Scope of IKS IKS based approaches on Knowledge Paradigms	6
	1.2	IKS in ancient India and in modern India	
2.0		**Importance of Health & Wellness in IKS**	
2	2.1	Ayurveda -Importance of Sleep and Food, Role of water in wellbeing	6
	2.2	Yoga and Triguṇa System. Healthy regimen to maintain state of wellbeing Dinacharya, the Daily regimen including Daily detoxification, exercise, Intake of Food, Water, Air and Sunlight, work and ergonomics, Rest and sleep hygiene.	
3.0		**Life sciences**	
3	3.1	Life Science - Plants-Herbal medicines, Herbal preparations, modern herbal medicines, Herbal medicines from *Allium sativum*	6
	3.2	Neutraceuticals, Traditional probiotic foods and their importance in human health	
4.0		**Environment, and Health**	
4	4.1	Ecology and Environment- Concept & structure of ecosystem, kinds of ecosystem, functions of ecosystem,	6
	4.2	Āyurveda, Integrated Approach to Healthcare, Medicine, Microbiology, Medicine, Surgery, and Yoga, etc.	
		Basic principles of Food, Nutrition from Ayurveda	
5	5.1	Understanding rich sources of nutrients Concept of Doshas & assessment	6
	5.2	Ayurvedic Principles of food habits and factors determining quality of food (Ahara Vidhi Visheshaayatana) FSSAI regulations on Ayurvedic Aahar.	

References

1 Kapur K and Singh A.K (Eds) 2005). Indian Knowledge Systems, Vol. 1. Indian Institute of

Advanced Study, Shimla. Tatvabodh of sankaracharya, Central chinmay mission trust, Bombay, 1995.

2 *Allium Sativum*: Chemical Constituents, Medicinal Uses and Health Benefits Plant science research and practices- Nova Science Publishers, Incorporated, 2016.

3 A textbook of Ayurvediya Physiology- Prof. Dr. Yogesh Chandra Mishra, Chaukhambha Publication, edition 2018,

4 Textbook on The Knowledge System of Bhārata by Bhag Chand Chauhan,

5 Swami BB Vishnu, Vedic Science and History - Ancient Indian's Contribution to the Modern World, gosai publication, 2015

6 Dr. Girish Nath Jha, Dr. Umesh Kumar Singh and Diwakar Mishra, Science and Technology in Ancient Indian Texts, DK Print World limited

7 J Auboyer, Daily Life in Ancient India from Approximately 200 BC to AD 700, Munshi ram Manoharlal publication, 1994.

8 Swami BB Vishnu, Vedic Science and History - Ancient Indian's Contribution to the Modern World, gosai publication, 2015

9 https://fssai.gov.in/ FSSAI Manual

- Internal Assessment (T1, T2 and FET):
  3. T1 should be based on first two modules and T2 should be based on next two modules, for 10 marks each.
  4. Fifth module will be assessed for 5 marks separately it will be taken as seminar.
- End Semester Examination:
  6. Question paper will comprise of 5 questions, each carrying 10 marks.
  7. The duration of end semester examination shall be 2 hours.
  8. The students need to solve all 5 questions.
  9. Question No.1 will be compulsory and based on entire syllabus.
  10. Remaining question (Q.2 to Q.5) will be selected from all the modules.

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Lab course

Course code	Course name	Teaching scheme (Hr/week)			Credits assigned		
U40PC102	**Plant Science Lab**	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		-	04	-	-	02	-

Evaluation scheme

Course code	Course name	In semester evaluation		End semester exam (OE/POE)		
U40PC102	**Plant Science lab**	FEP	Min pass	Marks	Min pass	Total (Marks)
		50	40%	-	-	50

Course description: This course is at odd semester of first year of B.Sc. Biotechnology. It is a foundation course in Plant Science and pre-requisites for other courses. It covers fundamental concepts of Plant Science.

Course outcomes: after the end of this course students will able to

CO1: **Describe**[2] morphology of the plants.

