NOIDA INSTITUTE OF ENGINEERING & TECHNOLOGY, GREATER NOIDA, GAUTAM BUDDH NAGAR (AN AUTONOMOUS INSTITUTE)



Affiliated to

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW



Evaluation Scheme & Syllabus

For

Bachelor of Technology Biotechnology

Second Year

(Effective from the Session: 2025-26)

NOIDA INSTITUTE OF ENGINEERING & TECHNOLOGY, GREATER NOIDA, GAUTAM BUDDH NAGAR (AN AUTONOMOUS INSTITUTE)

Bachelor of Technology Biotechnology

Evaluation Scheme

SEMESTER-III

Sl.	Subject	Subject	Types of Periods				E	valuat	tion Schem	es	End Semester		Total	Credit
No.	Codes		Subjects	L	T	P	CT	TA	TOTAL	PS	TE	PE		
1	BCSCC0301	Employability Skill Development - I	Mandatory	2	0	0	60	40	100				100	2
2	BASL0301N	Technical Communications	Mandatory	2	0	0	30	20	50		50		100	2
3	BBT0303	Genetics and Molecular Biology	Mandatory	2	0	0	30	20	50		50		100	2
4	BBT0302	Microbiology	Mandatory	3	0	0	30	20	50		100		150	3
5	BBT0301N	Biochemistry	Mandatory	2	0	0	30	20	50		50		100	2
6	BBT0306X	Analytical Techniques	Mandatory	3	0	0	30	20	50		100		150	3
7	BBT0353	Genetics and Molecular Biology Lab	Mandatory	0	0	4				50		50	100	2
8	BBT0352N	Microbiology and Biochemistry Lab	Mandatory	0	0	4				50		50	100	2
9	BBT0356	Analytical Techniques Lab	Mandatory	0	0	2				25		25	50	1
10	BBT0355	Bioinformatics	Mandatory	0	0	6				50		100	150	3
11	BBT0359X	Social Internship	Mandatory	0	0	2				50			50	1
12	BNC0301Y/ BNC0302Y	Artificial Intelligence and Cyber Ethics / Environmental Science	Compulsory Audit	2	0	0	30	20	50				50	NA
		*Massive Open Online Courses (For B.Tech. Hons. Degree)	*MOOCs											
		TOTAL		16	0	18			350	225	350	225	1150	23

* List of MOOCs Based Recommended Courses for Second year (Semester-III) B. Tech Students

Sr. No.	Subject Code	Course Name	University / Industry Partner Name	No of Hours	Credits
1	BMC0055	Bioinformatics for Biologists: An Introduction to Linux, Bash Scripting, and R	Future Learn	15h	1
2	BMC0009	Probability and Statistics using Python	Infosys Wingspan (Infosys Springboard)	16h	1

PLEASE NOTE: -

- A 3-4 weeks Internship shall be conducted during summer break after semester-II and will be assessed during semester-III
- Compulsory Audit (CA) Courses (Non-Credit BNC0301Y/BNC0302Y)
 - All Compulsory Audit Courses (a qualifying exam) do not require any credit.
 - The total and obtained marks are not added in the grand total.

Abbreviation Used:

L: Lecture, T: Tutorial, P: Practical, CT: Class Test, TA: Teacher Assessment, PS: Practical Sessional, TE: Theory End Semester Exam., CE: Core Elective, OE: Open Elective, DE: Departmental Elective, PE: Practical End Semester Exam, CA: Compulsory Audit, MOOCs: Massive Open Online Courses.

NOIDA INSTITUTE OF ENGINEERING & TECHNOLOGY, GREATER NOIDA, GAUTAM BUDDH NAGAR (AN AUTONOMOUS INSTITUTE)

Bachelor of Technology Biotechnology

Evaluation Scheme

SEMESTER-IV

Sl. No.	Subject	Subject	Types of	Per	iods	5	Eval	luatio	n Schemes		End Sem	ester	Total	Credit
5201100	Codes		Subjects	L	T	P	CT	TA	TOTAL	PS	TE	PE		010010
1	BASCC0401	Employability Skill Development - II	Mandatory	2	0	0	60	40	100				100	2
2	BBT0403N	Fermentation Engineering	Mandatory	3	0	0	30	20	50		100		150	3
3	BBT0402	Immunology and Immunotechnology	Mandatory	3	0	0	30	20	50		100		150	3
4	BBT0405	r-DNA Technology	Mandatory	3	0	0	30	20	50		100		150	3
5	BBT0406	Biophysics and Bioinstrumentation	Mandatory	3	1	0	30	20	50		100		150	4
6		Departmental Elective-I	Departmental Elective	3	0	0	30	20	50		100		150	3
7	BBT0453N	Fermentation Engineering Lab	Mandatory	0	0	4				50		50	100	2
8	BBT0452	Immunology and Immunotechnology Lab	Mandatory	0	0	2				25		25	50	1
9	BBT0407	Structural Bioinformatics	Mandatory	0	0	6				50		100	150	3
10	BBT0459	Mini Project	Mandatory	0	0	2				50			50	1
11	BCSCC0452	Problem Solving Approaches	Mandatory	0	0	2				50			50	1
12	BNC0402Y/ BNC0401Y	Environmental Science / Artificial Intelligence and Cyber Ethics	Compulsory Audit	2	0	0	30	20	50				50	NA
		*Massive Open Online Courses (For B.Tech. Hons. Degree)	*MOOCs											
		Applied English	VAC	1	0	0								
		TOTAL		20	1	16			350	225	500	175	1250	26

* List of MOOCs Based Recommended Courses for Second year (Semester-IV) B. Tech Students

S. No.	Subject Code	Course Name	University / Industry Partner Name	No of Hours	Credits
1	BMC0037	Financial Modelling - Biotech Company	Infosys Wingspan (Infosys Springboard)	20h 18 m	1.5
2	BMC0082	Introduction to AI & ML	Infosys Wingspan (Infosys Springboard)	64h 13m	4

PLEASE NOTE: -

- A 3-4 weeks Internship shall be conducted during summer break after semester-IV and will be assessed during Semester-V
- Compulsory Audit (CA) Courses (Non-Credit BNC0401Y/BNC0402Y)
 - All Compulsory Audit Courses (a qualifying exam) do not require any credit.
 - The Total and obtained marks are not added in the Grand Total.

Abbreviation Used:

L: Lecture, T: Tutorial, P: Practical, CT: Class Test, TA: Teacher Assessment, PS: Practical Sessional, TE: Theory End Semester Exam., CE: Core Elective, OE: Open Elective, DE: Departmental Elective, PE: Practical End Semester Exam, CA: Compulsory Audit, MOOCs: Massive Open Online Courses.

List of Departmental Elective

Sl. No.	Subject Codes	Subject Name	Types of Subjects	Bucket Name	Branch	Semester
1	BBT0411	Biosimilars Technology	Program Elective	Bioprocess	ВТ	IV
2	BBT0413	System Biology	Program Elective	Computational	ВТ	IV
3	BBT0412	Environmental Biotechnology	Program Elective	Environmental	ВТ	IV

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A student will be eligible to get Under Graduate degree with Honours only, if he/she completes the additional MOOCs courses such as Coursera certifications, or any other online courses recommended by the Institute (Equivalent to 20 credits). During Complete B.Tech. Program Guidelines for credit calculations are as follows.

