S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
1	BIO	IMMT	BIO-IMMT-1-0001	Biostatistics	1	0	0	1
2	BIO	IMMT	BIO-IMMT-1-0002	Computation/bioinformatics	1	0	0	1
3	BIO	IMMT	BIO-IMMT-1-0003	Basic Chemistry	1	0	0	1
4	BIO	IMMT	BIO-IMMT-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
5	BIO	IMMT	BIO-IMMT-2-3301	Biotechniques and Instrumentation	0	0	2	1
6	BIO	IMMT	BIO-IMMT-2-3302	Materials Characterization Technique	1	0	0	1
7	BIO	IMMT	BIO-IMMT-2-3303	Biology of Biology of Macromolecules	2	0	0	2
8	BIO	IMMT	BIO-IMMT-2-3304	Plant Environment Interaction	1	0	0	1
9	BIO	IMMT	BIO-IMMT-2-3305	Microbes and Environment	2	0	0	2
10	BIO	IMMT	BIO-IMMT-2-3306	*In Vitro* Development and Morphogenesis in Plants	1	0	0	1
11	BIO	IMMT	BIO-IMMT-2-3307	Biodiversity	1	0	0	1
12	BIO	IMMT	BIO-IMMT-3-3301	Seminar Course	1	0	0	1
13	BIO	IMMT	BIO-IMMT-3-3302	Biomaterials	1	0	0	1
14	BIO	IMMT	BIO-IMMT-3-3303	Genome and gene regulation	1	0	0	1
15	BIO	IMMT	BIO-IMMT-3-3304	Microbial Diversity and Habitat Ecology	1	0	0	1
16	BIO	IMMT	BIO-IMMT-3-3305	Biology & Chemistry of Natural Products	1	0	0	1
17	BIO	IMMT	BIO-IMMT-3-3306	Bioremediation	1	0	0	1
18	BIO	IMMT	BIO-IMMT-3-3307	Mineral Bioprocessing	2	0	0	2
19	BIO	IMMT	BIO-IMMT-3-3308	Taxonomy and Speciation	1	0	0	1
20	BIO	IMMT	BIO-IMMT-4-0001	Project Proposal Writing	0	0	4	2
21	BIO	IMMT	BIO-IMMT-4-0002	Review Article Writing	0	0	4	2
22	BIO	IMMT	BIO-IMMT-4-0003	CSIR-800 Project Work	0	0	8	4
23	BIO	CCMB	BIO-CCMB-1-0001	Biostatistics	1	0	0	1
24	BIO	CCMB	BIO-CCMB-1-0002	Computation/bioinformatics	1	0	0	1
25	BIO	CCMB	BIO-CCMB-1-0003	Basic Chemistry	1	0	0	1
26	BIO	CCMB	BIO-CCMB-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
27	BIO	CCMB	BIO-CCMB-2-1201	Biotechniques and Instrumentation	1	0	0	1
28	BIO	CCMB	BIO-CCMB-2-1202	Biology of Macromolecules	2	0	0	2
29	BIO	CCMB	BIO-CCMB-2-1203	Biology of Inheritance	2	0	0	2
30	BIO	CCMB	BIO-CCMB-2-1204	Biology of Infection	2	0	0	2
31	BIO	CCMB	BIO-CCMB-2-1205	Genomics: Information flow in Biological Systems	2	0	0	2
32	BIO	CCMB	BIO-CCMB-2-1206	Protein science and proteomics	2	0	0	2
33	BIO	CCMB	BIO-CCMB-2-1207	Plant-Microbe Interaction	2	0	0	2
34	BIO	CCMB	BIO-CCMB-2-1208	Epigenetics and Chromatin Organization	2	0	0	2
35	BIO	CCMB	BIO-CCMB-2-1209	Stem cells, regeneration and aging	1	0	0	1
36	BIO	CCMB	BIO-CCMB-2-1210	Self organizations in biology	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
37	BIO	CCMB	BIO-CCMB-2-1211	Cell Biology	2	0	0	2
38	BIO	CCMB	BIO-CCMB-3-1201	Seminar Course	1	0	0	1
39	BIO	CCMB	BIO-CCMB-3-1202	Nanobiology	1	0	0	1
40	BIO	CCMB	BIO-CCMB-3-1203	Brain and behaviour	1	0	0	1
41	BIO	CCMB	BIO-CCMB-3-1204	Genome organization	1	0	0	1
42	BIO	CCMB	BIO-CCMB-3-1205	NMR Micro-imaging and Spectroscopy	1	0	0	1
43	BIO	CCMB	BIO-CCMB-3-1206	Mass spectroscopy in biology	1	0	0	1
44	BIO	CCMB	BIO-CCMB-3-1207	Conservation biology	1	0	0	1
45	BIO	CCMB	BIO-CCMB-3-1208	Drug Discovery	1	0	0	1
46	BIO	CCMB	BIO-CCMB-3-1209	Immunology	1	0	0	1
47	BIO	CCMB	BIO-CCMB-3-1210	Genome Engineering	1	0	0	1
48	BIO	CCMB	BIO-CCMB-3-1211	Ecology and Evolution	1	0	0	1
49	BIO	CCMB	BIO-CCMB-3-1212	Post-translation Control	1	0	0	1
50	BIO	CCMB	BIO-CCMB-4-0001	Project Proposal Writing	0	0	4	2
51	BIO	CCMB	BIO-CCMB-4-0002	Review Article Writing	0	0	4	2
52	BIO	CCMB	BIO-CCMB-4-0003	CSIR-800 Project Work	0	0	8	4
53	BIO	CLRI	BIO-CLRI-1-0001	Biostatistics	1	0	0	1
54	BIO	CLRI	BIO-CLRI-1-0002	Computation/bioinformatics	1	0	0	1
55	BIO	CLRI	BIO-CLRI-1-0003	Basic Chemistry	1	0	0	1
56	BIO	CLRI	BIO-CLRI-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
57	BIO	CLRI	BIO-CLRI-2-2001	Biotechniques and Instrumentation	1	0	2	2
58	BIO	CLRI	BIO-CLRI-2-2002	Biomacromolecules	2	0	0	2
59	BIO	CLRI	BIO-CLRI-2-2003	Cell Signalling	2	0	0	2
60	BIO	CLRI	BIO-CLRI-2-2004	Chromatin Organisation	2	0	0	2
61	BIO	CLRI	BIO-CLRI-2-2005	Connective Tissue Biology	2	0	0	2
62	BIO	CLRI	BIO-CLRI-2-2006	Biomaterials	2	0	0	2
63	BIO	CLRI	BIO-CLRI-2-2007	Computer Aided Drug Discovery	2	0	0	2
64	BIO	CLRI	BIO-CLRI-2-2008	Biochemical Engineering Principles	2	0	0	2
65	BIO	CLRI	BIO-CLRI-2-2009	Enzyme and Fermentation Technology	2	0	0	2
66	BIO	CLRI	BIO-CLRI-2-2010	Gene Expression and Proteomics	2	0	0	2
67	BIO	CLRI	BIO-CLRI-3-2001	Seminar Course	2	0	0	2
68	BIO	CLRI	BIO-CLRI-3-2002	Nanobiology	3	0	0	3
69	BIO	CLRI	BIO-CLRI-3-2003	Industrial Microbiology and Enzymology	3	0	0	3
70	BIO	CLRI	BIO-CLRI-3-2004	Cell Death and Diseases	3	0	0	3
71	BIO	CLRI	BIO-CLRI-3-2005	Approaches to Drug Delivery	3	0	0	3
72	BIO	CLRI	BIO-CLRI-3-2006	Computational Biology	3	0	0	3

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
73	BIO	CLRI	BIO-CLRI-3-2007	Bioprocessing and Industrial Fermentations	2	0	0	2
74	BIO	CLRI	BIO-CLRI-3-2008	Cell and Tissue Engineering	2	0	0	2
75	BIO	CLRI	BIO-CLRI-3-2009	Nanomaterial Toxicology	2	0	0	2
76	BIO	CLRI	BIO-CLRI-3-2010	Byproduct Utilization	2	0	0	2
77	BIO	CLRI	BIO-CLRI-4-0001	Project proposal writing	0	0	4	2
78	BIO	CLRI	BIO-CLRI-4-0002	Review Article Writing	0	0	4	2
79	BIO	CLRI	BIO-CLRI-4-0003	CSIR-800 project work	0	0	8	4
80	BIO	IGIB	BIO-IGIB-1-0001	Biostatistics	1	0	0	1
81	BIO	IGIB	BIO-IGIB-1-0002	Computation/bioinformatics	0	0	2	1
82	BIO	IGIB	BIO-IGIB-1-0003	Basic Chemistry	1	0	0	1
83	BIO	IGIB	BIO-IGIB-1-0004	Research Methodology, Communication/ethics/safety	0	0	2	1
84	BIO	IGIB	BIO-IGIB-2-2601	Genomics: Information flow in Biological Systems	1	1	0	2
85	BIO	IGIB	BIO-IGIB-2-2602	Protein Science and Proteomics	1	1	0	2
86	BIO	IGIB	BIO-IGIB-2-2603	The host and the invaders: the eternal battle	1	1	0	2
87	BIO	IGIB	BIO-IGIB-2-2604	The nature of chemical and biological diversity	1	1	0	2
88	BIO	IGIB	BIO-IGIB-2-2605	Dynamic nature of biology	1	1	0	2
89	BIO	IGIB	BIO-IGIB-2-2606	Microbes and Environment	2	0	0	2
90	BIO	IGIB	BIO-IGIB-2-2607	Defence Mechanisms to Inflammatory Disease	2	0	0	2
91	BIO	IGIB	BIO-IGIB-2-2608	From proteins to proteomes: Principles of Protein	2	0	0	2
92	BIO	IGIB	BIO-IGIB-2-2609	Molecular and Cellular Mechanisms of Defense	2	0	0	2
93	BIO	IGIB	BIO-IGIB-3-2601	Playing with Genomes	1	0	2	2
94	BIO	IGIB	BIO-IGIB-3-2602	Complex Disease Genomics	1	1	0	2
95	BIO	IGIB	BIO-IGIB-3-2603	Death & Disease: the cellular dilemma	1	1	0	2
96	BIO	IGIB	BIO-IGIB-3-2604	The Micro-World	1	1	0	2
97	BIO	IGIB	BIO-IGIB-3-2605	Space and Time in Biological Systems	2	0	0	2
98	BIO	IGIB	BIO-IGIB-3-2606	Immortality: the everlasting quest	1	1	0	2
99	BIO	IGIB	BIO-IGIB-3-2607	Electronics for Biologists	1	0	2	2
100	BIO	IGIB	BIO-IGIB-3-2608	Molecular and Cellular Mechanisms of Defense	2	0	0	2
101	BIO	IGIB	BIO-IGIB-3-2609	Death or Immortality: the hard choice	2	0	0	2
102	BIO	IGIB	BIO-IGIB-3-2610	Basic Programming for biologists	0	0	4	2
103	BIO	IGIB	BIO-IGIB-3-2611	Formulating research problem	0	1	0	1
104	BIO	IGIB	BIO-IGIB-3-2612	Showcasing your science	0	0	2	1
105	BIO	IGIB	BIO-IGIB-3-2613	Structural Biology: Structure, Dynamics and Modeling of Biological Macromolecules	0	0	1	0.5
106	BIO	IGIB	BIO-IGIB-3-2614	Frontier areas of research in biology	1	0	0	1
107	BIO	IGIB	BIO-IGIB-3-2615	Imaging and image analysis	0	0	1	0.5

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
108	BIO	IGIB	BIO-IGIB-3-2616	Critical Analysis of Scientific Literature	0	0	2	1
109	BIO	IGIB	BIO-IGIB-3-2617	Ayurgenomics	2	0	2	2
110	BIO	IGIB	BIO-IGIB-3-2618	Genes and networks	1	0	0	1
111	BIO	IGIB	BIO-IGIB-3-2619	Disease Mechanisms: Integration of Metabolic and Cellular	1	0	0	1
112	BIO	IGIB	BIO-IGIB-4-0001	Project Proposal Writing	0	0	4	2
113	BIO	IGIB	BIO-IGIB-4-0002	Review Article Review Writing	0	0	4	2
114	BIO	IGIB	BIO-IGIB-4-0003	CSIR-800 Project Work	0	0	8	4
115	BIO	IHBT	BIO-IHBT-1-0001	Biostatistics	1	0	0	1
116	BIO	IHBT	BIO-IHBT-1-0002	Computation/bioinformatics	1	0	0	1
117	BIO	IHBT	BIO-IHBT-1-0003	Basic Chemistry	1	0	0	1
118	BIO	IHBT	BIO-IHBT-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
119	BIO	IHBT	BIO-IHBT-2-2701	Biotechniques and Instrumentation	1	0	0	1
120	BIO	IHBT	BIO-IHBT-2-2702	Biology of Macromolecules	2	0	0	2
121	BIO	IHBT	BIO-IHBT-2-2703	Biology of Inheritance	2	0	0	2
122	BIO	IHBT	BIO-IHBT-2-2704	Biology of Infection	2	0	0	2
123	BIO	IHBT	BIO-IHBT-2-2705	Genomics: Information flow in Biological Systems	2	0	0	2
124	BIO	IHBT	BIO-IHBT-2-2706	Protein Science and Proteomics	2	0	0	2
125	BIO	IHBT	BIO-IHBT-2-2707	Plant-Microbe Interaction	2	0	0	2
126	BIO	IHBT	BIO-IHBT-2-2708	Plant Environment Interaction	1	0	0	1
127	BIO	IHBT	BIO-IHBT-2-2709	Crop Protection	1	0	0	1
128	BIO	IHBT	BIO-IHBT-2-2710	Developmental Biology-Plants	1	0	0	1
129	BIO	IHBT	BIO-IHBT-2-2711	*In Vitro* Development and Morphogenesis in Plants	1	0	0	1
130	BIO	IHBT	BIO-IHBT-2-2712	Molecular Breeding of Plants	1	0	0	1
131	BIO	IHBT	BIO-IHBT-2-2713	Natural Resource Management	1	1	0	2
132	BIO	IHBT	BIO-IHBT-2-2714	Bioresources and Bioprospection	1	0	0	1
133	BIO	IHBT	BIO-IHBT-2-2715	Bioresource Production Systems	1	1	0	2
134	BIO	IHBT	BIO-IHBT-2-2716	Nutrigenomics	1	0	0	1
135	BIO	IHBT	BIO-IHBT-2-2717	Advances in protected cultivation of flower crops	1	0	0	1
136	BIO	IHBT	BIO-IHBT-2-2718	Biofertiliser Technology	1	0	0	1
137	BIO	IHBT	BIO-IHBT-3-2701	Seminar Course	1	0	0	1
138	BIO	IHBT	BIO-IHBT-3-2702	Cancer Biology	1	0	0	1
139	BIO	IHBT	BIO-IHBT-3-2703	Cell and Tissue Engineering	1	0	0	1
140	BIO	IHBT	BIO-IHBT-3-2704	Frontiers of Biology: Synthetic Biology	1	0	0	1
141	BIO	IHBT	BIO-IHBT-3-2705	Advanced Bioinformatics	2	0	0	2
142	BIO	IHBT	BIO-IHBT-3-2706	Nanobiology	1	0	0	1
143	BIO	IHBT	BIO-IHBT-3-2707	Gene Environment Interaction	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
144	BIO	IHBT	BIO-IHBT-3-2708	Microbial Diversity and Habitat Ecology	1	0	0	1
145	BIO	IHBT	BIO-IHBT-3-2709	Advances in Crop Disease Management	1	0	0	1
146	BIO	IHBT	BIO-IHBT-3-2710	Silencing, Drug Delivery Vehicle	1	0	0	1
147	BIO	IHBT	BIO-IHBT-3-2711	Dietary Supplements	1	0	0	1
148	BIO	IHBT	BIO-IHBT-3-2712	Advances in Phytogenetic Remodeling	2	0	0	2
149	BIO	IHBT	BIO-IHBT-3-2713	Special Technologies for Phytogenetic Remodeling	1	0	0	1
150	BIO	IHBT	BIO-IHBT-3-2714	Biometrical Approaches to Phytogenetic Remodeling	1	0	0	1
151	BIO	IHBT	BIO-IHBT-3-2715	Viral Pathogenesis in Plants	2	0	0	2
152	BIO	IHBT	BIO-IHBT-3-2716	Advances in protected cultivation of flower crops	1	0	0	1
153	BIO	IHBT	BIO-IHBT-3-2717	Advanced Insect Toxicology	1	0	0	1
154	BIO	IHBT	BIO-IHBT-3-2718	Epigenetics and Chromatin Organization	1	0	0	1
155	BIO	IHBT	BIO-IHBT-3-2719	Integrated Pest Management	1	0	0	1
156	BIO	IHBT	BIO-IHBT-3-2720	Crop Modelling and System Research	2	0	0	2
157	BIO	IHBT	BIO-IHBT-3-2721	Fermentation Technology	1	0	0	1
158	BIO	IHBT	BIO-IHBT-3-2722	Plant Conservation and Reproductive	1	0	0	1
159	BIO	IHBT	BIO-IHBT-3-2723	Ethnobotany and Traditional	1	0	0	1
160	BIO	IHBT	BIO-IHBT-4-0001	Project Proposal Writing	0	0	4	2
161	BIO	IHBT	BIO-IHBT-4-0002	Review Article Writing	0	0	4	2
162	BIO	IHBT	BIO-IHBT-4-0003	CSIR-800 Project Work	0	0	8	4
163	BIO	IITR	BIO-IITR-1-0001	Biostatistics	1	0	0	1
164	BIO	IITR	BIO-IITR-1-0002	Computation/Bioinformatics	1	0	0	1
165	BIO	IITR	BIO-IITR-1-0003	Basic Chemistry	1	0	0	1
166	BIO	IITR	BIO-IITR-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
167	BIO	IITR	BIO-IITR-2-3201	Biotechniques and Instrumentation	1	0	0	1
168	BIO	IITR	BIO-IITR-2-3202	Biology of Macromolecules	2	0	0	2
169	BIO	IITR	BIO-IITR-2-3203	Biology of Inheritance	1	0	0	1
170	BIO	IITR	BIO-IITR-2-3204	Xenobiotic Interaction and response	2	0	0	2
171	BIO	IITR	BIO-IITR-2-3205	Cell Signalling	2	0	0	2
172	BIO	IITR	BIO-IITR-2-3206	Intellectual Property Management	1	0	0	1
173	BIO	IITR	BIO-IITR-2-3207	Stem cells, Regeration and Aging	1	0	0	1
174	BIO	IITR	BIO-IITR-2-3208	System Immunology	2	0	0	2
175	BIO	IITR	BIO-IITR-3-3201	Seminar	1	0	0	1
176	BIO	IITR	BIO-IITR-3-3202	Bioremediation	1	0	0	1
177	BIO	IITR	BIO-IITR-3-3203	Environmental Toxicology	1	0	2	2
178	BIO	IITR	BIO-IITR-3-3204	Model systems in Toxicological Research	1	0	0	1
179	BIO	IITR	BIO-IITR-3-3205	Food & Chemical Toxicology	2	0	0	2

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
180	BIO	IITR	BIO-IITR-3-3206	Target Organ Toxicity	2	0	0	2
181	BIO	IITR	BIO-IITR-3-3207	Nanomaterial Toxicology	1	0	2	2
182	BIO	IITR	BIO-IITR-3-3208	Chemical Carcinogenesis and Chemoprevention	1	0	0	1
183	BIO	IITR	BIO-IITR-3-3209	Neurotoxicology	2	0	0	2
184	BIO	IITR	BIO-IITR-3-3210	Genes and Environmental Diseases	1	0	0	1
185	BIO	IITR	BIO-IITR-3-3211	Frontiers of Biology: Synthetic Biology	1	0	0	1
186	BIO	IITR	BIO-IITR-3-3212	Microbes in Environment & Industrial Waste Management	2	0	0	2
187	BIO	IITR	BIO-IITR-3-3213	Transgenic Technology: Principles and Applications	1	1	0	2
188	BIO	IITR	BIO-IITR-3-3214	Air Pollution and Environmental Impact Assessment	1	0	0	1
189	BIO	IITR	BIO-IITR-4-0001	Project Proposal Writing	0	0	4	2
190	BIO	IITR	BIO-IITR-4-0002	Review Article Writing	0	0	4	2
191	BIO	IITR	BIO-IITR-4-0003	CSIR-800 Project Work	0	0	8	4
192	BIO	NBRI	BIO-NBRI-1-0001	Biostatistics	1	0	0	1
193	BIO	NBRI	BIO-NBRI-1-0002	Computation/bioinformatics	1	0	0	1
194	BIO	NBRI	BIO-NBRI-1-0003	Basic Chemistry	1	0	0	1
195	BIO	NBRI	BIO-NBRI-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
196	BIO	NBRI	BIO-NBRI-2-3601	Biotechniques and Instrumentation	1	0	0	1
197	BIO	NBRI	BIO-NBRI-2-3602	Biology of Inheritance	1	0	0	1
198	BIO	NBRI	BIO-NBRI-2-3603	Genomics: Information flow in Biological Systems	1	0	0	1
199	BIO	NBRI	BIO-NBRI-2-3604	Plant-Microbe Interaction	1	0	0	1
200	BIO	NBRI	BIO-NBRI-2-3605	Plant Environment Interaction	1	0	0	1
201	BIO	NBRI	BIO-NBRI-2-3606	Cell Signaling	2	0	0	2
202	BIO	NBRI	BIO-NBRI-2-3607	Developmental Biology-Plants	1	0	0	1
203	BIO	NBRI	BIO-NBRI-2-3608	Epigenetics and Chromatin Organization	1	0	0	1
204	BIO	NBRI	BIO-NBRI-2-3609	Homeostasis and feedback in biological systems	1	0	0	1
205	BIO	NBRI	BIO-NBRI-2-3610	Molecular breeding of plants	1	0	0	1
206	BIO	NBRI	BIO-NBRI-2-3611	Biodiversity	1	0	0	1
207	BIO	NBRI	BIO-NBRI-2-3612	Plant morphogenesis and regeneration	1	0	0	1
208	BIO	NBRI	BIO-NBRI-3-3601	Seminar Course	1	0	0	1
209	BIO	NBRI	BIO-NBRI-3-3602	Cell and tissue engineering	1	0	0	1
210	BIO	NBRI	BIO-NBRI-3-3603	Climate change and Plants	1	0	0	1
211	BIO	NBRI	BIO-NBRI-3-3604	Bioremediation	1	0	0	1
212	BIO	NBRI	BIO-NBRI-3-3605	Environmental Biochem and Biotech	1	0	0	1
213	BIO	NBRI	BIO-NBRI-3-3606	Taxonomy and speciation	1	0	0	1
214	BIO	NBRI	BIO-NBRI-3-3607	Plant Conservation and Reproductive Biology	1	0	0	1
215	BIO	NBRI	BIO-NBRI-3-3608	Economic Plants and Pharmacology	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
216	BIO	NBRI	BIO-NBRI-3-3609	Floriculture and Agronomy	1	0	0	1
217	BIO	NBRI	BIO-NBRI-3-3610	Phylogenomics	1	0	0	1
218	BIO	NBRI	BIO-NBRI-3-3611	Biofuels	1	0	0	1
219	BIO	NBRI	BIO-NBRI-3-3612	Knowledgebase Research Management and it's utilization	1	0	0	1
220	BIO	NBRI	BIO-NBRI-4-0001	Project Proposal Writing	0	0	4	2
221	BIO	NBRI	BIO-NBRI-4-0002	Review Article Writing	0	0	4	2
222	BIO	NBRI	BIO-NBRI-4-0003	CSIR-800 Project Work	0	0	8	4
223	BIO	NIIST	BIO-NIIST-1-0001	Biostatistics	1	0	0	1
224	BIO	NIIST	BIO-NIIST-1-0002	Computation/bioinformatics	1	0	0	1
225	BIO	NIIST	BIO-NIIST-1-0003	Basic Chemistry	1	0	0	1
226	BIO	NIIST	BIO-NIIST-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
227	BIO	NIIST	BIO-NIIST-2-4101	Biotechniques and Instrumentation	1	0	0	1
228	BIO	NIIST	BIO-NIIST-2-4102	Protein Science and Proteomics	2	0	0	2
229	BIO	NIIST	BIO-NIIST-2-4103	Basics and Applied Microbiology	2	0	0	2
230	BIO	NIIST	BIO-NIIST-2-4104	Basic Molecular Biology	2	0	0	2
231	BIO	NIIST	BIO-NIIST-2-4105	Bioprospecting and Biochemical Pharmacology	2	0	0	2
232	BIO	NIIST	BIO-NIIST-2-4106	Fundamentals of Food processing	2	0	0	2
233	BIO	NIIST	BIO-NIIST-2-4107	Cell biology and Tissue Engineering	2	0	0	2
234	BIO	NIIST	BIO-NIIST-2-4108	Significance of Food Preservation	1	0	0	1
235	BIO	NIIST	BIO-NIIST-2-4109	Thermal Processing of Foods	1	0	0	1
236	BIO	NIIST	BIO-NIIST-2-4110	Cell Biology and Cell signalling	2	0	0	2
237	BIO	NIIST	BIO-NIIST-3-4101	Seminar course	1	0	0	1
238	BIO	NIIST	BIO-NIIST-3-4102	Introductive Bioinformatics	2	0	0	2
239	BIO	NIIST	BIO-NIIST-3-4103	Microbial Diversity and Ecology	2	0	0	2
240	BIO	NIIST	BIO-NIIST-3-4104	Bioprocess Technology	2	0	0	2
241	BIO	NIIST	BIO-NIIST-3-4105	Enzymology & Enzyme Technology	2	0	0	2
242	BIO	NIIST	BIO-NIIST-3-4106	Biodegradable polymers	2	0	0	2
243	BIO	NIIST	BIO-NIIST-3-4107	Metabolic Engineering	2	0	0	2
244	BIO	NIIST	BIO-NIIST-3-4108	Natural Product Chemistry	2	0	0	2
245	BIO	NIIST	BIO-NIIST-3-4109	Cardiovascular Disease Biology	2	0	0	2
246	BIO	NIIST	BIO-NIIST-3-4110	Molecular Biology of Diabetes	2	0	0	2
247	BIO	NIIST	BIO-NIIST-3-4111	Environmental Technology	2	0	0	2
248	BIO	NIIST	BIO-NIIST-3-4112	Biomass to fuels	2	0	0	2
249	BIO	NIIST	BIO-NIIST-3-4113	Biochemical Engineering	2	0	0	2
250	BIO	NIIST	BIO-NIIST-3-4114	Prebiotics and Probiotics	1	0	0	1
251	BIO	NIIST	BIO-NIIST-3-4115	Cancer Biology	2	0	0	2

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
252	BIO	NIIST	BIO-NIIST-3-4116	Functional Foods and nutraceuticals	2	0	0	2
253	BIO	NIIST	BIO-NIIST-3-4117	Chemistry of process induced food toxicants	1	0	0	1
254	BIO	NIIST	BIO-NIIST-4-0001	Project Proposal Writing	0	0	4	2
255	BIO	NIIST	BIO-NIIST-4-0002	Review Article Writing	0	0	4	2
256	BIO	NIIST	BIO-NIIST-4-0003	CSIR-800 Project Work	0	0	8	4
257	BIO	CSMCRI	BIO-CSMCRI-1-0001	Biostatistics	1	0	0	1
258	BIO	CSMCRI	BIO-CSMCRI-1-0002	Computation/bioinformatics	1	0	0	1
259	BIO	CSMCRI	BIO-CSMCRI-1-0003	Basic Chemistry	1	0	0	1
260	BIO	CSMCRI	BIO-CSMCRI-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
261	BIO	CSMCRI	BIO-CSMCRI-2-2501	Biotechniques and Instrumentation	1	0	0	1
262	BIO	CSMCRI	BIO-CSMCRI-2-2502	Biology of Macromolecules	2	0	0	2
263	BIO	CSMCRI	BIO-CSMCRI-2-2503	Biology of Inheritance	2	0	0	2
264	BIO	CSMCRI	BIO-CSMCRI-2-2504	Genomics: Information flow in Biological Systems	2	0	0	2
265	BIO	CSMCRI	BIO-CSMCRI-2-2505	Protein Science and Proteomics	2	0	0	2
266	BIO	CSMCRI	BIO-CSMCRI-2-2506	Plant-Microbe Interaction	2	0	0	2
267	BIO	CSMCRI	BIO-CSMCRI-2-2507	Plant Environment Interaction	1	0	0	1
268	BIO	CSMCRI	BIO-CSMCRI-2-2508	*In Vitro* Development and Morphogenesis in Plants	1	0	0	1
269	BIO	CSMCRI	BIO-CSMCRI-2-2509	Molecular Breeding of Plants	1	0	0	1
270	BIO	CSMCRI	BIO-CSMCRI-2-2510	Natural Resource Management	1	1	0	2
271	BIO	CSMCRI	BIO-CSMCRI-2-2511	Bioresource Production Systems	1	1	0	2
272	BIO	CSMCRI	BIO-CSMCRI-2-2512	Remote Sensing and its Application on Biological sciences	1	0	0	1
273	BIO	CSMCRI	BIO-CSMCRI-3-2501	Seminar Course	1	0	0	1
274	BIO	CSMCRI	BIO-CSMCRI-3-2502	Advanced Bioinformatics	2	0	0	2
275	BIO	CSMCRI	BIO-CSMCRI-3-2503	Gene Environment Interaction	1	0	0	1
276	BIO	CSMCRI	BIO-CSMCRI-3-2504	Advances in Gene Silencing and Epigenetics	1	0	0	1
277	BIO	CSMCRI	BIO-CSMCRI-3-2505	Microbial Diversity and Habitat Ecology	1	0	0	1
278	BIO	CSMCRI	BIO-CSMCRI-3-2506	Integrated Pest Management	1	0	0	1
279	BIO	CSMCRI	BIO-CSMCRI-3-2507	manipulation	2	0	0	2
280	BIO	CSMCRI	BIO-CSMCRI-3-2508	Biology of marine macroalgae	2	0	0	2
281	BIO	CSMCRI	BIO-CSMCRI-3-2509	Wasteland biology and reclamation	2	0	0	2
282	BIO	CSMCRI	BIO-CSMCRI-4-0001	Project Proposal Writing	0	0	4	2
283	BIO	CSMCRI	BIO-CSMCRI-4-0002	Review Article Writing	0	0	4	2
284	BIO	CSMCRI	BIO-CSMCRI-4-0003	CSIR-800 Project Work	0	0	8	4
285	BIO	CDRI	BIO-CDRI-1-0001	Biostatistics	1	0	0	1
286	BIO	CDRI	BIO-CDRI-1-0002	Computation/bioinformatics	1	0	0	1
287	BIO	CDRI	BIO-CDRI-1-0003	Basic Chemistry	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
288	BIO	CDRI	BIO-CDRI-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
289	BIO	CDRI	BIO-CDRI-2-1301	Biotechniques and Instrumentation	1	1	2	3
290	BIO	CDRI	BIO-CDRI-2-1302	Biology of Macromolecules	2	0	0	2
291	BIO	CDRI	BIO-CDRI-2-1303	Biology of Infection	2	0	0	2
292	BIO	CDRI	BIO-CDRI-2-1304	Protein Science and Proteomics	2	0	0	2
293	BIO	CDRI	BIO-CDRI-2-1305	Xenobiotic Interaction and Response	2	0	0	2
294	BIO	CDRI	BIO-CDRI-2-1306	Molecular Therapeutics	2	0	0	2
295	BIO	CDRI	BIO-CDRI-2-1307	Cell Signaling	2	0	0	2
296	BIO	CDRI	BIO-CDRI-2-1308	Chemical Biology	1	0	0	1
297	BIO	CDRI	BIO-CDRI-2-1309	Epigenetics and Chromatin Organization	2	0	0	2
298	BIO	CDRI	BIO-CDRI-2-1310	Homeostasis and feedback in biological systems	1	0	0	1
299	BIO	CDRI	BIO-CDRI-2-1311	Molecular and Cellular Mechanisms of Defence	1	0	0	1
300	BIO	CDRI	BIO-CDRI-2-1312	Dosage Form Design	1	0	0	1
301	BIO	CDRI	BIO-CDRI-3-1301	Seminar Course (compulsory)	1	0	0	1
302	BIO	CDRI	BIO-CDRI-3-1303	Microbial Pathogenesis	2	0	0	2
303	BIO	CDRI	BIO-CDRI-3-1304	Neurobiology	2	0	0	2
304	BIO	CDRI	BIO-CDRI-3-1305	Transcription and Gene Regulation	1	0	0	1
305	BIO	CDRI	BIO-CDRI-3-1306	Biol and Therapeutics of Life Style Disorders	2	0	0	2
306	BIO	CDRI	BIO-CDRI-3-1307	Animal Models in Biomedical Research	1	0	0	1
307	BIO	CDRI	BIO-CDRI-3-1308	Pharmacokinetics and metabolism	1	0	0	1
308	BIO	CDRI	BIO-CDRI-3-1309	Approaches to Drug Delivery	2	0	0	2
309	BIO	CDRI	BIO-CDRI-3-1310	An Intro to Drug Discovery & Development	2	0	0	2
310	BIO	CDRI	BIO-CDRI-3-1302	Cancer Biology	2	0	0	2
311	BIO	CDRI	BIO-CDRI-2-1313	Plant Taxonomy, biodiversity,conservation, ethnobotany and Pharmacognosy	2	0	0	2
312	BIO	CDRI	BIO-CDRI-3-1311	Plant secondary metabolites and their in vitro biosynthesis through plant tissue culture	2	0	0	2
313	BIO	CDRI	BIO-CDRI-4-0001	Project Proposal Writing	0	0	4	2
314	BIO	CDRI	BIO-CDRI-4-0002	Review Article Writing	0	0	4	2
315	BIO	CDRI	BIO-CDRI-4-0003	CSIR-800 Project Work	0	0	8	4
316	BIO	CECRI	BIO-CECRI-1-0001	Biostatistics	1	0	0	1
317	BIO	CECRI	BIO-CECRI-1-0002	Computation/bioinformatics	1	0	0	1
318	BIO	CECRI	BIO-CECRI-1-0003	Basic Chemistry	1	0	0	1
319	BIO	CECRI	BIO-CECRI-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
320	BIO	CECRI	BIO-CECRI-1-1401	Basics Mathematics & Numerical Methods	1	0	0	1
321	BIO	CECRI	BIO-CECRI-1-1402	Introduction to Chemical Biology	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
322	BIO	CECRI	BIO-CECRI-2-1401	Advanced Materials Characterization Techniques	2	0	0	2
323	BIO	CECRI	BIO-CECRI-2-1402	Environmental Biotechnology & Microbiology	2	0	0	2
324	BIO	CECRI	BIO-CECRI-2-1403	Biology of Macro molecules	2	0	0	2
325	BIO	CECRI	BIO-CECRI-2-1404	Biotechniques & Instrumentation	2	0	0	2
326	BIO	CECRI	BIO-CECRI-2-1405	Water & waste water treatment	2	0	0	2
327	BIO	CECRI	BIO-CECRI-2-1406	Fundamentals of Electrochemistry & Corrosion	2	0	0	2
328	BIO	CECRI	BIO-CECRI-2-1407	Advanced Surface Science	2	0	0	2
329	BIO	CECRI	BIO-CECRI-3-1401	Industrial & Applied Microbiology	2	0	0	2
330	BIO	CECRI	BIO-CECRI-3-1402	Bioremediation	2	0	0	2
331	BIO	CECRI	BIO-CECRI-3-1403	Advanced Treatments system	2	0	0	2
332	BIO	CECRI	BIO-CECRI-3-1404	Advanced Biochemical Engineering	2	0	0	2
333	BIO	CECRI	BIO-CECRI-3-1405	Electrochemical Power Sources	2	0	0	2
334	BIO	CECRI	BIO-CECRI-3-1406	Nano Biotechnology	2	0	0	2
335	BIO	CECRI	BIO-CECRI-3-1407	Functional Materials	2	0	0	2
336	BIO	CECRI	BIO-CECRI-3-1408	Electrochemical remediation	2	0	0	2
337	BIO	CECRI	BIO-CECRI-4-0001	Project Proposal Writing	0	0	4	2
338	BIO	CECRI	BIO-CECRI-4-0002	Review Article Writing	0	0	4	2
339	BIO	CECRI	BIO-CECRI-4-0003	CSIR-800 Project Work	0	0	8	4
340	BIO	CFTRI	BIO-CFTRI-1-0001	Biostatistics	1	0	0	1
341	BIO	CFTRI	BIO-CFTRI-1-0002	Computation/bioinformatics	1	0	0	1
342	BIO	CFTRI	BIO-CFTRI-1-0003	Basic Chemistry	1	0	0	1
343	BIO	CFTRI	BIO-CFTRI-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
344	BIO	CFTRI	BIO-CFTRI-2-1601	Instrumental Techniques	1	0	0	1
345	BIO	CFTRI	BIO-CFTRI-2-1602	Basics of Food Microbiology	1	0	0	1
346	BIO	CFTRI	BIO-CFTRI-2-1603	Significance of Food Preservation	1	0	0	1
347	BIO	CFTRI	BIO-CFTRI-2-1604	Thermal Processing of Foods	1	0	0	1
348	BIO	CFTRI	BIO-CFTRI-2-1605	Canning of Foods	1	0	0	1
349	BIO	CFTRI	BIO-CFTRI-2-1606	Controlled and Modified Atmosphere Storage of Foods	1	0	0	1
350	BIO	CFTRI	BIO-CFTRI-2-1607	Functional Preservatives	1	0	0	1
351	BIO	CFTRI	BIO-CFTRI-2-1608	Hurdle Technology	1	0	0	1
352	BIO	CFTRI	BIO-CFTRI-2-1609	Infestation Control and Grain Storage	1	0	0	1
353	BIO	CFTRI	BIO-CFTRI-2-1610	Animal Products Technology	1	0	0	1
354	BIO	CFTRI	BIO-CFTRI-2-1611	Spices and Plantation Products	1	0	0	1
355	BIO	CFTRI	BIO-CFTRI-2-1612	Microbial Fermentations	1	0	0	1
356	BIO	CFTRI	BIO-CFTRI-3-1601	Seminar courses	1	0	0	1
357	BIO	CFTRI	BIO-CFTRI-3-1602	Technology of Cereals and Pulses	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
358	BIO	CFTRI	BIO-CFTRI-3-1603	Technology of Fruits and Vegetables	1	0	0	1
359	BIO	CFTRI	BIO-CFTRI-3-1604	Food Biotechnology	1	0	0	1
360	BIO	CFTRI	BIO-CFTRI-3-1605	Functional Foods	1	0	0	1
361	BIO	CFTRI	BIO-CFTRI-3-1606	Nutraceuticals	1	0	0	1
362	BIO	CFTRI	BIO-CFTRI-3-1607	Dietary Supplements	1	0	0	1
363	BIO	CFTRI	BIO-CFTRI-3-1608	Convenience and Wellness Foods	1	0	0	1
364	BIO	CFTRI	BIO-CFTRI-3-1609	Prebiotics and Probiotics	1	0	0	1
365	BIO	CFTRI	BIO-CFTRI-3-1610	Fermented Foods and Beverages	1	0	0	1
366	BIO	CFTRI	BIO-CFTRI-3-1611	Sensory Profiling of Foods	1	0	0	1
367	BIO	CFTRI	BIO-CFTRI-3-1612	Microbial Kinetics	1	0	0	1
368	BIO	CFTRI	BIO-CFTRI-3-1613	Food Safety	1	0	0	1
369	BIO	CFTRI	BIO-CFTRI-3-1614	Food Based Nutritional Significance	1	0	0	1
370	BIO	CFTRI	BIO-CFTRI-3-1615	Food Chain Establishment	1	0	0	1
371	BIO	CFTRI	BIO-CFTRI-4-0001	Project proposal writing	0	0	4	2
372	BIO	CFTRI	BIO-CFTRI-4-0002	Review Article writing	0	0	4	2
373	BIO	CFTRI	BIO-CFTRI-4-0003	CSIR-800 project work	0	0	8	4
374	BIO	CIMAP	BIO-CIMAP-1-0001	Biostatistics	1	0	0	1
375	BIO	CIMAP	BIO-CIMAP-1-0002	Computation/bioinformatics	1	0	0	1
376	BIO	CIMAP	BIO-CIMAP-1-0003	Basic Chemistry	1	0	0	1
377	BIO	CIMAP	BIO-CIMAP-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
378	BIO	CIMAP	BIO-CIMAP-2-1801	Biotechniques and Instrumentation	1	0	0	1
379	BIO	CIMAP	BIO-CIMAP-2-1802	Biology of Macromolecules	2	0	0	2
380	BIO	CIMAP	BIO-CIMAP-2-1803	Biology of Inheritance	2	0	0	2
381	BIO	CIMAP	BIO-CIMAP-2-1804	Biology of Infection	1	0	0	1
382	BIO	CIMAP	BIO-CIMAP-2-1805	Genomics: Information flow in Biological Systems	2	0	0	2
383	BIO	CIMAP	BIO-CIMAP-2-1806	Protein Science and Proteomics	2	0	0	2
384	BIO	CIMAP	BIO-CIMAP-2-1807	Systems Biology	1	0	0	1
385	BIO	CIMAP	BIO-CIMAP-2-1808	Xenobiotic Interaction and Response	1	0	0	1
386	BIO	CIMAP	BIO-CIMAP-2-1809	Plant-Microbe Interaction	2	0	0	2
387	BIO	CIMAP	BIO-CIMAP-2-1810	Plant Environment Interaction	1	0	0	1
388	BIO	CIMAP	BIO-CIMAP-2-1811	Molecular Therapeutics	1	0	0	1
389	BIO	CIMAP	BIO-CIMAP-2-1812	Crop Protection	1	0	0	1
390	BIO	CIMAP	BIO-CIMAP-2-1813	Developmental Biology-Plants	1	0	0	1
391	BIO	CIMAP	BIO-CIMAP-2-1814	Epigenetics and Chromatin Organization	2	0	0	2
392	BIO	CIMAP	BIO-CIMAP-2-1815	Molecular Breeding of Plants	1	0	0	1
393	BIO	CIMAP	BIO-CIMAP-2-1816	Bioresources and Bioprospection	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
394	BIO	CIMAP	BIO-CIMAP-2-1817	Crop Production Systems	2	0	0	2
395	BIO	CIMAP	BIO-CIMAP-2-1818	Intellectual Property Management	1	0	0	1
396	BIO	CIMAP	BIO-CIMAP-2-1819	Plant/Cell/Tissue/ Organ Culture	2	0	0	2
397	BIO	CIMAP	BIO-CIMAP-2-1820	Crop Modelling and System Research	2	0	0	2
398	BIO	CIMAP	BIO-CIMAP-3-1801	Seminar Course	1	0	0	1
399	BIO	CIMAP	BIO-CIMAP-3-1802	Cell and Tissue Engineering	1	0	0	1
400	BIO	CIMAP	BIO-CIMAP-3-1803	Frontiers of Biology: Synthetic Biology	1	0	0	1
401	BIO	CIMAP	BIO-CIMAP-3-1804	Advanced Bioinformatics	2	0	0	2
402	BIO	CIMAP	BIO-CIMAP-3-1805	Gene Environment Interaction	1	0	0	1
403	BIO	CIMAP	BIO-CIMAP-3-1806	Advances in Gene Silencing	1	0	0	1
404	BIO	CIMAP	BIO-CIMAP-3-1807	Advances in Crop Disease Management	1	0	0	1
405	BIO	CIMAP	BIO-CIMAP-3-1808	Integrated Pest Management	1	0	0	1
406	BIO	CIMAP	BIO-CIMAP-3-1809	Anti microbial agents and drug resistance	1	0	0	1
407	BIO	CIMAP	BIO-CIMAP-3-1810	Drug delivery and Pharmaceutical formulations	1	0	0	1
408	BIO	CIMAP	BIO-CIMAP-3-1811	biotransformation	1	0	0	1
409	BIO	CIMAP	BIO-CIMAP-3-1812	Plant Pathogenesis	2	0	0	2
410	BIO	CIMAP	BIO-CIMAP-3-1813	Biology & Chemistry of Natural Products	2	0	0	2
411	BIO	CIMAP	BIO-CIMAP-3-1814	Biology of inflammation and diseases	1	0	0	1
412	BIO	CIMAP	BIO-CIMAP-3-1815	Soil and crop management	2	0	2	3
413	BIO	CIMAP	BIO-CIMAP-4-0001	Project Proposal Writing	0	0	4	2
414	BIO	CIMAP	BIO-CIMAP-4-0002	Review Article Writing	0	0	4	2
415	BIO	CIMAP	BIO-CIMAP-4-0003	CSIR-800 Project Work	0	0	8	4
416	BIO	IICB	BIO-IICB-1-0001	Biostatistics	1	0	0	1
417	BIO	IICB	BIO-IICB-1-0002	Computation/bioinformatics	1	0	0	1
418	BIO	IICB	BIO-IICB-1-0003	Basic Chemistry	1	0	0	1
419	BIO	IICB	BIO-IICB-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
420	BIO	IICB	BIO-IICB-2-2801	Biotechniques and Instrumentation	2	0	0	2
421	BIO	IICB	BIO-IICB-2-2802	Biology of Macromolecules	2	0	0	2
422	BIO	IICB	BIO-IICB-2-2803	Biology of Infection	2	0	0	2
423	BIO	IICB	BIO-IICB-2-2804	Protein Science and Proteomics	2	0	0	2
424	BIO	IICB	BIO-IICB-2-2805	Cell Biology and Cell signaling	2	0	0	2
425	BIO	IICB	BIO-IICB-2-2806	Bioinformatics	2	0	0	2
426	BIO	IICB	BIO-IICB-2-2807	Molecular and Cellular Immunology	2	0	0	2
427	BIO	IICB	BIO-IICB-3-2801	Seminar and Critical Appraisal	1	0	0	1
428	BIO	IICB	BIO-IICB-3-2802	Cancer Biology	2	0	0	2
429	BIO	IICB	BIO-IICB-3-2803	Cell and Tissue Engineering	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
430	BIO	IICB	BIO-IICB-3-2804	Microbial pathogenesis	1	0	0	1
431	BIO	IICB	BIO-IICB-3-2805	Neurobiology	2	0	0	2
432	BIO	IICB	BIO-IICB-3-2806	Genomics	2	0	0	2
433	BIO	IICB	BIO-IICB-3-2807	Eukaryotic Gene Regulatory Mechanisms	2	0	0	2
434	BIO	IICB	BIO-IICB-3-2808	Chemical Biology	1	0	0	1
435	BIO	IICB	BIO-IICB-3-2809	Synthetic & Systems Biology	2	0	0	2
436	BIO	IICB	BIO-IICB-3-2810	Biology	2	0	0	2
437	BIO	IICB	BIO-IICB-3-2811	Modern Drug Discovery & Design	2	0	0	2
438	BIO	IICB	BIO-IICB-4-0001	Project Proposal Writing	0	0	4	2
439	BIO	IICB	BIO-IICB-4-0002	Review Article Writing	0	0	4	2
440	BIO	IICB	BIO-IICB-4-0003	CSIR-800 Project Work	0	0	8	4
441	BIO	IICT	BIO-IICT-1-0001	Biostatistics	1	0	0	1
442	BIO	IICT	BIO-IICT-1-0002	Computation/bioinformatics	1	0	0	1
443	BIO	IICT	BIO-IICT-1-0003	Basic Chemistry	1	0	0	1
444	BIO	IICT	BIO-IICT-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
445	BIO	IICT	BIO-IICT-2-2901	Biotechniques & Instrumentation	1	0	0	1
446	BIO	IICT	BIO-IICT-2-2902	Chemical Biology	2	0	0	2
447	BIO	IICT	BIO-IICT-2-2903	Crop Protection	1	0	0	1
448	BIO	IICT	BIO-IICT-2-2904	Techniques for identifying newer pesticide molecules	1	0	0	1
449	BIO	IICT	BIO-IICT-2-2905	Techniques for identifying newer drug molecules	1	0	0	1
450	BIO	IICT	BIO-IICT-2-2906	proteomics and its application	1	0	0	1
451	BIO	IICT	BIO-IICT-2-2907	Principles of Pharmacology and Toxicology	1	0	0	1
452	BIO	IICT	BIO-IICT-2-2908	Environmental and Microbial Technology	1	0	0	1
453	BIO	IICT	BIO-IICT-3-2901	Seminar course	1	0	0	1
454	BIO	IICT	BIO-IICT-3-2902	Nanobiology	1	0	0	1
455	BIO	IICT	BIO-IICT-3-2903	Environmental Toxicology	1	0	0	1
456	BIO	IICT	BIO-IICT-3-2904	Advanced Pharmacology	2	0	0	2
457	BIO	IICT	BIO-IICT-3-2905	Disease Mechanisms	2	0	0	2
458	BIO	IICT	BIO-IICT-3-2906	Industrial /Applied Microbiology	1	0	0	1
459	BIO	IICT	BIO-IICT-3-2907	Protein Science and structural based drug design and development	1	0	0	1
460	BIO	IICT	BIO-IICT-4-0001	Project Proposal Writing	0	0	4	2
461	BIO	IICT	BIO-IICT-4-0002	Review Article Writing	0	0	4	2
462	BIO	IICT	BIO-IICT-4-0003	CSIR-800 Project Work	0	0	8	4
463	BIO	IIIM	BIO-IIIM-1-0001	Biostatistics	1	0	0	1
464	BIO	IIIM	BIO-IIIM-1-0002	Computation/bioinformatics	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
465	BIO	IIIM	BIO-IIIM-1-0003	Basic Chemistry	1	0	0	1
466	BIO	IIIM	BIO-IIIM-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
467	BIO	IIIM	BIO-IIIM-2-3001	Pharmacology	2	0	4	2
468	BIO	IIIM	BIO-IIIM-2-3002	Cancer Biology	1	0	0	1
469	BIO	IIIM	BIO-IIIM-2-3003	Stem Cell Biology and Regenerative Medicine	1	0	0	1
470	BIO	IIIM	BIO-IIIM-2-3004	Applications	2	0	4	2
471	BIO	IIIM	BIO-IIIM-2-3005	Introductory Plant Biology	2	0	4	2
472	BIO	IIIM	BIO-IIIM-2-3006	Basic Microbiology and Microbial Metabolism	2	0	4	2
473	BIO	IIIM	BIO-IIIM-2-3007	Basic Biology for interdisciplinary Sciences	1	0	0	1
474	BIO	IIIM	BIO-IIIM-3-3001	Molecular Cell Biology	1	0	0	1
475	BIO	IIIM	BIO-IIIM-3-3002	Formulation, Drug Delivery and Pharmacokinetics	1	0	0	1
476	BIO	IIIM	BIO-IIIM-3-3003	Neuropharmacology and Neuro-degenerative diseases	1	0	0	1
477	BIO	IIIM	BIO-IIIM-3-3004	Toxicology and Applied Pharmacology	1	0	0	1
478	BIO	IIIM	BIO-IIIM-3-3005	Infectious Diseases	1	0	0	1
479	BIO	IIIM	BIO-IIIM-3-3006	Biodiversity and Taxonomy	1	0	0	1
480	BIO	IIIM	BIO-IIIM-3-3007	Molecular biology of plant secondary metabolism	2	0	0	2
481	BIO	IIIM	BIO-IIIM-3-3008	In Vitro cellular and developmental biology of Plants	1	0	0	1
482	BIO	IIIM	BIO-IIIM-3-3009	Plant Functioning	1	0	0	1
483	BIO	IIIM	BIO-IIIM-3-3010	Techniques in plant molecular biology and biochemistry	1	0	0	1
484	BIO	IIIM	BIO-IIIM-3-3011	Medicinal and Aromatic Plants and Pharmacognosy	2	0	0	2
485	BIO	IIIM	BIO-IIIM-3-3012	Microbial Genetics and Enzyme Technology	2	0	0	2
486	BIO	IIIM	BIO-IIIM-3-3013	Plant-Microbe interaction	2	0	0	2
487	BIO	IIIM	BIO-IIIM-4-0001	Project Proposal Writing	0	0	4	2
488	BIO	IIIM	BIO-IIIM-4-0002	Review Article Writing	0	0	4	2
489	BIO	IIIM	BIO-IIIM-4-0003	CSIR-800 Project Work	0	0	8	4
490	BIO	IMT	BIO-IMT-1-0001	Biostatistics	1	0	0	1
491	BIO	IMT	BIO-IMT-1-0002	Computation/bioinformatics	1	0	0	1
492	BIO	IMT	BIO-IMT-1-0003	Basic Chemistry	1	0	0	1
493	BIO	IMT	BIO-IMT-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
494	BIO	IMT	BIO-IMT-2-3401	Biotechniques and Instrumentation	1	0	0	1
495	BIO	IMT	BIO-IMT-2-3402	Biology of Macromolecules	2	0	0	2
496	BIO	IMT	BIO-IMT-2-3403	Biology of inheritance	2	0	0	2
497	BIO	IMT	BIO-IMT-2-3404	Biology of infection	2	0	0	2
498	BIO	IMT	BIO-IMT-2-3405	Genomics: Information flow in Biological Systems	2	0	0	2
499	BIO	IMT	BIO-IMT-2-3406	Protein Science and Proteomics	2	0	0	2
500	BIO	IMT	BIO-IMT-2-3407	Systems Biology	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
501	BIO	IMT	BIO-IMT-2-3408	Cell Signaling	2	0	0	2
502	BIO	IMT	BIO-IMT-2-3409	Chemical Biology	1	0	0	1
503	BIO	IMT	BIO-IMT-2-3410	Molecular and Cellular Mechanisms of Defence	2	0	0	2
504	BIO	IMT	BIO-IMT-2-3411	Biodiversity	1	0	0	1
505	BIO	IMT	BIO-IMT-2-3412	Bioinformatics	2	0	0	2
506	BIO	IMT	BIO-IMT-2-3413	Biochemical Engineering	1	0	0	1
507	BIO	IMT	BIO-IMT-3-3401	Seminar Course	1	0	0	1
508	BIO	IMT	BIO-IMT-3-3402	Frontiers of Biology: Synthetic Biology	1	0	0	1
509	BIO	IMT	BIO-IMT-3-3403	Advanced Bioinformatics	2	0	0	2
510	BIO	IMT	BIO-IMT-3-3404	Mycobacterium tuberculosis	2	0	0	2
511	BIO	IMT	BIO-IMT-3-3405	Metagenomics	1	0	0	1
512	BIO	IMT	BIO-IMT-3-3406	Advanced Biochemical Engineering	2	0	0	2
513	BIO	IMT	BIO-IMT-4-0001	Project Proposal Writing	0	0	4	2
514	BIO	IMT	BIO-IMT-4-0002	Review Article Writing	0	0	4	2
515	BIO	IMT	BIO-IMT-4-0003	CSIR-800 Project Work	0	0	8	4
516	BIO	NCL	BIO-NCL-1-0001	Biostatistics	1	0	0	1
517	BIO	NCL	BIO-NCL-1-0002	Computation/bioinformatics	1	0	0	1
518	BIO	NCL	BIO-NCL-1-0003	Basic Chemistry	1	0	0	1
519	BIO	NCL	BIO-NCL-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
520	BIO	NCL	BIO-NCL-1-3701	Analytical Tools and Instrumentation	2	0	0	2
521	BIO	NCL	BIO-NCL-1-3702	Basic mathematics and numerical methods	2	0	0	2
522	BIO	NCL	BIO-NCL-1-3703	Basic Chemistry for Interdisciplinary sciences	1	0	0	1
523	BIO	NCL	BIO-NCL-1-3704	Introduction to Nanoscience and Nanotechnology	1	0	0	1
524	BIO	NCL	BIO-NCL-1-3705	Introduction to Chemical Biology	1	0	0	1
525	BIO	NCL	BIO-NCL-1-3706	Basic techniques in biology	1	0	0	1
526	BIO	NCL	BIO-NCL-2-3701	Advanced Techniques in Biology	3	0	0	3
527	BIO	NCL	BIO-NCL-2-3702	Introduction to infectious diseases	2	0	0	2
528	BIO	NCL	BIO-NCL-2-3703	Mathematics and statistics for biologists	2	0	0	2
529	BIO	NCL	BIO-NCL-2-3704	Structure determination and analysis of biomolecules	2	0	0	2
530	BIO	NCL	BIO-NCL-2-3705	Concepts in Microbiology	3	0	0	3
531	BIO	NCL	BIO-NCL-2-3706	Concepts in Plant Biotechnology	2	0	0	2
532	BIO	NCL	BIO-NCL-2-3707	Advances in Nanoscience and Nanotechnology	3	0	0	3
533	BIO	NCL	BIO-NCL-2-3708	Advances in Chemical Biology	3	0	0	3
534	BIO	NCL	BIO-NCL-2-3709	Advanced Biomaterials	3	0	0	3
535	BIO	NCL	BIO-NCL-3-3701	Molecular recognition and molecular interactions in structural biology	3	0	0	3

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
536	BIO	NCL	BIO-NCL-3-3702	Advances in Microbiology and Microbial Technology	3	0	0	3
537	BIO	NCL	BIO-NCL-3-3703	Applications in Plant Biotechnology	3	0	0	3
538	BIO	NCL	BIO-NCL-3-3704	Beyond Genomes: Concepts in comparative and functional genomics	3	0	0	3
539	BIO	NCL	BIO-NCL-3-3705	Chemistry and biology of Heterocycles	2	0	0	2
540	BIO	NCL	BIO-NCL-3-3706	Cell Signalling	3	0	0	3
541	BIO	NCL	BIO-NCL-3-3707	Introduction to Protein Misfolding Diseases	3	0	0	3
542	BIO	NCL	BIO-NCL-2-3710	Cell Structure and Membrane Protein Dynamics	2	0	0	2
543	BIO	NCL	BIO-NCL-4-0001	Project Proposal Writing	0	0	4	2
544	BIO	NCL	BIO-NCL-4-0002	Review Article Writing	0	0	4	2
545	BIO	NCL	BIO-NCL-4-0003	CSIR-800 Project Work	0	0	8	4
546	BIO	NEIST	BIO-NEIST-1-0001	Biostatistics	1	0	0	1
547	BIO	NEIST	BIO-NEIST-1-0002	Computation/bioinformatics	1	0	0	1
548	BIO	NEIST	BIO-NEIST-1-0003	Basic Chemistry	1	0	0	1
549	BIO	NEIST	BIO-NEIST-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
550	BIO	NEIST	BIO-NEIST-1-3901	Laboratory safety	1	0	0	1
551	BIO	NEIST	BIO-NEIST-2-3901	Biodiversity and Environmental Studies	1	0	0	1
552	BIO	NEIST	BIO-NEIST-2-3902	Natural resources	1	0	0	1
553	BIO	NEIST	BIO-NEIST-2-3903	Advance Plant Physiology	1	0	0	1
554	BIO	NEIST	BIO-NEIST-2-3904	Biotransformation & Bioremediation	1	0	0	1
555	BIO	NEIST	BIO-NEIST-2-3905	Molecular Biology & Biotechnology	1	0	0	1
556	BIO	NEIST	BIO-NEIST-2-3906	Pharmacokinetics,Pharmcodynamics and toxicology	1	0	0	1
557	BIO	NEIST	BIO-NEIST-2-3907	Basics of analoge drug design, preclinical and clinical design	1	0	0	1
558	BIO	NEIST	BIO-NEIST-2-3908	Plant Breeding	1	0	0	1
559	BIO	NEIST	BIO-NEIST-2-3909	Commerical Entamology	1	0	0	1
560	BIO	NEIST	BIO-NEIST-3-3901	Microbial Biotechnology	1	0	0	1
561	BIO	NEIST	BIO-NEIST-3-3902	Advances in physiological and molecular responses to abiotic stress	1	0	0	1
562	BIO	NEIST	BIO-NEIST-3-3903	Biodiversity and conservation	1	0	0	1
563	BIO	NEIST	BIO-NEIST-3-3904	Eco-restoration	1	0	0	1
564	BIO	NEIST	BIO-NEIST-3-3905	Ethnobotany and Traditional Knowledge	1	0	0	1
565	BIO	NEIST	BIO-NEIST-3-3906	Plant - Insect Interaction and Herbivore Managements	1	0	0	1
566	BIO	NEIST	BIO-NEIST-3-3907	Advances in Plant Microbes Interactions	1	0	0	1
567	BIO	NEIST	BIO-NEIST-3-3908	Advance Plant Physiology	1	0	0	1
568	BIO	NEIST	BIO-NEIST-3-3909	Insect Biotechnology	1	0	0	1
569	BIO	NEIST	BIO-NEIST-3-3910	Molecular and cell biology	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
570	BIO	NEIST	BIO-NEIST-3-3911	Molecular Markers and Breeding	1	0	0	1
571	BIO	NEIST	BIO-NEIST-3-3912	Functional Genomics	1	0	0	1
572	BIO	NEIST	BIO-NEIST-3-3913	Plant Biotechnology Management and Regulatory Issues	1	0	0	1
573	BIO	NEIST	BIO-NEIST-3-3914	Molecular and Immuno Pharmcology	1	0	0	1
574	BIO	NEIST	BIO-NEIST-3-3915	Biochemical Toxicology and free radicals pharmacology	1	0	0	1
575	BIO	NEIST	BIO-NEIST-3-3916	Sericulture and seribiotechnology	1	0	0	1
576	BIO	NEIST	BIO-NEIST-4-0001	Project Proposal Writing	0	0	4	2
577	BIO	NEIST	BIO-NEIST-4-0002	Review Article Writing	0	0	4	2
578	BIO	NEIST	BIO-NEIST-4-0003	CSIR-800 Project Work	0	0	8	4
579	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-1-0011	Basic Nutrition	3	0	2	4
580	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-1-0012	Nutritional Biochemistry	3	0	2	4
581	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-1-0013	Clinical Nutrition	3	0	2	4
582	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-1-0014	Cell Biology / Molecular cell / Tissue Biology	3	0	2	4
583	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-1-0015	Nutraceuticals and functional foods	3	0	2	4
584	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1613	Maternal Nutrition / Infant Nutrition	3	0	0	3
585	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1614	Public Health Nutrition	3	0	0	3
586	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1615	Food Microbiology	2	0	2	3
587	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1616	Health, Food and Environment	3	0	0	3
588	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1617	Dietetic Techniques and patient counselling	3	0	0	3
589	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1618	Food Safety	3	0	0	3
590	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1619	Convenience and wellness foods	3	0	0	3
591	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1620	Human physiology	3	0	0	3
592	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1621	Reproductive child health	3	0	0	3
593	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1622	Food Immunology	3	0	0	3
594	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1623	Sports Science and Nutrition	3	0	0	3
595	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1616	Nutritional Genomics/Metabolomics	2	0	2	3
596	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1617	Research Methodology	3	0	0	3
597	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1618	Food Biotechnology	3	0	0	3
598	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1619	Human Genetics	3	0	0	3
599	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1620	Metabolic /Genetic Basis of Diseases	3	0	0	3
600	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1621	Hospital organization and Personnel/Nutrition manager	3	0	0	3
601	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1622	Human ethics	3	0	0	3
602	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1623	Laboratory methods in Food and health sciences	2	0	2	3
603	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1624	Pharmacology/Toxicology/genotoxicity	2	0	2	3
604	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1625	Health Behavior and counselling	3	0	0	3
605	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1626	National/International health organizations; their role	3	0	0	3

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
606	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1627	Nutritional Psychology and its concepts	3	0	0	3
607	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1628	Bioinstrumentation; Laboratory methods in health scier	3	0	0	3
608	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1629	Genetic Engineering	3	0	0	3
609	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1630	Molecular dynamics/modelling	3	0	0	3
610	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1631	Integrated approach for food and health	3	0	0	3
611	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-4-0001	Project proposal writing	0	0	4	2
612	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-4-0002	Review Article writing	0	0	4	2
613	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-4-0003	CSIR-800 project work	0	0	8	4

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
1	BIO	IMMT	BIO-IMMT-1-0001	Biostatistics	1	0	0	1
2	BIO	IMMT	BIO-IMMT-1-0002	Computation/bioinformatics	1	0	0	1
3	BIO	IMMT	BIO-IMMT-1-0003	Basic Chemistry	1	0	0	1
4	BIO	IMMT	BIO-IMMT-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
5	BIO	IMMT	BIO-IMMT-2-3301	Biotechniques and Instrumentation	0	0	2	1
6	BIO	IMMT	BIO-IMMT-2-3302	Materials Characterization Technique	1	0	0	1
7	BIO	IMMT	BIO-IMMT-2-3303	Biology of Biology of Macromolecules	2	0	0	2
8	BIO	IMMT	BIO-IMMT-2-3304	Plant Environment Interaction	1	0	0	1
9	BIO	IMMT	BIO-IMMT-2-3305	Microbes and Environment	2	0	0	2
10	BIO	IMMT	BIO-IMMT-2-3306	*In Vitro* Development and Morphogenesis in Plants	1	0	0	1
11	BIO	IMMT	BIO-IMMT-2-3307	Biodiversity	1	0	0	1
12	BIO	IMMT	BIO-IMMT-3-3301	Seminar Course	1	0	0	1
13	BIO	IMMT	BIO-IMMT-3-3302	Biomaterials	1	0	0	1
14	BIO	IMMT	BIO-IMMT-3-3303	Genome and gene regulation	1	0	0	1
15	BIO	IMMT	BIO-IMMT-3-3304	Microbial Diversity and Habitat Ecology	1	0	0	1
16	BIO	IMMT	BIO-IMMT-3-3305	Biology & Chemistry of Natural Products	1	0	0	1
17	BIO	IMMT	BIO-IMMT-3-3306	Bioremediation	1	0	0	1
18	BIO	IMMT	BIO-IMMT-3-3307	Mineral Bioprocessing	2	0	0	2
19	BIO	IMMT	BIO-IMMT-3-3308	Taxonomy and Speciation	1	0	0	1
20	BIO	IMMT	BIO-IMMT-4-0001	Project Proposal Writing	0	0	4	2
21	BIO	IMMT	BIO-IMMT-4-0002	Review Article Writing	0	0	4	2
22	BIO	IMMT	BIO-IMMT-4-0003	CSIR-800 Project Work	0	0	8	4
23	BIO	CCMB	BIO-CCMB-1-0001	Biostatistics	1	0	0	1
24	BIO	CCMB	BIO-CCMB-1-0002	Computation/bioinformatics	1	0	0	1
25	BIO	CCMB	BIO-CCMB-1-0003	Basic Chemistry	1	0	0	1
26	BIO	CCMB	BIO-CCMB-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
27	BIO	CCMB	BIO-CCMB-2-1201	Biotechniques and Instrumentation	1	0	0	1
28	BIO	CCMB	BIO-CCMB-2-1202	Biology of Macromolecules	2	0	0	2
29	BIO	CCMB	BIO-CCMB-2-1203	Biology of Inheritance	2	0	0	2
30	BIO	CCMB	BIO-CCMB-2-1204	Biology of Infection	2	0	0	2
31	BIO	CCMB	BIO-CCMB-2-1205	Genomics: Information flow in Biological Systems	2	0	0	2
32	BIO	CCMB	BIO-CCMB-2-1206	Protein science and proteomics	2	0	0	2
33	BIO	CCMB	BIO-CCMB-2-1207	Plant-Microbe Interaction	2	0	0	2
34	BIO	CCMB	BIO-CCMB-2-1208	Epigenetics and Chromatin Organization	2	0	0	2
35	BIO	CCMB	BIO-CCMB-2-1209	Stem cells, regeneration and aging	1	0	0	1
36	BIO	CCMB	BIO-CCMB-2-1210	Self organizations in biology	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
37	BIO	CCMB	BIO-CCMB-2-1211	Cell Biology	2	0	0	2
38	BIO	CCMB	BIO-CCMB-3-1201	Seminar Course	1	0	0	1
39	BIO	CCMB	BIO-CCMB-3-1202	Nanobiology	1	0	0	1
40	BIO	CCMB	BIO-CCMB-3-1203	Brain and behaviour	1	0	0	1
41	BIO	CCMB	BIO-CCMB-3-1204	Genome organization	1	0	0	1
42	BIO	CCMB	BIO-CCMB-3-1205	NMR Micro-imaging and Spectroscopy	1	0	0	1
43	BIO	CCMB	BIO-CCMB-3-1206	Mass spectroscopy in biology	1	0	0	1
44	BIO	CCMB	BIO-CCMB-3-1207	Conservation biology	1	0	0	1
45	BIO	CCMB	BIO-CCMB-3-1208	Drug Discovery	1	0	0	1
46	BIO	CCMB	BIO-CCMB-3-1209	Immunology	1	0	0	1
47	BIO	CCMB	BIO-CCMB-3-1210	Genome Engineering	1	0	0	1
48	BIO	CCMB	BIO-CCMB-3-1211	Ecology and Evolution	1	0	0	1
49	BIO	CCMB	BIO-CCMB-3-1212	Post-translation Control	1	0	0	1
50	BIO	CCMB	BIO-CCMB-4-0001	Project Proposal Writing	0	0	4	2
51	BIO	CCMB	BIO-CCMB-4-0002	Review Article Writing	0	0	4	2
52	BIO	CCMB	BIO-CCMB-4-0003	CSIR-800 Project Work	0	0	8	4
53	BIO	CLRI	BIO-CLRI-1-0001	Biostatistics	1	0	0	1
54	BIO	CLRI	BIO-CLRI-1-0002	Computation/bioinformatics	1	0	0	1
55	BIO	CLRI	BIO-CLRI-1-0003	Basic Chemistry	1	0	0	1
56	BIO	CLRI	BIO-CLRI-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
57	BIO	CLRI	BIO-CLRI-2-2001	Biotechniques and Instrumentation	1	0	2	2
58	BIO	CLRI	BIO-CLRI-2-2002	Biomacromolecules	2	0	0	2
59	BIO	CLRI	BIO-CLRI-2-2003	Cell Signalling	2	0	0	2
60	BIO	CLRI	BIO-CLRI-2-2004	Chromatin Organisation	2	0	0	2
61	BIO	CLRI	BIO-CLRI-2-2005	Connective Tissue Biology	2	0	0	2
62	BIO	CLRI	BIO-CLRI-2-2006	Biomaterials	2	0	0	2
63	BIO	CLRI	BIO-CLRI-2-2007	Computer Aided Drug Discovery	2	0	0	2
64	BIO	CLRI	BIO-CLRI-2-2008	Biochemical Engineering Principles	2	0	0	2
65	BIO	CLRI	BIO-CLRI-2-2009	Enzyme and Fermentation Technology	2	0	0	2
66	BIO	CLRI	BIO-CLRI-2-2010	Gene Expression and Proteomics	2	0	0	2
67	BIO	CLRI	BIO-CLRI-3-2001	Seminar Course	2	0	0	2
68	BIO	CLRI	BIO-CLRI-3-2002	Nanobiology	3	0	0	3
69	BIO	CLRI	BIO-CLRI-3-2003	Industrial Microbiology and Enzymology	3	0	0	3
70	BIO	CLRI	BIO-CLRI-3-2004	Cell Death and Diseases	3	0	0	3
71	BIO	CLRI	BIO-CLRI-3-2005	Approaches to Drug Delivery	3	0	0	3
72	BIO	CLRI	BIO-CLRI-3-2006	Computational Biology	3	0	0	3