CO2: **Distinguish**[2] vegetative and reproductive structures

CO3: **Construct**[2] Temporary slides

List of Experiments

1	Study of algae (*Nostoc*) and fungi (*Aspergillus*).
2	Study of bryophyte (*Riccia*) and pteridophyte (*Pteris*).
3	Study of gymnosperms (*Pinus*) and angiosperms (Sunflower, Maize).
4	Plant anatomy – dicot and monocot root, stem, leaf.
5	Study of apical meristem (Stem and root).
6	Study of typical flower.

7	Study of plant using bulbs, runners and cutting.
8	Study of plant grafting.
9	Study of morphology and anatomy of seed (Monocot & dicot).
10	Breaking of seed dormancy and detection of seed viability.
11	Study tour to biodiversity spot, lead Botanical Garden.

References

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
2. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.
3. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
4. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.
5. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
6. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
7. Bhojwani S. S. and Bhatnagar S. P. Embryology of Angiosperms- Vikas Publication house, New Delhi 5th edition,
8. A. C. Datta. - Botany For Degree Students. Press-Delhi, Bombay, Madras
9. S. C. Datta. Systematic Botany. New Age International Publishers, New Delhi. (2015).

- Evaluation Scheme

4. FEP assessment must be based on the overall performance of the student with every assignment graded from time to time.
5. The grades will be converted to marks as per ‘credit and grading system’ manual and should be added and averaged.
6. Based on above scheme grading and FEP assessment should be done.

Lab course

Course code	Course name	Teaching scheme (Hr/week)			Credits assigned		
U40SE101	**Methods in biological sciences**	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		-	04	-	-	02	-

Evaluation scheme

Course code	Course name	In semester evaluation		End semester exam (OE/POE)		
U40SE101	**Methods in biological sciences**	FEP	Min pass	Marks	Min pass	Total (Marks)
		50	40%	-	-	50

Course outcomes: after the end of this course students will able to

CO1 **Understand** fundamental concepts in Biology

CO2 **Explain** basic processes essential for life such as metabolism, respiration and molecular interactions.

CO3 **Discuss** the diversity of life forms, their classification and evolutionary relationships

CO4 **Demonstrate** basic laboratory techniques in Biosciences

List of experiments

1	Preparation of wet mounts and stained slides of various plant and animal tissues.
2	Study of pollen germination.
3	Measurement of Size of cell / spore using micrometry.
4	Detailed study of frog by using computer models.
5	Investigating factors affecting enzyme activity using amylase.
6	Demonstrating production of Starch in leaves using iodine staining method.

7	Estimation of cellular respiration by measuring CO_2 production in yeast.
8	Observing osmosis in plant cells using various solutions (hypertonic/ hypotonic/ isotonic)
9	Study of mendelian genetics (monohybrid and dihybrid crosses)
10	Analysis of population dynamics in a local ecosystem.

Reference Books

1. Cell and Molecular Biology by P.S. Verma and V.K. Agarwal
2. Textbook of Biotechnology by R.C. Dubey
3. Genetics by B.D. Singh
4. Fundamentals of Biochemistry by J.L. Jain
5. Practical Microbiology by R.C. Dubey
6. Biology: A Global Approach* by Campbell, Urry, Cain, Wasserman, Minorsky, Reece
7. Genetics: From Genes to Genomes* by Leland H. Hartwell, Michael L. Goldberg, Janice A. Fischer, Leroy Hood
8. Fundamentals of Biochemistry: Life at the Molecular Level* by Donald Voet, Judith G. Voet, Charlotte W. Pratt

- **Evaluation Scheme**

7. FEP assessment must be based on the overall performance of the student with every assignment graded from time to time.
8. The grades will be converted to marks as per ‘credit and grading system’ manual and should be added and averaged.
9. Based on above scheme grading and FEP assessment should be done.

SEMESTER-II

Theory course

Course code	Course name	Teaching scheme (Hr/week)			Credits assigned		
U40PC201	**Fundamentals of Microbiology**	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		03	-	-	03	-	-

Evaluation scheme

Course Code	Course name	Evaluation scheme (in semester)					End semester exam (ESE)		
U40PC201	**Fundamentals of Microbiology**	T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
		10	10	5	25	40%	50	40%	75

Course description:

This course deals with study different types of Microbes like viruses, Fungi, Protozoa, and Bacteria and their related components in terms of their structure, their growth pattern, and their effect on the environment. This study will give opportunities to work in institutions like Laboratories, Clinics, and Hospitals, and so on with different profiles like Bacteriology, Virologist, Mycologist, and Cell Biologist.

