Kolhapur Institute of Technology's
College of Engineering Kolhapur
(Empowered Autonomous)

KOLHAPUR INSTITUTE OF TECHNOLOGY'S
COLLEGE OF ENGINEERING KOLHAPUR
(EMPOWERED AUTONOMOUS)

Department of Biotechnology

Curriculum and Syllabus for

B. Tech. Biotechnology

Scheme: 2023-24 (As Per NEP, 2020)

ABOUT THE DEPARTMENT

The Department of Biotechnology Engineering was established in 2002 with approval from DTE and AICTE, India, by the dynamic and proactive management of KIT\'s College of Engineering (Autonomous) Kolhapur. This move was made in recognition of the important role that biotechnology engineers were to play in the future industrial development of biotechnology related processes and products. It has a unique place in the development of Biotechnology Engineering discipline in Maharashtra. We currently offer B. Tech. (Biotechnology Engineering) programme at undergraduate and M.Tech (Biochemical Engineering and Biotechnology) programme at post graduate level. B Tech (Biotechnology Engineering) 4 years UG programme focuses more on studies of fermentative productions of various products such as insulin like biopharmaceuticals, antibiotics, fine chemicals, enzymes etc. Students completing their HSC are to obtain at least 45% for open category and 40% for backward class category/EWS/PwD, with non -zero score in CET(PCM /PCB)/NEET / JEE (MAIN) are eligible for B.Tech Biotechnology Engg. programme.

DEPARTMENT VISION

To be the Center of Excellence in Biotechnology Engineering and the preferred choice of Students, Faculty, Industry and Society at global level

DEPARTMENT MISSION

M1:	To use sophisticated techniques of modern biotechnology to strength and develop human resources and institutional capacity.
M2:	To transfer know how and develop appropriate facility and training in biotechnology related subjects considering safety in biotechnology by assessing management risk.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)	
PEO1:	**Preparation:** To prepare Biotechnology Engineering students, i)To excel in higher studies in Biotechnology engineering and management ii) To succeed in all Biotechnology industrial areas through global and rigorous education.
PEO2:	**Core Competence:** To provide students of Biotechnology Engineering with a solid foundation in the thrust areas such as Bioprocesses, Molecular Biology, Genetic Engineering, Pharmaceutical Biotechnology etc. required to work in Biotechnology industries.
PEO3:	**Breadth:** To train Biotechnology Engineering students with good scientific and engineering breadth particularly in Bioinformatics, Biostatistics, Biomedical Engineering, Food Technology, Medical Biotechnology so as to comprehend, analyze, design and create novel product and solutions to real life problems.
PEO4:	**Professionalism:** To inculcate in Biotechnology Engineering students i) Professional and ethical attitude, effective communication, teamwork skills, entrepreneurship skills with multidisciplinary approach ii) An ability to relate engineering issues in biotechnology for the welfare of mankind and environment.
PEO5:	**Learning Environment:** To provide students of Biotechnology Engineering with better social and academic environment aware of excellence, leadership, intellectual property rights, written ethical guidelines, and the life-long learning needed for a successful professional career.

PROGRAMME OUTCOMES (PO)	
PO1:	Apply the knowledge of mathematics, basic science and in-depth technical competence in Biotechnology engineering discipline to meet the solution of complex engineering problems.
PO2:	Apply the knowledge of mathematics, basic science and in-depth technical competence in Biotechnology engineering discipline to meet the solution of complex engineering problems.
PO3:	Design complex processes to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.

PO4:	Use research-based knowledge and research methods in the field of Biotechnology engineering to conduct experiments, analyze and interpret the data, design the equipment and processes as per the specifications and needs of biotech industries.
PO5:	Create, select, and apply appropriate techniques, resources, and software tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6:	Apply reasoning gained from the contextual knowledge of biotechnological engineering to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7:	Apply ethical principles and commit to professional ethics, responsibilities and norms of the biotechnology engineering practice.
PO8:	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary environments
PO9:	Communicate effectively on complex biotechnology engineering activities with the engineering community and with society at large, such as being able to make effective presentations, write effective reports and design documentation.
PO10:	Demonstrate knowledge and understanding of the biotechnology engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments.
PO11:	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of biotechnology engineering and technological change

PROGRAMME SPECIFIC OUTCOMES (PSO)	
PSO1:	**Research aptitude:** Inculcate the applicative knowledge of engineering & applied science to demonstrate research aptitude/skills in Emerging fields of biotechnology.
PSO2:	**Process & Product Development:** Display skills of Bioprocess Technology towards development of processes and products in global context
PSO3:	**Good Lab Practices (GLP) & Good manufacturing practices (GMP):** Exhibit adequate proficiency of GLP and GMP in terms of accuracy & precision, safety, ethics and reproducibility and able to follow standard operating procedures (SOP).

As per NEP Guidelines											
Scheme of Credit Distribution											
	Year	**FY**		**SY**		**TY**		**B. Tech**			
Sr. No.	**Curriculum Components**	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Actual**	**NEP Guidelines**
1	Basic Science Course **(BSC)**	8	8							**16**	**14-18**
2	Engineering Science Course **(ESC)**	10	3							**13**	**12-16**
3	Programme Core Courses **(PC)**		3	16	15	10	11	11		**66**	**44-56**
4	Programme Elective Course **(PEC)**					3	3	3	6	**15**	**20**
5	Multi Minor **(MM)**			2	3	3	3	3		**14**	**14**
6	Open Elective **(OE)**					3	3	2		**8**	**8**
7	Vocational And Skill Enhancement Course **(VSEC)**	1	3		1	1				**6**	**8**
8	Ability Enhancement Course **(AEC)**		3				1			**4**	**4**
9	Entrepreneurship / Economics/ Management Courses (MGMT/ Economics/ Marketing/ Finance) **(HSSM)**			2		2				**4**	**4**
10	Indian Knowledge System **(IKS)**	2								**2**	**2**
11	Value Education Course **(VEC)**			2	2					**4**	**4**
12	Research Methodology (Project) **(RM)**							4		**4**	**4**
13	Community Engagement Project/Field Project (PBL/Seminar/Mini Project) **(CEP)**					1	1			**2**	**2**
14	Project **(PP)**								4	**4**	**4**
15	Internship/OJT (PBL/ Seminar/ Mini Project/ Virtual Internship/ Physical) **(OJT)**			1	1				6	**8**	**12**
16	Co-curricular Courses **(CC)**		1		1		1		1	**4**	**4**
		20-22	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**174**	
		21	**21**	**23**	**23**	**23**	**23**	**23**	**17**	**174**	

SEMESTER-I												
Sr. No.	**Category**	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**	**Evaluation Scheme Component**			
1.	BSC	UHSBS0101	Engineering Mathematics-I	3	1	-	4	4	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
2.	BSC	UHSBS0108	General Physics and Optics	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
3.	ESC	UHSES0109	Engineering Mechanics	3	-	-	3	3	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
4.	ESC	UHSES0110	Basic Mechanical Engineering	2	-	-	2	2	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
5.	ESC	UHSES0111	Introduction to Python Programming	2	-	-	2	2	ISE1 MSE ISE2 ESE	10 30 10 50	 20	40
6.	BSC	UHSBS0128	General Physics and Optics Lab	-	-	2	2	1	ISE	50	20	
7.	ESC	UHSES0129	Engineering Mechanics Lab	-	-	2	2	1	ISE	50	20	
8.	ESC	UHSES0130	Basic Mechanical Engineering Lab	-	-	2	2	1	ISE	50	20	
9.	ESC	UHSES0131	Introduction to Python programming Lab	-	-	2	2	1	ISE	50	20	
10.	VSEC	UHSVS0132	Workshop Practice Lab	-	-	2	2	1	ISE	50	20	
11.	IKS	UHSIK0136	Ecology, Energy & Environment	2	-	-	2	2	ISE	100	40	
Total:							**26**	**21**	**Total Marks: 800** **Total Credit: 21**			

SEMESTER-II

Sr. No.	Category	Course Code	Course Name	L	T	P	Hrs. / Week	Credits	Evaluation Scheme Component			
1.	BSC	UHSBS0201	Engineering Mathematics-II	3	1	-	4	4	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
2.	BSC	UHSBS0212	Applied Chemistry	3	-	-	3	3	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
3.	AEC	UHSAE0203	Communication Skills	2	-	-	2	2	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
4.	ESC	UHSES0213	Basic Civil Engineering	2	-	-	2	2	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
5.	PC	UHSPC0214	Fundamentals of Electrical Engineering	2	-	-	2	2	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
6.	BSC	UHSBS0233	Applied Chemistry Lab	-	-	2	2	1	ISE	50	20	
7.	AEC	UHSAE0222	Communication Skills Lab	-	-	2	2	1	ISE	50	20	
8.	ESC	UHSES0234	Basic Civil Engineering Lab	-	-	2	2	1	ISE	50	20	
9.	PC	UHSPC0235	Fundamentals of Electrical Engineering Lab	-	-	2	2	1	ISE	50	20	
10.	VSEC	UHSVS0238	Computer Aided Engineering Drawing	-	-	2	2	3	ISE1	25		40
									ISE2	25		
									ESE (POE)	50	20	
11.	CC	UHSCC0239	Co-Curricular Course	1	-	-	-	1	ISE	100	40	
Total:							**24**	**21**	**Total Marks: 800** **Total Credit: 21**			

SEMESTER III

Sr. No.	Category	Course Code	Course Name	L	T	P	Hrs. / Week	Credits	Evaluation Scheme			
									Component	Marks		
										Max	Min for Passing	
1.	PC	UBTPC0301	Fluid Mechanics	3	1	0	4	4	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
2.	PC	UBTPC0302	Microbiology	3	0	0	3	3	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
3.	PC	UBTPC0303	Biochemistry	3	0	0	3	3	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
4.	PC	UBTPC0304	Cell and Molecular Biology	3	0	0	3	3	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
5.	VEC	UBTVE0305	Constitution of India	2	0	0	2	2	ISE	50	20	
6.	HSSM	UBTEM0306	Industrial Organization and Management	2	0	0	2	2	ESE	50	20	
7.	PC	UBTPC0331	Microbiology Laboratory	0	0	2	2	1	ISE	50		30
									ESE (POE)	25	10	
8.	PC	UBTPC0332	Biochemistry Laboratory	0	0	2	2	1	ISE	25	10	
9.	PC	UBTPC0333	Cell and Molecular Biology Laboratory	0	0	2	2	1	ISE	25		20
									ESE (OE)	25	10	
10.	OJT	UBTIL0371	Mini Project-I	0	0	2	2	1	ISE	50	20	
11.	MM	UBTMM03**	Multidisciplinary Minor	2	0	0	2	2	ESE	100	40	
							27	**23**	**Total Marks: 800 Total Credit: 23**			

Multi Disciplinary Minor - I (Data Analytics)		Multi Disciplinary Minor –II (Finance)	
UBTMM0341	Computational statistics	UBTMM0342	Fundamentals of Financial Accounting

SEMESTER IV

Sr. No.	Category	Course Code	Course Name	L	T	P	Hrs. / Week	Credits	Evaluation Scheme		
									Component	Marks Max	Marks Min for Passing
1	PC	UBTPC0401	Heat Transfer	2	0	0	2	2	ISE1	10	40
									MSE	30	
									ISE2	10	
									ESE	50	20
2	PC	UBTPC0402	Genetic Engineering	3	0	0	3	3	ISE1	10	40
									MSE	30	
									ISE2	10	
									ESE	50	20
3	PC	UBTPC0403	Immunology	3	0	0	3	3	ISE1	10	40
									MSE	30	
									ISE2	10	
									ESE	50	20
4	PC	UBTPC0404	Enzyme Technology	2	0	0	2	2	ISE1	10	40
									MSE	30	
									ISE2	10	
									ESE	50	20
5	PC	UBTPC0405	Bioinformatics	3	0	0	3	3	ISE1	10	40
									MSE	30	
									ISE2	10	
									ESE	50	20
6	VEC	UBTVE0406	Environmental Studies	2	0	0	2	2	ISE	50	20
7	PC	UBTPC0431	Heat Transfer Laboratory	0	0	2	2	1	ISE	25	20
									ESE (OE)	25	10
8	PC	UBTPC0432	Genetic Engineering Laboratory	0	0	2	2	1	ISE	25	20
									ESE (POE)	25	10
9	VSEC	UBTVS0433	Immunology Laboratory	0	0	2	2	1	ISE	25	10
10	CC	UBTCC0434	Co-Curricular Activities - II	0	0	2	2	1	ISE	50	20
11	OJT	UBTIL0471	Mini Project II	0	0	2	2	1	ISE	25	10
12	MM	UBTMM04**	Multidisciplinary Minor	3	0	0	3	3	ESE	100	40
			Total:				**28**	**23**	**Total Marks: 850 Total Credit: 23**		

Multi Disciplinary Minor - I (Data Analytics)		Multi Disciplinary Minor –II (Finance)	
UBTMM0441	Python and R language for data science (MM-I)	UBTMM0442	Cost and Management accounting(MM-II)