- 1. For 6 to 12 Hours =0.5 Credit
- 2. For 13 to 18 = 1 Credit
- 3. For 19 to 24 = 1.5 Credit
- 4. For 25 to 30 = 2 Credit
- 5. For 31 to 35 = 2.5 Credit
- 6. For 36 to 41 = 3 Credit
- 7. For 42 to 47 = 3.5 Credit
- 8. For 48 and above =4 Credit

For registration to MOOCs Courses, the students shall follow Coursera registration details as per the assigned login and password by the Institute these courses may be cleared during the B. Tech degree program (as per the list provided). After successful completion of these MOOCs courses, the students shall provide their successful completion status/certificates to the Controller of Examination (COE) of the Institute through their coordinators/Mentors only. The students shall be awarded Honours Degree as per following criterion.

- i. If he / she secures 7.50 as above CGPA.
- ii. Passed each subject of that degree program in the single attempt without any grace.
- iii. Successful completion of MOOCs based 20 credits



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Course	Code:	BASL030	1N			Cour	se Nam	e: Techr	nical Co	<mark>mmunic</mark>	ation	L	Т	P	C
		d in: CSE/	CSE (R)/ IT / C :	SE(Twir	1) /IT(T	win)/CS	E(Prof)/	/IT(Prof	f)/M. Tec	h	2	0	0	2
(Int.)/N	IE/BT/I	EC													
		Intermedi	ate leve	l (CEFR) and ab	ove									
Course	-														
1.		nstrate effe						on skills	in diver	se profes	sional se	etting	gs, inc	luding	
		igs, presen			•										
2.		op and app					propriat	e written	commu	nication,	such as	ema	ils, let	ters, mem	ios,
		e', using co	_												1
3.	_	communic	-		on cultu	ıral, orga	ınızatıon	al, and s	situation	al context	is to fos	ter in	clus1v	e and resp	pectful
4	_	sional relat	_		.11.	1.46	. (:		£			:			1.1
4.	_	y digital co fectively ir			_		_	ideo con	Terencin	g, busine	ss mess	agıng	g apps) responsi	biy
Сописо		ne: After o						aa abla t			Dlag	, n, 'c	Vnou	ledge Lev	_{zo1}
Course	Outcor	ne: Arter C	ompien	on or the	course,	me stud	ent win t	be able to	U		(KL)		KIIOW	ledge Lev	CI
CO1	Comp	rehend th	o princi	inles an	d functi	ons of t	ochnica	Loomm	unicati	20	(KL)			(2	
CO2		for specif	•	•						JII.				(3	
CO ₂		nize and p												(3	
CO4		effective								505					
CO5		nstrate th	•	_										(3 (3	
		ing (Scale					ication	tillougi	i uigitai	media.				.3	
		ing (Scale	I. LOW,	Z. Medi		ligii)									
CO-PO Mappi		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P	O11	PSO1	PSO2
CO1															
CO2															
CO3															
CO4															
CO5															
		ts / Syllab	us												
Module						uction to								4 hours	
		chnical Co				tion, Pro		•							
		rriers to C			_	_				nd cultur					1
		gnificance			echnical	commun	ication	Aud	lience	analysis	_	ınte	erests,	backg	round,
•		urrent kno	wledge I	evel	/Tr1	1 ***	4 1							<i>5</i> h	
Module		-1:1 XV		:11		cal Wri		1						5 hours	•
		chnical Wi siness Lett				cteristics nt organi	-		Lintent						
		genda and l								or a me	eting a	nd t	he m	inutes; fo	ormats;
example	_														<u> </u>
Module	e 3					cal Wri								.5. hours	
		o Applicati			-	ring effe	•					_	•	es; brief p	
		port, Propo	osal & te	echnical	Paper		Writi	ing Abs	tractsInt	roduction	ıs & Co	nclus	sions;	important	parts;
and for		:		~											
		nical Writi	ng	Copy I	Editing, l			Plagiaris	sm						
Module			0.00			Speakir								.6. hours	
		mponents		-	_	-	•			rranging	ideas. Ir	npor	tance	of KOPPA	ACT
		pearing fo	r a job ii	nterview										4 1	
Module	e 5				Virtua	l/Remot	e Comn	nunicati	on					.4. hours	;



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Module	e 5.1: R	emote Work Online platforms; Video conferencing Greedy Methods with Exan	nples Si	ich as Activity
Selecti	on, Tas	k Scheduling, Fractional Knapsack Problem.		
		tual Etiquette Professional email ids; usernames		
Module	e 3: Cre	ating Blogs & Vlogs Online content, sources		
		Total Lecture	Hours	24 hours
Textbo				
S.No		Title with publication agency & year	Autho	r
1		nical Communication – Principles and Practices, 4th Edition by Meenakshi		
	Rama	an & Sangeeta Sharma, Oxford Univ. Press, 2022, New Delhi.		
Refere	ence Bo	oks:		
S.No	Book	Title with publication agency & year	Autho	r
1		nnical Communication, 15th Edition by John M. Lannon & Laura J. ak, Pearson, 2021.		
2		ken English- A Manual of Speech and Phonetics (5th Edition) by R K sal & J B Harrison, Orient Blackswan, 2024, New Delhi.		
3	Moh	ness Correspondence and Report Writing by Prof. R C Sharma, Krishna an, and Virendra Singh Nirban (6th Edition), Tata McGraw Hill & Co. 2020, New Delhi.		
4		nical Communication in Virtual Exchange by Francesca Helm, bridge Univ. Press, 2024.		
NPTE	EL/Yo	utube/ Faculty Video Link:		
Modul	e 1	https://onlinecourses.nptel.ac.in/noc24_ge37/preview		
Modul	e 2	https://archive.nptel.ac.in/courses/109/106/109106094/		
Module	e 3	https://www.youtube.com/watch?v=kOJlwMJxEG0&t=8s		
Module	e 4	https://www.youtube.com/watch?v=Sg7Q_dC_fWU&list=PLPuC5CMF9Q7xJY6aezb	liqmuz	q_KQ4aw0V
Module	e 5	https://www.youtube.com/watch?v=ymLFJDpjgCk&list=PLPuC5CMH Q7xJY6aezb&index=6	iqmuzq	KQ4aw0V9