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
73	BIO	CLRI	BIO-CLRI-3-2007	Bioprocessing and Industrial Fermentations	2	0	0	2
74	BIO	CLRI	BIO-CLRI-3-2008	Cell and Tissue Engineering	2	0	0	2
75	BIO	CLRI	BIO-CLRI-3-2009	Nanomaterial Toxicology	2	0	0	2
76	BIO	CLRI	BIO-CLRI-3-2010	Byproduct Utilization	2	0	0	2
77	BIO	CLRI	BIO-CLRI-4-0001	Project proposal writing	0	0	4	2
78	BIO	CLRI	BIO-CLRI-4-0002	Review Article Writing	0	0	4	2
79	BIO	CLRI	BIO-CLRI-4-0003	CSIR-800 project work	0	0	8	4
80	BIO	IGIB	BIO-IGIB-1-0001	Biostatistics	1	0	0	1
81	BIO	IGIB	BIO-IGIB-1-0002	Computation/bioinformatics	0	0	2	1
82	BIO	IGIB	BIO-IGIB-1-0003	Basic Chemistry	1	0	0	1
83	BIO	IGIB	BIO-IGIB-1-0004	Research Methodology, Communication/ethics/safety	0	0	2	1
84	BIO	IGIB	BIO-IGIB-2-2601	Genomics: Information flow in Biological Systems	1	1	0	2
85	BIO	IGIB	BIO-IGIB-2-2602	Protein Science and Proteomics	1	1	0	2
86	BIO	IGIB	BIO-IGIB-2-2603	The host and the invaders: the eternal battle	1	1	0	2
87	BIO	IGIB	BIO-IGIB-2-2604	The nature of chemical and biological diversity	1	1	0	2
88	BIO	IGIB	BIO-IGIB-2-2605	Dynamic nature of biology	1	1	0	2
89	BIO	IGIB	BIO-IGIB-2-2606	Microbes and Environment	2	0	0	2
90	BIO	IGIB	BIO-IGIB-2-2607	Defence Mechanisms to Inflammatory Disease	2	0	0	2
91	BIO	IGIB	BIO-IGIB-2-2608	From proteins to proteomes: Principles of Protein	2	0	0	2
92	BIO	IGIB	BIO-IGIB-2-2609	Molecular and Cellular Mechanisms of Defense	2	0	0	2
93	BIO	IGIB	BIO-IGIB-3-2601	Playing with Genomes	1	0	2	2
94	BIO	IGIB	BIO-IGIB-3-2602	Complex Disease Genomics	1	1	0	2
95	BIO	IGIB	BIO-IGIB-3-2603	Death & Disease: the cellular dilemma	1	1	0	2
96	BIO	IGIB	BIO-IGIB-3-2604	The Micro-World	1	1	0	2
97	BIO	IGIB	BIO-IGIB-3-2605	Space and Time in Biological Systems	2	0	0	2
98	BIO	IGIB	BIO-IGIB-3-2606	Immortality: the everlasting quest	1	1	0	2
99	BIO	IGIB	BIO-IGIB-3-2607	Electronics for Biologists	1	0	2	2
100	BIO	IGIB	BIO-IGIB-3-2608	Molecular and Cellular Mechanisms of Defense	2	0	0	2
101	BIO	IGIB	BIO-IGIB-3-2609	Death or Immortality: the hard choice	2	0	0	2
102	BIO	IGIB	BIO-IGIB-3-2610	Basic Programming for biologists	0	0	4	2
103	BIO	IGIB	BIO-IGIB-3-2611	Formulating research problem	0	1	0	1
104	BIO	IGIB	BIO-IGIB-3-2612	Showcasing your science	0	0	2	1
105	BIO	IGIB	BIO-IGIB-3-2613	Structural Biology: Structure, Dynamics and Modeling of Biological Macromolecules	0	0	1	0.5
106	BIO	IGIB	BIO-IGIB-3-2614	Frontier areas of research in biology	1	0	0	1
107	BIO	IGIB	BIO-IGIB-3-2615	Imaging and image analysis	0	0	1	0.5

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
108	BIO	IGIB	BIO-IGIB-3-2616	Critical Analysis of Scientific Literature	0	0	2	1
109	BIO	IGIB	BIO-IGIB-3-2617	Ayurgenomics	2	0	2	2
110	BIO	IGIB	BIO-IGIB-3-2618	Genes and networks	1	0	0	1
111	BIO	IGIB	BIO-IGIB-3-2619	Disease Mechanisms: Integration of Metabolic and Cellular	1	0	0	1
112	BIO	IGIB	BIO-IGIB-4-0001	Project Proposal Writing	0	0	4	2
113	BIO	IGIB	BIO-IGIB-4-0002	Review Article Review Writing	0	0	4	2
114	BIO	IGIB	BIO-IGIB-4-0003	CSIR-800 Project Work	0	0	8	4
115	BIO	IHBT	BIO-IHBT-1-0001	Biostatistics	1	0	0	1
116	BIO	IHBT	BIO-IHBT-1-0002	Computation/bioinformatics	1	0	0	1
117	BIO	IHBT	BIO-IHBT-1-0003	Basic Chemistry	1	0	0	1
118	BIO	IHBT	BIO-IHBT-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
119	BIO	IHBT	BIO-IHBT-2-2701	Biotechniques and Instrumentation	1	0	0	1
120	BIO	IHBT	BIO-IHBT-2-2702	Biology of Macromolecules	2	0	0	2
121	BIO	IHBT	BIO-IHBT-2-2703	Biology of Inheritance	2	0	0	2
122	BIO	IHBT	BIO-IHBT-2-2704	Biology of Infection	2	0	0	2
123	BIO	IHBT	BIO-IHBT-2-2705	Genomics: Information flow in Biological Systems	2	0	0	2
124	BIO	IHBT	BIO-IHBT-2-2706	Protein Science and Proteomics	2	0	0	2
125	BIO	IHBT	BIO-IHBT-2-2707	Plant-Microbe Interaction	2	0	0	2
126	BIO	IHBT	BIO-IHBT-2-2708	Plant Environment Interaction	1	0	0	1
127	BIO	IHBT	BIO-IHBT-2-2709	Crop Protection	1	0	0	1
128	BIO	IHBT	BIO-IHBT-2-2710	Developmental Biology-Plants	1	0	0	1
129	BIO	IHBT	BIO-IHBT-2-2711	*In Vitro* Development and Morphogenesis in Plants	1	0	0	1
130	BIO	IHBT	BIO-IHBT-2-2712	Molecular Breeding of Plants	1	0	0	1
131	BIO	IHBT	BIO-IHBT-2-2713	Natural Resource Management	1	1	0	2
132	BIO	IHBT	BIO-IHBT-2-2714	Bioresources and Bioprospection	1	0	0	1
133	BIO	IHBT	BIO-IHBT-2-2715	Bioresource Production Systems	1	1	0	2
134	BIO	IHBT	BIO-IHBT-2-2716	Nutrigenomics	1	0	0	1
135	BIO	IHBT	BIO-IHBT-2-2717	Advances in protected cultivation of flower crops	1	0	0	1
136	BIO	IHBT	BIO-IHBT-2-2718	Biofertiliser Technology	1	0	0	1
137	BIO	IHBT	BIO-IHBT-3-2701	Seminar Course	1	0	0	1
138	BIO	IHBT	BIO-IHBT-3-2702	Cancer Biology	1	0	0	1
139	BIO	IHBT	BIO-IHBT-3-2703	Cell and Tissue Engineering	1	0	0	1
140	BIO	IHBT	BIO-IHBT-3-2704	Frontiers of Biology: Synthetic Biology	1	0	0	1
141	BIO	IHBT	BIO-IHBT-3-2705	Advanced Bioinformatics	2	0	0	2
142	BIO	IHBT	BIO-IHBT-3-2706	Nanobiology	1	0	0	1
143	BIO	IHBT	BIO-IHBT-3-2707	Gene Environment Interaction	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
144	BIO	IHBT	BIO-IHBT-3-2708	Microbial Diversity and Habitat Ecology	1	0	0	1
145	BIO	IHBT	BIO-IHBT-3-2709	Advances in Crop Disease Management	1	0	0	1
146	BIO	IHBT	BIO-IHBT-3-2710	Silencing, Drug Delivery Vehicle	1	0	0	1
147	BIO	IHBT	BIO-IHBT-3-2711	Dietary Supplements	1	0	0	1
148	BIO	IHBT	BIO-IHBT-3-2712	Advances in Phytogenetic Remodeling	2	0	0	2
149	BIO	IHBT	BIO-IHBT-3-2713	Special Technologies for Phytogenetic Remodeling	1	0	0	1
150	BIO	IHBT	BIO-IHBT-3-2714	Biometrical Approaches to Phytogenetic Remodeling	1	0	0	1
151	BIO	IHBT	BIO-IHBT-3-2715	Viral Pathogenesis in Plants	2	0	0	2
152	BIO	IHBT	BIO-IHBT-3-2716	Advances in protected cultivation of flower crops	1	0	0	1
153	BIO	IHBT	BIO-IHBT-3-2717	Advanced Insect Toxicology	1	0	0	1
154	BIO	IHBT	BIO-IHBT-3-2718	Epigenetics and Chromatin Organization	1	0	0	1
155	BIO	IHBT	BIO-IHBT-3-2719	Integrated Pest Management	1	0	0	1
156	BIO	IHBT	BIO-IHBT-3-2720	Crop Modelling and System Research	2	0	0	2
157	BIO	IHBT	BIO-IHBT-3-2721	Fermentation Technology	1	0	0	1
158	BIO	IHBT	BIO-IHBT-3-2722	Plant Conservation and Reproductive	1	0	0	1
159	BIO	IHBT	BIO-IHBT-3-2723	Ethnobotany and Traditional	1	0	0	1
160	BIO	IHBT	BIO-IHBT-4-0001	Project Proposal Writing	0	0	4	2
161	BIO	IHBT	BIO-IHBT-4-0002	Review Article Writing	0	0	4	2
162	BIO	IHBT	BIO-IHBT-4-0003	CSIR-800 Project Work	0	0	8	4
163	BIO	IITR	BIO-IITR-1-0001	Biostatistics	1	0	0	1
164	BIO	IITR	BIO-IITR-1-0002	Computation/Bioinformatics	1	0	0	1
165	BIO	IITR	BIO-IITR-1-0003	Basic Chemistry	1	0	0	1
166	BIO	IITR	BIO-IITR-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
167	BIO	IITR	BIO-IITR-2-3201	Biotechniques and Instrumentation	1	0	0	1
168	BIO	IITR	BIO-IITR-2-3202	Biology of Macromolecules	2	0	0	2
169	BIO	IITR	BIO-IITR-2-3203	Biology of Inheritance	1	0	0	1
170	BIO	IITR	BIO-IITR-2-3204	Xenobiotic Interaction and response	2	0	0	2
171	BIO	IITR	BIO-IITR-2-3205	Cell Signalling	2	0	0	2
172	BIO	IITR	BIO-IITR-2-3206	Intellectual Property Management	1	0	0	1
173	BIO	IITR	BIO-IITR-2-3207	Stem cells, Regeration and Aging	1	0	0	1
174	BIO	IITR	BIO-IITR-2-3208	System Immunology	2	0	0	2
175	BIO	IITR	BIO-IITR-3-3201	Seminar	1	0	0	1
176	BIO	IITR	BIO-IITR-3-3202	Bioremediation	1	0	0	1
177	BIO	IITR	BIO-IITR-3-3203	Environmental Toxicology	1	0	2	2
178	BIO	IITR	BIO-IITR-3-3204	Model systems in Toxicological Research	1	0	0	1
179	BIO	IITR	BIO-IITR-3-3205	Food & Chemical Toxicology	2	0	0	2

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
180	BIO	IITR	BIO-IITR-3-3206	Target Organ Toxicity	2	0	0	2
181	BIO	IITR	BIO-IITR-3-3207	Nanomaterial Toxicology	1	0	2	2
182	BIO	IITR	BIO-IITR-3-3208	Chemical Carcinogenesis and Chemoprevention	1	0	0	1
183	BIO	IITR	BIO-IITR-3-3209	Neurotoxicology	2	0	0	2
184	BIO	IITR	BIO-IITR-3-3210	Genes and Environmental Diseases	1	0	0	1
185	BIO	IITR	BIO-IITR-3-3211	Frontiers of Biology: Synthetic Biology	1	0	0	1
186	BIO	IITR	BIO-IITR-3-3212	Microbes in Environment & Industrial Waste Management	2	0	0	2
187	BIO	IITR	BIO-IITR-3-3213	Transgenic Technology: Principles and Applications	1	1	0	2
188	BIO	IITR	BIO-IITR-3-3214	Air Pollution and Environmental Impact Assessment	1	0	0	1
189	BIO	IITR	BIO-IITR-4-0001	Project Proposal Writing	0	0	4	2
190	BIO	IITR	BIO-IITR-4-0002	Review Article Writing	0	0	4	2
191	BIO	IITR	BIO-IITR-4-0003	CSIR-800 Project Work	0	0	8	4
192	BIO	NBRI	BIO-NBRI-1-0001	Biostatistics	1	0	0	1
193	BIO	NBRI	BIO-NBRI-1-0002	Computation/bioinformatics	1	0	0	1
194	BIO	NBRI	BIO-NBRI-1-0003	Basic Chemistry	1	0	0	1
195	BIO	NBRI	BIO-NBRI-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
196	BIO	NBRI	BIO-NBRI-2-3601	Biotechniques and Instrumentation	1	0	0	1
197	BIO	NBRI	BIO-NBRI-2-3602	Biology of Inheritance	1	0	0	1
198	BIO	NBRI	BIO-NBRI-2-3603	Genomics: Information flow in Biological Systems	1	0	0	1
199	BIO	NBRI	BIO-NBRI-2-3604	Plant-Microbe Interaction	1	0	0	1
200	BIO	NBRI	BIO-NBRI-2-3605	Plant Environment Interaction	1	0	0	1
201	BIO	NBRI	BIO-NBRI-2-3606	Cell Signaling	2	0	0	2
202	BIO	NBRI	BIO-NBRI-2-3607	Developmental Biology-Plants	1	0	0	1
203	BIO	NBRI	BIO-NBRI-2-3608	Epigenetics and Chromatin Organization	1	0	0	1
204	BIO	NBRI	BIO-NBRI-2-3609	Homeostasis and feedback in biological systems	1	0	0	1
205	BIO	NBRI	BIO-NBRI-2-3610	Molecular breeding of plants	1	0	0	1
206	BIO	NBRI	BIO-NBRI-2-3611	Biodiversity	1	0	0	1
207	BIO	NBRI	BIO-NBRI-2-3612	Plant morphogenesis and regeneration	1	0	0	1
208	BIO	NBRI	BIO-NBRI-3-3601	Seminar Course	1	0	0	1
209	BIO	NBRI	BIO-NBRI-3-3602	Cell and tissue engineering	1	0	0	1
210	BIO	NBRI	BIO-NBRI-3-3603	Climate change and Plants	1	0	0	1
211	BIO	NBRI	BIO-NBRI-3-3604	Bioremediation	1	0	0	1
212	BIO	NBRI	BIO-NBRI-3-3605	Environmental Biochem and Biotech	1	0	0	1
213	BIO	NBRI	BIO-NBRI-3-3606	Taxonomy and speciation	1	0	0	1
214	BIO	NBRI	BIO-NBRI-3-3607	Plant Conservation and Reproductive Biology	1	0	0	1
215	BIO	NBRI	BIO-NBRI-3-3608	Economic Plants and Pharmacology	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
216	BIO	NBRI	BIO-NBRI-3-3609	Floriculture and Agronomy	1	0	0	1
217	BIO	NBRI	BIO-NBRI-3-3610	Phylogenomics	1	0	0	1
218	BIO	NBRI	BIO-NBRI-3-3611	Biofuels	1	0	0	1
219	BIO	NBRI	BIO-NBRI-3-3612	Knowledgebase Research Management and it's utilization	1	0	0	1
220	BIO	NBRI	BIO-NBRI-4-0001	Project Proposal Writing	0	0	4	2
221	BIO	NBRI	BIO-NBRI-4-0002	Review Article Writing	0	0	4	2
222	BIO	NBRI	BIO-NBRI-4-0003	CSIR-800 Project Work	0	0	8	4
223	BIO	NIIST	BIO-NIIST-1-0001	Biostatistics	1	0	0	1
224	BIO	NIIST	BIO-NIIST-1-0002	Computation/bioinformatics	1	0	0	1
225	BIO	NIIST	BIO-NIIST-1-0003	Basic Chemistry	1	0	0	1
226	BIO	NIIST	BIO-NIIST-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
227	BIO	NIIST	BIO-NIIST-2-4101	Biotechniques and Instrumentation	1	0	0	1
228	BIO	NIIST	BIO-NIIST-2-4102	Protein Science and Proteomics	2	0	0	2
229	BIO	NIIST	BIO-NIIST-2-4103	Basics and Applied Microbiology	2	0	0	2
230	BIO	NIIST	BIO-NIIST-2-4104	Basic Molecular Biology	2	0	0	2
231	BIO	NIIST	BIO-NIIST-2-4105	Bioprospecting and Biochemical Pharmacology	2	0	0	2
232	BIO	NIIST	BIO-NIIST-2-4106	Fundamentals of Food processing	2	0	0	2
233	BIO	NIIST	BIO-NIIST-2-4107	Cell biology and Tissue Engineering	2	0	0	2
234	BIO	NIIST	BIO-NIIST-2-4108	Significance of Food Preservation	1	0	0	1
235	BIO	NIIST	BIO-NIIST-2-4109	Thermal Processing of Foods	1	0	0	1
236	BIO	NIIST	BIO-NIIST-2-4110	Cell Biology and Cell signalling	2	0	0	2
237	BIO	NIIST	BIO-NIIST-3-4101	Seminar course	1	0	0	1
238	BIO	NIIST	BIO-NIIST-3-4102	Introductive Bioinformatics	2	0	0	2
239	BIO	NIIST	BIO-NIIST-3-4103	Microbial Diversity and Ecology	2	0	0	2
240	BIO	NIIST	BIO-NIIST-3-4104	Bioprocess Technology	2	0	0	2
241	BIO	NIIST	BIO-NIIST-3-4105	Enzymology & Enzyme Technology	2	0	0	2
242	BIO	NIIST	BIO-NIIST-3-4106	Biodegradable polymers	2	0	0	2
243	BIO	NIIST	BIO-NIIST-3-4107	Metabolic Engineering	2	0	0	2
244	BIO	NIIST	BIO-NIIST-3-4108	Natural Product Chemistry	2	0	0	2
245	BIO	NIIST	BIO-NIIST-3-4109	Cardiovascular Disease Biology	2	0	0	2
246	BIO	NIIST	BIO-NIIST-3-4110	Molecular Biology of Diabetes	2	0	0	2
247	BIO	NIIST	BIO-NIIST-3-4111	Environmental Technology	2	0	0	2
248	BIO	NIIST	BIO-NIIST-3-4112	Biomass to fuels	2	0	0	2
249	BIO	NIIST	BIO-NIIST-3-4113	Biochemical Engineering	2	0	0	2
250	BIO	NIIST	BIO-NIIST-3-4114	Prebiotics and Probiotics	1	0	0	1
251	BIO	NIIST	BIO-NIIST-3-4115	Cancer Biology	2	0	0	2

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
252	BIO	NIIST	BIO-NIIST-3-4116	Functional Foods and nutraceuticals	2	0	0	2
253	BIO	NIIST	BIO-NIIST-3-4117	Chemistry of process induced food toxicants	1	0	0	1
254	BIO	NIIST	BIO-NIIST-4-0001	Project Proposal Writing	0	0	4	2
255	BIO	NIIST	BIO-NIIST-4-0002	Review Article Writing	0	0	4	2
256	BIO	NIIST	BIO-NIIST-4-0003	CSIR-800 Project Work	0	0	8	4
257	BIO	CSMCRI	BIO-CSMCRI-1-0001	Biostatistics	1	0	0	1
258	BIO	CSMCRI	BIO-CSMCRI-1-0002	Computation/bioinformatics	1	0	0	1
259	BIO	CSMCRI	BIO-CSMCRI-1-0003	Basic Chemistry	1	0	0	1
260	BIO	CSMCRI	BIO-CSMCRI-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
261	BIO	CSMCRI	BIO-CSMCRI-2-2501	Biotechniques and Instrumentation	1	0	0	1
262	BIO	CSMCRI	BIO-CSMCRI-2-2502	Biology of Macromolecules	2	0	0	2
263	BIO	CSMCRI	BIO-CSMCRI-2-2503	Biology of Inheritance	2	0	0	2
264	BIO	CSMCRI	BIO-CSMCRI-2-2504	Genomics: Information flow in Biological Systems	2	0	0	2
265	BIO	CSMCRI	BIO-CSMCRI-2-2505	Protein Science and Proteomics	2	0	0	2
266	BIO	CSMCRI	BIO-CSMCRI-2-2506	Plant-Microbe Interaction	2	0	0	2
267	BIO	CSMCRI	BIO-CSMCRI-2-2507	Plant Environment Interaction	1	0	0	1
268	BIO	CSMCRI	BIO-CSMCRI-2-2508	*In Vitro* Development and Morphogenesis in Plants	1	0	0	1
269	BIO	CSMCRI	BIO-CSMCRI-2-2509	Molecular Breeding of Plants	1	0	0	1
270	BIO	CSMCRI	BIO-CSMCRI-2-2510	Natural Resource Management	1	1	0	2
271	BIO	CSMCRI	BIO-CSMCRI-2-2511	Bioresource Production Systems	1	1	0	2
272	BIO	CSMCRI	BIO-CSMCRI-2-2512	Remote Sensing and its Application on Biological sciences	1	0	0	1
273	BIO	CSMCRI	BIO-CSMCRI-3-2501	Seminar Course	1	0	0	1
274	BIO	CSMCRI	BIO-CSMCRI-3-2502	Advanced Bioinformatics	2	0	0	2
275	BIO	CSMCRI	BIO-CSMCRI-3-2503	Gene Environment Interaction	1	0	0	1
276	BIO	CSMCRI	BIO-CSMCRI-3-2504	Advances in Gene Silencing and Epigenetics	1	0	0	1
277	BIO	CSMCRI	BIO-CSMCRI-3-2505	Microbial Diversity and Habitat Ecology	1	0	0	1
278	BIO	CSMCRI	BIO-CSMCRI-3-2506	Integrated Pest Management	1	0	0	1
279	BIO	CSMCRI	BIO-CSMCRI-3-2507	manipulation	2	0	0	2
280	BIO	CSMCRI	BIO-CSMCRI-3-2508	Biology of marine macroalgae	2	0	0	2
281	BIO	CSMCRI	BIO-CSMCRI-3-2509	Wasteland biology and reclamation	2	0	0	2
282	BIO	CSMCRI	BIO-CSMCRI-4-0001	Project Proposal Writing	0	0	4	2
283	BIO	CSMCRI	BIO-CSMCRI-4-0002	Review Article Writing	0	0	4	2
284	BIO	CSMCRI	BIO-CSMCRI-4-0003	CSIR-800 Project Work	0	0	8	4
285	BIO	CDRI	BIO-CDRI-1-0001	Biostatistics	1	0	0	1
286	BIO	CDRI	BIO-CDRI-1-0002	Computation/bioinformatics	1	0	0	1
287	BIO	CDRI	BIO-CDRI-1-0003	Basic Chemistry	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
288	BIO	CDRI	BIO-CDRI-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
289	BIO	CDRI	BIO-CDRI-2-1301	Biotechniques and Instrumentation	1	1	2	3
290	BIO	CDRI	BIO-CDRI-2-1302	Biology of Macromolecules	2	0	0	2
291	BIO	CDRI	BIO-CDRI-2-1303	Biology of Infection	2	0	0	2
292	BIO	CDRI	BIO-CDRI-2-1304	Protein Science and Proteomics	2	0	0	2
293	BIO	CDRI	BIO-CDRI-2-1305	Xenobiotic Interaction and Response	2	0	0	2
294	BIO	CDRI	BIO-CDRI-2-1306	Molecular Therapeutics	2	0	0	2
295	BIO	CDRI	BIO-CDRI-2-1307	Cell Signaling	2	0	0	2
296	BIO	CDRI	BIO-CDRI-2-1308	Chemical Biology	1	0	0	1
297	BIO	CDRI	BIO-CDRI-2-1309	Epigenetics and Chromatin Organization	2	0	0	2
298	BIO	CDRI	BIO-CDRI-2-1310	Homeostasis and feedback in biological systems	1	0	0	1
299	BIO	CDRI	BIO-CDRI-2-1311	Molecular and Cellular Mechanisms of Defence	1	0	0	1
300	BIO	CDRI	BIO-CDRI-2-1312	Dosage Form Design	1	0	0	1
301	BIO	CDRI	BIO-CDRI-3-1301	Seminar Course (compulsory)	1	0	0	1
302	BIO	CDRI	BIO-CDRI-3-1303	Microbial Pathogenesis	2	0	0	2
303	BIO	CDRI	BIO-CDRI-3-1304	Neurobiology	2	0	0	2
304	BIO	CDRI	BIO-CDRI-3-1305	Transcription and Gene Regulation	1	0	0	1
305	BIO	CDRI	BIO-CDRI-3-1306	Biol and Therapeutics of Life Style Disorders	2	0	0	2
306	BIO	CDRI	BIO-CDRI-3-1307	Animal Models in Biomedical Research	1	0	0	1
307	BIO	CDRI	BIO-CDRI-3-1308	Pharmacokinetics and metabolism	1	0	0	1
308	BIO	CDRI	BIO-CDRI-3-1309	Approaches to Drug Delivery	2	0	0	2
309	BIO	CDRI	BIO-CDRI-3-1310	An Intro to Drug Discovery & Development	2	0	0	2
310	BIO	CDRI	BIO-CDRI-3-1302	Cancer Biology	2	0	0	2
311	BIO	CDRI	BIO-CDRI-2-1313	Plant Taxonomy, biodiversity,conservation, ethnobotany and Pharmacognosy	2	0	0	2
312	BIO	CDRI	BIO-CDRI-3-1311	Plant secondary metabolites and their in vitro biosynthesis through plant tissue culture	2	0	0	2
313	BIO	CDRI	BIO-CDRI-4-0001	Project Proposal Writing	0	0	4	2
314	BIO	CDRI	BIO-CDRI-4-0002	Review Article Writing	0	0	4	2
315	BIO	CDRI	BIO-CDRI-4-0003	CSIR-800 Project Work	0	0	8	4
316	BIO	CECRI	BIO-CECRI-1-0001	Biostatistics	1	0	0	1
317	BIO	CECRI	BIO-CECRI-1-0002	Computation/bioinformatics	1	0	0	1
318	BIO	CECRI	BIO-CECRI-1-0003	Basic Chemistry	1	0	0	1
319	BIO	CECRI	BIO-CECRI-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
320	BIO	CECRI	BIO-CECRI-1-1401	Basics Mathematics & Numerical Methods	1	0	0	1
321	BIO	CECRI	BIO-CECRI-1-1402	Introduction to Chemical Biology	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
322	BIO	CECRI	BIO-CECRI-2-1401	Advanced Materials Characterization Techniques	2	0	0	2
323	BIO	CECRI	BIO-CECRI-2-1402	Environmental Biotechnology & Microbiology	2	0	0	2
324	BIO	CECRI	BIO-CECRI-2-1403	Biology of Macro molecules	2	0	0	2
325	BIO	CECRI	BIO-CECRI-2-1404	Biotechniques & Instrumentation	2	0	0	2
326	BIO	CECRI	BIO-CECRI-2-1405	Water & waste water treatment	2	0	0	2
327	BIO	CECRI	BIO-CECRI-2-1406	Fundamentals of Electrochemistry & Corrosion	2	0	0	2
328	BIO	CECRI	BIO-CECRI-2-1407	Advanced Surface Science	2	0	0	2
329	BIO	CECRI	BIO-CECRI-3-1401	Industrial & Applied Microbiology	2	0	0	2
330	BIO	CECRI	BIO-CECRI-3-1402	Bioremediation	2	0	0	2
331	BIO	CECRI	BIO-CECRI-3-1403	Advanced Treatments system	2	0	0	2
332	BIO	CECRI	BIO-CECRI-3-1404	Advanced Biochemical Engineering	2	0	0	2
333	BIO	CECRI	BIO-CECRI-3-1405	Electrochemical Power Sources	2	0	0	2
334	BIO	CECRI	BIO-CECRI-3-1406	Nano Biotechnology	2	0	0	2
335	BIO	CECRI	BIO-CECRI-3-1407	Functional Materials	2	0	0	2
336	BIO	CECRI	BIO-CECRI-3-1408	Electrochemical remediation	2	0	0	2
337	BIO	CECRI	BIO-CECRI-4-0001	Project Proposal Writing	0	0	4	2
338	BIO	CECRI	BIO-CECRI-4-0002	Review Article Writing	0	0	4	2
339	BIO	CECRI	BIO-CECRI-4-0003	CSIR-800 Project Work	0	0	8	4
340	BIO	CFTRI	BIO-CFTRI-1-0001	Biostatistics	1	0	0	1
341	BIO	CFTRI	BIO-CFTRI-1-0002	Computation/bioinformatics	1	0	0	1
342	BIO	CFTRI	BIO-CFTRI-1-0003	Basic Chemistry	1	0	0	1
343	BIO	CFTRI	BIO-CFTRI-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
344	BIO	CFTRI	BIO-CFTRI-2-1601	Instrumental Techniques	1	0	0	1
345	BIO	CFTRI	BIO-CFTRI-2-1602	Basics of Food Microbiology	1	0	0	1
346	BIO	CFTRI	BIO-CFTRI-2-1603	Significance of Food Preservation	1	0	0	1
347	BIO	CFTRI	BIO-CFTRI-2-1604	Thermal Processing of Foods	1	0	0	1
348	BIO	CFTRI	BIO-CFTRI-2-1605	Canning of Foods	1	0	0	1
349	BIO	CFTRI	BIO-CFTRI-2-1606	Controlled and Modified Atmosphere Storage of Foods	1	0	0	1
350	BIO	CFTRI	BIO-CFTRI-2-1607	Functional Preservatives	1	0	0	1
351	BIO	CFTRI	BIO-CFTRI-2-1608	Hurdle Technology	1	0	0	1
352	BIO	CFTRI	BIO-CFTRI-2-1609	Infestation Control and Grain Storage	1	0	0	1
353	BIO	CFTRI	BIO-CFTRI-2-1610	Animal Products Technology	1	0	0	1
354	BIO	CFTRI	BIO-CFTRI-2-1611	Spices and Plantation Products	1	0	0	1
355	BIO	CFTRI	BIO-CFTRI-2-1612	Microbial Fermentations	1	0	0	1
356	BIO	CFTRI	BIO-CFTRI-3-1601	Seminar courses	1	0	0	1
357	BIO	CFTRI	BIO-CFTRI-3-1602	Technology of Cereals and Pulses	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
358	BIO	CFTRI	BIO-CFTRI-3-1603	Technology of Fruits and Vegetables	1	0	0	1
359	BIO	CFTRI	BIO-CFTRI-3-1604	Food Biotechnology	1	0	0	1
360	BIO	CFTRI	BIO-CFTRI-3-1605	Functional Foods	1	0	0	1
361	BIO	CFTRI	BIO-CFTRI-3-1606	Nutraceuticals	1	0	0	1
362	BIO	CFTRI	BIO-CFTRI-3-1607	Dietary Supplements	1	0	0	1
363	BIO	CFTRI	BIO-CFTRI-3-1608	Convenience and Wellness Foods	1	0	0	1
364	BIO	CFTRI	BIO-CFTRI-3-1609	Prebiotics and Probiotics	1	0	0	1
365	BIO	CFTRI	BIO-CFTRI-3-1610	Fermented Foods and Beverages	1	0	0	1
366	BIO	CFTRI	BIO-CFTRI-3-1611	Sensory Profiling of Foods	1	0	0	1
367	BIO	CFTRI	BIO-CFTRI-3-1612	Microbial Kinetics	1	0	0	1
368	BIO	CFTRI	BIO-CFTRI-3-1613	Food Safety	1	0	0	1
369	BIO	CFTRI	BIO-CFTRI-3-1614	Food Based Nutritional Significance	1	0	0	1
370	BIO	CFTRI	BIO-CFTRI-3-1615	Food Chain Establishment	1	0	0	1
371	BIO	CFTRI	BIO-CFTRI-4-0001	Project proposal writing	0	0	4	2
372	BIO	CFTRI	BIO-CFTRI-4-0002	Review Article writing	0	0	4	2
373	BIO	CFTRI	BIO-CFTRI-4-0003	CSIR-800 project work	0	0	8	4
374	BIO	CIMAP	BIO-CIMAP-1-0001	Biostatistics	1	0	0	1
375	BIO	CIMAP	BIO-CIMAP-1-0002	Computation/bioinformatics	1	0	0	1
376	BIO	CIMAP	BIO-CIMAP-1-0003	Basic Chemistry	1	0	0	1
377	BIO	CIMAP	BIO-CIMAP-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
378	BIO	CIMAP	BIO-CIMAP-2-1801	Biotechniques and Instrumentation	1	0	0	1
379	BIO	CIMAP	BIO-CIMAP-2-1802	Biology of Macromolecules	2	0	0	2
380	BIO	CIMAP	BIO-CIMAP-2-1803	Biology of Inheritance	2	0	0	2
381	BIO	CIMAP	BIO-CIMAP-2-1804	Biology of Infection	1	0	0	1
382	BIO	CIMAP	BIO-CIMAP-2-1805	Genomics: Information flow in Biological Systems	2	0	0	2
383	BIO	CIMAP	BIO-CIMAP-2-1806	Protein Science and Proteomics	2	0	0	2
384	BIO	CIMAP	BIO-CIMAP-2-1807	Systems Biology	1	0	0	1
385	BIO	CIMAP	BIO-CIMAP-2-1808	Xenobiotic Interaction and Response	1	0	0	1
386	BIO	CIMAP	BIO-CIMAP-2-1809	Plant-Microbe Interaction	2	0	0	2
387	BIO	CIMAP	BIO-CIMAP-2-1810	Plant Environment Interaction	1	0	0	1
388	BIO	CIMAP	BIO-CIMAP-2-1811	Molecular Therapeutics	1	0	0	1
389	BIO	CIMAP	BIO-CIMAP-2-1812	Crop Protection	1	0	0	1
390	BIO	CIMAP	BIO-CIMAP-2-1813	Developmental Biology-Plants	1	0	0	1
391	BIO	CIMAP	BIO-CIMAP-2-1814	Epigenetics and Chromatin Organization	2	0	0	2
392	BIO	CIMAP	BIO-CIMAP-2-1815	Molecular Breeding of Plants	1	0	0	1
393	BIO	CIMAP	BIO-CIMAP-2-1816	Bioresources and Bioprospection	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
394	BIO	CIMAP	BIO-CIMAP-2-1817	Crop Production Systems	2	0	0	2
395	BIO	CIMAP	BIO-CIMAP-2-1818	Intellectual Property Management	1	0	0	1
396	BIO	CIMAP	BIO-CIMAP-2-1819	Plant/Cell/Tissue/ Organ Culture	2	0	0	2
397	BIO	CIMAP	BIO-CIMAP-2-1820	Crop Modelling and System Research	2	0	0	2
398	BIO	CIMAP	BIO-CIMAP-3-1801	Seminar Course	1	0	0	1
399	BIO	CIMAP	BIO-CIMAP-3-1802	Cell and Tissue Engineering	1	0	0	1
400	BIO	CIMAP	BIO-CIMAP-3-1803	Frontiers of Biology: Synthetic Biology	1	0	0	1
401	BIO	CIMAP	BIO-CIMAP-3-1804	Advanced Bioinformatics	2	0	0	2
402	BIO	CIMAP	BIO-CIMAP-3-1805	Gene Environment Interaction	1	0	0	1
403	BIO	CIMAP	BIO-CIMAP-3-1806	Advances in Gene Silencing	1	0	0	1
404	BIO	CIMAP	BIO-CIMAP-3-1807	Advances in Crop Disease Management	1	0	0	1
405	BIO	CIMAP	BIO-CIMAP-3-1808	Integrated Pest Management	1	0	0	1
406	BIO	CIMAP	BIO-CIMAP-3-1809	Anti microbial agents and drug resistance	1	0	0	1
407	BIO	CIMAP	BIO-CIMAP-3-1810	Drug delivery and Pharmaceutical formulations	1	0	0	1
408	BIO	CIMAP	BIO-CIMAP-3-1811	biotransformation	1	0	0	1
409	BIO	CIMAP	BIO-CIMAP-3-1812	Plant Pathogenesis	2	0	0	2
410	BIO	CIMAP	BIO-CIMAP-3-1813	Biology & Chemistry of Natural Products	2	0	0	2
411	BIO	CIMAP	BIO-CIMAP-3-1814	Biology of inflammation and diseases	1	0	0	1
412	BIO	CIMAP	BIO-CIMAP-3-1815	Soil and crop management	2	0	2	3
413	BIO	CIMAP	BIO-CIMAP-4-0001	Project Proposal Writing	0	0	4	2
414	BIO	CIMAP	BIO-CIMAP-4-0002	Review Article Writing	0	0	4	2
415	BIO	CIMAP	BIO-CIMAP-4-0003	CSIR-800 Project Work	0	0	8	4
416	BIO	IICB	BIO-IICB-1-0001	Biostatistics	1	0	0	1
417	BIO	IICB	BIO-IICB-1-0002	Computation/bioinformatics	1	0	0	1
418	BIO	IICB	BIO-IICB-1-0003	Basic Chemistry	1	0	0	1
419	BIO	IICB	BIO-IICB-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
420	BIO	IICB	BIO-IICB-2-2801	Biotechniques and Instrumentation	2	0	0	2
421	BIO	IICB	BIO-IICB-2-2802	Biology of Macromolecules	2	0	0	2
422	BIO	IICB	BIO-IICB-2-2803	Biology of Infection	2	0	0	2
423	BIO	IICB	BIO-IICB-2-2804	Protein Science and Proteomics	2	0	0	2
424	BIO	IICB	BIO-IICB-2-2805	Cell Biology and Cell signaling	2	0	0	2
425	BIO	IICB	BIO-IICB-2-2806	Bioinformatics	2	0	0	2
426	BIO	IICB	BIO-IICB-2-2807	Molecular and Cellular Immunology	2	0	0	2
427	BIO	IICB	BIO-IICB-3-2801	Seminar and Critical Appraisal	1	0	0	1
428	BIO	IICB	BIO-IICB-3-2802	Cancer Biology	2	0	0	2
429	BIO	IICB	BIO-IICB-3-2803	Cell and Tissue Engineering	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
430	BIO	IICB	BIO-IICB-3-2804	Microbial pathogenesis	1	0	0	1
431	BIO	IICB	BIO-IICB-3-2805	Neurobiology	2	0	0	2
432	BIO	IICB	BIO-IICB-3-2806	Genomics	2	0	0	2
433	BIO	IICB	BIO-IICB-3-2807	Eukaryotic Gene Regulatory Mechanisms	2	0	0	2
434	BIO	IICB	BIO-IICB-3-2808	Chemical Biology	1	0	0	1
435	BIO	IICB	BIO-IICB-3-2809	Synthetic & Systems Biology	2	0	0	2
436	BIO	IICB	BIO-IICB-3-2810	Biology	2	0	0	2
437	BIO	IICB	BIO-IICB-3-2811	Modern Drug Discovery & Design	2	0	0	2
438	BIO	IICB	BIO-IICB-4-0001	Project Proposal Writing	0	0	4	2
439	BIO	IICB	BIO-IICB-4-0002	Review Article Writing	0	0	4	2
440	BIO	IICB	BIO-IICB-4-0003	CSIR-800 Project Work	0	0	8	4
441	BIO	IICT	BIO-IICT-1-0001	Biostatistics	1	0	0	1
442	BIO	IICT	BIO-IICT-1-0002	Computation/bioinformatics	1	0	0	1
443	BIO	IICT	BIO-IICT-1-0003	Basic Chemistry	1	0	0	1
444	BIO	IICT	BIO-IICT-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
445	BIO	IICT	BIO-IICT-2-2901	Biotechniques & Instrumentation	1	0	0	1
446	BIO	IICT	BIO-IICT-2-2902	Chemical Biology	2	0	0	2
447	BIO	IICT	BIO-IICT-2-2903	Crop Protection	1	0	0	1
448	BIO	IICT	BIO-IICT-2-2904	Techniques for identifying newer pesticide molecules	1	0	0	1
449	BIO	IICT	BIO-IICT-2-2905	Techniques for identifying newer drug molecules	1	0	0	1
450	BIO	IICT	BIO-IICT-2-2906	proteomics and its application	1	0	0	1
451	BIO	IICT	BIO-IICT-2-2907	Principles of Pharmacology and Toxicology	1	0	0	1
452	BIO	IICT	BIO-IICT-2-2908	Environmental and Microbial Technology	1	0	0	1
453	BIO	IICT	BIO-IICT-3-2901	Seminar course	1	0	0	1
454	BIO	IICT	BIO-IICT-3-2902	Nanobiology	1	0	0	1
455	BIO	IICT	BIO-IICT-3-2903	Environmental Toxicology	1	0	0	1
456	BIO	IICT	BIO-IICT-3-2904	Advanced Pharmacology	2	0	0	2
457	BIO	IICT	BIO-IICT-3-2905	Disease Mechanisms	2	0	0	2
458	BIO	IICT	BIO-IICT-3-2906	Industrial /Applied Microbiology	1	0	0	1
459	BIO	IICT	BIO-IICT-3-2907	Protein Science and structural based drug design and development	1	0	0	1
460	BIO	IICT	BIO-IICT-4-0001	Project Proposal Writing	0	0	4	2
461	BIO	IICT	BIO-IICT-4-0002	Review Article Writing	0	0	4	2
462	BIO	IICT	BIO-IICT-4-0003	CSIR-800 Project Work	0	0	8	4
463	BIO	IIIM	BIO-IIIM-1-0001	Biostatistics	1	0	0	1
464	BIO	IIIM	BIO-IIIM-1-0002	Computation/bioinformatics	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
465	BIO	IIIM	BIO-IIIM-1-0003	Basic Chemistry	1	0	0	1
466	BIO	IIIM	BIO-IIIM-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
467	BIO	IIIM	BIO-IIIM-2-3001	Pharmacology	2	0	4	2
468	BIO	IIIM	BIO-IIIM-2-3002	Cancer Biology	1	0	0	1
469	BIO	IIIM	BIO-IIIM-2-3003	Stem Cell Biology and Regenerative Medicine	1	0	0	1
470	BIO	IIIM	BIO-IIIM-2-3004	Applications	2	0	4	2
471	BIO	IIIM	BIO-IIIM-2-3005	Introductory Plant Biology	2	0	4	2
472	BIO	IIIM	BIO-IIIM-2-3006	Basic Microbiology and Microbial Metabolism	2	0	4	2
473	BIO	IIIM	BIO-IIIM-2-3007	Basic Biology for interdisciplinary Sciences	1	0	0	1
474	BIO	IIIM	BIO-IIIM-3-3001	Molecular Cell Biology	1	0	0	1
475	BIO	IIIM	BIO-IIIM-3-3002	Formulation, Drug Delivery and Pharmacokinetics	1	0	0	1
476	BIO	IIIM	BIO-IIIM-3-3003	Neuropharmacology and Neuro-degenerative diseases	1	0	0	1
477	BIO	IIIM	BIO-IIIM-3-3004	Toxicology and Applied Pharmacology	1	0	0	1
478	BIO	IIIM	BIO-IIIM-3-3005	Infectious Diseases	1	0	0	1
479	BIO	IIIM	BIO-IIIM-3-3006	Biodiversity and Taxonomy	1	0	0	1
480	BIO	IIIM	BIO-IIIM-3-3007	Molecular biology of plant secondary metabolism	2	0	0	2
481	BIO	IIIM	BIO-IIIM-3-3008	In Vitro cellular and developmental biology of Plants	1	0	0	1
482	BIO	IIIM	BIO-IIIM-3-3009	Plant Functioning	1	0	0	1
483	BIO	IIIM	BIO-IIIM-3-3010	Techniques in plant molecular biology and biochemistry	1	0	0	1
484	BIO	IIIM	BIO-IIIM-3-3011	Medicinal and Aromatic Plants and Pharmacognosy	2	0	0	2
485	BIO	IIIM	BIO-IIIM-3-3012	Microbial Genetics and Enzyme Technology	2	0	0	2
486	BIO	IIIM	BIO-IIIM-3-3013	Plant-Microbe interaction	2	0	0	2
487	BIO	IIIM	BIO-IIIM-4-0001	Project Proposal Writing	0	0	4	2
488	BIO	IIIM	BIO-IIIM-4-0002	Review Article Writing	0	0	4	2
489	BIO	IIIM	BIO-IIIM-4-0003	CSIR-800 Project Work	0	0	8	4
490	BIO	IMT	BIO-IMT-1-0001	Biostatistics	1	0	0	1
491	BIO	IMT	BIO-IMT-1-0002	Computation/bioinformatics	1	0	0	1
492	BIO	IMT	BIO-IMT-1-0003	Basic Chemistry	1	0	0	1
493	BIO	IMT	BIO-IMT-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
494	BIO	IMT	BIO-IMT-2-3401	Biotechniques and Instrumentation	1	0	0	1
495	BIO	IMT	BIO-IMT-2-3402	Biology of Macromolecules	2	0	0	2
496	BIO	IMT	BIO-IMT-2-3403	Biology of inheritance	2	0	0	2
497	BIO	IMT	BIO-IMT-2-3404	Biology of infection	2	0	0	2
498	BIO	IMT	BIO-IMT-2-3405	Genomics: Information flow in Biological Systems	2	0	0	2
499	BIO	IMT	BIO-IMT-2-3406	Protein Science and Proteomics	2	0	0	2
500	BIO	IMT	BIO-IMT-2-3407	Systems Biology	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
501	BIO	IMT	BIO-IMT-2-3408	Cell Signaling	2	0	0	2
502	BIO	IMT	BIO-IMT-2-3409	Chemical Biology	1	0	0	1
503	BIO	IMT	BIO-IMT-2-3410	Molecular and Cellular Mechanisms of Defence	2	0	0	2
504	BIO	IMT	BIO-IMT-2-3411	Biodiversity	1	0	0	1
505	BIO	IMT	BIO-IMT-2-3412	Bioinformatics	2	0	0	2
506	BIO	IMT	BIO-IMT-2-3413	Biochemical Engineering	1	0	0	1
507	BIO	IMT	BIO-IMT-3-3401	Seminar Course	1	0	0	1
508	BIO	IMT	BIO-IMT-3-3402	Frontiers of Biology: Synthetic Biology	1	0	0	1
509	BIO	IMT	BIO-IMT-3-3403	Advanced Bioinformatics	2	0	0	2
510	BIO	IMT	BIO-IMT-3-3404	Mycobacterium tuberculosis	2	0	0	2
511	BIO	IMT	BIO-IMT-3-3405	Metagenomics	1	0	0	1
512	BIO	IMT	BIO-IMT-3-3406	Advanced Biochemical Engineering	2	0	0	2
513	BIO	IMT	BIO-IMT-4-0001	Project Proposal Writing	0	0	4	2
514	BIO	IMT	BIO-IMT-4-0002	Review Article Writing	0	0	4	2
515	BIO	IMT	BIO-IMT-4-0003	CSIR-800 Project Work	0	0	8	4
516	BIO	NCL	BIO-NCL-1-0001	Biostatistics	1	0	0	1
517	BIO	NCL	BIO-NCL-1-0002	Computation/bioinformatics	1	0	0	1
518	BIO	NCL	BIO-NCL-1-0003	Basic Chemistry	1	0	0	1
519	BIO	NCL	BIO-NCL-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
520	BIO	NCL	BIO-NCL-1-3701	Analytical Tools and Instrumentation	2	0	0	2
521	BIO	NCL	BIO-NCL-1-3702	Basic mathematics and numerical methods	2	0	0	2
522	BIO	NCL	BIO-NCL-1-3703	Basic Chemistry for Interdisciplinary sciences	1	0	0	1
523	BIO	NCL	BIO-NCL-1-3704	Introduction to Nanoscience and Nanotechnology	1	0	0	1
524	BIO	NCL	BIO-NCL-1-3705	Introduction to Chemical Biology	1	0	0	1
525	BIO	NCL	BIO-NCL-1-3706	Basic techniques in biology	1	0	0	1
526	BIO	NCL	BIO-NCL-2-3701	Advanced Techniques in Biology	3	0	0	3
527	BIO	NCL	BIO-NCL-2-3702	Introduction to infectious diseases	2	0	0	2
528	BIO	NCL	BIO-NCL-2-3703	Mathematics and statistics for biologists	2	0	0	2
529	BIO	NCL	BIO-NCL-2-3704	Structure determination and analysis of biomolecules	2	0	0	2
530	BIO	NCL	BIO-NCL-2-3705	Concepts in Microbiology	3	0	0	3
531	BIO	NCL	BIO-NCL-2-3706	Concepts in Plant Biotechnology	2	0	0	2
532	BIO	NCL	BIO-NCL-2-3707	Advances in Nanoscience and Nanotechnology	3	0	0	3
533	BIO	NCL	BIO-NCL-2-3708	Advances in Chemical Biology	3	0	0	3
534	BIO	NCL	BIO-NCL-2-3709	Advanced Biomaterials	3	0	0	3
535	BIO	NCL	BIO-NCL-3-3701	Molecular recognition and molecular interactions in structural biology	3	0	0	3

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
536	BIO	NCL	BIO-NCL-3-3702	Advances in Microbiology and Microbial Technology	3	0	0	3
537	BIO	NCL	BIO-NCL-3-3703	Applications in Plant Biotechnology	3	0	0	3
538	BIO	NCL	BIO-NCL-3-3704	Beyond Genomes: Concepts in comparative and functional genomics	3	0	0	3
539	BIO	NCL	BIO-NCL-3-3705	Chemistry and biology of Heterocycles	2	0	0	2
540	BIO	NCL	BIO-NCL-3-3706	Cell Signalling	3	0	0	3
541	BIO	NCL	BIO-NCL-3-3707	Introduction to Protein Misfolding Diseases	3	0	0	3
542	BIO	NCL	BIO-NCL-2-3710	Cell Structure and Membrane Protein Dynamics	2	0	0	2
543	BIO	NCL	BIO-NCL-4-0001	Project Proposal Writing	0	0	4	2
544	BIO	NCL	BIO-NCL-4-0002	Review Article Writing	0	0	4	2
545	BIO	NCL	BIO-NCL-4-0003	CSIR-800 Project Work	0	0	8	4
546	BIO	NEIST	BIO-NEIST-1-0001	Biostatistics	1	0	0	1
547	BIO	NEIST	BIO-NEIST-1-0002	Computation/bioinformatics	1	0	0	1
548	BIO	NEIST	BIO-NEIST-1-0003	Basic Chemistry	1	0	0	1
549	BIO	NEIST	BIO-NEIST-1-0004	Research Methodology, Communication/ethics/safety	1	0	0	1
550	BIO	NEIST	BIO-NEIST-1-3901	Laboratory safety	1	0	0	1
551	BIO	NEIST	BIO-NEIST-2-3901	Biodiversity and Environmental Studies	1	0	0	1
552	BIO	NEIST	BIO-NEIST-2-3902	Natural resources	1	0	0	1
553	BIO	NEIST	BIO-NEIST-2-3903	Advance Plant Physiology	1	0	0	1
554	BIO	NEIST	BIO-NEIST-2-3904	Biotransformation & Bioremediation	1	0	0	1
555	BIO	NEIST	BIO-NEIST-2-3905	Molecular Biology & Biotechnology	1	0	0	1
556	BIO	NEIST	BIO-NEIST-2-3906	Pharmacokinetics,Pharmcodynamics and toxicology	1	0	0	1
557	BIO	NEIST	BIO-NEIST-2-3907	Basics of analoge drug design, preclinical and clinical design	1	0	0	1
558	BIO	NEIST	BIO-NEIST-2-3908	Plant Breeding	1	0	0	1
559	BIO	NEIST	BIO-NEIST-2-3909	Commerical Entamology	1	0	0	1
560	BIO	NEIST	BIO-NEIST-3-3901	Microbial Biotechnology	1	0	0	1
561	BIO	NEIST	BIO-NEIST-3-3902	Advances in physiological and molecular responses to abiotic stress	1	0	0	1
562	BIO	NEIST	BIO-NEIST-3-3903	Biodiversity and conservation	1	0	0	1
563	BIO	NEIST	BIO-NEIST-3-3904	Eco-restoration	1	0	0	1
564	BIO	NEIST	BIO-NEIST-3-3905	Ethnobotany and Traditional Knowledge	1	0	0	1
565	BIO	NEIST	BIO-NEIST-3-3906	Plant - Insect Interaction and Herbivore Managements	1	0	0	1
566	BIO	NEIST	BIO-NEIST-3-3907	Advances in Plant Microbes Interactions	1	0	0	1
567	BIO	NEIST	BIO-NEIST-3-3908	Advance Plant Physiology	1	0	0	1
568	BIO	NEIST	BIO-NEIST-3-3909	Insect Biotechnology	1	0	0	1
569	BIO	NEIST	BIO-NEIST-3-3910	Molecular and cell biology	1	0	0	1

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
570	BIO	NEIST	BIO-NEIST-3-3911	Molecular Markers and Breeding	1	0	0	1
571	BIO	NEIST	BIO-NEIST-3-3912	Functional Genomics	1	0	0	1
572	BIO	NEIST	BIO-NEIST-3-3913	Plant Biotechnology Management and Regulatory Issues	1	0	0	1
573	BIO	NEIST	BIO-NEIST-3-3914	Molecular and Immuno Pharmcology	1	0	0	1
574	BIO	NEIST	BIO-NEIST-3-3915	Biochemical Toxicology and free radicals pharmacology	1	0	0	1
575	BIO	NEIST	BIO-NEIST-3-3916	Sericulture and seribiotechnology	1	0	0	1
576	BIO	NEIST	BIO-NEIST-4-0001	Project Proposal Writing	0	0	4	2
577	BIO	NEIST	BIO-NEIST-4-0002	Review Article Writing	0	0	4	2
578	BIO	NEIST	BIO-NEIST-4-0003	CSIR-800 Project Work	0	0	8	4
579	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-1-0011	Basic Nutrition	3	0	2	4
580	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-1-0012	Nutritional Biochemistry	3	0	2	4
581	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-1-0013	Clinical Nutrition	3	0	2	4
582	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-1-0014	Cell Biology / Molecular cell / Tissue Biology	3	0	2	4
583	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-1-0015	Nutraceuticals and functional foods	3	0	2	4
584	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1613	Maternal Nutrition / Infant Nutrition	3	0	0	3
585	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1614	Public Health Nutrition	3	0	0	3
586	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1615	Food Microbiology	2	0	2	3
587	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1616	Health, Food and Environment	3	0	0	3
588	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1617	Dietetic Techniques and patient counselling	3	0	0	3
589	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1618	Food Safety	3	0	0	3
590	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1619	Convenience and wellness foods	3	0	0	3
591	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1620	Human physiology	3	0	0	3
592	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1621	Reproductive child health	3	0	0	3
593	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1622	Food Immunology	3	0	0	3
594	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-2-1623	Sports Science and Nutrition	3	0	0	3
595	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1616	Nutritional Genomics/Metabolomics	2	0	2	3
596	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1617	Research Methodology	3	0	0	3
597	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1618	Food Biotechnology	3	0	0	3
598	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1619	Human Genetics	3	0	0	3
599	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1620	Metabolic /Genetic Basis of Diseases	3	0	0	3
600	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1621	Hospital organization and Personnel/Nutrition manager	3	0	0	3
601	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1622	Human ethics	3	0	0	3
602	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1623	Laboratory methods in Food and health sciences	2	0	2	3
603	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1624	Pharmacology/Toxicology/genotoxicity	2	0	2	3
604	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1625	Health Behavior and counselling	3	0	0	3
605	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1626	National/International health organizations; their role	3	0	0	3

S.NO.	Faculty	Lab Name	Course Nomenclature	Course Name	L	T	P	C
606	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1627	Nutritional Psychology and its concepts	3	0	0	3
607	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1628	Bioinstrumentation; Laboratory methods in health scier	3	0	0	3
608	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1629	Genetic Engineering	3	0	0	3
609	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1630	Molecular dynamics/modelling	3	0	0	3
610	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-3-1631	Integrated approach for food and health	3	0	0	3
611	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-4-0001	Project proposal writing	0	0	4	2
612	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-4-0002	Review Article writing	0	0	4	2
613	BIO	CFTRI-Nutri. Bio	BIO-CFTRI-4-0003	CSIR-800 project work	0	0	8	4

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-1-0001**			
Course Title	**Biostatistics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Summarization of Data: measures of center, dispersion, skewness (2 lectures) Dependence of variables: Correlation, linear regression, logistic regression (4 lectures) Basic probability distributions: Binomial, Normal, Chi-squares. (2 lectures) Estimation of parameters: method of moments, maximum likelihood (2 lectures) Testing of hypotheses: (5 lectures) (a) parametric tests: t-test, z-test, chi-squares test, ANOVA (b) non-parametric tests: Mann-Whitney, Kruskal Wallis, Kolmogorov-Smirnov

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-1-0002**			
Course Title	**Computation/bioinformatics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Computers: Introduction to computer. History of computers: Evolution, Generation of computers (I, II, III, IV, V). Classification of computers (Notebook, Personal Computers, Workstation, Mainframes, Minicomputers, Microcomputers, Supercomputers) – comparison with memory, power, cost, size - then and now. Fundamentals of computing. Bit and Byte, Introduction to types of Hardware and Software. Components of Computer- Central Processing Unit, Arithmatic Logrithmic Unit etc., Introduction to operating systems: Characteristics and Types of Operating system like DOS, windows XP/NT/VISTA/7, LINUX, Installation, portability and programming of these operating systems. Introduction to Computer Viruses. Network: Introduction. Network structure and architecture, Hierarchical networks, Ethernet and TCP/IP family of protocols, transport protocol design. Types of network, Topologies of network, Router, Switch, Data Communication (ISDN, Cable Modem), Communication Media (Coaxial Cables, Fiber Optics etc.), Optical vs. copper networking, Concept of Wireless networking, LAN, WAN, MAN, Security of the network, Fire-walls,. Network Applications, Information Technology: Concepts of client Server Architecture, Concept of search Engine, Database search engines. Introduction to Internet, World Wide Web, Advantages of Web, Web Terminology, Accessing the Internet, Dedicated Access, Dial – up access, Concepts of Domain, Concept of Web Browser, Internet Services, Internet Tools. Telnet/SSH, FTP, E-Mail (Using web E-Mail, client-mail, IMAP/POP configurations) Chat, newsgroups etc. MS-Word: Introduction to word, Introduction to parts of window (title bar, menu bar, tool bar, ruler, status bar), Creating, opening, saving and printing a document, Editing a document, Copy move and replace the text, text formatting, Page Setup, Margins, Gutters, text alignment, Line spacing, Page break, header and footers, spell checking. Creation and Manipulation of tables, Mail Merge, insert objects MS-Powerpoint: Introduction, Power Point Elements, Exploring Power Point Menu: opening and closing menu, working with dialog box, adding text, title. Moving and resizing text, starting a slide show, opening, saving and printing a slide show. Work with slide master. Views: Slide view, sorter view, notes view, online view, Formatting Text, Enhancing Text by using bullets, fonts style, font size, effect and color. Displaying slide show and adding multimedia and objects. MS-Excel: Introduction, format of electronic worksheet, adding data in worksheet, cell addressing, saving, opening and printing a worksheet, Ranges and different type of ranges, applying formula, copying formula, various mathematical function, statistical function and date functions, charts. Introduction to Bioinformatics: History of Bioinformatics, Genome sequencing projects, Human Genome Project, Applications of Bioinformatics. Introduction to databases, Type and kind of databases, Applications and limitations Literature Search Databases: e.g. PUBMED, MEDLINE Nucleic acid and protein databases: GenBank, EMBL, DDBJ, SWISS PROT, UNIPROT. Animal and plant databases: Ensembl Genome project TIGR database, Maize GDB etc. Biotechnological databases: EST, STS, GSS, HTG SNP Motifs and Pattern Databases: PROSITE, Pfam, BLOCKS, PRINTS etc. Databases for species identification and classification: GBIF, ICTV, taxonomy browser at NCBI etc. Structural databases: PDB, PDBsum, NDB, SCOP, CATH etc. Database Retrieval and deposition systems: SRS, Entrez, Bankit, Seqin, Webin, AutoDep. Web tools and resources for sequence analysis: Pairwise and multiple sequence Alignment, Sequence similarity search: BLAST, Pattern recognition, motif and family prediction, Restriction map analysis, primer design, Gene prediction, Phylogenetic Tree, Protein structure prediction and visualization.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-1-0003**			
Course Title	**Basic Chemistry**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Thermodynamics (2 lectures) Solutions and Ions (2 lectures) Chemical bonding and molecular structure (2 lectures) Chemical Kinetics (2 lectures) Stereochemistry (3 lectures) Introduction to drug discovery (Medicinal chemistry approach) (2 lectures) Drug target, discovery and development (forward and reverse approach (2 lectures)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-1-0004**			
Course Title	**Research Methodology, Communication/ethics/safety**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Philosophy and structure of scientific thoughts, Objective and Motivation of Research, Meaning of the Research, What constitutes a research topic? How to select a research topic?, Importance of literature review, Selection of appropriate methodology, Collection of data, Interpretation of data, Writing research paper, Paper presentation in scientific conference, Statistical methods, Importance of documentation, Procedure for Hypothesis Testing, Values and Ethical Problems, Criteria of Good Research, Good laboratory practice, Chemical, Radioactive and Biological safety: Possible hazards and precautionary measures; do and don'ts upon exposure Research methodology, communication, ethics, safety Asking the right questions: Originality, Depth, Precision can co-exist Formulating and refining the hypothesis: Those who do not learn from the past are condemned to repeat it Study design: Recognizing and minimizing bias Experiment design: Sometimes less is more and the importance of controls Good lab practices: Record keeping, organizing data, organizing the lab space Data interpretation; objectivity, quantification, double blind studies and necessity of statistics Comunicating your data:writing up your research Comunicating your data: presenting your findings Radiation safety Chemical and Biosafety Intellectual property rights What is ethics, the different interpretations & historical instances of unethical science Case studies: Data fraud/ plagiarism and Human Ethics violation Write a 2-page scientific review on a topic of choice + might have 5 min presentations by students on aspects of 'History of Science' Introduction to IGIB & TCGA facilities (Visit & 2 hour discussions on principles & applications of Clinic Genomics, Genome Sequencers, Mass Spec, Confocal, Microarray, AFM, EM)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-2-3301**			
Course Title	**Biotechniques and Instrumentation**			
Credit Distribution (L-T-P-C)	0	0	2	**1**

Course Description:

Separation and characterization Principles and applications of centrifugation: high speed, ultra and differential centrifugation. Chromatography: affinity, ion exchange, hydrophobic chromatography, size exclusion and reverse phase chromatography, GLC, HPLC, HPTLC, GCMS, LCMS and Flash chromatography Microscopy Microscopy and Imaging: Light Microscopy, Bright and dark field, phase contrast, Fluorescence, Confocal, atomic force, transmission electron and scanning electron microscopy, cryo-EM, Surface Plasmon Resonance Spectroscopy Spectrophotometry: UV-Visible, absorption and emission spectrophotometry, AAS and Mass spectrometry, NMR Spectroscopy, stead-state and time-resolved fluorescence spectroscopy. Vibrational spectroscopy, circular dichroism and dynamic light scattering, Magnetic resonance spectroscopy Techniques in Molecular biology DNA/RNA isolation, plasmid isolation, designing of primers, RFLP, RAPD, ISSR, PCR, Realtime PCR, agarose, polyacrylamide and 2D-PAGE, poly/mono-clonal antibodies, ELISA, blotting and hybridization techniques, DNA sequencing. Cloning: vectors, expressing cloned genes.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-2-3302**			
Course Title	**Materials Characterization Technique**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Size and surface area analysis; Interaction of X-rays with matter, diffraction techniques and applications; Optical principles of microscopy; electron diffraction, imaging (various contrasts), determination of crystal structure, burgers vector, electron beam-specimen interactions and other applications of Transmission Electron Microscopy; Applications of Scanning Electron Microscopy and, Electron Probe Micro-Analyser; Principles of Quantitative Microscopy: Overview of other characterization techniques such as Auger electron spectroscopy, Scanning Tunneling Microscopy, Atomic Force Microscopy.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-2-3303**			
Course Title	**Biology of Biology of Macromolecules**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Cell Biology Basic concept: life forms from prokaryotes to eukaryotes, Structure and function of Cell and Cell organelles, Nucleic acids and proteins; Molecular aspects of cell division and cell cycle, Chromatin structure; Organization of nucleosome and chromosomes, Chloroplast and Mitochondrial Genome Organization. Bacterial and Algal genome organization Biomolecules and pathways Basic macromolecular structure: DNA, RNA, protein, lipids and carbohydrates, Synthesis and degradation of macromolecules, Relation between sequence, structure and function, protein folding and flexibility, important metabolic pathways and regulation Enzymology Enzyme activity, kinetics, Single substrate, bisubstrate reactions, Determination of Km. Enzyme inhibition: Reversible and irreversible inhibition, Competitive, Non-competitive and uncompetitive inhibition, receptor binding and regulation, allosteric regulation. Genomics and proteomics DNA replication in Prokaryotes and Eukaryotes, Genetic code: RNA transcription and processing, Transcriptional regulation in prokaryotes and eukaryotes, Protein synthesis, protein modifications and secretion, Regulation of protein synthesis, Biological structure databases, Computer modelling of proteins and nucleic acid based on sequence data

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-2-3304**			
Course Title	**Plant Environment Interaction**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to environment: classification, components of environment; Ecology and ecosystems; Symbiotic relationships; Plant responses to abiotic & biotic stresses; Plant - soil interactions. Environment and Sustainable Development.Environment Pollution in National and Global Perspectives, Environmental pollution and its effect on plants, Sources and Fate of Pollutants in the Aquatic Ecosystems, Energy Resources and Conservation, Plant adaptation to Environmental stress, Environmental Degradation and Restoration, Biomonitoring of Environmental contaminants, Environmental Impact Assessment & Auditing