SEMESTER V

Sr. No.	Category	Course Code	Course Name	L	T	P	Hrs. / Week	Credits	Evaluation Scheme		
									Component	Marks: Max	Marks: Min for Passing
1	PC	UBTPC0501	Bioreaction Engineering	3	0	0	3	3	ISE1	10	
									MSE	30	
									ISE2	10	40
									ESE	50	20
2	PC	UBTPC0502	Mass Transfer	2	0	0	2	2	ISE1	10	
									MSE	30	
									ISE2	10	40
									ESE	50	20
3	PC	UBTPC0503	Fermentation Technology	3	0	0	3	3	ISE1	10	
									MSE	30	
									ISE2	10	40
									ESE	50	20
4	PEC	UBTPE05**	Program Elective I	3	0	0	3	3	ISE1	10	
									MSE	30	
									ISE2	10	40
									ESE	50	20
5	OE	UBTOE05**	Open Elective I	3	0	0	3	3	ISE1	10	
									MSE	30	
									ISE2	10	40
									ESE	50	20
6	AEC	UBTAE0501	Business Communication and Value Science	0	0	2	2	1	ISE	50	20
7	PC	UBTPC0531	Bioreaction Engineering Laboratory	0	0	2	2	1	ISE	25	
									ESE (OE)	25	10	20
8	VSEC	UBTVS0532	Fermentation Technology Laboratory	0	0	2	2	1	ISE	25	
									ESE (POE)	25	10	20
9	PC	UBTPC0533	Bioinformatics Laboratory	0	0	2	2	1	ISE	25	10
10	CEP	UBTIL0571	Mini Project III	0	0	2	2	1	ISE	25	10
11	MM	UBTMM05**	Multidisciplinary Minor	3	0	0	3	3	ESE	100	40
			Total:				**28**	**22**	**Total Marks: 800 Total Credit: 22**		

Multi Disciplinary Minor - I (Data Analytics)		Multi Disciplinary Minor –II (Finance)	
UBTMM0541	Fundamentals of data science (MM-I)	UBTMM0542	Taxation and Audit (MM-II)

Program Elective- I	
UBTPE0511	Cell Culture Technology (PE-I)
UBTPE0512	Biological Thermodynamics (PE-I)

Sr. No.	Open Elective – I T.Y.B.Tech (Sem-V)	Course Code	Credits
1	Sales and Distribution Management	UILOE0521	03
2	Global Marketing Management	UILOE0522	03
3	Customer Relationship Management	UILOE0523	03
4	Water Resources Management	UILOE0524	03
5	Agile Project Management	UILOE0525	03
6	Product Design and Manufacturing	UILOE0526	03
7	Leadership and Corporate Strategy	UILOE0527	03
8	Human Resource Development	UILOE0528	03
9	Corporate Finance	UILOE0529	03
10	Green Buildings	UILOE0530	03
11	Ethics in Engineering Practices	UILOE0531	03

SEMESTER VI

Sr. No.	Category	Course Code	Course Name	L	T	P	Hrs. / Week	Credits	Evaluation Scheme		
									Component	Marks Max	Marks Min for Passing
1	PC	UBTPC0601	Bioseparations	3	0	0	3	3	ISE1	10	40
									MSE	30	
									ISE2	10	
									ESE	50	20
2	PC	UBTPC0602	Process Calculations	3	0	0	3	3	ISE1	10	40
									MSE	30	
									ISE2	10	
									ESE	50	20
3	PC	UBTPC0603	Bioprocess Equipment Design	2	0	0	2	2	ISE1	10	40
									MSE	30	
									ISE2	10	
									ESE	50	20
4	PEC	UBTPE06**	Program Elective II	3	0	0	3	3	ISE1	10	40
									MSE	30	
									ISE2	10	
									ESE	50	20
5	OE	UBTOE06**	Open Elective II	3	0	0	3	3	ISE1	10	40
									MSE	30	
									ISE2	10	
									ESE	50	20
6	HSSM	UBTEM0601	Biotech Industry: Practices and Entrepreneurship	2	0	0	2	2	ESE	50	20
7	PC	UBTPC0631	Bioseparations Laboratory	0	0	2	2	1	ISE	25	20
									ESE (POE)	25	10
8	PC	UBTPC0632	Bioprocess Equipment Design Laboratory	0	0	2	2	1	ISE	25	20
									ESE (OE)	25	10
9	PC	UBTPC0633	Effluent Treatment Laboratory	0	0	2	2	1	ISE	25	10
10	CC	UBTCC0634	Co-Curricular Activities - III	0	0	2	2	1	ISE	50	20
11	FP	UBTIL0671	Mini project IV	0	0	2	2	1	ISE	25	10
12	MM	UBTMM06**	Multidisciplinary Minor	3	0	0	3	3	ESE	100	40
							28	**24**	**Total Marks: 850 Total Credit: 24**		

Multi Disciplinary Minor - I (Data Analytics)		**Multi Disciplinary Minor –II (Finance)**	
UBTMM0641	Data Mining (MM-I)	UBTMM0642	Financial Management(MM-II)
Program Elective- II			
UBTPE0611		Plant Biotechnology (PE- II)	
UBTPE0612		Bioprocesses (PE- II)	

Sr. No.	Open Elective – II T.Y.B.Tech (Sem-VI)	Course Code	Credits
1	Intellectual Property	UILOE0621	03
2	Engineering Econometrics	UILOE0622	03
3	Entrepreneurship Development	UILOE0623	03
4	Positive Psychology	UILOE0624	03
5	Landscape Design	UILOE0625	03
6	Microeconomics	UILOE0626	03
7	Waste Management	UILOE0627	03
8	Social Entrepreneurship	UILOE0628	03
9	Industrial Health & Safety	UILOE0629	03
10	Appropriate Technology	UILOE0630	03
11	Six Sigma	UILOE0631	03

SEMESTER VII

Sr. No.	Category	Course Code	Course Name	L	T	P	Hrs. / Week	Credits	Evaluation Scheme		
									Component	Marks	
										Max	Min for Passing
1	PC	UBTPC0701	Analytical Techniques in Biotechnology	3	0	0	3	3	ISE1	10	
									MSE	30	
									ISE2	10	
									ESE	50	20
											40
2	PC	UBTPC0702	Good Manufacturing Practices	3	0	0	3	3	ISE1	10	
									MSE	30	
									ISE2	10	
									ESE	50	20
											40
3	PC	UBTPC0703	Process Engineering Costing and Plant design	3	0	0	3	3	ISE1	10	
									MSE	30	
									ISE2	10	
									ESE	50	20
											40
4	PEC	UBTPE07**	Program Elective III	3	0	0	3	3	ISE1	10	
									MSE	30	
									ISE2	10	
									ESE	50	20
											40
5	OE	UBTOE07**	Open Elective III	2	0	0	2	2	ISE1	10	
									MSE	30	
									ISE2	10	
									ESE	50	20
											40
6	PC	UBTPC0731	Analytical Techniques Laboratory	0	0	2	2	1	ISE	25	
									ESE (OE)	25	10
											20
7	PC	UBTPC0732	Animal And Plant Tissue Culture Laboratory	0	0	2	2	1	ISE	25	
									ESE (OE)	25	10
											20
8	RM	UBTIL0771	Project –I	0	0	8	8	4	ISE	50	
									ESE (OE)	50	20
											40
9	MM	UBTMM07**	Multidisciplinary Minor	3	0	0	3	3	ESE	100	40
			Total:				**29**	**23**	**Total Marks: 800 Total Credit: 23**		

Multi Disciplinary Minor - I (Data Analytics)		Multi Disciplinary Minor –II (Finance)	
UBTMM0741	Data Visualization and analytics (MM- I)	UBTMM0742	Banking and Financial Services (MM-II)

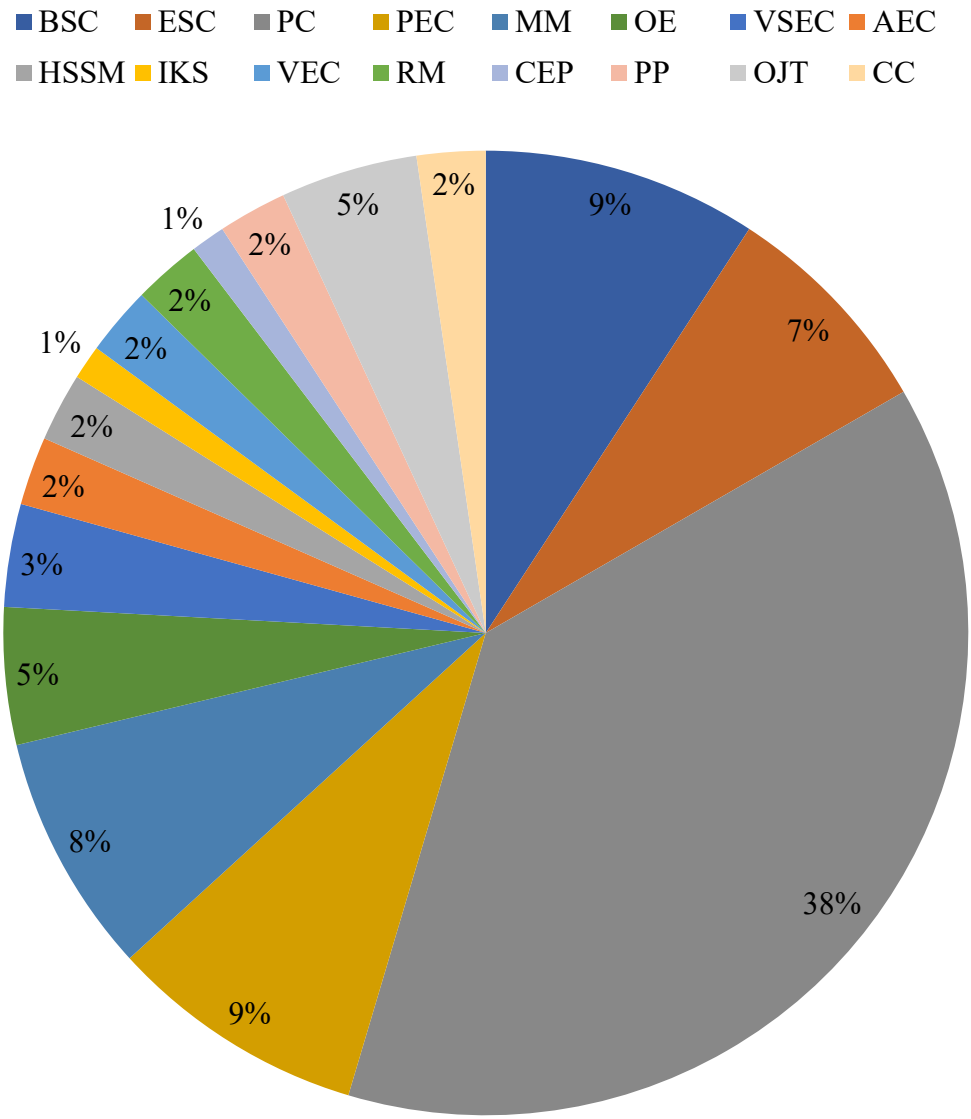
Program Elective- III	
UBTPE0711	Biopharmaceuticals (PE- III)
UBTPE0712	Food Technology (PE- III)

Sr. No.	Open Elective – III Final Year B.Tech (Sem-VII)	Course Code	Credits
1	Effective Paper Writing Skills	UILOE0721	02
2	Desktop Support and Services	UILOE0722	02
3	Healthcare and Technology	UILOE0723	02
4	Industrial Instrumentation	UILOE0724	02
5	Sustainable Energy Systems	UILOE0725	02
6	Urban and Rural Planning	UILOE0726	02
7	Design of Experiments and Research Methodology (DERM)	UILOE0727	02
8	Graphic and Product Design	UILOE0728	02
9	Environmental Policies and Law	UILOE0729	02
10	Environmental Impact Assessment	UILOE0730	02
11	Incubation and Entrepreneurship Enhancement	UILOE0731	02

SEMESTER VIII												
Sr. No.	**Category**	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**	**Evaluation Scheme**			
									Component	Marks		
										Max	Min for Passing	
1	PEC	UBTPE08**	Program Elective IV	3	0	0	3	3	ISE1	10		
									MSE	30		
									ISE2	10		40
									ESE	50	20	
2	PEC	UBTPE08**	Program Elective V	3	0	0	3	3	ISE1	10		
									MSE	30		
									ISE2	10		40
									ESE	50	20	
3	RM	UBTIL0871	Project –II	0	0	8	8	4	ISE	50		40
									ESE (OE)	50	20	
4	FP	UBTIL0872	Internship	0	0	12	12	6	ISE I	75	30	
									ISE II	75	30	
5	CC	UBTCC0831	Co-Curricular Activities - IV	0	0	2	2	1	ISE	50	20	
			Total:				**28**	**17**	**Total Marks: 500 Total Credit: 17**			

Program Elective IV		**Program Elective V**	
UBTPE0811	Tissue Engineering and organ Printing (PE- IV)	UBTPE0813	Next generation Sequencing and Analysis (PE-V)
UBTPE0812	Green Technology (PE-IV)	UBTPE0814	Drug development process (PE-V)