e 4

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY

GREATER NOIDA-201306

1			<u> </u>															
Course (Code: BB	T0303	Cou	rse Nan	ne: Gen	etics an	d Mole	cular B	iology	L	Ţ.	Γ	P	C				
	Offered in					y				2	(0	0	2				
Pre-requ	iisite: Bas	ics of B	iology,	Biochen	nistry.													
	-	-				_			_		_	mutations,	-					
		_			_							, and gene						
-			-		-				r basis o	of gene reg	gulation	s, and mod	lern techn	ologies				
	mphasis o											D1	? - W 1 -	.1				
Course	Outcome:	After co	ompieu	on or the	course,	the stud	ient wii	i de adie	6 10			Level ('s Knowle	eage				
	Underst	and the	concent	e of an	alitative	and au	antitatis	ie genet	ics incl	uding inl	neritance		K2					
CO1										tics princi			K2					
	Hardy-V	Veinberg	g equilib	rium.														
CO2										ons, chroi		1	K2					
										of mutation of the proc		f	K2, K3					
CO3		_					_			s, and ap			132, 133					
	techniqu	es in di	agnostic	and res	earch co	ntexts.												
CO4							nd regul	ation in	detail a	nd assess	the role	e	K4					
CO-PO	of methy Mapping																	
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3				
00/10	101	102	103	101	103	100	107	100	10)	1010	1011	1501	1502	1503				
CO1																		
COI	3	3	2	2	2	3	3	2	1	3	3	3	2	3				
G02																		
CO2	3	3	2	2	3	3	3	2	1	3	3	3	2	3				
CO3	3	3	3	3	3	3	3	2	2	3	3	3	3	3				
CO4	3	3	2	3	3	3	3	2	2	3	3	3	2	3				
Course	Contents /	/ Svllah	ne															
Modul	Qualitat	•		ntive Ge	netics							8 hours						
e 1	Quartat	i ve ana	Quantitu	inve de	neties							o nours						
sex limit mapping,	ed and s	ex, influ t, three-	uenced -point te	inheritai st cross	nce, ext es. Intro	ra-chroi duction	nosoma to quar	l inheri	tance, I	Linkage,	crossing	ation, sex l g over, rec lelic freque	combinatio	on, gene				
Modul e 2	Chromo	somes a	nd Muta	ntions								8 hours						
(FISH), c	hromosoi	nal diso	rders. M	Iutation,	Types	of mutat	ions, Te	echnique	es to det			scence in NA repair n						
Modul e 3	Genetic	materia	I, DNA	Replicat	ion, Tra	nscripti	on and T	Franslat	ion			8 hours						
prokaryo account,	tes and e	ukaryote cessing,	es, PCR Translat	amplifi tion in p	cation o	of DNA	, Trans	cription				acids, Diaryotes, Go						
Modul	Gene Ex	pression	n and G	ane regu	iation			expression and Gene regulation										



NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY GREATER NOIDA-201306

(An Autonomous Institute)
School of Biotechnology

Gene regulation, attenuation, post-transcriptional regulation; Eukaryotic transcription factors, enhancers, silencers, insulators, Post-translational modifications and protein stability. Epigenetics and methylation assays in disease diagnostics.

		Total Lecture Hours 32 hours
Textboo	k:	<u> </u>
S.No	Book Title with publication agency & year	Author
1	Molecular Biology, latest edition, Elsevier	U. Satyanarayana
2	Genetics, latest edition S. Chand Publishing	P.S. Verma and V.K. Agarwal
3	Molecular Biology of the Cell 7th ed. 2022, New York:	Bruce Alberts, Alexander Johnson, Julian Lewis, Marti
	Garland Science.	Raff, Keith Roberts, Peter Walte
Referen	ce Books:	
S.No	Book Title with publication agency & year	Author
1	Molecular Cell Biology, 8th ed. 2016	Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher, HiddePloegh, Angelika Amon and Kelsey C. Martin
2	Genetics a conceptual approach, 6th ed. 2017 WH freeman and, company, New York. Publisher	Benjamin A. Pierce
3	Principles of Genetics, 7th ed. 2018	D. Peter Snustad, Michael J. Simmons
4	Cell and Molecular Biology-Concepts and Experiments 8th ed. 2015: John Wiley.	Gerald Karp et al.
NPTEL/	Youtube/ Faculty Video Link:	
Module 1	https://www.youtube.com/watch?v=7S4WMwesMts	
Module 2	https://www.youtube.com/watch?v=0mURpZD-mmU	
Module 3	https://www.youtube.com/watch?v=xvWdIi6_fGg&t=118	<u>ss</u>
Module 4	https://www.youtube.com/watch?v=6gUY5NoX1Lk	



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Course C	odo. DD	T0202	Co	ourse Na	mor M	ionobio	logy				L	Т	P	С	
Course O							logy				3	0	0	3	
Pre-requi						3 y					3	U	U		
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impart pra										_	<i>-</i> - - - - - - - - - -	incir ui	14 114111411 11	carrii. 10	
Course O													Bloom's		
			-										Knowledg	ge Level	
													(KL)		
CO1										human v	velfare.		K		
CO2	Describe										. 1 . 1	41	K		
CO3										otrophs ar tors affe				K2	
CO4	growth.	zc and	compan	c structi	arc and	Tunctio	11 OI III	icioucs	and rac	tors arrec	Julia IIIIC	Tobiai	М1,	K2	
CO5	Explain						ronment	t, Indust	ry and F	Healthcare	e		K	2	
CO-PO N									1	•	1		-	, 	
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	
CO1	3	2	_	_	_	2	2	2	_	2	3	3		2	
	J														
CO2	3	3	2	2	3	_	_	_	1	2	_	3	3	2	
CO3	3	2	_	_	_	2	2	_	_	1	_	3	_	2	
CO4	3	2	2	2	2	_	1	_	1	2	2	3	2	2	
CO5	3	2	2	2	2	3	3	2	1	2	3	3	3	3	
		2	2	2	2	3	3	2	1		3	3			
Course C	Contents /	Syllabi	us												
Module 1	Histo	ory and	scope of	microb	iology							81	nours		
Introducti	on to mic	robiolo	gy: histo	ory and	scope o	f microl	oiology,	major c	ontribu	tion and e	events in	microbi	ology. Clas	sification	
and identi															
Module 2	2 Morp	phology	and fine	e structu	re of m	icroorga	anisms:					81	nours		
	~								_				of cellular		
					es) orga	ınisms, l	Identific	cation of	microo	rganisms	on the ba		olony morp	hology.	
Module 3	Micr	obial re	quireme	ents								81	nours		
													on). Nutrit		
							rophs ar	ıd lithotı	rophs, ty	pes of cu	lture med	lia, enur	neration of	microbial	
population												0.1	L		
Module 4		obial G					.* *						nours		
•		_				_							tants and a	ntiseptics,	
chemothe	rapeutic a	igents, r	viainten	ance and	ı preser	vation o	i microi	oiai cuit	ures and	ı its impo	rtance, ct	ilture ba	inks.		
Module 5		ronment											nours		
	_	-	_		_								Single Cell		
		-						ijor dise	ases car	used by d	ifferent i	nicroor	ganism, Me	thods for	
the detern	mnation (л апит	icrobial	emcacy	oi natt	ıraı proc	iucts								
									7	otal Lec	ture Hou	ırs 39	hours		
Textbook	:														