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-2-3305**			
Course Title	**Microbes and Environment**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Environmental (soil, water and air) pollution – source, effect and fate Management of pollutants Environment monitoring methodologies Control of pollutants Microbes and polluted environment Biogeochemical cycling Microorganisms in biodeterioration Microbial bioremediation Metabolic networks of microbial systems Biosensors – reporter and marker genes Geomicrobiology Microbial cell as a factory Synthetic biology Systems biology

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-2-3306**			
Course Title	**In Vitro Development and Morphogenesis in Plants**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction, Production of disease free quality planting materials; Somaclonal variations (concept and applications, visual, molecular and other screening methods); Haploids (anther, ovule culture and bulbosum technique, detection of haploids, applications); Endosperm culture, triploid production and its application; Protoplast culture, somatic hybrids and cybrids, selection strategies and applications; Secondary metabolites, hairy root culture, scale up studies using bioreactors; Ex situ conservation, short and long term storage of germplasm; Applications of tissue culture in commercialization; In vitro methods of crop improvement using transgenic technology and their Implications

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-2-3307**			
Course Title	**Biodiversity**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Aims, objectives and dynamics of Plant biodiversity Bio-geographic regions of plant biodiversity in India and world Diversity within different plant groups Assessment of biodiversity through classical taxonomic methods Ecological methods for plant diversity inventorying Role of Biosphere Reserve, National Parks, Wild Life Sanctuaries, Sacred Grooves in biodiversity conservation Species distribution and endemism Biodiversity and its sustainable uses Biodiversity and traditional knowledge Development of plant databases and its management Biodiversity legal and policy instruments Biodiversity, ecosystem function and ecosystem processes Ecological niche Impact of climate change on plant biodiversity Practical work: Field visit and ecological methods to study biodiversity

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-3-3301**			
Course Title	**Seminar Course**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Course details: Topic of the Seminers will be under the scope of the Ph.D. topic of respective Candidate

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-3-3302**			
Course Title	**Biomaterials**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Requisites of biomaterials and structure-property relation: metals, ceramics & polymers; Surface chemistry, surface & interfaces, cohesion and adhesion; Surface chemistry and physics of selected metals, polymers and ceramics; Property requirement of biomaterials; Concept of biocompatibility; Cell material interactions and foreign body response; Assessment of biocompatibility of biomaterials; Important biometallic alloys; Ti-based, stainless steels, Co-Cr-Mo alloys; Bioinert, Bioactive and bioresorbable ceramics; Processing and properties of different bioceramic materials with emphasize on hydroxyapatite; Synthesis of biocompatible coatings on structural implant materials; Microstructure and properties of glass-ceramics; Biodegradable polymers; Design concept of developing new materials for bio-implant applications

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-3-3303**			
Course Title	**Genome and gene regulation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Genome anatomy Genomes of prokaryotes and eukaryotes, genetic organization of the prokaryotic genome, operons (lac, mal, ara, trp). genetic and physical maps: RFLP, SSLP, SNPs, restriction mapping, FISH, STS. Chromatin modifications and genome expression, genome replication, Molecular phylogenetics, Gene location, experimental techniques for gene isolation Studying DNA DNA structure, Enzymes for DNA manipulation: DNA polymerase, nucleases, Restriction endonucleases, ligases, End-modification enzymes. DNA cloning, cloning vectors, Mutation, repair and recombination, Polymerase chain reaction, DNA sequencing. Transcriptomes Transcription complex, Bacterial RNA polymerase, promoter sequences, Coding and noncoding RNA, synthesis of bacterial and eukaryotic RNA, mapping of end of transcripts, transcriptional regulation, termination of transcription, sythesis and processing of non-coding RNAs, degradation of mRNAs, S1 mapping, primer extension, Run-on and run-off transcription Proteomes Ribosome structure, initiation, elongation and elongation of translation, protein folding, proteolytic cleavage, chemical modification, protein degradation, purifying and studying proteins, DNA-protein interactions, Gel mobility shift, DNase footprinting, Flowcytometry MALDI-MS/MS/TOF, LC-ESI-MS/MS.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-3-3304**			
Course Title	**Microbial Diversity and Habitat Ecology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to microbial lineages Techniques of studying culturable and unculturable microbes Methods in microbial taxonomy Microbial phylogeny Structure and function of microbial communities Genomic methods to identify microbial structure-function relationship Methods of studying uncultured microbes Plant-microbe interactions Mineral-microbe interaction Microbial metagenomics Environmental sampling and statistical analysis Instrumentation in microbial diversity study Latest sequencing technologies Assignments and discussions

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-3-3305**			
Course Title	**Biology & Chemistry of Natural Products**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Classification of metabolites - primary & secondary metabolites, Various classes of secondary metabolites - Alkaloids, Terpenoids, Steroids, Saponins, Flavonoids, Tannins etc., Extraction procedures for natural products, Purification and Isolation of pure compounds by chromatographic techniques, Structural elucidation of known/new compounds/NCEs by spectroscopic techniques, Structural modification of natural products

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-3-3306**			
Course Title	**Bioremediation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Principles and Applications, Bacterial Remediation of Metal and Metalloid Contamination, Bioremediation through Fungi and Mycorrhiza, Biodegradation of Recalcitrant Organic Wastes, Phytoremediation of Contaminated Water, soil & Constructed Wetlands, phytoremediation and Role of Nutrient Management, Role of Nanotechnology in Bioremediation Scope of Soil Carbon Sequestration in Degraded Soils, Limiting Factors in Bioremediation, Processes, Biodiversity, Climate change research, Microbe-Plant interactions, Eco-restoration and Remediation technologies, Environmental pollution and importance of microbes: Microbial diversity in different Ecosystem, Constructed wetlands for treatment of Wastewaters, Microbial diversity in different Ecosystem, Resource recovery from waste, Bio-energy Environmental Biotchnology Environmental Management: Waste management through Eco-friendly approaches, Concept and dynamics of ecosystem, biogeochemical cycles; Types of ecosystems, Community structure and organisation Practical Protocols/ Techniques of Soil Bioremediation using Microbes Protocols/ Techniques of Soil Phytoremediation Protocols/ Techniques of Phytoremediation for Aquatic Ecosystems Use of Soil Enzymology in Monitoring of Bioremediation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-3-3307**			
Course Title	**Mineral Bioprocessing**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to chemolithotrophic and heterotrophic nutrition of microbes. Chemical and electrochemical aspects of bioleaching. Understanding of role of microbes in biogeochemical cycles of Fe, Mn, Si, P etc. Bioleaching of valuable metals from ores/minerals. Role of microorganisms and their attachment to ore in bio-flotation and bio-beneficiation.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-3-3308**			
Course Title	**Taxonomy and Speciation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Unit-I: Taxonomy of plants History of plant taxonomy and classification of angiosperms International Code of Botanical Nomenclature Modern trends in Taxonomy: (a) Numerical taxonomy, chemo-taxonomy, cyto-taxonomy, and (b) Palynology, embryology, anatomy and palaeo-botany Relevance of Herbaria & Botanical Gardens Systematics of Pteridophytes and Gymnosperms (General characters, classification, important families) Systematics of non-vascular plants Plant descriptors, systematic of some selected families in Dicots & Monocots Methods and techniques in plant taxonomy and herbarium Unit –II: Molecular Systematics and speciation Species concept Speciation in plants Molecular Systematics: Concepts and applications Molecular markers in plant systematics Procedures for collecting and sampling of plant materials Molecular Phylogenetics Phylogenetic Inferences Phylogeography: concepts and case studies in plants

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-4-0001**			
Course Title	**Project Proposal Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Project Proposal to be prepared by selecting topics of high relevance and novelty, and will have state-of-the art review, methodologies, recommendations

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-4-0002**			
Course Title	**Review Article Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Review Article on the research area undertaken by the student

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMMT-Bhubaneshwar**			
Course Nomenclature	**BIO-IMMT-4-0003**			
Course Title	**CSIR-800 Project Work**			
Credit Distribution (L-T-P-C)	0	0	8	**4**

Course Description:

Six–Eight weeks have to be dedicated on a project concerned with societal/rural issues under the CSIR-800 Programs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-1-0001**			
Course Title	**Biostatistics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Summarization of Data: measures of center, dispersion, skewness Dependence of variables: Correlation, linear regression, logistic regression, Basic probability distributions: Binomial, Normal, Chi-squares. Estimation of parameters: method of moments, maximum likelihood Testing of hypotheses: (a) parametric tests: t-test, z-test, chi-squares test, ANOVA (b) non-parametric tests: Mann-Whitney, Kruskal Wallis, Kolmogorov-Smirnov

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-1-0002**			
Course Title	**Computation/bioinformatics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Computers: Introduction, Evolution and Classification of computers. Fundamentals ofcomputing. Bit and Byte, Introduction to types of Hardware and Software. Componentsof Computer. Introduction to operating systems. Introduction to Computer Viruses.Network: Introduction. Network structure and architecture, Hierarchical networks,Ethernet and TCP/IP family of protocols, transport protocol design. Types of network,Topologies of network, Router, Switch, Data Communication, Concept of Wirelessnetworking, LAN, WAN, MAN, Security of the network, Fire-walls, Network ApplicationsInformation Technology: Concepts of client Server Architecture, Concept of searchEngine, Database search engines. Introduction to Internet.Introduction to Word, Powerpoint and Excel Introduction to Bioinformatics: History of Bioinformatics, Genome sequencing projects,Human Genome Project, Applications of Bioinformatics. Introduction to databases, Type and kind of databases, Applications and limitations. Literature Search Databases, Nucleic acid and protein databases, Animal and plant databases, Ensembl Genome project TIGR database, Biotechnological databases, Motifs and Pattern Databases, Databases for species identification and classification, Structural databases. Database Retrieval and deposition systems. Web tools and resources for sequence analysis: Pairwise and multiple sequence Alignment, Sequence similarity search: BLAST, Pattern recognition, motif and family prediction, Restriction map analysis, primer design, Gene prediction, Phylogenetic Tree,Protein structure prediction and visualization.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-1-0003**			
Course Title	**Basic Chemistry**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Thermodynamics Solutions and Ions Chemical bonding and molecular structure Chemical Kinetics Stereochemistry Introduction to drug discovery (Medicinal chemistry approach) Drug target, discovery and development (forward and reverse approach

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-1-0004**			
Course Title	**Research Methodology, Communication/ethics/safety**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Philosophy and structure of scientific thoughts, Objective and Motivation of Research, Meaning of the Research, What constitutes a research topic? How to select a research topic?, Importance of literature review, Selection of appropriate methodology, Collection of data, Interpretation of data, Writing research paper, Paper presentation in scientific conference, Statistical methods, Importance of documentation, Procedure for Hypothesis Testing, Values and Ethical Problems, Criteria of Good Research, Good laboratory practice, Chemical, Radioactive and Biological safety: Possible hazards and precautionary measures; do and don'ts upon exposure Research methodology, communication, ethics, safety Asking the right questions: Originality, Depth, Precision can co-exist Formulating and refining the hypothesis: Those who do not learn from the past are condemned to repeat it Study design: Recognizing and minimizing bias Experiment design: Sometimes less is more and the importance of controls Good lab practices: Record keeping, organizing data, organizing the lab space Data interpretation; objectivity, quantification, double blind studies and necessity of statistics Comunicating your data:writing up your research Comunicating your data: presenting your findings Radiation safety Chemical and Biosafety Intellectual property rights What is ethics, the different interpretations & historical instances of unethical science Case studies: Data fraud/ plagiarism and Human Ethics violation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-2-1201**			
Course Title	**Biotechniques and Instrumentation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

i. General Instrumentation: handling, care, usage and safety (this includes spectrophotomers, rotors, cuvettes, etc). ii. UV spectroscopy: stead-state and time-resolved fluorescence spectroscopy iii. Vibrational spectroscopy: basic principles and applications in biology iv. Magnetic resonance spectroscopy v. Atomic force microscopy vi. Confocal and fluorescence microscopy vii. Analytical ultracentrifuge viii. Calorimetry (isothermal titration and differential scanning calorimtry) ix. Surface Plasmon Resonance x. Chromatography

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-2-1202**			
Course Title	**Biology of Macromolecules**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to biological Macromolecules, The need for polymeric macromolecules for the living cell, Information content (general ideas on Shannon's information theory), Non-covalent forces (electrostatic, hydrophobic, hydrogen bonding, etc.), Properties of water in relation to macromolecular conformation Problem of protein folding, Introduction to protein folding, Levinthal's paradox and necessity for folding pathways, discussion on folding pathways (framework, hydrophobic collapse, nucleation-condensation-propagation, zigzag puzzle models and experimental evidence in support and against for these models), Current view of protein folding, Folding surface and funnel, Assisted protein folding, Need for assistance in protein folding in vivo, Differences between in vitro and in vivo folding, Discovery of molecular chaperone, classification of chaperone and brief description of functions of GroEL, Methods for investigating protein folding, Fluorescence and circular dichroism, Basic principles and applications Structure-function relationship : why structure?, Overview of different methods of structure determination, Retrieving, visualizing and understanding macromolecular structures, Correlation between structure and function Protein architecture, Organization of protein structure, Supersecondary structural elements, Ramachandran plot, Structure determination by X-ray crystallography, Globular proteins, Identification of folds and classification, Examples of structurefunction relationship Macro-Molecular interactions, Various models of ligand-protein interactions (simple as well as complex binding models), Analysis strategies (Scatchard and Klotz plots), cooperativity in biology and Hill plot, Methodology and principles for estimation of binding stoichiometry; classical (gel filtration, equilibrium dialysis, stopped flow) as well as advanced methods (absorption, CD, fluorescence, NMR, ITC, SPR etc)., Thermodynamics of interaction and principles of ligand design, Protein-protein interactions Enzymes, Enzyme kinetics, Why study enzyme kinetics? Single substrate, bisubstrate reactions, Determination of Km. Enzyme inhibition – Reversible and irreversible inhibition, Competitive, Non-competitive and uncompetitive inhibition. Independent identical and non-identical substrate binding sites on enzymes, allosteric regulation. Reactions on enzymes and rate enhancements, Transient state stabilization, Transition state analogues and catalytic antibodies.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-2-1203**			
Course Title	**Biology of Inheritance**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Prokaryotic genetics Mutagenesis, DNA repair, applications of mutagenesis, mechanisms of gene transfer including conjugation & transduction, and Recombination & mapping. Applications and uses of transposable elements, gene regulation, virulence functions and horizontal gene transfer. Eukaryotic genetics Mendelian principles; Segregation and linkage; Recombination and mapping; Gene interactions, forward and reverse genetics. Bayesian methods of risk assessment; consanguinity in humans and model genetic systems; chromosome rearrangements and their effects on gene expression in Drosophila and Neurospora.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-2-1204**			
Course Title	**Biology of Infection**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Bacterial Pathogenesis (7 Lectures): Introduction to Bacterial Pathogens, Bacterial Virulence Mechanisms, Mycobacterial Pathogenesis Pathogenesis of Parasites (7 Lectures): Introduction to Parasite Biology, Pathogenesis of Malaria Viral Pathogenesis I (7 Lectures), Introduction to Virology , Molecular Mechanisms of Viral Infections Viral Pathogenesis II (7 Lectures): Inflammation Biology, Cellular Invasion by Viruses, Cellular Detection of Pathogens

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-2-1205**			
Course Title	**Genomics: Information flow in Biological Systems**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Overview of human genome (4 lectures): Nuclear genome (2 lectures), Mitochondrial genome (2 lectures) Genome mapping (4 lectures): Markers and methods for genome mapping (2 lectures), Linkage analysis (1 lecture), Genome-wide association studies (1 lecture) Genome sequencing (5 lectures): Different methods and applications (2 lectures), Human genome project (1 lecture), Next generation sequencing (2 lectures) Molecular Basis of human diseases (6 lectures): Molecular epidemiology (1 lecture), Autosomal (1 lecture), X-linked (1 lecture), Y-linked (1 lecture), Mitochondrial (2 lectures) Molecular Phylogenetics (4 lectures) Methods for phylogenetic analysis (2 lectures): Origin and migration of modern human (1 lecture), Role of India in early human migration (1 lecture) Pharmacogenomics (2 lectures): Genome variation and drug response (1 lecture), Pharmacogenomics: Indian Scnario (1 lecture) DNA profiling (3 lectures): Evolution of DNA fingerprinting technology (2 lectures), DNA fingerprinting in medicolegal and forensic applications (1 lecture)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-2-1206**			
Course Title	**Protein science and proteomics**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Experimental aspects of protein characterization with emphasis on techniques currently used b. Approaches to studying protein conformation in solution c. Holistic approach towards proteomics d. Theoretical methods for studying dynamics of proteins

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-2-1207**			
Course Title	**Plant-Microbe Interaction**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

i. Over view – 1 lecture ii. Plant pathogen virulence functions (bacterial, fungal, and viral) – 8 lectures iii. Host-resistance mechanisms (elicitor and effector triggered immunity) – 5 lectures iv. Plant-symbiont interactions (plant interactions with bacteria and fungi) – 10 lectures v. Plant growth promoting rhizobacteria and biocontrol – 3 lectures vi. Summary – 1 lecture

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-2-1208**			
Course Title	**Epigenetics and Chromatin Organization**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

I. Transcription and Gene Expression 10 lectures (1) Details of the process of transcription in eukaryotes Promoter structure and function: the role of cis-regulatory elements that affect gene function locally and globally (1 lecture), The structure, function, and regulation of general transcription factors, RNA polymerases (1 lecture), Transcriptional initiation, elongation, and termination (3 lectures) (2) Gene Activation (2 lectures) DNA-protein Interaction, Gene-specific factors: Activators and repressors (3) Post transcriptional processing and regulation (2 lectures) connections between RNA processing and upstream events in transcription, integration of transcriptional and translational response mechanisms to external stimuli (4) Genome-wide approaches (1 lecture): New surprises, Pervasive transcription II. Chromatin organization 3 lectures (1) Nucleosome structure (2) Nucleosome positioning (3) Chromatin Assembly: Nucleosome assembly, Fiber folding III. Epigenetic Regulatory Mechanisms 15 lectures Transcriptional repression/anti-repression mechanisms (1) Chromatin remodeling (1 lecture) (2) Variation in conservation: Histone variants (1 lecture) (3) Histone Code: covalent modifications (4 lectures): Writing and erasing the Histone code, Reading the Histone code, Functional correlates of epigenetic marks (4) Genome-wide studies (1 lecture): Nucleosome landscape of species, Cross-talks between epigenetic markings (5) Cross-talk between transcription and chromatin (1 lecture) (6) Involvement of RNAi and non-coding small RNAs in gene silencing and genome defense (Lectures by AJ Rachel): Small RNAs: History, discovery and RNAi, miRNAs, piRNAs (3 lectures); and Noncoding RNAs (2 lectures) (7) DNA Methylation and Heterochromatinization (2 lectures by AJ Rachel)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-2-1209**			
Course Title	**Stem cells, regeneration and aging**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Pluripotency- in the context of embryo, adult and reprogramming. Molecular basis of pluripotency, self renewal and nitch, role of epigenetic changes, stem cells in tissue and organ development. Methods in stem cell research- isolation, characterization and maintenance of human and murine stems cells, derivation of induced pluripotent cells, in vitro differentiation towards derivation of specific lineages. Importance of regeneration, model organisms, molecular mechanisms, role of stem cells in regeneration, regeneration in higher vertebrates, tissue engineering and other techniques in regenerative medicine. Apoptosis, programmed cell death, importance of stress and ROS in apoptosis, stem cell theory of ageing, role of telomeres. Stem cells in cancers.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-2-1210**			
Course Title	**Self organizations in biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

What is so unique about membrane organization ? What holds the membrane together ? The hydrophobic effect Membrane dynamics ¾ the key to membrane function: time scales ¾ how to monitor membrane dynamics: spectroscopic approaches ? Lipid-protein interactions Membrane proteins: receptors and signaling Membrane domains: platforms for organization ? Evolving role of membranes in pathogenecity II.(4 lectures): Lipid structures (2 lectures) Primacy of membranes in biology, chemistry, distribution, crystal structure of lipids Lipid phase transitions (1 lecture) Biological role of phase transitions, fusion. Emergent properties of lipids (1 lecture) Long range order, heterogeneity and membrane shape control

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-2-1211**			
Course Title	**Cell Biology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

A. Structural compartmentation of function in the cell B. Bacterial, Mammalian and Plant Cell Death Pathways; Cellular Differentiation Aging and Cellular Senescence C. Signal transduction in mammalian cells D. Cell cycle and cytoskeleton

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-3-1201**			
Course Title	**Seminar Course**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

History of science with emphasis on Indian contribution: Seminar by students

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-3-1202**			
Course Title	**Nanobiology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Nanoparticle synthesis – various methods including bottoms-up and top-down approaches; Property of Band-gap in materials The significance of nano size, multiplexing and multilayering. Optical properties and nanoparticle shape dependence. Tool used for nano-technology Basic principle of different types of tools (such as nano-lithography, TEM, AFM and other x-ray base detections techniques) will be discussed and their relevance to biological system characterization. Application of nano-technology for development of functional materials for biological applications. Different types of interactions at nano-scale will be discussed to understand and modulate biological response by designing nanostructures and functions. In this lecture basics of micro fluidics systems will also be discussed which create new opportunities for the spatial and temporal control of micro environment for biological applications.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-3-1203**			
Course Title	**Brain and behaviour**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

I. Overview of the Nervous System and functioning of Neurons at structuralanatomical level, cellular level, molecular level; II. Techniques and tools in understanding Brain and Behaviour, at system lev III. Circuitry level approach to understand Brain and Behavio a. Chemosensory circuit (perception of odour and pheromones), b. Reward circuit (Addiction, Depression, anxiety & related Mood Disorders), c. Learning and memory circuit (Cognitive disorders and mental retardation) IV. Environmental perturbations affecting Brain and Behavior Change in environment affects the gene functions, and also brain and behaviour, via epigenetic mechanisms; Environmental perturbations in early stage of life affect circuit development and maturation and have implications to pervasive CNS disorders in adulthood; V. Biology of Neurodegeneration and Repair (Molecular Biology of Adult Neurogenesis, Neural Progenitor or stem cells)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-3-1204**			
Course Title	**Genome organization**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

I. Overview of genomes, 1 lecture i. The new science of genomics, major questions and potentials (1 lecture) II. Packaging of genome and higher order regulation of gene expression, 9 lectures i. Chromatinization of genome (2 lectures) ii. Structural and functional domains in genome(2 lectures) iii. Structural basis of epigenetic cellular memory (3 lectures) iv. Chromosomal position effect (1 lecture) v. Nuclear architecture and genomic packaging (1 lecture) III. High throughput techniques and tools in analysis of genome organization (4 lecture) i. Epigenome mapping (2 lectures) ii. Bioinformatic tools of comparative genomics (2 lecture)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-3-1205**			
Course Title	**NMR Micro-imaging and Spectroscopy**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction: Zeeman Interaction, Chemical Shift, Coupling Constants, Relaxation, Nuclear Overhouser Effect, etc. Heteronuclear NMR and Simplification of NMR: Techniques for Improving Sensitivity, Editing in NMR, etc. In Vivo NMR Spectroscopy: Water Suppression, Localization, Outer Volume Suppression, STEAM, etc. Image Construction Using NMR: Slice Selection, Frequency and Phase Encoding, Contrast in MRI: T1, T2, diffusion; functional MRI

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-3-1206**			
Course Title	**Mass spectroscopy in biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

a. Historical introduction to mass spectroscopy b. Study of tissues to molecules by mass spectroscopy c. Limitations of mass spectroscopy

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-3-1207**			
Course Title	**Conservation biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Concepts, history, ethics, values and legal foundations Population genetics and biodiversity, threats to biodiversity, conservation genetics Interventions- Genetic management, conservation of populations and ecosystems, habitat management, origin and conservation of genetic diversity in agricultural plants and animals Sustainable development, climate change and conservation of biodiversity, economics of conservation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-3-1208**			
Course Title	**Drug Discovery**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Journey of a drug from discovery to use Target identification and validation Assay development and screening methodologies Designing small molecule compounds (computational tools and mechanism-based) Moving from in vitro to in vivo testing: toxicity and bioavailability

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-3-1209**			
Course Title	**Immunology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

I. Overview of Immunology (The old science of immunology – concepts/participants/ modalities of interactions… that some of us still struggle with) II. Discussion of 4 landmark articles that help highlight: techniques/concepts/interconnections within immune system /new directions These papers will be decided between now and the actual course. The papers will be discussed with the students as an in-class presentation and the ppt will be shared. (but the paper will not be given out at this time)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-3-1210**			
Course Title	**Genome Engineering**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

1. Genetic Manipulations - Transgenic and locus specific manipulation tools in bacteria and yeast and vertebrate systems. 2. DNA manipulation tools - Recombineering (plasmids and BACs), Overlap extension PCR for site directed mutagenesis and cloning, Gibson Assembly. Concepts, tools designing and applications. (Will be regularly updated with the new developments in the field.) 3. Genome editing tools - Zinc Finger Nuclease, TALENS and CRISPRs in Prokaryotic and Eukaryotic model systems - concepts, tools and designing. (Will be regularly updated with the new developments in the field.)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-3-1211**			
Course Title	**Ecology and Evolution**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Key words: Species diversity theory; measurement of species diversity; niche concept; species interactions; community assembly; dispersal; patterns in endemism; adaptation; phylogeny; population genetics. 2 lectures: Biological communities comprising of several species are organized in some predictable ways. This allows measurement of species diversity and using it as a parameter of interest to look at responses to various perturbations. The factors underlying the organisation of biological communities are key to understanding the functional role of a species, and all of species diversity. Therefore, the interactions between species and species assembly are phenomena that are still being investigated. These form the basis for the science of conservation biology. 2 lectures: Biogeographic pattern are often non-random and thereby, an explanation that drives the pattern is of interest to biologists. Vicariance and dispersal are two broad processes that drive biogeographic patterns. However, with our increasing knowledge about different species, explanations for biogeographic patterns have become complex. The utility of biogeography is in prioritizing areas for conservation and understanding earth's processes that have played a role in shaping the biological diversity. 2 lectures: Natural selection has revolutionized our understanding of 'life on earth'. The journey in time made towards understanding causality of 'variation' has led to development of evolutionary biology. This field of biology integrates adaptations in an organism (phenotype) to the shifts that are made in the allele frequencies in their population. The factors that enhance fitness of an organism through modifications in their behaviour and life history strategies are crucial to expanding our understanding of evolutionary biology.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-3-1212**			
Course Title	**Post-translation Control**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

1. Introduction (a). Cell biology (b). Genetic Decoding and macromolecules (c). Protein functions (d). Regulation of cellular processes (e). Regulatory mechanisms (f). Transcriptional control (g). Translational control (h). Post-translational control (i). Mechanisms of post-translational control II. Protein Degradation (a). Introduction (b). Selective Protein Degradation (c). Non-selective Protein Degradation (d). Introduction to protein modifications (e). Introduction to proteases (f). Ubiquitin-proteasome system (i). Ubiquitin (ii). Proteasome (iii). Ubiquitylation (g). Protein degradation by 26S Proteasome (i). Ubiquitin-dependent protein degradation (ii). Ubiquitin-independent protein degradation (h). N-end rule pathway and hypoxia response (i). Endoplasmic reticulum associated degradation (ERAD) pathway (j). Cellular protein Quality control 1. Introduction (a). Cell biology (b). Genetic Decoding and macromolecules (c). Protein functions (d). Regulation of cellular processes (e). Regulatory mechanisms (f). Transcriptional control (g). Translational control (h). Post-translational control (i). Mechanisms of post-translational control II. Protein Degradation (a). Introduction (b). Selective Protein Degradation (c). Non-selective Protein Degradation (d). Introduction to protein modifications (e). Introduction to proteases (f). Ubiquitin-proteasome system (i). Ubiquitin (ii). Proteasome (iii). Ubiquitylation (g). Protein degradation by 26S Proteasome (i). Ubiquitin-dependent protein degradation (ii). Ubiquitin-independent protein degradation (h). N-end rule pathway and hypoxia response (i). Endoplasmic reticulum associated degradation (ERAD) pathway (j). Cellular protein Quality control III. Regulation of cellular metabolism by protein degradation (a). Introduction (b). Metabolism of polyamines (c). Functions of polyamines (d). Polyamines and diseases (e). Regulation of polyamine bio-synthesis (i). ODC (Ornithine decarboxylase) (ii). ODC-Antizyme (f). Ubiquitin-independent degradation of ODC, p53 and Rpn4 (g). ODC degradation signal (h). Ubiquitin-dependent degradation of ODC-antizyme (i). Polyamine control of ODC and ODC-antizyme degradation IV. Biochemical methods and advanced genetic strategies (a). Introduction (b). Assay of protein stability (i). Cycloheximide Chase Analysis (ii). Pulse-Chase Analysis (c). Assay of protein modifications (d). Assay of proteasome assembly and maturation (e). Advanced strategies of genetic screening (i). Genetic screening of OAD mutants V. Re-programmed genetic decoding (a). Introduction (b). +1 ribosomal frameshifting (c). -1 ribosomal frameshifting (d). Stop codon read-through (e). Translational bypassing (f). Decoding of OAZ1mRNA by programmed +1 ribosomal frameshifting (g). Nascent peptide mediated Co-translational control (h). Co-translational polyamine sensing by nascent ODC-antizyme VI. Protein Modifications (a). Introduction (b). Non-protein: protein modifications (i). Hypusination (c). Protein:protein modification (i). Ubiquitylation (d). Ubiquitin-related modifiers (i). Sumoylation (ii). Neddylation (iii). FAT10 (iv). ATG8 (v). ATG12 (vi). PUP1

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-4-0001**			
Course Title	**Project Proposal Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Project Proposal to be prepared by selecting topics of high relevance and novelty, and will have state-of-the art review, methodologies, recommendations

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-4-0002**			
Course Title	**Review Article Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Review Article on the research area undertaken by the student

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CCMB, Hyderabad**			
Course Nomenclature	**BIO-CCMB-4-0003**			
Course Title	**CSIR-800 Project Work**			
Credit Distribution (L-T-P-C)	0	0	8	**4**

Course Description:

Six–Eight weeks have to be dedicated on a project concerned with societal/rural issues under the CSIR-800 Programs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-1-0001**			
Course Title	**Biostatistics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Summarization of Data: measures of center, dispersion, skewness Dependence of variables: Correlation, linear regression, logistic regression Basic probability distributions: Binomial, Normal, Chi-squares. Estimation of parameters: method of moments, maximum likelihood Testing of hypotheses: (a) parametric tests: t-test, z-test, chi-squares test, ANOVA (b) non-parametric tests: Mann-Whitney, Kruskal Wallis, Kolmogorov-Smirnov

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-1-0002**			
Course Title	**Computation/bioinformatics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Computers: Introduction, Evolution and Classification of computers. Fundamentals of computing. Bit and Byte, Introduction to types of Hardware and Software. Components of Computer. Introduction to operating systems. Introduction to Computer Viruses. Network: Introduction. Network structure and architecture, Hierarchical networks, Ethernet and TCP/IP family of protocols, transport protocol design. Types of network, Topologies of network, Router, Switch, Data Communication, Concept of Wireless networking, LAN, WAN, MAN, Security of the network, Fire-walls, Network Applications Information Technology: Concepts of client Server Architecture, Concept of search Engine, Database search engines. Introduction to Internet Introduction to Word, Powerpoint and Excel Introduction to Bioinformatics: History of Bioinformatics, Genome sequencing projects, Human Genome Project, Applications of Bioinformatics. Introduction to databases, Type and kind of databases, Applications and limitations. Literature Search Databases, Nucleic acid and protein databases, Animal and plant databases, Ensembl Genome project TIGR database, Biotechnological databases, Motifs and Pattern Databases, Databases for species identification and classification, Structural databases. Database Retrieval and deposition systems. Web tools and resources for sequence analysis: Pairwise and multiple sequence Alignment, Sequence similarity search: BLAST, Pattern recognition, motif and family prediction, Restriction map analysis, primer design, Gene prediction, Phylogenetic Tree, Protein structure prediction and visualization.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-1-0003**			
Course Title	**Basic Chemistry**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Thermodynamics Solutions and Ions Chemical bonding and molecular structure Chemical Kinetics Stereochemistry Introduction to drug discovery (Medicinal chemistry approach) Drug target, discovery and development (forward and reverse approach

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-1-0004**			
Course Title	**Research Methodology, Communication/ethics/safety**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Philosophy and structure of scientific thoughts, Objective and Motivation of Research, Meaning of the Research, What constitutes a research topic? How to select a research topic?, Importance of literature review, Selection of appropriate methodology, Collection of data, Interpretation of data, Writing research paper, Paper presentation in scientific conference, Statistical methods, Importance of documentation, Procedure for Hypothesis Testing, Values and Ethical Problems, Criteria of Good Research, Good laboratory practice, Chemical, Radioactive and Biological safety: Possible hazards and precautionary measures; do and don'ts upon exposure Research methodology, communication, ethics, safety Asking the right questions: Originality, Depth, Precision can co-exist Formulating and refining the hypothesis: Those who do not learn from the past are condemned to repeat it Study design: Recognizing and minimizing bias Experiment design: Sometimes less is more and the importance of controls Good lab practices: Record keeping, organizing data, organizing the lab space Data interpretation; objectivity, quantification, double blind studies and necessity of statistics Communicating your data:writing up your research Communicating your data: presenting your findings Radiation safety Chemical and Biosafety Intellectual property rights What is ethics, the different interpretations & historical instances of unethical science Case studies: Data fraud/ plagiarism and Human Ethics violation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-2-2001**			
Course Title	**Biotechniques and Instrumentation**			
Credit Distribution (L-T-P-C)	1	0	2	**2**

Course Description:

General Instrumentation: handling, care, usage and safety (this includes spectrophotomers, rotors, cuvettes, etc). UV spectroscopy: stead-state and time-resolved fluorescence spectroscopy Vibrational spectroscopy: basic principles and applications in biology Magnetic resonance spectroscopy, ESR Atomic force microscopy Confocal and fluorescence microscopy Analytical ultracentrifuge Calorimetry (isothermal titration and differential scanning calorimtry) Surface Plasmon Resonance Chromatography Single molecule spectroscopy

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-2-2002**			
Course Title	**Biomacromolecules**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to biological Macromolecules, The need for polymeric macromolecules for the living cell, Non-covalent forces (electrostatic, hydrophobic, hydrogen bonding, etc.), Properties of water in relation to macromolecular conformation, peptide backbone, side chains, polarity, absorbance, single letter codes etc. Protein separation and purification methods, protein structure, primary, secondary, tertiary and quaternary structure, covalent modifications DNA structure – Watson and crick model, forms of DNA, Conformation of nucleic acids (A-, B-Z- DNA), t-RNA, micro-RNA. Lipids and Carbohydrates: Structure, function and classification.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-2-2003**			
Course Title	**Cell Signalling**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

General principles of cell signaling, G Protein-Coupled Receptor (GPCR) Signaling, Growth Factor/ Receptor Tyrosine Kinases (RTKs) , Calcium and Cytokine signaling, Wnt signaling, JAK/STATs , Ras, Mitogen-Activated protein Kinase (MAPK) pathways Protein Kinases and Phosphatases, Ion channels.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-2-2004**			
Course Title	**Chromatin Organisation**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Chromatin structure; Organization of nucleosome and chromosomes; Molecular aspects of cell division and cell cycle. DNA replication in Prokaryotes and Eukaryotes. RNA transcription and processing; Transcriptional regulation in prokaryotes and eukaryotes; Protein synthesis, protein modifications and secretion; Regulation of protein synthesis; Transposable genetic elements, Types and mechanisms of transposition.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-2-2005**			
Course Title	**Connective Tissue Biology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Extracellular matrix (ECM) proteins, lipids and glycoproteins, Triple helix structure of collagen, Functions of skin and other connective tissues Types of collagen , Stability, crosslinking and Thermal properties , Biosynthesis of collagen, Matrix metalloproteinases and action on ECM, Biology of wound healing and other disorders

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-2-2006**			
Course Title	**Biomaterials**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Physical properties of materials and their measurements Biomaterial tissue interaction Stabililisation of biomaterial Metals, Polymers and biodegradable polymers Cell addition and colonization of surfaces Physico - chemical characterization of biomaterials, Surface characterization Design of composites and their application . Bioceramics, Tissue response to implants and biocompatibility Biosensor technologies

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-2-2007**			
Course Title	**Computer Aided Drug Discovery**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Use of molecular modeling to Discover and Design of Drugs, Molecular modeling in drug discovery; computer representation of molecules, chemical databases and 2D substructure searching, 3D Database searching, Deriving and Using 3D pharmacophore, constrained systematic search, Ensemble distance geometry, Ensemble molecular dynamics and genetic algorithms, clique detection method for finding pharmacophore, maximum likelihood method, incorporating geometric futures in 3D pharmacophore. Molecular Docking; Various types of docking techniques, Scoring functions, Applications of database searching and docking, Molecular similarity and similarity searching, Molecular Descriptors, Quantitative structure- activitiy relationships, selecting compounds for QSAR analysis, various types of descriptors, Deriving QSAR equations, Cross validation, interpreting QSAR equation, Regression analysis, Partial Least squares, Principle component analysis, Molecular field Analysis, 2D-QSAR, 3D-QSAR and muti-dimensional QSAR approaches. Structure based methods to identify lead compound, de novo ligand design

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-2-2008**			
Course Title	**Biochemical Engineering Principles**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Basics of Microbiology – Structure of cells, important cell types; Chemicals of life – Sugars, polysaccharides, lipids, nucleotides and nucleic acids, amino acids and proteins; cellular organization. Enzyme kinetics – Michelis-Menten kinetics, substrate activation and inhibition, multiple substrates, temperature and pH effects on enzyme reaction rates; applied enzyme catalysis; enzyme immobilization and kinetics; stoichiometry of cell growth and product formation. Molecular genetics – gene expression, induction and repression, genetic code, protein synthesis; recombinant DNA technology; kinetics of microbial growth, substrate utilization, product formation; sterilization and thermal death kinetics; batch and continuous sterilization; Transport phenomena - Gas liquid mass transfer in cell systems, basic mass transfer rates, measurement of kLa; Heat transfer aspects; Design and analysis of bioreactors, ideal reactors and non-ideal mixing; multiphase bioreactors – CSTR, packed bed, bubble column, etc; animal and plant cell bioreactors; scale up criteria Instrumentation and control – physical and chemical sensors; off-line analytical methods; process control; Downstream processing – filtration, centrifugation, sedimentation, extraction, precipitation; chromatography, membrane separations; Bioprocess economics; Biological waste water treatment.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-2-2009**			
Course Title	**Enzyme and Fermentation Technology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Microbial metabolism – metabolic regulation, catabolic regulation, feedback regulation, permeability control; biosynthesis of primary and secondary metabolites; proteins – structure, characterization; factors important to enzyme fermentations. Fermentation Kinetics – Microbial growth, chemical description; measurement of biomass – direct and indirect methods; Monod kinetics, nutrient utilization and product formation, yields and productivities; heat evolution; factors affecting microbial growth; medium formulation Batch and continuous cultures, chemostat; multiple substrates and mixed cultures; chemostat with cell recycle, multi stage continuous culture; transient growth; product formation in continuous culture; catabolic products, microbial metabolites, enzyme production. Kinetics and engineering of medium sterilization, kinetics of sterilization; batch and continuous sterilization; aeration and agitation, power requirements, types of fluids – Newtonian and non-newtonian; oxygen transfer efficiency; Translation of laboratory, pilot and plant scale data; scale-up practices and methods; fermentation control; measurement of dissolved and gaseous oxygen and CO2 concentration; intermediate sensors; mechanical disruption; precipitation of polymers; filtration, centrifugation, cell disruption, chromatography

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-2-2010**			
Course Title	**Gene Expression and Proteomics**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Primer characteristics and Designing, Polymerase Chain Reaction - Semiquantitative and quantitative PCR; Experimental aspects of protein characterization with emphasis on techniques currently used, approaches to studying protein conformation in solution,holistic approach towards proteomics,theoretical methods for studying dynamics of proteins. Proteomics and its advantages over genomics,1Dand 2D Gel Staining methods and analysis Protein spot/Band processing for Mass spectrometric analysis,application of Mass spectrometers such as MALDI-TOF/TOF and electrospray mass spectrometer and sequencing.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-3-2001**			
Course Title	**Seminar Course**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

History of science with emphasis on Indian contribution: Seminar by students

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-3-2002**			
Course Title	**Nanobiology**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Nanomaterial synthesis and characterization Incorporation of nanoparticles in biomaterials, Nanoparticles for therapeutic purposes Multifunctional nanocomposites and nanobiocomposites. Characterization of nanoparticles/nanocomposties Use in targeting and imaging

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-3-2003**			
Course Title	**Industrial Microbiology and Enzymology**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Introduction to Microorganisms, Growth & metabolism: Microbial nutrients and physiology Metabolic pathways and bioconversions: Introduction to Enzymology: Role of microbes in Industrial sector:

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-3-2004**			
Course Title	**Cell Death and Diseases**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Cell cycle regulation, Apoptosis, Autophagy, Necrosis Morphology, Mechanisms in cell death pathways, Participation of organelles-ER , Mitochondria, cytoskeleton Signaling Involved in Cell Survival & Death Inflammation/Toll-like receptors/NF-kB signaling Signalling cross-talk.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-3-2005**			
Course Title	**Approaches to Drug Delivery**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Sustained release drug delivery systems. (SRDDS) Polymers for controlled drug delivery systems Concepts and system design for the rate – controlled drug delivery Parenteral controlled release drug delivery systems Transdermal drug delivery systems (TDDS) Controlled release oral drug delivery systems Targeted drug delivery system

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-3-2006**			
Course Title	**Computational Biology**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Concepts in molecular modelling: Introduction to Statistical Mechanics and Classical Mechanics. Molecular mechanics: Potential energy surface, Born-Oppenheimer approximation, Features of molecular mechanics, force fields, Bonds structure and bending angles, Electrostatic Vander Waals and non-bonded interactions, Hydrogen bonding in molecular mechanics, Derivatives of molecular mechanics energy function, Calculating thermodynamic properties using force field for metals and inorganic systems, Application of energy minimization. Molecular dynamics and monte carlo simulation methods: Molecular Dynamics using simple models, Molecular Dynamics with continuous potentials and at constant temperature and pressure, Solvent effect in molecular Dynamics, conformational changes from Molecular Dynamics simulation, Analysis of molecular dynamics trajectory, Normal Model analysis, ANM, GNM, Coarse graining approaches: modeling of protein aggregation. Monte Carlo Method in various ensembles and its applications.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-3-2007**			
Course Title	**Bioprocessing and Industrial Fermentations**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Industrial microorganisms – Screening, isolation and preservation techniques; Measurement techniques for biomass – qualitative and quantitative; strain improvement /enrichment techniques - wild types, mutation, genetic engineering principles and techniques. Screening of enzymes and metabolites; enzyme assays; Purification methods – ammonium sulphate precipitation, ultrafiltration, aqueous two-phase extraction, spray drying; chromatographic methods – Gas chromatography, Liquid Chromatography, Characterization of enzymes Bioprocessing – Submerged fermentation - Medium preparation and sterilization; inoculum preparation; shake flask culture, ; principles of fermentations at laboratory, pilot scale and commercial scales; factors influencing growth and production; monitoring and control; Solid state fermentation – substrates and inoculum types; critical factors of influence; reactors and scale up; downstream processing; formulations. Industrial fermentations – Single cell protein, enzymes – protease, lipase, tannase, cellulase, etc; organic acids – citric and lactic acids; ethanol, vinegar; secondary metabolites; high value products; food fermentations; enzymes in leather processing. Technology aspects – Costing and economics of bioprocessing; IPR aspects; validation of processes; detailed project report preparation; marketing strategies.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-3-2008**			
Course Title	**Cell and Tissue Engineering**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Cell and Tissue culture, Angiogenic factors and growth factors Introduction to Tissue engineering, Artificial skin Embryonic and adult stem cells, Induced pluripotency, Cancer stem cell Stem cell differentiation, Therapeutics prospects, Ethics issues, Implants Basic principle of different types of tools (such as nano-lithography, TEM, AFM and other x-ray base detections techniques) will be discussed and their relevance to biological system characterization. Analytical electron microscopy.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-3-2009**			
Course Title	**Nanomaterial Toxicology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Basics of nanotechnology Synthesis and characterization of engineered nanomaterials (ENMs) Sol gel, biological and ball milling methods for synthesis of ENMs and characterisation using electron microscopy (TEM, SEM), dynamic light scattering (DLS) and confocal microscopy. Safety assessment of ENMs – methods and challenges Methods for assessment of toxicology of ENMs; preparation of nano-suspensions; exposure paradigm, cellular uptake, absorption and distribution; in silico approaches for macromolecule interaction with ENMs. Mechanism of toxicity of ENMs Effect of size, shape and surface chemistry on cellular responses (oxidative stress, cytotoxicity, genotoxicity, immunotoxicity etc) Ecotoxicity of ENMs Models and methods used for ecotoxicity assessment of ENMs;.life cycle analysis of ENMs. Safe handling of ENMs and their disposal Practical: Preparation of nano-suspensions and their characterization Cellular uptake using flow cytometer Cytotoxicity assessment for ENMs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-3-2010**			
Course Title	**Byproduct Utilization**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Nature and composition of tannery byproducts. Present methods of tannery waste management/ utilization. Recovery of organic and inorganic components from different types of biowastes generate at different unit operations. Determination of proximate composition; protein molecular weight mapping. Microbial enzyme technology: production, characterization and application of enzymes in tannery for pollution abatement; Enzymatic treatment of tannery wastes and recovery of value added products for recycling/reuse etc. Development of collagen based biomaterials for biomedical application.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-4-0001**			
Course Title	**Project proposal writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Project Proposal to be prepared by selecting topics of high relevance and novelty, and will have state-of-the art review, methodologies, recommendations

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-4-0002**			
Course Title	**Review Article Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Review Article on the research area undertaken by the student

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CLRI, Chennai**			
Course Nomenclature	**BIO-CLRI-4-0003**			
Course Title	**CSIR-800 project work**			
Credit Distribution (L-T-P-C)	0	0	8	**4**

Course Description:

Six–Eight weeks have to be dedicated on a project concerned with societal/rural issues under the CSIR-800 Programs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-1-0001**			
Course Title	**Biostatistics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Summarization of Data: measures of center, dispersion, skewness Dependence of variables: Correlation, linear regression, logistic regression Basic probability distributions: Binomial, Normal, Chi-squares. Estimation of parameters: method of moments, maximum likelihood Testing of hypotheses: (a) parametric tests: t-test, z-test, chi-squares test, ANOVA (b) non-parametric tests: Mann-Whitney, Kruskal Wallis, Kolmogorov-Smirnov

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-1-0002**			
Course Title	**Computation/bioinformatics**			
Credit Distribution (L-T-P-C)	0	0	2	**1**

Course Description:

Linux/ Unix / DOS Connecting to a remote machine - ssh, scp, Putty, Team viewer etc. Shell script - Basic Linux commands Know your HPC Introduction to programming. Why programming? - Perl Statements, Basic Syntax and Variables - String variables and operators - how to manipulate string data Finding Patterns in Biological sequences - Regular expressions in Perl Introduction to R, a programming and environment language for statistical computation and graphics Sequence analyses using loops, conditions and boolean operators Reading and writting files, lists, dataframes and S4 objects Data retrieval from online sources, vectors, matrices - writting your own functions Random sampling, statistical tests and data visualization Bioconductor - installation and sequence analyses Bioconductor - Gene expression analyses

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-1-0003**			
Course Title	**Basic Chemistry**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Thermodynamics Solutions and Ions Chemical bonding and molecular structure Chemical Kinetics Stereochemistry Introduction to drug discovery (Medicinal chemistry approach) Drug target, discovery and development (forward and reverse approach

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-1-0004**			
Course Title	**Research Methodology, Communication/ethics/safety**			
Credit Distribution (L-T-P-C)	0	0	2	**1**

Course Description:

An introduction to research methods and methodology Qualitative and quantitative studies Theoretical and experimental analysis Hypothesis generation and hypothesis testing Primary and secondary research Exploratory, descriptive and explanatory studies Problem identification and question framing Research tools and techniques Study design and implementation Data analysis and interpretation Research presentation and knowledge dissemination Reviewing scientific advancements and projecting future prospects

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-2-2601**			
Course Title	**Genomics: Information flow in Biological Systems**			
Credit Distribution (L-T-P-C)	1	1	0	**2**

Course Description:

G. K. Chesterton said: "A building is akin to dogma; it is insolent, like dogma. Whether or no it is permanent, it claims permanence, like a dogma. People ask why we have no typical architecture of the modern world, like impressionism in painting. Surely it is obviously because we have not enough dogmas; we cannot bear to see anything in the sky that is solid and enduring, anything in the sky that does not change like the clouds of the sky." Science moves forward by the demolishing of existing dogmas. Nowhere in biology is it more relevant today than our understanding of the genome and its complexity. The course will chart the changes in our understanding and appreciation of the human, and other, genomes. It will attempt to bring forth the latest concepts in dissecting the genome and revealing functional elements of evolutionary and regulatory importance.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-2-2602**			
Course Title	**Protein Science and Proteomics**			
Credit Distribution (L-T-P-C)	1	1	0	**2**

Course Description:

Proteins, sequence-folding relationship, evolution of sequence, silent mutations and folding, diseases of conformation. · Structure and conformation, techniques and challenges · Dynamic regulation of protein function · Why proteomics?, Basic principles, 1D and 2D gel electrophoresis, Differential in gel electrophoresis, Fractionation techniques used in proteomics, Peptide fragmentation, Quantitative proteomics using LC MS approach, Challenges in plasma proteomics

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-2-2603**			
Course Title	**The host and the invaders: the eternal battle**			
Credit Distribution (L-T-P-C)	1	1	0	**2**

Course Description:

The invader: survival stratagies of pathogens, virulence factors, sensing of environment and regulation of virulence gene expression, subversion of host defence mechanisms. The Host: host defence processes, involvement of immune cells and their mediators, abnormalities in host immune system and their implication in disease processes.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-2-2604**			
Course Title	**The nature of chemical and biological diversity**			
Credit Distribution (L-T-P-C)	1	1	0	**2**

Course Description:

Molecular Diversity and Biosynthetic pathways, Multi-functional Enzymatic assemblies, Coevolution of the chemical and biological world within the organisms

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-2-2605**			
Course Title	**Dynamic nature of biology**			
Credit Distribution (L-T-P-C)	1	1	0	**2**

Course Description:

Dynamic regulation of biological processes enable the cell and in turn the organism to survive a changing environment and thrive. Regulation has multiple layers starting from genome structure to gene expression and function. The mechanisms of regulation and the consequences of breakdown of regulation such as disease and loss of viability will be discussed.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-2-2606**			
Course Title	**Microbes and Environment**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Survival strategies of bacterial pathogen -I Survival strategies of Bacterial Pathogen-II Signalling Mechanisms in Bacteria-I Signalling Mechanisms in Bacteria-II Virulence Factors of Pathogenic Bacteria I Virulence Factoors of Pathogenic Bacteria II Microbial communities in nature microbial population dynamics analysis of microbial populations role of microbial populations in human disease transport systems in microbes Metal ion transport and metabolism in bacteria-1 Metal ion transport and metabolism in bacteria-2 Transport of complex metabolites in bacteria Bacterial secretions systems Role of complex molecules in bacterial physiology Microbes and immunity-1 Microbes and immunity-2 Role of quorum sensing in populations and their dynamics

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-2-2607**			
Course Title	**Defence Mechanisms to Inflammatory Disease**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction: What is the Immune System Innate and Adaptive Immunity Molecular Understanding of the Innate Immune Response Molecular Understanding of the Adptive Immune Response Defenders In Action Conduits of Information Microbiome and immunity Autoimmune theories The enemy within: Trojan Horses and Tuberculosis Too much of a good thing? Systemic Inflammatory Response Syndrome Heritable Variability of Immune Function Acquired Variability of Immune Function Non classical immune players and pigmentation as innate immune response Experimental Biology - Infection and Immune Response Why Defenders become Attackers? Limiting the Immune Response: Self Tolerance Refereeing the Fight: Acquired Tolerance Fighting Shadows: Allergy Inflammation and immune response in complex disorders

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-2-2608**			
Course Title	**From proteins to proteomes: Principles of Protein Structure, Function and Dynamics**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Protein Science & Proteomics

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-2-2609**			
Course Title	**Molecular and Cellular Mechanisms of Defense**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Old course "Defence Mechanism for inflammatory disease

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-3-2601**			
Course Title	**Playing with Genomes**			
Credit Distribution (L-T-P-C)	1	0	2	**2**

Course Description:

The course will provide hands-on oppurtunity to assemble and annotate a genome.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-3-2602**			
Course Title	**Complex Disease Genomics**			
Credit Distribution (L-T-P-C)	1	1	0	**2**

Course Description:

Using the genome to unravel complex diseases · Looking for the needles in the haystack: Genome Wide Association Studies (GWAS) · The intimate but mysterious relationship between genotype and phenotype · Genetic differences & personalized medicine · Genetic differences and predictive power

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-3-2603**			
Course Title	**Death & Disease: the cellular dilemma**			
Credit Distribution (L-T-P-C)	1	1	0	**2**

Course Description:

Cellular death, various forms and mechanisms · The why and wherefore of death · Death as a preventative for disease · When death pathways breakdown

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-3-2604**			
Course Title	**The Micro-World**			
Credit Distribution (L-T-P-C)	1	1	0	**2**

Course Description:

Microbial diversity · Culturable and unculturable bacteria · Microbial community structure and dynamics · Microbial-Environmental Interactions · Human body as a microbial observatory Metagenomics and synthetic biology

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-3-2605**			
Course Title	**Space and Time in Biological Systems**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

The different scales of time in biology How time is defined at the organismal and cellular level How time delays and periodicity is generted in biological systems How do network motifs regulate biological processes

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-3-2606**			
Course Title	**Immortality: the everlasting quest**			
Credit Distribution (L-T-P-C)	1	1	0	**2**

Course Description:

The ability to regenerate lost or damaged organs is a dream humans have had since the beginning of civilization. Although humans have very limited capacity for regeneration, there are a many organisms that can regenerate complete organs and at times their whole body. We will explore these magical organisms and distill what we have learnt from studies of such organisms. The discussion course will try to estimate what our challenges will be if stem cell biology has to meet its expectations. We will discuss the latest advances made in the field of stem cell biology and the extent of our present ability to convert somatic cells into stem cells and then lead them down particular pathways of differentiation. The need to understand development and cellular reprogramming to generate tissues of our choice from the pluripotent stem cells.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-3-2607**			
Course Title	**Electronics for Biologists**			
Credit Distribution (L-T-P-C)	1	0	2	**2**

Course Description:

Revolution in electronics has transformed our lives over the last few decades. However, most of the complex electronic systems that we see today are constructed from a few basic electronic components. The aim of the course is two-fold: To explain and demonstrate how complexity arises out of a few basic electronic elements thereby encouraging students to draw parallels between complex biological systems and electronic systems. Secondly, students will learn how to create complex interactive objects and environments such as sensing platforms using open source Arduino microcontrollers. Basic principles of optics will also be introduced as a part of the course and participants will have an opportunity for hands-on exploration of common biological instruments such as microscopes, cell sorters and sequencers. The course has enough flexibility built-in so that students can design their own assignment projects and explore their areas interest.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-3-2608**			
Course Title	**Molecular and Cellular Mechanisms of Defense**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

What is the Immune System Innate and Adaptive Immunity Molecular Understanding of the Innate Immune Response Molecular Understanding of the Adptive Immune Response Defenders In Action Conduits of Information Microbiome and immunity Autoimmune theories The enemy within: Trojan Horses and Tuberculosis Too much of a good thing? Systemic Inflammatory Response Syndrome Heritable Variability of Immune Function Acquired Variability of Immune Function Non classical immune players and pigmentation as innate immune response Experimental Biology – Infection and Immune Response Why Defenders become Attackers? Limiting the Immune Response: Self Tolerance Refereeing the Fight: Acquired Tolerance Fighting Shadows: Allergy Inflammation and immune response in complex disorders

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-3-2609**			
Course Title	**Death or Immortality: the hard choice**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Signalling pathways in apoptosis Organelle stress sensors and cell death mechanisms in neurodegenerative diseases. Mitochondrial paradigm of metabolic and degenerative diseases, aging, and cancer The molecular mechanisms linking ER stress to apoptosis with emphases on relevance to pathophysiology and integration and complementation among the various apoptotic pathways induced by ER stress. How the mitochondrial sirtuins function in the control of basic mitochondrial biology, including energy production, metabolism, apoptosis and intracellular signaling. Redox Mediated Signaling Cascade Leading to Cell Death in Cancer Aging, Disease, Injury & Death Regeneration, Stem Cells, Differentiation & Patterning

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-3-2610**			
Course Title	**Basic Programming for biologists**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

Basics of programming work environment. Basics of Matrix Algebra Matrix and Vector Operations. Concepts of Algorithms. File handling and introduction to data types. Basic programming. Highthroughput Data Handling. Statistical curation of data. Data clustering using multiple techniques.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-3-2611**			
Course Title	**Formulating research problem**			
Credit Distribution (L-T-P-C)	0	1	0	**1**

Course Description:

The students will go through an exercise of formulating a workable problem within a set of parameters. At the end of the exercise they will write up and then defend their project proposal.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-3-2612**			
Course Title	**Showcasing your science**			
Credit Distribution (L-T-P-C)	0	0	2	**1**

Course Description:

Following a training on formulating a research problem, collectingand analysing data and writing the results up in a presentable format, the students will be present the data in a invited talk format. They will be trained for this and then evaluated on their presentation skills

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-3-2613**			
Course Title	**Structural Biology: Structure, Dynamics and Modeling of Biological Macromolecules**			
Credit Distribution (L-T-P-C)	0	0	1	**0.5**

Course Description:

Structural Biology is a discipline of science aiming to understand the correlation between molecular structure and function of proteins. It is largely concerned with finding out these three dimensional structures at atomic detail, understanding how they fold, and how these structures lead to biological function. Specifically, students will receive training in: 1) Introduction to structure and dynamics of biomolecules 2) Tools used to model and visualize structures in depth (This will include practical workshop to give hands-on-training on MODELLER and VMD) 3) Basic Introduction to Biomolecular Modeling and Simulation Methods

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-3-2614**			
Course Title	**Frontier areas of research in biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Seminar course: Students will be exposed to scientific talks in a variety of areas in biology to broaden their knowledgebase

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-3-2615**			
Course Title	**Imaging and image analysis**			
Credit Distribution (L-T-P-C)	0	0	1	**0.5**

Course Description:

Students will be given practical training on the principles of imaging and image analysis with examples and some hands-on data handling

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-3-2616**			
Course Title	**Critical Analysis of Scientific Literature**			
Credit Distribution (L-T-P-C)	0	0	2	**1**

Course Description:

Students will read and discuss, through presentations, scientific publications. The emphasis will be on critically analyzing the idea itself and the results

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-3-2617**			
Course Title	**Ayurgenomics**			
Credit Distribution (L-T-P-C)	2	0	2	**2**

Course Description:

About Science and Practice of Ayurveda Ayurveda for Predictive, Preventive, Personalised, Participatory and Promotive Medicine (P5 Medicine) Contemporary P4 medicine: Approach and Challenges Ayurgenomics : an integrative approach for P4 medicine Introduction to the TRISUTRA framework of Ayurveda in the perspective of systems biology and networks medicine Concept of Tridosha, the common organising principle of Ayurveda : link between internal and external environment & role in health, disease and human individuality Multiscalar Sytems Biology : Resonance with Tridosha at different functional hierarchies from genotype to phenotype Mechanotransduction in biological systems : Resonance with principles and application of Trisutra Ayurveda Human Individuality and concept of Prakriti Prakriti development and influencing factors: Parallels with prevailing concepts and molecular mechanisms Phenome Stratification: Methods of Prakriti evaluation by Ayurveda and modern objective parameters Application of Ayurveda's Prakriti principles and stratification methods in understanding variability in response to external environment, disease susceptibility, progression and therapeutic management Molecular correlates of Tridosha and Prakriti : examples from earlier studies Ayurgenomics approach for understanding health- disease transitions and mechanisms of disease; Disease gene network and disease-phenotype de-convolution through Ayurgenomics approach Therapeutic aspects of Ayurveda with respect to pharmacological and life style interventions : Contempory relevance of practice and science Novel insights into mechanisms of disease and drug action through integration of therapeutic aspects of Ayurveda with modern biology and genomics

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-3-2618**			
Course Title	**Genes and networks**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction of participants, Course material distribution, Discussion on the need to study network modules 10 minute discussion on dimerization. Define network modules. Transcriptional networks Discussion on the expected outputs of FFL, NAR, SIM, cascade etc Circadian rhythms, oscillations the role of delay Repressilator. The spirit of synthetic biology The objectives of the course are so students learns to Appreciate the value of systems biology Navigate a paper gene networks Know the limits of your hypothesis or approach (especially when you choose experimental techniques) Start appreciating the difference between empirical science and quantitative science

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-3-2619**			
Course Title	**Disease Mechanisms: Integration of Metabolic and Cellular Signaling**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Focus of the course: How physiological changes are routed through metabolic and cellular pathways and lead to diseased states Topics: • Metabolic flux, partitioning and cellular outcomes • Design principles of electron transport in conjunction with metabolism • Mitochondrial dynamics • Cellular signaling pathways – conduits of information propagation • Calcium dynamics and cross-talk • ER quality control • Autophagy and its involvement beyond degradation • Maladaptation and defining the diseased state: from genotype incompatibility to environmental influence • Analyzing complex cellular fates

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-4-0001**			
Course Title	**Project Proposal Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Project Proposal to be prepared by selecting topics of high relevance and novelty, and will have state-of-the art review, methodologies, recommendations

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-4-0002**			
Course Title	**Review Article Review Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Review Article on the research area undertaken by the student

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IGIB, New Delhi**			
Course Nomenclature	**BIO-IGIB-4-0003**			
Course Title	**CSIR-800 Project Work**			
Credit Distribution (L-T-P-C)	0	0	8	**4**

Course Description:

Six–Eight weeks have to be dedicated on a project concerned with societal/rural issues under the CSIR-800 Programs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-1-0001**			
Course Title	**Biostatistics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Summarization of Data: measures of center, dispersion, skewness Dependence of variables: Correlation, linear regression, logistic regression Basic probability distributions: Binomial, Normal, Chi-squares. Estimation of parameters: method of moments, maximum likelihood Testing of hypotheses: (a) parametric tests: t-test, z-test, chi-squares test, ANOVA (b) non-parametric tests: Mann-Whitney, Kruskal Wallis, Kolmogorov-Smirnov

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-1-0002**			
Course Title	**Computation/bioinformatics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Computers: Introduction, Evolution and Classification of computers. Fundamentals of computing. Bit and Byte, Introduction to types of Hardware and Software. Components of Computer. Introduction to operating systems. Introduction to Computer Viruses. Network: Introduction. Network structure and architecture, Hierarchical networks, Ethernet and TCP/IP family of protocols, transport protocol design. Types of network, Topologies of network, Router, Switch, Data Communication, Concept of Wireless networking, LAN, WAN, MAN, Security of the network, Fire-walls, Network Applications Information Technology: Concepts of client Server Architecture, Concept of search Engine, Database search engines. Introduction to Internet Introduction to Word, Powerpoint and Excel Introduction to Bioinformatics: History of Bioinformatics, Genome sequencing projects, Human Genome Project, Applications of Bioinformatics. Introduction to databases, Type and kind of databases, Applications and limitations. Literature Search Databases, Nucleic acid and protein databases, Animal and plant databases, Ensembl Genome project TIGR database, Biotechnological databases, Motifs and Pattern Databases, Databases for species identification and classification, Structural databases. Database Retrieval and deposition systems. Web tools and resources for sequence analysis: Pairwise and multiple sequence Alignment, Sequence similarity search: BLAST, Pattern recognition, motif and family prediction, Restriction map analysis, primer design, Gene prediction, Phylogenetic Tree, Protein structure prediction and visualization.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-1-0003**			
Course Title	**Basic Chemistry**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Chromatography and Analytical Techniques:Thin Layer Chromatography: Theory and Applications, High Performance Liquid Chromatography: Principles, Instrumentation, Choice of Column, Detector and Applications. Gas Chromatography: Principles, Instrumentation, Choice of Column, Detector and Applications.Principle of Green Chemistry.Need and Challenge of Green Chemistry; Definition and Principles of Green Chemistry; Example of Wasteful Reaction e.g., Fridel Craft Acylation; Improved Catalysis; Green and Brown Synthesis of Ibuprofen; Effect of Improved Synthesis of Sertraline on Waste.Natural products and their applications in medicinal chemistry.Principles of Drug Design: Lipinski's rule of Fives, Pharmacophore, Isosterism, Bioisosterism, Lengthening Alkyl Chains. Drug Discovery Optimization & Development, Discovery of Lead Compound. Natural Product derived Drugs, Process of Drug Discovery from Plants, Reverse Pharmacology.Phenolics.Classes of Polyphenols, Basic Nature and Carbon Skeleton, Occurrence, Distribution and Biosynthesis of Flavonoid Group, Steriochemistry of Flavonoids. Isolation, Identification and Characterization. Importance and role in Plants, Animals and Humans.Terpenoids:Introduction, Distribution, Classification, Essential Oil, Monoterpenoids,Sesquiterpenoids, Diterpenoids, Triterpenoids, Sterol, their Biosynthetic Pathways and Isolation and Characterization.Alkoloids:Definition, Nomenclature, Occurrence, Isolation, General method of structure Elucidation, Role of alkaloids in plants, Physiological action.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-1-0004**			
Course Title	**Research Methodology, Communication/ethics/safety**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Philosophy and structure of scientific thoughts, Objective and Motivation of Research, Meaning of the Research, What constitutes a research topic? How to select a research topic?, Importance of literature review, Selection of appropriate methodology, Collection of data, Interpretation of data, Writing research paper, Paper presentation in scientific conference, Statistical methods, Importance of documentation, Procedure for Hypothesis Testing, Values and Ethical Problems, Criteria of Good Research, Good laboratory practice, Chemical, Radioactive and Biological safety: Possible hazards and precautionary measures; do and don'ts upon exposure Research methodology, communication, ethics, safety Asking the right questions: Originality, Depth, Precision can co-exist Formulating and refining the hypothesis: Those who do not learn from the past are condemned to repeat it Study design: Recognizing and minimizing bias Experiment design: Sometimes less is more and the importance of controls Good lab practices: Record keeping, organizing data, organizing the lab space Data interpretation; objectivity, quantification, double blind studies and necessity of statistics Comunicating your data:writing up your research Comunicating your data: presenting your findings Radiation safety Chemical and Biosafety Intellectual property rights What is ethics, the different interpretations & historical instances of unethical science Case studies: Data fraud/ plagiarism and Human Ethics violation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-2-2701**			
Course Title	**Biotechniques and Instrumentation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

pH and Buffers in Biology, Chromatography, Electrophoresis, Mass spectrometry, Radioisotopes, Microscopy, Immunotechniques, Gene and genome technologies, Spectroscopy, Protein and proteomics, Techniques in Plant Physiology, Techniques in Microbiology, Techniques in cell and tissue culture

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-2-2702**			
Course Title	**Biology of Macromolecules**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Structure and function of Cell and Cell organelles, Nucleic acids and proteins; Chromatin structure; Organization of nucleosome and chromosomes; Molecular aspects of cell division and cell cycle; DNA replication in Prokaryotes and Eukaryotes; RNA transcription and processing; Transcriptional regulation in prokaryotes and eukaryotes; Genetic code: Properties and codon usage patterns; Protein synthesis, protein modifications and secretion; Regulation of protein synthesis; Transposable genetic elements, Types and mechanisms of transposition; Chloroplast and Mitochondrial Genome Organization Enzymes, Enzyme kinetics, Why study enzyme kinetics? Single substrate, bisubstrate reactions, Determination of Km. Enzyme inhibition – Reversible and irreversible inhibition, Competitive, Non-competitive and uncompetitive inhibition