Curriculum Components and Credit Distribution



Multi-Disciplinary Minor - I Data analytics								
Sr. No.	**Category**	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	MM-I	UBTMM0341	Computational statistics	2	0	0	2	2
2	MM-I	UBTMM0441	Python and R language for data science	3	0	0	3	3
3	MM-I	UBTMM0541	Fundamentals of data science	3	0	0	3	3
4	MM-I	UBTMM0641	Data Mining	3	0	0	3	3
5	MM-I	UBTMM0741	Data Visualization and analytics	3	0	0	3	3
			Total:				**14**	**14**

Multi-Disciplinary Minor-II Finance								
Sr. No.	**Category**	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs./ Week**	**Credits**
1	MM-II	UBTMM0342	Fundamentals of Financial Accounting	2	0	0	2	2
2	MM-II	UBTMM0442	Cost and Management accounting	3	0	0	3	3
3	MM-II	UBTMM0542	Taxation and Audit	3	0	0	3	3
4	MM-II	UBTMM0642	Financial Management	3	0	0	3	3
5	MM-II	UBTMM0742	Banking and Financial Services	3	0	0	3	3
						Total:	14	14

Emerging minor- I Bioinformatics											
Sr. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**	**Evaluation Scheme**			**Category**
								Component	Marks		
									Max	Min for Passing	
1	UBTMN0361	Biology for Engineers	3	1	0	4	4	ESE	100	40	MN
2	UBTMN0461	Fundamentals of Biomolecules	3	1	0	4	4	ESE	100	40	MN
3	UBTMN0561	Basics of Bioinformatics	3	1	0	4	4	ESE	100	40	MN
4	UBTMN0661	Structural Bioinformatics and Proteome based Technology	3	1	0	4	4	ESE	100	40	MN
5	UBTMN0761	Genomics and Proteomics	2	0	0	2	2	ESE	100	40	MN
		Total:				**18**	**18**	**Total Marks: 500 Total Credit: 18**			

B. Tech (Hons.) Biotechnology Engineering with Specialization in Biosimilar Technology

Sr. No.	Course Code	Course Name	L	T	P	Hrs./ Week	Credits	Evaluation Scheme			Category
								Component	Marks		
									Max	Min for Passing	
1	UBTHN0351	Biosimilar Therapeutics: Introduction	3	1	0	4	4	ESE	100	40	HN
2	UBTHN0451	Biosimilar: Manufacturing Technology-I	3	1	0	4	4	ESE	100	40	HN
3	UBTHN0551	Biosimilar Manufacturing Technology-II	3	1	0	4	4	ESE	100	40	HN
4	UBTHN0651	Biosimilar Therapeutics: Characterization	3	1	0	4	4	ESE	100	40	HN
5	UBTHN0751	Biosimilar Therapeutics: RegulatoryApproval Processes	2	0	0	2	2	ESE	100	40	HN
		Total:				**18**	**18**	**Total Marks: 500 TotalCredit:18**			

EXIT COURSES-Courses after Second year exit											
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs./ Week**	**Credits**	**Evaluation Scheme**			**Category**
								Component	Marks		
									Max	Min	
1	UBTEX0491	Agricultural Biotechnology	3	0	0	3	3	ISE	50	20	MEES
2	UBTEX0492	Introduction to Plant tissue culture	3	0	0	3	3	ISE	50	20	MEES
3	UBTEX0493	Training	0	0	2	2	2	ISE	50	20	MEES
					Total:	**8**	**8**	**Total Marks: 150 Total Credit: 8**			

EXIT COURSES-Courses After Third year exit											
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs./ Week**	**Credits**	**Evaluation Scheme**			**Category**
								Component	Marks		
									Max	Min	
1	UBTEX0691	Upstream Processing	3	0	0	3	3	ISE	50	20	MEES
2	UBTEX0692	Downstream Processing	3	0	0	3	3	ISE	50	20	MEES
3	UBTEX0693	Training	0	0	2	2	2	ISE	50	20	MEES
					Total:	**8**	**8**	**Total Marks: 150 Total Credit: 8**			

Title of the Course: Fluid Mechanics	**L**	**T**	**P**	**Credit**
Course Code: UBTPC0301	3	1		**4**

Course Pre-Requisite: Basic knowledge of mathematics and physics

Course Description: The basic purpose of this course is to introduce students to the concepts of fluid statics dynamics and its applications.

Course Objectives:

1. To introduce fluid statics and fluid dynamics for process fluids.
2. To illustrate the basic principles of flow measuring devices.
3. To explain the general theory of laminar and turbulent boundary layer fundamentals and flow past immersed bodies.
4. To explain selection and scale up of agitation system.
5. To explain screen analysis

Course Outcomes:

CO	**After the completion of the course the student will be able to**	Bloom's Taxonomy	
		level	Descriptor
CO1	Apply the fundamentals and basic principles of fluid statics	3	Applying
CO2	Analyze the fluid flow through pipes, fluidized bed and packed bed	4	Analyzing
CO3	Select and to scale-up agitation system	3	Applying
CO4	Explain particle size analysis	2	Understanding

CO-PO-PSO Mapping:

COs	**POs**											**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3											1	1	
2	3	3	2	3										
3	3	3	1	1								1		
4	1			1										

Assessments:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment	**Marks**
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and **ISE 2** are based on Assignment/Declared test/Quiz/Seminar/Group discussions/Presentation etc.

MSE is based on 50% of course content

ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Unit:1 Fluid statics and its applications: Hydrostatic equilibrium, Hydrostatic equilibrium in a centrifugal field, Applications of fluid statics: manometers, continuous gravity decanter, and centrifugal decanter.	**7 Hrs.**
UNIT:2 Fluid flow through pipes: Types of flow, shear rate and shear stress, rheological properties of fluids, Continuity equation, Bernoulli equation, Pump power calculations. Shear stress distribution in a cylindrical tube, laminar and turbulent flow in pipes, effect of roughness, friction factor chart, Pressure drop calculations across fittings.	**8 Hrs.**
UNIT:3 Pumping devices for gases: Fans, blowers and compressors, Measurement of flowing fluids: venturimeter, orifice meter, rotameter, pitot tube.	**8 Hrs.**
UNIT:4 Flow past immersed bodies: Drag and drag coefficients, Friction in flow through beds of solids, Motion of particles through fluids, Fluidization	**7 Hrs.**
UNIT:5 Mixing: Agitated vessels, flow patterns in agitated tanks, mechanism of mixing, power requirements for mixing Agitator selection and scale up.	**8 Hrs.**
UNIT:6 Screening: Types of screens, Screen efficiency, Average particle diameter, Comparison of ideal and actual screens, Industrial screening equipment.	**7 Hrs.**

Textbooks and references:

1. W. L. McCabe, W. L. Smith, and P. Harriot 'Unit Operations of Chemical Engineering', McGraw-Hill International Edition (Sixth edition) (2001).
2. Pauline M. Doran 'Bioprocess Engineering Principles', Elsevier Science & Technology Books, May 1995 .
3. R. W. Fox and A. T. McDonald, Introduction to Fluid Mechanics (Fourth Edition) Wiley Singapore (1995).
4. J. O. Wilkes, Fluid Mechanics for Chemical Engineers, Prentice Hall (1999).
3. R. B. Bird, W. L. Stewart and E. L. Lightfoot, Transport Phenomena (Second edition), Wiley Singapore (2002).
5. M. M. Denn, Process Fluid Mechanics, Prentice Hall (1980).

Title of the Course: Microbiology	L	T	P	Credit
Course Code: UBTPC0302	3	-	-	3

Course Pre-Requisite: Basic knowledge of prokaryotes

Course Description: This course explains the basics of microbiology and applied microbiology

Course Learning Objectives:

1 To acquaint students with the world of microorganisms, their types and characteristics.
2 To find the growth requirements and their role in bacterial growth.
3 To describe disinfection and sterilization techniques.
4 To explain role of various environmental factors on microbial growth.

Course Outcomes:

CO	After the completion of the course the student will be able to	Bloom's Taxonomy	
		level	Descriptor
CO1	Explain the world of microorganisms, their types and characteristics	2	Understanding
CO2	Select the media constituents, types of media and various culturing methods used for microbial growth	3	Applying
CO3	Examine various physical, chemical and biological agents affecting microbial growth	4	Analyzing
CO4	Apply suitable methods to control microbes	3	Applying

CO-PO-PSO Mapping:

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	2	2	1	1	2			3				3	3	
2	2	2	1	1	2			3				3	3	
3	2	2	1	1	2			3				3	3	
4	2	2	1	1	2			3				3	3	

Assessments:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and **ISE 2** are based on Assignment / Declared test / Quiz / Seminar / Group discussions / Presentation etc. **MSE** is based on 50% of course content **ESE** is based on 100% course content with 60-70% weightage for course content covered after MSE.	
Course Contents:	
Unit 1:--- Introduction to microorganisms History of Microbiology: - Spontaneous generation, Germ theory of diseases. Prokaryotic cell structure :- The bacterial nucleus, cell wall, cell membrane, capsules and slimes, flagella, pili, reserve materials and other cellular inclusions, endospores.	**7 Hrs**
Unit 2:---General characteristics of microorganisms :- Archaebacteria, Actinomycetes, Fungi Viruses Rickettsia, Mycoplasma, Chlamydia,	**8 Hrs**
Unit 3:--- Microbial Nutrition And Identification And Characterization Of Bacteria Requirement for C, N, S and growth factors, Role of oxygen Various types of culture media, pure culture techniques, aerobic and anaerobic culturing,	**8 Hrs**
Unit 4:--- Microbial Growth Microscopy, types of staining, analysis of Cultural characteristics, Culture preservation methods Nutritional categories among microorganisms, Typical growth curve, Diauxic growth, synchronous growth, batch and continuous culture	**7 Hrs**
Unit 5:--- Effect of Environmental Factors And Antibiotics On Growth Of Microorganisms Effects of solutes on growth and metabolism, effect of temperature on microbial growth, effect of ion concentration, effect of hydrostatic pressure, effect of heavy metal ions on microbial growth Antibiotics :- historical highlights, characteristics of antibiotics and their mode of action, microbial susceptibility testing of antibiotics and resistance to antibiotics	**7 Hrs**
Unit 6:--- The Control Of Microorganisms Physical agents :- High Temperature a) Moist heat - Stem under pressure, Fractional sterilization, boiling water, pasteurization, b)Dry heat – Hot air sterilization, Incineration, c) Desiccation, d) Osmotic pressure, e)Radiations- ionizing and non-ionizing f) Filtration Chemical agents:-Definitions and terms , Phenol, Alcohol, Halogens, Heavy metals, gaseous agents	**8 Hrs**

Textbooks and references:

1 Stanier R.Y. *et al* "General Microbiology", Macmilan press, 5th edition. 1999.
2 Pelczar, Jr. *et. al*, "Microbiology", Tata McGrawHill 5th Edition 1999
3 Schlegel H.G. "General Microbiology" Cambridge University Press;7th edition, 1999
4 M T Madigan *et al* "Brock biology of microorganism", Pearson, 14th edition. 2014.
5 Purohit,S.S. "Microbiology", Agrobios, 6th edition. 1999

Title of the Course: Biochemistry	**L**	**T**	**P**	**Credit**
Course Code: UBTPC0303	**3**	**-**	**-**	**3**

Course Pre-Requisite: Students must have a basic understanding of the living cells, organic chemistry in order to follow the physicochemical properties and metabolic reactions of biomolecules.

Course Description: The course deals with structure and function of biomolecules, metabolism of biomolecules and bioenergetics.

Course Objectives:

1. To state properties and functions of biomolecules.
2. To explain the energetics and transport mechanism of biomolecules.
3. To summarize the metabolism of Biomolecules.
4. To understand the importance of metabolic pathways and associated disorders.