GREATER NOIDA-201306

S.No	Book Title with publication agency & year	Author
1	Microbiology: Pelczar, 5 th Edition	Michael J. (Michael Joseph)
Reference	Books:	
S.No	Book Title with publication agency & year	Author
1	Brock Biology of Microorganisms (12th ed.). Pearson Education (2013).	Brock, T. D., and Madigan, M. T.
2	Dictionary of Microbiology and Molecular Biology	Paul Singleton & Diana Sainsbury
3	Bergey's Manual of Systematic Bacteriology	John G. Holt (Editor); Noel R. Krieg (Editor)
NPTEL/ Y	outube/ Faculty Video Link:	
Module 1	https://www.youtube.com/watch?v=IiqpUJ4j_bs	
Module 2	https://www.youtube.com/watch?v=FZyDZ3PLZ-4	
Module 3	https://www.youtube.com/watch?v=U 7vjo5pJXQ	
Module 4	https://www.youtube.com/watch?v=L5_6kAQBN5E	
Module 5	https://www.youtube.com/watch?v=t2cQXfnwLQ0	



GREATER NOIDA-201306

Course	Code: I	BT03011	N Co	ourse Na	ame: Bi	ochemi:	stry					L	Т	P	C
Course	Offered	l in: Depa	rtment	of Biote	chnolog	зу						2	0	0	2
Pre-req	uisite: I	Basics of E	Biology a	and cher	nistry										
Course	Objecti	ve: This c	ourse pr	ovides a	compre	hensive	unders	tanding	of essen	tial biom	olecules	and their	roles in	biolog	gical
systems.	It explo	ores the sig	gnifican	ce of wa	ter, pH,	and buf	fers in r	naintain	ing cell	ular funct	tion and	stability. S	tudents	will s	tudy
major m	etabolic	pathways	and hov	w they a	re regul	ated. Th	e course	e also in	troduces	s key biod	chemical	technique	s and to	ols us	ed in
research	and dia	gnostics. l	Emphasi	s is plac	ed on ap	plying	biochen	nical kno	owledge	to under	stand hea	alth, disea	se mech	anism	ıs,
and adva	ancemei	nts in bion	nedical r	esearch.											
Course	Outcon	ne: After o	ompleti	on of the	e course	, the stu	dent wil	ll be able	e to				Blo	om's	
													Kno	wledg	ge
													Lev	el (KI	Ĺ)
												n the body	у,	K1, K	2
		oly the ear										, , and appl	17	K1, K	7
		i and assoc ied knowl									tile body	, and appi	y	K1, K	.2
											apply th	ne acquire	ed	K1, K	3
												trial level.		,	
CO4							ism of	nucleic	acids a	nd solve	associate	ed researc	h	K2, K	.3
		ns with the													
CO-PO	Mappi	ng (Scale	1: Low,	2: Med	ium, 3:	High)	ı	T	1				1	1	
CO/PC	PO	1 PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PS	O3
CO1	3	2	2	2	3	2	2	2	2	-	2	3	3	2	
CO2	3	2	3	2	3	2	2	2	2	-	2	3	3	3	
CO3	3	3	2	2	2	2	2	2	2	-	2	3	3	3	
CO4	3	3	3	2	2	2	2	3	3	-	3	3	3	2	
Course	Conten	ts / Syllab	us												
Module	1	Buffer sys	tem and	Carboh	ydrates								9 h	ours	
												ering agai			
												osidic bo			
										i: Glycol	ysis and	oxidation	of Pyru	vate,	TCA
Module		genesis, P Fatty acids			e Patriw	ay. Euo	nogy or	Diabete	ss.				9 ho	nire	
					nd linide	nomei	aclatura	of linide	. Matab	oliem: O	vidation	of fatty ac			ation
												nsport ch			
_		. Etiology				, –	,					F			
Module	3	Amino aci	ds and p	eptides									9 h	ours	
Structure	e and cl	assificatio	n, pKa	and pI v	alues o	f amino	acids, l	Peptide	bond, to	orsional a	ngles in	proteins-o	mega, p	hi an	d psi
												plot, Prote			
					deamina	tion, tra	ınsamin	ation, U	rea cycl	e, Glucos	se Alanir	ne cycle; (Overviev	v of a	mino
		s- Role of Nucleic ac		ine.									Oh		
Module				. C 1		D1 1.	. 11 4	1 1 F	.	1 4	. 1 1	.1 1.	9 h		. 1'
						-			•			ribonucle			
			•									ıcleoside ı	-	-	
nucieosi	de tripn	ospnates,	Formatio	on or dec	oxyriboi	nucleoti	des. Cat	abolism	and sai			d Pyrimid			
Tax-41	.1									1	otai Leci	ture Houi	rs 36 f	ours	
Textboo		Rool, Tial	o with	ublicati	on ecc-	νον, Ω	oor					uthor			
S.No		Book Title						charc				uthor	ngar N-	1000 -	nd.
1		Principles	OI BIOC	iemistry	/IVICIVIIII	an wor	ui Püöli	sners.				.L. Lehnii	nger, Ne	ison a	เมน
											C	Cox			



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2	Harper's Biochemistry- 25th edition.	Rober K. Murray, Daryl K.
		Grammer, McGraw Hill,
		Lange Medical Books.
3	Biochemistry: Third Edition; Tata McGraw Hill Education Pvt. Ltd. New	S.C. Rastogi
	Delhi.	
Reference E	Books:	•
S.No	Book Title with publication agency & year	Author
1	Biochemistry:, W. H. Freeman	Stryer
2	Biochemistry:, John Wiley and Sons, Inc. USA	Voet and Voet
NPTEL/ Yo	utube/ Faculty Video Link:	•
Module 1	https://www.youtube.com/watch?v=WhLrKCXxp08	
Module 2	https://www.youtube.com/watch?v=OOc3zEgLLtk	
Module 3	https://nptel.ac.in/courses/102/105/102105034/	
Module 4	https://nptel.ac.in/courses/104/103/104103121/	



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Course O Course O analytical		: Depa	ntmont							niques							C
Course O	isite: Stud		rumem	of Bio	technol	logy								3	0	0	3
		lents sl	nould k	now ab	out the	differer	nt analy	tical tec	hnique	s.							
analytical	-	-							-				•				
-	l technique		_				_	-		hniques	and deta	ail interp	retatio	on of	result	s that	will
help them Course O														Bloc	m's		
course o	outcome.	7 III C	ompiet	1011 01 0	ne cour	se, the	student	will be	able to						wledg	e Le	vel
														(KL)		
COI	Describe characteri	ze bior	nolecul	es.											K		
COZ	Describe separation	ı of a h	ypothe	tical pro	otein sar	nple.	_					-			K1,		
	CO3 Understand the regions of electromagnetic spectrum and relate them to spectroscopic methods CO4 Outline and understand the concept of gel electrophoresis.														K2 K2		
CO5 Outline and understand the concept of gel electrophoresis. CO5 Apply centrifugation techniques for the separation of biological samples.												K					
CO-PO N										-F			ı				
CO-PO N	Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSC	D 1	PSO2	PS	SO3
CO1		3	3	1	3	3	3	3			3	3	3	í	3	2	
CO2		3	3	3	3	3	3	3	2	2	3	3	3		3	3	
CO3		3	3	1	3	3	3	3			3	3	3	í	3	3	
CO4		3	3	3	3	3	3	3	2	2	3	3	3	í	3	3	
CO5		3	3	3	2	3	3	3			3	3	3		3	3	
Course C	Contents /	Syllab	ous														
Module 1	1		ľ	Microso	copy an	d its ty	pes								6	hou	rs
Light mic								uoresce	nce m	icrosco	py, Phas	se Contr	ast m	icros	сору,	Ele	ctron
Module 2	2			Chroma	atograp	hy									7	hou	rs
Principle Liquid Ch				_				_	1 .		_	_	graphy	, Hig	gh Per	form	ance
Module 3	3		5	Spectro	scopy			•							8	hou	rs
Electroma applicatio diffraction	ons of UV	-VIS, I	NMR, I	ESR an	d IR sp	ectrom	eter, Pr									_	
Module 4	4		1	Electro	phoresi	s									6	hou	rs
Theory of Electroph	-				_	_					-					, Aga	arose
Module 5	5		(Centrifi	ıgation	and Bi	osensoi	·s							8	hou	rs