Course outcome(s):

After successful completion of this course, students will able to

CLO1 **State**[1] history of microbiology.

CLO2 **Explain**[2] various techniques used microbiology.

CLO3 **Describe**[2] bacterial morphology, with principles of instruments and equipment's

CLO4 **Identify**[1] microbial nomenclature, bacterial types on the basis of staining

Course Contents

Module	Unit	Description	Hours
1.0		**Introduction to Microbiology:**	
1	1.1	**Scope and history of Microbiology:** Historical developments in microbiology, contributions of various scientists (Leeuwenhoek, Jenner, Pasteur, Koch, Lister, Beijernick and Fleming), spontaneous generation vs biogenesis: germ theory of diseases, scope and recent developments in Microbiology, major microbiological institutes in India.	9
	1.2	**General principles of bacterial nomenclature:** Classification of microorganisms, Whitakers' 5 kingdom classification, taxonomic ranks.	
2.0		**Microbial systematics**	
2	2.1	Criteria for bacterial classification- Morphological, cultural, biochemical, serological characters and molecular characters. General principles of bacterial nomenclature- Taxonomic ranks, Common or Vernacular name, Scientific or International name,	9
	2.2	General characteristics of bacteria- archaebacteria, eubacteria, mycoplasma. **Introduction to virology-** General characteristics, principles of cultivation, classification, lytic cycle of T4 bacteriophage, lysogenic cycle of lambda phage.	
3.0		**Microscopy and staining:**	
3	3.1	**Microscopy:** Introduction and types principle, construction and working of: compound microscope, bright field microscope, dark field microscope, fluorescent microscope, phase contrast microscope. Introduction to advanced microscopic techniques: confocal microscopy, electron microscopy, preparation of sample for electron microscope.	9
	3.2	**Introduction to stains:** Natural, acidic and basic stains, theory and types of staining: definition, classification, simple staining, negative staining, differential staining, special staining.	
4.0		**Morphology and culture of bacteria:**	
4	4.1	Bacterial morphology, external structures- Cell wall, capsule, flagella, pili, fimbriae. Structure and chemical composition of bacterial cell wall. Bacterial internal structures-Cell membrane, protoplast, membrane intrusions, cytoplasm, cytoplasmic inclusions, nuclear material,	9

		sporogenesis.	
	4.2	**Culture of bacteria:** physical and chemical requirements for growth, bacteriological media and its types, natural microbial population (mixed and pure cultures)	
5.0		**Reproduction and growth of bacteria**	
5	5.1	Introduction and definition of growth, modes of cell division in prokaryotes.	9
	5.2	Bacterial growth curve. Synchronous culture and continuous cultures of bacteria, Measurement of Bacterial growth.	

- Internal Assessment (T1, T2 and FET):
    1. T1 should be based on first two modules and T2 should be based on next two modules, for 10 marks each.
    2. Fifth module will be assessed for 5 marks separately.
- End Semester Examination:
    1. Question paper will comprise of 5 questions, each carrying 10 marks.
    2. The duration of end semester examination shall be 3 hours.
    3. The students need to solve all 5 questions.
    4. Question No.1 will be compulsory and based on entire syllabus.
    5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

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Lab course

Course code	Course name	Teaching scheme (Hr/week)			Credits assigned		
U40PC203	**Fundamentals of microbiology lab**	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		End Semester Exam (OE/POE)		
U40PC203	**Fundamentals of Microbiology Lab**	FEP	Min pass	Marks	Min pass	Total (Marks)
		25	40%	-	-	25

Course outcomes: after the end of this course students will able to

CO1: **Describe** various methods of sterilization

CO2: **Explain** the basic principles of microbial staining

CO3: **Demonstrate** various bacterial isolation and culturing techniques

List of experiments

1	Study of permanent slides of bacteria, fungi, algae and protozoa.
2	Preparation of stains and staining agents.
3	Gram staining technique and motility of bacteria.
4	Study of solid and liquid media cultures.
5	Preparation of glassware for sterilization and disposal of lab media and cultures.
6	Isolation of bacteria by streak plate, pour plate and spread plate method.
7	Measurement of size of microorganism by micrometry (Demonstration).
8	Bacterial growth curve by colorimetric method. Determination of generation time and growth rate of *E coli.*
9	Blood cell count i) Differential count of W. B. Cs. ii) Total count of W. B. Cs and R. B. Cs.
10	Determination of haemoglobin.