Course Outcomes:

CO	**After the completion of the course the student will be able to**	**Bloom's Taxonomy**	
		level	**Descriptor**
CO1	State properties and functions of biomolecules.	1	Remembering
CO2	Explain the energetic and transport mechanism of biomolecules.	2	Understanding
CO3	Summarize the metabolism of biomolecules.	2	Understanding
CO4	Analyze the metabolic pathways and cause for a metabolic disorder.	4	Analyzing

CO-PO-PSO Mapping:

COs	**POs**											**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	1	1		1								2		
2	1			1								2		
3	1			2								2		
4	2			1								2		

Assessments:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment	**Marks**
ISE 1	10

MSE	30
ISE 2	10
ESE	50

ISE 1 and **ISE 2** are based on Assignment/Declared test/Quiz/Seminar/Group discussions/Presentation etc.
MSE is based on 50% of course content
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents:

Unit 1:-Water in Biological System: Physical and chemical properties of water, weak interactions in macromolecular structure and function, Water as solvent for biochemical reaction- physical and chemical properties of water, ion product of water: pH scale, Acid, Base, Acid-Base Indicators, Buffers, Fitness of the aqueous environment for Living organism.	8 **Hrs.**
Unit 2:- Amino acids and Proteins: Classification, Structure and properties of amino acids, stereochemistry of amino acids , absorption spectra, analysis of amino acid mixtures. Composition of protein, Classification of protein based on structure and function, Case study : Protein physiology function, Ramachandran Plot (Allowed and Disallowed confirmation)	8 **Hrs.**
Unit 3:- Bioenergetics & Transport Mechanism: Structure and properties of ATP. High energy compounds, Biological membranes: structure, permeability, properties, passive transport and active transport, facilitated transport, energy requirement, mechanism of sodium- potassium, glucose and amino acid transport. Organization of transport activity in cell	6 **Hrs.**
Unit 4:--- Metabolism of Carbohydrates: Basics of bioenergetics in metabolism(anabolism and catabolism), Classification and chemical properties of carbohydrates- monosaccharides, disaccharides, oligo and polysaccharides, Glycoconjugates (proteoglycans, glycoprotein, glycolipids) Metabolism of carbohydrates : Glycolysis and alternate pathways, TCA cycle, Electron transport chain, Gluconeogenesis, Metabolism Disorders	8 **Hrs.**
Unit 5:-Metabolism of Lipid: Classification and chemical properties of lipids, Function of lipids (simple- storage and functional-membrane lipids) Metabolism of lipids: β oxidation of saturated and unsaturated fatty acid, propionate pathway, Biosynthesis of lipids, Metabolism Disorders	8 **Hrs.**
Unit 6:--- Metabolism of amino acids and nucleotides: Catabolism amino acids, Biosynthesis of amino acids, Catabolism of purines and pyrimidines, Biosynthesis of purines and pyrimidines, Urea cycle, Metabolism	**7 Hrs.**

Textbooks and references:

1.H.K Das, Textbook of Biotechnology, 5th Edition, John Wiley Publisher, 2017.

2. Nelson and Cox, Lehninger-Principles of Biochemistry, 5TH Edition, W.H. Freeman and Company Pub, 2017.

3. Rao Rama V.S.S,Textbook of Biochemistry,4th Edition, Narosa Pub. House, New Delhi, 2008.

Title of the Course: Cell and Molecular Biology	**L**	**T**	**P**	**Credit**
Course Code: UBTPC0304	**3**	**-**	**-**	**3**

Course Pre-Requisite:

Student must have a basic knowledge of macromolecules and organelle's basic structure, organization and characteristics.

Course Description:

The course contains basic features of cellular organelle's, cell cycle and control, stem cells, DNA analysis and its expression.

Course Objectives:

1. Define the basics of Cell organelle, cell cycle control and stem cells
2. Explain the DNA expression in the form of replication, transcription and translation
3. Identify and analyze the various techniques of genetic mutation, repair and recombination.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	To acquaint students with fundamental of cellular organelles, cell cycle control and stem cells	2	**CO1**
CO2	To get the knowledge with the necessary background and technical skills to work professionally in r-DNA Technology and Molecular Biology.	3	**CO2**
CO3	Analyze the gene manipulation, mutation and recombination.	3	**CO3**

CO-PO-PSO Mapping:

COs	**POs**											**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	1			1								2		
2	1			1								2		
3	2			2	2							2		

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively

Assessment	**Marks**
ISE 1	10

MSE	30
ISE 2	10
ESE	50

ISE 1 and **ISE 2** are based on Assignment / Declared test / Quiz / Seminar / Group discussions / Presentation etc.
MSE is based on 50% of course content
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Unit 1:--- Cell structure Introduction to Prokaryotes and eukaryotes 1. The compartmentalization of higher cells, the cytosol, the endoplasmic reticulum, the Golgi apparatus, lysosomes and peroxisomes, mitochondria and chloroplasts The nucleus: Nuclear membrane, nuclear pores, chromosomes, nucleolus and other nuclear bodies	8 **Hrs.**
Unit 2:--- Cell signaling and transport 1. Molecular mechanism of signal transduction 2. Principles and importance of cell signaling 3. Signaling through G- protein linked receptors 4. Signaling through enzyme linked cell surface receptors 5. Ion channel gated receptors, active and passive transport	8 **Hrs.**
Unit 3:--- Cell Cycle and Stem cell biology **1.** Components of cell cycle control system, **2.** Cell division: Mitosis and Meiosis 2. Introduction to stem cells, classification- ES cells and adult stem cells Unipotency, pluripotency, multipotency and differentiation of stem cells.	6 **Hrs.**
Unit 4:--- Organization of genetic material 1. Different forms of DNA 2. Central dogma of Molecular Biology 3. Viruses: Nature of genetic material, unfolding and packing 4. Organization of genetic material in prokaryotes 5. Eukaryotes: Nucleosomes, Chromatin and heterochromatin, histones and non-histone proteins, Giant chromosomes, satellite DNA. Classes of the genes 6. Split genes and overlapping genes.	8 **Hrs.**
Unit 5:---DNA Replication, damage, repair and recombination 1. Prokaryotic DNA replication 2. Eukaryotic DNA replication 3. Organelle DNA replication – chloroplasts and mitochondria. 4. Plasmid – replication and general properties 5. Types of damages, damaging agents, repair mechanisms - Photo- reactivation, dark repair, post replicational recombination repair, SOS repairs. 6. Homologous recombination, Site-specific recombination	8**Hrs.**

Unit 6:--- Transcription and Translation 1. Transcription in prokaryotes and eukaryotes, RNA processing, structures of rRNA, tRNA and mRNA, post-transcriptional processes, Novel structural motifs in transcription factors in eukaryotes and prokaryotes. 2. Genetic code-Deciphering of genetic code and important properties of genetic code. 3. Translation in prokaryotes and eukaryotes, Molecular aspects of gene regulation and expression. 4. operon models-lactose, tryptophan and arabinose, Post-translational modifications.	**6 Hrs.**

Textbooks and references:

1. Roy S.C. and De Kalyan Kumar Cell Biology 4 New Central Book Agency **2019.**
2. De Robertis E.D.P. and De Robertis, Jr. E.M.F. Cell and Molecular biology 8 Lippincott Williams & Wilkins 2017
3. James D. Watson et al, Molecular Biology of the genes Pearson and Benjamin Cummings Publication. **2013**
4. Maxine Singer and Paul Berg Genes and Genomes 2 University Science book, Mill Vally California Publication 1991.

Title of the Course: Constitution of India	L	T	P	Credit
Course Code: UBTVE0305	2	--	--	2

Course Pre-Requisite: Basics of Indian History, Independence Movement, Fundamentals of Civics.

Course Description: This Course is an introduction of Indian Constitution and basic concepts highlighted in this course for understanding the Constitution of India. This course is structured to give a deeper insight for making the nexus between the other law subjects.

Course Objectives

At the end of the course the student is expected to have acquired:

1. A basic understanding of Constitution of India.
2. Builds the ability to apply the knowledge gained from the course to current social legal issues.
3. Ability to understand and solve the contemporary challenges.
4. Understanding constitutional remedies.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Explain the significance of Indian Constitution as the fundamental law of the land	II	Understanding
CO2	Exercise his fundamental rights in proper sense at the same time Identifies his responsibilities in national building.	II	Applying
CO3	Analyze the Indian political system, the powers and functions of the Union, State and Local Governments in detail	II	Understanding
CO4	Understand Electoral Process, Emergency provisions and Amendment procedure.	II	Understanding

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	PSO1	PSO2	PSO3
CO1						3		3			3			
CO2						3		3	3	3	3			
CO3						3			3		3			
CO4						3			3		3			

Assessments:

Assessment	Marks
ISE	50

Course Contents:

Unit 1:-Constitution – Structure and Principles : Meaning and importance of Constitution : Making of Indian Constitution – Sources : Salient features of Indian Constitution	**4 Hrs.**
Unit 2:- Fundamental Rights and Directive Principles : Fundamental Rights & Fundamental Duties : Directive Principles of State Policy	**10 Hrs.**
Unit 3:-Union Government & Executive : President of India – Qualification, Powers and Impeachment : Lok Sabha & Rajya Sabha Sabha- Composition, Powers & Functions, Scope to amendment in Constitution	**4 Hrs.**
Unit 4:- State Government & Executive 4.1 : Governor – Qualification, Appointment, Powers & Functions : Legislative Assembly & Legislative Council – Composition, Powers & Functions	**4Hrs.**
Unit 5:-The Judiciary 5.1 : Features of Judicial System in India : Hierarchy of Courts, Composition and Jurisdiction	**4Hrs.**
Unit 6:- Local Self Government and other constitutional Organizations 6.1 : 73rd and 74th Constitutional Amendments : Public Service Commission, Election Commission, CAG, National Commissions for SC, ST etc.	**4 Hrs.**

Textbooks and references:

1. Durga Das Basu Introduction to the Constitution of India(23rd Gurgaon of India edn.) LexisNexis,; 2018
2. Shripad Desai Shridhar Constitutional Law-I -- S.S. Law Publicaion 2021
3. Shripad Desai Shridhar Constitutional Law-II -- S.S. Law Publicaion 2021
4. https://www.india.go v.in/sites/upload_file s/npi/files/coi_part_full.pdf Constitution of India (Full Text), India.gov.in -- National Portal of India
5. Durga Das Basu, Bharatada Samvidhana Parichaya -- Gurgaon LexisNexis Butterworths Wadhwa 2015

Title of the Course: Industrial Organization and Management	L	T	P	Credit
Course Code: UBTEM0306	2	-	-	2

Course Pre-Requisite: The students should have a basic knowledge need of management in any industry or organization.

Course Description: This course gives idea about the industrial organization and management principles.

Course Objectives:

1. List and explain the levels of management, their functions and functional areas of management.
2. Justify the need to study different managerial functions.
3. To understand basics principles of material management.
4. To understand process of manpower planning and its sources.

Course Outcomes:

CO	After the completion of the course the student will be able to	Bloom's Taxonomy	
		Level	Descriptor
CO1	Understand the need of implementation of management principles	1	Understand
CO2	Understand and analyze the need of study of different managerial functions.	4	Analyze
CO3	Understand and apply the basics principles of material management.	3	Apply
CO4	Understand the process of manpower planning and its sources.	1	Understand

CO-PO-PSO Mapping:

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1								3	3	2	2			
2								3	3	2	2			
3								3	3	2	2		2	
4								3	3	2	2		2	

Assessments:

ESE: Assessment is based on 100% all course content.

Assessment	Marks
ESE	50

Course Content

UNIT:1 Introduction to Management and Principles of Management: Concept of Industrial Management, Industrial Management Process, Importance of Industrial Management., levels of management, principles and significance of scientific management.	**7 Hrs**

UNIT:2 Functions of Management: Planning- Meaning, Importance, Steps, Decision making- Meaning, types process, Communication- Importance, steps in communication, Barriers to communication, Controlling- Meaning, Importance, Steps	**8 Hrs**
UNIT:3 Materials Management: Definition, objectives, duties of material manager, importance **Purchasing**- definition, objectives, purchasing methods, vendor selection and rating.	**7 Hrs**
UNIT:4 Personnel Management: Manpower planning, sources of recruitment- Internal & External sources, Recruitment Procedure, Training and development of staff, Training methods, Performance appraisal	**8 Hrs**

Textbooks and References:

1. M.T. Telsang , Industrial and business Management, (S. Chand and Co. New Delhi)
2. N. K. Hukeri, Organizational Mgmt. and Behaviour, (Electrosted publication. Satara)
3. James A. F. Stoner, R. Edward Freeman Management (Prentice Hall of India, New Delhi)
4. Burton and Thakur, Management Today- Principles and practice- (TATA McGraw Hill Pub., New Delhi)
5. Benham, F., Economics- (Sir Issocpitham and Sons Ltd., London)
6. Seth M. L., Principles of Economics- (L. N. Agarwal Pub., Agra)
7. Harold Koontz, Heinz Weihrich Essentials of Management,(McGraw-Hill)

Title of the Course: Microbiology Laboratory	L	T	P	Credit
Course Code: UBTPC0331	-	-	2	1

Course Pre-Requisite: Basic knowledge of microorganisms

Course Description: Microbiological staining and culturing techniques.

Course Objectives:

1. To demonstrate the structure of microorganism using staining and microscopic techniques.
2. To perform media preparation and describe sterilization techniques.
3. To examine the effect of various physical, chemical, biological factors on microbial growth.

Course Outcomes:

CO	After the completion of the course the student will be able to	Bloom's Taxonomy	
		level	Descriptor
CO1	Demonstrate the structure of microorganism using staining and microscopic techniques	2	Understanding
CO2	Analyze effect of various factors on growth of microbes	3	Applying
CO3	Select sterilization techniques for equipments, glassware, media	4	Analyzing

CO-PO-PSO Mapping:

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	1	2	1	1			1			1		3	3	
2	2	2	3	2	3	3	2	2		2	2	2	3	
3	2		1	1						1	1	3	2	

Assessments:

One component of In Semester Evaluation (ISE) and one component End Semester Examination (ESE) having 67% and 33% weights respectively

Assessment	Marks
ISE	50
ESE(POE)	25

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group discussion/ Internal oral etc.