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Theory of centrifugation and sedimentation. Types of centrifuges, Preparative and analytical centrifugation; Density gradient centrifugation. Application of centrifugation for preparative and analytical purpose. Biosensors: Principles and definition, characteristics of Ideal biosensors, Biochemical components of biosensors: Enzyme based biocatalyst sensors, Bioaffinity systems, Immunosensors.

Textboo											
	ok:										
S.No	Book Title with publication agency & year	Author									
1	Principles and Techniques of Practical Biochemistry 5th Edn., Cambridge Knew pros 1997.	Wilson and Wal	ker								
2	Biotechniques: Theory and Practice: Second Edition Rustogi Publications. SVS Rana										
Referen	ice Books:										
S.No	Book Title with publication agency & year	k Title with publication agency & year Author									
1	Bioanalytical Techniques Narosa Publishing House, New Delhi. 4.: ML Srivastava; Narosa Publishing House, New Delhi.	Saroj Dua And Neera Gar									
NPTEL/	Youtube/ Faculty Video Link:										
Module	1 <u>https://www.youtube.com/watch?v=7S4WMwesMts</u>										
Module	2 https://www.youtube.com/watch?v=0mURpZD-mmU										
Module	Module 3 https://www.youtube.com/watch?v=xvWdIi6_fGg&t=118s										
Module	4 https://www.youtube.com/watch?v=6gUY5NoX1Lk										



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LAB Cours	se Code: BBT0353 LAB Course Name: Genetics and Molecular Biology Lab	L	T	P	C		
Course Off	fered in: Department of Biotechnology	0	0	4	2		
Pre-requisi							
Course Ob	jectives: To provide students the knowledge and skill about analysing the genotypic and allel	c frequ	encie	s,			
	ne mapping, DNA and RNA extraction, techniques of DNA, RNA and Protein separations, regand DNA microarray techniques.	ulation	of ge	ene			
Course Ou	Bloo	m's					
		(KL))				
CO1	Calculate genotypic and allelic frequencies and demonstrate the linkage, crossing over, and gene mapping in Drosophila melanogaster.		K	.3			
CO2	Perform polytene chromosome from insect salivary gland and design their study with drosophila mutants		K	.3			
CO3	Enhance their knowledge and skills for extraction of genomic DNA and RNA from biological samples, and evaluation of DNA concentration and protein molecular weight using electrophoretic techniques.		K	[4			
CO4	Enhance their knowledge in gene expression, regulation of gene expression and gene expression using DNA microarray.		K	2			

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	1	-	2	1	1	3	2	2
CO2	3	2	2	2	2	1	1	-	2	1	1	3	2	2
CO3	3	3	2	3	3	1	1	-	2	1	2	3	3	3
CO4	3	3	2	3	3	2	2	1	2	2	2	3	3	3

List Of Practical's (Indicative & Not Limited To)

- 1. To understand and calculate the genotypic and allelic frequencies in a given population using the Hardy-Weinberg equilibrium principle.
- 2. Study on linkage, crossing over, and gene mapping in *Drosophila melanogaster*.
- 3. Study of polytene chromosome from insect salivary gland.
- 4. Study and Observation of mutants in Drosophila.
- 5. Extraction of genomic DNA from Drosophila/ animal cell.
- 6. To understand the principles and applications of Polymerase Chain Reaction (PCR) amplification and gel electrophoresis in molecular biology.
- 7. Estimation of size in bp of DNA using agarose gel electrophoresis
- 8. Polyacrylamide gel electrophoresis and estimation of MW of proteins.
- 9. Demonstration of gene expression, regulation of gene expression by using a digital platform.
- 10. Demonstration of gene expression using DNA microarray by using a digital platform.



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LAB Course	se Code: BBT0352N	L	Т	P	С	
Course Offe	ered in: Department of Biotechnology	0	0	4	2	
Pre-requisit	te:					
•	jectives: The course aims to equip students with practical skills and theoretical knowledge actices, and the identification and analysis of microorganisms using various methods.	in microb	ial te	chniq	ues,	
Course Out	Bloc	Bloom's				
	Kno	Knowledge Level				
		(KL)			
CO1	Demonstrate proficiency in good microbial laboratory practices and biosafety protocols.		K	2		
CO2	Identify microorganisms based on colony morphology and Gram staining techniques.		K2			
CO3	Prepare, sterilize, and inoculate culture media, and enumerate microbes from environment samples.	tal	l K3			
CO4	Cultivate and isolate microorganisms using various microbiological techniques, as analyze microbial samples from soil and analyze protein, amino acids and sugars samples		K	4		

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	2	2	2	2	2	-	3	3	2
CO2	3	2	2	1	3	3	3	3	3	2	-	3	3	2
CO3	3	2	2	2	3	2	2	2	2	2	-	3	3	3
CO4	3	2	2	2	3	2	2	2	3	2	-	3	3	3

List Of Practical's (Indicative & Not Limited To)

- Good microbial lab practices and biosafety.
- Preparation of nutrient agar plate, slant nutrient broth and their sterilization. (Heating oven, autoclave, laminar air hood)
- Inoculation of agar slant, plate and nutrient broth. (Incubator, laminar air hood)
- Culture of microorganisms using various techniques. (Spread-plate method, pore-plate method, streaking method) 4.
- Identification of microbial colony based on microbial morphology.
- Isolation and identification (based on colony morphology) of microorganisms from soil sample.
- To identify given microorganisms based on gram staining.
- To study the anti-microbial efficacy of plant extract.
- To study the microbial Growth Curve Determination
- 10. Identification of the microbes based on biochemical tests.
- 11. Estimation of carbohydrates in the given sample.
- 12. Estimation of protein in the given sample.