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-2-2703**			
Course Title	**Biology of Inheritance**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Evolution, Mendel's Laws of Inheritance, Chromosome theory of inheritance, Codominance and incomplete dominance; pleiotropism, genotypic interactions, epistasis, mechanism of epistasis; Mitosis and Meiosis in plants, animal and human. Cell cycle and cell division. Linkage and mapping in eukaryotes; Coincidence and interference. Concept of sex determination and patterns in plants and animals; sex chromosomes; Sex-linked, sex-limited and sexinfluenced characters. Extra-nuclear inheritance: determining non-Mendelian Inheritance; maternal effects, cytoplasmic inheritance. Nature and components of variation, heritability and genetic advance, self incompatibility and male sterility system, role of mutations and chromosome modifications, Genetic consequences of self and cross fertilization, mating systems, apomixes.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-2-2704**			
Course Title	**Biology of Infection**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Host pathogen interaction Infection and infectious process and routes of transmission, Methods of transmission and role of vectors (Mosquitoes, Sand fly) Description and pathology of bacterial diseases Infections caused by Gram negative and Gram positive bacteria, Tuberculosis, Principles of antibiotic action mechanisms and molecular basis of antibiotic resistance Description and pathology of fungal diseases Infections caused by candida spp, Infections caused by filamentous fungi Description and pathology of parasitic infections e.g. Malaria and Leishmania General properties of viruses Structure and replication of DNA and RNA viruses, Virus-host interactions, Detection and Cultivation of viruses Description and pathology of viral infections Infections caused by Flavi-viruses, Pox viruses, herpes viruses, myxo and paramyxo viruses, adenoviruses and other respiratory viruses, hepatitis viruses, HIV Biology and pathogenesis involved in Flavi-viruses Immunology Innate and acquired immunity, Components of immune system, T-cell subsets and surface markers, antigen processing and presentation, Antigen-antibody interactions, Types of hypersensitivity reactions, Host response to viral infection (anti-viral immunity), antiviral compounds, Vaccines and vaccinations Techniques in diagnostic microbiology: Immunological techniques, Serological techniques, Nucleic acid techniques, Biological safety in handling pathogenic bacteria and viruses

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-2-2705**			
Course Title	**Genomics: Information flow in Biological Systems**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to genomics; Cloning vectors (plasmids, cosmids, BAC, PAC, YAC). Genome Organization: Nuclear, Mitochondrial and Chloroplast Genome, Techniques in genomics; Advance sequencing techniques and their application in genomics; Application of genomics study in plants Genome mapping: Markers and methods for genome mapping, Linkage analysis, Genome-wide association studies. Overview of Arabidopsis and rice genome.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-2-2706**			
Course Title	**Protein Science and Proteomics**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Amino Acids and Proteins Peptide backbone, side chains, polarity, Absorbance, Single letter codes etc. Protein Structure Primary, secondary, tertiary and quaternary structure, covalent modifications of the polypeptide chain, Forces that determine protein structure, Structural motifs in regulatory proteins: DNA-binding proteins, Zinc finger motif, Helix T urn Helix motif Basic Leucine Zipper motifs. Tools: Databank of protein sequences (SWISS-PROT), Basics of protein sequence alignment Protein Regulation Enzymes I: Mechanism of Catalysis Enzymes II: Kinetics & Regulation Protein Methods: Protein separation and purification Methods Protein Function Analysis The Life Cycle of a Protein: Folding to Destruction (Proteasomes and unbiquitination) Introduction proteomics; Extraction of proteins for proteomics analysis; Separation of proteins for proteomics analysis; Organelle proteomics; Protein identification and characterization; Post-translational modifications; Structural proteomics and computational analysis; Protein-protein interactions; Techniques for Proteome research; High throughput proteomic screening for novel bioactive peptides/proteins/enzymes

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-2-2707**			
Course Title	**Plant-Microbe Interaction**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Principles and Concepts in Host-Pathogen Relationship, Recognition Concept and Infection for Pathogens and Non-Pathogens, Role of Enzymes, Toxins, Growth Regulators in Disease Development, Oxidative Burst, Phenolics, Phytoalexins, PR Proteins, Elicitors-Defense Strategies, Signal Transduction, Systemic Acquired Resistance and Induced Systemic Resistance Structural Genes, Defense Genes, Hypersensitive Reaction, Reactive Oxygen Species, Phytoalexins, Programmed Cell Death, Viral Induced Gene Silencing, R-Gene Expression and Transcription Profiling, Mapping and Cloning of Resistance Genes and Marker-Aided Selection, Gene Pyramiding. Economic Impact of Viral and Viroid Diseases, Molecular Characteristics, Movement through Plasmodesmata and Vasculature, Viral Determinants Involved in Phloem Transport of Plant Viruses.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-2-2708**			
Course Title	**Plant Environment Interaction**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to environment: classification, components of environment; Ecology and ecosystems; Phenotypic plasticity and plant adaptation; Introduction to abiotic stress; Plant responses to abiotic stresses; Introduction to biotic stress; Plant responses to biotic stress

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-2-2709**			
Course Title	**Crop Protection**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Major pests of crops, insect host plant relationship, principles of insect physiology, toxicology and pathology, insecticide resistance and residue monitoring, insect pest management, biopesticides, principals of integrated pest management

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-2-2710**			
Course Title	**Developmental Biology-Plants**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to developmental biology of plants, genetic regulation of plant growth and development, gametophyte development, fertilization and seed development, seed germination, seed adaptation in relation to environment

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-2-2711**			
Course Title	**In Vitro Development and Morphogenesis in Plants**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction, Production of disease free quality planting materials; Somaclonal variations (concept and applications, visual, molecular and other screening methods); Haploids (anther, ovule culture and bulbosum technique, detection of haploids, applications); Endosperm culture, triploid production and its application; Protoplast culture, somatic hybrids and cybrids, selection strategies and applications; Secondary metabolites, hairy root culture, molecular farming, scale up studies using bioreactors; Ex situ conservation, short and long term storage of germplasm; Applications of tissue culture in commercialization; In vitro methods of crop improvement using transgenic technology and their Implications

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-2-2712**			
Course Title	**Molecular Breeding of Plants**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to molecular breeding; Techniques in molecular breeding; Morphological and Molecular markers, QTL analysis; Application of molecular breeding in plants, Mapping populations (F2, Back crosses, Recombinant Inbred Lines , Near Isogenic Lines and Doubled Haploid lines). Molecular mapping and gene tagging of important traits, Marker-assisted selection, Gene pyramiding, Association mapping, Genomic selections.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-2-2713**			
Course Title	**Natural Resource Management**			
Credit Distribution (L-T-P-C)	1	1	0	**2**

Course Description:

Sustainable agriculture, Soil fertility and productivity, SOM, Nutrients function, Dynamics of major plant nutrients, nutrient use efficiency, IPNMS system, Precision agriculture, Growth Analysis, Crop response function, Economics of Agroforestry systems

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-2-2714**			
Course Title	**Bioresources and Bioprospection**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Phyto-taxonomy principles and fundamentals, Hotspots, Mega-diversity, Threat categorization, Conservation initiatives, Principles and Practices of Ecology, habitats, Biomes, Community and continuum, Community organization, Diversity, Succession, Productivity, Trophic organization and Plant invasion, Principles of remote sensing, Sensors, Platforms, Digital image processing, Introduction and component of GIS, GIS data types, GIS analysis.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-2-2715**			
Course Title	**Bioresource Production Systems**			
Credit Distribution (L-T-P-C)	1	1	0	**2**

Course Description:

Advances in Soil-plant-water Relationship: Energy concepts, Physiomorphological behaviour of plants, Soil physico-chemical properties, isotopes and radiation techniques, Metabolic and hormonal responses, Water use efficiency, Crop growth and yield, adaptation of plants to water variation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-2-2716**			
Course Title	**Nutrigenomics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Nutrition and its importance in human health, nutrition and human genetic diversity, epigenomicc and nutrition, ethical issue and social implication, nutritional enrichment and quality improvement of food products, nutrient toxicity and safety assessment, national and International standards, regulations and recommendation for human nutrition

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-2-2717**			
Course Title	**Advances in protected cultivation of flower crops**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Crop introduction, structures, external factors influencing plant growth and flowering, propagation, growing media and bed preparation, plantation, varieties, deficiency and toxicity symptoms of major and micro-nutrients, fertigation, method of crop development, crop protection, yield, grading, and post-harvest handling.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-2-2718**			
Course Title	**Biofertiliser Technology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Plant Growth Promoting Bacteria, Mycorrhizae, Actinorhiza, Current Advances in Microbial Bio-Inoculants, Latest Concepts in Taxonomy of Nitrogen Fixing Microorganisms, Plant Growth Promoting Rhizobacteria, Mechanism of Nitrogen Fixation, Molecular Basis for Legume Rhizobia Interaction, Nitrogen Fixation in Free Living and Associative Bacteria, Actinorhizal Symbiosis, Role of Biotechnology in Agriculture.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2701**			
Course Title	**Seminar Course**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Two parts- theory and practice Theory (1 class and one invited speaker): Understanding listeners ; organizing content; creating presentation; using visual aids; vocal impact; presentation skill; maintaining confidence and building positive image; and managing interactive session. Practice: Delivering seminar on a specific topic.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2702**			
Course Title	**Cancer Biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to cancer, cancer types and their prevalence, diseased and cancerous cell: morphological and microscopic features, important tumor markers, molecular basis of Key Players like carcinogens, tumor virology, oncogenes, tumor suppressor genes, cell cycle regulation in cancer development, role of genomic instability in cancer pathogenesis, Histone acetylases/deacetylases in cancer progression, Understanding of posttranscriptional and posttranslational modifications in cancer cell, angiogenesis and malignancy, stem cell biology & cancer stem cells, Hypoxia/ tumor cell microenvironment and important signaling pathways involved in cancer progression, Systems Biology in cancer, epigenetics in cancer, MicroRNAs and cancer, cell death: nacrosis and apoptosis. Discovery and clinical validation of a targets in cancer, Pharmacokinetic and Pharmacodynamic parameters of important anticancer drugs, tools, techniques & important parameters involved in screening new bioactive(s) as possible anticancer agent(s), Cell cycle regulators: Role as therapeutic targets in cancer, gene silencing and RNAi technology in cancer treatment. Role of Histopathological & Immunocytochemical techniques in cancer diagnostics and research, initiation and propagation of cancer cells in cell culture systems: Evaluation of important properties and their relevance with human biology, Pathways involved in cell differentiation/ immortalization in cancer. Aggressive tumors: Gleason score in pathology, Orthotropic and xenografted models: Importance and their limitations in understanding cancer

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2703**			
Course Title	**Cell and Tissue Engineering**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Molecular mechanisms regulating metabolic pathways and cellular processes, Recombinant technology, optimization and upscaling of engineered cells /tissue for higher metabolite production

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2704**			
Course Title	**Frontiers of Biology: Synthetic Biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Molecular biology of metabolic processes in plants and microbes. Molecular regulators of metabolic pathways. Approaches of engineering metabolic pathways in plants and microbes

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2705**			
Course Title	**Advanced Bioinformatics**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Databases and resources in Bioinformatics, Gene expression analysis, Sequence analysis and algorithms, Next generation sequencing, Non-coding elements, Structural Bioinformatics, Programming and Scripting, Statistics

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2706**			
Course Title	**Nanobiology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Nanobiotechnology and nanomaterials, Nanomaterials synthesis, Characterizations of nanoparticles, Biomolecules-nanoparticle interaction, Applications in nanomedicines and nanodiagnostics.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2707**			
Course Title	**Gene Environment Interaction**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Recent advances in plant responses to biotic and abiotic stresses. Impact of environmental changes at molecular and cellular levels in plants.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2708**			
Course Title	**Microbial Diversity and Habitat Ecology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Current developments in microbial taxonomy, phenotypic microarrays, chemotaxonomy, nucleic acid and protein based methods, explorations for yet to be cultured microorganisms, metagenomics approach and recent topics on various groups of microorganisms, basis of adaptation to extreme environments, biotechnological applications of extremophilic microorganisms, industrially important extremophilic enzymes, assignments and discussions

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2709**			
Course Title	**Advances in Crop Disease Management**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Genetic improvement of microbial biocontrol agents-metabolites, rhizosphere colonization, disease control; Mass multiplication of biocontrol agents, delivery systems, monitoring, commercial biopesticides, quality control of biocontrol agents; Enzyme based formulations-status and problems Molecular diagnostic methods, pathogen-derived resistance, genetic engineering approaches to develop disease resistance plants, biosafety issues related to GM crops Integrated Disease Management and Integrated Pest Management strategies for control of viruses and their vectors RNAi silencing in plant disease management

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2710**			
Course Title	**Plant Viruses as Expression Vectors for Vaccines, Gene Silencing, Drug Delivery Vehicle**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Protein expression/vaccine production; drug delivery; functional characterization of plant genes (VIGS vectors)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2711**			
Course Title	**Dietary Supplements**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Dietary supplements and their relation to nourishment, Nutraceutical and Functional food, bioactive molecules as dietary supplements, interaction between bioactive dietary supplement in specific diseases, in vitro cellular and molecular mechanism of bioactive molecules and safety assessment.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2712**			
Course Title	**Advances in Phytogenetic Remodeling**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Genetic basis of generation advancement, mating systems, apomixes and its applications, Inheritance of qualitative and quantitative characters, Response and aids to selection, Gene pool concept, plant introduction and role of plant genetic resources in plant improvement, domestication, Hybridization and selection methods for self and cross-pollinated plants, combining ability, genetic basis of heterosis and inbreeding, development of inbreds, Development of hybrids, self incompatibility and male sterility in crop plants and their commercial exploitation, development of synthetics and composites; improvement of asexually/clonally propagated plants, quality seed production, concept of plant ideotype, Plant breeders rights.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2713**			
Course Title	**Special Technologies for Phytogenetic Remodeling**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Nature and classification of mutations; mutagens; factors affecting mutagenesis, Induction of polyploidy, role of mutation and polyploidy in plants; wide hybridization, barriers to crossability and methods to overcome, cell and tissue culture, micropropagation, in vitro screening for resistance to biotic and abiotic stresses, haploids and doubled haploids (DH) production, embryo culture and its applications, somaclonal variation; protoplast culture and protoplast fusion

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2714**			
Course Title	**Biometrical Approaches to Phytogenetic Remodeling**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Foundations of biometrical concepts; continuous variation - its nature and origin; polygene concept; scales and transformation; components of means and variance; heritability; prediction of response; mating designs; combining ability analysis using line x tester and diallel approach; genotype x environment interaction and stability analysis; genetic divergence; genotypic and phenotypic correlations; path-coefficients and discriminant function in plant selection

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2715**			
Course Title	**Viral Pathogenesis in Plants**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Manipulation of host and insect vectors by viruses for their transmission; Replication, plant virus interactions and plant responses to biotic stress ; Mechanism of action of viral suppressors of RNA silencing; endogenous suppressors employed by plant viruses to overcome silencing; viral sRNAmediated regulation of gene expression in compatible interactions, transcriptome and proteome dynamics in response to infection

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2716**			
Course Title	**Advances in protected cultivation of flower crops**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Crop introduction, structures, external factors influencing plant growth and flowering, propagation, growing media and bed preparation, plantation, varieties, deficiency and toxicity symptoms of major and micro-nutrients, fertigation, method of crop development, crop protection, yield, grading, and post-harvest handling.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2717**			
Course Title	**Advanced Insect Toxicology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Advanced Insect Toxicology Principals of insecticide toxicology; classification of pesticides, structure and mode of action of pesticides, degradation of pesticides by various agents, evaluation of insecticide toxicity, hazards of pesticides to human, joint action of insecticides, factors affecting toxicity of insecticides, insecticide compatibility, phytotoxicity, metabolism; pest resistance to insecticides, resistance management, pest resurgence. Safe handling of insecticides, diagnosis, and insecticide-poisoning treatment. Integrated Pest Management Trends in the development of Integrated Pest Management in national and international level, IPM Theory and Practice, economic threshold concept and economic consideration, Biological control agents, Integration of different methods of pest management. Cost-benefit ratios, case studies of successful IPM programmes.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2718**			
Course Title	**Epigenetics and Chromatin Organization**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to epigenetics; Techniques in epigenetics; Epigenetics in plants evolution, adaptation and environmental stress, Chromatin structure; Organization of nucleosome and chromosomes; Molecular aspects of cell division and cell cycle. DNA replication in Prokaryotes and Eukaryotes. Transcriptional Gene Regulation: Operon Concept, Transcription Factors, Promoters, cis-regulatory elements and enhancers; Gene Silencing: Transcriptional gene silencing, Post transcriptional gene silencing; Small RNAs and their mechanism of regulation;RNA processing and Inron splicing

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2719**			
Course Title	**Integrated Pest Management**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Trends in the development of Integrated Pest Management in national and international level, IPM Theory and Practice, economic threshold concept and economic consideration, Biological control agents, Integration of different methods of pest management. Cost-benefit ratios, case studies of successful IPM programmes.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2720**			
Course Title	**Crop Modelling and System Research**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Systems-definition, input-output relationships, crop modeling-static descriptive and explanatory models, modeling techniques, Crop modeling- methods for water and nitrogen stress effects, data requirement and limitations, Modeling crop-environment interaction, applications of simulation modeling in environmental impact assessment

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2721**			
Course Title	**Fermentation Technology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Types of fermentation, fermentation kinetics, factors affecting fermentation process, process parameters optimization, bioreactor design and function and modes of operation, aeration and agitation, sterlization downstream processsing and industrial fermentation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2722**			
Course Title	**Plant Conservation and Reproductive Biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Conservation Biology: Principles and Applications Introduction to the science of conservation biology, Threats to plant diversity- Causes and consequences of habitat fragmentation, destruction, overexploitation , diseases, invasive aliens, pollution, and climate change Vulnerability to Extinction Habitats, Species and populations vulnerable to extinction, Examples and Case Studies Conservation at Species and Population Levels: Population Genetics and Conservation I Measurement of genetic diversity, Population bottlenecks and maintenance of genetic diversity Population Genetics and Conservation II Gene flow, Reproductive/mating systems, Inbreeding and out-breeding depression Effective population size and management of genetic diversity Conservation Biology or Rare and Endangered Plants Concepts and practical approaches, Case studies, Designing framework for new case studies Conservation at Landscape and Ecosystems Levels Methods and strategic approaches, Case studies Plant Species Loss: Assessment of Extension Risks IUCN Red lists: Criteria and Classification, National Red Lists, Biodiversity hot spots Plant Conservation Methods and Strategies In situ conservation, Ex situ conservation, Integrated conservation, Recovery, Reintroduction and rehabilitation of endangered habitats and species, Case studies; Visit to botanic garden, Conservatories, Gene banks, etc. Introduction of Plant Reproductive Biology Modes and mechanics of reproduction in plants Functional Mechanism of Sex Gametes and Reproductive Behavior Ontogeny and development of sex gametes in cryptogams, Ontogeny and development of sex gametes in phaenerorgams, Floral biology and phenology Reproductive Progression and Plant Breeding Intra and Inter-gametophytic mating and sporophyte development, Nature os breeding system, homozygosity and heterozygosity, Reproductive success and origin of polyploidy genotype Pollen and Pollination Biology Structural and developmental pattern of pollen, factors influencing pollen productivity (environment, genetic) and pollen syndrome, Pollination mechanism, Plan-pollinator interactions, Pollen and pistil interaction Fertilization and Seed Biology Fertilization mechanism, embryo and endosperm development, Fruit biology, seed formation, dispersion, and syndrome, Seed germination and seedling demography Abnormal Reproductive Behavior in Plants Male sterility and self incompatibility, Polyembryony, Parthenogenesis, Parthnocarpy, Apogamy, Apomixes, Apospory Recent Trends in Reproductive Biology In vitro culture of pollen, spores, gametophytes, sporophytes, embryo and tissues, Physiological and molecular aspects of sex gamete expression, differentiation, development and floral induction, Production of androgenic plants and somatic hybridization Reproductive Biology and Threatened Plants Genetic load and reproductive barriers, Physiological and genetic infringement of reproductive barriers, Case study, Visit to Conservatory, fernery and moss houses etc

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-3-2723**			
Course Title	**Ethnobotany and Traditional Knowledg**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Ethnobotany, definition and scope, Role and relevance of Ethnobotany, Ethnobotany and medical botany, Interdisciplinary nature of Ethnobotany, Medical Botany and drug development, Methods and approach of ethnobotany, Ethnobotany and plant taxonomy, Ethnobotany and bioprospection, Validation of Ethnobotanical knowledge, Cross cultural Ethnobotany, Plant folk medicines and H.P. India, Ethnobotany and biopiracy, Documentation and development of database.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-4-0001**			
Course Title	**Project Proposal Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Project Proposal to be prepared by selecting topics of high relevance and novelty, and will have state-of-the art review, methodologies, recommendations

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-4-0002**			
Course Title	**Review Article Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Review Article on the research area undertaken by the student

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IHBT, Palampur**			
Course Nomenclature	**BIO-IHBT-4-0003**			
Course Title	**CSIR-800 Project Work**			
Credit Distribution (L-T-P-C)	0	0	8	**4**

Course Description:

Six–Eight weeks have to be dedicated on a project concerned with societal/rural issues under the CSIR-800 Programs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-1-0001**			
Course Title	**Biostatistics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Summarization of Data: measures of center, dispersion, skewness Dependence of variables: Correlation, linear regression, logistic regression Basic probability distributions: Binomial, Normal, Chi-squares. Estimation of parameters: method of moments, maximum likelihood Testing of hypotheses: (a) parametric tests: t-test, z-test, chi-squares test, ANOVA (b) non-parametric tests: Mann-Whitney, Kruskal Wallis, Kolmogorov-Smirnov

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-1-0002**			
Course Title	**Computation/Bioinformatics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Computers: Introduction, Evolution and Classification of computers. Fundamentals of computing. Bit and Byte, Introduction to types of Hardware and Software. Components of Computer. Introduction to operating systems. Introduction to Computer Viruses. Network: Introduction. Network structure and architecture, Hierarchical networks, Ethernet and TCP/IP family of protocols, transport protocol design. Types of network, Topologies of network, Router, Switch, Data Communication, Concept of Wireless networking, LAN, WAN, MAN, Security of the network, Fire-walls, Network Applications Information Technology: Concepts of client Server Architecture, Concept of search Engine, Database search engines. Introduction to Internet Introduction to Word, Powerpoint and Excel Introduction to Bioinformatics: History of Bioinformatics, Genome sequencing projects, Human Genome Project, Applications of Bioinformatics. Introduction to databases, Type and kind of databases, Applications and limitations. Literature Search Databases, Nucleic acid and protein databases, Animal and plant databases, Ensembl Genome project TIGR database, Biotechnological databases, Motifs and Pattern Databases, Databases for species identification and classification, Structural databases. Database Retrieval and deposition systems. Web tools and resources for sequence analysis: Pairwise and multiple sequence Alignment, Sequence similarity search: BLAST, Pattern recognition, motif and family prediction, Restriction map analysis, primer design, Gene prediction, Phylogenetic Tree, Protein structure prediction and visualization.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-1-0003**			
Course Title	**Basic Chemistry**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Thermodynamics Solutions and Ions Chemical bonding and molecular structure Chemical Kinetics Stereochemistry Introduction to drug discovery (Medicinal chemistry approach) Drug target, discovery and development (forward and reverse approach)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-1-0004**			
Course Title	**Research Methodology, Communication/ethics/safety**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Philosophy and structure of scientific thoughts, Objective and Motivation of Research, Meaning of the Research, What constitutes a research topic? How to select a research topic?, Importance of literature review, Selection of appropriate methodology, Collection of data, Interpretation of data, Writing research paper, Paper presentation in scientific conference, Statistical methods, Importance of documentation, Procedure for Hypothesis Testing, Values and Ethical Problems, Criteria of Good Research, Good laboratory practice, Chemical, Radioactive and Biological safety: Possible hazards and precautionary measures; do and don'ts upon exposure Research methodology, communication, ethics, safety Asking the right questions: Originality, Depth, Precision can co-exist Formulating and refining the hypothesis: Those who do not learn from the past are condemned to repeat it Study design: Recognizing and minimizing bias Experiment design: Sometimes less is more and the importance of controls Good lab practices: Record keeping, organizing data, organizing the lab space Data interpretation; objectivity, quantification, double blind studies and necessity of statistics Comunicating your data:writing up your research Comunicating your data: presenting your findings Radiation safety Chemical and Biosafety Intellectual property rights What is ethics, the different interpretations & historical instances of unethical science Case studies: Data fraud/ plagiarism and Human Ethics violation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-2-3201**			
Course Title	**Biotechniques and Instrumentation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Affinity chromatography, gel filtration chromatography, high performance liquid chromatography (HPLC), PCR, restriction fragment length polymorphism (RFLP), Agarose gel electrophoresis, Polyacrylamide gel electrophoresis (PAGE), two dimensional gel electrophoresis, MALDI-TOF, LCMS/ MS, ELISA, RNAi, blotting techniques, Microarray technology. Separation and characterization of biopolymers, UV/Visible Spectrophotometry, Co-immunoprecipitation, transfection, transgenics, Light microscopy, Fluorescence microscopy, fixation and staining techniques, Transmission electron microscopy (TEM), Scanning, electron microscopy (SEM), flow cytometry.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-2-3202**			
Course Title	**Biology of Macromolecules**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Structure and function of cell and cell organelles. Cell division, cell cycle, apoptosis, senescence and response mechanism of cells in stress conditions. Nucleic acids structure and types. Replication, Transcription and Translation. Regulation and mechanism of Expression. MicroRNAs and post-transcriptional regulation. Interaction studies between protein, RNA and DNA. Genetic code: Properties and codon usage patterns. Enzyme basics and kinetics. Understandings of Km and Velocity. Enzyme inhibition: types and mechanism. Single and multi substrate reaction. Mechanism and types of enzymes used in molecular biology

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-2-3203**			
Course Title	**Biology of Inheritance**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Mutagenesis, DNA repair and applications of mutagenesis; Mechanisms of gene transfer including conjugation & transduction, and Recombination & mapping in prokaryotes; Applications and uses of transposable elements, gene regulation, virulence functions and horizontal gene transfer. Mendelian principles; Segregation and linkage; Recombination and mapping in eukaryotes; Gene interactions, forward and reverse genetics; chromosome rearrangements and their effects on gene expression.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-2-3204**			
Course Title	**Xenobiotic Interaction and response**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to the discipline of toxicology and basic concepts essential for understanding the action of exogenous agents on biological systems; Principles underlying the absorption, distribution, metabolism, and elimination of chemicals. Toxicokinetics, specific classes of toxic responses, and experimental methods used to assess toxicity; ethics in toxicological studies, Regulatory toxicology.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-2-3205**			
Course Title	**Cell Signalling**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

[Introduction, historical perspective, classification]; Growth/ Differentiation/Apoptosis Leukocyte integrin/endothelial cells interaction; Receptorligand interactions/Cytokine signaling/G-protein-mediated signalling; Growth hormones/Receptor-mediated signalling; Neuronal signalling/Signaling in stem cells; Ion channels; Signaling in immune cells; Signaling aberration & Diseases [cancer, cardiovascular, diabetes]; Gene expression [Relevant transcription factors]; Cell regulatory mechanism [Role of p53, pRb, PTEN]; Nuclear Receptors & Signal transduction; Signal transduction pathways [Ras-MAPK, PI3K-AKT, p53, pRb; TGF-β, JAK-STAT, cAMP, Notch, Hedgehog and Wnt]; Signaling Crosstalks; Small group discussion [Literature review].

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-2-3206**			
Course Title	**Intellectual Property Management**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

1. Introduction to IP: 2. International Treaties: 3. Invention & Patent: 4. Patent Searching and Analytics: 5. Filing of Patent Applications: 6. Copyright and Related rights: 7. Trademarks: 8. Industrial Designs, Layout design of integrated circuits and Geographical Indications: 9. Undisclosed information (Trade Secrets): 10. Biotechnology & IP: 11. IP in Digital Economy: 12. IP Audit, Valuation & Licensing of IP: 13. Emerging Issues in IP 14. Case study

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-2-3207**			
Course Title	**Stem cells, Regeration and Aging**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Stem cells: the concept, types, development and plasticity; Isolation, purification, characterization, cultivation and differentiation of stem cells in laboratory conditions; Stem cell niche, homing, and migration; Genomics and proteomics of stem cells; Role of epigenetics to decide the fate of stem cells; Cellular and nuclear reprogramming to develop induced pluripotent stem cells; Therapeutic prospects of stem cells; Stem cells and biomaterial scaffolds for constructing tissues and drug delivery; Cancer stem cells: immunologic targeting; Applications of stem cells in toxicology studies; Ethical issues associated with stem cells.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-2-3208**			
Course Title	**System Immunology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

System Immunology: Integrated perspective on entities and players participating at different system levels to the immune function; Antibody Structure, Antigenantibody interactions, Binding Sites, Affinity (Mathematical derivation) Avidity (Mathematical derivation); Major histocompatibility complex (organisation, function, inheritance & self restriction); Infection & Immunity (emphasis on TB, AIDS & Influenza); Signalling in immune cells and signalling aberration; Molecular Biology of CMI and delayed reactions; Complement System (different components, functions, regulation and biological consequences); Allergy and Inflammation, IgE (Hypersensitive reactions & Mediators); Organ specific and systemic Autoimmunity; Transplantation (immunologic basis and clinical manifestation of graft rejection; immune tolerance and xenotransplantation)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-3-3201**			
Course Title	**Seminar**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

History of science with emphasis on Indian contribution: Seminar by students.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-3-3202**			
Course Title	**Bioremediation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Principles and Applications, Bacterial Remediation of Metal and Metalloid Contamination, Bioremediation through Fungi and Mycorrhiza, Biodegradation of Recalcitrant Organic Wastes, Phytoremediation of Contaminated Water, soil & Constructed Wetlands, phytoremediation and Role of Nutrient Management, Role of Nanotechnology in Bioremediation Scope of Soil Carbon Sequestration in Degraded Soils, Limiting Factors in Bioremediation, Processes, Biodiversity, Climate change research, Microbe-Plant interactions, Eco-restoration and Remediation technologies, Environmental pollution and importance of microbes: Microbial diversity in different Ecosystem, Constructed wetlands for treatment of Wastewaters, Microbial diversity in different Ecosystem, Resource recovery from waste, Bio-energy, Environmental Biotchnology Environmental Management: Waste management through Eco-friendly approaches, Concept and dynamics of ecosystem, biogeochemical cycles; Types of ecosystems, Community structure and organisation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-3-3203**			
Course Title	**Environmental Toxicology**			
Credit Distribution (L-T-P-C)	1	0	2	**2**

Course Description:

Environmental Toxicology in present and future perspective; Environmental hazards (physical, chemical and biological aspects); Origin, sources and types of toxicants/pollutants; Dispersal/movement of toxicants in environmental compartments; Conventional and alternate models in toxicity assessment; Assessment of toxicity of pollutants; Absorption, distribution and storage of toxicants; Dose response relationships; Biotransformation and elimination of toxicants; Mechanisms of action of toxicants; Gene-environment Interactions Pollution monitoring and Risk assessment; Tools for detection; Fate and transport Hazardous waste management; Regulation, approaches and strategies; Mitigation of environmental pollutants; Physico-chemical and biological processes Practicals Xenobiotics exposure/effect assessment using alternate animal models; Case histories/studies and new concepts or topics will be interactively discussed; Case studies: real-life sites/ecological settings/industry in and around Lucknow

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-3-3204**			
Course Title	**Model systems in Toxicological Research**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

In vitro: Basics and principles of cell and tissue culture; primary cell cultures, cell lines, stem cells. In vivo: Bacteria, Yeast, Paramecium, Tetrahymena, Caenorhabditis elegans, Drosophila, Daphnia, Tubifex, Snail, Zebrafish, mammalian models. In silico: Basics of QSAR and modeling of macromolecules

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-3-3205**			
Course Title	**Food & Chemical Toxicology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Food and Chemical Toxicology: Uniqueness and Complexity; Toxicity of Metals; Toxicity of Pesticides; Methods for detection and analysis of metals and pesticides in different matrices; Principles of drug induced toxicity; Cosmetic Toxicity; Protocols for identification of protein allergens: mucous membrane test, patch test; Nutraceuticals; Sea Food: Safety issues; Plant Toxins & Phytomedicine; Preparation and characterization of herbal extracts; Genetically Engineered Food/Crops; Food Contaminants and Adulterants; Analysis of food additives, contaminants and adulterants; Food Borne Pathogens; Toxicity of Tobacco Related Products; Protocols for assessment of genotoxicity and carcinogenicity: Food Poisoning and Food Safety: Prevention of Food Adulteration Act

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-3-3206**			
Course Title	**Target Organ Toxicity**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Overview: Types of injury that may be produced in specific mammalian organs and organ systems by exposure to chemical toxicants; Neurotoxicity and its mechanisms: Concepts in neuropharmacology and neurophysiology; Neurogenesis; Neuro-behavioral toxicology; Chemical induced neurodegeneration and neuroprotection/ neuroregenration; Hepatotoxicity: Overview; Effect of xenobiotics on liver; Regulatory mechanism involved in hepatotoxicity; Nephrotoxicity: Renal structure and function; Chemical induced renal injury; Pulmonary toxicity: Structure and function of the respiratory system with emphasis on lungs; Systemic lung injuries; Immunotoxicity: Basics of the immune system; Mechanisms of immunotoxicity; Immunosensitization and allergy; Endocrine and reproductive toxicity: Teratogenicity; Reproductive organs and chemicals affecting reproduction; Endocrine system and chemical induced endocrine disruption

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-3-3207**			
Course Title	**Nanomaterial Toxicology**			
Credit Distribution (L-T-P-C)	1	0	2	**2**

Course Description:

Basics of nanotechnology: Synthesis and characterization of engineered nanomaterials (ENMs); Sol gel, biological and ball milling methods for synthesis of ENMs and characterisation using electron microscopy (TEM, SEM), dynamic light scattering (DLS) and confocal microscopy; Safety assessment of ENMs – methods and challenges: Methods for assessment of toxicology of ENMs; preparation of nano-suspensions; exposure paradigm, cellular uptake, absorption and distribution; in silico approaches for macromolecule interaction with ENMs; Mechanism of toxicity of ENMs: Effect of size, shape and surface chemistry on cellular responses (oxidative stress, cytotoxicity, genotoxicity, immunotoxicity etc); Ecotoxicity of ENMs: Models and methods used for ecotoxicity assessment of ENMs; life cycle analysis of ENMs; Safe handling of ENMs and their disposal. Practical Preparation of nano-suspensions and their characterization Cellular uptake using flow cytometer Cytotoxicity assessment for ENMs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-3-3208**			
Course Title	**Chemical Carcinogenesis and Chemoprevention**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Chemical Carcinogenesis: Past, Present and Future, Genetic and Epigenetic Mechanism of Carcinogenesis, Models, Mechanism and Etiology of Cancer, Role of Oncogenes in Cancer Development, Cell Transformation and Apoptosis, Mutation and Cancer, Targeted Drug Delivery in Cancer Chemotherapy.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-3-3209**			
Course Title	**Neurotoxicology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction- Basic elements of central, peripheral and autonomic nervous system; Organization of CNS- Brain & Spinal Cord; Anatomy of Neuron and neuronal supportive cells – Glial cells; Physiology of Neuron –generation and propagation of AP; Central Neurotransmitters & Receptors: Catecholamines (Epinephrine, Norepineprine & Dopamine), 5-Hydroxytrytamine (5-HT), Acetylcholine, Histamine Inhibitory Amino Acid (GABA, Glycine & Benzodiazepines) Excitatory Amino Acid (Glutamate); Neurotoxicology: Basic concepts and principles; Developmental neurotoxicology; Neurotoxicology of metals, pesticides, solvents, monomers, natural agents; Neurobehavioal approaches to screen neurotoxicity; Assessment of neurotoxicity involving neuromorphological, neuropathological, neurophysiological and neuroimaging approaches; Assessment of neurotransmitters and neurotransmitter receptors: Usefulness in neurotoxicology; In vitro and in vivo models in neurotoxicology; Clinical neurotoxicology : basic principles; Neurotoxins and neurodegenerative disorders; Risk assessment and use of biological markers for neurotoxicity; Neuroprotective and regenerative approaches

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-3-3210**			
Course Title	**Genes and Environmental Diseases**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

An introduction to abiotic stress, effect of temperature and pollutants on the gene expression, recent advances in organismal responses to abiotic stresses; Current tools to measure environmental exposures/pollutants; Effect of environment and methods to detect genetic variation; Genes, environment and neurodegenerative diseases; Genes, environment and cancer; Genes, environment and asthma and allergy; Genes, environment and reproductive diseases

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-3-3211**			
Course Title	**Frontiers of Biology: Synthetic Biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Basic concepts of biological components and design principles. Definition and basic understanding of synthetic biology. Emerging conmcepts of engineering principles in biology like network circuits, feedback loops, switches, oscillators, pulse generators, logic and filter circuits with vivid examples from immunology, cell signalling, transcriptomics etc. Usefullness of synthetic biology in toxicology research, stem cell biology and environment. Method for reconstruction of new parts and pathways in model organisms using modern genome engineering tools.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-3-3212**			
Course Title	**Microbes in Environment & Industrial Waste Management**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to environmental Microbiology, principle and methods for detection of pathogenic bacteria from water,soil & food, MPN, P-A test, Indicator bacteria, Total coliform, Fecal coliform bacteria, horizontal gene transfer and antibiotic sensitivity pattern in polluted environment, microbial toxin and toxicoids, concept of bioremediation , biostimulation, bioaugmentation, bioventing, biosparging, bipodgradation and biotransformation of complex and persistent oganic pollutants (POPs) and industrial waste, Rhizoremediation and Rhizofiltration of complex waste and POPs, Detection, Bioassay & purification of Microbial detoxifying enzyme from polluted environment, role of Nanomaterial for biostimulation and detoxifying enzyme, development of biosensor, quorum sensing and biofilm formation, Biosurfactant and quorum sensing molecules, detection of microbial community and metgenome in polluted environment, principle and various bioreactor for wastewater treatment,biodegradation of industrial waste in value added product.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-3-3213**			
Course Title	**Transgenic Technology: Principles and Applications**			
Credit Distribution (L-T-P-C)	1	1	0	**2**

Course Description:

Transgenic Technology overview: Design, selection, generation and optimization of constructs for in vivo expression, embryo collection, microinjection, identification of transgenic progeny, optimization of breeding population from founders; Types of transgenesis: Random and site specific integration; Lentiviral and BAC transgenesis; germ-line transformation in Drosophila; somatic transformation in C. elegans, pronuclear microinjection in mouse; Gene Targeted Transgenesis: Homologous Recombination, Cre-loxP site specific recombinase technology, FLP-FRT recombination, construct design, transfection, selection; Generation of Gene Knockouts; Conditional transgenics: GAL4/UAS system, Tet-on/Tet-off system, Cre-lox recombination system; transgenic phenotype analysis; Applications of transgenics: functional analyses of genes; Drug and toxicological testing, transgenics for animal agriculture; Transgenic models of human disease and therapeutics; Concerns associated with transgenics: maintenance, ethical issues and associated risks; Future prospects of transgenics

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-3-3214**			
Course Title	**Air Pollution and Environmental Impact Assessment**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction, Sources and classification of air pollution, Meteorology and air pollution dispersion, Monitoring and assessment of environmental parameters, Measurement techniques using modern instruments and their basic principles, Air Quality Standards, Air Quality Models, Effects of air pollution, Air pollution control device and technology, Environmental Impact Assessment (EIA), Environmental Statement (ES), Risk Assessment and Environmental Management Plan (EMP), Water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act, 1981, Environment (Protection) Act, 1986, Hazardous Waste Act/Rules 1989, International Treaties Related to Environmental issues, Climate change and Global warming.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-4-0001**			
Course Title	**Project Proposal Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Project Proposal to be prepared by selecting topics of high relevance and novelty, and will have state-of-the art review, methodologies, recommendations

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-4-0002**			
Course Title	**Review Article Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Review Article on the research area undertaken by the student

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IITR, Lucknow**			
Course Nomenclature	**BIO-IITR-4-0003**			
Course Title	**CSIR-800 Project Work**			
Credit Distribution (L-T-P-C)	0	0	8	**4**

Course Description:

Six–Eight weeks have to be dedicated on a project concerned with societal/rural issues under the CSIR-800 Programs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-1-0001**			
Course Title	**Biostatistics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Summarization of Data: measures of center, dispersion, skewness Dependence of variables: Correlation, linear regression, logistic regression Basic probability distributions: Binomial, Normal, Chi-squares. Estimation of parameters: method of moments, maximum likelihood Testing of hypotheses: (a) parametric tests: t-test, z-test, chi-squares test, ANOVA (b) non-parametric tests: Mann-Whitney, Kruskal Wallis, Kolmogorov-Smirnov

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-1-0002**			
Course Title	**Computation/bioinformatics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Computers: Introduction, Evolution and Classification of computers. Fundamentals of computing. Bit and Byte, Introduction to types of Hardware and Software. Components of Computer. Introduction to operating systems. Introduction to Computer Viruses. Network: Introduction. Network structure and architecture, Hierarchical networks, Ethernet and TCP/IP family of protocols, transport protocol design. Types of network, Topologies of network, Router, Switch, Data Communication, Concept of Wireless networking, LAN, WAN, MAN, Security of the network, Fire-walls, Network Applications Information Technology: Concepts of client Server Architecture, Concept of search Engine, Database search engines. Introduction to Internet Introduction to Word, Powerpoint and Excel Introduction to Bioinformatics: History of Bioinformatics, Genome sequencing projects, Human Genome Project, Applications of Bioinformatics. Introduction to databases, Type and kind of databases, Applications and limitations. Literature Search Databases, Nucleic acid and protein databases, Animal and plant databases, Ensembl Genome project TIGR database, Biotechnological databases, Motifs and Pattern Databases, Databases for species identification and classification, Structural databases. Database Retrieval and deposition systems. Web tools and resources for sequence analysis: Pairwise and multiple sequence Alignment, Sequence similarity search: BLAST, Pattern recognition, motif and family prediction, Restriction map analysis, primer design, Gene prediction, Phylogenetic Tree, Protein structure prediction and visualization.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-1-0003**			
Course Title	**Basic Chemistry**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Thermodynamics Solutions and Ions Chemical bonding and molecular structure Chemical Kinetics Stereochemistry Introduction to drug discovery (Medicinal chemistry approach) Drug target, discovery and development (forward and reverse approach

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-1-0004**			
Course Title	**Research Methodology, Communication/ethics/safety**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Philosophy and structure of scientific thoughts, Objective and Motivation of Research, Meaning of the Research, What constitutes a research topic? How to select a research topic?, Importance of literature review, Selection of appropriate methodology, Collection of data, Interpretation of data, Writing research paper, Paper presentation in scientific conference, Statistical methods, Importance of documentation, Procedure for Hypothesis Testing, Values and Ethical Problems, Criteria of Good Research, Good laboratory practice, Chemical, Radioactive and Biological safety: Possible hazards and precautionary measures; do and don'ts upon exposure Research methodology, communication, ethics, safety Asking the right questions: Originality, Depth, Precision can co-exist Formulating and refining the hypothesis: Those who do not learn from the past are condemned to repeat it Study design: Recognizing and minimizing bias Experiment design: Sometimes less is more and the importance of controls Good lab practices: Record keeping, organizing data, organizing the lab space Data interpretation; objectivity, quantification, double blind studies and necessity of statistics Comunicating your data:writing up your research Comunicating your data: presenting your findings Radiation safety Chemical and Biosafety Intellectual property rights What is ethics, the different interpretations & historical instances of unethical science Case studies: Data fraud/ plagiarism and Human Ethics violation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-2-3601**			
Course Title	**Biotechniques and Instrumentation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Part-I Chromatographic Analysis: GLC, HPLC, HPTLC and Flash chromatography Part- II- Spectroscopic analysis: UV, AAS and Mass spectrometry Part- III – Microscopy Light Microscopy, Confocal Microscopy, SEM and TEM NMR Spectroscopy in Plant Metabolomics: Introduction & Scope of NMR Spectroscopy and Applications of NMR Spectroscopy in Plant Metabolomics Electrophoresis: agarose and polyacrylamide gel (native and denaturing), 2-D gel Centrifugation (high speed, ultra and differential centrifugation) Common Molecular Biology Techniques Chromatography: affinity, ion exchange, hydrophobic chromatography, size exclusion and reverse phase chromatography Proteomics- MALDI-MS/MS, LC-ESI-MS/MS Practical Chromatography Techniques Spectroscopy Techniques

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-2-3602**			
Course Title	**Biology of Inheritance**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

What, why and how of this course Introduction, Scope of the course syllabus, Reading lists and handouts for students, Lottery for Term / Review paper topics In the beginning: Cell, chromosome, gene, hereditary units, hereditary materials, what is heredity? Unit of life – A cell and cellular basis for heredity: Why a cell divides? How it divides? Cell cycle, How does cell division impact heredity? Cell division – rules and parameters Chromosomal basis for heredity: Chromosome structures, its functions, chromosomes in cell division, chromosomes in heredity, Aneuploids, Polyploids Everyone had an opinion about heredity: Assorted theories for inheritance, Darwinism, Neo-Darwinism, Lamarckism Gregor Johann Mendel and his seminal contributions to our understanding of genetics and heredity: Where would we be if Mendel had not made his landmark contributions? Mendelism: Genes, determinants, alleles, Mendel's postulates, Laws of inheritance, their applications in real life, Universality or otherwise of these laws What happens when Mendelian laws are not followed / obeyed? Epigenetics, Transposition, Pleiotropy, Heterosis What happens when heredity rules go wrong? Inherited disorders, chromosome errors, single gene mutations, induced mutations Mechanisms of inheritance: Recombination, crossing over, chimerism, gene dosage, dominance and incomplete dominance, linkage and linkage disequilibrium, QTLs Does heredity in individuals differ from or impact on populations and communities? Population genetics, genetic communities, quantitative genetics Molecular genetics: Architecture of a Mendelian locus, its dissection and mapping, linkage, genetic and molecular mapping Why is study of genetics central to: Our understanding of evolution, populations, communities, ecology, recombinant DNA technologies? Students display their learning: Return of term / review papers, Seminars / Round-Table brainstorming How far did we succeed? Evaluation times are here again!!! Students to complete a test (30 min, MCQ with negative markings; 1/3 descriptive question); Students evaluate Faculty (15 min – Predesigned questionnaire); Valedictory and Closure of the Course (15 min)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-2-3603**			
Course Title	**Genomics: Information flow in Biological Systems**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction: From Sequence to function in the Age of genomics, Genome databases of various plants. Genome Organization: Nuclear, Mitochondrial and Chloroplast Genome Genome analysis: Cloning systems used in genomics, Sequencing and analyzing genome, Principles of Gene Annotation and prediction, tools and resources Genomes and transcriptomes of model organisms Small RNAs and their role in regulation of gene expression Functional genomics: Strategies to find important genes in the genome and their functional analysis Differential gene expression profiling methods (differential display, subtractive analysis, Microarrays, comparative transcriptomics) Comparative genomics and synteny (Multiple Sequence Alignments & Phylogenetic analysis) Practical Courses: Demonstration of microarray system Demonstration of 454 whole genome sequencing system Demonstration of Sequnome system

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-2-3604**			
Course Title	**Plant-Microbe Interaction**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Plant associated soil micro-organisms and microbial diversity Plant responses to PGPRs and pathogens Rhizosphere dynamics, effectors and signaling Plant microbe interaction in stressed conditions Molecular mechanisms of PGPRs and pathogens Application of Proteomics in plant microbe interaction Role of mutagenesis in plant microbe interaction Bioinoculants for nutrient and disease management Virus structure and morphology, plant virus diseases and symptomatology Transmission of plant viruses Replication and translocation of viral genomes Genome organization of viruses Practical Techniques for study of PGPRs and pathogens-I Techniques for study of PGPRs and pathogens-II Methodology for assay, detection and diagnosis Modern approaches of virus control

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-2-3605**			
Course Title	**Plant Environment Interaction**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Environment and Sustainable Development. Environment Pollution in National and Global Perspectives Sources of Air Pollutants and Plant Responses Sources and Fate of Pollutants in the Aquatic Ecosystems Responses of Plants to Water Pollution Sources and Behavior of Soil Pollutants Responses of Plants to Soil Pollutants Prevention and Mitigation of Air Pollution Prevention and Control of Water pollution Energy Resources and Conservation Plant adaptation to Environmental stress Environmental Degradation and Restoration Biomonitoring of Environmental contaminants Environmental Impact Assessment & Auditing Practical To study improvement in physico-chemical characteristics of waste water after treatment with aquatic plants, Physiological and Biochemical response of plants to toxic metals

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-2-3606**			
Course Title	**Cell Signaling**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Cell communication: Inter-organellar communication Nucleus-plastidmitochondrion, Plasmodesmata, signal delivery systems. Membrane receptors, Protein kinases: Ion channels, G-protein-coupled receptors, Wall associated kinases, MAPK kinases, Ca++-calmodulin system. Ethylene signalling: Plant two-component signaling systems Ethylene biosynthesis, ethylene signaling cascade ethylene responses in different tissues. Auxin signalling: Auxin receptors, Auxin-responsive gene expression, Proteolysis and auxin signalling. ABA signalling: Biosynthesis and Catabolism Pathways, Regulation of ABA synthesis and metabolism, ABA Signaling in seed maturation processes Proteolysis and protein interactions, ABA Signaling in Guard Cells, ABA as Antagonizing Signal to Light in Stomatal Movement. Cytokinins, Gibberellins: Cytokinin metabolism, Cytokinin signal transduction, Gibberellin metabolic pathway, Genes of GA Biosynthesis and regulation, Signal transduction pathway, Downstream transcriptional events induced by Gas, Sites of GA Signaling. Brassinosteroids, strigolactones, Signaling by JA, SA, polyamines: Biosynthesis, metabolism, signal transduction-mode of action Light signalling: Phytochrome-mediated responses-energy dependence, Structure of phytochromes, Phytochromes- mechanism of action, Phytochrome interacting factors, Phytochrome-regulated gene transcription Cross talk between signaling pathways

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-2-3607**			
Course Title	**Developmental Biology-Plants**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Root - Architecture and types, cell types, molecular basis of root development, lateral root formation, adventitious roots, root hairs, storage roots, gravitropism, hormonal control, root symbiosis, root apex Shoot - Shoot apical meristem, cell division,differentiation, xylogenesis, phloem, branching, secondary wood, molecular basis of development, hormonal control, cell growth, programmed cell death Leaf - Types, phyllotaxis, size and shape control, cell types, venation, plastid biogenesis, stomatal development, senescence Flower - Types, determinacy, ABC model, architecture, pigmentation, control of flowering time, photoperiod control, senescence, hormonal basis, scent, development of reproductive organs, pollination, apomixis Reproduction – Male and female gametophyte development, Pollination, fertilization, zygote, embryogenesis, Molecular basis, male sterility self incompatibility, somatic embryogenesis Fruit - Development, size control, ripening, parthenocarpy, molecular basis, hormonal control, climacteric fruits, abscission, sex determination Seed - Genetic control of seed development, seed structure, types of storage reserves, molecular basis, oil seeds, dormancy and germination, hormonal control, recalcitrance in seeds, photomorphogenesis, endosperm Secondary growth, cambium, trichomes, fibre, totipotency

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-2-3608**			
Course Title	**Epigenetics and Chromatin Organization**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Theory Epigenetics: DNA methylation and concept of epigenetics, Histone modifying enzymes and their role, Chromatin modifying matchinary, Chromatin architecture, Histone modifications, Hostone methylation, demethylation etc Transcriptional Gene Regulation: Operon Concept,, Transcription Factors and Classification, Promoters, cis-regulatory elements and enhancers, Pre-initiation complex and RNA Polymerase, transciprtion elongation and termination Gene Silencing: Transcriptional gene silencing, Post transcriptional gene silencing : Small RNA world and mechanism of regulation Post-transcriptional gene regulation: RNA processing, Inron splicing etc., Post- translational modifications of protein and their regulation Practical Nuclear Protein preparation, EMSA, Chromatin Immunoprecipitation and analysis

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-2-3609**			
Course Title	**Homeostasis and feedback in biological systems**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Light use and leaf gas exchange: Leaf anatomy, light interception and gas exchange, Chloroplasts and energy capture Carbon dioxide assimilation and respiration: Modes of photosynthesis, Photorespiration, Respiration and energy generation Gaining water and nutrients: root function: Root system architecture, Extracting water and nutrients from soil, Soil–root interface, Absorption of water and nutrients by roots Using water and nutrients: cell growth: Membrane transport and ion balance, Regulation of nutrient ion and Cell enlargement Vascular integration and resource storage: Long-distance transport of water and nutrients and Distribution of photoassimilates within plants, Phloem transport, Phloem loading, Phloem unloading and sink utilization Growth analysis: a quantitative approach: Concepts and techniques, Environmental physiology and Crop growth analysis

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-2-3610**			
Course Title	**Molecular breeding of plants**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Breeding strategies of self and cross pollinated crops Mode of reproduction in plants, pure line and mass selection, pedigree and bulk population, backcross, population improvement, Self incompatibility and male sterility and their use in hybrid seed production, recurrent selection Experimental designs in relation to plant breeding Randomized complete block design (RBD); latin square designs; augmented block design, Merits and limitations of different designs, Statistical and biometrical methods in plant breeding Analysis of Variance (ANOVA), Correlation, regression and path analysis, heritability, genetic advance, genetic gain, combining ability, heterosis and inbreeding depression, Tests of significance: Sampling distribution of mean and standard error; z and t-test, Chi- square test for goodness of fit, F test. Mutation and polyploidy breeding Selection of parents, mutagen treatment and handling of treated material, development of polyploids and their evaluation, Molecular Markers Overview of markers, Concept, Development methodology of AFLP, SSR, and SNP markers, Merits and demerits of different types of markers Mapping populations and phenotyping Types and developmental strategies (F2, RILs, DH lines), Merits and demerits of various types of mapping populations, Field experimental design and phenotyping Construction of linkage map Linkage map, marker polymorphism, genotyping, Data scoring, softwares and Linkage analysis, Germplasm characterization and Diversity Analysis Selection of markers, Genotyping, Data acquisition, Softwares, statistical methodologies and analysis Quantitative Trait Loci (QTLs) and QTL analysis Principle of QTL analysis,Genotyping, phenotyping, Methods to detect QTLs (Single markers, Simple and composite interval mapping), data acquisition, Softwares and analysis, Association mapping in plants Introduction, Choice of population, Analysis of population structure, Trait evaluation (phenotyping), Identification of marker/sequence polymorphism, Statistics of association mapping-Linkage disequlibrium (LD), measure of LD, factors affecting LD Marker Assisted Selection (MAS) Gene tagging by Bulk segreegent Analysis (BSA) and near isogenic lines (NILs), Gene pyramiding, advanced backcross QTL (AB-QTL) analysis, Breeding by Design, Effectiveness and efficiency of MAS over phenotypic selection, foreground and background selections; marker assisted hybrid (MAH) breeding; important examples of successful MAS. Practical Emasculation, pollination, Genotyping (PAGE and ABI DNA Analyzer), data scoring, polymorphism detection.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-2-3611**			
Course Title	**Biodiversity**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Aims, objectives and dynamics of Plant biodiversity Bio-geographic regions of plant biodiversity in India and world Diversity within different plant groups Assessment of biodiversity through classical taxonomic methods Ecological methods for plant diversity inventorying Drivers of biodiversity loss Role of Biosphere Reserve, National Parks, Wild Life Sanctuaries, Sacred Grooves in biodiversity conservation Species distribution and endemism Biodiversity and its sustainable uses Biodiversity and traditional knowledge Development of plant databases and its management Biodiversity legal and policy instruments Biodiversity, ecosystem function and ecosystem processes Ecological niche Impact of climate change on plant biodiversity Practical work: Field visit and ecological methods to study biodiversity

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-2-3612**			
Course Title	**Plant morphogenesis and regeneration**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

History and scope of plant tissue culture, concept of cellular differentiation Dedifferentiation, re-differentiation, totipotency and media composition. Plant Growth Regulators Auxin, cytokinin, GA, ABA, JA, ethylene signaling pathway Organogenesis and somatic embryogenesis: Fundamental aspects of morphogenesis, somatic embryogenesis and androgenesis, mechanisms, techniques and utility. Culture of different plant parts: Root, stem, leaf, meristem culture, ovary, ovule and nucellus culture, embryo culture, endosperm culture. Production of Haploids: Techniques for development of androgenic haploids, factors affecting anther culture, pollen culture, gynogenesis, applications of haploids. Somatic Hybridization: Protoplast isolation, fusion and culture, hybrid selection and regeneration, possibilities, achievements and limitations of protoplast research Application of Plant Tissue Culture: Clonal propagation, artificial seed production/ encapsulation somaclonal variation, production of secondary metabolites/natural products, automation in plant tissue culture, cryopreservation and germplasm storage Specific gene transfer: Direct and indirect methods, current status and limitations. Practical Laboratory organization and equipments, preparation and sterilization of media. Explant preparation, surface-sterilization, inoculation and subculture. Hardening and field transfer of tissue-raised plants, excised root culture, callus culture, encapsulation of seeds/somatic embryos.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-3-3601**			
Course Title	**Seminar Course**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Two compulsory seminars and group dicussion

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-3-3602**			
Course Title	**Cell and tissue engineering**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Genetic engineering of plant cells -Transgenic plants Methods of direct and Agrobacterium mediated gene transfer (Ti plasmid). Methods for DNA transformation: electroporation, microinjection, particle-gun technology. Strategies for crop improvement with special mention of biotic and abiotic resistant plants and value addition. Recombinase-directed chromosome engineering in plants Cre & lox system FLP& FRT system PhiC31 & aatP-attB system R and RS system/ParA& MRS system Production of pharmaceutically important drugs and therapeutics using genetic engineering Large scale production of secondary metabolites using cell and suspension cultures. Hairy root culture and Ri plasmid, Hairy root cultures as phytochemical factories and process of elicitation. Recombinant therapeutic protein production (medical molecular pharming) in plant cells/tissues. Metabolic Engineering of major metabolic pathways and products. Cloning and characterization of secondary metabolic genes. Bioengineering and other means to develop new plant products. Use of genetic engineering and molecular biology tools for Metabolic Engineering. Plant Cell reactors- type of reactors, comparison of reactor performances, Immobilized plant cell reactors. Practical Experiments Electroporation & particle-gun technology Molecular characterization of transgenic plants Hairy root induction and establishment Demonstration of bioreactor

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-3-3603**			
Course Title	**Climate change and Plants**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Sources of Green House Gases (GHGs) and their impact, Mitigation strategies of GHGs, Impact of elevated CO2 and temperature on plants, Plant responses to O3 stress, Drought tolerance mechanism of plants, Crop simulation modeling, Carbon sequestration, Green technologies to combat climate change, Climate change and forest ecosystems, Climate change and plant diseases, Climate simulation modeling, Remote Sensing & GIS, FACE technology Practical Ozone monitoring techniques Methane efflux measurement Ambient Air Quality Monitoring

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-3-3604**			
Course Title	**Bioremediation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Bioremediation: Principles and Applications Bacterial Remediation of Metal and Metalloid Contamination Fungal Bioremediation Mycorrhiza and Rhizoremediation Phycoremediation Biodegradation of Recalcitrant Organic Wastes Phytoremediation of Contaminated Water & Constructed Wetlands Phytoremediation of Contaminated Soils Phytoremediation and Role of Nutrient Management Role of Nanotechnology in Bioremediation Scope of Soil Carbon Sequestration in Degraded Soils Limiting Factors in Bioremediation Processes Practical Protocols/ Techniques of Soil Bioremediation using Microbes Protocols/ Techniques of Soil Phytoremediation Protocols/ Techniques of Phytoremediation for Aquatic Ecosystems Use of Soil Enzymology in Monitoring of Bioremediation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-3-3605**			
Course Title	**Environmental Biochem and Biotech**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Advances in Environmental Biotechnology Physiology of toxic metal transport and accumulation by plants I Physiology of toxic metal transport and accumulation by plants II Biochemical basis of metal hyperaccumulation in plants Detoxification mechanisms of toxic organic compounds Transgenic microbes for pollution management Molecules and pathways associated with metal detoxification in plants. Gene mining for metal accumulation and transport Transgenic plants as hyperaccumulators of heavy metals. Transgenic crops for low accumulation of toxic metals. Metagenomics of polluted habitats. GM crops and their impact on Environment. Practical Element estimation by AAS, ICPMS Enzyme assays- Antioxidant enzymes. Measurement of non protein thiols/Phytochelatins Gene expression by heavy metals (Microarray/RTPCR).

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-3-3606**			
Course Title	**Taxonomy and speciation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Unit-I: Taxonomy of plants History of plant taxonomy and classification of angiosperms International Code of Botanical Nomenclature Modern trends in Taxonomy: (a) Numerical taxonomy, chemo-taxonomy, cytotaxonomy, and (b) Palynology, embryology, anatomy and palaeo-botany Relevance of Herbaria & Botanical Gardens Systematics of Pteridophytes and Gymnosperms (General characters, classification, important families) Systematics of non-vascular plants Plant descriptors, systematic of some selected families in Dicots & Monocots Methods and techniques in plant taxonomy and herbarium Unit –II: Molecular Systematics and speciation Species concept Speciation in plants Molecular Systematics: Concepts and applications Molecular markers in plant systematics Procedures for collecting and sampling of plant materials Molecular Phylogenetics Phylogenetic Inferences Phylogeography: concepts and case studies in plants

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-3-3607**			
Course Title	**Plant Conservation and Reproductive Biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Conservation biology: principles and applications Introduction to the science of conservation biology, Threats to plant diversity- Causes and consequences of Habitat fragmentation, destruction, overexploitation, diseases, invasive aliens, pollution, and climate change Vulnerability to extinction Habitats, Species and Populations vulnerable to extinction, Examples and Case Studies Conservation at species and population levels: Population genetics and conservation I Measurement of genetic diversity, Population bottlenecks and maintenance of genetic diversity Population genetics and conservation II Gene flow, Reproductive/mating systems; -inbreeding and out - breeding depression Effective population size and management of genetic diversity Conservation biology of rare and endangered plants Concepts and practical approaches, Case studies, Designing framework for new case studies Conservation at Landscape and Ecosystems levels Methods and strategic approaches, Case studies Plant species loss: assessment of extinction risks IUCN Red lists: Criteria and Classification, National Red Lists, Biodiversity Hot spots Plant conservation methods and strategies In situ conservation, Ex situ conservation, Integrated conservation, Recovery, Reintroduction and Rehabilitation of endangered habitats and species, Case studies; visit to botanic garden, conservatories, gene banks, etc. Introduction to Plant Reproductive Biology Modes and mechanics of reproduction in plants Functional Mechanism of Sex gametes and Reproductive behaviour Ontogeny and development of sex gametes in cryptogams, Ontogeny and development of sex gametes in phaenerogams, Floral biology and phenology Reproductive Progression and Plant Breeding Intra and Inter gametophytic mating and sporophyte development , Nature of breeding system, homozygosity and heterozygosity, Reproductive success and origin of polyploid genotype Pollen and Pollination Biology Structural and developmental pattern of pollen, factors influencing pollen productivity (environment, genetic) and pollen syndrome, Pollination mechanism, plant-pollinator interactions , Pollen and pistil interaction Fertilization and Seed Biology Fertilization mechanism, embryo and endosperm development, Fruit biology, seed formation, dispersion and syndrome, Seed germination and seedling demography Abnormal Reproductive Behaviour in Plants Male sterility and self incompatibility, Polyembryony, parthenogenesis, parthenocarpy, Apogamy, apomixis, apospory Recent Trends in Reproductive Biology In vitro culture of pollen, spores, gametophytes, sporophytes, embryo and tissues, Physiological and molecular aspects of sex gamete expression, differentiation, development and floral induction , Production of androgenic plants and somatic hybridization Reproductive Biology and Threatened Plants Genetic load and reproductive barriers, Physiological and genetic infringement of reproductive barriers, Case study, visit to conservatory, fernery and moss houses etc .