Reference Books

1 Modi, H.A., Elementary Microbiology- Vol I and II, Akta Prakashan.

2 Patel R.J, Patel K.R, Experimental Microbiology-Vol I, Aditya Publications, Ahmedabad.

3 Dubey R.C, Maheshwari D.K, Practical Microbiology, S. Chand and Company Ltd. New Delhi.

4 Frobisher M, Hinsdill, Crabtree and Goodheart, Fundamentals of Microbiology, 9th Edition, W.B. Saunders Co. USA.

5 Konika Sharma, Manual of Microbiology- Tools and Techniques, Anne Book Publishers, New Delhi.

6 Pelczar, M.J., Chan E.C.S Crieg N.R, Microbiology 5th Edition, Tata McGraw Hill Publication Ltd, New Delhi.

7 Salle S.J. (1947), Fundamental principles of Bacteriology, Tata McGraw Hill Publication Ltd, New Delhi.

8 Stanier, R.Y. Lingraham, J.L. Wheelis, M.J. Painter General Microbiology, 5th Edition, Mc Millan Press Ltd, London.

9 Tortora, Funke and Case. Microbiology-An introduction, 8th Edition, Pearson Education, New Delhi.

- Evaluation Scheme

    1. FEP assessment must be based on the overall performance of the student with every assignment graded from time to time.
    2. The grades will be converted to marks as per ‘credit and grading system’ manual and should be added and averaged.
    3. Based on above scheme grading and FEP assessment should be done.

Theory Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U21PC203	**Chemistry for Biologist**	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		3	-	-	3	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					End Semester Exam (ESE)		
U21PC203	**Chemistry for Biologist**	T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
		10	10	5	25	40%	50	40%	75

Course Description: *Chemistry for Biologists* course aim to help you understand the chemistry and chemical principles that underlie a good deal of biology. This course is offered to non-chemistry biology majors. This course deals with structure and properties of biomolecules, such as amino acids, proteins, carbohydrates, lipids, and nucleic acids. The focus of this course will be on the relationship between protein structure and its biological function.

Pre-requisites: The Students should have basic knowledge of concepts in chemistry and basic biology.

Course Objectives:

- ❖ Understand the structure and properties of biomolecules.
- ❖ Correlate their pathways inside body.

Course Learning Outcomes: At the end of this course, students will be able to,

- **CO1** Understand[1] the fundamental concepts in biology, chemistry and biochemistry.
- **CO2** Apply[3] basic principles of chemistry to biological systems and molecular biology.
- **CO3** Relate[2] various interrelated physiological and metabolic events.

Course Contents

Module	Unit	Description	Hours

1.0		**Introduction**	
1	1.1	Introduction to Chemistry of life, Organic Molecules for Biology, functional groups.	9
	1.2	Inorganic Ions: Plants, Nutrients, Cations and Anions in Mammelian diet. Water and Living Organisms: Water molecule, Solvent, Proton transfer reactions, Buffer, Metabolites and living environment, Amino acids, Concept of Chirality.	
2.0		**Carbohydrates, Proteins and Enzymes**	
2	2.1	Carbohydrates: Monosaccharides and Disaccharides, Polysaccharides, Glycogen and Cellulose. Lipids: Glycerol, Fatty acids, Esters, Triglycerides, Phospholipids.	9
	2.2	Proteins Importance of Proteins, Amino acids, Peptide bond formation, Primary and Three-dimensional structure and functions. Enzymes: Concept of Catalysis, General Properties of Enzymes, Function and structures, Enzyme catalysis.	
3.0		**Nucleic Acids, Cells and Metabolism**	
3	3.1	Nucleic Acids: Introduction, Sugars-Phosphates-Bases, Formation of nucleotides, Structure of DNA and hydrogen bonding.	9
	3.2	In and Out of Cell: Cells, Membranes and walls. Phospholipids, Proteins, Plant cell walls, Passive and active transport. Metabolism and Energy: Chemical reactions in cell, Anabolism and catabolism, Chemical reactions during metabolism.	
4.0		**Energy**	