ESE Assessment is based on practical and oral examination.

Course Contents:

Experiment No. 1:--- Washing of glassware, Preparation of plug, wrapping of glassware, pipettes, standard practicing of tagging **Aim and Objectives:** To Learn various laboratory practices	**2 Hrs.**

Experiment No. 2:--- Preparation of nutrient broth and nutrient agar bacteriological media sterilization using autoclave, sterilization of heat sensitive material, sterilization of glassware using autoclave or hot air oven, preparation of slants and stabs, liquid culturing , aseptic transfers using wire loop and needle **Aim and Objectives:** To Learn preparation of media, sterilization techniques and aseptic transfers	**2 Hrs**
Experiment No. 3:---Spread, pore, streak - Plating methods for pure culture, Observation of growth and its interpretation **Aim and Objectives:** To learn various culturing techniques.	**2 Hrs**
Experiment No. 4:---Effect of temperature on microbial growth. **Aim and Objectives:** To examine effect of temperature on metabolic activities of microorganisms.	**2 Hrs**
Experiment No. 5:--- Effect of pH on microbial growth. **Aim and Objectives:** To examine effect of pH on metabolic activities of microorganisms.	**2 Hrs**
Experiment No. 6:--- Effect of antibiotics on microbial growth **Aim and Objectives:** To examine effect of various antibiotics on metabolic activities of microorganisms.	**2 Hrs**
Experiment No. 7:--- Gram staining **Aim and Objectives:** To perform gram staining.	**2 Hrs**
Experiment No. 8:--- Motility testing **Aim and Objectives:** To perform motility testing.	**2 Hrs**

Textbooks and references:

1 Stanier R.Y. *et al* "General Microbiology", Macmilan press, 5th edition. 1999.

2 Pelczar, Jr. *et. al*, "Microbiology", Tata McGrawHill 5th Edition 1999

3 Schlegel H.G. "General Microbiology" Cambridge University Press;7th edition, 1999

4 M T Madigan *et al* "Brock biology of microorganism", Pearson, 14th edition. 2014.

5 Purohit,S.S. "Microbiology", Agrobios, 6th edition. 1999.

Title of the Course: Biochemistry Laboratory	L	T	P	Credit
Course Code: UBTPC0332	-	-	2	1

Course Pre-Requisite: Basic knowledge of chemistry.

Course Description: This lab is related to the qualitative and quantitative analysis of biomolecules.

Course Objectives:

5. To analyze the biomolecules qualitatively and quantitatively in a given sample.

Course Outcomes:

CO	After the completion of the course the student will be able to	Bloom's Taxonomy	
		level	Descriptor
CO1	Analyze the biomolecules qualitatively and quantitatively from given sample	4	Analyze

CO-PO-PSO Mapping:

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	1	1	1	2	2							3		

Assessments:

One component of In Semester Evaluation (ISE).

Assessment	Marks
ISE	25

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

Lab Experiment Contents:

Experiment No. 1:---Preparation of buffers, molar and normal solutions. Aim and Objective: To prepare buffers and solutions.	**02 Hrs.**
Experiment No.2:---Isoelectric precipitation of casein present in Milk. Aim and Objective: To perform the isoelectric precipitation of casein present in milk.	**02 Hrs.**
Experiment No. 3:--- Spectrophotometry. Aim and Objective: To identify absorption maximum wavelength and verify Beer's law.	**02 Hrs.**
Experiment No. 4:---Qualitative tests for carbohydrates Aim and Objective: To analyze presence carbohydrates both qualitatively	**02 Hrs.**
Experiment No. 5:---Estimation of reducing sugars by DNS method Aim and Objective:. To analyze presence of different types of amino acids	**02 Hrs.**
Experiment No. 6:---Protein analysis – qualitative detection Aim and Objective: To analyze presence of different types of proteins	**02 Hrs.**
Experiment No. 7:---Estimation of total proteins by Lowry's method Aim and Objective: To estimate the total protein content in the sample	**02Hrs.**
Experiment No. 8:---Quantitative Estimation of Amino Acids by Ninhydrin Aim and Objective: To estimate the amino acid in the given sample	**02 Hrs.**

Experiment No. 9:---Lipid analysis – qualitative and quantitative detection **Aim and Objective:** To analyze presence of lipids qualitatively and quantitatively	**02 Hrs.**
Note: Any 8 experiments out of 9 may be conducted.	

Textbooks and references:

1. Plummer D.T.; Introduction toPractical Biochemistry, 3rd Edition, TMH Pub. New Delhi, 1987.
2. J. Jayaraman, Laboratory Manual in Biochemistry, 2nd Edition, New Age International, 2011.

Title of the Course: Cell and Molecular Biology Laboratory Course Code: UBTPC0333	L	T	P	Credit
	-	-	2	1

Course Pre-Requisite:

Student must have a basic knowledge of macromolecules and organelle's basic structure, organization and characteristics.

Course Description:

The course contains basic features of cellular organelle's, cell cycle and control, stem cells, DNA analysis and its expression.

Course Objectives:

1. To perform and study isolation of Cell organelles and cell cycle control
2. To isolate and estimate DNA and RNA from various sources
3. To identify and analyze the technique of in vitro transcription

Course Outcomes:

CO	After the completion of the course the student will be able to	Bloom's Taxonomy	
		level	Descriptor
CO1	Acquaint students with isolation and define of cellular organelles and cell cycle control.	2	Understanding
CO2	Isolate and estimate DNA and RNA from various sources	3	Applying

CO-PO-PSO Mapping:

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	1	1	1	2	2							3		
2	1	1	1	2	2							3		

Assessments:

Assessment	Marks
ISE	25
ESE(OE)	25

Experiment No. 1:--- **Aim:** Isolation of Cellular Organelles and visualize under microscope. **Outcome:** Isolate the Mitochondria or chloroplast from eukaryotic sources.	**2 Hrs.**
Experiment No. 2:--- **Aim:** Perform and observe cell division and cell cycle. **Outcome:** Visualise and observe meiosis from onion root tips.	**2 Hrs.**
Experiment No. 3:--- **Aim:** Isolation of Cellular Organelles and visualize under microscope. **Outcome:** Isolate the nucleus from eukaryotic sources.	**2 Hrs.**
Experiment No. 4:--- **Aim:** Perform and observe cell division and cell cycle. **Outcome:** Visualise and observe Mitosis from onion root tips.	**2 Hrs.**

Experiment No. 5:--- **Aim :** To perform agarose gel electrophoresis of DNA or RNA **Outcomes:** To visualize separated DNA fragments according to their molecular size by applying an electric current to the gel matrix.	**2 Hrs.**
Experiment No. 6:--- **Aim:** Spooling of chromosomal DNA from onion cells. **Outcomes: 1.** Isolation and partial purification of DNA from mashed onion. 2. Precipitation of DNA by Ethanol. 3. Observation and spooling of precipitated DNA.	**2 Hrs.**
Experiment No. 7:--- **Aim:** To measure the concentration of DNA from given sample **Outcome:** To calculate the concentration of DNA from given formula by spectrophotometric method	**2 Hrs.**
Experiment No. 8:--- **Aim:** To isolate plasmid DNA from bacteria by alkaline lysis method. **Outcome:** 1. To isolate plasmid DNA from *E. coli* bacteria by alkaline lysis method.	**2 Hrs.**

Textbooks and references:

1. Gerald Karp Cell & Molecular Biology-Concepts & experiments 3 John Wiley and sons. New York 2002
2. Roy S.C. and De Kalyan Kumar Cell Biology 4 New Central Book Agency 2019
3. J.F. Sambrook and D.W. Russell Molecular Cloning Vol. I, II & III 4 Cold Spring Harbor 2002 University Publishing
4. Maxine Singer and Paul Berg Genes and Genomes 2 University Science book, Mill Vally California Publication. 1991

Title of the Course: Mini Project I	L	T	P	Credits
Course Code: UBTIL0371	-	-	2	1

Course Pre-Requisite: All theoretical concepts and practical skills learnt in second year courses

Course Description: Mini Project I includes a group of students working on a problem statement provided
with preparation of work plan, execution and submission of a synoptic summary in the form of report.

Course Objectives: 1. To explain the approach to address the problem statement provided using the fundamental understanding of concepts.
To develop a plan of work based on aim and objectives finalized.
To elaborate the synoptic plan and executed project work effectively using oral and written means.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive Level	Bloom's Cognitive Descriptor
CO1	To explain the approach to address the problem statement provided using the fundamental understanding of concepts.	2	Understanding
CO2	To develop a plan of work based on aim and objectives finalized.	3	Applying
CO3	To elaborate the synoptic plan and executed project work effectively using oral and written means	3	Applying

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3			1			3			3		
CO2		3	2			1			2	3			3		
CO3	3	3	3	3	1			1	3	3	2	1	3		3

Assessment Scheme:
One component of In Semester Evaluation (ISE) with 100% weightage

Assessment Component	Marks
ISE	50

ISE is based on rubrics based progressive report submission and presentation to supervisors.

Description :

The objective of the project is to make use of the knowledge gained by the student at various stages of the degree course. This helps to judge the basic understanding of concepts in various courses, capacity of planning and executing the application of the knowledge. Reporting the outcomes effectively. Projects Areas can be related to - Microbiology Biochemistry Cell Biology Molecular Biology Enzyme Technology Immunology Genetic Engineering Bioinformatics Fluid Mechanics Heat Transfer	

Title of the Course: Computational Statistics Course Code: UBTMM0341	L	T	P	Credit
	2	-	-	2

Course Pre-Requisite: NIL

Course Description: In this course students will learn topics from Probability, Statistics and Statistical Inference.

Course Objectives:

The objective of this course is to familiarize the students with statistical techniques. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

Course Outcomes:

COs	Upon completion of the course, students shall have ability to	Blooms Level	Descriptor
CO1	Understanding concepts of the statistics and probability	II	Understand
CO2	Make use of statistical techniques to practical applications.	III	Apply
CO3	Make Use of R Programming Language to apply statistical methods to the given data.	III	Apply
CO4	Analyze the right test statistic to test the hypothesis formulated from the given data.	IV	Analyze

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2	PSO3
CO1	3	2										1		
CO2	3	2										3		
CO3	3	2										2		
CO4	3	2										3		

Assessment Scheme: End Semester Examination (ESE) having 100% weightage.

Assessment Component	Marks
ESE	100

Course Contents

Unit No.	Unit Title and Contents	Hours
1	**Exploratory Data Analysis** Different types of statistical problems and related data analysis. Concept of population, sample and statistical inference through examples. Summarization of univariate data; graphical methods, measures of location, spread.	7 Hrs
2	**Probability and Probability Distributions** Elementary concepts of probability: experiments, outcomes, sample space, events, Conditional probability, independence. Random variable, probability distribution and properties; probability mass/density function, cumulative distribution function, expectation, variance. Probability Distributions: Binomial, Poisson and Normal.	8 Hrs

3	**Statistical Inference** Concept of estimation (point and interval), Concept of testing of hypotheses. Significance level, size, power and p-value. Sampling distributions: z test, t-test, chi-square test for Categorical data analysis: contingency tables, measures of association, Goodness of fit, test of independence.	**8 Hrs**
4	**Introduction to R- Package:** R-software: Introduction to R, data types and objects, operators, data input, data import and export, built in functions for descriptive statistics, random sampling and computation of pdf, cdf and quantiles of well known distribution. Strings and Dates in R. apply family of functions. Saving work in R. Graphical procedures, frequencies and cross tabulation, built in functions: lm, t.test, z.test, var.test, chisq.test, aov. Control statements. Programming, user defined functions, R-packages. R-studio.	**7 Hrs**

Textbooks:

1. Probability and Statistics for Engineers (4th Edition), I.R. Miller, J.E. Freund and R. Johnson.
2. Fundamentals of Statistics, vol. I & II, A. Goon, M. Gupta and B. Dasgupta, World Press.

Reference Books:

1. Introduction to the Theory of Statistics, A.M. Mood, F.A. Graybill& D.C. Boes.
2. Hands-on Programming with R,- Garrett Grolemund
3. R for Everyone: Advanced Analytics and Graphics, Jared P. Lander

Title of the Course: Fundamentals of Financial Accounting	L	T	P	Credit
Course Code: UBTMM0342	2	-	-	2

Course Pre-Requisite: Nil

Course Description:

Course Objectives:

1. To understand the accounting procedure and preparation of financial statements.
2. To understand the various business forms and its accounting
3. To understand different assets and liabilities, profit and profitability of a business
4. To know the accounting of non-profit organizations

Course Outcomes:

CO	After the completion of the course the student will be able to	Bloom's Taxonomy	
		level	Descriptor
CO1	Understand significance of accounting in financial management and related terminologies	I	Identify
CO2	Understand forms of Business organizations and accounting procedures	I	Identify
CO3	Analyze Profitability of business from financial accounting	II	Analyze

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO 11	PSO1	PSO2
CO1	-	-	-	-	-	-	- -	-		3	2	-	-
CO2	-	-	-	-	-	-	- -	-	-	3	2	-	-
CO3	-	-	-	-	-	-	- -	-	-	3	2	-	-
CO4	-	-	-	-	-	-	- -	-	-	3	2	-	-

Assessments:

End Semester Examination (ESE) having 100% weightage.