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-3-3608**			
Course Title	**Economic Plants and Pharmacology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

1. Introduction to economic plants (Plant biodiversity of India vis-à-vis economic plant wealth, ethnobotany vs. economic botany, agriculture and cash crops) 2.Medicinal and health care plants (examples from vascular and non-vascular plants) 3.Plants for essential oils, flavouring agents, dye, colour and gum 4.Plants used in beverages, narcotics, wood, fiber and household article 5.Over exploitation of economically important plants, trade vs. environment concern, biodiversity loss and conservation (examples of threatened economic plants, methods for conservation) 6.Importance of quality control and standardization of herbal drugs, macro-microscopic evaluation, physico-chemical analysis. 7.Methods for collection practices, preparation of passport data sheet, post harvest processing, drying and packaging of herbal drugs. 8.Botanical (Morphological and anatomical/microscopical) identification of raw herbal drugs. 9.Detection of common adulterants and substitutes in whole and powdered drugs. 10.Pharmacopoeias and monographs, its preparations importance. 11.Evaluation of different Ayurvedic formulations, their quality control and SOP. 12.Seasonal variations and shelf-life studies of herbal drugs/formulations. 13.Pharmacological screening of herbal drugs and Toxicological evaluation of herbal drugs for toxicity studies. 14.Practical–Extraction of raw herbal drugs and essential oil, phytochemical screening of primary/secondary metabolites. 15.Practical–Quantification of chemical constituents in herbal drugs using chromatographic techniques- HPTLC. 16.Practical–Quantification of chemical constituents in herbal drugs using chromatographic techniques- GLC, HPLC.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-3-3609**			
Course Title	**Floriculture and Agronomy**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

1. Status and scope of Floriculture as a vibrant commercial entity and effective contribution for the enhancement of Agricultural GDP of India. 2.Development of trait specific new ornamentals (short duration, temperature and stress tolerant) by employing different breeding methods (hybridization, gamma radiation, chemical mutagens etc.) to cope with climate change effects for sustainable floricultural production. 3.Formulation of descriptors of commercial ornamentals by phenotypic and molecular characterization following DUS parameter in view of IPR issues. 4.Techniques of mass multiplication of ornamentals and production of disease free plantlets for large scale commercialization (rose, gladiolus, chrysanthemum, gerbera etc.) 5.Development of entrepreneurship in commercial floriculture (branding, protected cultivation, marketing export etc.). 6.Post harvest management of floricultural crops for better market value (extension of vase life, packaging, cool chain, storage, transport, auction etc.). 7. Value addition to floricultural produce (dehydration of flowers, seeds, plant parts and creation of artefacts, showpieces for enhancing commerciality of the floricultural produce after value addition.) 8.Selection, evaluation and standardization of mechanism for using house plants for mitigating indoor air pollution. 9.Organic farming-Principles & Practices 10.Natural Resource Management 11.Experimental Designs for Field Experiments 12.Soil Organic Matter and Integrated Nutrient Management 13.Plant Protection and Integrated Pest Management 14.Introduction to Major Industrial Crops 15.Sustainable Rural Development- Programmes & Policies Practical; Basic Soil and Plant Analysis

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-3-3610**			
Course Title	**Phylogenomics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

1. What is PHYLOGENOMICS? (1lecture) 2. Salient features and aspects of Phylogenomics R&D? How or when or why we need phylogenomics? (2 lectures) 3. How phylogenomics interfaces with two disciplines inplant sciences? What kindof experimental skills are requiredto carry out Phylogenomics R&D (1lectures) 4. Relateddisciplines that are usually associated with or impact Phylogenomics -Phylogeography, Palaeobotany, Phylogenetics, Cladistics, Neural Networks, Fuzzy Logic and (3 lectures) 5. Emergingtrends and state-of-the-science in Phylogenomics (1lecture) 6. The applications of phylogenomics inunderstandingthe tree oflife (includingplants); Chloroplast phylogenomics of different plant groups; Phylogenomics and plant adaptations (3 lectures) 7. Specialty studies inphylogenomics -perspectives on co-evolution of insects and adaptationto parasitism inplants (2 lectures) 8. Case study / Assignment in Phylogenomics and presentationofthese data -Case study topics can be allotted on the first day but the last 3 lecture slots to be used for their presentations: individual seminars ifnumber of students is less; else group discussions / group presentation (3 lecture hour equivalents)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-3-3611**			
Course Title	**Biofuels**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

1. What are BIOFUELS? What is their importance interms of geo-political realities and scenarios? (2 lectures) 2. What kindof biofuel options are available, known and / or developed at present, inthe global and inthe Indiancontext? (2 lectures) 3. Biofuel R&D -technology and process development -A state-of-the-art description, industrial and technological aspects (3 lectures) 4. Specialty biofuels including BIODIESEL, BIOETHANOL and BIOHYDROGEN (3 lectures) 5. Prospects for biological engineering, process and technology development for biofuels (2 lectures) 6. Value additionto biofuels programs (2 lectures) 7. Experimental simulation, designing and developing process through simulation and or actual practicals (2 lecture hour equivalents)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-3-3612**			
Course Title	**Knowledgebase Research Management and it's utilization**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

1. General Management-2 lecture Vision, Mandate of the organization, structure ofthe organization, budgeting of different component, control & functioning. 2. Project Management-2 lecture Technical manpower planning, Financial management, Event management, Project review and control, Media management, Inter & Intra Networking, Motivation, Project feasibility, Phases & Project Management. 3. Development of Business and R&D activities -2 lecture • Demand & supply • Product marketing • Concept marketing • Customer satisfaction • Quality • Media Management. • Backup by Highend research • Continuous upgradation 4. Technology Management Technology Management — 2 lecture • Issues intechnology development. • Interaction with industry case study/role playing • Agreement Negotiations & Drafting. • Issues in technology transfer. 5. Intellectual property rights management-2 lecture • Patents • Other than patents (Copy Right, Geographical Indicator, Trade Mark). 6. Benefits of R&D management-2 lecture • Benefits from licensing of technology. • Benefits from royalty. • Benefits from consultancy projects. • Benefit sharing vis-a-vis PPV and FRA, Biodiversity Act. 7. Regulatory authorities and legal misuse-2 lecture • Govt, agencies (GEAC, Bio-safety). • Different legal issues. • Biodiversity Act and National Biodiversity Authority. • Plant Protection Varieties and Farmers Right Act. • Material Transfer Agreements (MTA), Memorandum of Understanding (MOU). 8. Excellence in R&D management- 2 lecture Role of R&D management for excellence. Network of Science & Technology in India, Science Auditing: Performance measure and Indicators, Scientometrics: Concepts and applications

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-4-0001**			
Course Title	**Project Proposal Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Project Proposal to be prepared by selecting topics of high relevance and novelty, and will have state-of-the art review, methodologies, recommendations

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-4-0002**			
Course Title	**Review Article Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Review Article on the research area undertaken by the student

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NBRI, Lucknow**			
Course Nomenclature	**BIO-NBRI-4-0003**			
Course Title	**CSIR-800 Project Work**			
Credit Distribution (L-T-P-C)	0	0	8	**4**

Course Description:

Six–Eight weeks have to be dedicated on a project concerned with societal/rural issues under the CSIR-800 Programs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-1-0001**			
Course Title	**Biostatistics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Summarization of Data: measures of center, dispersion, skewness Dependence of variables: Correlation, linear regression, logistic regression Basic probability distributions: Binomial, Normal, Chi-squares. Estimation of parameters: method of moments, maximum likelihood Testing of hypotheses: (a) parametric tests: t-test, z-test, chi-squares test, ANOVA (b) non-parametric tests: Mann-Whitney, Kruskal Wallis, Kolmogorov-Smirnov

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-1-0002**			
Course Title	**Computation/bioinformatics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Computers: Introduction, Evolution and Classification of computers. Fundamentals of computing. Bit and Byte, Introduction to types of Hardware and Software. Components of Computer. Introduction to operating systems. Introduction to Computer Viruses. Network: Introduction. Network structure and architecture, Hierarchical networks, Ethernet and TCP/IP family of protocols, transport protocol design. Types of network, Topologies of network, Router, Switch, Data Communication, Concept of Wireless networking, LAN, WAN, MAN, Security of the network, Fire-walls, Network Applications Information Technology: Concepts of client Server Architecture, Concept of search Engine, Database search engines. Introduction to Internet Introduction to Word, Powerpoint and Excel Introduction to Bioinformatics: History of Bioinformatics, Genome sequencing projects, Human Genome Project, Applications of Bioinformatics. Introduction to databases, Type and kind of databases, Applications and limitations. Literature Search Databases, Nucleic acid and protein databases, Animal and plant databases, Ensembl Genome project TIGR database, Biotechnological databases, Motifs and Pattern Databases, Databases for species identification and classification, Structural databases. Database Retrieval and deposition systems. Web tools and resources for sequence analysis: Pairwise and multiple sequence Alignment, Sequence similarity search: BLAST, Pattern recognition, motif and family prediction, Restriction map analysis, primer design, Gene prediction, Phylogenetic Tree, Protein structure prediction and visualization.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-1-0003**			
Course Title	**Basic Chemistry**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Thermodynamics Solutions and Ions Chemical bonding and molecular structure Chemical Kinetics Stereochemistry Introduction to drug discovery (Medicinal chemistry approach) Drug target, discovery and development (forward and reverse approach

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-1-0004**			
Course Title	**Research Methodology, Communication/ethics/safety**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Philosophy and structure of scientific thoughts, Objective and Motivation of Research, Meaning of the Research, What constitutes a research topic? How to select a research topic?, Importance of literature review, Selection of appropriate methodology, Collection of data, Interpretation of data, Writing research paper, Paper presentation in scientific conference, Statistical methods, Importance of documentation, Procedure for Hypothesis Testing, Values and Ethical Problems, Criteria of Good Research, Good laboratory practice, Chemical, Radioactive and Biological safety: Possible hazards and precautionary measures; do and don'ts upon exposure Research methodology, communication, ethics, safety Asking the right questions: Originality, Depth, Precision can co-exist Formulating and refining the hypothesis: Those who do not learn from the past are condemned to repeat it Study design: Recognizing and minimizing bias Experiment design: Sometimes less is more and the importance of controls Good lab practices: Record keeping, organizing data, organizing the lab space Data interpretation; objectivity, quantification, double blind studies and necessity of statistics Comunicating your data:writing up your research Comunicating your data: presenting your findings Radiation safety Chemical and Biosafety Intellectual property rights What is ethics, the different interpretations & historical instances of unethical science Case studies: Data fraud/ plagiarism and Human Ethics violation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-2-4101**			
Course Title	**Biotechniques and Instrumentation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

General Instrumentation: handling, care, usage and safety. Concepts of spectroscopy and use of UV-VIS spectrophotometers, Concepts of centrifugation, use of centrifuges, Electrophoretic equipments-ID and 2D electrophoresis and data analyses, Blotting techniques, Immuno-cytochemisty, ELISAs, PCR – equipment and techniques, RT-PCR, QPCR, chromatographic techniques- GC, LC and HPLC, Microscopy- Bright Field, Dark field, Phase contrast, fluorescence and confocal imaging, Electron microscopy, Concepts of DNA and protein sequencing and equipment for sequencing, Equipments for highthroughput assays – Micro-titer plate readers and multimode readers, ultra-filtration equipment.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-2-4102**			
Course Title	**Protein Science and Proteomics**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Amino Acids and Proteins; Peptide backbone, side chains, polarity, Absorbance, Single letter codes etc. Protein Structure-Primary, secondary, tertiary and quaternary structure, covalent modifications of the polypeptide chain, Forces that determine protein structure, Structural motifs in regulatory proteins: DNA-binding proteins, Zinc finger motif, Helix Turn Helix motif Basic Leucine Zipper motifs. Tools: Databank of protein sequences (SWISS-PROT), Basics of protein sequence; alignment; Protein Regulation Enzymes I: Mechanism of Catalysis; Enzymes II: Kinetics & Regulation Protein Methods: Protein separation and purification Methods;Protein Function Analysis Practical Training to protein separation/detection using Western blotting; 1D and 2D Gel Electrophoresis: pI, Isoelectric focussing, 2 dimensional gel; Gel Staining methods and analysis Protein spot/Band processing for Mass spectrometric analysis Introduction to Mass spectrometers such as MALDI-TOF/TOF and electrospray mass spectrometer. Spectral Peak Annotation and Database search Shotgun Proteomics

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-2-4103**			
Course Title	**Basics and Applied Microbiology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Isolation, Culture and Preservation of Microorganisms Streak plate method; pour plate method, pH, temperature and oxygen requirements. Cultivation of anaerobic bacteria, Isolation of soil algae. Aseptic handling of microbes including Sterilization (autoclaving). Culture Media: Solid and broth cultures shake cultures. Specific media for different group of microorganisms. Inoculum development, Methods of culture preservation- Refrigeration, Freezing, preservation in soil, freeze drying (Lyophilization, Principles of freeze drying- Predrying, ampoule preparation, harvesting the cultures, Primary drying, secondary drying, opening of ampoules Sterilization – concepts and methods Identification and classification of microbes- Colony characters, Staining methods, Biochemical tests, physiological tests and polyphasic approach. Classification based on extreme conditions like thermophiles, Alkaliphiles and halophiles Methods in applied microbiology Screening, primary, secondary, enrichment cultures Industrial Microbiology- Production of microbial Metabolites- organic acids, amino acids, antibiotics, enzymes, biopolymers. Microbial assisted processes, Immobilization techniques and processes employing immobilized whole cells. Strain improvement- Classical and modern techniques. Agricultural Microbiology – Role of microbes in plant health, plantmicrobe interactions, Biofertilizers, Biopesticides, PGPR

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-2-4104**			
Course Title	**Basic Molecular Biology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Nucleic Acid Techniques -I Isolation of DNA (genomic, plasmid, bacterial, fungal, plant and mammalian), total RNA and mRNA. Gene cloning -prokaryotic and eukaryotic; Cloning strategies – shot gun cloning, PCR cloning, cDNA cloning. Cloning vectors –plasmids, viral vectors, phagemids, cosmids, fosmids, BAC vectors, YAC vectors, shuttle vectors, and expression vectors. Common host organisms used for genetic engineering. Construction of genomic and cDNA libraries. Gene transfer techniqueschemical transformation, electroporation, virus mediated transfer, Agarose gel electrophoresis for DNA separation, Denaturing gels for RNA Nucleic acid Techniques II PCR, RT-PCR, qPCR techniques and applications. Primer design – manual and using software, design of degenerate primers. DNA sequencing, primary analyses of sequences, nucleic acid databases searches, sequence deposition and access. Applications of nucleic acid base specificity in research – hybridizations, microarray techniques; Probes in nucleic acid detection –radioactive and non radioactive. Genomics –Functional, Comparative; High throughput analyses – Microarrays, Metagenomics, Applications of genomics.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-2-4105**			
Course Title	**Bioprospecting and Biochemical Pharmacology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Cellular organization and interaction i. Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. ii. Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle. iii. Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways. iv. Cellular communication: General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins. Molecular Processes i. DNA replication, repair and recombination: ii. RNA synthesis and processing: iii. Protein synthesis and processing: iv. Control of gene expression at transcription and translation level Methods in Research i . Molecular biology methods: Isolation and purification of RNA , DNA (genomic and plasmid) and proteins, different separation methods; analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis, isoelectric focusing gels; RFLP, RAPD, AFLP techniques, PCR and RT-PCR. i i. Histochemical and Immunotechniques: Antibody generation, detection of molecules using ELISA, RIA, western blot, immune precipitation, flow cytometry and immune-fluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH, HPLC, Ultra centrifugation. Chemistry of Natural Products i. Secondary Metabolites/ Alkaloids: Occurrence, isolation, classification and properties of alkaloids, structure determination, synthesis and physiological activities of ephedrine, nicotine, atropine and morphine. Terpenoids: occurrence, isolation, geraniol, citral, amyrin. ii. Phenolic compounds: Classification and properties. iii. Therapeutics: Bioactive principles in herbs, plants with hepatoprotective, hypoglycemic, anticancer, antibacterial, antiviral and antimalarial, anti-inflammatory properties. iv. Free radicals: Types, sources, importance, production, free radicals induced damages, lipid peroxidation, measurement of free radicals, disease caused by radicals, reactive oxygen species, antioxidant defence system, enzymic and nom-enzymic antioxidants, role of antioxidants in prevention of diseases ,phytochemicals as antioxidants.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-2-4106**			
Course Title	**Fundamentals of Food processing**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Thermal Processing of Foods Principles, Classification - Cooking, blanching, pasteurization, sterilization, evaporation, extrusion, drying, Equipments and Applications Separations and concentration methods in food processing General Principle and application, Evaporation, Membrane processing, Reverse osmosis, Nanofiltration, Ultrafiltration, pervaporation, freeze drying , Extraction- liquid-liquid & solid liquid, Super critical extraction, Osmotic dehydration, Sedimentation, Equipments and Applications Separations and concentration methods in food processing General Principle and application, Evaporation, Membrane processing, Reverse osmosis, Nanofiltration, Ultrafiltration, pervaporation, freeze drying , Extraction- liquid-liquid & solid liquid, Super critical extraction, Osmotic dehydration, Sedimentation, Equipments and Applications Size reduction and its application in food industry Size reduction, Size measurement, Dry and wet grinding, Slicers/dicers, Pulpers and granulators, Milling equipments, Size separation Food Emulsions Basics and examples, Homogenizers and colloid mills- Principles, types and applications Mixing and Kneading Basics, Equipment and Applications Advances in Food processing Minimal processing, Hurdle technology,High pressure technology, Irradiation, Microwave, Cryogenics, Ohmic heating, Pulsed electric heating, ultrasound processing, Equipments and Applications Basic packaging Machinery Can sealing, Bottle washing, Filing and sealing, Powder fillers, Liquid fillers, Foam – fill and seal systems Sterilization techniques Basics, Techniques and Applications Maintenance of Food Plant & Equipment Maintenance of food plant and equipment, pumps, valves and conveyers

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-2-4107**			
Course Title	**Cell biology and Tissue Engineering**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. iCell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle. Cell signaling Basic Cell culture Types of cells grown in culture, work area and equipment, preservation and storage, maintenance, safety considerations, cell culture methods, determination of cell counts and viability, Cell based assays Animal cell culture Basic principles of cell culture, Preparation of culture lab, maintenance of aseptic conditions, biology of cells in culture, choice of materials, Generals methods of cell culture and parameters, monolayer culture, suspension culture, immobilized cultures, Cell line preservation and authentication: cell freezing, quantitation of recovery, authentication, Cytotoxicity and cell viability assays: specific techniques, end points, assay comparisons, protocols, interpretation, Flourescence in situ hybridization, Genetic modification: Basics of Transfection, microcell mediated chromosome transfer, irradiation fusion gene transfer, Stem cell identification, isolation and culture, Senescence, apoptosis and necrosis, Animal cell culture and drug designing.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-2-4108**			
Course Title	**Significance of Food Preservation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Objectives of food processing; Composition of foods; Degree of perishability of unprocessed foods; Causes of quality deterioration and spoilage of perishable foods; Intermediate moisture foods; Principles and methods of blanching; Test for adequacy of blanching; Conventional methods of preservation – Dehydration, Canning, Freezing, Fermentation, Smoking, Pickling, Chemical preservatives and others; Methods of drying and their application to fruits & vegetables; Procedures and technological applications relating to storage of foods at low, chilling and freezing temperatures

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-2-4109**			
Course Title	**Thermal Processing of Foods**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Principles and types of retorts; Thermal destruction of microorganisms – Determination of D, z & F0 values; Heat resistance in microorganisms; Cooking, blanching, pasteurization and sterilization of foods; Heat penetration and inoculation pack studies

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-2-4110**			
Course Title	**Cell Biology and Cell signalling**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

1. Cell growth and division, including cell cycle: Phases of cell cycle, Regulation of cell cycle, Cell cycle check point, Cell growth 2. Intracellular sorting of proteins: Nuclear import and export mechanism; Organelle targeting; Transport of protein to cell surface; Soluble protein sorting 3. Cell adhesion, cell junction and Extra Cellular Matrix: Cell adhesion molecules; Cell Junction; Extracellular matrix; Cell-cell recognition 4. Cytoskeletal structure-function and related macromolecules: Cytoskeletal proteins; Role in vesicular movement; Cellular morphology and cytoskeletal protein; Drug modulating cytoskeletal 5. Signal transduction pathways: Extracellular signals; Intracellular signals; 2nd Messengers; Signal transduction pathways 6. Cell death and proliferation: Programmed cell death; Cell renewal system; Mitochondria and apoptosis; ER-stress 7. Cellular starvation, stress and Autophagy: Oxidative and nitrosative stress; Stress response; Autophagic vacuole turnover; Cellular homeostasis 8. Metabolic disorder and signaling aberrations: Abnormal Signaling in Cancer; Signaling for diabetic complication Angiogensis; Signaling for failure in diabetes.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-3-4101**			
Course Title	**Seminar course**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Advanced topics related to the thesis

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-3-4102**			
Course Title	**Introductive Bioinformatics**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to bioinformatics-Historical perspectives. Introduction to data mining, internet and bioinformatics, applications of data mining to bioinformatics problems and applications of bioinformatics. Sequence Alignments - Pair wise sequence alignments – Global and Local, Methods of alignment, Algorithms for sequence comparisons – Smith Waterman, Needlman and Wunsch , Dynamic Programming, Scoring matrices and gap penalties. Multiple sequence alignments – scoring multiple sequence alignments, methods for multiple sequence alignments. Tools for sequence alignment – web based and local – BLAST, Clustal W, BLOCKS. Phylogenetic prediction and analysis – methods, gene prediction. Biological databases and their interfaces-Types of databases, nucleotide database-Genebank, EMBL, PDBJ, Genes, Entrez. Protein sequence databases – Swiss Prot/ TrEMBL; Sequence motif/domain databases – Pfam, PROSITE; Protein sequence databases - PDB, CATH, SCOP. Protein classification and structure prediction - Conserved domains, motifs, structure function relationships, viewing protein structure; Protein sequence alignments, use of sequence pattern for structure prediction, prediction of secondary structures – tools, tertiary structure prediction by homology modeling. Applications of Bioinformatics - Phylogenetic analysis, Comparative genomics – functional genomics, Drug discovery, Gene expression analyses.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-3-4103**			
Course Title	**Microbial Diversity and Ecology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Microbial Taxonomy and Diversity: Bacteria, Archea and their broad classification; Eukaryotic microbes: Yeasts, molds and protozoa; Viruses and their classification; Molecular approaches to microbial taxonomy. Role of microbial life in the evolution and ecology of the biosphere, application of classical ecological concepts to microbial populations and communities, Underlying principles that drive microbial population structure in the environment, Community function and dynamics at both the molecular and the organismal level, Abiotic and biotic interactions within microbial communities, Ecophysiology and thermodynamic constraints on microbial community structure, Molecular and genomic tools for understanding the physiology and ecology of microbial communities, Microbial metabolism and biogeochemical cycling. Microbial interactions with the Environments: Interactions of microorganisms with their physical and chemical environment, biogeochemical cycles, Interactions with the biotic environment: symbiosis, competition, parasitism, predation, Interactions within microbial communities: quorum sensing, syntrophy, antibiotics, Interactions of microorganisms with algae and plants, Interactions of microorganisms with animals and humans. Methods in Microbial Ecology: Pure culture techniques, principles of microbial, nutrition, enrichment culture techniques for isolation of microorganisms. Characterization of microbial communities: PCR, sequencing, molecular fingerprints, Characterization of microbial communities: culture-based methods, biomarkers, cell stains, Characterization of microbial communities by culture independent molecular methods, Methods of extracting total bacterial DNA /RNA from a habitat: FISH, real-time PCR, DGGE, T-RFLP, SSCP, functional Clone library (metagenomics), pyrosequencing. Software tools in Metagenomics, Newer approaches for exploring uncultivable bacteria, methods in Taxonomy of Bacteria (including archae, bacteria,) and Fungi: Morphological Methods, Chemotaxonomy, Genetic Methods ,Methodology of rRNA, Methodology of identification of unknown pure cultures: Strategy and methods.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-3-4104**			
Course Title	**Bioprocess Technology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to Bioprocess Technology; Introduction, microbial metabolites an overview (primary and secondary), Factors on growth and product formation, raw materials and media formulation, microbial growth curve and growth kinetics, sterilization, death kinetics. Fermentation Technology Types of Fermentation (submerged and solid state fermentation), Batch, fed batch and continuous modes of fermentation, Fermentation kinetics, Factors affecting fermentation process, Process parameter optimizations using statistical tools Bioreactors Introduction, Bioreactor configurations, design features, Sterile operations, Types of bioreactors (stirred tank, fluidized bed, packed columns, airlift etc), Bioreactors for submerged fermentation, Bioreactors for SSF, concepts of mass transfer, heat transfer, Engineering aspects in bioreactor designing. Downstream Processing Unit operations in downstream processing, concentration –filtration, flocculation, precipitation, chromatography techniques, dialysis, reverse osmosis, ultra filtration, electrophoresis, electrodialysis, crystallisation, drying, monitoring downstream process and process integration. Industrial Microbiology Characteristics of industrial micro organisms , Industrial applications of microbial biotechnology (production of organic acids, enzymes, amino acids, antibiotics etc), Industrial strain improvement, classical mutations, protoplasmic fusion, auxotrophic mutants, role of metabolic engineering in industrial biotechnology

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-3-4105**			
Course Title	**Enzymology & Enzyme Technology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to Enzymology- Introduction to enzymes, modes of action, Classification and nomenclature of the enzymes- Oxidoreductase, Transferase, Hydrolase, Lyase, Isomerase, Ligase. Production and purification of enzymes- Industrial production of enzymes - Production methodology, Optimization of culture medium and production conditions, techniques used for enzyme homogenization, Down-stream processing. Techniques for enzyme assays- Spectrophotometric method, colorimetric method, fluorescence method, manometric method, viscometric method. Purification methods, Concentration of enzyme - Salting out using ammonium sulfate, fractionation using organic solvents, fractionation using non-ionic polymers, fractionation using polyelectrolyte etc, Dialysis, ultra-filtration., Chromatographic separation of enzymes – Adsorption chromatography, ion-exchange chromatography, affinity chromatography, gel filtration chromatography, chromatofocusing. Techniques for protein separation- paper electrophoresis, gel electrophoresis, capillary electrophoresis, isoelectric focusing. Crystallization of enzymes. Characterization of enzymes- Determination of temperature and pH optima, Determination of molecular weight of enzyme- gel filtration chromatography, PAGE, other methods. Enzyme inhibitors – competitive inhibition, non-competitive inhibition, mixed type of inhibition, uncompetitive inhibition. Kinetics of enzyme reaction- Concept of ES complex, active site, specificity, Mechanism of enzyme reaction, measurement of reaction velocity, Different plots for the determination of Km & Vmax and their physiological significances. Importance of Kcat/Km. Kinetics of zero & first order reactions. Significance and evaluation of energy of activation. Michaelis pH functions & their significance. Michaelis & Menten equation for uni-substrate reactions, Lineweaver–Burk plot, Hanes–Woolf plot, Scatchard equation. Immobilization of enzymes and industrial applications of enzymes- Methods of immobilization- carrier binding method, physical adsorption method, ionic binding, covalent binding, cross linking method, entrapping method, microencapsulation. Industrial applications of enzymes – Food and baking industry, Textile industry, Leather industry, Detergent industry, paper and pulp industry, animal feed industry, therapeutic and diagnostic applications, enzymes in biofuel industry.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-3-4106**			
Course Title	**Biodegradable polymers**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Biodegradable polymers – Historical outline, Classification (natural and synthetic biopolymers). Important polyesters that have been commercialised and under commercialization such as PHA, PHB, PLA and others. Biopolymers-microbial production, Production processes, downstream processing Methods for characterisation of polymers (TLC, FTIR, GPC, Viscometric methods, NMR), structure, physio-chemical properties, Life cycle assessment biopolymer and applications. Production processes for biopolymer, Chemical modifications and its significance. Biotic and abiotic degradation of biopolymers. Microbial deterioration (aerobic and anaerobic). Biodegradability testing. Role of enzymes in biodegradation. Factors affecting biodegradation. Application of biopolymers-biodegradable plastics, tissue engineering, drug delivery.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-3-4107**			
Course Title	**Metabolic Engineering**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Review of cellular metabolism (Transport processes, fuelling reactions, biosynthesis, growth energetic) Review of cellular stoichiometry. Regulation of metabolic pathways: Levels of regulation of enzymatic activity (overview of kinetics, reversible and irreversible inhibitions, allosteric enzymes and cooperativity) – regulation of enzymes concentration (Control of transcription and translation – example with respect of lacoperon and catabolite repression)- Global controlregulation of metabolic networks (Branch point classification, coupled reactions and global currency metabolities and energy regulation) Metabolic engineering in practice: Concept of directed cellular energy utilization – analytical and synthetic elements of metabolic engineering – targets of metabolic engineering. Metabolic Pathway analysis (Typical case study: Lysine Biosynthesis) Strategies for redirecting branched and linear pathways: (Alteration of feed back regulation; limiting accumulation of end product feedback resistant mutants, alteration of permeability). Metabolic Flux Analysis: Concept and utility of MFA – Theory – case studies – over determined systems – experimental determination of MFA by isotope labeling – applications of MFA: Case studies-concept & fundamentals of metabolic control analysis (Basic concept only). Application of pathway manipulations: Strategies for overproduction of primary metabolites. Strategies for overproduction of secondary metabolites (precursor effects, prophophase idiophase relationship, enzyme induction, feedback regulation.) Bioconversions: (ME concepts applied in process decisions for enhanced bioconversion). Examples of pathway manipulations: Enhancement of product yield (alcohol, amino acids)– extension of substrate ranges (lignocelluloses utilization) – extension of product spectrum (antibiotic, biopolymers) - improvement of cellular properties (alteration of metabolism, enhanced efficiency and yield, genetic stability).

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-3-4108**			
Course Title	**Natural Product Chemistry**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Structure, Bonding & Nomemclature Lewis structures, orbital hybridization, configuration and stereo chemical notation, conformational analysis, systematic IUPAC nomenclature. Functional Groups Preparation, reactions, and interconversions of alkanes, alkenes, alkynes, dienes, alkyl halides, alcohols, ethers, epoxides, sulfides, thiols, aromatic compounds, aldehydes, ketones, carboxylic acids and their derivatives, amines Reaction Mechanisms Nucleophilic displacements and addition, nucleophilic aromatic substitution, electrophilic additions, electrophilic aromatic substitutions, eliminations, Diels-Alder and other cyclo additions Reactive Intermediates Chemistry and nature of carbocations, carbanions, free radicals, carbenes, benzynes, enols Resonance, molecular orbital theory, catalysis, acid-base theory, carbon acidity, aromaticity, antiaromaticity. Natural products i. Carbohydrates-glucose-The structure and configuration of glucose- Anomeric forms of monosaccharides-glycosides-Disaccharides: cellobiose, maltose, gentibiose, trehalose ii. Polysaccharides-starch, cellulose, hemicellulose, modification of cellulose, Extraction, separation and quantification methods iii. Polyketides- biosynthesis-Acetyl Coenzyme-A, Orsellinic acid - structure iv. Lipids:,Fatty acids, structure, reactions, extraction methods, saturated and unsaturated fatty acids oleic, linoleic, linolenic, PUFA, waxes, phospholipids v. Terpenoids-general –isolation methods- isoprene rule, biosynthesis ,monoterpenes alpha-pinene, beta-pinene, cineole, citrals, geraniol,sesquiterpenes, caryophyllenes, zingiberene, humulenes, nerolidols, farnesols, oxides of caryophyllene, diterpenes - abeitic acid, triterpenoids- sqalenes and carotenoids-beta carotene, capsanthins vi. Alkaloids: Biosynthesis structure, general classification, sources, isolation methods, properties-piperine, coniine, quinine vii. Steroids-general-cholesterol and sitosterols, isolation methods viii. Phenyl propanoids- biosynthesis general characteristics-coniferyl alcohol ix. Aminoacids – assay, isolation methods, alpha aminoacids-reactions, essential amino acids, Peptides& proteins – primary structure of peptides-assay x. Saponins-general, isolation methods, sources, properties, polyketides - general structure, properties, isolation techniques xi. Vitamins-general, classification, sources,V-A,V-B complex,V-C, structures, dietary importance, Assay for V-C,V-A and V-E

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-3-4109**			
Course Title	**Cardiovascular Disease Biology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Pathophysiology of various heart diseases. Biochemical changes associated with myocardial infarction (MI) viz., oxidative stress, Lipid peroxidation and metabolic changes associated with MI. Risk factors associated with myocardial infarction. Biochemical risk factors, modifiable risk factors and non modifiable risk factors Physiology of cardiac function, Cardiac hypertrophy, various types of cardiac hypertrophy, pathophysiology. Molecular basis of cardiac hypertrophy, Ishcmeia/reperfusion injury Signaling pathways in cardiac hypertrophy, calcineurin-NFAT pathway, Cyclic GMP/PKG-1 pathway, G-protein coupled receptors, Gq/G11 signaling, Histone deacetylases, MAPK pathways Various systems involved in the pathophysiology of cardiac hypertrophy viz., Na/H Exchanger, Renin angiotensin system (RAS), Atrial natriuretic peptide (ANP), Nitric oxide, Tumor necrosis factor (TNF-alpha), Peroxisome proliferators activated receptor). Drugs that affect cardiac function, Cardiac angiogenesis, calcium transient in hypertrophy, calcium overload Thrombosis, Platelets and Anti-Platelet Therapy in Cardiovascular Disease: Molecular Mechanisms, Blood Coagulation and Atherothrombosis, Thrombosis and Thrombolytic therapy. Drugs that act on the coagulation cascade

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-3-4110**			
Course Title	**Molecular Biology of Diabetes**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to Diabetes Mellitus, Preclinical and Clinical Methods for Evaluating Antidiabetic Activity of Plants, in vitro Models for Assessing Antidiabetic Activity, Plant metabolites and other Antioxidant Polyphenols in alleviating diabetic complications Insulin Secretion in Type II Diabetes, cellular effects of insulin, insulin signalling pathways, regulation mechanisms Cellular Effects of Elevated Glucose Concentrations, regulation by Insulin and an Insulinomimetic Approach to Lowering Blood Glucose Levels, Insulin resistance, its importance in diabetes and tissues affected, Obesity and its link to diabetes Metabolic Aspects of Glycogen Synthase Activation and its role in the pathogenesis of Insulin Resistance and Hypoglycemia, the distinction between 'Glucose set point', 'Glucose Threshold'and 'Glucose Sensor' is critical for understanding the role of the Pancreatic β-Cell in Glucose Homeostasis Mechanisms of Diabetic Complications, Oxidative Stress and Advanced Glycosylation End Products and Diabetic Retinopathy Drugs currently used in the treatment of Diabetes its proposed mechanism of action and reported side effects, therapeutic potential of recombinant gene transfer studies

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-3-4111**			
Course Title	**Environmental Technology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Waste Characterization Organic and inorganic pollutants, Chemical oxygen demand (COD), Biological oxygen demand (BOD), Suspended solids (SS), Mixed liquor suspended solids (MLSS), Volatile suspended solids (VSS), Nutrient load, Total nitrogen (TN), Ammonia-nitrogen (NH4-N), Total phosphorus (TP), Microbial load, drinking water standards, discharge limits, Persistent organic pollutants, Ambient air quality, Air quality monitoring, VOC emission factor. Biological Waste Water Treatment Biological wastewater treatment, waste air treatment, biofilters, anaerobic digestion, composting, aerobic, anoxic and anaerobic wastewater treatment, combined treatment systems, soil remediation, phytoremediation, constructed wet lands, lake remediation Process parameters in engineered biological systems Batch, Fed-batch and continuous bioreactors, Sequence-batch reactor (SBR), Fluidized bed and packed bed bioreactors, Photo-bioreactor, Upflow anaerobic sludge blanket reactors (UASB), Flocculated and granular sludge, Hydrolic retention time (HRT), Solid retention time (SRT), Pollutant loading rate, Microbial growth kinetics Molecular Microbial Analysis Microbial community analysis in waste treatment systems, Molecular markers for microbial diversity analysis, Fluorescent microscopy, Whole cell fluorescent in-situ hybridization (FISH), PCR, DGGE/TGGE, rep-PCR, 16S DNA sequence analysis and phylogenetic analysis, protein profiling.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-3-4112**			
Course Title	**Biomass to fuels**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

To recognize the diversity of plants, plant parts and plant structures that provide raw material for biofuel production. To understand basic principles of plant light energy conversion to chemical energy and carbon fixation. C3 and C4 plants. To examine the basic chemistry and biochemistry involved in the conversion of sugars to liquid alcohol Ecological dimensions of biofuels Impact of biofuels in global climate change and food production Case Study: Corn, cellulosic and sugar cane ethanol pros and cons Starch-Corn-ethanol: Resources and energy consumed by the industry: water, fertilizer and pesticides. Biorefineries & distribution, transport and green house gas emissions, denaturation with gasoline, distribution Cellulose stocks for biofuel, mill residues, forest residues, and agriculture waste. Cellulose-ethanol pathway starting from degradation of the plant cell wall, pretreatments to make biomass more accessible to enzymatic attack, hydrolysis of cellulose to glucose and conversion to ethanol. Lignin problem

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-3-4113**			
Course Title	**Biochemical Engineering**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to Engineering calculations. Energy and Material Balances Unit operations and unit processes: historical and more recent developments in chemical engineering; Process variables and degrees of freedom; Differential and integral balances; Lumped and distributed balances; Balances in systems involving physical changes Steady state energy and material balances Balances in reacting systems; Balances in systems involving recycle, purge, and bypass; Computer aided calculations; Generalization to unsteady state balances Introduction to transport phenomena: Momentum transfer Viscosity; Molecular theory of Gases and Liquids; Shell balance: Falling film, Circular tube; Equations of Change for isothermal systems: Continuity, Motion, Energy, Substantial derivatives; Unidirectional flows: Pipe flow, Variable viscosity falling film, Couette viscometer, Rotating Sphere; Unsteady flows: Startup Plate flow, Parallel plates etc Introduction to transport phenomena: Heat & Mass transfer Thermal conductivity and mechanism of energy transport; Shell energy balances and temperature distributions in solids and laminar flow; Diffusivity and the mechanisms of mass transport; Concentration distributions in solids and laminar flow; Equations of change for multicomponent systems; Introduction to the concept of heat and mass transfer coefficients; Dimensional Analysis Reactor Engineering- Bioreactor configurations

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-3-4114**			
Course Title	**Prebiotics and Probiotics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Microorganisms and human health; Prebiotics – definition, nomenclature and significance; Non-digestible higher polysaccharides; Categories of prebiotics; Interaction between prebiotics and microbiota; Probiotics – definition, nomenclature, selection criteria and attributes; Probiotic microorganisms – lactic acid bacteria, bifidobacteria, yeasts; Protocols for commercial probiotic preparations; Health and therapeutic attributes; Safety of probiotics and food applications; Molecular characterization of benefitical attributes associated with probiotics and prebiotics

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-3-4115**			
Course Title	**Cancer Biology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

1. Cancer Immunology: The immunological status of adaptive and innate immune cells in cancer, cellular interactions between immune and cancer cells in tumor progression or rejection, immunological mechanisms, regulation and function involved in host responses to tumors, anti-tumor immunity, cancer-induced immune tolerance, immunosuppression, dysregulation of the immune system and poorer outcome in the disease 2. Cancer stem cells : Origin/Hypothesis/Concept ; Signaling pathways in cancer stem cells 3. Cell signaling in cancer : Description of major classes of cell signalling: cell death signalling, cell survival signalling and developmental/stem cell signalling; signal networking and chemotharapy 4. Oncogenesis and epigenetics in cancer :Oncogenes and their regulation in signalling aberration; Acetylation/methylation in DNA and histones; Silencing/De-silencing of gene expression 5. Metabolic Engineering in cancer; Metagenomics and cancer 6. Cancer biomarkers and diagnosis : Selection of clinical specimens, recent advancement for identification of biomarkers through different approaches like genomics, proteomics and glycomics in combination with molecular pathology with potential clinical value; Application of biomarkers for cancer staging and personalization of therapy at the time of diagnosis to improve patient care. 7. Cancer drug discovery : Identification of lead molecules, target identification in cancer cells; combined approaches (in vitro, in vivo and in silico) for validation, various steps involved towards successful drug discovery; immunotherapeutic approaches e.g. cancer vaccines, monoclonal antibodies, adoptive immune cell transfer etc. And combination strategies to treat malignancies 8. Angiogenesis and metastasis

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-3-4116**			
Course Title	**Functional Foods and nutraceuticals**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Definition and applicability; Basis to identify functional components in varied sources; Characterization of bioactives from edible sources with defined functional attributes and elucidation of their structure-function relationship; Benefits of identified functional attributes in food ingredients and prepared foods; Legal requirements and regulations for functional foods; Effect of food processing parameters on defined functional attributes

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-3-4117**			
Course Title	**Chemistry of process induced food toxicants**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Role of food processing, Techniques used in food processing, General approaches to food processing, Concern about food safety during food processing, Definition of Process induced toxicant and types of hazards-Microbiological, Physical and Chemical. Acrylamide, Heterocyclic aromatic amines, Polyaromatic hydrocarbons, NDMA, Ethyl carbamate, Furan and 3-MCPD- Structure, occurrence in food, Formation pathways, Dietary intake and health risks; Absorption, distribution, metabolism, bioavailability and biomarkers; Mechanism and factors affecting its formation during thermal treatment; Different analytical techniques for detection in foods.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-4-0001**			
Course Title	**Project Proposal Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Project Proposal to be prepared by selecting topics of high relevance and novelty, and will have state-of-the art review, methodologies, recommendations

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-4-0002**			
Course Title	**Review Article Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Review Article on the research area undertaken by the student

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NIIST, Thiruvananthapuram**			
Course Nomenclature	**BIO-NIIST-4-0003**			
Course Title	**CSIR-800 Project Work**			
Credit Distribution (L-T-P-C)	0	0	8	**4**

Course Description:

Six–Eight weeks have to be dedicated on a project concerned with societal/rural issues under the CSIR-800 Programs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-1-0001**			
Course Title	**Biostatistics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Summarization of Data: measures of center, dispersion, skewness Dependence of variables: Correlation, linear regression, logistic regression Basic probability distributions: Binomial, Normal, Chi-squares. Estimation of parameters: method of moments, maximum likelihood Testing of hypotheses: (a) parametric tests: t-test, z-test, chi-squares test, ANOVA (b) non-parametric tests: Mann-Whitney, Kruskal Wallis, Kolmogorov-Smirnov

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-1-0002**			
Course Title	**Computation/bioinformatics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Computers: Introduction, Evolution and Classification of computers. Fundamentals of computing. Bit and Byte, Introduction to types of Hardware and Software. Components of Computer. Introduction to operating systems. Introduction to Computer Viruses. Network: Introduction. Network structure and architecture, Hierarchical networks, Ethernet and TCP/IP family of protocols, transport protocol design. Types of network, Topologies of network, Router, Switch, Data Communication, Concept of Wireless networking, LAN, WAN, MAN, Security of the network, Fire-walls, Network Applications Information Technology: Concepts of client Server Architecture, Concept of search Engine, Database search engines. Introduction to Internet Introduction to Word, Powerpoint and Excel Introduction to Bioinformatics: History of Bioinformatics, Genome sequencing projects, Human Genome Project, Applications of Bioinformatics. Introduction to databases, Type and kind of databases, Applications and limitations. Literature Search Databases, Nucleic acid and protein databases, Animal and plant databases, Ensembl Genome project TIGR database, Biotechnological databases, Motifs and Pattern Databases, Databases for species identification and classification, Structural databases. Database Retrieval and deposition systems. Web tools and resources for sequence analysis: Pairwise and multiple sequence Alignment, Sequence similarity search: BLAST, Pattern recognition, motif and family prediction, Restriction map analysis, primer design, Gene prediction, Phylogenetic Tree, Protein structure prediction and visualization.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-1-0003**			
Course Title	**Basic Chemistry**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Thermodynamics Solutions and Ions Chemical bonding and molecular structure Chemical Kinetics Stereochemistry Introduction to drug discovery (Medicinal chemistry approach) Drug target, discovery and development (forward and reverse approach

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-1-0004**			
Course Title	**Research Methodology, Communication/ethics/safety**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Philosophy and structure of scientific thoughts, Objective and Motivation of Research, Meaning of the Research, What constitutes a research topic? How to select a research topic?, Importance of literature review, Selection of appropriate methodology, Collection of data, Interpretation of data, Writing research paper, Paper presentation in scientific conference, Statistical methods, Importance of documentation, Procedure for Hypothesis Testing, Values and Ethical Problems, Criteria of Good Research, Good laboratory practice, Chemical, Radioactive and Biological safety: Possible hazards and precautionary measures; do and don'ts upon exposure Research methodology, communication, ethics, safety Asking the right questions: Originality, Depth, Precision can co-exist Formulating and refining the hypothesis: Those who do not learn from the past are condemned to repeat it Study design: Recognizing and minimizing bias Experiment design: Sometimes less is more and the importance of controls Good lab practices: Record keeping, organizing data, organizing the lab space Data interpretation; objectivity, quantification, double blind studies and necessity of statistics Comunicating your data:writing up your research Comunicating your data: presenting your findings Radiation safety Chemical and Biosafety Intellectual property rights What is ethics, the different interpretations & historical instances of unethical science Case studies: Data fraud/ plagiarism and Human Ethics violation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-2-2501**			
Course Title	**Biotechniques and Instrumentation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Part-I Chromatographic Analysis: GLC, HPLC, HPTLC and Flash chromatography Part- II- Spectroscopic analysis: UV, AAS and Mass spectrometry Part- III – Microscopy Light Microscopy, Confocal Microscopy, SEM and TEM NMR Spectroscopy in Plant Metabolomics: Introduction & Scope of NMR Spectroscopy and Applications of NMR Spectroscopy in Plant Metabolomics Electrophoresis: agarose and polyacrylamide gel (native and denaturing), 2-D gel Centrifugation (high speed, ultra and differential centrifugation) Common Molecular Biology Techniques Chromatography: affinity, ion exchange, hydrophobic chromatography, size exclusion and reverse phase chromatography Proteomics- MALDI-MS/MS, LC-ESI-MS/MS Practical Chromatography Techniques Spectroscopy Techniques

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-2-2502**			
Course Title	**Biology of Macromolecules**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Structure and function of Cell and Cell organelles, Nucleic acids and proteins; Chromatin structure; Organization of nucleosome and chromosomes; Molecular aspects of cell division and cell cycle; DNA replication in Prokaryotes and Eukaryotes; RNA transcription and processing; Transcriptional regulation in prokaryotes and eukaryotes; Genetic code: Properties and codon usage patterns; Protein synthesis, protein modifications and secretion; Regulation of protein synthesis; Transposable genetic elements, Types and mechanisms of transposition; Chloroplast and Mitochondrial Genome Organization

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-2-2503**			
Course Title	**Biology of Inheritance**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Evolution, Mendel's Laws of Inheritance, Chromosome theory of inheritance, Codominance and incomplete dominance; pleiotropism, genotypic interactions, epistasis, mechanism of epistasis; Mitosis and Meiosis in plants, animal and human. Cell cycle and cell division. Linkage and mapping in eukaryotes; Coincidence and interference. Concept of sex determination and patterns in plants and animals; sex chromosomes; Sex-linked, sex-limited and sex-influenced characters. Extra-nuclear inheritance: determining non-Mendelian Inheritance; maternal effects, cytoplasmic inheritance. Nature and components of variation, heritability and genetic advance, self incompatibility and male sterility system, role of mutations and chromosome modifications, Genetic consequences of self and cross fertilization, mating systems, apomixes.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-2-2504**			
Course Title	**Genomics: Information flow in Biological Systems**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to genomics; Techniques in genomics; Advance sequencing techniques and their application in genomics; Application of genomics study in plants

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-2-2505**			
Course Title	**Protein Science and Proteomics**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction proteomics; Extraction of proteins for proteomics analysis; Separation of proteins for proteomics analysis; Organelle proteomics; Protein identification and characterization; Post-translational modifications; Structural proteomics and computational analysis; Protein-protein interactions; Techniques for Proteome research; High throughput proteomic screening for novel bioactive peptides/proteins/enzymes

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-2-2506**			
Course Title	**Plant-Microbe Interaction**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Plant growth promoting bacteria, mycorrhizae, actinorhiza, current advances in microbial bio-inoculants, latest concepts in taxonomy of nitrogen fixing microorganisms, plant growth promoting rhizobacteria, mechanism of nitrogen fixation, molecular basis for legume rhizobia interaction, nitrogen fixation in free living and associative bacteria, actinorhizal symbiosis, role of biotechnology in agriculture Concept, definitions, importance, principles of plant disease management with bioagents, history of biological control, merits and demerits of biological control, types of biological interactions, operational mechanisms and its relevance in biological control, Factors governing biological control of pathogens, comparative approaches to biological control of plant pathogens by resident and introduced antagonists Economic impact of viral and viroid diseases, molecular characteristics, movement through plasmodesmata and vasculature, viral determinants involved in phloem transport of plant viruses

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-2-2507**			
Course Title	**Plant Environment Interaction**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to environment: classification, components of environment; Ecology and ecosystems; Symbiotic relationship; Introduction to abiotic stress; Plant responses to abiotic stresses; Introduction to biotic stress; Plant responses to biotic stress

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-2-2508**			
Course Title	**In Vitro Development and Morphogenesis in Plants**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction, Production of disease free quality planting materials; Somaclonal variations (concept and applications, visual, molecular and other screening methods); Haploids (anther, ovule culture and bulbosum technique, detection of haploids, applications); Endosperm culture, triploid production and its application; Protoplast culture, somatic hybrids and cybrids, selection strategies and applications; Secondary metabolites, hairy root culture, molecular farming, scale up studies using bioreactors; Ex situ conservation, short and long term storage of germplasm; Applications of tissue culture in commercialization; In vitro methods of crop improvement using transgenic technology and their Implications

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-2-2509**			
Course Title	**Molecular Breeding of Plants**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to molecular breeding; Techniques in molecular breeding; Morphological and Molecular markers, QTL analysis; Application of molecular breeding in plants., development of mapping populations (F2, Back crosses, Recombinant Inbred Lines , Near Isogenic Lines and Doubled Haploid lines). Molecular mapping and gene tagging of important traits, Marker-assisted selection, Gene pyramiding. Antisense RNA technology. production of transgenic plants; gmos, biosafety issues.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-2-2510**			
Course Title	**Natural Resource Management**			
Credit Distribution (L-T-P-C)	1	1	0	**2**

Course Description:

Sustainable agriculture, Soil fertility and productivity, SOM, Nutrients function, Dynamics of major plant nutrients, nutrient use efficiency, IPNMS system, Precision agriculture, Growth Analysis, Crop response function, Economics of Agroforestry systems

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-2-2511**			
Course Title	**Bioresource Production Systems**			
Credit Distribution (L-T-P-C)	1	1	0	**2**

Course Description:

Advances in Soil-plant-water Relationship: Energy concepts, Physio-morphological behaviour of plants, Soil physico-chemical properties, isotopes and radiation techniques, Metabolic and hormonal responses, Water use efficiency, Crop growth and yield, adaptation of plants to water variation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-2-2512**			
Course Title	**Remote Sensing and its Application on Biological sciences & Marine sciences.**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Remote Sensing (4 Lectures) Principles and Background of Remote Sensing: Concept of Remote Sensing; Electromagnetic Radiation; Fundamentals of Remote Sensing; Spatial, Temporal and Spectral resolution; Remotely sensed data/images; Image analysis and data interpretation; Ground truth; and Accuracy measurement. Marine Ecology (2 Lectures) Marine zonation; Pelagic and abyssal; inshore, onshore, offshore; supra-tidal, intertidal, sub-tidal; photic and aphotic zone; Abysso pelagic etc. Marine Ecosystem: Food web; Food chain; Species realm; species interaction; Niche; Intertidal ecology: Stress tolerance, adaptation; Tide pool. Sub- tidal ecology: interaction between biotic and a biotic factors. Marine Environment (4 Lectures) Physical Oceanography: Tide; Wave; Current; SST(Surface Seawater Temperature); Chemical Oceanography: Water chemistry; Salinity; pH, DO (Dissolved Oxygen); COD (Chemical Oxygen Demand); Carbon cycles; Species and speciation; Nutrients (N02 N, N03-N, PO.,-P, Si03-Si etc) cycling; Toxic metals and metalloids; Pollutants; Biological Oceanography: Primary productivity; Gross productivity; Net productivity; New productivity; and Bioturbation. Geological Oceanography: Sedimentation; Chemistry of sediment; Sediment Characterisation; sedimentary rock formation; etc. Various Applications of Remote Sensing (4 Lectures) Species specific micro algae/macro algae bloom detection: Pigment in micro algae / macro algae; Species specific absorption and reflection spectra study; species specific bloom detection; Macro algal mapping. Application on Agriculture and Forests: Plant species identification; Agricultural land use & land cover, Plant growth study; Diseased / Stressed plant detection; Mangrove vegetation study; Invasive species detection. Coastal Geomorphology: Coast line change detection, Coastal Ocean & EEZ Monitoring. Marine Environmental Impact Assessments: SST, Chlorophyll o, Phytoplankton productivity; Nutrient study; and Marine EIA.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-3-2501**			
Course Title	**Seminar Course**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

History of science with emphasis on Indian contribution: Seminar by students on any contemporary topic

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-3-2502**			
Course Title	**Advanced Bioinformatics**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Databases and resources in Bioinformatics, Gene expression analysis, Sequence analysis and algorithms, Next generation sequencing, Non-coding elements, Structural Bioinformatics, Programming and Scripting, Statistics

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-3-2503**			
Course Title	**Gene Environment Interaction**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Recent advances in plant responses to biotic and abiotic stresses. Impact of environmental changes at molecular and cellular levels in plants.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-3-2504**			
Course Title	**Advances in Gene Silencing and Epigenetics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Gene silencing: Mechanism of gene silencing in plants, Techniques in gene silencing, Application of gene silencing in plants; Introduction to small RNA; Biogenesis of small RNAs; Translocation of small RNAs in plants; Methods of small RNA isolation and characterization; Application of small RNAs in plants. Mechanism and applications of Epigenetics in plants

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-3-2505**			
Course Title	**Microbial Diversity and Habitat Ecology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Current developments in microbial taxonomy, phenotypic microarrays, chemotaxonomy, nucleic acid and protein based methods, explorations for yet to be cultured microorganisms, metagenomics approach and recent topics on various groups of microorganisms, basis of adaptation to extreme environments, biotechnological applications of extremophilic microorganisms, industrially important extremophilic enzymes, assignments and discussions

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-3-2506**			
Course Title	**Integrated Pest Management**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Trends in the development of Integrated Pest Management in national and international level, IPM Theory and Practice, economic threshold concept and economic consideration, Biological control agents, Integration of different methods of pest management, Cost-benefit ratios, case studies of successful IPM programmes

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-3-2507**			
Course Title	**Salt tolerance mechanism in plants and Genetic manipulation**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Gene resources: Salt responsive genes from halophytes; Gene cloning: Subtractive hybridization, RACE; Cloning vectors and their characteristics, Restriction digestion, ligation of DNA molecules; Recombinant selection and confirmation. Transcript profiling under salt stress, isolation of stress inducible promoter and their characterization, Plant transformation: Construction of expression vector, Methods of transformation- Agrobacterium mediated and Gene gun. Transgenic analysis: PCR approach, Southern blotting, Northern blotting.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-3-2508**			
Course Title	**Biology of marine macroalgae**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

The marine environment; Introduction to marine macroalgae, Classification, Molecular systematic & phylogeny and life histories; Seaweed communities and biotic interactions; Physiology: Nutrient uptake, assimilation and growth kinetics; Abiotic stress mechanisms; In vitro culture and micropropagation: media preparation and culture methods; Clonal propagation and selection of strains; Macroalgal diseases, control measures and defense system; Application of biotechnological interventions for genetic improvement; Cultivation of macroalgae; seaweed conservation; Economic importance of macroalgae and their products.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-3-2509**			
Course Title	**Wasteland biology and reclamation**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Categories of wasteland in India, Land use capability classification, Principles and methods of soil, plant and water analysis, Dynamics of macro and micro-nutrients in soil, Soil fertility and productivity, Soil-plant-water relationship, Response of plants to various environmental stress, Wastelands vegetations, Microbial community structure, Plant-microbe interaction, Biofuel and non-traditional crops for wastelands, Sustainable agriculture and precision farming, Management of saline, sodic and other wastelands, Life cycle assessment for production systems

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-4-0001**			
Course Title	**Project Proposal Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Project Proposal to be prepared by selecting topics of high relevance and novelty, and will have state-of-the art review, methodologies, recommendations

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-4-0002**			
Course Title	**Review Article Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Review Article on the research area undertaken by the student

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CSMCRI, Bhavnagar**			
Course Nomenclature	**BIO-CSMCRI-4-0003**			
Course Title	**CSIR-800 Project Work**			
Credit Distribution (L-T-P-C)	0	0	8	**4**

Course Description:

Six–Eight weeks have to be dedicated on a project concerned with societal/rural issues under the CSIR-800 Programs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-1-0001**			
Course Title	**Biostatistics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Summarization of Data: measures of center, dispersion, skewness Dependence of variables: Correlation, linear regression, logistic regression Basic probability distributions: Binomial, Normal, Chi-squares. Estimation of parameters: method of moments, maximum likelihood Testing of hypotheses: (a) parametric tests: t-test, z-test, chi-squares test, ANOVA (b) non-parametric tests: Mann-Whitney, Kruskal Wallis, Kolmogorov-Smirnov

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-1-0002**			
Course Title	**Computation/bioinformatics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Computers: Introduction, Evolution and Classification of computers. Fundamentals of computing. Bit and Byte, Introduction to types of Hardware and Software. Components of Computer. Introduction to operating systems. Introduction to Computer Viruses. Network: Introduction. Network structure and architecture, Hierarchical networks, Ethernet and TCP/IP family of protocols, transport protocol design. Types of network, Topologies of network, Router, Switch, Data Communication, Concept of Wireless networking, LAN, WAN, MAN, Security of the network, Fire-walls, Network Applications Information Technology: Concepts of client Server Architecture, Concept of search Engine, Database search engines. Introduction to Internet Introduction to Word, Powerpoint and Excel Introduction to Bioinformatics: History of Bioinformatics, Genome sequencing projects, Human Genome Project, Applications of Bioinformatics. Introduction to databases, Type and kind of databases, Applications and limitations. Literature Search Databases, Nucleic acid and protein databases, Animal and plant databases, Ensembl Genome project TIGR database, Biotechnological databases, Motifs and Pattern Databases, Databases for species identification and classification, Structural databases. Database Retrieval and deposition systems. Web tools and resources for sequence analysis: Pairwise and multiple sequence Alignment, Sequence similarity search: BLAST, Pattern recognition, motif and family prediction, Restriction map analysis, primer design, Gene prediction, Phylogenetic Tree, Protein structure prediction and visualization.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-1-0003**			
Course Title	**Basic Chemistry**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Thermodynamics,Solutions and Ions, Chemical bonding and molecular structure ,Chemical Kinetics ,Stereochemistry ,Introduction to drug discovery (Medicinal chemistry approach) Drug target, discovery and development (forward and reverse approach

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-1-0004**			
Course Title	**Research Methodology, Communication/ethics/safety**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Philosophy and structure of scientific thoughts, Objective and Motivation of Research, Meaning of the Research, What constitutes a research topic? How to select a research topic?, Importance of literature review, Selection of appropriate methodology, Collection of data, Interpretation of data, Writing research paper, Paper presentation in scientific conference, Statistical methods, Importance of documentation, Procedure for Hypothesis Testing, Values and Ethical Problems, Criteria of Good Research, Good laboratory practice, Chemical, Radioactive and Biological safety: Possible hazards and precautionary measures; do and don'ts upon exposure Research methodology, communication, ethics, safety Asking the right questions: Originality, Depth, Precision can co-exist Formulating and refining the hypothesis: Those who do not learn from the past are condemned to repeat it Study design: Recognizing and minimizing bias Experiment design: Sometimes less is more and the importance of controls Good lab practices: Record keeping, organizing data, organizing the lab space Data interpretation; objectivity, quantification, double blind studies and necessity of statistics Comunicating your data:writing up your research Comunicating your data: presenting your findings Radiation safety Chemical and Biosafety Intellectual property rights What is ethics, the different interpretations & historical instances of unethical science Case studies: Data fraud/ plagiarism and Human Ethics violation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-2-1301**			
Course Title	**Biotechniques and Instrumentation**			
Credit Distribution (L-T-P-C)	1	1	2	**3**

Course Description:

IImmunotechniques: ELISA, Immunofluorescence, Immunohistochemistry, Immuno-precipitation, ChIP etc. Automation in Drug Discovery: High Content and High throughput Screening High resolution microscopy: Transmission and Scanning electron microscopies Confocal microscopy Gene expression analysis, DNA microarray and Proteomics Scintillation counting and autoradiography Flow cytometry: Principle and applications animal handling training for 3 days in Animal house Small animal imaging (fluorescence and Bioluminescence) instrument principle and hands on training EchoMRI instrument principle and Hands on training CLAMS (Comprehensive Laboratory Animal Monitoring Systems) instrument principle and Hands on training Ultrasound Echocardiography machine) instrument principle and Hands on training

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-2-1302**			
Course Title	**Biology of Macromolecules**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to Primary and secondary structures of proteins and nucleic acids; hydrogen bonding, ionic and hydrophobic interactions. Optical spectroscopy: Photons, chromophores, transition dipole moments, absorbance. Circular Dichroism, Fluorescence and surface plasmon resonance. Particles in a field: Applications of MS for complex proteins, electrophoresis and sedimentation. X-ray diffraction: Overview of theory. Scattering from a periodic lattice, reciprocal space, and symmetry. Phase problem, Patterson functions, molecular replacement, model building and refinement. Nuclear magnetic resonance: overview and practical aspects. Nuclear spin and coupling interactions, multi-dimensional experiments, determination of protein and nucleic acid structures, protein folding, dynamics, SAR by NMR. Cryo-EM: Applications of Cryo-EM on the architecture of molecular machines, organels and organisms. Bioinformatics: 3D structure modeling, visualization softwares, homology modeling, similarity searches, sequence alignment.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-2-1303**			
Course Title	**Biology of Infection**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Bacterial (Tuberculosis):Overview of mycobacteria Organization of mycobacterial cell wall and its biosynthesis. Organization of mycobacterial genomes, plasmids and transposons. Mycobacterial infection and pathogenesis. Host response to mycobacterial infection (Immune response). Lab work: Mycobacterial staining, growth analysis, antibiotic tolerance. Virology: Introduction to Viruses (different types of viruses). Basics of Virus-host interaction. Progression of Viruses (viral DNA replication and gene expression). Host response to viral infection (anti-viral immunity). Drugs against viral infection. Lab work: in vitro viral infection. Parasite Biology: Malaria, Leishmania, Filaria Parasite interactions in vector and human host Pathogenesis Immune response to parasitic infection Diagnosis, Treatment and prophylaxis Drug targets and drug resistance

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-2-1304**			
Course Title	**Protein Science and Proteomics**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Amino Acids and Proteins Peptide backbone, side chains, polarity, Absorbance, Single letter codes etc. Protein Structure Primary, secondary, tertiary and quaternary structure, covalent modifications of the polypeptide chain, Forces that determine protein structure, Structural motifs in regulatory proteins: DNA-binding proteins, Zinc finger motif, Helix T urn Helix motif Basic Leucine Zipper motifs. Tools: Databank of protein sequences (SWISS-PROT), Basics of protein sequence alignment Protein Regulation Enzymes I: Mechanism of Catalysis Enzymes II: Kinetics & Regulation Protein Methods: Protein separation and purification Methods Protein Function Analysis The Life Cycle of a Protein: Folding to Destruction (Proteasomes and unbiquitination) Practical Training to protein separation/detection using Western blotting Introduction to Proteomics and its advantages over genomics 1D and 2D Gel Electrophoresis: pI, Isoelectric focussing, 2 dimensional gel Gel Staining methods and analysis Protein spot/Band processing for Mass spectrometric analysis Introduction to Mass spectrometers such as MALDI-TOF/TOF and electrospray mass spectrometer. Spectral Peak Annotation and Database search Shotgun Proteomics Protein quantification using Mass spectrometry: ITRAQ, ICAT and SILAC Practical Training for 1D and 2 D gel electrophoresis and subsequent Mass Spectrometric analysis of processed protein spot using MALDI-TOF/TOF

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-2-1305**			
Course Title	**Xenobiotic Interaction and Response**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Principles of Xenobiotic interactions Overview of various classes of xenobiotics Introduction to Regulatory Toxicology /Guidelines for Regulatory Toxicology Strategies for Toxicological evaluation of xenobiotics Organ specific histopathological response to xenobiotics Systemic effects of xenobiotic action (Hematology) Systemic effects of xenobiotic action (Neurotoxicology) Systemic effects of xenobiotic action (Immunotoxicology) Systemic effects of xenobiotic action (Genotoxicity) Systemic effects of xenobiotic action (Reproductive Toxicology) Systemic effects of xenobiotic action (Hepatotoxicity) Toxicokinetics Molecular Toxicology Biochemical mechanisms of xenobiotic action Computational Toxicology Xenobiotics of environmental origin and their effects Experimental systems in toxicology research: in vitro and in vivo Alternative systems in Toxicology Safe and responsible conduct of toxicology research

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-2-1306**			
Course Title	**Molecular Therapeutics**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Roadmap to New Drug Discovery and Development Drugs from Nature Molecular Mechanisms of Drug Action Adverse Drug Reactions Safety Pharmacology Molecular Pharmacokinetics of therapeutic agents Drug Absorption/Molecular permeability of therapeutic agents Pharmacogenomics and pharmacogenetics in therapeutic efficacy and molecular metabolism Molecular basis of drug interactions Targeted and controlled drug delivery system Laboratory Work

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-2-1307**			
Course Title	**Cell Signaling**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Principles of Cell Signalling and Biological Consequences Introduction: Overview of Pathways and Networks and GPCR Signalling G Protein–Coupled Receptors G Protein Effectors Ligand-Gated Ion Channels Regulation of Ion Channels by G Proteins Protein Kinases Protein Phosphatases Ras-MAPK Pathways Growth Factor and Receptor Tyrosine Kinases Cytokine Receptors and Jak-STAT Signaling Nuclear Transactivators and Repressors Nuclear Receptors Chromatin Remodeling Regulation of Complexes by Cytoskeletal Elements: Integrins as Force Transducers Linking Mechanical Stimuli and Biochemical Signals Apoptosis MicroRNA

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-2-1308**			
Course Title	**Chemical Biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Chemistry and life: Science at the Interface Chemistry-Biology Introduction to Chemical Biology : This lecture will provide a survey of major topics, technologies, and themes in Chemical Biology RNA interference: Including lectures on RNAi biological applications, siRNA- A tool in chemical biology and designing and synthesizing siRNAs Click Chemistry applications in Chemical Biology Fluorescent probes and fluorescent sensors for studying the biology Chemical Genetics: amelioration of biology through chemistry Semisynthesis of proteins and Protein ligation, native chemical ligation Unnatural amino acids as probes of protein structure and function

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-2-1309**			
Course Title	**Epigenetics and Chromatin Organization**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Nuclear ultrastructure, chromatin network and spatial organization in the nucleus DNA Replication (Origin recognition and initiation of DNA replication, mechanisms of replication, analyzing DNA replication origins and mechanisms) Transcriptional regulation (The transcription initiation complex: components, transcription factor, recruitment and regulation, regulatory DNA elements) Chromatin organization in prokaryotes and eukaryotes, chromatin assembly/disassembly and transcriptional control, epigenetic control of cancer Protein translation, post-translational modifications, retrotransport Organelle targeting and cellular transport of proteins Transport across membranes and signal transduction Ligand receptors, ion channels, signal transduction pathways Calcium signaling Molecular and cellular evolution Abiogenesis, mechanisms of evolution (random mutation, natural selection, genetic drift, endosymbiosis and current controversies Cell cycle regulation and apoptosis Maintenance and transition of the phases of the cell cycle, pathways of programmed cell death Molecular processes in development Gradients and cascades in embryo development

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-2-1310**			
Course Title	**Homeostasis and feedback in biological systems**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Levels of organization: Molecular, Cellular and Tissue Physiology Control and Regulation: Nervous and Endocrine Systems Overview of physiological adaptation Components of homeostasis & physiological feedback Regulation of homeostasis and adaptive mechanisms of glucose, water, pressure & volume, mineral & ion, acid-base (include oxygen-CO2 regulation), temperature Pathways affecting homeostasis Physiological Applications: Reproductive System and contraception

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-2-1311**			
Course Title	**Molecular and Cellular Mechanisms of Defence**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Cells and tissues of the immune system Innate immunity Effectors of adaptive immunity Antigen and antibody Complement system and inflammatory reaction Major Histocompatibility Complex Antigen processing, presentation Cytokines, chemokines and leukocyte trafficking Immunobiology of the pulmonary system Immune tolerance and autoimmunity Immunobiology and pathology of Malaria Immunobiology and pathology of Leishmania Immunobiology and pathology of Filaria Tumor immunology Transplantation immunology Vaccines

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-2-1312**			
Course Title	**Dosage Form Design**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Pre-formulation studies Formulation development of Tablets using different excipients, technology involved to develop different types of tablets. Problems associated with production of tablets and its evaluation parameters. Tablet coating Introduction to capsules, different size of capsules, excipient selection, different types of capsules, quality control parameters Sterile Products and admixtures: Development of injectable preparations, small volume and large volume parenterals, excipients used, Quality control parameters Solubilization: Solubility of drugs, drug solubilization in surfactant systems, different techniques for solubilization, hydrotropic solubilization etc. Poly-disperse systems: Development of suspension and emulsions. Stability issues, implications of particle size on stability and its quality control parameters Aerosols: Preparation, characterization and applications

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-3-1301**			
Course Title	**Seminar Course (compulsory)**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

History of science with emphasis on Indian contribution Seminar by students

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-3-1303**			
Course Title	**Microbial Pathogenesis**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Clinical spectrum of AIDS, Dengue, Tuberculosis, Malaria & Kala-azar (Lectures in reference to Clinical symptoms, Diagnosis, Prophylaxis and Treatments) Cellular and Host tropisms of Organisms and Pathological changes (Lectures in reference to molecular bases of survival of the organisms in the hosts) Metabolic and Enzymatic Pathways (Lectures based on the molecules involved in virulence, diagnosis and drug targets) Mechanism of Actions of Drugs and Drug Resistance (Lectures highlighting present drugs, SDR, MDR, XDR and role of Hosts) Delineations of Genomes and Proteomes of HIV, Plasmodium, L. donovani and M. tuberculosis (Lectures based on Identification of important molecules involved in patho-biology of organisms, future drugs and Immunogens) Laboratory Work: Culture of micro-organisms in laboratory and Infections in vivo and in ex vivo

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-3-1304**			
Course Title	**Neurobiology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction- Nervous System Anatomy of Neuron Physiology of Neuron –generation and propagation of AP Neuronal supportive cells – Glial cells Organization of CNS- Brain & Spinal Cord Neurotransmission Neuronal Synapse Neurotransmitters & Receptor Central Neurotransmitters Catecholamines (Epinephrine, Norepineprine & Dopamine) Acetylcholine 5-Hydroxytrytamine (5-HT) Histamine Inhibitory Amino Acid (GABA, Glycine & Benzodiazepines) Excitatory Amino Acid (Glutamate) Neuropeptides Endogenous Opioid System Autonomic Nervous System Sensory –Motor Reflexes Neurotransmitters & Diseases Neurotransmitter Mechanisms & Drug Design Experiments (In rodents): Recording of Gross behavior activities, Evaluation of Neuromuscular co-ordination & sensory reflexes

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-3-1305**			
Course Title	**Transcription and Gene Regulation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Molecular Basis of transcription (RNA Polymerases and mechanism of transcription, positive and negative control of transcription, post transcriptional processing, CTD phosphorylation and function) Chromatin dynamics in gene regulation (DNA methylation, histone variants, nucleosome positioning, histone code, chromatin r Integration of transcription to translation, protein degradation Histone modification and signal transduction

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-3-1306**			
Course Title	**Biol and Therapeutics of Life Style Disorders**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Concept and introduction to the subject Introduction to disorders affecting central nervous system (pathophysiology and therapeutics) Introduction to disorders affecting cardiovascular system (pathophysiology and therapeutics) Biology of Inflammation and inflammatory disorders (pathophysiology and therapeutics) Pathophysiology and therapeutics of ulcers Energy metabolism and diabetes (pathophysiology and therapeutics) Obesity and syndrome X (pathophysiology and therapeutics) Laboratory work (in vitro and in vivo experiments)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-3-1307**			
Course Title	**Animal Models in Biomedical Research**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to model systems, Origins of Animal Experimentations Laws, regulations and policies affecting the use of Laboratory animals Brief account of biology and diseases of commonly used Rodent models (Mouse, Rat, Hamster, Guinea pigs, Gerbils and Mastomys) Brief account of biology and diseases of different Non-Rodent models (Rabbit, Dog, nonhuman primates) Laboratory Animal Biosecurity (Prevention, containing and eradication) Planning and Execution of Animal Experiments Common Zoonotic Diseases and Prevention. Genetic manipulations and Transgenesis: Principles and methods. Transgenic and Knockout Models for specific diseases. Genetic Monitoring of Experimental Animals. Alternative Models (cell based, Yeast, Drosophila, C. elegans, Zebrafish), advantages and disadvantages. Animal handling, care and Laboratory animal Techniques (practicals).