4	4.1	Energy flow: Energy and chemical compounds, Photosynthesis, Transfer of energy through energy cycles. Gas Exchange during respiration and in flowering plants.	9
	4.2	Transport of Oxygen in blood: Blood, Red blood cells and Haemoglobin, Effect of CO_2 in blood. Respiration: ATP and cells, Oxidation and reduction, Aerobic and anaerobic respiration.	
5.0		**Biochemical transformations**	
5	5.1	Photosynthesis: Leaves and leaf structure, stages of photosynthesis, light dependent and light independent reactions. ATP from ADP.	9
	5.2	Excretion and the Liver: Excretion in mammals and function of liver, amino acid regulations, detoxification in liver. Nerves and Hormones: Nervous coordination in mammals. Carbonyl chemistry: Aldol reaction, Claisen Reaction, Prenyl Transfer Reaction.	
References			

1. Carol Higginbotham, Introductory Biochemistry
2. Chemistry for Biologists (rsb.org.uk)

- Internal Assessment (T1, T2 and FET):

T1 should be based on first two modules, T2 should be based on third and fourth modules, for 10 marks.

Fifth module will be assessed for 5 marks separately.

- End Semester Examination:

1. Question paper will comprise of 5 questions, each carrying 7 marks.
2. The duration of end semester examination shall be 2 hours.
3. The students need to solve all 5 questions.
4. Question No.1 will be compulsory and based on entire syllabus.
5. Remaining question (Q.2 to Q.5) will be selected from all the modules

Lab Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U21PC204	**Chemistry for Biologist Lab**	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		End Semester Exam (OE/POE)		
U21PC204	**Chemistry for Biologist Lab**	Term Work	Min pass %	Marks	Min pass %	Total (Marks)
		25	40	-	-	25

Course Description: This course is a foundation course in chemistry for non chemistry majors. This course covers the basic laboratory skills in chemistry that are relevant to biology majors.

Pre-requisites: Basic knowledge of chemistry, biology and basic laboratory equipments.

Course Outcomes: after the end of this course students will able to,

CO1 Understand[1] and relate theory to common laboratory techniques.
CO2 Understand[2] the isolation and purification methods for biological samples.
CO3 Demonstrate[3] the basic laboratory skills of biochemistry.

List of Experiments

1.	Introduction to laboratory safety practices in biology laboratory.
2.	Preparation of reagents, buffers etc. for biological samples.

3.	Determination of total amino acid concentration by ninhydrin method.
4.	Estimation of protein concentration by- i) Biuret method ii) Lowry method iii) Spectrophotometric method.
5.	Estimation of reducing sugar concentration by DNSA method.
6.	Estimation total sugar concentration by i) Phenol-H_2SO_4 method ii) Anthrone method
7.	Determination of fructose concentration by resorcinol method.
8.	Isolation of DNA and RNA.
9.	Estimation of DNA and RNA. a] Estimation of DNA by diphenyl amine method. b] Estimation of DNA by Spectrophotometric method. c] Estimation of RNA by orcinol method.
10.	Isolation of Characterization of casein from milk.
11.	Isolation and characterization of starch from potato.
12.	Isolation of cholesterol and lecithin from egg yolk.
	Reference Books
1	Boyer, Rodney F.; Biochemistry laboratory: Modern theory and techniques.
2	Philip L.R. Bonner, Alan J. Hargreaves, Basic Bioscience Laboratory Techniques, Wiley Blackwell.
3	E. Dilipan, Methods and Protocols: A Laboratory Manual for Biochemistry and Biotechnology, INSC International Publishers.

- **Evaluation Scheme**

1. Teamwork assessment of 25 marks shall be based on the overall performance of the student with every assignment graded from time to time.
2. The grades will be converted to marks as per the ‘credit and grading system’ manual and should be added and averaged.
3. Based on the above scheme grading and Teamwork assessment should be done.