Assessment Component	Marks
ESE	100

Course Contents:

Unit-1:	**8 Hrs**
Introduction, need and importance of Financial accounting, Important terms of accounting, Internal and external users of Accounting information, Accounting principles, Accounting cycle, Accounting system: single entry and double entry, Nature of accounting transactions, subsidiary books & Cash Book,	

Unit-2: Depreciation: meaning, need and methods, provisions and reserves Goodwill: meaning, valuation methods Bills of Exchange: Negotiable Instrument Act, Parties to BOE, Transactions with BOE Royalty, Patent, Copyright, Trademark, AGMARK	**8 Hrs**

Unit-3: Journal, Ledger, Trial Balance, preparation of final accounts: Trading, Profit & Loss Account & Balance sheet of Sole trader, partnership firm and Company final account	**8Hrs**
Unit-4: Accounting of Non-Profit making Organizations: Amalgamation, Absorption and Take-over Computerised accounting and reporting system	**6 Hrs**

Textbooks and references:

1. Advanced Accountancy - Shukla M.C. and Grewal T.S.
2. Financial Accounting by V.K.Goyal
3. Financial Accounting for Management: An Analytical Perspective – Ambrish Gupta
4. Financial Accounting by S. N. Maheshwari
5. Introduction to Accounting by T.S, Grewal
6. Financial Accounting study notes by: The Institute of Cost Accountants of India (ICAI)

Title of the Course: Heat Transfer	L	T	P	Credit
Course Code: UBTPC0401	2	-	-	2

Course Pre-Requisite: Basic knowledge in thermodynamics, fluid mechanics, units, dimensions and conversions.

Course Description: The course will introduce the fundamental concepts of various modes of heat transfer. It deals with fundamental applied aspects of process design principles of heat transfer equipments and governing equations.

Course Objectives:

1. To introduce the mechanism and principles of heat transfer.
2. To explain heat transfer to fluids without phase change and with phase change
3. To explain different types of heat exchange equipments.
4. To analyze performance and design of evaporator.

Course Outcomes:

CO	After the completion of the course the student will be able to	Bloom's Taxonomy	
		level	Descriptor
CO1	Explain the mechanism and principles of heat transfer.	2	Understanding
CO2	Calculate the heat transfer co-efficient in laminar, transition and turbulent regime	3	Applying
CO3	Analyze the design and performance of heat exchangers and Evaporators	4	Analyzing

CO-PO-PSO Mapping:

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	2	2												
2	3	2	2									1		
3	3	2	3	1								2		

Assessments:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and **ISE 2** are based on Assignment/Declared test/Quiz/Seminar/Group discussions/Presentation etc.

MSE is based on 50% of course content

Unit:1 Mechanism of heat flow: Conduction, Convection, radiation. Heat transfer by conduction in solids: Fourier's law, steady state heat conduction through walls, single and multilayer. Heat flow through a cylinder and sphere, unsteady state heat conduction, and critical radius of lagging, Problems.	**6 Hrs.**

UNIT:2 Principles of heat flow in fluids: Typical heat exchange equipment, co-current and counter current flow. Energy balances, rate of heat transfer, LMTD, overall and individual heat transfer coefficient. Calculation of overall heat transfer co-efficient from individual heat transfer coefficients, fouling factors. Problems	**8 Hrs.**
UNIT:3 Heat transfer to fluids with and without phase change: Thermal boundary layer, heat transfer by forced convection in laminar flow. Heat transfer by forced convection in turbulent flow, Heat transfer in transition region, heat transfer by forced convection outside tubes, Estimation of heat transfer coefficient in natural convection, Heat transfer to fluids with phase change: condensation, Problems	**8 Hrs.**
UNIT:4 Heat exchange equipments: Types of heat exchangers, single and multi-pass heat exchangers, correction of LMTD for multi-pass exchangers. Design calculations of heat exchangers. Evaporation**,** Types of evaporators, Performance of tubular evaporator- capacity, economy. Enthalpy balances for single effect evaporators	**8 Hrs.**

Textbooks and references:

1. Pauline M. Doran 'Bioprocess Engineering Principles', Elsevier Science & Technology Books, May 1995
2. McCabe, W. L.,Smith, J. C., and Harriott,P "Unit Operations of Chemical Engineering",., McGraw-Hill, 6th.Ed., 2001
3. Holman J.P.,"Heat Transfer", McGraw-Hill, 9th.Ed., 2002
4. Dutta B.K.,"HeatTransfer:Principles and Applications",PHI, 2001
5. Kern D. Q.,"Process Heat Transfer", Tata McGraw-Hill Edition, 1997
6. Coulson, J.M., Richardson, J.F.,"Chemical Engineering",Vol. I.,Pergamon and ECBS, 1970.

Title of the Course: Genetic Engineering	L	T	P	Credit
Course Code: UBTPC0402	3	-	-	3

Course Pre-Requisite: Student must have a knowledge of basic Molecular Biology

Course Description: Course contain basic processes used in Genetic Engineering, Gene Manipulation techniques and their applications**.**

Course Objectives: The student will be able to:

1) To define Biohazards and bioethics as well as need of Genetic Engg.
2) To categorize, select and use most suitable enzymes as well as vectors for gene manipulation
3) To explain and apply the basic principles of cloning, genetic manipulations and DNA library
4) To analyze and design various molecular techniques for r DNA technology
5) To evaluate heterologous protein expression and applications in Protein Engineering

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Taxonomy	
		level	Descriptor
CO1	Define Biohazards and bioethics as well as need of Genetic Engineering	3	Applying
CO2	Categorize, select and use most suitable enzymes as well as vectors for gene manipulation	2	Understanding
CO3	Explain and apply the basic principles of cloning, genetic manipulation DNA library	2	Understanding
CO4	Explain various molecular techniques for r DNA technology	2	Understanding

CO-PO-PSO Mapping:

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	2			1								3		
2	2			1								3		
3	2			2	2							3		
4	2			2	2							3		

Assessments:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and **ISE 2** are based on Assignment / Declared test / Quiz / Seminar / Group discussions / Presentation etc.

MSE is based on 50% of course content

ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Unit 1: Recombinant DNA technology The recombinant DNA concept, Important Discoveries, Principles of cloning, Biohazards; risk for human health, environment, agriculture, interaction with non-target organism and Bioethics of Genetic Engineering	**6Hrs.**
Unit 2: The Tools – Enzymes Nucleases, Restriction Endonucleases, Gibson assembly, Ligation independent , recombinant enzymes, DNA ligase, DNA polymerase I, Reverse transcriptase, Poly A polymerase. Synthetic Biology	**7 Hrs.**
Unit 3: The Tools – Vectors Vector Systems -*E coli* systems –Plasmid Vectors, Bacteriophage vectors, Plasmid-Phage combination vectors, Eukaryotic Host-Vector Systems: Yeast, Insect, Animal, Plant.	**9 Hrs.**
Unit 4: The Means: Constructing, Cloning, and Selecting Inserts, Ligating vectors to insert, Infection, Transfection, and Cloning, Screening Cloned Populations of Recombinants, Genomic Libraries:- construction of genomic library, cDNA library: synthesis of cDNA screening of cDNA clone, Ligation independent cloning.	**7 Hrs.**
Unit 5: Molecular research procedures DNA sequencing techniques; Maxam and Gilbert's chemical degradation method, Sanger and Courlson's dideoxynucleotide chain termination method, PCR and its types, Blotting Techniques; southern, northern blotting Gene silencing techniques, CRISPER- CAS 9, Knockout Technology.	**7 Hrs.**
Unit 6: Methods of protein engineering Random and Site directed mutagenesis, PCR and error PCR based strategies for protein engineering, DNA/Gene Shuffling, Directed molecular evolution strategy- Phage Display systems, Cell Surface display systems, CAR-T therapy.	**8 Hrs.**
Textbooks and references: 1. Bernard R. Glick, Cheryl L. Patten Molecular Biotechnology: Principles and Applications of Recombinant DNA 6 (American Society for Microbiology) 2022 2. Benjamin Lewin Genes VIII 8 (Benjamin Cummings) 2003 3. Singer M and Berg P Genes & Genomes, a Changing Perspective 1 uscibooks 1992 4. Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter Molecular Biology of the Cell 4 Garland Science 2002	

Title of the Course: Immunology	L	T	P	Credit
Course Code: UBTPC0403	3	-	-	3

Course Pre-Requisite:
Basic knowledge of Cell biology and general biology

Course Description: The course covers types of immunity, antigen, antibody, cells and organs involved in immunology, faulty B: T cell interactions hypersensitivity, autoimmunity, cancer immunology and antigen
presentation.

Course Objectives:
1. To describe the structure, component, function and mechanism of immune system.
2. To explain mechanisms involved in immune system development and responsiveness.
3. To apply the knowledge of immunotechniques in various industries.

Course Outcomes:

CO	After the completion of the course the student will be able to	Bloom's Taxonomy	
		level	Descriptor
CO1	Explain the structure, component, function and mechanism of immune system	2	Understanding
CO2	Explain mechanisms involved in immune system development and responsiveness	2	Understanding
CO3	Apply the knowledge of immunotechniques in various industries	3	Applying

CO-PO-PSO Mapping:

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	2	2	1	1	2		3				3	3		
2	2	2	1	1	2		3				3	3		
3	2	2	1	1	2		3				3	3		

Assessments:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and **ISE 2** are based on Assignment / Declared test / Quiz / Seminar / Group discussions / Presentation etc.

MSE is based on 50% of course content

ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents:

Unit 1:--- Outlines of Immunology - Types of Immunity, Primary and Secondary lymphoid organs, Antigen structure and Function, Antibody structure and Function	**7 Hrs**
Unit 2:--- Immune Response - Cells of Immune system- Macrophages, T cells, B Cells, NK Cells, Mast cells. Subtypes of T Cells and their functions: Cytotoxic T cells, Helper T cells, Suppressor T cells and Regulatory T cells. Cytokines and their biological role; Phagocytosis; Humoral and Cell mediated Immune Response	**8 Hrs**
Unit 3:--- Immunity of diseases - CD4 and CD8 mediated antibacterial, antihelmenthic, antiviral immunity. MHC and its significance, Hypersensitivity Type I, II, III, IV	**8 Hrs**
Unit 4:--- Transplantation and Tumor Immunity -Transplantation - immunological basis of graft rejection, Immunological tolerance sub-acute, acute and chronic graft rejection Tumor immunology – ADCC, natural killer cell and CTL mediated Immunity	**7 Hrs**
Unit 5:--- Autoimmune diseases and Immunodeficiencies - SLE, Rheumatoid Arthritis. T cell mediated immunodeficiency, B cell mediated immunodeficiency/ B combined cell mediated immunodeficiency, Disorders of phagocytosis, complement system and Disorders of complement	**8 Hrs**
Unit 6:---Immunotechniques - Antigen – Antibody interactions- cross reactivity, precipitation, agglutination, neutralization, opsonization etc and their applications	**7 Hrs**
Textbooks and references: 1 Lydyard, P.M. *et al* "Immunology", Viva Books, 1th edition. 1999. 2 Roitt, I.M, "Essential Immunology", Blackwell Scientific, 9th Edition 1997 3 Kuby, J Freeman "Immunology" Oxford Press;3rd edition, 1999 4 Janeway, et al "Immunobiology", Garland Science, 3rd edition. 2004. 5 William E Paul *et al* "Fundamental immunology", Lippincott Williams press, 5th edition. 2003.	

Title of the Course: Enzyme Technology	**L**	**T**	**P**	**Credit**
Course Code: UBTPC0404	**2**	**-**	**-**	**2**

Course Pre-Requisite: Basic knowledge of amino acids and chemistry.

Course Description: Study of enzymes, their classification, production, mechanism of enzyme catalysis, kinetics, immobilization techniques and its application in industrial sector.

Course Objectives:

1. To understand the various concepts of enzymes, their classification, mechanism of catalysis.
2. To apply different kinetics of enzyme, and determination of enzyme activity.
3. To understand different enzyme immobilization techniques along with their applications in different industrial sector.

Course Outcomes:

CO	**After the completion of the course the student will be able to**	Bloom's Taxonomy	
		level	Descriptor
CO1	Explain various concepts of enzymes, their classification, and mechanism of catalysis.	2	Understanding
CO2	Apply enzyme kinetics for calculation of enzyme activity	3	Apply
CO3	Explain the enzyme immobilization techniques and their applications in different industries.	2	Understanding

CO-PO-PSO Mapping:

COs	**POs**											**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	1													
2	1	1			2							3		
3	2	1	2		2							3		

Assessments:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment	**Marks**
ISE1	10
MSE	30
ISE2	10
ESE	50

ISE 1 and **ISE 2** are based on Assignment/Declared test/Quiz/Seminar/Group discussions/Presentation etc.

MSE is based on 50% of course content.

ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

UNIT 1:- Enzymes: Classification and nomenclature, chemical nature and structure of enzymes, coenzyme and cofactors, concept of active site, lock-key hypothesis, induced fit hypothesis, transition-state stabilization hypothesis, specificity of enzymes, chemical mechanisms of enzyme catalysis proximity and orientation effects, distortion or strain, different mechanisms of enzyme catalysis, acid base and covalent catalysis and metal-ion catalysis.	**7 Hrs.**
UNIT 2:- Enzyme kinetics and inhibition: Catalysis, Activation energy, transition state theory, time course of enzymatic reaction, kinetics of single substrate enzyme catalyzed reaction- Michaelis-Menten equation, significance of Km and Vmax, turnover number, catalytic efficiency, modifications of Michaeli's-Menten plot, allosteric enzymes and sigmoidal kinetics, enzyme inhibition reversible and irreversible inhibition, kinetics of inhibition.	**7 Hrs.**
UNIT 3:- Experimental measures of enzyme activity Concept of enzyme activity, initial velocity measurements- direct, indirect, and coupled assays; analysis of progress curves; continuous versus end point assays; initiating, mixing and stopping reactions, detection methods- assays based on optical spectroscopy, fluorescence measurements, radioisotopic measurements, reporting enzyme activity data, enzyme stability-stabilizing enzyme during storage, enzyme inactivation during activity assay.	**7 Hrs.**
UNIT 4:- Enzyme immobilization and applications of enzymes Concept and need of enzyme immobilization, Methods of immobilization - Immobilization on Supports: carrier-bound enzymes, immobilization by entrapment (encapsulation), carrier-free immobilization by cross-linking, immobilization on/in nonmaterial's, terminology and general considerations-immobilization yield, the immobilization efficiency and the activity recovery, properties of immobilized enzymes. terminology and general considerations-immobilization yield, the immobilization efficiency and the activity recovery, properties of immobilized enzymes. Enzyme biosensors, Applications of enzymes in food, leather, detergent industries etc., use of enzymes in drug and medicine	**9 Hrs.**
Textbooks and references: 1. Travor Palmer and Philip Bonner, Enzymes, Horwood Publishing Series,2007 2. Andr´ esIllanes, Enzyme Biocatalysis principles and applications, Springer,2008 3. Nelson D. et al, Lehninger: Principles of Biochemistry, Worth Publishers,2004	

Title of the Course: Bioinformatics	L	T	P	Credit
Course Code: UBTPC0405	3	-	-	3

Course Pre-Requisite: Biochemistry, Molecular Biology, Genetic Engineering, Chemistry, Mathematics and Computer Literacy.

Course Description: This subject provides information of biological databases, basics of matrices, genomics, proteomics and various applications of bioinformatics.

Course Objectives:

1. To introduce and impart students to Bioinformatics, its Applications and understandingofdatabasesofBioinformaticswithdifferencesbetweenvarious databases.
2. To learn and demonstrate the data storage, retrieval from different resources and sequence, structure visualization.
3. To illustrate the tools required the questions related genomics and proteomics.
4. To provide the opportunity to think, apply the tools and methods used in the course eg: to address the issues related to structural bioinformatics.

Course Outcomes:

CO	After the completion of the course the student will be able to	Bloom's Taxonomy	
		level	Descriptor
CO1	Explain the importance, opportunities, challenges, applications and the differences between various databases in Bioinformatics.	2	Understanding
CO2	Demonstrate the knowledge of data storage, retrieval from different resources, sequence alignment and structure visualization.	2	Understanding
CO3	Make use of the tools required to answer the questions related to genomics and proteomics.	3	Applying
CO4	Make use of the tools and methods used in the course to address the issues related to structural bioinformatics.	3	Applying

CO-PO-PSO Mapping:

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	1	1		1								2		
2	1	1		1								2		
3				1	3							3		
4				2	3							3		

Assessments:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE1	10
MSE	30

ISE2	10
ESE	50

ISE1 and **ISE2** are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on100%course content with 60-70%weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:--- Introduction and Applications of Bioinformatics History, importance, opportunities and challenges of Bioinformatics. **Data generation**: Generation of large scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, microarray and Next Generation Sequencing: Data Analysis). Applications of Bioinformatics.	**8 Hrs.**
Unit 2:--- Introduction and importance of Databases Primary sequence databases, Secondary sequence databases, Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDBsum).	**7 Hrs.**
Unit 3:---Data storage and retrieval and Interoperability Flat files, relational, object oriented databases and controlled vocabularies. File Format (Genbank, DDBJ, FASTA, PDB, SwissProt). Introduction to Metadata and search; Indices, Boolean, Fuzzy, Neighboring search. The challenges of data exchange and integration. Ontologies, interchange languages and standardization efforts. General Introduction to XML, UMLS, CORBA, PYTHON.	**6 Hrs.**
Unit 4 Sequence Alignments and Visualization Sequence Alignments and Visualization, Introduction to Sequences, alignments and Dynamic Programming, Local alignment and Global alignment (algorithm and example), Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm).Methods for presenting large quantities of biological data: sequence viewers (Artemis, SeqVISTA), 3D structure viewers (Rasmol, SPDBv, Chime, Cn3D, PyMol), Anatomical visualization.	**8 Hrs.**
Unit 5:--Introducing: Genomics and Proteomics Inheritance pattern in eukaryotes, Mutations, Gene variation, Gene-disease association, diagnostic genes and drug targets, genotyping tools - DNA Chips, diagnostic assays. Introduction to proteins, use of peptides as probes. Proteins as drugs; Mass-spec based analysis of protein expression. "Protein Chip"- interactions and detection techniques. Two dimensional PAGE for proteome analysis, Detection of proteins on SDS gels, Protein cleavage, Edman protein microsequencing, Automation in proteomics.	**8 Hrs.**
Unit 6:---Introduction to Molecular Structural Bioinformatics Introduction to Molecular Modeling and Simulation, QSAR and QSPR; brief introduction to protein structure hierarchy. Modeling applications – prediction of secondary structure of Protein and RNA. Docking Process – Protein preparation, ligand building, Setting of boundary box, Prediction of Binding pockets, pocket analysis, running of docking calculations.	**8 Hrs.**

Textbooks and references:

1. Rastogi S. C.,N.Mendiratta., P Rastogi, Bioinformatics:Methods and Applications, PHI Learning,2013.
2. David Mount, Bioinformatics: sequence and genome analysis, Cold springer harbor press,2004.
3. T.K.Attwood and Parry-SmithD.J, Introduction to Bioinformatics, Pearson Education Ltd.,2007.
4. Sabesan, Genomics and Proteomics, Ane Books, 2007.

Title of the Course: Environmental Studies	L	T	P	Credits
Course Code: UBTVE0406	2	-	-	2

Course Pre-Requisite: Students shall have knowledge of basic science (Physics and Chemistry)

Course Description: The objective of the course is imparting fundamental knowledge and awareness of Environmental Studies among students and importance of conservation of environment.

Course Objectives:

At the end of the course students will be able to :

1. Study scope and importance of natural resources, ecosystems, biodiversity for creating awareness and their conservation in multiple disciplines.
2. Learn various types of pollution, their impacts and control measures for minimizing pollution and sustainable development.
3. Understand social issues related to environment, environmental ethics and human rights towards environment.
4. Study various laws and regulations related to environment and its applicability in society and industries

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive Level	Bloom's Cognitive Descriptor
CO1	Summarize natural resources, importance of ecosystem and conservation of biodiversity with respect to multiple disciplines	2	Understanding
CO2	Explain causes, effects, solutions for various pollution problems and its minimization strategies.	2	Understanding
CO3	Interpret environmental ethics and their implementation for betterment of environment and human life.	2	Understanding
CO4	Summarize the requirements of laws and regulations for environmental conservation and applicability of legislations in society and industries.	2	Understanding

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1														
CO2							2							
CO3								2						
CO4						2								

Assessment Scheme:

Assessment Component	Marks
ISE	50

Course Contents:

Unit 1: Nature of Environmental Studies — 4 **Hrs.**

Definition, scope and importance, Multidisciplinary nature of environmental studies, Need for public awareness.

Unit 2: Natural Resources and Associated Problems a) Forest resources: Use and over-exploitation, deforestation, dams and their effects on forests and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam's benefits and problems. c) Mineral resources: Usage and exploitation. Environmental effects of extracting and using mineral resources. d) Food resources: World food problem, changes caused by agriculture effect of modern agriculture, fertilizer-pesticide problems. e) Energy resources: Growing energy needs, renewable and nonrenewable energy resources, use of alternate energy sources. Solar energy, Biomass energy, Nuclear energy. f) Land resources: Solar energy, Biomass energy, Nuclear energy, Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of individuals in conservation of natural resources.	5 **Hrs.**
Unit 3: Ecosystems Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers. Energy flow in the ecosystem, Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristics features, structure and function of the following ecosystem :- a) Forest ecosystem, b) Grassland ecosystem, c) Desert ecosystem, d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).	4 **Hrs.**
Unit 4:Biodiversity and its conservation Introduction- Definition: genetic, species and ecosystem diversity. Bio-geographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. India as a mega- diversity nation, Western Ghat as a biodiversity region. Hot-spot of biodiversity. Threats to biodiversity habitat loss, poaching of wildlife, manwildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity	4 **Hrs.**
Unit 5: Environmental Pollution Definition: Causes, effects and control measures of: Air pollution, Water pollution, soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.	4 **Hrs.**
Unit 6: Social Issues and the Environment Disaster management: floods, earthquake, cyclone, tsunami and landslides. Urban problems related to energy Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issue and possible solutions. Global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products.	4 **Hrs.**

Unit 7:Environmental Protection	5 **Hrs.**
From Unsustainable to Sustainable development. Environmental Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Population Growth and Human Health, Human Rights.	

Textbooks:

1. Environmental Studies by Dr. P.D.Raut (Shivaji University, Kolhapur)

Reference Books:

1. Miller T.G. Jr., Environmental Science. Wadsworth Publications Co.(TB).
2. Odum, E.P.1971, Fundamentals of Ecology, W.B.Saunders Co. USA,574p
3. Trivedi R.K. Handbook of Environmental Laws, Rules, Guidelines,Compliances and Standards, vol. I and II, Environmental Media (R)

Title of the Course: Heat Transfer Laboratory	L	T	P	Credit
Course Code: UBTPC0431	-	-	2	1

Course Pre-Requisite: Basic knowledge in thermodynamics, fluid mechanics, units, dimensions and conversions

Course Description: To understand the fundamentals of heat transfer mechanisms and its applications.

Course Objectives:

1.To calculate thermal conductivity,

2 To calculate heat transfer coefficient

3. To calculate efficiency of heat exchanger

Course Outcomes:

CO	After the completion of the course the student will be able to	Bloom's Taxonomy level	
CO1	Determine the thermal conductivity of various materials	5	Evaluating
CO2	Determine heat transfer co-efficient for natural and forced convection	5	Evaluating
CO3	Compare the effectiveness of double pipe heat exchangers for parallel and counter flow	4	Analyzing

CO-PO-PSO Mapping:

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	1													
2	2											1		
3	2	2		1										

Assessments:

Assessment	Marks
ISE	25
ESE(OE)	25

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

ESE –Assessment based on oral examination.

ExperimentNo.1:---Heat transfer in metal rod Aim and Objectives: To determine thermal conductivity of metal	**2Hrs.**
Experiment No. 2:--- Heat Transfer through insulating powder Aim and objectives: To determines thermal conductivity of insulating powder	**2Hrs.**
ExperimentNo.3:---Double pipe heat exchanger Aim and Objectives: To determine experimentally Log Mean Temperature Difference(LMTD),Overall heat transferr coefficient(U) and Effectiveness of Parallel flow and Counter flow Heat Exchangers	**2Hrs.**
ExperimentNo.4:---Shell & tube heat exchanger Aim and Objectives; To explain construction and working of shell and tube heat exchanger	**2Hrs.**

ExperimentNo.5:---Forced convection Aim and Objectives: To determine average heat transfer coefficient in forced convection	**2Hrs.**
ExperimentNo.6:---Natural convection Aim and Objectives: To determine average heat transfer coefficient in natural convection	**2Hrs.**
ExperimentNo.7:---Heat transfer through Lagged pipe Aim and Objectives: To determine thermal conductivity of insulating material used in lagged pipe	**2Hrs.**
ExperimentNo.8:---Heat transfer through composite wall Aim and Objectives: To determine the equivalent thermal resistance of composite wall	**2Hrs.**

Textbooks and references:

1. Pauline M. Doran 'Bioprocess Engineering Principles', Elsevier Science & Technology Books, May 1995
2. McCabe, W. L.,Smith, J. C., and Harriott,P "Unit Operations of Chemical Engineering",., McGraw-Hill, 6th.Ed., 2001
3. Holman J.P.,"Heat Transfer", McGraw-Hill, 9th.Ed., 2002
4. Dutta B.K.,"HeatTransfer:Principles and Applications",PHI, 2001
5. Kern D. Q.,"Process Heat Transfer", Tata McGraw-Hill Edition, 1997
6. Coulson, J.M., Richardson, J.F.,"Chemical Engineering",Vol. I.,Pergamon and ECBS, 1970.