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-3-1308**			
Course Title	**Pharmacokinetics and metabolism**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction; Pharmacokinetics and its role in drug discovery and development; Drug absorption, distribution, metabolism and excretion; routes of drug administration; Plasma drug concentration time profile, Pharmacokinetic parameters Bioanalysis tools and techniques; Method development and validation; Regulatory considerations for pharmacokinetic and metabolic data for pre-clinical (e.g. IND) and clinical (e.g. NDA and ANDA) submissions. Bioavailability introduction; measurement of bioavailability; Biopharmaceutics classification system; Methods for enhancement of bioavailability. Absorption of Drugs; Mechanisms of drug absorption. Permeability/absorption models, Factors influencing absorption and bioavailability. Distribution of Drugs; Volume of distribution; Factors determining the distribution of drugs: perfusion, molecular size, solubility, protein binding; Significance of drug uptake by the lung; Binding of drug to tissue components. Drug Metabolism and its role in drug discovery and development; Drug metabolizing organs and enzymes. Reaction Phenotyping; Metabolite identification Phase I and Phase II metabolic reactions. Tools and Techniques for studying drug metabolism; Factors affecting metabolism. Pharmacogenetics and Pharmacogenomics; Reactive metabolites and metabolic toxicity; Metabolites in safety testing- need and criterions. Excretion of drugs-basic considerations; Renal and non-renal excretion of drugs. Clearance; Renal function, renal failure and dose adjustment in renal failure. Non-linear Pharmacokinetics; Causes of non-linearity; Michaelis Menten Equation Chronopharmacokinetics, Pharmacokinetic variations in paediatric, geriatric and obese populations Applications of pharmacokinetic principle: Design of dosage regimens, Individualization and Therapeutic Drug Monitoring (TDM). High Throughput approaches in pharmacokinetics and drug metabolism; Applications of computational/predictive tools in pharmacokinetics and drug metabolism; Drugdrug/ Food-drug/herb-drug pharmacokinetic interaction studies.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-3-1309**			
Course Title	**Approaches to Drug Delivery**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Conventional dosage forms- for per-oral and parenteral drug delivery Analytical approaches and method development for pharmaceutical analysis Storage stability under ICH and Schedule Y regimes Controlled release-Principles and strategies Oral controlled release systems Targeted drug delivery with special reference to colloidal particles. Cutaneous and Transdermal drug delivery Delivery of drugs by Pulmonary route Microparticles and nanoparticles for drug delivery Strategies for the delivery of biomacromolecules. Liposomes as drug delivery vehicles BCS system and applications of microemulsions for delivery of poorly soluble drugs. Laboratory Work Matrix-controlled release tablet Adhesive-dispersion transdermal Drug powder for inhalation Development of nanosuspension

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-3-1310**			
Course Title	**An Intro to Drug Discovery & Development**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Drug Discovery Approaches: Observation-based/Physiology-based (Phenotype),Targetbased approach to drug discovery Areas of interest in drug discovery “Me Too” drugs, New chemical entities, Generics, Pro-drugs, Orphan drugs Milestones in Drug Discovery Technologies impacting each milestone Serendipity/Repositioning Target discovery/validation/druggability/introduction to proteomics and genomics Assay Development—in Vitro/Cell-based/in vivo Biological screening glossary Characteristics of hit/lead Screening techniques: HTS, NMR, X-ray, Virtual Sources of chemical libraries for screening/selection of molecules, natural products/privileged structure Target oriented and Diversity oriented synthesis Biologics Toxicity/PK studies/Formulation Bioinformatics in drug discovery IPR: IND/NDA Clinical trials Phase I/II/III

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-3-1302**			
Course Title	**Cancer Biology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Course content: • Cancer: The nature of cancer and class organization • Hall Marks of Cancer Evasion of Apoptosis Limitless replicative potential Sustained Angiogenesis Inflammation • Cancer: The Key Players (Carcinogens, tumor virology, oncogenes, tumor suppressor genes, cell cycle regulation) • Hypoxia and Angiogenesis in cancer • Metabolism and cancer • MicroRNAs and cancer • Stem Cells and Cancer • Chemoresistance & Radioresistance in Cancer • Experimental approaches to understanding the origins, diagnosis and treatment of cancer • Recent advances in the field and future prospects

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-2-1313**			
Course Title	**Plant Taxonomy, biodiversity,conservation, ethnobotany and Pharmacognosy**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

S.No. Course content No. of lectures 1 Principles and fundamentals of Plant taxonomy; classification of angiosperms; 8 International Code of Botanical Nomenclature; concept of plant taxa, plant nomenclature and plant identification; plant description procedures (monocots and dicots); modern trends in taxonomy, speciation in plants 2 Role of herbaria, botanical gardens and taxonomic literature for plant identification; 4 methods and techniques of plant collection, processing and herbarium preparation 3 Molecular systematics: concepts and applications, molecular markers in plant 5 systematic, procedures for collecting and sampling of plant materials, molecular phylogenetics. 4 Floristic diversity: scope and perspective; species distribution and endemism; hotspots 6 and mega-diversity; threats of plant diversity and assessment of plants as per IUCN recommendations; conservation of threatened plants: in situ and ex situ;types of protected area, role of Biosphere Reserve, National Parks, Wild Life Sanctuaries and Sacred Grooves in biodiversity conservation 5 National Biological Diversity Act and biopiracy 2 6 Bio prospection: principle, techniques and applications 2 7 Ethnobotany: definition and scope; interdisciplinary nature of Ethnobotany and its role 3 in drug development 8 Pharmacognosy: role in Indian Pharmacopeia, development of quality control 2 parameters for evaluation of crude drug samples/ herbal drug formulation/ adulteration and substitutions

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-3-1311**			
Course Title	**Plant secondary metabolites and their in vitro biosynthesis through plant tissue culture**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

S.No. Course content No. of lectures 1 Plant secondary metabolites: classification, plant environment interaction and its 6 production, role of these metabolites in drug development 2 Plant tissue culture: history, concepts, vocabulary, terminology, types and applications 3 General methods and laboratory organisation of plant tissue culture; types and 4 constituents of plant tissue culture media 4 Microproprogation: principles, types, method and application; somatic embryogenesis Production of medicinally important secondary metabolites by callus/cell suspension/hairy root cultures. Optimization of physical/chemical factors, precursorfeeding and elicitation for enhanced production Transgenic plants: methods and advances in producing transgenics, selection, identification, molecular analysis for confirmation; biotransformation using cell/hairy root cultures for generating pharmaceutical lead molecules; approaches of engineering metabolic pathways in heterologous systems.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-4-0001**			
Course Title	**Project Proposal Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Project Proposal to be prepared by selecting topics of high relevance and novelty, and will have state-of-the art review, methodologies, recommendations

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-4-0002**			
Course Title	**Review Article Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Review Article on the research area undertaken by the student

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CDRI, Lucknow**			
Course Nomenclature	**BIO-CDRI-4-0003**			
Course Title	**CSIR-800 Project Work**			
Credit Distribution (L-T-P-C)	0	0	8	**4**

Course Description:

Six–Eight weeks have to be dedicated on a project concerned with societal/rural issues under the CSIR-800 Programs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-1-0001**			
Course Title	**Biostatistics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Summerization of Data: measures of center, dispersion, skewness Dependence of variables: Correlation, linear regression, logistic regression: Basic probability distributions: Binomial, Normal, Chi-squares. Estimation of parameters: method of moments, maximum likelihood Testing of hypotheses: (a) Parametric tests: t-test, z-test, chi-squares test, ANOVA (b) non-parametric tests: Mann-Whitney, Kruskal Wallis, Kolmogorov-Smirnov

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-1-0002**			
Course Title	**Computation/bioinformatics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Computers: Introduction, Evolution and Classification and computers. Fundamentals of computing. Bit and Byte, introduction to types of Hardware and Software. Components of Computer. Introduction to operating systems. Introduction to Computer viruses. Network: Introduction. Network structure and architecture, Hierarchical networks, Ethernet and TCP/IP family of protocols, transport protocol design. Types of network, Toipologies of network, Router, Switch, Data Communicatio, concept of wireless networking, LAN, WAN, MAN, Security of the network, Fire-walls, Network Applications. Information Technology: Concipts of client Server Architecture, Concept of search Engine, Database search engines. Introduction to Internet. Introduction to Word, Powerpoint and Excel. Introduction to Bioinformatics: History of Bioinformatics, Genome sequencing projects, Human Genome Project, Applications of Bioinformatics. Introduction to databases, Type and kind of databases, Applications and limitations. Literature Search Databases, Nucleic acid and protein databases, Animal and plant databases, Ensembl Genome project TIGR database, Biotechnological databases, Motifs and Pattern Databases, Databases for species identification and classification, Structural databases. Database Retrieval and deposition systems. Web tools and resources for sequence analysis: Pairwise and multiple sequence Alignment, Sequence similarity search: BLAST, Pattern recognition, motif and family prediction, Restriction map analysis, primer design, Gene prediction, Phylogenetic Tree, Protein structure prediction and visualization.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-1-0003**			
Course Title	**Basic Chemistry**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Thermodynamics Solutions and Ions Chemical bonding and molecular structure Chemical Kinetics Stereochemistry Introduction to drug discovery (Medical chemistry approach) Drug target, discovery and development(forward and reverse approach)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-1-0004**			
Course Title	**Research Methodology, Communication/ethics/safety**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Philosophy and struture of scientific thoughts, Objective and Motivation of Research, Meaning of the Research, What constitutes a research topic? How to select a research topic? Importance of literature review, Selection of appropriate methodology, Collection of data, Interpretation of data, Writing research paper, Paper presentation in scientific conference, Statistical methods, Importance of documentation, Procedure for Hypothesis Testing, Values and Ethical Problems, Criteria of Good Research, Good laboratory practice, Chemical, Radioactive and Biological safety: Possible hazards and precautionary measure; do and don'ts upon exposure. Research methodology, communication, ethics, safety Asking the right questions: Originality, Depth, Precision can co-exist Formulating and refining the hypothesis: Those who do not learn from the past are condemned to repeat it Study design: Recognizing and minimizing bias Experiment design: Sometimes less is more and the importance of controls Good lab practices: Record keeping, organizing data, organizing the lab space Data interpretation; objectivity, quantification, double blind studies and necessity of statistics Communicating your data: writing up your research Communicating your data: presenting your findings Radiation safety Chemical and Biosafety Intellectual property rights What is ethics, the different interpretation & historical instances of unethical science Case studies: Data fraud/ plagiarism and Human Ethics violation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-1-1401**			
Course Title	**Basics Mathematics & Numerical Methods**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Determinants and Matrices, Complex Variables, Infinite Series, Special Functions, Differential Equations, Interpolation and Approximation, Numerical differentiation and Integration, Basic Linux, Introduction to Algorithms, basic programming, Shell and Shell Scripting, Network Computing and Parallel Computing, Matlab/Scilab/Octave/Gnuplot.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-1-1402**			
Course Title	**Introduction to Chemical Biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Chemical biology/synthetic biology, Structure, function and chemistry of biological macromolecules including amino acids, proteins, nucleic acids and carbohydrates, Chemical kinetics and thermodynamics in biology, Chemical reactions and chemical diversity in Biology The Chemistry of Enzymes, Lipids, Fats & Steroids, Drug discovery, Drugs from Nature, Drug interaction.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-2-1401**			
Course Title	**Advanced Materials Characterization Techniques**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Optical Microscopy, Electron microscopy: TEM, HRTEM, SEM, STEM, EDX, FIB, e-beam lithography, Scanning probe microscopy: AFM, STM, MFM, confocal, etc, Raman spectroscopy/microscopy, Thermal analysis techniques, Magnetic measurements, Electrical measurements, Spectroscopic ellipsometry.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-2-1402**			
Course Title	**Environmental Biotechnology & Microbiology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Biological Treatment of Wastewater – Aerobic System, Biological processes for domestic and industrial waste water treatments; Aerobic systems – activated sludge process, trickling filters, biological filters, rotating biological contractors (RBC), Fluidized bed reactor (FBR), expanded bed reactor, Inverse fluidized bed biofilm reactor (IFBBR) packed bed reactors air- sparged reactors, Biological Treatment of Wastewater – Anaerobic System Anaerobic biological treatment – contact digesters, packed column reactors, UASB. Introduction, constraints and priorities of Bioremediation, Biostimulation of Naturally occurring microbial activities, Bioaugmentation, in situ, ex situ, intrinsic & engineered bioremediation, Solid phase bioremediation – land farming, prepared beds, soil piles, Phytoremediation. Composting, Bioventing &Biosparging; Liquid phase bioremediation – suspended bioreactors, fixed biofilm reactors.Mining and Metal biotechnology – with special reference to Copper &Iron.Microbial transformation, accumulation and concentration of metals, metal leaching, extraction and future prospects. Microorganisms and energyrequirements of mankind; Production of nonconventional fuels – Methane (Biogas), Hydrogen, Alcohols and algal hydrocarbons, Use of microorganisms in augmentation of petroleum recovery. Introduction – Xenobiotic compounds, recalcitrance. Hazardous wastes biodegradation of Xenobiotics .Biological detoxification – market for hazardous biotechnology application to hazardous waste management – examples of biotechnological applications to hazardous waste management – cyanide detoxification – detoxification of oxalate, urea etc. – toxic organics – phenols.Classification of microorganisms – prokaryotic, eukaryotic, cell structure, characteristics, Preservation of microorganisms, DNA, RNA, replication, Recombinant DNA technology. Distribution of microorganisms – Distribution / diversity of Microorganisms – fresh and marine, terrestrial – microbes in surface soil, Air – outdoor and Indoor, aerosols, biosafety in Laboratory – Extreme Environment – archaebacteria – Significance in water supplies – problems and control. Concentration and detection of virus, Transmissible diseases. Nutrition and metabolism in microorganisms, growth phases, carbohydrate, protein, lipid metabolism – respiration, aerobic and anaerobic-fermentation, glycolysis, Kreb'scycle, hexose monophosphate pathway, electron transport system, oxidative phosphorylation, environmental factors, enzymes, Bioenergetics. Transmission of pathogens – Bacterial, Viral, Protozoan, Indicator organisms of wa ter – Coliforms – total coliforms, E-coli, Streptococcus, Clostridium, Control of microorganisms; Microbiology of biological treatment processes – aerobic and anaerobic, ß-oxidation, nitrification and denitrification, eutrophication. Factors influencing toxicity. Effects – acute, chronic, concentration response relationships. Test organisms – toxicity testing, Bioconcentration – Bioaccumulation, 4iomagnifications, bioassay, biomonitoring, bioleaching.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-2-1403**			
Course Title	**Biology of Macro molecules**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to biological Macromolecules, The need for polymeric macromolecules for the living cell, Information content (general ideas on Shannon's information theory), Non-covalent forces (electrostatic, hydrophobic, hydrogen bonding, etc.), Properties of water in relation to macromolecular conformation,Problem of protein folding, Introduction to protein folding, Levinthal's paradox and necessity for folding pathways, discussion on folding pathways (framework, hydrophobic collapse, nucleation-condensation-propagation, zigzag puzzle models and experimental evidence in support and against for these models), Current view of protein folding, Folding surface and funnel, Assisted protein folding, Need for assistance in protein folding in vivo, Differences between in vitro and in vivo folding, Discovery of molecular chaperone, classification of chaperone and brief description of functions of GroEL, Methods for investigating protein folding, Fluorescence and circular dichroism. Basic principles and applications Structure-function relationship : why structure?, Overview of different methods of structure determination, Retrieving, visualizing and understanding macromolecular structures, Correlation between structure and function Protein architecture, Organization of protein structure, Supersecondary structural elements, Ramachandran plot, Structure determination by X-ray crystallography, Globular proteins, Identification of folds and classification, Examples of structure function relationship. Macro-Molecular interactions, Various models of ligand-protein interactions (simple as well as complex binding models), Analysis strategies (Scatchard and Klotz plots), cooperativity in Biology and Hill plot, Methodology and principles for estimation of binding stoichiometry; classical (gel filtration, equilibrium dialysis, stopped flow) as well as advanced methods (absorption, CD, fluorescence, NMR, ITC, SPR etc)., Thermodynamics of interaction and principles of ligand design, Protein-protein interactions Enzymes, Enzyme kinetics, Why study enzyme kinetics? Single substrate, bisubstrate reactions, Determination of Km. Enzyme inhibition – Reversible and irreversible inhibition, Competitive, Non-competitive and uncompetitive inhibition. Independent identical and non-identical substrate binding sites on enzymes, allosteric regulation. Reactions on enzymes and rate enhancements, Transient state stabilization, Transition state analogues and catalytic antibodies.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-2-1404**			
Course Title	**Biotechniques & Instrumentation**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Part-I Chromatographic Analysis: GLC, HPLC, HPTLC and Flash chromatography Part- II- Spectroscopic analysis: UV, AAS and Mass spectrometry Part- III – Microscopy Light Microscopy, Confocal Microscopy, SEM and TEM NMR Spectroscopy in Plant Metabolomics: Introduction & Scope of NMR SpectroscopandApplications of NMR Spectroscopy in Plant Metabolomics Electrophoresis agarose and polyacrylamide gel (native and denaturing), 2-D gel Centrifugation (high speed, ultra and differential centrifugation) Common Molecular Biology Techniques Chromatography: affinity, ion exchange, hydrophobic chromatography, size exclusionandreverse phase chromatography Proteomics- MALDI-MS/MS, LC-ESI-MS/MS.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-2-1405**			
Course Title	**Water & waste water treatment**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Water treatment concepts; pretreatment, primary treatment, secondary treatment, tertiary treatment.Water quality standards; characteristics. Theory and design of physicochemical unit operations; screening, grit, removal equalisation, sedimentation, floatation, caogulation-flocculation, filtration, disinfection, membrane processes, desalination, ion-exchange, aeration/gas transfer, precipitation, adsorption. Hydraulics of treatment plant; flow measurement and hydraulic control points, hydraulic analysis of unit operations, hydraulic profile through the treatment plant. Wasterwater treatment concepts; pretreatment, primary treatment, secondary treatment, tertiary treatment.Water quality standards; characteristics.Theory and design of physicochemical unit operations; screening, grit, removal equalisation, sedimentation. Theory and design of biological unit operations; aerobic and anaerobic processes; Aerobic unit operations for organic carbon removal such as activated sludge, tricling filter, oxidation ditch, oxidations ponds, aerated lagoons, root zone treatment, vermifilter etc. Anaerobic operations for organic carbon removal such as UASB, filters, fluidised/expanded bed systems etc. Biological unit operations for nitrogen and phosphorus removal. Theory and design of Sludge treatment, sludge thickening, sludge drying, incineration, aerobic and anaerobic digestion of sludges. Theory and design of wastewater disposal and systems;disposal to inland water bodies, sea/ocean disposal; land/underground disposal.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-2-1406**			
Course Title	**Fundamentals of Electrochemistry & Corrosion**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Basic electrochemistry concepts, Reference electrodes, Electrochemical Thermodynamics, Kinetics of electron transfer, the Tafel equation, Diffusion, Double Layers, electrode Kinetics, the Gibbs adsorption isotherm, Electro capillary phenomena, the Lippmann equation, infinitely dilute solutions and thermal balance, Faradaic vs. capacitive currents, transport properties, potential theory, Electrochemical Techniques, Voltammetry, Reversible and irreversible reactions, Mass transport by convection, rotating electrodes, Equivalent circuits, A.C. voltammetry, Electrolysis methods, Adsorption, Electrochemistry of polymers and inorganic solids. Basic aspects, Forms of corrosion, Atmospheric corrosion and protective coatings, Immersion corrosion and electrochemical protection, Corrosion monitoring, impedence spectroscopy, harmonics and NDT techniques.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-2-1407**			
Course Title	**Advanced Surface Science**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to Surface Science - Surface phenomena - Adsorption, Desorption, Adsorption Models, Special properties of surfaces and interfaces, Electronic structure of surfaces, Surface modification and its applications, Nanoscale catalysis and applications, Surface spectroscopy and microscopy tools for nanocatalysis.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-3-1401**			
Course Title	**Industrial & Applied Microbiology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction Industrial and environmental microbiology; Intermediate microbial metabolism for exploitation of microbes; Microbial enzymology and kinetics, Intermediate microbial metabolism; Microbial transformations; Immobilization and applications; Microbial processes for waste water management; Microbial processes for Air pollution management; Anaerobic digestion of organic solids Microbial solid waste management; Microbial fermentation; Microbial Energy Engineering; Microbial energy engineering and Biorefinery.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-3-1402**			
Course Title	**Bioremediation**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Concept and dynamics of ecosystem, biogeochemical cycles; Types of ecosystems, Community structure and organisation; Environmental pollution and importance ofmicrobes, Bioremediation: Microcosms, Mesocosms, Bioaugmentation, Biostimulation Biodiversity, Climate change research, Microbe-Plant interactions, Eco-restoration and Remediation technologies, Environmental Management, Waste management through Eco-friendly approaches, Constructed wetlands for treatment of Wastewaters, Biomolecules in remediation, Microbial diversity in different Ecosystem, Bioremediation/Phytoremediation, Carbon sequestration and Clean Development Mechanisms, Resource recovery from waste, Bio-energy, Bioproduct, Environmental Biotchnology, Green chemistry.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-3-1403**			
Course Title	**Advanced Treatments system**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Gas phase transfer: Aeration systems, Design of aeration systems. Membrane filtration: Introduction , Process classification, Membrane configurations, Membrane operation for micro filtration, Ultra filtration and Reverse osmosis, Design of membrane systems. Microbial growth kinetics, Modelling suspended and attached growth treatment processes. Suspended growth processes for biological nitrification and denitrification, Biological nitrogen and phosphorous removal. Advanced oxidation processes, aeration/stripping, adsorption, nanoparticles, low pressure membrane processes, and sea water desalination. Principles of mass and momentum transport, aquatic chemistry and chemical reaction engineering are applied to these unit processes. Anaerobic sludge blanket processes, Design considerations for Up flow Anaerobic Sludge Blanket process. Theory and design of Sludge treatment, sludge thickening, sludge drying, incineration, aerobic and anaerobic digestion of sludge. Wetland and aquatic treatment systems; Types, application, Treatment kinetics and effluent variability in constructed wetlands and aquatic systems, Free water surface and subsurface constructed wetlands, Floating plants (water hyacinths and duckweed), Combination systems, Design procedures for constructed wetlands, Management of constructed wetlands and aquatic systems. Physical separation for hazardous solid wastes , gravity flotation, dissolved air flotation, air stripping. Steam stripping, Solvent extraction. Sorption processes and chemical treatment including hydroxide, sulfide, carbonate precipitation, Solidification and stabilization, Oxidation ad reduction of solid wastes. Thermal treatment and incinerator design. Biological treatment introduction and configuration.Safe disposal methodologies.Quantitative Risk analysis and site remediation.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-3-1404**			
Course Title	**Advanced Biochemical Engineering**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Bioreactions – Cell growth and product formation kinetics, growth associated, non-growth associated and mixed - growth associated product formation, cell growth and product formation models – quantitative review of biochemistry, metabolism and metabolic engineering, engineering aspects of microbial process and bioconversions – Bioreactors – Design of bioreactors – kinetic analysis, packed bed bioreactor, Fluidized bed batch, fed-batch and continuous culture – Bioprocess development – Exploitation of genetic engineering and bioprocess development, Plant cell culture, Mammalian cell culture, Enzyme technology – Downstream processing – Purification and separation technology, integrated bioseparation schemes – Case studies – Production of protein pharmaceuticals as a paradigm of the application of biochemical engineering to advanced process development within the frame work of current business and regulatory requirements – Chemicals from biomass

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-3-1405**			
Course Title	**Electrochemical Power Sources**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Energy scenario, emissions and global warming, fuel cells, Thermodynamic potentials, electrochemical processes and electrode kinetics, Proton exchange membranes, proton conducting mechanisms, recent advances, Operating conditions, overview of characterization techniques, technical aspects, advantages, materials, significances and challenges, Materials for supercapacitor applications, recent advances in the system development, battery vs. supercapacitor, modern technologies, challenges and prospects.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-3-1406**			
Course Title	**Nano Biotechnology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Concept of hybrid systems, signaling and signaling responses; biological systems as transducers, Biology at the nano-interface, fluorescent nanoparticles for life sciences, applications, DNA based particles used as building blocks, micelles, Nucleic Acid Engineering using DNA as Nano materials, Cells &Microfabricated Devices, Nanomaterials for drug delivery, imaging, diagnostics, therapy, separation, Biosensors

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-3-1407**			
Course Title	**Functional Materials**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction- surface properties and functionalization – nanomaterials – design of functional materials – characterization techniques – functional materials for energy applications – biomaterials – materials for solar energy – magnetic materials – thermoelectric materials – smart materials – organic materials for electronics application – computational materials science – modelling of nanomaterials – electronic and band structures

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-3-1408**			
Course Title	**Electrochemical remediation**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Overview of electrochemical remediation technologies – electro chemical transport and transformation – basics – electrokinetic (Ek) removal of chlorinated organic compounds – lasagne technology – remediation of heavy metals and other inorganic pollutants – Ek removal of nitrate and fluoride – Ek remediation of mixed metal contaminants – electrokineticsbiofences - bioremediation and applied aspects – mathematical modelling.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-4-0001**			
Course Title	**Project Proposal Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Project Proposal to be prepared by selecting topics of high relevance and novelty, and will have state-of-the art review, methodologies, recommendations

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-4-0002**			
Course Title	**Review Article Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Review Article on the research area undertaken by the student

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CECRI, Karaikudi**			
Course Nomenclature	**BIO-CECRI-4-0003**			
Course Title	**CSIR-800 Project Work**			
Credit Distribution (L-T-P-C)	0	0	8	**4**

Course Description:

Six–Eight weeks have to be dedicated on a project concerned with societal/rural issues under the CSIR-800 Programs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-1-0001**			
Course Title	**Biostatistics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Summarization of Data: measures of center, dispersion, skewness Dependence of variables: Correlation, linear regression, logistic regression Basic probability distributions: Binomial, Normal, Chi-squares. Estimation of parameters: method of moments, maximum likelihood Testing of hypotheses: (a) parametric tests: t-test, z-test, chi-squares test, ANOVA (b) non-parametric tests: Mann-Whitney, Kruskal Wallis, Kolmogorov-Smirnov

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-1-0002**			
Course Title	**Computation/bioinformatics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Computers: Introduction, Evolution and Classification of computers. Fundamentals of computing. Bit and Byte, Introduction to types of Hardware and Software. Components of Computer. Introduction to operating systems. Introduction to Computer Viruses. Network: Introduction. Network structure and architecture, Hierarchical networks, Ethernet and TCP/IP family of protocols, transport protocol design. Types of network, Topologies of network, Router, Switch, Data Communication, Concept of Wireless networking, LAN, WAN, MAN, Security of the network, Fire-walls, Network Applications Information Technology: Concepts of client Server Architecture, Concept of search Engine, Database search engines. Introduction to Internet Introduction to Word, Powerpoint and Excel Introduction to Bioinformatics: History of Bioinformatics, Genome sequencing projects, Human Genome Project, Applications of Bioinformatics. Introduction to databases, Type and kind of databases, Applications and limitations. Literature Search Databases, Nucleic acid and protein databases, Animal and plant databases, Ensembl Genome project TIGR database, Biotechnological databases, Motifs and Pattern Databases, Databases for species identification and classification, Structural databases. Database Retrieval and deposition systems. Web tools and resources for sequence analysis: Pairwise and multiple sequence Alignment, Sequence similarity search: BLAST, Pattern recognition, motif and family prediction, Restriction map analysis, primer design, Gene prediction, Phylogenetic Tree, Protein structure prediction and visualization.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-1-0003**			
Course Title	**Basic Chemistry**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Thermodynamics Solutions and Ions Chemical bonding and molecular structure Chemical Kinetics Stereochemistry Introduction to drug discovery (Medicinal chemistry approach) Drug target, discovery and development (forward and reverse approach

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-1-0004**			
Course Title	**Research Methodology, Communication/ethics/safety**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Philosophy and structure of scientific thoughts, Objective and Motivation of Research, Meaning of the Research, What constitutes a research topic? How to select a research topic?, Importance of literature review, Selection of appropriate methodology, Collection of data, Interpretation of data, Writing research paper, Paper presentation in scientific conference, Statistical methods, Importance of documentation, Procedure for Hypothesis Testing, Values and Ethical Problems, Criteria of Good Research, Good laboratory practice, Chemical, Radioactive and Biological safety: Possible hazards and precautionary measures; do and don'ts upon exposure Research methodology, communication, ethics, safety Asking the right questions: Originality, Depth, Precision can co-exist Formulating and refining the hypothesis: Those who do not learn from the past are condemned to repeat it Study design: Recognizing and minimizing bias Experiment design: Sometimes less is more and the importance of controls Good lab practices: Record keeping, organizing data, organizing the lab space Data interpretation; objectivity, quantification, double blind studies and necessity of statistics Comunicating your data:writing up your research Comunicating your data: presenting your findings Radiation safety Chemical and Biosafety Intellectual property rights What is ethics, the different interpretations & historical instances of unethical science Case studies: Data fraud/ plagiarism and Human Ethics violation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1601**			
Course Title	**Instrumental Techniques**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Qualitative and quantitative analysis of carbohydrates, proteins, fats, vitamins, minerals and dietary fibre; Spectroscopy – principle and application in analysis of food constituents; Chromatographic methods for separation of proteins and determination of molecular mass and homogeneity; (vii) Isolation and purification of enzymes, assay of enzymes and enzyme kinetics; Elucidation of protein structure by physical chemistry methods; Assessment for biological activities associated with phytochemicals; Structural characterization of potent biomolecules by state-of-theart instrumental methodologies – HPLC, GC/GLC, LC-MS, NMR and others; Animal and cell culture methods for evaluation of biological activities associated with active principles of diversified sources; Chemical and physical tests of packaging materials - migration tests for food grade packaging materials, water vapour and gas transmission rates of packaging materials for food storage; Determination of shelf life of packaged foods; Determination of additives & preservatives in foods and residue analysis in foods; Evaluation of physical and chemical properties of rice and cooking quality of rice; Parboiling of paddy and quality evaluation; Rheological characterization of dough and batter; Sensory profile of food ingredients and products – texture, aroma, flavor, consistency and overall acceptability; Aerobic and anaerobic culture methods for determination of microbial populations; Evaluation of food ingredients and products for microbial safety

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1602**			
Course Title	**Basics of Food Microbiology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Historical development in microbiology; Developments in microscopy; Morphology, cytology and reproduction of bacteria, yeasts and molds; Microbial growth curve; Physical, chemical and biological factors influencing microbial behaviour; Recombination, Transduction, Transformation and Mutations in bacteria; Microbiology of fruits & vegetables; Cereals & cereal products; Meat & meat products; Poultry & eggs; Fish & fish products and milk & milk products; Major types of spoilage and pathogenic microbes and their characteristics; Foodborne infections and intoxications; Mycotoxins – characteristics, types and causative fungal species

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1603**			
Course Title	**Significance of Food Preservation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Objectives of food processing; Composition of foods; Degree of perishability of unprocessed foods; Causes of quality deterioration and spoilage of perishable foods; Intermediate moisture foods; Principles and methods of blanching; Test for adequacy of blanching; Conventional methods of preservation – Dehydration, Canning, Freezing, Fermentation, Smoking, Pickling, Chemical preservatives and others; Methods of drying and their application to fruits & vegetables; Procedures and technological applications relating to storage of foods at low, chilling and freezing temperatures

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1604**			
Course Title	**Thermal Processing of Foods**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Principles and types of retorts; Thermal destruction of microorganisms – Determination of D, z & F0 values; Heat resistance in microorganisms; Cooking, blanching, pasteurization and sterilization of foods; Heat penetration and inoculation pack studies

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1605**			
Course Title	**Canning of Foods**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Basic principles of canning; pH classification of foods; Tin plate containers including coating methods; Can fabrication; Aluminum cans; Canning of fruits & vegetables / meat products

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1606**			
Course Title	**Controlled and Modified Atmosphere Storage of Foods**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Basic principles; Minimally processed fruits & vegetables; Modified atmosphere packaging of selected fruits & vegetables; Controlled atmosphere packaging of selected fruits & vegetables; Quality and safety evaluation of MAP and CAP stored products

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1607**			
Course Title	**Functional Preservatives**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Chemical preservatives as effective antimicrobials and antioxidants; Qualitative evaluation of sulphur dioxide and benzoate in foods; Lactic acid bacteria as preservatives

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1608**			
Course Title	**Hurdle Technology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Principles and application; Intrinsic and extrinsic factors as effective hurdles; Behaviour of microbial contaminants in food system; Shelf life determination

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1609**			
Course Title	**Infestation Control and Grain Storage**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Principles of food commodity storage; Biology of insect pests; Infestation detection and monitoring methods; Pesticides – Classification and chemistry; Controlled atmosphere for insect control and food protection; Pesticide residues in foods; Pesticides and health hazards

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1610**			
Course Title	**Animal Products Technology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Raw and processed products of meat, fish and poultry; Abattoir design and slaughter methods; Hygienic meat production and carcass evaluation; Meat tenderization; Meat emulsions, sausages and comminuted meat products; Preparation of meat-based traditional food products – tandoori chicken, kababs, etc.; Quality and safety of animal products

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1611**			
Course Title	**Spices and Plantation Products**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Major constituents in pepper, ginger, chilli and turmeric; Analysis of spice oils and oleoresins; Flavour formulations; Tea – brewing and tasting; Coffee – characteristics, roasting and brewing; Cocoa beans – physical & chemical characteristics and chocolate making

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1612**			
Course Title	**Microbial Fermentations**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Microbial growth phase; Physical, chemical and biological factors influencing microbial survival and growth; Fermentative process – solid state and submerged; Design of working of batch, fed-batch and continuous fermenters; Process optimization (Lab. scale to Pilot scale) for higher yield and quality attributes; Downstream processing and quantitative profile of purified metabolites

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1601**			
Course Title	**Seminar courses**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Seminar in topics of courses listed in level 300

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1602**			
Course Title	**Technology of Cereals and Pulses**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Characteristics of wheat & its milled products – physical, chemical and rheological; Influence of ingredients, processing conditions and additives on quality attributes of bakery products; Physical & chemical characteristics of rice and rice-based processed products; Cooking quality of rice; Parboiling of paddy; Processed products of maize, sorghum and finger millet; Processing of pulses including cooking quality; Oilseeds as source of edible protein and oil; Extraction methods for edible oil – ghanni, expeller and solvent; Processing of oilseeds for protein concentrates and isolates

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1603**			
Course Title	**Technology of Fruits and Vegetables**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Maturity indices in fruits and vegetables; Post-harvest spoilage – microbiological and physiological; wax coating; fruit ripening; Measurement of texture & colour in fruits and vegetables; Canning of fruits and vegetables; Preparation of fruit juices/beverages – RTS, squashes, syrups, lime juice cordial; Tomato-based juice, puree, paste, ketchup and soup; Fruit juice concentrates and powders; Fruit & vegetable-based pickles; Preserves and candies; commercial cold storages and supply chain management

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1604**			
Course Title	**Food Biotechnology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Basic concepts and food applications; Natural food colours and flavours; Recombinant DNA technology and genetic manipulation; Genetically modified organisms/foods – basic concepts and methods to achieve & identify target genes; Safety and applicability of modified foods and food ingredients; Anti-nutritional factors in cereals and pulses; Biotechnological approaches (enzymes/proteins & effective processing parameters)towards reducing/modifying anti-nutritional factors in foods and food ingredients

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1605**			
Course Title	**Functional Foods**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Definition and applicability; Basis to identify functional components in varied sources; Characterization of bioactives from edible sources with defined functional attributes and elucidation of their structure-function relationship; Benefits of identified functional attributes in food ingredients and prepared foods; Legal requirements and regulations for functional foods; Effect of food processing parameters on defined functional attributes

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1606**			
Course Title	**Nutraceuticals**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Definition, terminologies and scope; Plant, animal (marine & sea foods) and microbial based nutraceuticals and their characteristics; Structure-function relationship of defined & characterized nutraceuticals; Potential nutraceuticals (one or two) and their benefits in selected (two each) fruits, vegetables, pulses, cereals, algae (including marine), herbs, spices, plantation crops, desirable microbes and sea foods; Legal requirements and regulations for nutraceuticals; Effect of food processing parameters on defined nutraceuticals

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1607**			
Course Title	**Dietary Supplements**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Definition, characteristics and scope; Status in selected countries across the globe; Intake of dietary supplements and positive health benefits; Performance and functionality; Interaction with one or more functions of human health; Technological suitability of supplements in food processing; Legal requirements and regulations for usage of dietary supplements

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1608**			
Course Title	**Convenience and Wellness Foods**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Major bioactive constituents in pepper, ginger, chilli and turmeric; Cocoa bean fermentation and cocoa based products; Citrus peel oil, fruit pectin and vinegar; Protein isolates and hydrolysates from pulses (oilseeds) and their biological activities; Millets and minor legumes as potential source of bioactives and nutritionals; Emerging trends – frozen dough and healthy bakery foods; Cured meat products; Fermented (including traditional) meat and fish products; Ready-toprepare (cook) foods based on cereals and legumes; Ready-to-eat shelf stable thermally (retorting) processed foods

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1609**			
Course Title	**Prebiotics and Probiotics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Microorganisms and human health; Prebiotics – definition, nomenclature and significance; Non-digestible higher polysaccharides; Categories of prebiotics; Interaction between prebiotics and microbiota; Probiotics – definition, nomenclature, selection criteria and attributes; Probiotic microorganisms – lactic acid bacteria, bifidobacteria, yeasts; Protocols for commercial probiotic preparations; Health and therapeutic attributes; Safety of probiotics and food applications; Molecular characterization of benefitical attributes associated with probiotics and prebiotics

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1610**			
Course Title	**Fermented Foods and Beverages**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Lactic, acetic, alcoholic and mixed fermentations; Microbial production of polysaccharides, vitamins, amino acids, colours and flavours with one example for each category of products; Milk-based fermented foods – cheese and fermented milks (including Indian traditional foods); Fermented foods based on cereals & pulses, meat and vegetables

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1611**			
Course Title	**Sensory Profiling of Foods**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to sensory perception; Physical and chemical sensory scores – quantitative descriptive analysis; Food flavourings; Taints and off-flavours; Instrumental analysis of food flavours; Texture and colour measurements; Packaging materials and their interactions with food constituents; Instrumental and statistical methods in sensory analysis; Requisites of sensory panel, consumer test ranking and Hedonic data analysis

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1612**			
Course Title	**Microbial Kinetics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Kinetics of microbial growth and death; Bioreactors for microbial cultures and their metabolites; Scale-up process and requisite equipments and process controls; Optimized parameters in fermentation process – composition & sterilization of nutrient medium, aeration, temperature and other influencing parameters

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1613**			
Course Title	**Food Safety**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Microbial contaminants – spoilage & pathogenic bacteria and fungi; Microbial toxins; Limiting factors for survival/growth of pathogenic and spoilage microorganisms; Other food contaminants – heavy metals and residues of pesticides & antibiotics; Food regulations – national and international; Quality systems in food chain – ISO 9001, 14001, 17025 and 22000

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1614**			
Course Title	**Food Based Nutritional Significance**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Nutrition and human health; Macro- and micro-nutrients in food ingredients; Influence of food processing parameters on the efficacy of nutrients; Nutrition related metabolic disorders; Dietary strategies in health and disease management; Health benefits from plant and animal derived bioactive molecules including spice principles; Food based approach and community nutrition; Recommended dietary intake for nutrients and balanced diets in Indian scenario

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1615**			
Course Title	**Food Chain Establishment**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Food plant management – definition and scope; Food plant design & machineries – Regulatory requirements; Concept of hygiene & sanitation in food plant design; Management and its role in planning and coordination; System analysis – basic principles and methodologies; Market research and promotional avenues; Financial aspects and inventory control; Demand and supply in food industry; Computer applications in food processing sector – database, operating systems, networking and others; Intellectual Property Rights and Patents; Scientific documentation of Research outputs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-4-0001**			
Course Title	**Project proposal writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

This would focus on the following: Identification of a research topic of relevance (non-Ph.D. programme) in the area of food science and technology; Status of literature as in public domain focusing on IPRs; Reason for selecting the topic; Questions to be asked; Proposed hypothesis as a solution finder; Gaps in existing knowledge base and answers therein; Cost/economic analysis and commercial viability

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-4-0002**			
Course Title	**Review Article writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

This would include the following: Preamble to the proposed topic of research; Review of literature taking into account contemporary aspects in prior art; Objectives; Programme of work including methodology; Relevance of proposed Ph.D. programme in the context of national and international scenario; Impact and benefits to CSIR and the Institute's knowledge base; Final submission as a project document.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-4-0003**			
Course Title	**CSIR-800 project work**			
Credit Distribution (L-T-P-C)	0	0	8	**4**

Course Description:

Project to be undertaken in line with CSIR-800 focused programme of CSIR; Theme of project to be selected from the objectives and commitments of respective Laboratory (CSIR-CFTRI, Mysore) in CSIR-800, wherein the enrolled Ph.D. Scholar is pursuing Ph.D. programme

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-1-0001**			
Course Title	**Biostatistics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Summarization of Data: measures of center, dispersion, skewness Dependence of variables: Correlation, linear regression, logistic regression Basic probability distributions: Binomial, Normal, Chi-squares. Estimation of parameters: method of moments, maximum likelihood Testing of hypotheses: (a) parametric tests: t-test, z-test, chi-squares test, ANOVA (b) non-parametric tests: Mann-Whitney, Kruskal Wallis, Kolmogorov-Smirnov

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-1-0002**			
Course Title	**Computation/bioinformatics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Computers: Introduction, Evolution and Classification of computers. Fundamentals of computing. Bit and Byte, Introduction to types of Hardware and Software. Components of Computer. Introduction to operating systems. Introduction to Computer Viruses. Network: Introduction. Network structure and architecture, Hierarchical networks, Ethernet and TCP/IP family of protocols, transport protocol design. Types of network, Topologies of network, Router, Switch, Data Communication, Concept of Wireless networking, LAN, WAN, MAN, Security of the network, Fire-walls, Network Applications Information Technology: Concepts of client Server Architecture, Concept of search Engine, Database search engines. Introduction to Internet Introduction to Word, Powerpoint and Excel Introduction to Bioinformatics: History of Bioinformatics, Genome sequencing projects, Human Genome Project, Applications of Bioinformatics. Introduction to databases, Type and kind of databases, Applications and limitations. Literature Search Databases, Nucleic acid and protein databases, Animal and plant databases, Ensembl Genome project TIGR database, Biotechnological databases, Motifs and Pattern Databases, Databases for species identification and classification, Structural databases. Database Retrieval and deposition systems. Web tools and resources for sequence analysis: Pairwise and multiple sequence Alignment, Sequence similarity search: BLAST, Pattern recognition, motif and family prediction, Restriction map analysis, primer design, Gene prediction, Phylogenetic Tree, Protein structure prediction and visualization.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-1-0003**			
Course Title	**Basic Chemistry**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Thermodynamics Solutions and Ions Chemical bonding and molecular structure Chemical Kinetics Stereochemistry Introduction to drug discovery (Medicinal chemistry approach) Drug target, discovery and development (forward and reverse approach

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-1-0004**			
Course Title	**Research Methodology, Communication/ethics/safety**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Philosophy and structure of scientific thoughts, Objective and Motivation of Research, Meaning of the Research, What constitutes a research topic? How to select a research topic?, Importance of literature review, Selection of appropriate methodology, Collection of data, Interpretation of data, Writing research paper, Paper presentation in scientific conference, Statistical methods, Importance of documentation, Procedure for Hypothesis Testing, Values and Ethical Problems, Criteria of Good Research, Good laboratory practice, Chemical, Radioactive and Biological safety: Possible hazards and precautionary measures; do and don'ts upon exposure Research methodology, communication, ethics, safety Asking the right questions: Originality, Depth, Precision can co-exist Formulating and refining the hypothesis: Those who do not learn from the past are condemned to repeat it Study design: Recognizing and minimizing bias Experiment design: Sometimes less is more and the importance of controls Good lab practices: Record keeping, organizing data, organizing the lab space Data interpretation; objectivity, quantification, double blind studies and necessity of statistics Comunicating your data:writing up your research Comunicating your data: presenting your findings Radiation safety Chemical and Biosafety Intellectual property rights What is ethics, the different interpretations & historical instances of unethical science Case studies: Data fraud/ plagiarism and Human Ethics violation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-2-1801**			
Course Title	**Biotechniques and Instrumentation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Chromatography, Mass spectrometry and Protein identification, Protein interactions : Isothermal calorimetry, Analytical ultracentrifuge, Surface Plasmon resonance, Fluorescence spectroscopy, FACS, Imaging: Electron microscopy, Confocal microscopy, Atomic force microscopy, Single molecule imaging and structure determination of protein complexes, In vivo imaging, RNA/ DNA quantitation (capillary based methods), DNA and protein microarray, NMR, X-Ray crystallography

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-2-1802**			
Course Title	**Biology of Macromolecules**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Basic concept: life forms from prokaryotes to eukaryotes; molecules, building blocks;Water and Buffer systems; Nucleic acids and proteins; Lipids; Sugars; Anabolism and catabolism of building blocks and macromolecules

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-2-1803**			
Course Title	**Biology of Inheritance**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Evolution, Mendel's Laws of Inheritance, Chromosome theory of inheritance, Codominance and incomplete dominance; pleiotropism, genotypic interactions, epistasis, mechanism of epistasis; Mitosis and Meiosis in plants, animal and human. Cell cycle and cell division. Linkage and mapping in eukaryotes; FISH / GISH, coincidence and interference. Concept of sex determination and patterns in plants and animals; sex chromosomes; Sex-linked, sex-limited and sex-influenced characters. Extra-nuclear inheritance: determining non-Mendelian Inheritance; maternal effects, cytoplasmic inheritance. Nature and components of variation, heritability and genetic advance, self incompatibility and male sterility system, role of mutations and chromosome modifications, induction of polyploidy and its significance, Genetic consequences of self and cross fertilization, mating systems, apomixes.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-2-1804**			
Course Title	**Biology of Infection**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to microorganisms, types of infection, development and manifestation, defence against infection, prevention of infections, resistance in infectious organisms.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-2-1805**			
Course Title	**Genomics: Information flow in Biological Systems**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to genomics; Cloning vectors (plasmids, cosmids, BAC, PAC, YAC) genomes and genes; genome organization; Techniques in genomics; Advance sequencing techniques and their application in genomics; DNA Sequence assembly; Application of genomics tools in genotype designing and drug discovery; Defining the genome: from size to functions; Chloroplast and mitochondrial genomes; Functional genomics and beyond.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-2-1806**			
Course Title	**Protein Science and Proteomics**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction proteomics; Extraction of proteins; Separation of proteins; Organelle proteomics; Protein identification and characterization; Structural proteomics and computational analysis; Protein-protein interactions; Techniques for Proteome research; High throughput proteomic screening for novel bioactive peptides/proteins/enzymes

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-2-1807**			
Course Title	**Systems Biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Central dogma of life, Concept of genome, transcriptome, proteome and metabolome; Comparasion of genomes/transcriptome/proteomes /metabolomes; Synteny; Gene expression subsets; Primary and secondary metabolism; Analytical tools for systems biology; Applications in plant research.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-2-1808**			
Course Title	**Xenobiotic Interaction and Response**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Toxicokinetics, general toxicology, phytotoxicology, environmental toxicology, adverse drug reaction, drug safety profiling and regulatory toxicology.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-2-1809**			
Course Title	**Plant-Microbe Interaction**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Plant growth promoting microbes; Microbial bio-inoculants; Nitrogen fixing microorganisms: mechanism of nitrogen fixation; Plant diseases and management, Biological control of pathogens; Role of microbial technology in agriculture.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-2-1810**			
Course Title	**Plant Environment Interaction**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to environment: classification, components of environment; Ecology and ecosystems; Symbiotic relationships; Plant responses to abiotic & biotic stresses; Plant - soil interactions.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-2-1811**			
Course Title	**Molecular Therapeutics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

General pharmacology, phytopharmacology, drug receptor interactions, in-vitro and invivo bioassays in drug discovery and development

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-2-1812**			
Course Title	**Crop Protection**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Major pests of crops; Insect - plant relationship; Principles of insect physiology; Toxicology and pathology; Insecticide resistance and residue monitoring; Biopesticides and integrated pest management.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-2-1813**			
Course Title	**Developmental Biology-Plants**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Development and differentiation in plants: Physiological and biochemical basis; Genetic regulation of spatial and temporal development; Genetic regulation of plant growth and development, gametophyte development, fertilization and seed development, seed germination, seed adaptation in relation to environment; Effect of development on plant secondary metabolism.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-2-1814**			
Course Title	**Epigenetics and Chromatin Organization**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to epigenetics; Techniques in epigenetics; Epigenetics in plants evolution, adaptation and environmental stress, Chromatin structure; Organization of nucleosome and chromosomes; Molecular aspects of cell division and cell cycle. DNA replication in Prokaryotes and Eukaryotes. RNA transcription and processing; Transcriptional regulation in prokaryotes and eukaryotes; Protein synthesis, protein modifications and secretion; Regulation of protein synthesis; Transposable genetic elements, Types and mechanisms of transposition.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-2-1815**			
Course Title	**Molecular Breeding of Plants**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction and techniques in molecular breeding; Morphological and Molecular markers, QTL analysis; Application of molecular breeding in plants; Development of mapping populations; Molecular mapping and gene tagging of important traits; Markerassisted selection; Gene pyramiding.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-2-1816**			
Course Title	**Bioresources and Bioprospection**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Bioresources and Bioprospection Phyto-taxonomy principles and fundamentals; Biodiversity: principles, importance and characterization; Threats, conservation and gene banking; Remote sensing and GIS concepts and approaches; Bio prospection: principle, techniques and applications.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-2-1817**			
Course Title	**Crop Production Systems**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Sustainable agriculture: crop growth and yield, adaptation of plants to water variation; Soil fertility and nutrient management; IPNMS system; Precision agriculture; Agroforestry systems; Soil-plant-water relationship; Energy concepts; Physiomorphological behaviour of plants; Isotopes and radiation techniques; Metabolic and hormonal responses; Natural resource management.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-2-1818**			
Course Title	**Intellectual Property Management**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

General Principles of Intellectual Property: Copyright, Trademark, Patents: need of patents, major types of patents, patent offices in India, US and Europe, International registration of patents, how patents are obtained for drugs and their impact on pharmaceutical industry and patients, patent term and extension The Patents Act, 1970 – salient features, trade related aspects (TRIPS), international & regional agreements. Geo indicator, Aroma Industry. Plant protection variety and farmers' right act (PPVFRA). Regulatory affairs: An introduction to regulatory guidelines related to herbal medicines in India and rest of the world, particularly WHO, US-FDA guidelines and European countries guidelines. Drugs and Cosmetic Act 1940 and rules 1945 with reference to schedule M, U and Y, schedules. Related quality systems: Objectives and guidelines of USFDA, WHO and ICH, Introduction to ISO series. In-process quality tests, IPQC problems in Pharmaceutical industries.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-2-1819**			
Course Title	**Applied and fundamental aspects of In Vitro Plant/Cell/Tissue/ Organ Culture**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to Plant Cellular totipotency: Process and mechanism; Differentiation, morphogenesis and Somatic embryogenesis; Haploids: Androgenic and gynogenic; Endosperm culture, triploid production and its applications; Somaclonal variations; Somatic hybridization; In vitro production of commercially useful secondary metabolites; Scale up studies using bioreactors; Biotransformations.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-2-1820**			
Course Title	**Crop Modelling and System Research**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Systems-definition, input-output relationships, crop modelling-static descriptive and explanatory models, modelling techniques, Crop modelling- methods for water and nutrient stress effects, data requirement and limitations, Modelling crop-environment interaction, applications of simulation modelling in environmental impact assessment; Agro and post-harvest technology development and dissemination.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-3-1801**			
Course Title	**Seminar Course**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Relevant area of research, nobel prize wining work, popular publications/reviews in relevant area

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-3-1802**			
Course Title	**Cell and Tissue Engineering**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Transgenic plants: Advances in producing transgenics, selection, identification, molecular analysis for confirmation and applications. Molecular farming: salient achievements and future prospects. Metabolic engineering for pathway modulations: propose and potentials. Agrobacterium as natural genetic engineer; molecular mechanism, controlling factors and advantages.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-3-1803**			
Course Title	**Frontiers of Biology: Synthetic Biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Molecular biology of metabolic processes in plants and microbes. Molecular regulators of metabolic pathways. Approaches of engineering metabolic pathways in heterologous systems (plants, microbes and insect cell lines)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-3-1804**			
Course Title	**Advanced Bioinformatics**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Databases and resources in Bioinformatics, Gene expression analysis, Sequence analysis and algorithms, Protein and nucleic acid properties, Taxonomy and phylogeny, Next generation sequencing, Structural Bioinformatics, Molecular modeling and simulations, Comparative and functional genomics, Modelling biological systems, Drug design, Advanced programming and scripting.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-3-1805**			
Course Title	**Gene Environment Interaction**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Recent advances in plant responses to biotic and abiotic stresses. Impact of environmental changes at molecular and cellular levels in plants.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-3-1806**			
Course Title	**Advances in Gene Silencing**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Gene silencing: Mechanism, techniques and applications; Antisense RNA technology, RNAi and VIGS; siRNA & miRNA : Biogenesis, translocations, Methods of isolation, characterization and application.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-3-1807**			
Course Title	**Advances in Crop Disease Management**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Genetic improvement of microbial bio control agents-metabolites, rhizosphere colonization, disease control; Mass multiplication of bio control agents, delivery systems, monitoring, commercial bio pesticides, quality control of bio control agents; Enzyme based formulations-status and problems; Molecular diagnostic methods, pathogen-derived resistance, genetic engineering approaches to develop disease resistant plants; Integrated disease management strategies.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-3-1808**			
Course Title	**Integrated Pest Management**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Trends in the development of Integrated Pest Management in national and international level, IPM Theory and Practice, economic threshold concept and economic consideration, Biological control agents, Integration of different methods of pest management, Cost-benefit ratios, case studies of successful IPM programmes

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-3-1809**			
Course Title	**Anti microbial agents and drug resistance**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Classification of antimicrobial agents; mechanism of antimicrobial agents, mechanism of drug resistance, strategies for combating drug resistance

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-3-1810**			
Course Title	**Drug delivery and Pharmaceutical formulations**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to pharmaceutical dosage forms, Conventional methods for drug delivery, Novel Drug Delivery Systems (NDDS)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-3-1811**			
Course Title	**In-vitro secondary metabolite production and biotransformation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Production of commercially useful secondary metabolites by callus/ cell suspension/ hairy root cultures: induction, kinetics of growth and product formation, optimization of physical/chemical factors, precursor-feeding, permeabilization, elicitation and immobilization for improved product recovery. Scale up studies using bioreactors for commercial production-general principles of bioreactors, design optimizations and downstream processing. Biotransformations using cell/hairy root cultures for generating pharmaceutical lead molecules.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-3-1812**			
Course Title	**Plant Pathogenesis**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Principles and concepts in host-pathogen relationship, recognition concept and infection for pathogens; role of enzymes, toxins, growth regulators in disease development; oxidative burst; phytoalexins, PR proteins, elicitors-defense strategies, signal transduction, systemic acquired resistance and induced systemic resistance, defense genes, hypersensitive reaction, programmed cell death, viral induced gene silencing, Rgene expression and transcription profiling

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-3-1813**			
Course Title	**Biology & Chemistry of Natural Products**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Classification of plant metabolites – primary & secondary metabolites; various classes of secondary metabolites – Alkaloids, Terpenoids, Phenylpropanoids and their complexes; extraction procedures for natural products; structure elucidation methods for identification of new compound/NCEs; structural modification of natural products. Bioprospecting natural products.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-3-1814**			
Course Title	**Biology of inflammation and diseases**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Activated innate and adapted immune responses, Pathobiology of inflammation, inflammatory reactions in infectious and non-infectious disease conditions, autoimmune disorders

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-3-1815**			
Course Title	**Soil and crop management**			
Credit Distribution (L-T-P-C)	2	0	2	**3**

Course Description:

Chemistry of soil fertility, principles and methods of soil and plant analysis, fertilizer and fertilizers use technology, mineral nutrition of plants, manures and fertilizers, development and management and of salt affected and other problematic soils, agrometrology, cropping and farming systems, allelochemicals interaction in plants and soils.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-4-0001**			
Course Title	**Project Proposal Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Project Proposal to be prepared by selecting topics of high relevance and novelty, and will have state-of-the art review, methodologies, recommendations

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-4-0002**			
Course Title	**Review Article Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Review Article on the research area undertaken by the student

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CIMAP, Lucknow**			
Course Nomenclature	**BIO-CIMAP-4-0003**			
Course Title	**CSIR-800 Project Work**			
Credit Distribution (L-T-P-C)	0	0	8	**4**

Course Description:

Six–Eight weeks have to be dedicated on a project concerned with societal/rural issues under the CSIR-800 Programs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-1-0001**			
Course Title	**Biostatistics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Summarization of Data: measures of center, dispersion, skewness Dependence of variables: Correlation, linear regression, logistic regression Basic probability distributions: Binomial, Normal, Chi-squares. Estimation of parameters: method of moments, maximum likelihood Testing of hypotheses: (a) parametric tests: t-test, z-test, chi-squares test, ANOVA (b) non-parametric tests: Mann-Whitney, Kruskal Wallis, Kolmogorov-Smirnov

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-1-0002**			
Course Title	**Computation/bioinformatics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Computers: Introduction, Evolution and Classification of computers. Fundamentals of computing. Bit and Byte, Introduction to types of Hardware and Software. Components of Computer. Introduction to operating systems. Introduction to Computer Viruses. Network: Introduction. Network structure and architecture, Hierarchical networks, Ethernet and TCP/IP family of protocols, transport protocol design. Types of network, Topologies of network, Router, Switch, Data Communication, Concept of Wireless networking, LAN, WAN, MAN, Security of the network, Fire-walls, Network Applications Information Technology: Concepts of client Server Architecture, Concept of search Engine, Database search engines. Introduction to Internet Introduction to Word, Powerpoint and Excel Introduction to Bioinformatics: History of Bioinformatics, Genome sequencing projects, Human Genome Project, Applications of Bioinformatics. Introduction to databases, Type and kind of databases, Applications and limitations. Literature Search Databases, Nucleic acid and protein databases, Animal and plant databases, Ensembl Genome project TIGR database, Biotechnological databases, Motifs and Pattern Databases, Databases for species identification and classification, Structural databases. Database Retrieval and deposition systems. Web tools and resources for sequence analysis: Pairwise and multiple sequence Alignment, Sequence similarity search: BLAST, Pattern recognition, motif and family prediction, Restriction map analysis, primer design, Gene prediction, Phylogenetic Tree, Protein structure prediction and visualization.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-1-0003**			
Course Title	**Basic Chemistry**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Thermodynamics Solutions and Ions Chemical bonding and molecular structure Chemical Kinetics Stereochemistry Introduction to drug discovery (Medicinal chemistry approach) Drug target, discovery and development (forward and reverse approach

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-1-0004**			
Course Title	**Research Methodology, Communication/ethics/safety**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Philosophy and structure of scientific thoughts, Objective and Motivation of Research, Meaning of the Research, What constitutes a research topic? How to select a research topic?, Importance of literature review, Selection of appropriate methodology, Collection of data, Interpretation of data, Writing research paper, Paper presentation in scientific conference, Statistical methods, Importance of documentation, Procedure for Hypothesis Testing, Values and Ethical Problems, Criteria of Good Research, Good laboratory practice, Chemical, Radioactive and Biological safety: Possible hazards and precautionary measures; do and don'ts upon exposure Research methodology, communication, ethics, safety Asking the right questions: Originality, Depth, Precision can co-exist Formulating and refining the hypothesis: Those who do not learn from the past are condemned to repeat it Study design: Recognizing and minimizing bias Experiment design: Sometimes less is more and the importance of controls Good lab practices: Record keeping, organizing data, organizing the lab space Data interpretation; objectivity, quantification, double blind studies and necessity of statistics Comunicating your data:writing up your research Comunicating your data: presenting your findings Radiation safety Chemical and Biosafety Intellectual property rights What is ethics, the different interpretations & historical instances of unethical science Case studies: Data fraud/ plagiarism and Human Ethics violation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-2-2801**			
Course Title	**Biotechniques and Instrumentation**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

1.Chromatography : Different chromatographic techniques, HPLC 2.Centrifugation: Principles and uses, application in modern biology 3.Electrophoresis: Theory and hypothesis, SDS-PAGE, Western Blot, 2D gel electrophoresis 4.Mass spectrometry and Protein identification: Principles and theory, application in proteomics 5.Colorimetry : ITC, DSC, Determination of protein stability, analysis of binding properties 6.Surface Plasmon resonance: Techniques and its use in biology 7.Optical spectroscopy: Absorption, fluorescence, FT-IR, Raman and other techniques 8.FACS: Principles and application 9. Imaging: Electron microscopy, Confocal microscopy, Atomic force microscopy, In vivo imaging 10. NMR: 1D NMR, 2D NMR and application in structural biology 11. X-Ray crystallography: Basic theory and its application in structural biology

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-2-2802**			
Course Title	**Biology of Macromolecules**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

1. Protein – Nucleic acid interactions 2. Synthesis and degradation of macromolecules 3. The folding process and structural background 4. Modular structures, Protein flexibility, Domain motions, Domain-swapping; and Large macromolecular complexes 5. Enzyme activity, receptor binding and regulation, binding specificity, catalysis and cooperativity in enzymes and receptors 6. Methods for the determination of macromolecules structure and interaction 7. Macromolecular function in transcription, translation, signaling and other fields of cell biology, integration and control mechanisms 8. Structure and evolution of important protein motifs and folds. [e.g. Coiled-coil proteins, helical bundles, signaling domains (sh2, sh2, pdz etc), Immunoglobulin-like proteins, kinases, TIM barrels, DNA/RNA binding motifs 9. Principles of macromolecular engineering 10. The most important metabolic pathways and regulation 11. Relation between sequence, structure and function 12. Biological structure databases 13. Computer modeling of secondary- and tertiary structure of proteins and nucleic acid based on sequence data 14. Enzyme/receptor-based drugs-rational drug design

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-2-2803**			
Course Title	**Biology of Infection**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Parasitology 1. Malaria Parasite General nature of Apicomplexan parasite; Biology of malaria parasite; Antimalarial drugs; Mechanism of drug resistance; Drug target and new antimalarial development; Host –parasite interaction, mechanism of multi-organ failure 2. Leishmania Parasite Biology of Leishmania parasite;Anti-Leishmanial drug; Host-parasite interaction 3. Entamoeba Protozoa Life pattern and pathogenecity 4. Nemathelminths Ascaris Sp.; Biology and mechanism of pathogenesis Filaria Sp;Biology and mechanism of pathogenesis 5. Medical Parasitology Sanitation and parasite infection;Detection of parasite infection; Precautionary measure to prevent parasite infection; Origin of new strain; Parasite and malnutrition; Ecology of parasite and vectors Bacteriology 1. General basic characteristics and fundamental structure of bacteria, particularly structures important for pathogenicity and virulence in microbial infections, brief description of some major medically important bacterial pathogens involved in organ and system infections in humans, biological safety in handling pathogenic bacteria 2. Molecular laboratory diagnosis of infection, definition of bacteriostatic and bacteriocidal agents, principles of antibiotic action mechanisms and molecular basis of antibiotic resistance and its importance in healthcare 3. Bacterial growth and metabolism, molecular basis of survival mechanisms under various in vivo and in vitro stressful environments 4. Importance of different virulence factors, namely, exotoxins, endotoxin, secretion systems, invasive properties, antigenic variation and other mechanisms to avoid the immune system 5. Regulation of virulence gene expression, motility, chemotaxis etc., importance of bacterial two-component signaling systems; Role of different mobile genetic elements in evolution of pathogens

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-2-2804**			
Course Title	**Protein Science and Proteomics**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Protein Science: 1. Basic building blocks of protein and their composition, chemical behavior, properties. 2. Peptide bond, geometry and parameters; Backbone geometry and parameters, side chain geometry and parameters, Ramachandran plot. 3. Primary, secondary, tertiary and quaternary structures. 4. Protein structure stabilizing forces – hydrogen bond, electrostatic bond or salt bridges; hydrophobic forces 5. Protein folding, dynamics and thermodynamics. 6. Protein: from gene to function. 7. Protein and diseases. 8. Some important proteins in cellular functions. Proteomics: 1. Protein cloning, expression and purification. 2. Protein chromatography systems and purification procedures – HPLC, FPLC etc. 3. Bioinformatics of protein sequences – sequence analysis, comparison, alignment etc. 4. Mass spectrometry – introduction to mass spectroscopy, gel mass spectroscopy, LC-MS, LC-MS-MS, MALDI-TOF 5. Protein NMR, FTIR Raman, CD 6. Protein Crystallography.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-2-2805**			
Course Title	**Cell Biology and Cell signaling**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

1. Cell growth and division, including cell cycle: Phases of cell cycle, Regulation of cell cycle, Cell cycle check point, Cell growth 2. Intracellular sorting of proteins: Nuclear import and export mechanism; Organelle targeting; Transport of protein to cell surface; Soluble protein sorting 3. Cell adhesion, cell junction and Extra Cellular Matrix: Cell adhesion molecules; Cell Junction; Extracellular matrix; Cell-cell recognition 4. Cytoskeletal structure-function and related macromolecules: Cytoskeletal proteins; Role in vesicular movement; Cellular morphology and cytoskeletal protein; Drug modulating cytoskeletal 5. Signal transduction pathways: Extracellular signals; Intracellular signals; 2nd Messengers; Signal transduction pathways 5. Cell death and proliferation: Programmed cell death; Cell renewal system; Mitochondria and apoptosis; ER-stress 6. Cellular starvation, stress and Autophagy: Oxidative and nitrosative stress; Stress response; Autophagic vacuole turnover; Cellular homeostasis 7. Metabolic disorder and signaling aberrations: Abnormal Signaling in Cancer; Signaling for diabetic complication Angiogensis; Signaling for failure in diabetes

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-2-2806**			
Course Title	**Bioinformatics**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

1. Specialized and derived databases for bio-molecular sequences and structure: Genome Databases of model organisms, human, pathogenic microbes & human micro biome; RNA Fold database, Small molecule databases; Structural databases and Structural comparison databases like CDD, FSSP, DALI etc. 2. Functional genomics and whole genome data-mining techniques: Application of sequence-based/structure-based approaches to assignment of gene functions; Identification of Virulence Cassettes & other genome islands; Analysis of gene repertoire, repeat sequences, CpG islands etc.; Prediction of miRNA/siRNA sequences & their putative targets; Use of SNPs for identification of genetic traits 3. Gene expression and Mass spectroscopy data analysis: Analysis of DNA microarray data (especially clustering approaches) and correlation of gene expression data to biological processes. In silico tools for analysis of proteomics data (Tools available at ExPASy Proteomics server); Computational methods for identification of polypeptides from mass spectrometry data. 4. Biological Pathway and interaction network analysis: Databases on metabolic pathways such as KEGG, EMP; Databases and tools for analysis of protein-protein interactions 5. Molecular modeling and simulation: Basic concepts in molecular modeling; Computer representations of molecules with different surface rendering; Principles for fold recognition, 1D profiles and threading approaches; Principles of molecular dynamic simulation; Concepts of force fields: representations of atoms and atomic interactions, potential energy; Purpose & concepts in 3D structure comparison, algorithms such as FSSP, VAST and DALI 6. Drug discovery and design: Drug discovery cycle; Drug discovery Vs design; Role of Bioinformatics in drug design;Target identification; Structure-based drug design; Modeling of target-small molecule interactions 7. Genome assembly & annotation: Contig Assembly, Prediction of Genes, Promoters & Splice sites 8. Taxonomy and Phylogenetic analysis: Basic concepts in systematic; Phylogenetic analysis algorithms such as Maximum Parsimony, UPGMA, Neighbor-Joining; Probabilistic models like Maximum likelihood algorithm. 9. Concept of important algorithms applied in bioinformatics: PSSM, HMM, NN, SVM, DP: 10. Concepts and application of advance statistical analysis in bioinformatics.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-2-2807**			
Course Title	**Molecular and Cellular Immunology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

1. History of immunological ideas and cellular components of immune system Transplantation antigens: structure, function, genetics, transplantation 2. Phagocytosis and antigen presentation Fc receptor and scavenger receptor mediated phagocytosis, markers to follow phagocytosis, presentation of endogenous and exogenous antigens, cross-presentation 3. Antibody structure, antigen-antibody interactions, binding site, affinity, avidity, Fc functions, molecular biology of immunoglobulins; B cell triggering: Tcell-B cell Interactions 4. Humoral immune response and cytokines: Signaling through B cell receptors, plasma cell differentiation, proinflammatory / anti-inflammatory effects of cytokines, transcriptional control of cytokine synthesis 5. Structure of lymphoid organs, ontogeny of lymphoid cells; Complement system and disease : Classical and alternative pathways of complement activation, complement regulation and deficiencies 6. Immune response to parasitic infections : Cell mediated immunity: delayed reactions, immunodeficiency; Allergy, Arthus reaction, serum sickness, inflammation; Autoimmunity: regulation of immune response and autoimmune diseases; Tutorial