Course code	Course name	Teaching scheme (Hr/week)			Credits assigned		
U40PC202	**Animal Science Lab**	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		-	04	-	-	02	-

Evaluation Scheme

Course code	Course name	In semester evaluation		End semester exam (OE/POE)		
U40PC202	**Animal Science Lab**	FEP	Min pass	Marks	Min pass	Total (Marks)
		50	40%	-	-	50

Course description: This course is at even semester of first year of B.Sc. Biotechnology. It is a foundation course in Animal Science and pre-requisites for other courses. It covers fundamental concepts of Animal Science.

Course outcomes: after the end of this course students will able to

CO1: **Understand** principals of animal anatomy, physiology and behaviour

CO2: **Identify** different characters of chordates and non-chordate

CO3: **Demonstrate** basic techniques related to diagnostic and preventive health

List of Experiments

1	Study of characteristics of non-chordate phyla using one example.
2	Study of characteristics of chordate subphyla using one example.
3	Study of earthworm anatomy and physiology.
4	Study of cockroach anatomy and physiology.
5	Study of frog anatomy and physiology.
6	Study of fish anatomy and physiology.
7	Study of sperm using permanent slide.
8	Study of histology of tumour and diabetes using permanent slide.

Reference books

1. Animal Physiology by R.D. Singh
2. Animal Nutrition by D.V. Reddy and S. Pal
3. Animal Physiology: Adaptation and Environment by Knut Schmidt-Nielsen
4. Principles of Animal Physiology by Christopher D. Moyes and Patricia M. Schulte
5. Animal Nutrition by Peter McDonald et al.
6. Animal Anatomy and Physiology by Ruth Lawler

- Evaluation Scheme

1. FEP assessment must be based on the overall performance of the student with every assignment graded from time to time.
2. The grades will be converted to marks as per ‘credit and grading system’ manual and should be added and averaged.
3. Based on above scheme grading and FEP assessment should be done.

Course code	Course name	Teaching scheme (Hr/week)			Credits assigned		
U40SE202	**Introduction to Biostatistics**	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		-	04	-	-	02	-

Evaluation Scheme

Course code	Course Name	In semester evaluation		End semester exam (OE/POE)		
U40SE202	**Introduction to Biostatistics**	FEP	Min pass	Marks	Min pass	Total (Marks)
		50	40%	-	-	50

Course outcomes: after the end of this course students will able to

CO1 **Analyze**[3] and **visualize** the data.

CO2 **Apply**[3] R for the Measures of central tendency and dispersion.

List of experiments

1. Collection of data and graphical representation of data.
2. Construction of discrete and continuous frequency distribution.
3. Construction of bar diagram, histogram, Pie diagram, frequency curve and frequency polygon.

4. Measures of central tendency: Definition, formula and calculation of mean, median, mode, geometric mean and harmonic mean for grouped and ungrouped data.
5. Definition, formula and calculation of quartiles, deciles and percentiles for grouped and ungrouped data.
6. Measures of Central tendency using R.
7. Measures of dispersion: Definition, formula and calculation of absolute measures of dispersion, Range, Quartile Deviation, mean deviation, standard deviation.
8. Measures of dispersion using R.

Text Book

1 Practicals in Statistics, by Dr. H. L. Sharma.
2 Statistical Methods, by G. W. Snedecor.
3 Experimental Designs and Survey Sampling: Methods and Applications, by H. L. Sharma.
4 A handbook of Agricultural Statistics BY Dr. S. R. S Chandel

Reference Books

1 G.I.S- Anji Reddy, MacGrawHill Publications.
2 American Society of Photogrammetry Washington D. C. Manual of Photographic Interpretation. (1960) and (1975).
3 The Theory of Sample surveys and Statistical Decisions by K. S. Kushwaha and Rajesh Kumar.
4 Fundamentals of Mathematical Statistics by S. C. Gupta and V. K. Kapoor.
5 A Text book of Agricultural Statistics, R. Rangaswamy, New Age International (P) Limited, publishers.
6 *Data Visualisation with R by* Thomas Rahlf, Springer International Publishing, New York, 2017.
7 *Introduction to statistical data analysis with R* by Matthias Kohl, bookboon.com, London, 2015.

Evaluation scheme

1. FEP assessment must be based on the overall performance of the student with every assignment graded from time to time.
2. The grades will be converted to marks as per ‘credit and grading system’ manual and should be added and averaged.
3. Based on above scheme grading and FEP assessment should be done.