Title of the Course: Genetic Engineering Laboratory	L	T	P	Credit
Course Code: UBTPC0432	-	-	2	1

Course Pre-Requisite: Student must have a knowledge of basic Molecular Biology

Course Description: Course contain basic processes used in Genetic Engineering ,Gene Manipulation techniques and their applications

Course Objectives: The student will be able to:

1) To perform restriction digestion and mapping of DNA
2) To demonstrate and design PCR reaction and blotting of nucleic acid
3) To explain and apply size determination and karyotyping of DNA
4) To analyze and perform transformation of DNA in E. coli

Course Outcomes:

CO	After the completion of the course the student will be able to	Bloom's Taxonomy	
		level	Descriptor
CO1	Perform restriction digestion and mapping of DNA	2	Defining
CO2	Demonstrate and design PCR reaction and blotting of nucleic acid	3	Categorizing
CO3	Explain and apply size determination and karyotyping of DNA.	3	Applying
CO4	Analyze and perform transformation of DNA in *E. coli*	4	Analyzing

CO-PO-PSO Mapping:

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	1	1	1	2	2							3		
2	1	1	1	2	2							3		
3	1	1	1	2	2							3		
4	1	1	1	2	2							3		

Assessments:

.

Assessment	Marks
ISE	25
ESE(POE)	25

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

ESE –Assessment based on Practical oral examination.

Experiment No. 1:--- **Aim:** To perform **r**estriction digestion of DNA. **Outcome:** DNA can be cleaved at specific site by RE enzymes and used for gene manipulation.	**2 Hrs.**
Experiment No. 2:--- **Aim:** To perform **r**estriction mapping of Plasmid DNA. **Outcome:** DNA can be cleaved at specific site by RE enzymes and used for formation of restriction map of DNA.	**2 Hrs.**
Experiment No. 3:--- **Aim:** To demonstrate and perform PCR reaction of nucleic acid. **Outcome:** By using this advanced technique, specific segment of DNA can be amplified in vitro.	**2 Hrs.**

Experiment No. 4:--- **Aim:** To perform size determination of DNA or RNA. **Outcome:** Based on molecular marker and semi log graph size of unknown DNA molecule can be determined.	**2 Hrs.**
Experiment No. 5:--- **Aim : Aim:** To perform Southern Blotting of DNA **Outcome:** 1. To blot the DNA on nylon or nitrocellulose membrane.	**2 Hrs.**
Experiment No. 6:--- **Aim:** To perform karyotyping of chromosomes **Outcomes:** Karyotype of chromosome is useful to identify genetic diseases and analysis.	**2 Hrs.**
Experiment No. 7:--- **Aim:** To prepare competent *E. Coli* cells for transformation **Outcome:** The bacterial culture get revived and treated with $Cacl_2$ for making them competent for transformation.	**2 Hrs.**
Experiment No. 8:--- **Aim:**To perform transformation and screening transformants. **Outcome:** The bacterial cultures get transformed by heat shock treatment and later on screened for transformants by blue white screening.	**2 Hrs.**

Textbooks and references:

5. Bernard Glick & Cheryl Patten Molecular Biotechnology: Principles and Applications of Recombinant DNA 6 American Society for Microbiology 2022
6. Benjamin Lewin Genes VIII 8 (Benjamin Cummings) 2003
7. Singer M and Berg P Genes & Genomes, a Changing Perspective 1 uscibooks 1992
8. Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter Molecular Biology of the Cell 4 Garland Science 2002
9. J.F. Sambrook and D.W. Russell Molecular Cloning Vol. I, II & III 4 Cold Spring Harbor University Publishing 2002

Title of the Course: Immunology Laboratory	L	T	P	Credit
Course Code: UBTVS0433	-	-	2	1

Course Pre-Requisite: Basic knowledge of Cell biology & general biology.

Course Description: The course covers types of immunity, antigen, antibody, cells and organs involved in immunology, faulty B: T cell interactions hypersensitivity, autoimmunity, cancer immunology and antigen presentation.

Course Objectives:

1. To identify different cells of immune system using staining and microscopic techniques.
2. To perform immunotechniques.

Course Outcomes:

CO	After the completion of the course the student will be able to	Bloom's Taxonomy	
		level	Descriptor
CO1	Identify different cells of immune system using staining and microscopic techniques	3	Applying
CO2	Analyze the results of immunotechniques	4	Analyzing

CO-PO-PSO Mapping:

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	2		1	2	2		3		3	1	3	3		
2	2		1	2	2		3	3	3	2	3	3		

Assessments:

Assessment	Marks
ISE	25

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group discussion/ Internal oral etc.

Course Contents:

Experiment No. 1:---To examine the cells that comprise the immune system (counts and morphology) **Aim and Objectives:** To perform the examination of the cells that comprise the immune system (counts and morphology)	**2 Hrs.**
Experiment No. 2:---Immunological detection of blood group typing.(A,B, AB and O, Rh Factor) **Aim and Objectives:** To perform blood group typing.	**2 Hrs**
Experiment No. 3:---Ouchterlony double diffusion **Aim and Objectives:** To perform Ouchterlony double diffusion	**2 Hrs**
Experiment No. 4:---Radial immunodiffussion **Aim and Objectives:** To perform Radial immunodiffussion	**2 Hrs**
Experiment No. 5:---Immunoelectrophoresis **Aim and Objectives:** To perform Immunoelectrophoresis	**2 Hrs**
Experiment No. 6:---ELISA **Aim and Objectives:** To perform ELISA	**2 Hrs**
Experiment No. 7:---Western blotting **Aim and Objectives:** To perform western blotting	**2 Hrs**

Experiment No. 8:---Detection of pregnancy by HCG technique **Aim and Objectives:** To perform HCG technique	**2 Hrs**

Textbooks and references:

1 Lydyard, P.M. *et al* "Immunology", Viva Books, 1th edition. 1999.

2 Roitt, I.M, "Essential Immunology", Blackwell Scientific, 9th Edition 1997

3 Kuby, J Freeman "Immunology" Oxford Press;3rd edition, 1999

4 Janeway, et al "Immunobiology", Garland Science, 3rd edition. 2004.

5 William E Paul *et al* "Fundamental immunology", Lippincott Williams press, 5th edition. 2003.

Title of the Course: Mini Project II	L	T	P	Credits
Course Code: UBTIL0471	-	-	2	1

Course Pre-Requisite: All theoretical concepts and practical skills learnt in second year courses

Course Description: Mini Project I includes a group of students working on a problem statement provided with preparation of work plan, execution and submission of a synoptic summary in the form of report.

Course Objectives: 1. To explain the approach to address the problem statement provided using the fundamental understanding of concepts.
2. To develop a plan of work based on aim and objectives finalized.
3. To elaborate the synoptic plan and executed project work effectively using oral and written means.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive Level	Bloom's Cognitive Descriptor
CO1	To explain the approach to address the problem statement provided using the fundamental understanding of concepts.	2	Understanding
CO2	To develop a plan of work based on aim and objectives finalized.	3	Applying
CO3	To elaborate the synoptic plan and executed project work effectively using oral and written means	3	Applying

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3			1			3			3		
CO2		3	2			1			2	3			3		
CO3	3	3	3	3	1			1	3	3	2	1	3		3

Assessment Scheme:
One component of In Semester Evaluation (ISE) with 100% weightage

Assessment Component	Marks
ISE	25

ISE is based on rubrics based progressive report submission and presentation to supervisors.

Description :

The objective of the project is to make use of the knowledge gained by the student at various stages of the degree course. This helps to judge the basic understanding of concepts in various courses, capacity of planning and executing the application of the knowledge. Reporting the outcomes effectively. Projects Areas can be related to - Microbiology Biochemistry Cell Biology Molecular Biology Enzyme Technology Immunology Genetic Engineering Bioinformatics Fluid Mechanics Heat Transfer	

Title of the Course- Python and R for Data Science (MM-I)	L	T	P	Credit
Course Code: UBTMM0441	3	-	-	3

Course Pre-Requisite: Basic Programming languages such as C.

Course Description: This course is intended to learn R and Python programming and apply the knowledge to solve applications of data science in the field of biotechnology.

Course Objectives:

Course Outcomes:

COs	Upon completion of the course, students shall have ability to	Blooms Level	Descriptor
CO1	Understand fundamentals of R and Python Programming (syntax and compilation process)	II	Understand
CO2	Apply the knowledge of R programming to solve the applications	III	Apply
CO3	Apply the knowledge of Python programming to solve the applications	III	Apply

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO3
CO1	1				3									
CO2	1				3	2						3		
CO3	1				3	2						3		

Assessment Scheme: End Semester Examination (ESE) having 100% weightage.

Assessment Component	Marks
ESE	100

Course Contents

Unit No.	Unit Title and Contents	Hours
1	**Basics of R Programming** Overview of R programming, Environment setup with R Studio, R Commands, Variables and Data Types, Control Structures, Array, Matrix, Vectors, Factors, Functions, R packages.	7
2	**Data Visualization using R** Reading and getting data into R (External Data): Using CSV files, XML files, Web Data, JSON files, Databases, Excel files. Working with R Charts and Graphs: Histograms, Boxplots,Bar Charts, Line Graphs, Scatterplots, Pie Charts	8
3	**Statistics with R** Random Forest, Decision Tree, Normal and Binomial distributions, Time Series Analysis, Linear and Multiple Regression, Logistic Regression, Survival Analysis	8

4	**Basics of Python Programming** Basic Syntax, Data types, Functions, List, Tuple, Dictionary, Strings, File Handling	**7**
5	**Essential Tools of Python for Data Science** **Numpy:** Multidimensional Arrays, Reshaping and Stacking, Slicing and logical array operations, Array element wise operations, Numpy datainput/output **Pandas:** Using Series, Using Dataframes, Reindexing, Deleting Items, Advanced Indexing, Common Operations, Displaying dataframes	**7**
6	**Data Visualization using Python** **Matplotlib:** Setting Defaults, Legends, subplots, Spines, Sharing axes **Seaborn:** Automatic Aggragtion , Multiple plots, Distribution plots **Holoviews :** Image Data, Tabular Data, Pandas integration with hvplot Tableau and Power BI: Introduction to power BI and Tablue	**8**

Textbooks:

1) An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team. Version 3.0.1 (2013-05-16). URL: https://cran.r- oject.org/doc/manuals/r-release/R-intro.pdf Fundamentals of Statistics, vol. I & II, A. Goon, M. Gupta and B. Dasgupta, World Press.
2) Python Programming for Data Analysis By José Unpingco · 2021

Reference Books:

1. Python for Data Analysis Data Wrangling with Pandas, NumPy, and IPython By Wes McKinney · 2017
2. Power BI, Excel and Tableau - Business Intelligence Clinic Create and Learn By Roger F. Silva · 2020

Title of the Course: Cost and Management Accounting Accounting (MM-II) Course Code: UBTMM0442	L	T	P	Credit
	3	-	-	3

Course Pre-Requisite:

Course Description:

Course Objectives:

1. To summarize cost associated with engineering projects.
2. To relate accounting information for decision making.
3. To define capital structure of a company and select appropriate sources of finance.

Course Outcomes:

CO	After the completion of the course the student will be able to	Bloom's Taxonomy	
		level	Descriptor
CO1	Understand cost associated in Capital Projects	I	Identify
CO2	Apply the knowledge of management accounting in decision making	I	Identify
CO3	Evaluate Capital projects based on financial analysis	II	Analyze

CO-PO-PSO Mapping:

Assessments:

ESE consists of 100 marks Question Paper with equal weightage to each unit of the Course.

Course Contents:

Unit-1: Cost accounting Objective and scope of cost accounting, the difference between financial accounting, cost accounting, and management accounting, elements of cost, classification of cost, and preparation of cost sheet	**08 Hrs**
Unit-2: Management accounting - I Objectives and functions of management accounting, tools and techniques (ratio analysis) of management accounting,	**7 Hrs**
Unit-3: Management accounting - II The role of management accounting in decision making, concept of Break-even Point	**6 Hrs**
Unit-4: Budget and budgetary control - I Meaning, scope and importance of budget and budgetary control, types of budget, techniques of capital budgeting	**7 Hrs**
Unit-5: Budget and budgetary control - II Types of budget, techniques of capital budgeting	**7 Hrs**
Unit-6: Capital structure Capital structure- concept and theories, cost of capital, sources of finance and financial market, working capital management	**10 Hrs**

References Books-

1. Finance for Engineers, F.K Crundewell, Springer Publication, UK
2. Cost and management accounting, S.P Jain and K.L. Narang, Kalyani Publishers, Delhi
3. Cost and management accounting, Saxena and Vashishta, S. Chand Publication, Delhi
4. Cost and management accounting, M.N Arora, Himalaya Publication, Mumbai
5. Management accounting, I.M Pandey, Vikas Publication, Noida

Reference Journals:

1. The Management accountant, Institute of Cost and Management Accountants, Kolkat