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LAB Cou	L	Т	P	С	
Course O	ffered in: Department of Biotechnology	0	0	2	1
Pre-requi	site:	•			
	bjectives: To provide students with practical skills in using analytical instruments such as electrotometry, and to develop their ability to apply these techniques in research and laboratory setting		esis a	nd U	V
Course O	vutcome: After completion of the course, the student will be able to	Bloo	m's		
		Kno	wledg	ge Le	vel
		(KL))		
CO1	Prepare students to gain practical knowledge about the instruments for analytical techniques used in laboratory.		K	2	
CO2	Develop among students hand-on experience of separation of biomolecules on electrophoresis		K2,	K3	
CO3	Provide students with handing of UV spectrophotometer and its understanding.		K	2	
CO4	To make students understand the application of analytical techniques in research laboratories.		K	2	

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3

List Of Practical's (Indicative & Not Limited To)

- 1. Demonstration of basic concept of precision and accuracy using appropriate experimental data.
- 2. To study principle and working of laboratory microscope.
- 3. To analyse the isolated plant pigments using paper chromatography
- 4. Separation of amino acids using thin layer chromatography
- 5. Separation of a mixture of polar and non-polar compounds using column chromatographic technique
- 6. Study of Beer-Lambert's law-using UV-Visible spectrophotometer
- 7. To study and analysis of DNA sample by agarose gel electrophoresis
- 8. To study and analysis of protein sample by SDS- PAGE.
- 9. To study the separation of compounds using liquid-liquid extraction experiments.
- 10. To study the separation of biological compounds using various membrane separation.



Module 2

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										2.000		761						
LAB Co	urse Code: E	BT035	55		LA	AB Cou	urse Na	ame: B	ioinfor	matics	(Works	shop mo	de) l	L '	Г	P	C	
Course (Offered in: D	epartn	nent of	Biote	chnolog	gy							(0	0	6	3	
														•		•		
	isite: Basics	of biol	ogy, m	olecula	r biolo	gy, Bio	chemis	stry										
	Objectives:																	
	stand the bas etic analysis															g ma	triz	
										.1011 01		inatics in	arug de	.515111	5.			
	Outcome: Af														1			
CO1	Understar	nd the the	heoreti	cal basi	is behir	nd bioir	nformat	ics and	conce	pt of B	iological	Databas	ses		K2			
CO2	Search da	tabases	access	ible on	the int	ernet f	or litera	ature re	lating t	o Mole	cular Bi	ology an	d		K2			
	Biotechno	ology																
CO3	Understar	nd scori	ing mat	rices a	nd its t	ypes in	cluding	PAM	, BLOS	SUM se	eries and	matrice	s for nuc	cleic	K	2		
	acid and p																	
CO4	Apply phy constructi		y and it	s conc	epts in	molecu	ılar evo	olution	and dif	ferent	methods	of Phylo	ogenetic	tree	K	3		
CO5	Query bio		l data,	interpr	et and	model	biologi	cal inf	ormatic	on and	apply th	is to the	solutio	n of	K	3		
	biological	proble	ems in a	any are	na invo	lving n	nolecul				11.7							
CO-PO	Mapping (Sc	ale 1:]	Low, 2	: Medi	um, 3:	High)	1				<u> </u>					I		
СО-РО	Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	P: 2	SO	PS 3	O	
CO1		3	2	-	-	2	-	-	-	-	2	3	2	-		3		
CO2		2	2	-	-	3	-	-	-	2	3	2	2	-		3		
CO3		3	2	-	2	2	-	-	-	-	2	3	2	_		3		
CO4		3	3	-	2	2	1	-	-	-	2	2	2	-		3		
CO5		3	3	2	3	3	1	1	-	2	3	3	2	1		3		
Course (Contents / Sy	llabus																
Module					Genera	al Intro	oductio	n				16 ł	nours					
Exercise	1: Introduction	on to B	ioinfor	matics;	Humai	n Geno	me Pro	ject				J.						
Exercise	2: Biological	databa	ıses: Nı	ıcleotic	le datal	oases, F	Protein	databa	ses, Spe	ecialize	d databa	ses						
Exercise	3: Laboratory	y data s	ubmiss	ion and	d data r	etrieva	l tools.											
Exercise	4: Various fil	le form	ats for	biomol	ecular	sequen	ces: Ge	nBank	, EMBI	L, FAS	TA, GC	G, MSF,	nbrf-pir	etc.				
	5: Basic cond					_							•					
	6: Definition	_	_		-				-									
	7: Sequence		_	•	J	•	_											
2xercise	8: Sequence	promes	8															

Database Searching

16 hours



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	School of Biotechno	logy							
Exercise 9 Sequence Alignment									
Exercise 10: Database Searching:	Introduction, Evolutionary Basis of Sequence Alignment								
Exercise 11: Database similarity s	earching: FASTA, BLAST								
Exercise 12: Various versions of b	pasic BLAST and FASTA,								
Exercise 13: Advance version of l	Exercise 13: Advance version of BLAST: PHI-BLAST and profile-based database searches using PSIBLAST								
Exercise 14: Multiple sequence al	ignment: progressive method and Iterative method								
Exercise 15: Applications of pairs	wise and multiple sequence alignment								
Exercise 16: Tools for multiple se	equence alignment: CLUSTAL ω and Pileup (Algorithmic	concepts)							
Module 3	Scoring Matrics	16 hours							
Exercise 17: Basic concept of a so	coring matrix, Similarity and distance matrix								
Exercise 18: Substitution matrices	s: Matrices for nucleic acid and proteins sequences, PAM	and BLOSUM series							
Exercise 19: Principles based on v	which these matrices are derived								
Exercise 20: Gap Penalty, concep	ot of Gap opening and extension penalty.								
Module 4	Phylogenetic analysis	16 hours							
Exercise 21: Phylogeny and conce	epts in molecular evolution; nature of data used in taxonor	my and phylogeny							
Exercise 22: Definition and descri	ption of Phylogenetic trees								
Exercise 23: Various types of Phy	logenetic trees								
Exercise 24: Phylogenetic tree con	nstruction through UPGMA								
Exercise 25: Phylogenetic tree con	nstruction through Fitch-Margoliash Algorithm								
Exercise 26: case studies in phylo	genetic sequence analysis								
Module 5	Applications of Bioinformatics	16 hours							
Exercise 27: Protein identification	based on composition, Physical properties based on sequ	uence, Motif and pattern							
Exercise 28: Secondary structure	(Statistical method: Chou Fasman and GOR method, Net	ural Network and Nearest neighbor							
method) and folding classes, spec									
Exercise 29: Tertiary structures (F	Homology Modeling); Structure visualization methods (R.	ASMOL, CHIME etc.)							
Exercise 30: Protein Structure alig	gnment and analysis. Application of bioinformatics in dru	g discovery and drug designing.							
	Total Lecture Hours:	80 hours							
Textbook:									
S.No Book Title with public	cation agency & year	Author							