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-3-2801**			
Course Title	**Seminar and Critical Appraisal**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

This course is based on current literature survey and its critical appreciation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-3-2802**			
Course Title	**Cancer Biology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

1. Cancer Immunology: The immunological status of adaptive and innate immune cells in cancer, cellular interactions between immune and cancer cells in tumor progression or rejection, immunological mechanisms, regulation and function involved in host responses to tumors, anti-tumor immunity, cancer-induced immune tolerance, immunosuppression, dysregulation of the immune system and poorer outcome in the disease 2. Cancer stem cells : Origin/Hypothesis/Concept ; Signaling pathways in cancer stem cells 3. Cell signaling in cancer : Description of major classes of cell signalling: cell death signalling, cell survival signalling and developmental/stem cell signalling; signal networking and chemotharapy 4. Oncogenesis and epigenetics in cancer :Oncogenes and their regulation in signaling aberration; Acetylation/methylation in DNA and histones; Silencing/De-silencing of gene expression 5. Metabolic Engineering in cancer; Metagenomics and cancer 6. Cancer biomarkers and diagnosis : Selection of clinical specimens, recent advancement for identification of biomarkers through different approaches like genomics, proteomics and glycomics in combination with molecular pathology with potential clinical value; Application of biomarkers for cancer staging and personalization of therapy at the time of diagnosis to improve patient care. 7. Cancer drug discovery : Identification of lead molecules, target identification in cancer cells; combined approaches (in vitro, in vivo and in silico) for validation, various steps involved towards successful drug discovery; immunotherapeutic approaches e.g. cancer vaccines, monoclonal antibodies, adoptive immune cell transfer etc. and combination strategies to treat malignancies 8. Angiogenesis and metastasis 9. Project writing

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-3-2803**			
Course Title	**Cell and Tissue Engineering**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

1. Introduction 2. Cell & Tissues : Definition of cells, tissues and organs 3. Tissue culture: Propagation of somatic cells 4. Stem cells : Source, biology and therapeutics 5. Biology of blood and artificial blood 6. Biology of skin and artificial skin 9. Biomaterials: source and usage 10. Hybrid cells: theory and instrumentation 11. Tissue transplantation 12. Biomolecules: angiogenic factors, growth factors 13. Mouse genetics 14. Transgenics, Knock-out

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-3-2804**			
Course Title	**Microbial pathogenesis**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

1. Parasitic pathogenesis : An introduction to protozoan parasites: Entaemoeba histolytica: Life cycle, morphology and pathogenesis. Kinetoplastidae: Leishmania and Trypanosome : morphology, life cycle, mode of infection and molecular biology (replication of KDNA and RNA editing). Plasmodium : morphology, life cycle and mode of infection. 2. Major malaria vectors of India: distribution, Bio-ecology, potentiality, present sustainability status, form and function. 3. Helminthes and Nematodes: General introduction. 4. Host parasite interactions: Vector biology and its importance in parasite transmission, antigenic variation, potential drug targets, virulence factors, mechanism of drug resistance, vaccine strategies and proteomic approaches. 5. Organelle variations in protozoa: Cytoskeleton, mitotic spindle, hydrogenosomes, glycosomes. 6. Bacterial pathogenesis: Modulation of host signaling pathways during bacterial infection ; Bacterial strategies to overcome host defense; Cell-cell communication in bacteria; Role of the microbiome in health and disease; In silico data mining tools for bacterial genomics

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-3-2805**			
Course Title	**Neurobiology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

1. Introduction: Introduction to central and peripheral nervous system; Basic elements of nervous system (neuron, glia and fibers). 2. Developmental Neurobiology : Neural tube formation, migration, differentiation, axonal guidance, myelination, synaptic re-arrangement and pruning; factors like growth factors, interleukins, steroid super-family, etc. on brain morphogenesis 3. Developmental neurological diseases: Neural tube defect, Autism, Dyslexia, Schizophrenia etc. 4. Functional & Chemical Neuroanatomy: Anatomical organization of central nervous system in relation to regulation of functions - brain stem autonomic regulatory nuclei, cardiovascular & respiratory functions of medulla & pons; chemical organization of the central nervous system in relation to anatomy - basal ganglia, anatomy, chemistry and functions; forebrain limbic system – arousal, fear, stress and feeding; integration of sensory and motor systems – peripheral sensory pathways and receptors, pain, auditory & visual systems, motor cortex output & pathways; neurotransmitters, neuromodulators and synaptic transmission. 5. Neuronal Physiology: Electrical signaling; action potential; voltage gated and receptor gated ion channels 6. Neural signaling: Receptors, second messengers and signaling 7. Epigenetics in brain development and behaviors: Epigenetic inheritance, chromatin regulation and histone modifications, Specificity of DNA methylation response 8. Neural stem cells and differentiation: Neural stem cells characteristics; differentiation into specific neural cells; stem cells in the adult brain; migration of stem cells in response to injury. 9. Research tools in neuroscience : Brain stereotaxy; patch clamp; LCDM: MRI; CT; PET; NMR-S, etc. 10. Overview of neurodegeneration : Basic mechanism of neuronal apoptosis such as extrinsic and intrinsic apoptotic pathways; protein aggregation, proteosomal dysfunction, aberrant cell cycle activation 11. Neurodegenerative diseases: Use of animal models of human dysfunctions; pathophysiology of dementia and movement disorders; causes and corrections; regenerative therapy; deep brain stimulation 12. Neurogenomics in development and diseases: Detection of genes for neurological disorders; the study of gene expression in the CNS; creation of transgenic models of neurological disorders.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-3-2806**			
Course Title	**Genomics**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

1. An introduction to transition from genetics to genomics Family Pedigree Karyotyping and Linkage Analysis DNA Sequence Analysis The Need for an Animal Model System Phenotypic heterogeneity in monogenic disorders The need for genomic information 2. Genome Sequence Acquisition How Are Genomes Sequenced? The lesson from Unicellular Genomes The lesson from Metazoan Genomes 3. Comparative Genomics in Evolution and Medicine Comparative Genomics Evolution of Genomes Genomic Identifications Biomedical Genome Research 4. Genomic Variation Human Genomic Variation Ethical Consequences of Genomic Variations 5. Genomic Expression Basic Research with DNA Microarrays Alternative Uses of DNA Microarrays Applied Research with DNA Microarrays Improving Health Care with DNA Microarrays 6. Whole Genome Perspective Why Can't We Cure More Diseases? Genomic Circuits in Single Genes Integrated Genomic Circuits 7. Genomics of Microbes and Microbiomes Genome architecture of microbes Dynamics of Microbial Diversity Metagenomics- DNA sequence from multiple organisms The Human microbiom

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-3-2807**			
Course Title	**Eukaryotic Gene Regulatory Mechanisms**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

In each module the study material will consist of a few original research articles covering some of the latest developments in the field, to be chosen by the instructors for open discussion in the class. Discussion may include one or more of the following topics. Students are expected to brush up their post graduate knowledge of these topics before attending the lectures. 1. Chromatin Structures and Epigenetics Nucleosome assembly and the modification of nucleosomes and of DNA/ The assembly of chromatin into higher order structures/ Different aspects of heritable patterning of gene expression and the biological importance of epigenomes/ Mechanisms of inheritance as well as imprinting, X inactivation and the role of RNA in establishing silent chromatin/ The impact of chromatin structure on differentiation, cell plasticity and development. 2. Transcriptional Regulation and Gene Expression Regulatory interplay between transcription factors: Regulatory DNA sequences (promoters, enhancers, locus control regions) /General transcription machinery/ Transcription factors: cell-specific and ubiquitous regulatory factors/ Mechanistic aspects of transcription activation / Chromatin, histones, DNA methylation /Gene regulatory networks /Transcription factors in health and disease/ Transcription factors as the final integrators of signaling cascades. 3. Structure, Processing, Trafficking and Function of RNA Chemistry and structure of RNA/ major lectures of cellular RNAs (mRNAs, tRNAs, rRNAs, snRNAs, and the newly discovered small regulatory RNAs/pre-mRNA processing with emphasis on splicing and polyadenylation/ biogenesis of tRNA and rRNA/ biochemistry and function of RNA interference (RNAi) and microRNAs/ RNA trafficking in the cell/ RNA quality control and RNA degradation/regulated mRNA translation during development/ RNA-protein interactions and major lectures of ribonucleoprotein particles;RNA granules and bodies /evolution of RNAs: The RNA world/ 4. Translational Control and Post-translational Protein Modification The translational control: Codons and frame shifting, attenuation, phosphorylation, and transformation/the role of translational control in the regulation of cell growth and differentiation.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-3-2808**			
Course Title	**Chemical Biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

An overview of Chemical Biology Protein-protein interactions and its inhibitors Ligands for protein surfaces Ligands for Nucleic Acid surfaces Chemical Genetics Synthetic and semi synthetic proteins Applications of chemical biology, enzyme based biosensors, catalytic antibody

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-3-2809**			
Course Title	**Synthetic & Systems Biology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

1. Synthetic Biology: Concepts, useful definitions, basic cellular and molecular biology, biological components and properties Enzyme kinetics, gene structure and control of gene expression Intrinsic and extrinsic noises Basic knowledge in network circuits like feedback loops, switches, oscillators, feed forward loops, pulse generators, logic and filter circuits Synthetic networks, example and applications Metabolic network structure and metabolic or pathway engineering, applications of synthetic biology in pathway engineering Whole genome synthesis and related areas 2. Systems Biology: Introduction to systems biology Philosophy of systems biology Emergent properties of the system Biological robustness Experimental approaches in systems biology Global approaches to data collection Designing single cell experiments Utility of model organisms in systems biology Application of microfluidic and nanotechnology devices Integration of information derived from various data types Mathematical and statistical modeling of biological systems Graph theory Logical steady state approach Flux balance analysis Multivariate statistics Few examples of biological systems Cell signaling network Immune system network Transcriptional network Metabolic network

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-3-2810**			
Course Title	**Understanding Glycan structure & their role in Chemical Biology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

1. Overview, as an introduction to the topic and to emphasize the importance of carbohydrates in food and nutrition and biology.Discussion on the structures, shapes and various sources of carbohydrates. This may complement course "MC- 630 Structure and Function of Biomolecules" in certain respects. 2. Reactions of carbohydrates: Discussion on the relative reactivities of the hydroxyl groups; convergent synthesis of biologically active oligosaccharides, glycolipids and glycoproteins. Discussion on the chemical and enzymatic methods after highlighting the need for synthesis. 3. Carbohydrate Therapeutics: Discussion on various drugs (aminoglycoside antibiotics including glycopeptides, enediynes, macrolides, anthracyclines, etc., alkaloid, steroid and terpenoid. Glycosides: polyphenol glycosides etc.) that contains carbohydrate moiety (moieties) including polysaccharide therapeutics. 4. Polysaccharide vaccines: Carbohydrate microarray. Understanding glycan structures and their analogues. Carbohydrate dynamics. The role carbohydrate structures in normal and diseased states.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-3-2811**			
Course Title	**Modern Drug Discovery & Design**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

1. In-silico drug design, and docking studies. Fragment based drug design; Structure-activity relationship (SAR), Quantitative structure-activity relationship (QSAR); Concept of drug, classification of drugs, Molecular basis of drug action: basic ligand concept, agonist, antagonist, partial agonist. Chemistry & therapeutic uses of bio-active molecules . 2. Physicochemical properties Hydrophobicity, electronic effects, Steric factors, solvent accessible surface area; Stability 3. Lead generation Diversity oriented synthesis, Combinatorial chemistry; Sources of drugs, lead modification, prodrugs and soft drugs. Peptidomimetics, anti-sense RNA, DNA, PNA, LNA. 4. Pharmacokinetics, Pharmacokinetics, Bioavailability, Pharmacodynamics, drug metabolizing enzymes, route of administration, route of excretion, halflife, analysis, bioanalytical methods in mass spectrometry, therapeutic window 5. Drug delivery systems. Nano-particle drug carrier, liposomes etc.; Recombinant DNA products (vaccine), peptide drugs etc.; MAb :anti-idiotype vaccines, therapeutic drug targeting, diseasespecific antigens 6. Drug target identification: Qualification a drug target, Rationale and Approaches: (a) Forward Genetics and Reverse Genetic/Chemical Genetics; (b) Gene-network; (c) Trancriptomics; (d) Interactome 7. Drug target validation: In vitro/in vivo models; High Throughput Screening (HTS) Assay designing Chemical and genetic knock down studies 8. Lead optimization and targeting and clinical trial Qualification for clinical trial Preclinical studies for toxicity, Efficacy Human clinical trials for safety.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-4-0001**			
Course Title	**Project Proposal Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Project Proposal to be prepared by selecting topics of high relevance and novelty, and will have state-of-the art review, methodologies, recommendations

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-4-0002**			
Course Title	**Review Article Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Review Article on the research area undertaken by the student

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICB, Kolkata**			
Course Nomenclature	**BIO-IICB-4-0003**			
Course Title	**CSIR-800 Project Work**			
Credit Distribution (L-T-P-C)	0	0	8	**4**

Course Description:

Six–Eight weeks have to be dedicated on a project concerned with societal/rural issues under the CSIR-800 Programs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-1-0001**			
Course Title	**Biostatistics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Summarization of Data: measures of center, dispersion, skewness Dependence of variables: Correlation, linear regression, logistic regression Basic probability distributions: Binomial, Normal, Chi-squares. Estimation of parameters: method of moments, maximum likelihood Testing of hypotheses: (a) parametric tests: t-test, z-test, chi-squares test, ANOVA (b) non-parametric tests: Mann-Whitney, Kruskal Wallis, Kolmogorov-Smirnov

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-1-0002**			
Course Title	**Computation/bioinformatics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Computers: Introduction, Evolution and Classification of computers. Fundamentals of computing. Bit and Byte, Introduction to types of Hardware and Software. Components of Computer. Introduction to operating systems. Introduction to Computer Viruses. Network: Introduction. Network structure and architecture, Hierarchical networks, Ethernet and TCP/IP family of protocols, transport protocol design. Types of network, Topologies of network, Router, Switch, Data Communication, Concept of Wireless networking, LAN, WAN, MAN, Security of the network, Fire-walls, Network Applications Information Technology: Concepts of client Server Architecture, Concept of search Engine, Database search engines. Introduction to Internet Introduction to Word, Powerpoint and Excel Introduction to Bioinformatics: History of Bioinformatics, Genome sequencing projects, Human Genome Project, Applications of Bioinformatics. Introduction to databases, Type and kind of databases, Applications and limitations. Literature Search Databases, Nucleic acid and protein databases, Animal and plant databases, Ensembl Genome project TIGR database, Biotechnological databases, Motifs and Pattern Databases, Databases for species identification and classification, Structural databases. Database Retrieval and deposition systems. Web tools and resources for sequence analysis: Pairwise and multiple sequence Alignment, Sequence similarity search: BLAST, Pattern recognition, motif and family prediction, Restriction map analysis, primer design, Gene prediction, Phylogenetic Tree, Protein structure prediction and visualization.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-1-0003**			
Course Title	**Basic Chemistry**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Thermodynamics Solutions and Ions Chemical bonding and molecular structure Chemical Kinetics Stereochemistry Introduction to drug discovery (Medicinal chemistry approach) Drug target, discovery and development (forward and reverse approach

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-1-0004**			
Course Title	**Research Methodology, Communication/ethics/safety**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Philosophy and structure of scientific thoughts, Objective and Motivation of Research, Meaning of the Research, What constitutes a research topic? How to select a research topic?, Importance of literature review, Selection of appropriate methodology, Collection of data, Interpretation of data, Writing research paper, Paper presentation in scientific conference, Statistical methods, Importance of documentation, Procedure for Hypothesis Testing, Values and Ethical Problems, Criteria of Good Research, Good laboratory practice, Chemical, Radioactive and Biological safety: Possible hazards and precautionary measures; do and don'ts upon exposure Research methodology, communication, ethics, safety Asking the right questions: Originality, Depth, Precision can co-exist Formulating and refining the hypothesis: Those who do not learn from the past are condemned to repeat it Study design: Recognizing and minimizing bias Experiment design: Sometimes less is more and the importance of controls Good lab practices: Record keeping, organizing data, organizing the lab space Data interpretation; objectivity, quantification, double blind studies and necessity of statistics Comunicating your data:writing up your research Comunicating your data: presenting your findings Radiation safety Chemical and Biosafety Intellectual property rights What is ethics, the different interpretations & historical instances of unethical science Case studies: Data fraud/ plagiarism and Human Ethics violation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-2-2901**			
Course Title	**Biotechniques & Instrumentation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Principles and applications of Centrifugation, Chromatography, Electrophoresis and spectroscopy. Immuno-techniques: ELISA, Immuno-fluorescence, Immuno-histochemistry, immunoprecipitation, ChIP, etc. Automation in Drug Discovery: High-Content and High- Throughput Screening procedures.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-2-2902**			
Course Title	**Chemical Biology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Science at the Interface of Chemistry and Biology; Introduction to Chemical Biology to encompass a survey of major topics, technologies, and themes in drug discovery. Screening methods for the identification of lead molecules . Current screening methods in chemical biology including cell based and target based automated assays; Overview of drug delivery systems with special emphasis on lipid mediated targeted gene delivery systems; siRNA as a tool in chemical biology; Biological applications of RNAi. Small molecule mediators of cell signaling pathways.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-2-2903**			
Course Title	**Crop Protection**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Major pests of crops; Insect - plant relationship; Principles of insect physiology; Toxicology and pathology; Insecticide resistance and residue monitoring; Biopesticides and integrated pest management.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-2-2904**			
Course Title	**Techniques for identifying newer pesticide molecules**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Classification of evaluation (Agricultural pest and Public health important vectors), Larvicidal, Pupicidal, Insecticidal, Anti-feedant, Insect growth regulators. Xenobiotics exposure/effect assessment using alternate animal models, How to evaluate commercial products.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-2-2905**			
Course Title	**Techniques for identifying newer drug molecules**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

An overview of the various screening methodologies including in vitro and in vivo models. Correlations between in vitro and in vivo experiments. Choosing a right model and its relevance to human disease. Principles of high throughput screening (HTS). An overview of ex vivo techniques with special reference to isolated tissue experiments. An overview of methods for identifying hit molecules from NCEs. In vitro cell culture based screening techniques in the area of diabetes.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-2-2906**			
Course Title	**proteomics and its application**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to Proteomics and its advantages over genomics. 1D and 2D Gel Electrophoresis: pI, Isoelectric focussing, 2 dimensional gel Staining methods and analysis. Protein spot/Band processing for Mass spectrometric analysis. Introduction to Mass spectrometry and application of MALDI-TOF/TOF and electrospray/ liquid chromatography - mass spectrometer. Spectral Peak Annotation and Database search. Shotgun Proteomics, Protein quantification using Mass spectrometry: ITRAQ, and SILAC. Application of chemical proteomicsin drug design, Practical Training for 1D and 2 D gel electrophoresis and subsequent mock practice for Mass spectrometric analysis of processed protein spot using MALDI-TOF/TOF

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-2-2907**			
Course Title	**Principles of Pharmacology and Toxicology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

A general introduction to Pharmacology and Toxicology, Topics include absorption, distribution, biotransformation, elimination and calculation of dosages, Experimental design and data analysis for Pharmacology and Toxicology, Interdisciplinary Toxicology, Routes of administration. General principles and the application of toxicological knowledge are discussed including clinical toxicology, forensic toxicology, and risk assessment, Determination of median lethal concentration (manual calculations) Anticancer drugs and environmental agents exert their cytotoxic effects through DNA damage, The biochemical principles and molecular mechanisms underlying the toxicity of drugs and foreign agents.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-2-2908**			
Course Title	**Environmental and Microbial Technology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Concepts of environmental Microbiology, Complexity of microbial world, Environmental Ecology and Eutrophication, Fundamentals of microbial nutrition, Overview of microbial metabolism, Microbial diversity, Microbes and climate change, Water microbiology, Biodegradation and bioremediation, Microbial biogeochemistry, Microbial biofilm and corrosion, Concepts of microbial reactors, Perception of bioenergy, Hazardous waste bioremediation Biotransformation.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-3-2901**			
Course Title	**Seminar course**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Topic is decided in consultation with supervisors

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-3-2902**			
Course Title	**Nanobiology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to nanoscience and nanotechnology. Optical and electronic properties of nanoparticles. Morphologies [nanotubes and nanowires, fullerenes (buckyballs, graphene)] of nanoparticles. Semiconductor/quantum dots nanoparticles. Historical background of nanotechnology/nanoparticle in medicine. Several synthesis routes for nanoparticles (physical, chemical and biological) Several physico-chemical techniques (XRD, TEM, SEM, AFM, TGA, DSC, FTIR, UV-visible spectra etc.) and their basic principles for the characterization of nanoparticles. Surface functionalization of nanoparticles for development of nanoconjugates. Application of nanoparticles in various fields. Why nanotechnology is important in biology and medicine? Application of nanotechnology in therapeutics, diagnostics and drug delivery system. Different interaction of nanoparticales with biological system. In vitro and in vivo toxicity study of nanoparticles.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-3-2903**			
Course Title	**Environmental Toxicology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Environmental Toxicology in present and future perspective (01 lecture), Environmental hazards (physical, chemical and biological aspects), Origin, sources and types of toxicants/pollutants; Dispersal/movement of toxicants in environmental compartments Ecotoxicology : Conventional and alternate models in toxicity assessment; Assessment of toxicity of pollutants; Absorption, distribution and storage of toxicants; Dose response relationships; Biotransformation and elimination of toxicants; Mechanisms of action of toxicants; Gene-environment Interactions. Pollution monitoring and Risk assessment: Tools for detection; Fate and transport. Hazardous waste management: Regulation, approaches and strategies

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-3-2904**			
Course Title	**Advanced Pharmacology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

An outline of basic ethics in animal experimentation. Common laboratory animals, handling and care, different routes of administration of drugs and euthanasia techniques. Breeding techniques, random and selective breeding. Dose calculations in animals. Animal models in pharmacology, general perspectives, selection of suitable species and strains for disease models. Detailed study of the animal models related to inflammation, arthritis and diabetes. In vitro cell culture techniques, cell counting and cell viability assays. Commonly used isolated tissue experiments, physiological salt solutions, and recording transducers. Basic principles of pharmacokinetics, Concepts related to absorption, distribution, metabolism and Elimination (ADME), Factors influencing absorption of drugs.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-3-2905**			
Course Title	**Disease Mechanisms**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Hall Marks of Cancer; Mechanisms of carcinogenesis (oncogenes, tumor supressors, tumor virology, chemical carcinogens) and disease progression. Mechanisms of chemoresistance and alternative strategies to overcome; Current knowledge on tumor metastasis; Emerging trends in cancer therapeutics – role of micro RNA's and stem cells. Introduction to factors affecting cardiovascular diseases; Pathophysiology, epidemiology and current therapeutic interventions related to atherosclerosis, hypertension and diabetes. An overview of central nervous system and neurophysiology; Neurocircuitry - circuitry level approach to understand Brain and Behavior, chemosensory circuit, reward circuit, learning and memory circuit (Cognitive disorders and mental retardation). An overview of disease mechanisms with specific emphasis on target development and plausible therapeutic interventions pertaining to Parkinson's and Alzheimers disease. Biology of neurogenesis and Repair mechanisms (Molecular Biology of Adult Neurogenesis, Neural Progenitor or stem cells).

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-3-2906**			
Course Title	**Industrial /Applied Microbiology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

INDUSTRIAL/ APPLIED MICROBIOLOGY:Introduction Industrial and environmental microbiology; Intermediate microbial metabolism for exploitation of microbes; Microbial enzymology and kinetics, Intermediate microbial metabolism; Microbial transformations; Immobilization and applications; Microbial processes for waste water management; Microbial processes for Air pollution management; Anaerobic digestion of organic solids Microbial solid waste management; Microbial fermentation; Microbial Energy Engineering; Microbial energy engineering and Biorefinery.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-3-2907**			
Course Title	**Protein Science and structural based drug design and development**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Biochemistry and engineering of proteins, protein structure, structural motifs in functional regulation, methods of structure determination by NMR and crystallography, enzyme inhibitor complexes, structure based inhibitor design, modeling and bioinformatics. Enzymes: Mechanism of Catalysis, Kinetics & Regulation Protein Methods: Protein separation and purification Methods Practical Training to protein separation/detection using Western blotting, Protein structure: methods of crystallization, X-ray data collection, structure determination and analysis.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-4-0001**			
Course Title	**Project Proposal Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Project Proposal to be prepared by selecting topics of high relevance and novelty, and will have state-of-the art review, methodologies, recommendations

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-4-0002**			
Course Title	**Review Article Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Review Article on the research area undertaken by the student

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IICT, Hyderabad**			
Course Nomenclature	**BIO-IICT-4-0003**			
Course Title	**CSIR-800 Project Work**			
Credit Distribution (L-T-P-C)	0	0	8	**4**

Course Description:

Six–Eight weeks have to be dedicated on a project concerned with societal/rural issues under the CSIR-800 Programs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-1-0001**			
Course Title	**Biostatistics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Summarization of Data: measures of center, dispersion, skewness Dependence of variables: Correlation, linear regression, logistic regression Basic probability distributions: Binomial, Normal, Chi-squares. Estimation of parameters: method of moments, maximum likelihood Testing of hypotheses: (a) parametric tests: t-test, z-test, chi-squares test, ANOVA (b) non-parametric tests: Mann-Whitney, Kruskal Wallis, Kolmogorov-Smirnov

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-1-0002**			
Course Title	**Computation/bioinformatics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Computers: Introduction, Evolution and Classification of computers. Fundamentals of computing. Bit and Byte, Introduction to types of Hardware and Software. Components of Computer. Introduction to operating systems. Introduction to Computer Viruses. Network: Introduction. Network structure and architecture, Hierarchical networks, Ethernet and TCP/IP family of protocols, transport protocol design. Types of network, Topologies of network, Router, Switch, Data Communication, Concept of Wireless networking, LAN, WAN, MAN, Security of the network, Fire-walls, Network Applications Information Technology: Concepts of client Server Architecture, Concept of search Engine, Database search engines. Introduction to Internet Introduction to Word, Powerpoint and Excel Introduction to Bioinformatics: History of Bioinformatics, Genome sequencing projects, Human Genome Project, Applications of Bioinformatics. Introduction to databases, Type and kind of databases, Applications and limitations. Literature Search Databases, Nucleic acid and protein databases, Animal and plant databases, Ensembl Genome project TIGR database, Biotechnological databases, Motifs and Pattern Databases, Databases for species identification and classification, Structural databases. Database Retrieval and deposition systems. Web tools and resources for sequence analysis: Pairwise and multiple sequence Alignment, Sequence similarity search: BLAST, Pattern recognition, motif and family prediction, Restriction map analysis, primer design, Gene prediction, Phylogenetic Tree, Protein structure prediction and visualization.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-1-0003**			
Course Title	**Basic Chemistry**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Thermodynamics Solutions and Ions Chemical bonding and molecular structure Chemical Kinetics Stereochemistry Introduction to drug discovery (Medicinal chemistry approach) Drug target, discovery and development (forward and reverse approach

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-1-0004**			
Course Title	**Research Methodology, Communication/ethics/safety**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Philosophy and structure of scientific thoughts, Objective and Motivation of Research, Meaning of the Research, What constitutes a research topic? How to select a research topic?, Importance of literature review, Selection of appropriate methodology, Collection of data, Interpretation of data, Writing research paper, Paper presentation in scientific conference, Statistical methods, Importance of documentation, Procedure for Hypothesis Testing, Values and Ethical Problems, Criteria of Good Research, Good laboratory practice, Chemical, Radioactive and Biological safety: Possible hazards and precautionary measures; do and don'ts upon exposure Research methodology, communication, ethics, safety Asking the right questions: Originality, Depth, Precision can co-exist Formulating and refining the hypothesis: Those who do not learn from the past are condemned to repeat it Study design: Recognizing and minimizing bias Experiment design: Sometimes less is more and the importance of controls Good lab practices: Record keeping, organizing data, organizing the lab space Data interpretation; objectivity, quantification, double blind studies and necessity of statistics Comunicating your data:writing up your research Comunicating your data: presenting your findings Radiation safety Chemical and Biosafety Intellectual property rights What is ethics, the different interpretations & historical instances of unethical science Case studies: Data fraud/ plagiarism and Human Ethics violation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-2-3001**			
Course Title	**Pharmacology**			
Credit Distribution (L-T-P-C)	2	0	4	**2**

Course Description:

• General Pharmacology • Principles of Pharmacology, Pharmacodynamics • Assessment of new drugs, Determining drug action, Adverse effects of drugs, Mechanisms of drug interactions, Autacoid Pharmacology • Defined Animal models, Principles, methods and applications of In vivo Imaging • Animal experimentation, Biology of laboratory animals, Advancements in animal model systems • Laws, regulations and policies affecting the use of Laboratory animals. • Laboratory Animal Biosecurity (Prevention, control and eradication). • Importance of health and genetic monitoring of experimental animal models. Practicals: Animal handling, drug administration, collection and preservation of blood, fluid, tissue and organ samples, Non invasive in vivo imaging of animals

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-2-3002**			
Course Title	**Cancer Biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

• Cancer development, progression and metastasis- an overview • Role of Various cellular Signals (e.g. Ras-Raf-MEK-ERK, Wnt/beta-catenin, E.cadherin, TGF-β / Smad signaling) in cancer development and progression • Cell death and survival: Role and Regulation of various cellular programs in cancer cells • Stem Cells in Cancer: Cancer Stem Cells and their role in cancer progression, metastasis and drug Resistance. • Genetic and Epigenetic regulation of Cancer Stem Cells in Cancer • Cancer Drug Discovery: Past Present and Future • Successful Discovery of Best in Class Cancer Drugs.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-2-3003**			
Course Title	**Stem Cell Biology and Regenerative Medicine**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

• Stem cell basics, stem cell niche, types of stem cells (embroyonic stem cells, adult stem cells, induced stem cells, cancer stem cells). • Human embryo and embryonic stem cells. • Stem cells and tissue regeneration. • Stem cells and ethical issues. • Role of stem cells in medicine and biomedical research. • Methods of Induced pluripotent stem cell generation and characterisation. • Role of OSKM transcription factors in stem cells. • Role of cell signalling and epigenetic pathways in stem cell biology • Role of small molecules in stem cell biology.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-2-3004**			
Course Title	**Plant biochemistry and Molecular Biology: Principles and Applications**			
Credit Distribution (L-T-P-C)	2	0	4	**2**

Course Description:

Molecular cell biology, an introduction to metabolic pathways in plants, Tools and techniques in phytochemical analysis (Chromatographic techniques and their principles), concepts in plant functional genomics, crop improvement and transgenic plants, transgenic plants as expression hosts for therapeutic proteins.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-2-3005**			
Course Title	**Introductory Plant Biology**			
Credit Distribution (L-T-P-C)	2	0	4	**2**

Course Description:

Plant kingdom and different plant forms, Plant evolution, Basics of plant taxonomy, Environmental botany, concepts in plant ecology, plant morphology and anatomy, plant development, plant embryology, Economic botany

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-2-3006**			
Course Title	**Basic Microbiology and Microbial Metabolism**			
Credit Distribution (L-T-P-C)	2	0	4	**2**

Course Description:

Biosafety, Biosecurity and Bioethics; The microbial world and the scope of microbiology, Microbial ecology and diversity in function; bioremediation and bioaugmentation, culture independent methods for microbial detection, extremophiles, biodiversity hotspots, myxobacteria . Isolation, characterization and identification of microbes; Long term preservation of microbes Introduction to fermentation technology; Microbial nutrition and growth; Fermentation Types and their applications; types of bioreactors, Up-stream / down-stream processing; Industrial microbiology Role of microbes in natural product drug discovery; Fungal secondary metabolism; Induced production of secondary metabolites in fungi; Microbial Volatile Organic products (VOCs); Activation of cryptic biosynthetic pathways; bioprocesses and case studies

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-2-3007**			
Course Title	**Basic Biology for interdisciplinary Sciences**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Chemical biology/synthetic biology, Structure, function and chemistry of biological macromolecules including amino acids, Proteins, Nucleic acids and Carbohydrates, Chemical kinetics and thermodynamics in biology, Chemical reactions and chemical diversity in biology, The chemistry of enzymes, Lipids, Fats & Steroids, Drugs from nature, Drug interaction, Sustainable utilization of raw material, DNA fingerprinting-principle & techniques, Methods of making herbarium specimens, PCR- principle & techniques

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-3-3001**			
Course Title	**Molecular Cell Biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

• Cell basics; recent advancements and understandings. • Important signaling pathways in cell. • Modulation of signaling pathways in stem cells/cancer cells by small molecules. • Cell in health & disease; Influence on drug discovery. • Gene expression, regulation and its important players; Role in initiation and development of cancers. • Understanding of posttranslational modifications in physiology and disease; DNA methylation cycle & machinery. • Pathways for identification of new biomarkers and drug targets. • Histone acetylases/deacetylases/methyl transferases in cancer/stem cell fate determination

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-3-3002**			
Course Title	**Formulation, Drug Delivery and Pharmacokinetics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

• Pre-formulation considerations in the pharmaceutical product development • Introduction and classification of dosage form • Basic considerations in sterile product development and quality control parameters • Basic concepts in oral drug delivery • Novel formulation approaches for therapeutic agents • Biopharmaceutics and Drug Delivery Systems • Drug disposition (ADME) • Bioavailability and Bioequivalence • Pharmacokinetics and Therapeutic drug monitoring • Drug-drug interactions and cancer chemotherapy

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-3-3003**			
Course Title	**Neuropharmacology and Neuro-degenerative diseases**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

• Structure and functions of nervous system • Energy metabolism of the brain • Membrane transport and intracellular trafficking • Neurotransmission and cellular signaling • Introduction to Neurodegenerative diseases: Parkinson, Alzheimer and Huntington • Modeling of Neurodegenerative diseases • Pharmacology of Neurodegenerative diseases

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-3-3004**			
Course Title	**Toxicology and Applied Pharmacology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

• Basic Pharmacokinetics • Principles of Toxicology • Preclinical Toxicology and Mutagenesis • System Toxicology and Teratology • Regulatory Pharmacology • Toxicology in Drug-discovery • Drug Biotransformation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-3-3005**			
Course Title	**Infectious Diseases**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

• GENERAL PRINCIPLES OF INFECTIOUS DISEASES: Nature and pathogenicity of micro-organisms: microbial pathogenesis and the mechanisms of microbial escape. Host defense and anti-microbial immune responses (including vaccines and vaccination). • INFECTIONS OF GLOBAL IMPACT: Bacterial, fungal, protozoal and viral infections overview, diagnosis and therapeutics, Mechanism of antimicrobial drug resistance , Oral Microbiology • Tuberculosis: Overview, Diagnosis and Therapeutics. Mycobacterium tuberculosis adaptation to survive in a human host, Emerging antimicrobial drug targets. • EMERGING AND RESURGENT INFECTIONS: Viral hemorrhagic fevers; Japanese encephalitis; Chikungunya; Dengue & SARS; Other neglected infectious diseases

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-3-3006**			
Course Title	**Biodiversity and Taxonomy**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Aims, objectives and dynamics of Plant biodiversity, Bio-geographic regions of plant biodiversity in India and world, Diversity within different plant groups, Bioprospection, Biodiversity and traditional knowledge, Assessment of biodiversity, Role of Biosphere Reserve, National Parks, Wild Life Sanctuaries, Species distribution and endemism, sustainable uses of Biodiversity, ecosystem function and ecosystem processes, Ecological niche, Threats to Phytodiversity, Exotic species invasion, Global Warming and Climate Change. Taxonomy: scope and application, classification of angiosperms, ICBN, herbarium techniques: survey- trapping-maintenance, floristic analysis, IUCN red lists, national red lists, taxa endemism and hot spots, species concept, sacred groves, surrogate species, Introduction to molecular taxonomy. Practical on Biodiversity assessment, Plant taxonomy and visits field

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-3-3007**			
Course Title	**Molecular biology of plant secondary metabolism**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Overview of plant secondary metabolism, Diversity and distribution of secondary metabolites, Pathways, Molecular aspects of biosynthesis of important classes of plant secondary metabolites, Biological significance of plant secondary metabolites, Molecular approaches to modulate secondary metabolism in plants: Plant Metabolic engineering, some examples of successfully engineered plant secondary metabolites of human interest. Plant cell signaling: an overview, Phytohormones as signalling molecules in regulation of plant growth, development and metabolism, Physiological roles of phytohormones Molecular basis of biosynthesis and action of different classes of phytohormones, Role of mutant plants in elucidation of phytohormone action and their signaling networks.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-3-3008**			
Course Title	**In Vitro cellular and developmental biology of Plants**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction, Production of disease free quality planting materials; Somaclonal variations (concept and applications, visual, molecular and other screening methods); Haploids (anther, ovule culture detection of haploids, applications); Endosperm culture, triploid production and its application. Ex situ conservation, short and long term storage of germplasm. Transgenic technology and In vitro development and secondary metabolites production (Hairy root culture, molecular farming, scale up studies using bioreactors; Applications of tissue culture in commercialization); In vitro methods of crop improvement using transgenic technology and their Implication.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-3-3009**			
Course Title	**Plant Functioning**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Plant morphology and cellular structure, Plant ecology and adaptation, Mineral nutrition: uptake & transport, Plant movements & Circadian rhythm, Perspectives of Chemical Ecology. Photosynthesis, Respiration, Stress Physiology, Signal Transduction, Responses to plant pathogens. Photosynthesis ,Physicochemical Properties of Soil

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-3-3010**			
Course Title	**Techniques in plant molecular biology and biochemistry**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Assessment of plant health: photosynthesis, stomatal conductance, fluorescence, fv/fm, etc, Protein purification and characterization: Isolation and purification of protein fractions using ammonium sulfate, affinity chromatography, size exclusion chromatography, etc., and various molecular weight estimation techniques. Biochemical Activities in plants: Enzyme assays, antioxidants and other biochemical assays in plants, Genetic transformation of plants

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-3-3011**			
Course Title	**Medicinal and Aromatic Plants and Pharmacognosy**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction, practice and scope of pharmacognosy. Main crude drugs in commerce, their adulterants and substitutes. Cultivated and wild crude drugs. Good cultivation and post-harvesting processing. Factors affecting cultivation, collection, drying and storage. Standardization of crude drugs. Principles and procedures of microtomy and advanced histological techniques applied to Pharmacognosy. Economic importance of medicinal and aromatic plants. Introduction to MAPs: diversity and distribution in India, ethnobotany: research and application, genetic resources: conservation and captive cultivation, techniques for mapping of MAPs and databasing Medicinal plants of Kashmir , Aromatic plants and their agrotechnologies developed by IIIM , Extension activities of MAPs, Conservation and biotechnological interventions in plants

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-3-3012**			
Course Title	**Microbial Genetics and Enzyme Technology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

General genetics, DNA and RNA structure, DNA Replication,Transcription,Translation, Regulation of Bacterial Gene Expression, lac Operon, Tryptophan Operon, Mutations and its causes, types of mutants, importance of mutations, molecular basis of mutagenesis, mutagenic chemicals and radiations and their mechanism of action, Genetic Transfer and Recombination, Genetic Engineering, Bacteriophage genetics, Archaea genetics, Fungal genetics, Gene cloning, Heterologous gene expression in microbial systems, Types of vectors, Types of hosts Introduction, sources and classification of enzymes; enzyme activity and specific activity; Monomeric and oligomeric enzymes; Specificity of enzymes; effect of pH & temperature; enzyme kinetics, Enzyme Inhibition; Investigation of active site structure and allosteric enzymes; Application of enzymes; enzyme immobilization; case studies on enzyme based processes Microbial enzymes, Microbial diversity of NW Himalayas, extremophiles, cold active enzymes, gene cloning in bacteria

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-3-3013**			
Course Title	**Plant-Microbe interaction**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to plant-microbe interaction; bioprospecting from endophytes; plant metabolites from endophytes, intrinsic microbial products from endophytes; host specificity, endophytic technology in agriculture; characterization of biosynthetic pathways in endophytes, production of pharmaceutically active secondary metabolites in response to biotic stress, fungal endophytes as source of bioactives; enzymes in plant-microbe interaction; gene sequencing, VIGS and viral suppressors of RNAi; Agrobacterium & crown gall disease, Arabidopsis thaliana- Xanthomonas compestris model

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-4-0001**			
Course Title	**Project Proposal Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Project Proposal to be prepared by selecting topics of high relevance and novelty, and will have state-of-the art review, methodologies, recommendations

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-4-0002**			
Course Title	**Review Article Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Review Article on the research area undertaken by the student

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IIIM, Jammu**			
Course Nomenclature	**BIO-IIIM-4-0003**			
Course Title	**CSIR-800 Project Work**			
Credit Distribution (L-T-P-C)	0	0	8	**4**

Course Description:

Six–Eight weeks have to be dedicated on a project concerned with societal/rural issues under the CSIR-800 Programs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-1-0001**			
Course Title	**Biostatistics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Summarization of Data: measures of center, dispersion, skewness Dependence of variables: Correlation, linear regression, logistic regression Basic probability distributions: Binomial, Normal, Chi-squares. Estimation of parameters: method of moments, maximum likelihood Testing of hypotheses: (a) parametric tests: t-test, z-test, chi-squares test, ANOVA (b) non-parametric tests: Mann-Whitney, Kruskal Wallis, Kolmogorov-Smirnov

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-1-0002**			
Course Title	**Computation/bioinformatics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Computers: Introduction, Evolution and Classification of computers. Fundamentals of computing. Bit and Byte, Introduction to types of Hardware and Software. Components of Computer. Introduction to operating systems. Introduction to Computer Viruses. Network: Introduction. Network structure and architecture, Hierarchical networks, Ethernet and TCP/IP family of protocols, transport protocol design. Types of network, Topologies of network, Router, Switch, Data Communication, Concept of Wireless networking, LAN, WAN, MAN, Security of the network, Fire-walls, Network Applications Information Technology: Concepts of client Server Architecture, Concept of search Engine, Database search engines. Introduction to Internet Introduction to Word, Powerpoint and Excel Introduction to Bioinformatics: History of Bioinformatics, Genome sequencing projects, Human Genome Project, Applications of Bioinformatics. Introduction to databases, Type and kind of databases, Applications and limitations. Literature Search Databases, Nucleic acid and protein databases, Animal and plant databases, Ensembl Genome project TIGR database, Biotechnological databases, Motifs and Pattern Databases, Databases for species identification and classification, Structural databases. Database Retrieval and deposition systems. Web tools and resources for sequence analysis: Pairwise and multiple sequence Alignment, Sequence similarity search: BLAST, Pattern recognition, motif and family prediction, Restriction map analysis, primer design, Gene prediction, Phylogenetic Tree, Protein structure prediction and visualization.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-1-0003**			
Course Title	**Basic Chemistry**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Thermodynamics Solutions and Ions Chemical bonding and molecular structure Chemical Kinetics Stereochemistry Introduction to drug discovery (Medicinal chemistry approach) Drug target, discovery and development (forward and reverse approach

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-1-0004**			
Course Title	**Research Methodology, Communication/ethics/safety**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Philosophy and structure of scientific thoughts, Objective and Motivation of Research, Meaning of the Research, What constitutes a research topic? How to select a research topic?, Importance of literature review, Selection of appropriate methodology, Collection of data, Interpretation of data, Writing research paper, Paper presentation in scientific conference, Statistical methods, Importance of documentation, Procedure for Hypothesis Testing, Values and Ethical Problems, Criteria of Good Research, Good laboratory practice, Chemical, Radioactive and Biological safety: Possible hazards and precautionary measures; do and don'ts upon exposure Research methodology, communication, ethics, safety Asking the right questions: Originality, Depth, Precision can co-exist Formulating and refining the hypothesis: Those who do not learn from the past are condemned to repeat it Study design: Recognizing and minimizing bias Experiment design: Sometimes less is more and the importance of controls Good lab practices: Record keeping, organizing data, organizing the lab space Data interpretation; objectivity, quantification, double blind studies and necessity of statistics Comunicating your data:writing up your research Comunicating your data: presenting your findings Radiation safety Chemical and Biosafety Intellectual property rights What is ethics, the different interpretations & historical instances of unethical science Case studies: Data fraud/ plagiarism and Human Ethics violation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-2-3401**			
Course Title	**Biotechniques and Instrumentation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Instruments - Acquaintance and handling of instruments (For example: weighing balance, pH meter, centrifuges, HPLC, FPLC, PCR machine etc) Techniques in Biology - Handling of microbes and their basic characterization, Taxonomic characterization microbes and biochemical tests for characterization of a bacterium by Gram staining, MRVP test, Lactose fermentation, fatty acid profiling etc. Recombinant DNA technology - Concept of cloning, Plasmid DNA isolation, bacterial transformation with plasmid DNA, restriction digestion etc. - DNA sequencing: scope, application and troubleshooting. Protein expression and purification (concept of chromatography) Biochemical/Biophysical techniques - MALDI and its application. Steady state fluorescence spectroscopy and its use - Protein-DNA interaction: Electrophoretic mobility shift assay and use of phosphoimager - X-ray crystallography: Crystallization of proteins. Application of NMR. Cell Biology tools - Use of electron microscopy - Applications of confocal microscopy. Use of flowcytometer. Tools and techniques of Fermentation - Animal handling

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-2-3402**			
Course Title	**Biology of Macromolecules**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Protein conformation - Protein crystallography - Protein-Protein interaction – enzymes Protein-Nucleic acids interaction - Cryo-EM – SAXS - Protein structure analysis - Macromolecular complexes - Membrane proteins - Classification of proteins - Structural bioinformatics

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-2-3403**			
Course Title	**Biology of inheritance**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Classical and molecular genetics of bacteria - Molecular genetics and genome wide approaches in yeasts - Nucleic acids structure and topology - Central dogma and concepts on DNA transactions – Replication - Transcription & Transposition - DNAprotein contact probing - Molecular mechanisms and dynamics of replication Control - Licensing mechanisms – Telomeres - Transcriptional regulation and gene expression - Genetic Recombination - Chromatin structure and remodeling - The mechanisms of RNA interference - Ribozymes and riboswitches - Genome imprinting

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-2-3404**			
Course Title	**Biology of infection**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Evolution of Bacterial Pathogens: a) Genetic basis of Virulence b) Techniques involved in identification of virulence genes c) Population Genetics of pathogen - Glycobiology paradigm in host-pathogen interactions. Delivery of Virulence factors through various transporter systems - Regulation of Virulence gene expression : a) One and Two component signal transduction, b) Quorum sensing mediated virulence expression c) Environmental signals (such as pH, osmotic stress, temperature, antibiotics, NO, host factor etc) mediated virulence traits Molecular pathogenesis of Bacterial pathogens, Protozoan pathogens (Malaria) and Fungal pathogens (Candida albicans). Model systems to understand the function of unique virulence factors

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-2-3405**			
Course Title	**Genomics: Information flow in Biological Systems**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction - Next-generation sequencing technologies - Strategies for large scale DNA sequencing - Library preparation and sequencing of a genome Computational assembly of a genome – Information sources for genomics – Principles of sequence analysis - Annotation and analysis of a genome – Evolutionary concepts in genomics - Genomes and the protein universe - Genome properties - DNA Repeats in genomes – Phylogenomics - Introduction to comparative genomics - Comparative genomics - Population genetics - Case study – genomics approach – Metagenomics - Analysis of gene expression

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-2-3406**			
Course Title	**Protein Science and Proteomics**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Protein Spectroscopy - Design Principles of Protein molecular machines - Translational and transcriptional - Unwinders and Degraders - Filters and Transporters - Post-translation modification - Therapeutic protein - Protein vehicles - Proteomics - Glycobiology - Nano-biotechnology

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-2-3407**			
Course Title	**Systems Biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction - Mathematical Tools for systems biology - Physico-chemical understanding of the system - Building kinetic and statistical mechanical model of biological processes - Modeling of gene expression - Systems biology of signal transduction - Autoregulation and kinetic proof readings in biology - Modeling of biological processes at multi-level

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-2-3408**			
Course Title	**Cell Signaling**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Cell Signaling research – a historical perspective - Cell Signaling hardwires – kinases, phosphatses, GPCR, Small GTPase – Cell Signaling in prokaryotes – Twocomponent system – environment sensing, Nutrient sensing and stress response – quorum sensing and social behavior in prokaryotes – Cell signaling in Fungi – Pheromone response pathway, nutrient sensing, osmosensing signal transduction pathway – Cell signaling softwares – Control mechanisms in cell signaling – System level and genome scale understanding of signaling pathways – Cell signaling in Metazoan – Differentiation and disease, cell communication – Methods in cell signaling research – kinase, phosphatase, GTPase etc assay – use of inhibitors and non-hydrolysable analogs – use of dominant and recessive mutants – analog sensitization – multiplex western blotting – protein-protein and proteinligand interactions – FRET and FRAP analysis – Applications of Fluorescence microscopy in cell signaling research

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-2-3409**			
Course Title	**Chemical Biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Organic Chemistry and Biology - Chemical Biology and Computers - Lipid and Sugar Chemistry - Drug Discovery through screening - Enzyme Conformation- Activity

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-2-3410**			
Course Title	**Molecular and Cellular Mechanisms of Defence**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to Immunology - Historical perspective of immunology - Immune organs - Immune cells - Innate immunity - Adaptive immunity - Cellular Immunology - T and B cell biology, antigen presenting cells, Major Histocompatibility Complex (MHC) - Signaling and effectors of immune system - Immunoglobulins, cytokines, chemokines and cell signaling - Disease and immunity - Immunology of infectious diseases, cancer, autoimmune disorder and hypersensitivity-mediated diseases - Recent trends in immunology - Reproductive immunology, immunodiagnostics and immunotherapy.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-2-3411**			
Course Title	**Biodiversity**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Universal tree of life: domains of life, bacteria, archaea and eukarya - Prokaryotic species concept: Characterization of prokaryotes – polyphasic taxonomy - Overview of microbial diversity, methods, and limitations in studying microbial diversity - Molecular phylogeny : different types of genes used for phylogenetic studies and their importance - Metagenomics and its applications - The world of fungi : Diversity, taxonomy, classification, preservation and their maintenance - Microbial life in the biosphere –interactions between the microorganisms and ecosystem, adaptations to the extreme environments - Phototrophic Bacteria: Methods of cultivation and applications - Microbial diversity – bio-prospecting, applications and economic importance - Anaerobic microbes – methods to cultivate the anaerobic microorganisms and their metabolism

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-2-3412**			
Course Title	**Bioinformatics**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Biological Databases - Database- introduction and definition. Primary, secondary and tertiary databases. Type and kind of databases. Literature (PUBMED and MEDLINE). Nucleic acid and protein databases (GenBank, EMBL, SWISS PROT, UNIPROT etc.). Plants and Animal databases (Ensembl Genome project, Flybase, Maize GDB). Structural databases- PDB, PDBsum, NDB, CATH, SCOP etc. Motifs and Pattern Databases- PROSITE, Pfam, etc. RNA databases: RNABase etc. Carbohydrates and lipid databases- GlycoSuiteDB, LIPIDAT etc. Database Retrieval and deposition systems- SRS, Entrez, Bankit, etc. and AutoDep. Protein-Protein Interaction Networks and databases- DIP (Database of Interacting Proteins), BIND - Biomolecular Interaction Network Database, Yeast Interaction Database etc. siRNA/miRNA resources. File formats- GenBank, EMBL, fasta, free format etc. Alignment of Sequences - Sequence alignmentintroduction and concepts; Sequence comparison using DOT matrix. Scoring matrices (Identity, Chemical, Substitution- PAM, BLOSUM); Local and global alignment concepts. Dynamic programming (Needleman-Wunch, Smith-Waterman algorithm). Similarity and percent identity score (open, extended gap penality). Multiple sequence alignment-introduction and concepts. Types of multiple sequence alignment techniques. Description of major software (MSA, CLUSTALW, PILEUP). Database Scanning and Sequence similarity searches. Algorithm of FASTA. Description of BLAST algorithm. Various BLAST programs (e.g., BLASTP, BLASTN). Concept of iterative search (PSI-BLAST and PHI-BLAST). Application of PSSM profile. Sequencing and Annotation of Genomes - Introduction to genomes. Sequencing techniques. Sequencing of whole genomes. Next Gen Sequencing. Assembling of Genomes from Short Reads. Concept of Metagenomics. Types of repeats and repeat finding techniques. Structure of genes. Prediction of gene in prokaryotic and eukaryotic genomes. Prediction of promoter prediction in E.coli and in eukaryotes. Description of major gene prediction methods. Comparison of genomes. Genome projects and sequence archive databases. Phylogenetic Analysis - Evolutionary analysis. Relationship of phylogenetic analysis to sequence alignment. Genome complexity. Concept of evolutionary trees. Methods-maximum parsimony method, distance methods, the maximum likelihood approach. Sequence alignment based on evolutionary model. Reliability of phylogenetic predictions. Complications from phylogenetic analysis - Protein Structure Analysis - Protein Structure –Introduction. Protein Structure analysis. Secondary structure assignments (DSSP). Protein Structure Comparison and alignment. Distance Matrices. Maximum Common Sub-graph Algorithm (PROCOR). Structural alignment algorithms (CE, VAST, DALI, SSAP etc.) - Prediction of Protein Structure - Protein structure prediction-concepts. Use of sequence patterns for protein structure prediction. Prediction of protein secondary structure from the amino acid sequence- Secondary structure Prediction methods: First, second, third and fourth generation methods like CHOU-FASMAN, GOR; Nearest neighbor methods like GOR-IV etc., Neural network methods like PHD, PSIPRED, JPRED. Hidden Markov Models like HMMER. Concepts, algorithms and their limitations. Evaluation of success of structure predictions. Benchmarking, CASP, CAFASP, EVA etc.- Protein three dimensional structure prediction- Introduction. Homology Modeling (method- SWISS-MODEL, MODELER, Fold recognition method- 3-D PSSM, SAM, I-TASSER etc. abinitio method –Introduction and concepts - Basic principle 2D and 3D graphics and use of molecular graphics packages (e.g. Rasmol, MOLMOL, Chimera, Pymol, spdbviewer), Building small molecules using chemical information. Structure Visualization techniques (Software & Hardware) - RNA Structure Prediction - Importance of RNA structure. Features of RNA secondary structure. Development of prediction methods. Self complementary regions in RNA sequences. Minimum free energy method. MFOLD and use of energy plots. Covariation analysis in RNA sequences and its use in structure prediction. Mutual information content. Limitations of prediction - Molecular Simulation and Docking - Introduction to Molecular Modeling. What are models used for? Areas of application – Single molecule calculation, assemblies of molecules, Coordinate Systems. Potential energy surface - Molecular structure and internal energy. Molecular Potential Energy function. Empirical force field. Sources of force field data. Examples of important force fields - Energy Minimization- Concepts. First derivative techniques: steepest descent and conjugate gradients, Second derivative techniques: Newton-Raphson, Global Optimization

(simulated annealing) - Molecular dynamics- Introduction, Molecular dynamics using simple models, Dynamics with continuous potentials. Constant Temperature and constant dynamics, Conformation searching, Systematic Search. - Conformational Analysis: Systematic Methods, Random search methods, distance geometry - Principles and methods of docking. docking problem. Scoring functions. Macromolecular docking- Concept. Practice and limitations of Computer assisted drug discovery process - Computer Aided Subunit Vaccine Design - Introduction to immunoinformatics. Concept of subunit vaccine: Endogenous and Exogenous antigen processing. Prediction of CTL epitopes (MHC Class I binders, Cleavage sites, TAP binders, Nonepitope MHC binders). Identification of T-helper epitopes and promiscuous MHC class II binders. Prediction of B-cell epitopes (linear and conformational epitopes). Role of innate immunity in adjuvant design; Integrative approach for epitope or peptide based vaccine – Microarray - Introduction, history and types of microarrays. Application of microarray. Affyemetrix Technology. Stanford/cDNA chip. Processing and analysis of images. Preprocessing of expression data. Normalization of data; Differential Gene expression. Expression based clustering of genes (Supervised, Unsupervised, K-means, Hierarchical). Prediction of function from expression data. Microarray databases.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-2-3413**			
Course Title	**Biochemical Engineering**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Bio-reactions and bioreactors – Introduction to bioprocess engineering – interaction of chemical engineering – biochemistry and microbiology, cell growth and product formation kinetics – mammalian cell culture – biocatalysis – immobilization of cells and enzymes – types of reactors – mass transfer and heat transfer – asepsis and sterilization – scale up and scale down of bioprocesses – Downstream processing – Principles of choosing a separation/ purification process – Intracellular and extracellular product recovery methods – bioprocess synthesis.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-3-3401**			
Course Title	**Seminar Course**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

History of science with emphasis on Indian contribution: Seminar by students

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-3-3402**			
Course Title	**Frontiers of Biology: Synthetic Biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to synthetic biology – Biobricks/parts, devices, systems – Peptide and protein building blocks for synthetic biology – reconstruction of genetic circuits, logic gates – application of synthetic biology – in medicine, energy, environment etc – Future perspectives – Major ongoing and international initiatives – Methods for large scale reconstruction of parts/ metabolic pathways

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-3-3403**			
Course Title	**Advanced Bioinformatics**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Computer Software - Concept of LAMP (Linux, Apache MySQL and PERL) learning. Introduction to Linux. Installation of Linux; Basic and advance Linux commands. Editors (vi, emacs). Software installation and configuration; Introduction to Apache. Configuration of Apache. Launching of web site using Apache; Introduction of HTML. Development of web sites; Concept of common gateway interface (CGI). Concept of FORMS in HTML. Introduction to MySQL. Development of Databases using MySQL. Introduction to PERL. Example PERL programs. Handing FASTA files. Program for calculating amino or nucleotide composition of sequences – Algorithms - Algorithms and techniques used for developing programs for biological problems. Quantitative matrices. Introduction to Machine Learning Techniques. Artificial Neural Network. Support Vector Machine. Hidden Markov Model. Example-based leanings. Major Software for implementing algorithms (SVM_light; SNNS; HMMER; Weka). Introduction to R: Introduction to R. Installation of R. Description of R environment. Using R interactively. Getting help with functions. Assigning variables. Arrays and vectors. Functions on vectors. Using R commands from terminal. Reading data from files. Programming in R. - Bioinformatics Software for Annotation of Proteins - Important of annotation of proteins. Classification of protein annotation methods. Protein Sub-cellular Localization (amino acid, dipeptide, split-amino acid composition). Prediction of Antigenic regions in proteins (motif, matrix and ANN based methods). Secondary structure prediction (probability, segment, evolutionary approaches). DNA/RNA interacting residues in proteins (binary, PSSM and composition based approaches). (Note: This course is designed for students interested in research in the field of bioinformatics particularly in developing prediction and classification programs/web-servers. Equal number of theory and practical classes shall be taken up in this course.)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-3-3404**			
Course Title	**Mycobacterium tuberculosis**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to TB & A historical prospective of TB - Diagnosis of TB- development of Tuberculosis Vaccines - Treatment of tuberculosis-Drugs under development - Experimental animal models of tuberculosis - Molecular evolution of Mycobacterium - Ultra-structure and Biochemistry of mycobacterial cell- Lipids of mycobacterium-Structure, biosynthesis and biological activity - Redox homeostasis in Mycobacterium - Latency of mycobacterium-An overview of latency and mechanisms involved in persistence - Hypoxia and NO-A window to persistence of mycobacterium - Mechanism of signal transduction in mycobacterium. Serine-threonine kinases and two component proteins of mycobacterium - Transcription machinery of mycobacterium-Sigma factors and their role in the virulence of mycobacterium - Experimental Genetics of Mycobacterium - Interaction of Mtb with macrophages - Immunopathology of TB

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-3-3405**			
Course Title	**Metagenomics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to metagenomics, challenges, functional applications - A typical metagenomic study - eg.human distal gut microbiome Metagenomic library preparation and sequencing - Metagenomicassembly basics - Metagenomic gene identification, metabolic reconstruction - Genome variations, Detecting genome variations in metagenomic data, Quasi species detection Community and comparative metagenomics - Amplicon sequencing and Gene Targeted (GT) metagenomics - Strategies for enrichment, functional screens - Bioprospecting metagenomes for novel enzymes - Metatranscriptomics and metaproteomics

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-3-3406**			
Course Title	**Advanced Biochemical Engineering**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Bioreactions – Cell growth and product formation kinetics, growth associated, non-growth associated and mixed-growth associated product formation, cell growth and product formation models – quantitative review of biochemistry, metabolism and metabolic engineering, engineering aspects of microbial process and bioconversions – Bioreactors – Design of bioreactors – kinetic analysis, packed bed bioreactor, Fluidized bed batch, fed-batch and continuous culture – Bioprocess development – Exploitation of genetic engineering and bioprocess development, Plant cell culture, Mammalian cell culture, Enzyme technology – Downstream processing – Purification and separation technology, integrated bio separation schemes – Case studies – Production of protein pharmaceuticals as a paradigm of the application of biochemical engineering to advanced process development within the frame work of current business and regulatory requirements – Chemicals from biomass

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-4-0001**			
Course Title	**Project Proposal Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Project Proposal to be prepared by selecting topics of high relevance and novelty, and will have state-of-the art review, methodologies, recommendations

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-4-0002**			
Course Title	**Review Article Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Review Article on the research area undertaken by the student

Faculty	**Biological Sciences**			
Lab Name	**CSIR-IMT, Chandigarh**			
Course Nomenclature	**BIO-IMT-4-0003**			
Course Title	**CSIR-800 Project Work**			
Credit Distribution (L-T-P-C)	0	0	8	**4**

Course Description:

Six–Eight weeks have to be dedicated on a project concerned with societal/rural issues under the CSIR-800 Programs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-1-0001**			
Course Title	**Biostatistics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Summarization of Data: measures of center, dispersion, skewness Dependence of variables: Correlation, linear regression, logistic regression Basic probability distributions: Binomial, Normal, Chi-squares. Estimation of parameters: method of moments, maximum likelihood Testing of hypotheses: (5 lectures) (a) parametric tests: t-test, z-test, chi-squares test, ANOVA (b) non-parametric tests: Mann-Whitney, Kruskal Wallis, Kolmogorov-Smirnov

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-1-0002**			
Course Title	**Computation/bioinformatics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Computers: Introduction, Evolution and Classification of computers. Fundamentals of computing. Bit and Byte, Introduction to types of Hardware and Software. Components of Computer. Introduction to operating systems. Introduction to Computer Viruses. Network: Introduction. Network structure and architecture, Hierarchical networks, Ethernet and TCP/IP family of protocols, transport protocol design. Types of network, Topologies of network, Router, Switch, Data Communication, Concept of Wireless networking, LAN, WAN, MAN, Security of the network, Fire-walls, Network Applications Information Technology: Concepts of client Server Architecture, Concept of search Engine, Database search engines. Introduction to Internet Introduction to Word, Powerpoint and Excel Introduction to Bioinformatics: History of Bioinformatics, Genome sequencing projects, Human Genome Project, Applications of Bioinformatics. Introduction to databases, Type and kind of databases, Applications and limitations. Literature Search Databases, Nucleic acid and protein databases, Animal and plant databases, Ensembl Genome project TIGR database, Biotechnological databases, Motifs and Pattern Databases, Databases for species identification and classification, Structural databases. Database Retrieval and deposition systems. Web tools and resources for sequence analysis: Pairwise and multiple sequence Alignment, Sequence similarity search: BLAST, Pattern recognition, motif and family prediction, Restriction map analysis, primer design, Gene prediction, Phylogenetic Tree, Protein structure prediction and visualization.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-1-0003**			
Course Title	**Basic Chemistry**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Thermodynamics Solutions and Ions Chemical bonding and molecular structure Chemical Kinetics Stereochemistry Introduction to drug discovery (Medicinal chemistry approach) Drug target, discovery and development (forward and reverse approach

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-1-0004**			
Course Title	**Research Methodology, Communication/ethics/safety**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Philosophy and structure of scientific thoughts, Objective and Motivation of Research, Meaning of the Research, What constitutes a research topic? How to select a research topic?, Importance of literature review, Selection of appropriate methodology, Collection of data, Interpretation of data, Writing research paper, Paper presentation in scientific conference, Statistical methods, Importance of documentation, Procedure for Hypothesis Testing, Values and Ethical Problems, Criteria of Good Research, Good laboratory practice, Chemical, Radioactive and Biological safety: Possible hazards and precautionary measures; do and don'ts upon exposure Research methodology, communication, ethics, safety Asking the right questions: Originality, Depth, Precision can co-exist Formulating and refining the hypothesis: Those who do not learn from the past are condemned to repeat it Study design: Recognizing and minimizing bias Experiment design: Sometimes less is more and the importance of controls Good lab practices: Record keeping, organizing data, organizing the lab space Data interpretation; objectivity, quantification, double blind studies and necessity of statistics Comunicating your data:writing up your research Comunicating your data: presenting your findings Radiation safety Chemical and Biosafety Intellectual property rights What is ethics, the different interpretations & historical instances of unethical science Case studies: Data fraud/ plagiarism and Human Ethics violation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-1-3701**			
Course Title	**Analytical Tools and Instrumentation**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Thermal methods (TG, DTG, DTA, TMA, DSC), X-ray methods (XRD, XRF, SAXS), NMR (1H, 13C) and other Spectroscopic methods (EPR, IR, UV, Fluorescence), Chromatographic methods (TLC, GC, LC), Mass spectroscopy, Electron Microscopy (SEM, TEM), Electron Probe Micro Analysis (EDS, WDS), Quantitative Analysis (AAS, ICP, CHN)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-1-3702**			
Course Title	**Basic mathematics and numerical methods**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Determinants and Matrices, Complex Variables, Vector analysis, Infinite Series, Special Functions, Differential Equations, Interpolation and Approximation, Numerical differentiation and Integration, Basic Linux, Introduction to Algorithms, basic programming, Shell and Shell Scripting, Network Computing and Parallel Computing, Matlab/Scilab/Octave/Gnuplot

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-1-3703**			
Course Title	**Basic Chemistry for Interdisciplinary sciences**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Basics of inorganic, organic, physical and biochemistry, Nomenclature (IUPAC), molarity, molality and normality, types of bonding, Ionic, covalent and nonbonding interactions, Acids and bases, Atomic structure, periodic table and periodic properties, stoichiometry, chemical reactions and kinetics, solvent effects, functional groups in organic compounds, general named reactions and reaction mechanisms, carbohydrates, lipids, proteins, nucleotides, enzymes, photosynthesis

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-1-3704**			
Course Title	**Introduction to Nanoscience and Nanotechnology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

General considerations, Introduction, definitions, consequences of size reduction, Properties: structural, thermodynamic, optical, electrical and magnetic properties, Methods of synthesis, Surface modifications, factors governing the stability and assembly, Characterization of nanomaterials, Applications of Nanomaterials

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-1-3705**			
Course Title	**Introduction to Chemical Biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Amino Acids, Peptides & Proteins, The Chemistry of Carbohydrates, Nucleic acids, The Chemistry of Enzymes, Lipids, Fats & Steroids, Drug discovery, Drugs from Nature, Drug interaction

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-1-3706**			
Course Title	**Basic techniques in biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Basic techniques in microbiology Basic techniques in plant tissue culture Basic techniques in plant molecular biology Basic techniques in animal cell culture Basic Entomological techniques Microscopy - Light and florescence Freeze drying, centrifugation, ultra-centrifugation, ultra-filtration, etc. Electrophoretic techniques (DNA/RNA/Protein-Native/denaturing) / IEF and Agarose / PAGE / Capillary electrophoresis Chromatography techniques (Ion exchange, Affinity, Gel filtration) Purification and characterization of biomolecules (Proteins & metabolites)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-2-3701**			
Course Title	**Advanced Techniques in Biology**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Sequencing of nucleic acids and proteins Functional characterization of biomolecules Advanced microscopy (TEM, SEM, Confocal, AFM, etc.) Biophysical techniques (UV, Fluorescence, CD) Spectrometry (GC-MS, LCMS) High performance chromatography (HPLC, FPLC) Tracer techniques NMR for biomolecules Proteomics (2D, MALDI-TOF, ESI, Database search, de novo sequencing) Microarray analysis Techniques in molecular biology (PCR, RT-PCR, Sequencing, Southern, Northern, etc.) Gene cloning and over-expression: identification of genes, designing primers, selecting vectors and cloning, expression in cells, solubilization of inclusion body, protein purification, site-directed mutagenesis Immunological techniques- Antigen-Antibody reaction, ELISA, RIA, In situ hybridization, immunoblotting, Western blotting, etc. Techniques in structural biology: crystallization and X-ray structure determination Bioinformatics tools and databases