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1.	Bioinformatics: Sequence and Genome Analysis by, 2ND EDITION	David W. Mount
2.	Bioinformatics: A Practical Guide to the Analysis of Genes and Protein.	
Reference	e Books:	
S.No	Book Title with publication agency & year	Author
1.	Bioinformatics for Dummies, 2ND EDITION	Jean-Michel Claverie and Cedric Notredame
NPTEL/	Youtube/ Faculty Video Link:	
Module 1	https://www.youtube.com/watch?v=zvyv_snBih8andpp=ygUmR2VuZXJhbCBJbnRyb2 lvaW5mb3JtYXRpY3M%3D	R1Y3Rpb24gb2YgYm
Module 2	https://www.youtube.com/watch?v=rDhElW5ox6wandpp=ygUkRGF0YWJhc2UgU2Vhb2luZm9ybWF0aWNz	cmNoaW5nIG9mIGJp
Module 3	https://www.youtube.com/watch?v=AgIMm4B Ticandpp=ygUeU2NvcmluZyBNYXRyWF0aWNz	aWNzIEJpb2luZm9yb
Module 4	https://www.youtube.com/watch?v=Wj0OV2jf1VQandpp=ygUkUGh5bG9nZW5ldGljI0Zm9ybWF0aWNz0gcJCYsJAYcqIYzv	GFuYWx5c2lzIEJpb2lu
Module 5	https://www.youtube.com/watch?v=z2XvrbRw7y8andpp=ygUeQXBwbGljYXRpb25zIGF0aWNz	G9mIEJpb2luZm9ybW



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Course Code: BNC0302Y	Course Name: Environmental Science	L	T	P	C
Course Offered in: Department of Biotechnology		2	0	0	NA

Pre-requisite: Basic knowledge of biology, chemistry, ecology, geology, mathematics, and understanding of human impacts on natural systems.

Course Objectives: This course aims to equip students with a basic understanding of the interrelationship between humans and the environment, fostering awareness of environmental issues and promoting a positive attitude toward sustainability. It also seeks to develop the necessary skills and capabilities to address and solve environmental problems through social, political, cultural, and educational approaches.

Course	Outcome: After completion of the course, the student will be able to	Bloom's Knowledge
		Level (KL)
CO1	Understand the basic principles of ecology and environment. Ecosystem: Basic concepts, components of ecosystem, food chains and foodwebs. Ecological pyramids	K1,K2
CO2	Understand the different types of natural recourses like food, forest, Minerals and energy and their conservation	K1,K2
CO3	Understand the importance of biodiversity, Threats of biodiversity and different methods of biodiversity conservation.	K1,K2
CO4	Understand the different types of pollution, pollutants, their sources, effects and their control methods.	K1,K2
CO5	Understand the basic concepts of sustainable development, Environmental Impact Assessment (EIA) and different acts related to environment	K1,K2

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

	11 0					0 ,								
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	3	3	2	-	2	2	3	2	2
CO2	3	3	2	2	1	3	3	2	2	2	2	2	2	2
CO3	3	3	2	2	1	3	3	2	2	2	2	2	2	2
CO4	3	3	2	2	-	3	3	3	2	2	2	2	2	2
CO5	3	3	2	2	-	3	3	2	2	2	2	2	2	2

Course Contents / Syllabus

Module 1 Basic Principle of Ecology 4 hours

Definition, Scope and basic principles of ecology and environment. Ecosystem: Basic concepts, components of ecosystem. Food chains and food. Webs. Ecological pyramids, Energy flow in ecological systems, Characteristics of different ecosystems. Biogeochemical Cycles: Importance, gaseous and sedimentary cycles. Carbon, Nitrogen, Phosphorus and Sulphur Cycles. Basic concepts of sustainable development, SDGs, Ecosystem services, UN Decade for Eco restoration ,

Module 2 Natural Resources and Associated Problems 4 hours

Natural resources and associated problems. Forest resources: Use and over- exploitation, deforestation. Timber extraction, mining, dams and their effects on forest and tribal people. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. Food resources: World food problems, changes caused by agriculture and over- grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. Land resources: Land as a resource, land degradation, man induced landslides. Equitable use of resources for sustainable lifestyles. Non-Renewable Energy Resources: Fossil fuels and their reserves, Nuclear energy, types, uses and effects, Renewable Energy Resources: hydropower, Solar energy, geothermal, tidal and wind energy, Biomass energy, biogas and its advantages.

Module 3 Biodiversity Succession and Non-Renewable Energy Resources 4 hours



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Biodiversity and their importance, Threats to biodiversity, major causes, extinction's, vulnerability of species to extinction, IUCN threat categories, Red data book. Strategies for biodiversity conservation, principles of biodiversity conservation in-situ and exsitu conservation strategies Mega diversity zones and Hot spots, concepts, distribution and importance. Succession: Concepts of succession, Types of Succession. Trends in succession. Climax and stability.

Module 4 Pollution and Solid Waste Management 4 hours

Air pollution: sources of air pollution, Primary and secondary air pollutants. Origin and effects of SOX, NOX, Cox,CFC, Hydrocarbon, control of air pollution. Water pollution: sources and types of water pollution, Effects of water pollution, Eutrophication, Soil pollution: Causes of soil pollution, Effects of soil pollution, Major sources of and effects of noise pollution on health, Radioactive and thermal pollution sources and their effects on surrounding environment. Solid waste disposal and its effects on surrounding environment, Climate change, global warming, acid rain, ozone layer depletion.

Module 5 Role of CommModuley and Environmental Protection Acts 4 hours

Role of community, women and NGOs in environmental protection, Bio indicators and their role, Natural hazards, Chemical accidents and disasters risk management, Environmental Impact Assessment (EIA), Salient features, of following Acts: a. Environmental Protection Act, 1986, Wildlife (Protection) Act, 1972.b. Water (Prevention and control of pollution) Act, 1974.c. Air (Prevention and control of pollution) Act, 1981. Forest (Conservation) Act, 1980. Wetlands (Conservation and Management) Rules, 2017; Chemical safety and Disaster Management law. District Environmental Action Plan. Climate action plans.

	Total Lecture Hours 20 hours							
k:								
Book Title with publication agency & year	Author							
The nature and properties of Soils, Tenth Edition. Mac Millan	Brady, N.C.							
Publishing Co., New York. 1990.								
ce Books:								
Book Title with publication agency & year	Author							
Air Pollution, Tata McGraw Hill Publishing Co. Ltd., New Delhi 1989	Rao M.N. and H.V.N. Rao							
A Text Book of environmental Science	Shashi Chawla							
Environmental studies- Oxford Publication	R, Rajagopalan							
Environmental Science: Toward a Sustainable Future"	Richard T. Wright and Dorothy F. Boorse							
"Living in the Environment"	G. Tyler Miller and Scott Spoolman							
Youtube/ Faculty Video Link:	-							
1 https://www.youtube.com/watch?v=T21OO0sBBfc								
	<u>://</u>							
· · · · · · · · · · · · · · · · · · ·								
<u></u>								
	Book Title with publication agency & year The nature and properties of Soils, Tenth Edition. Mac Millan Publishing Co., New York. 1990. The Books: Book Title with publication agency & year Air Pollution, Tata McGraw Hill Publishing Co. Ltd., New Delhi 1989 A Text Book of environmental Science Environmental studies- Oxford Publication Environmental Science: Toward a Sustainable Future' "Living in the Environment" Youtube/ Faculty Video Link:							



GREATER NOIDA-201306

Module 3	https://www.youtube.com/watch?v=GK_vRtHJZu4,
Module 4	https://www.youtube.com/watch?v=b6Ua_zWDH6U, https://www.youtube.com/watch?v=7tgNamjTRkk,
Module 5	https://www.youtube.com/watch?v=ErATB1aMiS



NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY GREATER NOIDA-201306

(An Autonomous Institute)
School of Biotechnology

Course Code: BBT0403N	Course Name: Fermentation Engineering	L	T	P	C
Course Offered in: Department of Biotec	chnology	3	0	0	3

Pre-requisite: The students should know the basics of microbiology, genetics and molecular biology and biochemistry.