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-2-3702**			
Course Title	**Introduction to infectious diseases**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Human microbiome and normal flora Pathogens responsible for human infectious diseases i. Virus: classification, biology and diseases caused / Specific case studies will be discussed ii. Bacteria: classification, biology and diseases caused / Specific case studies will be discussed iii. Protozoans: classification, biology and diseases caused / Specific case studies will be discussed iv. Fungal: classification, biology and diseases caused / Specific case studies will be discussed v. Worm: classification, biology and diseases caused / Specific case studies will be discussed Virulence mechanisms Host pathogen interaction and overview of host immune response against specific pathogens Overview on veterinary pathogens Epidemiology / Transmission / preventive strategies Diagnostic methods and techniques against infectious diseases Drugs / Drug resistance / Drug discovery Vaccines Infectious disease studies in the 'post genomic era'. Overview of genome sequencing efforts, and highlight the importance of genome information in helping to under the biology and disease caused by specific pathogens. Discuss the role of genomics in epidemiology, diagnosis and drug discovery Special focus on neglected tropical diseases.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-2-3703**			
Course Title	**Mathematics and statistics for biologists**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to algebra and geometry Trigonometry: Ratios of single and compound angles, their relations, inverse function. Complex numbers: algebra and geometrical interpretation Matrices and determinants: algebra, inverse of matrix, elementary transformations and solving equations Vectors: algebra, coordinate system, unit vectors, direction cosines, vector operations, products. Eigen value and eigen vectors Coordinate transformations and rotation about a general direction Calculus: continuity and limit of functions, derivatives, integrals, differential equations, Fourier transform, applications. Biostatistics: introduction Probability distributions (normal, binomial and Poisson), Sampling techniques, Correlation and Regression, Null hypothesis, Confidence intervals, Significance levels Experimental Design and Methods of sampling, Basic and Two-Way ANOVA

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-2-3704**			
Course Title	**Structure determination and analysis of biomolecules**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Introduction to the structure of biomolecules: DNA, RNA, sugar, lipid, protein Conformation of biopolymers, energetics of folding Crystallization of Proteins: Principles and techniques, preparation of heavy atom derivatives, Freezing protein crystals for storage and data collection. Single crystals: Three-dimensional structure determination using protein crystallography, Arrangement of molecules in crystals, Lattice, symmetry, unit cell, point groups, space groups. Diffraction: X-ray diffraction, Laue an Bragg equations, reciprocal lattice, structure factor equation, Fourier transform, phase problem, diffraction data collection, indexing, systematic absences Structure determination: Solution to phase problem using direct methods, molecular replacement, Patterson method, isomorphous replacement and anomalous scattering, phasing of protein reflections, accuracy of phasing and refinement of phases, electron density and model fitting, Refinement: methods for structure refinement, structure validation, structure deposition, database. Fiber diffraction and small angle scattering Biophysical and spectroscopic techniques: NMR, Fluorescence, Circular Dichroism

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-2-3705**			
Course Title	**Concepts in Microbiology**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Topics Architecture of Bacterial cell Architecture of Fungal cell Taxonomy of bacteria Taxonomy of fungi Bacterial genetics Fungal genetics Microbial diversity Fungi from different environments Strain improvement Whole cell & enzyme immobilization Secondary metabolites Morphological and physiological characterization of microorganisms

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-2-3706**			
Course Title	**Concepts in Plant Biotechnology**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Structural genomics including genome architecture, gene structure, large insert libraries and classical genome sequencing, next generation sequencing, physical mapping Functional genomics including differential expression (microarray technology, real time and digital PCR), over expression, gene silencing (miRNA and siRNA), mutation, transposable elements, Genome-wide technologies (Transcriptomics, TILLING, SAGE, etc.) Molecular markers including concept, properties, classes, advantages and applications, population development Plant cell, tissue and organ culture Plant transformation methods including tissue culture and non tissue culture based, Agro bacterium mediated co-cultivation, particle bombardment, plant vectors, promoters and analysis Endophytes and their applications Phytoremediation

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-2-3707**			
Course Title	**Advances in Nanoscience and Nanotechnology**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Low-dimensional structures: Quantum wells, Quantum wires, and Quantum dots, Nano clusters & Nano crystals, fullerenes, carbon nano tubes and graphene, Nano Composites, synthesis and characterization techniques, Properties at Nano Scales and comparison with bulk materials, fabrication techniques, general applications, nanomaterials in biology.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-2-3708**			
Course Title	**Advances in Chemical Biology**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Amino Acids, Peptides & Proteins: Structure and functions of peptides and proteins, Design of poly peptides, Peptide hormones and their pharmaceutical significance, Peptide mimetics as therapeutics The Chemistry of Carbohydrates: Glycosylation methods, Oligosaccharide synthesis and biosynthesis, Sugar derivatives and reactions, Glycoconjugates and glycomimetics Nucleic acids: Structural aspects of nucleic acids, Building blocks of nucleic acids , Structure & function of DNA and RNA, Nucleic acid mimetics & their therapeutic applications. The Chemistry of Enzymes: Enzymes: Classification & Nomenclature, The Mechanism of Enzyme action, Enzymes as Catalysts Lipids, Fats & Steroids: Chemical synthesis & biosynthesis, Drug discovery , Basic principles of medicinal chemistry, The process of drug discovery and combinatorial chemistry, Case studies in drug discovery, Drugs from Nature: Introduction to natural products chemistry, Natural products based drug discovery, Naturally occurring antimalarials, anticancer and antimicrobial agents.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-2-3709**			
Course Title	**Advanced Biomaterials**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Definition of biomaterials, Surface property requirements of biomaterials, Types of materials used in medicine, Synthesis and surface characterization, Biology of wound healing, foreign body response and tissue remodeling, Molecular and cellular interactions of materials with biological environment, Degradation and long term fate of materials used in medicine, Requirements of biomaterials for biomedical implants, surface coatings, wound dressings, sutures, cardiovascular devices, ophthalmology, dentistry, orthopedics and cosmetic surgeries, Applications in drug delivery and tissue engineering, Standard protocols for testing the efficacy and efficiency of biomaterials, The regulatory environment for biomaterials, Some concepts for design development of common biomaterials.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-3-3701**			
Course Title	**Molecular recognition and molecular interactions in structural biology**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Databases and tools used in structural biology Enzyme kinetics, active site and inhibition Metabolism of DNA and RNA: Replication, recombination, transcription Ribosome structure and mechanism of protein synthesis. Protein folding, degradation and prediction of protein conformation Protein-DNA interaction: case study of transcription factors and student assignment. Protein-carbohydrate interactions: case study of lectins and student assignment. Structural studies of genetic diseases and student assignment. Proteins as enzymes: case study of proteases and student assignment. Proteins as enzymes: carbohydrate digesting enzymes and assignment. Protein superfamily: Ntn hydrolases and assignment. Molecular recognition: case study of antigen-antibody interactions and student assignment. Virus structures. Membrane proteins and student assignment Protein evolution: globins and cytochromes and student assignment Cell signaling and cell-cell interactions and student assignment Cell motility and transport and student assignment Structure based drug design: case study. Structural genomics, proteomics and metabolomics

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-3-3702**			
Course Title	**Advances in Microbiology and Microbial Technology**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Fungal morphogenesis Microbial diversity: Metagenomics/Functional genomics Evolution of bacteria Evolution of fungi Host-pathogen interaction Microbial and plant lectins Signal transduction Programmed cell death Metabolic Engineering Synthetic biology Agriculture microbiology: Biofertilizer and Biocontrol agents Industrial enzymes Biotransformation Concept to commercialization Submerged and solid state fermentation Down stream processing Nanobiotechnology Single cell microbiology IPR Surface expression of enzymes

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-3-3703**			
Course Title	**Applications in Plant Biotechnology**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Plant –pathogen/microbe/insect interactions, plant defense, defense proteins, such as AI, PI, lectins, defensins, etc. Abiotic stress tolerance in plants Plant genetic engineering for crop improvement with case studies, safety practices in handling GMOs Applications of molecular markers in linkage mapping, gene tagging, gene introgression, synteny mapping, Hybrid testing, germplasm analysis, DNA fingerprinting, MAS, map based cloning Identifying and mapping of QTLs including strategies of QTL mapping (SMA, SIM, CIM, MTIM), QTL x QTL and QTL x environment interactions, expression QTLs, Softwares used, Association mapping Biodiversity including genetic diversity, molecular diversity and taxonomy, DNA barcoding, population genetics, conservation of diversity and endangered species Metabolomics including plant secondary metabolites, functional molecules, metabolic engineering, analytical methods Molecular farming and Biotransformation Proteomics including recognition, sequencing, applications of proteomics in plant biotechnology, identification, differential analysis, intensity fading etc. Application of nano-biotechnology in plant sciences

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-3-3704**			
Course Title	**Beyond Genomes: Concepts in comparative and functional genomics**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Overview of genome sequencing, assembly and annotation. Will discuss recent advances in genome sequencing technology and assembling short reads, gene finding and annotation. Accessing genome sequences and genomic-scale datasets: Genome browsers and databases Genome wide experiments 1. Gene expression and genetic variation analysis by microarray and sequencing. 2. Gene silencing / knock down techniques (micro RNA / siRNA) 3. Epigenetics / Histone modifications 4. Chemical genomics Comparative genomics 1. Synteny mapping 2. Overview of phylogenetics, orthology (orthologs / paralogs), gene duplication and functional specialization. Case study – the human kinome 3. Lateral gene transfer and functional specialization. Case study – the apicoplast organelle genome and function of apicomplexan parasite Metagenomics Population genetics Genome wide association studies (GWAS) and systems biology – integrating diverse datasets to understand biological functions and disease mechanisms Genomics and Drug discovery. The druggable genome concept. The EnCODE and 1000 genome projects Case study on current status of select genomes (humans / mouse / Arabidopsis / Plasmodium species / Mycobacterium species)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-3-3705**			
Course Title	**Chemistry and biology of Heterocycles**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Privileged heterocycles, Electronic properties, reactivity (electrophilicity and nucleophilicity), Synthetic methodologies, Biological properties of Natural products and drug candidates, Biosynthesis, Dimeric compounds and related stereochemistry

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-3-3706**			
Course Title	**Cell Signalling**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

1. Introduction to Cellular Signalling Principles of Cell Signalling Modes of Cell Signalling Endocrine Paracrine Juxtacrine Cell-cell Signalling Synaptic Amplification and Coordination of Signals 2. Signalling at the Membrane Membrane Receptors G protein Coupled Receptors (GPCRs) Receptor Tyrosine Kinases (RTKs) Guanyl Cyclase Receptors Cytokine Receptors TNF (Tumor Necrosis Factor) Receptor Family Regulation of Receptors 3.Cellular Signalling and Post translational modifications Reversible Phosphorylation; Kinase and Phosphatase Serine and Threonine Phosphorylation and de-Phosphorylation Tyrosine and Histidine Phosphorylation and de-Phosphorylation Ubiquitination Other covalent modifications CAAX modification Modifications due to reactive oxygen and reactive nitrogen species 4. Key signalling elements Cyclic Nucleotides Cyclases G Proteins 5. Secondary Messengers Role of Calcium as a secondary messenger Nitric Oxide Lipid based secondary messengers 6. Most studied signalling pathways Ras, Raf, and the MAP Kinase Pathway Wnt Pathways Pinephrine and Norepinephrine Pathways Apoptotic Pathways Insulin Signalling System 7. Over view of Signaling at the Neuromuscular Junction 8. Biochemical and Biophysical tools to study Signaling pathways 9. Introduction to mathematical modeling of pathways Systems Biology Simulation and data based modelling Dynamic modelling

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-3-3707**			
Course Title	**Introduction to Protein Misfolding Diseases (Neurodegenerative diseases)**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

1. Molecular Features of Neurodegenerative disease: Alzheimer's Disease, Parkinson Disease, Huntington Disease, Amyotrophic Lateral Sclerosis and Prion Diseases. (5 classes) 2. Role of Protein Misfolding and Aggregation in Disease: Protein folding problem, mis-folding and aggregation machinery. Structural role and stabilization of molecular chaperones in protein misfolding diseases. (15 classes) 3. Structural and mechanistic Basis of Protein Misfolding and Aggregation: Conformation of various stages of molecules (unfolded nature, proto-fibrils, Oligomer and polymer (Paired helical filaments)). Dis-aggregation mechanism in protein misfolding diseases. (12 classes) 4. Cell Culture and Animal models of Neurodegenerative Diseases Misfolded protein conformation in Drosophila, mouse, C. elegans, and hibernating animal model. Primary neuronal cell culture model for protein misfolding diseases. (8 classes) 5. Target for Therapy: 1. Stabilization of the native protein conformation; 2. Inhibition and reversion of protein conformational changes; and 3. Increase the clearance of the misfolded protein. (5 classes)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-2-3710**			
Course Title	**Cell Structure and Membrane Protein Dynamics**			
Credit Distribution (L-T-P-C)	2	0	0	**2**

Course Description:

Membrane protein dynamics: Membrane Proteins: Membrane lipids and chemical composition and differences among eukaryotes, bacteria, and archaea. Mechanisms of membrane protein synthesis, SRP, membrane targeting and molecular machinery for translocation, trafficking, and topogenesis. T he secretory pathway: Prokaryotic and Eukaryotic pathways, molecular mechanisms of endo- and exocytosis, notch signaling, membrane fusion and SNARE proteins Membrane Receptors: ligand-gated ion channels, GPCR, and catalytic receptors. Signalling cascades. Transport of Ions across Biological Membranes: Ion channels, ion pumps, transporters, cotransporters, exchangers, and the underlying physicochemical principles. Cytoskeleton: Microfilaments, intermediate filaments: Actin Structure and the dynamics of Actin assembly. Intermediate filaments and their regulation. Microtubules: Microtubules organization (microtubule assembly, dis-assembly of tubulin) and dynamics. Intracellular transport and the role of kinesin and dynein. Microtubule dynamics and Motor Proteins in Mitosis.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-4-0001**			
Course Title	**Project Proposal Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Project Proposal to be prepared by selecting topics of high relevance and novelty, and will have state-of-the art review, methodologies, recommendations

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-4-0002**			
Course Title	**Review Article Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Review Article on the research area undertaken by the student

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NCL, Pune**			
Course Nomenclature	**BIO-NCL-4-0003**			
Course Title	**CSIR-800 Project Work**			
Credit Distribution (L-T-P-C)	0	0	8	**4**

Course Description:

Six–Eight weeks have to be dedicated on a project concerned with societal/rural issues under the CSIR-800 Programs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-1-0001**			
Course Title	**Biostatistics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Summarization of Data: measures of center, dispersion, skewness Dependence of variables: Correlation, linear regression, logistic regression, Basic probability distributions: Binomial, Normal, Chi-squares. Estimation of parameters: method of moments, maximum likelihood Testing of hypotheses: (a) parametric tests: t-test, z-test, chi-squares test, ANOVA (b) non-parametric tests: Mann-Whitney, Kruskal Wallis, Kolmogorov-Smirnov

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-1-0002**			
Course Title	**Computation/bioinformatics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Computers: Introduction, Evolution and Classification of computers. Fundamentals ofcomputing. Bit and Byte, Introduction to types of Hardware and Software. Componentsof Computer. Introduction to operating systems. Introduction to Computer Viruses.Network: Introduction. Network structure and architecture, Hierarchical networks,Ethernet and TCP/IP family of protocols, transport protocol design. Types of network,Topologies of network, Router, Switch, Data Communication, Concept of Wirelessnetworking, LAN, WAN, MAN, Security of the network, Fire-walls, Network ApplicationsInformation Technology: Concepts of client Server Architecture, Concept of searchEngine, Database search engines. Introduction to Internet.Introduction to Word, Powerpoint and Excel Introduction to Bioinformatics: History of Bioinformatics, Genome sequencing projects,Human Genome Project, Applications of Bioinformatics. Introduction to databases, Type and kind of databases, Applications and limitations. Literature Search Databases, Nucleic acid and protein databases, Animal and plant databases, Ensembl Genome project TIGR database, Biotechnological databases, Motifs and Pattern Databases, Databases for species identification and classification, Structural databases. Database Retrieval and deposition systems. Web tools and resources for sequence analysis: Pairwise and multiple sequence Alignment, Sequence similarity search: BLAST, Pattern recognition, motif and family prediction, Restriction map analysis, primer design, Gene prediction, Phylogenetic Tree,Protein structure prediction and visualization.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-1-0003**			
Course Title	**Basic Chemistry**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Thermodynamics Solutions and Ions Chemical bonding and molecular structure Chemical Kinetics Stereochemistry Introduction to drug discovery (Medicinal chemistry approach) Drug target, discovery and development (forward and reverse approach

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-1-0004**			
Course Title	**Research Methodology, Communication/ethics/safety**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to research concept, identification, selection and formulation of research problem, justification, hypothesis, literature retrieval, survey, bibliography presentation, digital resource (internal), data collection, sampling techniques, collection, documentation, presentation and interpretation of data

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-1-3901**			
Course Title	**Laboratory safety**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Team work culture in laboratory, General Safety and lab-safety procedures, Chemical, electrical and UV safety, safe handling of toxic and hazardous chemicals, storage and disposal of chemicals etc. Common laboratory Instruments and applications: Principles and practices of instruments used in microbiology, biochemistry, molecular biology, genetics engineering, fermentation technology, bioremediation, plant biotechnology, ecology etc.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-2-3901**			
Course Title	**Biodiversity and Environmental Studies**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Overview of Biodiversity and conservation: types of protected area, protected areas of N E India, Environmental and Forest policies and Laws. Scope of environmental studies, Environmental studies in a multidisciplinary approaches. Ecosystems – major types, structure and functions, productivity of ecosystems and sustenance.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-2-3902**			
Course Title	**Natural resources**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Types of resources, basics of conservation, natural resources of N E India, Traditional knowledge with reference to natural resources and their application potential.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-2-3903**			
Course Title	**Advance Plant Physiology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to plant biology, physiological and molecular responses of plant to abiotic stress, advances in mineral nutrition, photosynthesis and ecological adaptation.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-2-3904**			
Course Title	**Biotransformation & Bioremediation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Microbial biotransformation, biodegradation of petroleum, xenobiotics, bioremediation and phyto-remediation, production of microbial enzymes and fermentation, physico-chemical parameters for maximum enzyme production, enzyme purification, characterization and immobilization of enzymes, enzyme use for biotransformation, chiral synthesis.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-2-3905**			
Course Title	**Molecular Biology & Biotechnology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Isolation, purification and characterization of microbes. DNA Finger printing, Electrophoresis, PCR, Real Time PCR, Reverse Transcriptase PCR, Sequencing of DNA, basic knowledge and application of bioinformatics etc. Molecular basis of plant-microbe interactions and application of microbes in industry and agriculture

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-2-3906**			
Course Title	**Pharmacokinetics,Pharmcodynamics and toxicology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Pharmacokinetics: Drug absorption, distribution, biotransformation and elimination (ADME), bioavailability and bioequivalence (BA&BE) of drug products. Pharmacodynamics: General aspects of receptor pharmacology, Structural and functional aspects of receptors, Regulation of receptors, Classification and characterization of receptors, Theories and forces involved in drug receptor interaction, forces. Receptor polymorphism, dimerization and its importance in drug design. Physiochemical properties in relation to biological action and drug: Fundamentals of complex of events between drug administration and drug action, Solubility & partition coefficient, Basics of important physiochemical properties like isosterism, steric behaviour, ionization, hydrogen bonding, chelation, oxidation- reduction potential, surface actions. Basic Toxicology: Principles of Toxicology, Fundamentals of acute, sub acute, chronic toxicity and special toxicity, LD50, ED50, TD50, IC50 determination, genotoxicity, carcinogenicity, teratogenicity and mutagenicity studies, General principles of treatment of poisoning.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-2-3907**			
Course Title	**Basics of analoge drug design, preclinical and clinical design**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Basic considerations of drug design: De- novo drug design, lead seeking methods, rational drug design, Prodrug concepts. A general treatment of the approaches to drug design: including the methods of variation, study of the use of biochemical and physiological information involving new drugs. New approaches in drug discovery: a. Combinatorial chemistry; b. Pharmacogenomics; c. Proteomics; d. Array technology. Rational drug design Fundamentals of QSAR- objectives, expressions of biological activity, Principles of Computer aided drug design, Docking and High throughput screening, Guidelines: CPCSEA, OECD, FDA, ICH, WHO ethics and animal experimentation. Importance of alternative experimental models, its advantages and disadvantages. Preclinical & Clinical trials: Basics of Preclinical trials and Clinical trials of drugs, design of clinical trials and testing of drugs in humans.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-2-3908**			
Course Title	**Plant Breeding**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Principle of genetics : Laws of inheritance, linkage, crossing over, recombination analysis, genotyping concepts for genetic mapping, construction of genetic linkage map for gene and qualitative trait loci (QTL) mapping. Introduction to linkage mapping software packages and interfaces breeding by design. Methods of plant breeding, self incompatibility and their sequences. Heterosis breeding, Mating design, stability parameters, pure line, back cross, pedigree methods and SSD.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-2-3909**			
Course Title	**Commerical Entamology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Bee keeping-General colony management during different seasons. Seasonal management. Managing colonies for honey production and pollination. Artificial queen rearing. Pests and diseases of honey bees. Bee poisoning. Production and marketing of quality honey and value added honey products. Establishment and maintenance of apiaries. Study of different species of silkworms, characteristic features, moriculture, silk and its uses, pests and diseases of silkworms, rearing and management of silkworms. Lac insect- natural enemies and their management. Economic and public health importance of insect pests in human habitation and habitats, biology, damage and control of mosquitoes, houseflies, bed bugs, ants, termites, cockroaches, flies, silverfish, head and body lice, carpet beetles, cloth moths, crickets, wasps, house dust mites, insect pests of cattle, poultry, pet animals and their management.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-3-3901**			
Course Title	**Microbial Biotechnology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Isolation, screening of microbes for industrial and agriculture application, production of bioactive metabolites for pharmaceutical and industrial lead/hits, DNA fingerprinting, DNA sequencing, Molecular characterization of genes and traits responsible for biological activity, enzyme production, isolation, purification, characterization and applications. Exploitation of microbes for bioremediation & biotransformation.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-3-3902**			
Course Title	**Advances in physiological and molecular responses to abiotic stress**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Plant ecology and stress physiology with basic concepts and approaches applicable to all types of plants. Emphasis on the relationship between environmental parameters (radiation, temperature, water, nutrients), heavy metals, and their effect on development, membranes, phytohormones, carbon balance, and the use of stable isotopes in stress, physiological processes (photosynthesis, respiration, cellular and molecular responses, mineral nutrition), and plant responses (leaf expansion, partitioning of dry mass, water status, and transpiration). Integration of plant responses into models for better understanding and predict growth and yield.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-3-3903**			
Course Title	**Biodiversity and conservation**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Concept and definition of Biodiversity, existing regulations, laws and NBA, Bio-profiling, in-situ- and ex-situ preservation, Bio-prospection and utilization, Methods and Approaches for value additions, Role and Relevance of Biodiversity, Technology development and dissemination, Ecology and socio-economic impact of local resources on stack-holders. Biotic and abiotic interaction, Impact of stress factors on Life forms, Climatic changes and agro biology, Adaptation Biology and Evolution, Ecotourism managements.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-3-3904**			
Course Title	**Eco-restoration**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Ecology and nature of environmental degradation of ecosystems due to natural and manmade activity and different measures adopted for ecological restoration. Phenocopies and Ecotypes; genetic Assimilation and natural selection; Phenotypic Accommodation; Evolutionary considerations; Developmental mechanisms of phenotypic accommodation; Reciprocal accommodation, Niche construction

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-3-3905**			
Course Title	**Ethnobotany and Traditional Knowledge**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Ethnobotany, definition and scope, Role and relevance of Ethnobotany, Ethnobotany and medical botany, Interdisciplinary nature of Ethnobotany, Medical botany and drug development,Methods and approach of ethnobotany, Ethnobotany and plant taxonomy, Ethnobotany and bioprospection, Validation of Ethnobotanical knowledge, Cross cultural Ethnobotany, Plant folk medicines and NE India, Ethnobotany and biopiracy, Documentation and development of database.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-3-3906**			
Course Title	**Plant - Insect Interaction and Herbivore Managements**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Herbivore-Plant Interaction. Tritrophic interactions of plant-insect & parasitodids,Plant defence Secondary plant metabolites, Botanical Pesticides past , present and future Plant-Pollinator interactions. Insect as pollinator- Honey bee & Butterfly as pollinator- Honeybee & crop production pollination Biology Butterfly as environmental indicator. Butterfly biodiversity, Host range, conservation Herbivores- induced plant defence. Induced biosynthesis of plant defense compounds-use of plant signal in agricultural crops- Transgenic plants. Insect behaviour. Manipulation of insect behaviour for insect pest management-Evolution of insect behavior Novel methods of Insect-pest management. IPM- Concept & Evolution, Ecology of pest- IPM of major pests, Resistance, Biocontrol/Biocides, Molecular approaches in Insect-pest Management.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-3-3907**			
Course Title	**Advances in Plant Microbes Interactions**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Biology and Ecology of Plant Pathogens and Endophytes. Biology and ecology of major group of plant pathogens viz. fungi, bacteria, viruses, nematodes and mollicutes and endophytes. Concepts of plant diseases, etiology, microbial communities, virulence and resistance, population biology, disease development and epidemiology. Genetics of Host Pathogen interaction and Mechanism of Host Defence. Genes and plant diseases, genetics of resistance and pathogenicity, recognition mechanisms in host pathogen interaction. Pathogenesis and host defence, passive and active defence mechanisms- structural and biochemical defences, systemic acquired resistance. Advances in Plant Disease Management. Introduction to biology of the pathogens that cause plant diseases, disease diagnosis. Topics include principles and practices of plant disease management including physical methods, regulatory methods, biological and chemical methods, host resistance and integrated plant disease management (IPDM). Biotechnology of Edible and Medicinal Mushroom. Prospects of edible and medicinal mushrooms , biochemistry of mushroom fructification, nutritive and medicinal values, spawn and spawn preparation, agrotechnology , pest and diseases ,genetic improvement.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-3-3908**			
Course Title	**Advance Plant Physiology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Overview of Essential Concepts. Plant and cell Architecture, Energy and Enzymes Transport and Translocation of Water and Solutes. Water and Plant Cells, Water Balance of the Plant, Mineral Nutrition, Solute Transport. Biochemistry and Metabolism. Photosynthesis: The Light Reactions, Photosynthesis: Carbon Reactions, Photosynthesis: Physiological and Ecological Considerations, Translocation in the Phloem, Respiration and Lipid Metabolism, Assimilation of Mineral Nutrients, Plant Defences: Surface Protection and Secondary Metabolites. Growth and Development. Signal Transduction, Cell Walls: Structure, Biogenesis, and Expansion, Growth, Development, and Differentiation, Phytochrome, Blue Light, Responses: Stomatal Movements and Morphogenesis, Growth Hormones, the Control of Flowering, Stress Physiology

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-3-3909**			
Course Title	**Insect Biotechnology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Insect cell and tissue culture: History and scope of animal cell and tissue culture; advantages and disadvantages. Primary culture - cell lines and cloning: Disaggregation (enzymatic and mechanical) of tissue and primary culture - cultured cells and evolution of cell lines – maintenance of cultures – large scale cell cultures - somatic cell fusion. Isolation of protein/hormone from insects, insect tissues, In Vitro and In Vivo assays, Metabolism of Proteins, carbohydrates and silk protein biosynthesis, enzymes kinetics, microbial protein based products and process.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-3-3910**			
Course Title	**Molecular and cell biology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Introduction to Molecular Biology, Historical background (Vital force theory, the scientific approach, classic experiments), Physico-chemical approach to biology,(Schrodinger's book, theory of the chemical bond, crystallography), Biomolecules and replication (DNA, RNA, protein, background to their discovery and analysis, roles played in biology, replication machinery in prokaryotes and eukaryotes, problem of packaging genetic information)., Flow of genetic information (Central dogma, adaptor hypothesis, operon concept, transcription, translation), Gene expression and control (Operon, cistron, polycistronic/monocistronic messages, transcriptional control, RNA processing, chromosomal histone modification, cell cycle), Evolution (organismal,bacterial, molecular, Darwin to Oparin, Hardy- Weinberg law, analysis of evidence, C-value paradox in eukaryotes, cot value), Cells and Biomolecules, Prokaryotic and eukaryotic cells overview and comparisons, Techniques for the study of cell structure and function (Histology, staining, karyotyping, freeze fracture, microscopy, FISH, flow cytometry, patch clamp, live cell imaging, probing with toxins), Microbial and phage genetics, (Discovery of the genetic material, Classic experiments in microbial and phage genetics - phage lysogeny, restriction and modification, bacterial conjugation, transformation, transduction) Cell components (cell wall, membrane, nucleus, mitochondria, chloroplasts, lysosomes, vacuoles, cytoskeleton), Protein sorting and secretion, biotechnological considerations (Golgi and ER, targeting of proteins, use of principles in high-expression systems)

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-3-3911**			
Course Title	**Molecular Markers and Breeding**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Genome Organization Organellar genome and Nuclear Genome: Unique sequences, Repeat DNA sequences, Classification of Repeat DNA (Tandem repeats, Interspersed repeats, Micro-satellites, Minisatellites, midi-satellites, VNTRs), The dynamic genome: Polymorphisms and Sources of Genetic variation, Oveview of Genetic Markers: Phenotypic Markers, Biochemical markers, DNA based markers Molecular marker and DNA fingerprinting techniques: Concepts, classification and methodologies: Hybridization based markers (viz. Restriction Fragment Length Polymorphism, Oligonucleotide fingerprinting), PCR based markers (viz. DNA Amplification Fingerprinting, Arbitrarily Primed PCR, Randomly Amplified Polymorphic DNA, SSRs, STMS, SCARs, Inter-SSRs, Multiple Arbitrary Amplicon Profiling, Amplified Fragment Length Polymorphism, electively Amplified Microsatellite Polymorphic Loci, Inter retrotransposon amplified polymorphism, retrotransposon-microsatellite amplified polymorphism, Diversity Array Technology (DArTs), SNPs and SNP based assays for high-throughput genotyping, EST based markers, Sequencing by Hybridization (SBH), Molecular Markers and Assessment of genetic diversity: Principles of Numerical taxonomy, binary matrix to phonetic dendograms, Structure analysis, Case Studies and examples, Molecular Markers for genome mapping: Marker Assisted Selection (MAS), gene introgression and pyramiding, BSA Genotyping for Physical mapping: Fingerprinting for BAC assembly, Types of Mapping populations in Plants: F2 populations, RILs (recombinant inbred lines), Backcross lines, NILS (Near Isogenic Lines), HIF (Heterogenous Inbred Families), AILs (Advanced Intercross Lines), Other Application of Molecular Markers: Genotyping tools as plant variety protection, hybrid purity tests, diagnostics (transgenics, forensics) Other Mapping tools and Methodologies: Introduction to Cytogenetic maps, Radiation Hybrid Maps, HAPPY mapping, Physical Maps, Comparative/Synteny mapping.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-3-3912**			
Course Title	**Functional Genomics**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Gene Expression and the transcriptome analysis Medium throughput techniques. Northern, Quantitative RT-PCRs, RACEs, cDNA-AFLP, Inventories for gene discovery and annotation: EST databases, full-length cDNA /ORF clones Hi through put-genome wide Analytical Platforms. Microarrays: Whole Genome arrays, cDNA arrays and Tiling Arrays: Concept, designing, fabrication, probing, and data analysis, Applications: Global gene expression profiling, discovery of novel genetic pathways and targets, Genotyping for DNA polymorphism, Mapping genome wide epigenetic states, alternative splicing, miRNA microarrays, ChIPchips for identifying DNA binding sites. Hi through put-genome wide Profiling Platforms. Serial Analysis of Gene Expression, Digital Northerns, Massively Parallel Signture Sequences, Roche's 454-FLX Sequencer, Solexa/Illumina's 1G Genome Analyser Proteomics and integrative genomics. Protein separation and 2-D PAGE, Mass Spectrometry and protein identification: N-terminal sequencing, MALDI –TOF, LC-MS/MS, Tandem-MS/MS. SELDI-TOF, ICAT, I TRAQ, MUDPIT, Protein interaction maps, analysis of cellular constituents, metabolomics. Reverse genetics-Navigating from structure to Function Mutant analysis. Forward versus reverse genetic approaches, Mutagens and methodologies for Reverse genetic systems: Random and Targeted mutagenegis, Insertional Mutatagenesis viz. T-DNA tagging, Ac/Ds system for Transposon Tagging, TILLING, Deleteagene, Activation mutagenesis (Gene traps, Enhancer Traps and Promoter Traps), mis-expressions (viz ectopic expression, two component systems for tissue specific gene expression), RNAi based Silencing Techniques (viz. Antisense RNA, co-suppression, artificial miRNA, tissue or stage specific knockouts) Zinc-finger nucleases, Homologous Recombination, Genome-wide Mutant Libraries and resources. Genetic screens for molecular genetic analysis. Enhancer, suppressor and dominant modifier screens, Core-collections and germplasm resources for Reverse Genetics Natural Genetic Variation. Discovery of novel genes and alleles, Case studies from Rice and Arabidopsis Elucidation of molecular genetic Pathways and Processes. Flowering Time Control and flower development in Arabidopsis, Stress response and SOS pathways in Arabidopsis, Caenorhabditis elegans and Drosophila development, AtGenExpress: Transcriptome atlas of Arabidopsis thaliana-Case Study

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-3-3913**			
Course Title	**Plant Biotechnology Management and Regulatory Issues**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Constitution, Statutes, Rules, Regulations, Judicial System, Judicial Review, Administrative set up. International Law, Sources, Treaties Principles of Regulation Competing Models of Risk Assessment, Models of risk consideration: Scientific rationality trajectory and Social rationality trajectory. Risk Analysis Framework Risk Assessment, Risk Management and Risk Communication. The Concept of Precaution in Regulation Precautionary principle and precautionary approach Country Comparisons about Approaches to Biotechnology Regulation The U.S. and E.U. approaches on Biotechnology research, Intentional introduction into environment, GM Food, labelling etc. Multilateral Agreements. Convention on Biological Diversity, Cartagena Protocol on Biosafety, WTO Agreements, Codex Alimentarius, Plant Genetic Resources for Food and Agriculture. Regulatory Systems in India. Environment Protection Act, 1986 Rules for the manufacture, use, import, export and storage of hazardous microorganisms, genetically engineered organisms or cells. Institutional Structure, Powers and Functions Relevant Guidelines and Protocols. Other relevant laws Plant Quarantine order Biological Diversity Act Protection of Plant Varieties and Farmer's Rights Act Drugs and Cosmetics Act, Policy and the rules Seed Policy DGFT Notification Recent Initiatives Draft National Biotechnology Regulatory Bill 2008 IPRs Introduction. A Brief history of IP protection, Rationale for IPR, Types of IPRs, Patents, Copyright, Trademarks, Trade Secrets, Plant, Variety protection, Geographical Indications, Farmer's, Rights, Traditional Knowledge Patents and Agricultural Biotechnology. Patentability criteria, Relevant Case law, Indian Patent Act, 1970, TRIPS, Amendments to Indian Patents Act (2005), IP applications and Procedures Patent drafting, Patent and prior art searches etc. Management of IPR Assets, Licensing and contracts, Negotiations, Valuation of patents, IPR Enforcement

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-3-3914**			
Course Title	**Molecular and Immuno Pharmcology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Molecular pharmacology: Introduction to cell structure and function, Cell signaling, organization of signal transduction pathway and biosensors, Protein structure prediction and molecular modeling, Gene expression, regulation and gene mapping, Recombinant DNA technology, Gene cloning, Genetic recombination, pharmacogenomics, pharmacogenetics, chrono pharmacology. Gene transfer technologies (viral and non viral vectors), Clinical application of gene therapy. Disease targets for gene therapy, pharmacokinetics of peptide and protein drugs. Novel target sites: Caspase, Rho kinase, Peroxisome proliferator's activator receptors, Protein kinase, Phosphodiesterases, Phosphoinositide 3-kinase, Poly (ADP-ribose) polymerase (PARP), AMP activated protein kinase, Application of molecular pharmacology to drug design. Immuno Pharmacology: Hybridoma technology and its application, General principles of immunoassay, theoretical basis, optimization of immunoassay Production of Immunoassay reagents: Introduction, receptors or binders, unlabelled ligands calibrators, labelled ligands and receptors, separation techniques. Immunoassay methods evaluation: Protocol outline, evaluation of precision, standard tracer, sensitivity, accuracy, antibody characteristics monitoring, reaction conditions, clinical evaluation, Fc receptors, Fc8R family. Immunotoxins, Cell and biochemical mediators involved in allergy, immunomodulation and inflammation. Classification of hypersentitivity reactions and diseases involved, therapeutic agents for allergy, asthma, COPD and other immunological diseases.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-3-3915**			
Course Title	**Biochemical Toxicology and free radicals pharmacology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Biochemical pharmacology: Cell injury, oxido reductive stress, reactive oxygen species, antioxidant defense mechanisms, apoptosis and necrosis, acute and chronic inflammation, Cytokines and chemokines, Growth factors, biology of vascular endothelium, neuropeptides, transport proteins, cell adhesion molecules and matrix proteins, oxygen intermediates, atrial peptides Toxicology and Free Radicals Pharmacology: Details of Heavy metals and heavy metal antagonists, Abnormal action of drugs such as tolerance, addiction, habituation, idiosyncracy, allergy, hypersensitivity, antagonism, synergism, potentiation, tachyphylaxis, Adverse drug reactions and its monitoring. Hepatotoxicity and drugs used to correct hepatic function, Immunotoxins, OECD guidelines for toxicity evaluations and in-vitro screens for specific toxicities. Protocols in organ and other toxicology studies. Generation of free radicals, role of free radicals in etiopatholgy of various diseases, protective activity of antioxidants.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-3-3916**			
Course Title	**Sericulture and seribiotechnology**			
Credit Distribution (L-T-P-C)	1	0	0	**1**

Course Description:

Biodiversity of mulberry and non mulberry silkworms. Applications of biotechnology in conservation of seri-biodiversity. Studies to develop new/superior varieties of non mulberry host plants having more nutritional properties, more foliage production, resistant to pests and diseases. Studies on various types of diseases in non mulberry silkworm and diagnostic kits for important diseases. Studies of Genetic manipulation of silk protein genes for increased production of silk and to identify specific genes to be responsible for disease resistance, temperature tolerance, better digestibility and high yielding varieties of non mulberry silkworms, Gene transfer methods in plants; Target cells for transformation; Gene transfer techniques using Agrobacterium. Selectable and scanable markers; Agro infection and gene transfer; DNA mediated gene transfer (DMGT). Transgenic plants for mulberry crop improvement, molecular farming and regulated gene expression. Studies of preparation of artificial diets for indoor rearing of non mulberry silkworms.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-4-0001**			
Course Title	**Project Proposal Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Project Proposal to be prepared by selecting topics of high relevance and novelty, and will have state-of-the art review, methodologies, recommendations

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-4-0002**			
Course Title	**Review Article Writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

One Review Article on the research area undertaken by the student

Faculty	**Biological Sciences**			
Lab Name	**CSIR-NEIST, Jorhat**			
Course Nomenclature	**BIO-NEIST-4-0003**			
Course Title	**CSIR-800 Project Work**			
Credit Distribution (L-T-P-C)	0	0	8	**4**

Course Description:

Six–Eight weeks have to be dedicated on a project concerned with societal/rural issues under the CSIR-800 Programs

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-1-0011**			
Course Title	**Basic Nutrition**			
Credit Distribution (L-T-P-C)	3	0	2	**4**

Course Description:

Basic nutrition in Nutrition biology course is essential to understand the balanced food required to provide adequate amounts of nutrients for vital activity of normal organs including 1. organ development/functioning; 2. Cell production, growth and maintenance; 3. Food for high energy requirement during various physiological/pathological conditions to meet working efficiency; 4. To resist infection and disease; 5. To repair tissue damage or injury etc. Since it is understood that no single nutrient works for many of these activities, and since each nutrient is dependent on the presence of others to bring the desired results, it is important to study nature of each nutrients, their absorption, metabolism and regulation. Although everyone needs the same nutrients, each individual requires different amounts and it depends also on age, gender, physiological make up, genetic makeup, physical activity etc. Study of basic nutrition thus aims to impart the learners the knowledge about good nutrition that is important for the quality of people's life and health. Subject for study thus includes 1. Definition of nutrition, health, wellness, nutrients/nutrient composition, nature their functions and requirement. Two distinct types of nutrients– macro nutrients that are required by the body in higher amounts (> 1g/day) such as protein, fat, carbohydrate & water and micronutrients (< 1g/day) such as vitamins and minerals will be included in the syllabus. Besides; since food provides energy to drive various functions of the body, calorie requirement, food/energy values of foods and the guidelines in promoting good nutrition will also be included. Major goals to study "Basic Nutrition" thus are to identify the basic guidelines in promoting nutrition; to discuss the principles of moderation, balance and variety in the food guide pyramid and, nutritional guidelines. Study of "Basic Nutrition" thus helps in understanding how one know what and how much food to eat, what food to eat and when to eat, which is an essential component of day to day life to safe guard the body and body composition to remain healthy and face challenges if any during the daily activities. Precisely Basic Nutrition envisages dietary guidelines, digestion, absorption, and metabolism; Carbohydrates, lipids, protein, vitamins, minerals, fluids and electrolytes; Energy balance and body composition, Nutrition in Physical fitness and exercise; Nutrition in Pregnancy and Lactation; Nutrition in Infancy, Childhood, and Adolescence; Nutrition in Adulthood, Energy metabolism- B.M.R.; Energy requirement at different stages, balanced diet; Diet planning in health and disease. Specific Dynamic Action (SDA) and Thermic effect of foods. Water – Role of water in the body and water balance

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-1-0012**			
Course Title	**Nutritional Biochemistry**			
Credit Distribution (L-T-P-C)	3	0	2	**4**

Course Description:

Nutrition biochemistry enables the study on the role of nutrition in long-term health, prevention and treatment of disease, in addition to the study of chemistry and functions of nutrients, bioactive constituents and their biochemical, metabolic, physiological functions. In other words it covers biochemical molecules and metabolic pathways that are essential for nutritional homeostasis, with a focus on micronutrient metabolism. It reviews the biological system of energy metabolism, chemical / biochemical properties and metabolic pathways of carbohydrate, lipid and protein, regulatory mechanism of macronutrient metabolism and associated signaling pathways. Objective of the study also includes the understanding of research techniques used in basic biochemistry and nutritional biochemistry research in addition to advanced experimental approaches for research on nutritional biochemistry. An important focus will be on the application of knowledge in nutritional biochemistry to the synergistic relationship among diet, health and disease susceptibility. CSIR-CFTRI has a strong research lead in the area of nutrition biochemistry and thus caters the need of research in nutrition biochemistry with the help of integrated programmes. Precisely Nutrition Biochemistry aims at the study of over view of energy metabolism, carbohydrate /lipid /protein /amino acid metabolism and Nucleic acids metabolism; In born errors and errors in metabolism during disease conditions, metabolic enzymes, enzyme kinetics and regulation; methods of estimation of nutrients, food analysis, quality control, role of nutrients in diseases; Definitions of nutraceuticals, functional foods, dietary supplements; Some of the common metabolic deficiency syndrome such as pyruvate dehydrogenase deficiency, hypoglycemica, fructose intolerance, phenylketonuria, homocystinuria etc., will be included. Secondary prevention of coronary heart disease, alcoholic hepatitis, protein catabolism and trauma etc., will also be covered since diet has a greater impact on these complications.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-1-0013**			
Course Title	**Clinical Nutrition**			
Credit Distribution (L-T-P-C)	3	0	2	**4**

Course Description:

Essential topics in CN thus include diagnosis, treatment and prevention of human diseases caused by deficiency/excess or metabolic imbalance of dietary nutrients; Nutrition care, over/under nutrition leading to obesity/malnutrition, anorexia, nutritional anemias, nutrition in times of stress such as nutritional implications on Trauma and surgery, parenteral and tube feeding; Diseases and nutrition; gastrointestinal disorders including oral cavity and gastric disorders, intestinal disorders, pancreatitis, gall bladder disease and food allergies, Nutrition imbalance and immunological status/ infectious diseases, metabolic abnormalities such as diabetes mellitus, development and diagnosis, diabetes mellitus treatment and complications, liver disorders, alcohol metabolism, other metabolic problems such as hypoglycemia, gout, cardiovascular and renal disorders such as hyperlipoproteinemias, atherosclerosis, coronary heart disease, congestive heart failure, hypertension, renal disorder and critical disease conditions leading to imbalances in nutritional metabolism, research applications in Clinical Nutrition and Dietetics are included. Management of specific diseases through specific functional foods, nutraceuticals; Nutrition practice, program planning, implementation and evaluation, Nutrition, fitness and wellness, Interdisciplinary perspectives, Nutritional epidemiology and nutrition throughout the lifespan are covered precisely.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-1-0014**			
Course Title	**Cell Biology / Molecular cell / Tissue Biology**			
Credit Distribution (L-T-P-C)	3	0	2	**4**

Course Description:

Human body is a collection of interconnected cells and tissue that perform a similar function within an organism. Learning cell growth and regulation is an important aspect in understanding the normal physiological functioning of human body and to understand its normal functioning and during abnormal disease conditions. Topic of study thus include cell cycle, regulation of cell cycle, apoptosis, biochemistry of aging, stem cells and their differentiation , cell surface molecules, cell-cell interactions and adhesion molecules, cytogenetics, homostasis and thrombosis, glycocalyx and impact on functioning, membrane structure and function; molecular transporters etc; the vessel wall, prostacyclin, nitric oxide, clotting factors, blood clotting, platelets, coagulation, fibrinolysis, coagulation disorders and anticoagulants.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-1-0015**			
Course Title	**Nutraceuticals and functional foods**			
Credit Distribution (L-T-P-C)	3	0	2	**4**

Course Description:

This course will describe functional foods and nutraceuticals, including their health benefits, development, and regulation. It includes definition of functional foods and nutraceuticals , nutraceuticals identification, strengths, limitations, and future directions and the link between nutrition and medicine. It also envisages nutraceuticals for health/wellness during pre/post disease conditions. Isolation, purification and characterization, Methods used for identification and characterization; Bioactivity guided purification, testing of nutraceutical properties using specific biochemical, in vitro / in vivo tests and validation of bioactivity.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1613**			
Course Title	**Maternal Nutrition / Infant Nutrition**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Nutrition in pregnancy and lactation, nutrition in infancy, childhood , adolescence, adulthood; Energy requirement at different stages of growth, Factors (Heredity and environment) influencing development, physical, motor, cognitive, language, emotional, psychological development during prenatal, perinatal, neonatal period, infancy and toddlerhood, preschool and late child hood group.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1614**			
Course Title	**Public Health Nutrition**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Public health nutrition is a complex, multifaceted set of programs that are dedicated to improving the health of the population through improved nutrition. Primarily it exists to improve the health of the whole population and to teach high risk subgroups within the population for improved nutrition & health. Public health nutrition emphasizes applying nutrition in public health where it intends to understand the role of nutrition in public health service. Topic of the study in nutrition biology includes the importance of public health nutrition programs in preventing disease and promoting adult health, preventing diseases, chronic diseases, leading causes of death and disability, prevention strategies, dietary guidelines for disease prevention, diet and health nutrition strategies and risk factors, assuring nutrition services for older adults, providing nutrition in public health care, chronic disease management and self-management, identification of wellness food needs, maintaining nutrition and food service standards in group care, protecting public nutritional health, securing adequate food for the public security of the food supply and bioterrorism. Managing the system, planning and evaluating nutrition services for the community, managing data, managing money, mobilizing personnel, managing public health nutrition personnel, leveraging nutrition education through the public health team surviving in a competitive world, marketing nutrition programs and services, earning administrative support striving for excellence and envisioning the future will also be included. It is important to also understand the impact of nutrition on public health, which depends on individual gene set up and the way it is nurtured with a given environment and the diet. Knowledge on nutrient control of gene expression and epigenetic regulation of the genome by nutrients, risk reduction of nutrition-related chronic diseases is important and nutrition addresses the needs of various groups of population (Normal, physically handicapped, economically disadvantaged); high or low risk to nutritional deficiencies. Health and Disease , Meaning and concept of public health, Indices and levels of health, factors affecting health care (poverty, ignorance, cultural patterns, availability and non-utilization of reverses), Raising health standards, Immunization, assessment of nutritional status of a community – theoretical aspects, Nutrition education, nutrition education programmes, nutrition intervention schemes and programmes at part of the curriculum.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1615**			
Course Title	**Food Microbiology**			
Credit Distribution (L-T-P-C)	2	0	2	**3**

Course Description:

Historical development in microbiology; Developments in microscopy; Morphology, cytology and reproduction of bacteria, yeasts, molds and endophytes; Microbial growth curve; Physical, chemical and biological factors influencing microbial behaviour; Recombination, Transduction, Transformation and Mutations in bacteria; Microbiology of fruits & vegetables; Cereals & cereal products; Meat & meat products; Poultry & eggs; Fish & fish products and milk & milk products; Major types of spoilage and pathogenic microbes and their characteristics; Foodborne infections and intoxications; Mycotoxins – characteristics, types and causative fungal species, Intrinsic & extrinsic properties of foods , Traditional detection & enumeration methods Fermented foods, Food spoilage, Food preservation , Indicator organisms, criteria & regulations , Parasites & seafood toxins, Viruses & prions.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1616**			
Course Title	**Health, Food and Environment**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

This course provides an understanding of the complex and challenging public health issue of food security and in a world where one billion people are undernourished while another billion are overweight. Explores the connections among diet, the current food and food animal production systems, the environment and public health, considering factors such as economics, population and equity. Case studies are used to examine these complex relationships and as well as alternative approaches to achieving both local and global food security and the important role public health that can play. Topic includes, the concepts of food security and describe how food systems relate public health, food production, population and resources, inter-relate to impact each other and ultimately human health. Describes factors that have helped to shape the current food system, identifying challenges to encourage dietary behavior change, support sustainable agriculture, improved food security and lessen the environmental and public health impact of food production and consumption.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1617**			
Course Title	**Dietetic Techniques and patient counselling**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Dietetic techniques and patient counselling during stress, aging and other trauma conditions includes diet therapy and nutritional care in diseases. Essential topic includes nutritional intervention, diet modifications, Interactions between drugs, food nutrients, disease markers; Nutritional status, Disease of the G. I. System - Nutritional Assessment, Diet in diseases of the liver, pancreas and biliary system; Diet in disease of the endocrine pancreas; Dietary care in diseases of the adrenal cortex, thyroid gland and parathyroid gland; Nutritional care for weight management, diseases of the circulatory system, anemia, renal disease, allergy, osteoporosis/osteoarthritis; nutrition in cancer; physiological stress, physiological stress and effect on the body etc., will be covered.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1618**			
Course Title	**Food Safety**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Overview of food safety and foodborne illness; prevalence of foodborne pathogens. Environment, human behavior and transmission of foodborne pathogens; Basic concepts in food virology; Bacteriophage and its application in food safety, Prion disease, Chemical hazards, Physical hazards - Toxins, foodborne allergens, pest control and food safety, Inactivation of pathogens and toxins during food processing, hygiene, handling, cleaning and sanitation, HACCP and federal policy and systems for risk management and risk assessment are included.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1619**			
Course Title	**Convenience and wellness foods**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Convenience and well ness foods are important in recent days due to life style changes for survival such as round the clock functioning, night/day duty shift, and isolated family set up etc. The subject enables the learning of how food handling practices prevent food borne illness, measurement of nutrients and nutracetuticals, Recipes, effect of cooking equipment on nutrients and nutraceuticals, school foods, food guide pyramid, importance of whole grain for lifetime good nutrition, learning lifetime guidelines exhibiting importance of nutrition and wellness, customs and cultural foods, identification of eating patterns in the globe, pros and cons of convenience foods, food budget, food label, food safety, food professionals, food laws, health drinks and beverages; learning of Food and Agricultural sustainability, partake in community service utilizing preparations are included.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1620**			
Course Title	**Human physiology**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Human physiology is the science of the mechanical, physical, bioelectrical, and biochemical functions of humans in good health, their organs, and the cells of which they are composed. Physiology focuses principally at the level of organs and systems. Chemical composition of the body, cell structure and genetic control, cell respiration and metabolism, neurons and membrane potentials, nervous system, muscular system, blood and blood clotting, Immune system, cardiovascular system, respiratory physiology etc; are covered.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1621**			
Course Title	**Reproductive child health**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

The purpose of this course is to examine reproductive health issues, programs, services, and policies in developed and developing countries. The course content will emphasize social, economic, environmental, behavioral, and political factors that affect family planning, reproductive health, fertility, and pregnancy outcome. The course will have topics focusing on nutritional programs to improve reproductive health; policies that affect reproductive health with an emphasis on global policies; Nutritional status and funding, Analysis of a reproductive health problem relative to the public health implications and development of outlines for policy or programmatic initiatives are included. Identification of the major governmental and non-governmental agencies who make global health policy; Nutritional elements that contribute to effective interventions to improve the reproductive health of adolescents, men, and women and how “effective” interventions will vary according to political, social, cultural, and economic realities across the globe are included. Identification of major data sources for global health that allows cross-country comparisons. Also appreciation of the complexity of local contexts (e.g., villages, towns, districts, cities, provinces, countries) and the difficulty of applying nationally and globally defined interventions and policies are covered.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1622**			
Course Title	**Food Immunology**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Immunoassay has a prominent position in rapid and sensitive detection. As understanding of the application of immunoassay in food safety increases, and consumer awareness of hazardous factors in food grows, demand for high sensitive immunoassay techniques will rise remarkably. Food Immunochemistry and Immunology reviews the latest development in immunoassay of typical pollutes in foods are included. The first part (relate to the primary knowledge of various immunoassay techniques and the preparation of immuno-molecules including antigen and antibody. The second part, considers the common pollutes in food such as agrochemicals, veterinary drugs, mycotoxins and other emerging contaminants and outlines the latest scientific achievements. Food Immunochemistry and Immunology will provide professionals and researchers around the globe with a useful hint for health and disease conditions.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-2-1623**			
Course Title	**Sports Science and Nutrition**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Sports – one of the global activity that enhances inter-relationship both in culture, education and economics. Nutrition in sports thus is important. Sports specific requirements, diet manipulation pre-game and post- game meals, use of different nutragenic aids and commercial supplements. Sports drinks. Diets for persons with high energy requirements stress, fracture and injury will be covered. Significance of physical fitness and nutrition in prevention and management of weight control regimes; Nutrition guidelines for maintenance of health and fitness; Awareness about the alternative systems for health and fitness, like ayurveda, yoga, Meditation, vegetarianism and traditional diets , metabolic and physiologic basis for macronutrient and micronutrient will be included in the syllabus.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1616**			
Course Title	**Nutritional Genomics/Metabolomics**			
Credit Distribution (L-T-P-C)	2	0	2	**3**

Course Description:

The genetic makeup that individuals inherit from their ancestors is responsible for variation in responses to food and susceptibility to chronic diseases. Common variations in gene sequences produce differences in complex traits in metabolism, food-gene interactions, and disease susceptibilities. Nutrigenomics thus is novel approach to understand initiation of disease susceptibility in individuals and has tremendous potentials to alter future of dietary guidelines in terms of personalized medicinal approach for better health perspectives. Study on Human Genome Project; Identification and cloning of human disease genes, modern technologies for genome analysis, personal genomics; Genome wide association studies for complex diseases and Personal genomics with respect to diet-gene interactions are essential component of Nutrigenomics, Under this broad area of research, the nutrient-gene interactions including the role of nutrients in regulation of gene, Genome organization of eukaryotes and molecular biology of the gene, Influence of nutrition and bioactive components of food on global gene expression, Nutrigenetic interactions in ontogenesis/Mutagenesis, and molecular nature of diseases; Gene isolation and experimental micro-manipulations. Genetically modified organisms/foods and genetic risks will be studied. Biomarkers and their use in diagnostics of metabolic disorders and tumor diseases; Genetic basics of immune reactions; Methods of immunogenetic analysis; Concept and applications of Nutrigenomics and Pharmacogenomics; Health Informatics- Concept and applications; Nucleic acid and Protein Data Bases, Nutrient data bases, Sequence similarity searching by BLAST, Principle, features and types of BLAST; Significance of Multiple Sequence Alignments; Phylogenetic Tree, Cloning and PCR, DNA sequencing, Structure and organization of the human genome, Epigenetics and impriniting,, etc., will be covered.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1617**			
Course Title	**Research Methodology**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Definition of research and its objectives; Types of research – basic, applied, academic, industrial and clinical; Review of literature – identifying gaps, formulating hypothesis and proposing research topic of relevance; Collection and interpretation of research data; Documentation & presentation of research outputs as publication in peer reviewed journals of national and international repute and presentation in scientific forums; Criteria for good laboratory practices and conduct of research; Overall guidance to Ph.D. research scholars with focus on Ph.D. thesis writing and submission; Status of planned research proposals in public domain in respect of Intellectual Property Rights (Patents & Processes); Ethical issues in research planning and documentation; Safety issues in research laboratory – physical, chemical and biological; Corrective and preventive measures in the control of health hazards (contamination) for laboratory Fellows and surrounding environment

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1618**			
Course Title	**Food Biotechnology**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Basic concepts and food applications; Natural food colours and flavours; Recombinant DNA technology and genetic manipulation; Genetically modified organisms/foods – basic concepts and methods to achieve & identify target genes; Safety and applicability of modified foods and food ingredients; Anti-nutritional factors in cereals and pulses; Biotechnological approaches (enzymes/proteins & effective processing parameters)towards reducing/modifying anti-nutritional factors in foods and food ingredients

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1619**			
Course Title	**Human Genetics**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

The course will cover hereditary and molecular genetics as it applies to humans, with a strong genomics and human disease perspective. It will cover transmission genetics, genetic testing, gene therapy and embryonic stem cells. The objectives provide a solid understanding of the concepts and scientific methods of modern genetics as it applies to humans. Development of a better appreciation of the power and the limitations of a genetics; centric view of human biology and disease; development of conceptual skills to address questions in genetics research and clinical practice, development of critical thinking with regard to advances in genetics and their social implications will be included. Syllabus thus include, review of DNA and chromosomes, mitosis, meiosis, pedigree analysis of single gene diseases, Multifactorial and complex traits, genome analysis, animal models of human diseases, genetic testing, Gene therapy etc.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1620**			
Course Title	**Metabolic /Genetic Basis of Diseases**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Comprehend the principles that underlie inheritance and expression of genetic information, Know the meaning of the genetic terms autosomal dominant, autosomal recessive, X-linked, and atypical patterns of inheritance; Understand how inherited defects in genes coding for enzymes, structural proteins, receptors, channels, and transporters can lead to a variety of genetic diseases. Topic of learning includes Patterns of single gene inheritance, enzyme defects, Tay sach disease, accessory protein defect, membrane protein defects, familial hypercholesterolemia, lysosomal transporter defect and receptor defects in diseases.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1621**			
Course Title	**Hospital organization and Personnel/Nutrition management**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

The organization intends to involve capacity building and human resources development that can address hospital organization and personnel/nutrition management considering the existing national and international problems in this area. The course provide guidelines and curricula for nutritional requirements of patients in various specialty hospitals, management of personnel's with skills and knowledge on diet and diseases. Deitary schemes are prepared and will be validated using hospital based surverys, screening and monitoring the disease status

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1622**			
Course Title	**Human ethics**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Ethics of Human Subject Research intends to be offered by the organization is to creat awareness on limits of heterogenous diets on wide range of patients with varieties of diseases. Attention will be focused on the disease specific dietary needs and their security in the country. The course introduces students to the ethics of human subject research. Ethical theory and principles are introduced, followed by a brief history of research ethics. Topics covered in lectures and moderated discussions include informed consent for research participation, role and function of institutional review boards, just selection of research subjects, ethical aspects of study design, and privacy and confidentiality.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1623**			
Course Title	**Laboratory methods in Food and health sciences**			
Credit Distribution (L-T-P-C)	2	0	2	**3**

Course Description:

It includes a wide range of laboratory methods employed in the analysis of food for health and diseases. Advanced research methods include data analysis and presentation and selected topics in advanced nutritional and food sciences. Topic also covers the identification of needs for development of newer methods for precise identification of nutrients, nutraceutical and their bioactivity and bioefficacy, chemistry/biochemistry, texture, microbial evaluation, sensory evaluation etc., are included. Topic also includes the learning on standard operating protocols for various dietary components; NABL and ISO certifications.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1624**			
Course Title	**Pharmacology/Toxicology/genotoxicity**			
Credit Distribution (L-T-P-C)	2	0	2	**3**

Course Description:

Pharmacology is the branch of biology and medicine that studies the actions of drug molecules in the body and the actions of the body on drugs. In addition to desired effects, a drug may also alter the molecular, cellular or biochemical functions of offtarget organ systems or cause undesirable side effects by interaction with other drugs in the body. In similar lines nutritional / nutraceutical effects on targets /off targets will be included. Pre-Clinical nutrition studies emphasizes the discovery of new drug/food targets, design and selection of new lead therapeutic compounds, studies of nutraceutical efficacy, potency, and pharmacokinetics as well as documentation of adverse effects in the intended therapeutic dose range. Pre-clinical food - drug discovery research is conducted using advanced in silico, in vitro, and in vivo models and methods. Good laboratory practice on isolation of nutraceuticals and guidelines to fit into food and drug administration, sub-discipline of Safety studies to assure the absence of significant off-target adverse effects of nutraceutical under development on a core set of vital organ systems at therapeutic doses. In contrast, toxicology studies characterize genotoxicity, immunotoxicity, carcinogenicity, and reproductive toxicity of food and food-drugs at and above therapeutic doses. Pharmacologists play a vital role in these processes of discovery and development of effective and safe drugs. The discipline of pharmacology and nutrition is and addresses formulation and dispensing of approved nutraceuticals for human use.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1625**			
Course Title	**Health Behavior and counselling**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

The course provides the tools that are required to make healthy, lifelong behavior changes, along with updated and timely understanding of health issues. The course aims to address the health topics of primary concern to existing population.. The following aspects are reflected in this course; Promoting healthy behavior change, Psychosocial health: Being mentally, emotionally, socially, and spiritually well, Managing stress: Coping with Life's Challenges, violence and abuse; Creating healthy environments, Healthy relationships; Daily Challenges in Nutrition: Eating for Optimum Health, Managing healthy Weight; Finding a healthy balance of nutrients, Personal fitness: improving health through exercise; diet counselling for cardiovascular disease; reducing risks for cancer: Reducing risk, for Infectious and Noninfectious conditions: Nutrition for management of risks, responsibilities and Life's transitions; Aging process, Environmental health: Thinking globally, Acting locally Consumerism: Selecting health care products and services and complementary and alternative Medicines.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1626**			
Course Title	**National/International health organizations; their role**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Global Public health is a dynamic world and it includes a review of how economic and political factors have and continue to affect global public health. The course outlines the major players in global public health and their various roles. The course also explains epidemiological profiles of disease and how they differ in low, medium and high income countries and how the structure of societies influence the state of public health in these populations, including the role of social inequalities in explaining persistent differences in health status. The class will learn public health outcomes after ecological disasters and how they cost to human life and suffering. Additionally, the course will focuses on the link between neoliberal globalization and illness, death and injury and discuss how neoliberal globalization affects the work place and occupational safety. Learning also includes how globalization influences public health, health care reform systems and concepts.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1627**			
Course Title	**Nutritional Psychology and its concepts**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Health psychologists are on the leading edge of research focusing on the biopsychosocial model in areas such as HIV, oncology, psychosomatic illness, and compliance with medical regimens, health promotion, and the effect of psychological, social, and cultural factors on numerous specific disease processes (e.g., diabetes, cancer, hypertension and coronary artery disease, chronic pain, and sleep disorders). Research in health psychology examines: the causes and development of illness, methods to help individuals develop healthy lifestyles to promote good health and prevent illness, the treatment people get for their medical problems, the effectiveness with which people cope with and reduce stress and pain, biopsychosocial connections with immune functioning, and dietary factors in the recovery, rehabilitation, and psychosocial adjustment of patients with serious health problems. This course will cover discussions on the history of health, healthcare, and health policy. The psychological and biological underpinnings of health, the impact of stress, anger, fear, nutrition, substance abuse and addictions will be considered. In addition, the course will explore and investigate health debilitations, chronic disease and terminal illnesses, such as cancer, cardiovascular disease, diabetes, HIV/AIDS, allergies and infectious diseases and more. The course also will discuss the environmental influences on health. The role of complementary/alternative and energy medicine will also be investigated as well as new models for health and healthcare systems.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1628**			
Course Title	**Bioinstrumentation; Laboratory methods in health sciences**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Introduces basic components of instruments for biological applications. Explores sources of signals and physical principles governing the design and operation of instrumentation systems used in medicine and physiological research. Topics include data acquisition and characterization; signal-to-noise concepts and safety analysis; interaction of instrument and environment. Laboratory experience with instrumental methods of measuring biological systems, its response etc. Topic Introduces various sensors and transducers to measure physical, chemical, and biological properties and envisages data reliability, dynamic behavior, and reproducible data analysis.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1629**			
Course Title	**Genetic Engineering**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

Genetic Engineering is the applied aspects of Molecular Biology which is the very basis of all living species. Molecular Biology deals with the molecular basis of biological or genetic specificity. It has three components: Biochemistry, Genetics & Cell Biology. Broadly Genetic Engineering means the manipulation of genes under controlled laboratory conditions. Gene cloning which includes the isolation and characterization of single genes and reintroduction and expression of these genes into cells of same or different species, is the main focus of Genetic Engineering. Biotechnology is the application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services. Here, the biological agents include microbial, animal or plant cells and enzymes that are used to synthesize, degrade or transform materials. The scientific and engineering principles are mainly Biochemistry, Microbiology, Genetics and Biochemical & Chemical Engineering.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1630**			
Course Title	**Molecular dynamics/modelling**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

The aim of this course is to provide an understanding of the methods, capabilities, and limitations of molecular simulation. This should enable the learners to: make sound judgements regarding the quality of molecular simulation studies reported in the literature; to decide whether molecular simulation is suited for application to their research, and if so, to know how to begin developing a simulation program applicable to their problems and; to understand the workings and limitations of commercial molecular simulation software. Further, it is expected that completion of this course will leave the student with a much deeper understanding of the molecular basis of physical behavior of the molecule. Course content includes Molecular dynamics of hard spheres, demonstrating elementary concepts Structure of a simulation program and introduction to programming methods used in the course, Elementary classical statistical mechanics, modeling of molecules, Free energy calculations, thermodynamic integration, free-energy perturbation and histogram methods, Phase equilibria calculations etc. Advanced molecular dynamic methods, including constraints and non-equilibrium molecular dynamics will also be included in the curriculum.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-3-1631**			
Course Title	**Integrated approach for food and health**			
Credit Distribution (L-T-P-C)	3	0	0	**3**

Course Description:

The Integrated Science Curriculum (ISC) synthesizes multiple disciplines in offer foundational training addressing the demands of 21st century science. This unique curriculum is built around student teams attacking problem-oriented exercises while mastering interdisciplinary concepts; Biology, chemistry, mathematics, physics and statistics are intertwined to achieve a dynamic understanding of a wide range of fundamental principles within the modern scientific method. The boundaries between traditional scientific disciplines such as biology, chemistry, and physics are becoming increasingly blurred as the scientific problems we attack are becoming more complex. With this blurring of boundaries, modern science is evolving into a fundamentally interdisciplinary and collaborative endeavor.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-4-0001**			
Course Title	**Project proposal writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

This would focus on the following: Identification of a research topic of relevance (non-Ph.D. programme) in the area of food science and technology; Status of literature as in public domain focusing on IPRs; Reason for selecting the topic; Questions to be asked; Proposed hypothesis as a solution finder; Gaps in existing knowledge base and answers therein; Cost/economic analysis and commercial viability

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-4-0002**			
Course Title	**Review Article writing**			
Credit Distribution (L-T-P-C)	0	0	4	**2**

Course Description:

This would include the following: Preamble to the proposed topic of research; Review of literature taking into account contemporary aspects in prior art; Objectives; Programme of work including methodology; Relevance of proposed Ph.D. programme in the context of national and international scenario; Impact and benefits to CSIR and the Institute's knowledge base; Final submission as a project document.

Faculty	**Biological Sciences**			
Lab Name	**CSIR-CFTRI, Mysore**			
Course Nomenclature	**BIO-CFTRI-4-0003**			
Course Title	**CSIR-800 project work**			
Credit Distribution (L-T-P-C)	0	0	8	**4**

Course Description:

Project to be undertaken in line with CSIR-800 focused programme of CSIR; Theme of project to be selected from the objectives and commitments of respective Laboratory (CSIR-CFTRI, Mysore) in CSIR-800, wherein the enrolled Ph.D. Scholar is pursuing Ph.D. programme