Course Objectives: This course provides an understanding of fermentation processes, emphasizing microbial selection, medium optimization, and advanced technologies. It explores metabolic regulations, highlights fermentation applications in the food industry, and addresses bioprocess engineering with a focus on sustainability.

Course	Outcome: After completion of the course, the student will be able to	Bloom's
		Knowledge Level
		(KL)
CO1	Explain different fermentation types and microbial culture optimization.	K1
CO2	Design and control fermentation processes using advanced techniques and tools.	K2
CO3	Describe metabolic regulation mechanisms in microbial fermentation.	K2
CO4	Apply knowledge of fermentation processes in food and beverage production.	K3
CO5	Analyze bioprocesses for industrial applications, emphasizing sustainability	K2

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PS03
CO1	3	2	1	-	-	2	-	-	1	2	1	3	3	2
CO2	3	3	2	1	2	2	-	-	1	2	2	3	3	2
CO3	3	3	2	2	2	2	-	1	1	1	1	3	3	2
CO4	3	2	2	2	1	2	-	1	2	2	2	3	3	3
CO5	3	3	3	2	2	2	1	1	2	2	3	3	3	3

Course Contents / Syllabus

Module 1 Fermentation Fundamentals and Requirements 8 hours

Interaction between Biochemical engineering, Microbiology and Biochemistry. History and development of fermentation industry: Microbial culture selection for fermentation processes, Strain development; Preservation and improvement of industrially important microorganisms. The range of fermentation processes – Microbial biomass, microbial enzymes, microbial metabolites, recombinant products, transformation processes The chronological development of the fermentation industry The component parts of a fermentation process

Module 2 Advanced Fermentation Technologies

Introduction, Criteria for transfer of inoculum, development of inoculum for bacterial processes, yeast processes and mycelial processes. Inoculum development for plant fermenter, aseptic method of inoculation, achievement and maintenance of aseptic conditions. Fermentation Material and Energy balance, Microbial growth kinetics: Microbial growth cycle, measurement of growth, Batch culture, continuous culture, fed-batch culture, applications and examples.

Module 3 Metabolic Regulation in Fermentation 8 l	hours
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Media ingredients, medium formulation,* Oxygen requirements, antifoams, medium optimization, Media sterilization, Batch Process (thermal death kinetics), continuous sterilization process; sterilization of fermenter and other ancillaries, filter sterilization of air and media. Advanced microbial metabolic regulation; Global metabolic control analysis; Induction and repression mechanisms (lac and trp operons, detailed studies); Catabolite repression; Crabtree and Pasteur effects; Metabolic flux analysis; Feedback and allosteric regulation.

Module 4	Fermentation in Food Industry	8 hours

Quality and pretreatment of raw materials; Innovations in alcoholic beverages; Industrial mushroom cultivation (Oyster, Button, Shiitake); Probiotics and functional fermented foods; Oriental fermented foods (Soy products, fermented dairy); Traditional foods (Kimchi, Kombucha); Safety and regulatory aspects.

Module 5 Industrial Fermentation Applications and Bioprocess Engineering 8 hours

Antibiotic production (Penicillin, Cephalosporin); Bio-solvents and bioethanol; Amino acids and organic acids biotechnology; Industrial enzyme engineering; Recombinant enzyme technology; Biopharmaceuticals (insulin, monoclonal antibodies, vaccines); Scale-up considerations; Bioprocess economics; Sustainability in fermentation.

Total Lecture Hours								
Textbook:	,							
Book Title with publication agency & year	Author							
Principles of Fermentation Technology. Butterworth-	Stanbury, P. F., Whitaker, A., and Hall, S. J. (2016).							
Heinemann.								
Reference Boo	ks:							
Book Title with publication agency & year	Author							
Bioprocess Engineering Principles (3rd ed.). Academic Press (Elsevier). (2024).	Doran, P. M.							
Bioprocess Engineering: Basic Concepts (3rd ed.). Pearson Education.	Shuler, M. L., Kargi, F., and DeLisa, M. (2021).							
NPTEL/ Youtube/ Faculty	y Video Link:							
https://youtu.be/MkW0eLxKNeI2								
2 https://youtu.be/LsWHqyjaD003								
3 https://youtu.be/AYv7tvgtmBk4								
4 https://youtu.be/C3J2jN-Gi9w5								
5 https://youtu.be/dC2mPnVbSc8								
	Book Title with publication agency & year Principles of Fermentation Technology. Butterworth- Heinemann. Reference Boo Book Title with publication agency & year Bioprocess Engineering Principles (3rd ed.). Academic Press (Elsevier). (2024). Bioprocess Engineering: Basic Concepts (3rd ed.). Pearson Education. NPTEL/ Youtube/ Faculty https://youtu.be/MkW0eLxKNeI2 https://youtu.be/LsWHqyjaD003 https://youtu.be/AYv7tvgtmBk4 https://youtu.be/C3J2jN-Gi9w5							

Course	Code: BBT()402			Cou	rse Na	me: In	nmuno	ology a	nd Imi	nunotec	hnology		L	T	P	
Course	Offered in:	Depart	ment o	f Biote	chnolo	ogy								3	0	0	
Pre-rec	uisite: Stude	nts sho	uld kno	w the b	oasics o	of cell l	oiology	and h	uman p	hysiolo	ogy						_
Course	Objectives:	The cor	urse wi	ll foste	r an un	derstan	ding o	f immu	ınologi	cal prii	nciples, i	ncluding	antigei	n-anti	body		
	ions, immune						_		_	•	-	-			-	rn to	
	y analyze scie				-			-			•						ati
	unological me			-				-			_	-		-			
	rs, vaccines,								_				,			r	
	Outcome: A		•		•									Bloc	m's		_
Jourse	outcome.	irter cor	приспо	11 01 111	Cours	e, the s	raaciit	will oc	uoie i	,					wledg	re I e	ve
														(KL)	-	,c Lc	•
CO1	Identify and	d explai	n in de	tail the	basic o	compoi	nents a	nd fund	ctionali	ties of	the imm	une syst	em.		K	1	_
CO2	Identify and														K1	,K2	
LU2	the associat																
CO3	Understand the technical aspect of immunological reactions and their application in scientific research.										entific	K2,K3					
004	Describe various ways of regulation of immune response; and thus, will be able to critically											tically		K2	,K4	_	
CO4	evaluate the		•	_									,			*	
CO5	Associate t conditions.	he imn	nunolog	gical m	nechani	isms w	ith vai	rious k	inds of	huma	n diseas	ses and	health	K2			
CO-PC	Mapping (S	cale 1:	Low, 2	2: Med	ium, 3	: High)										_
CO-PO	O Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PS	SO2	PS	03
CO1		3	2	-	-	-	1	1	-	-	-	2	3	-		-	
CO2		3	2	_	_	_	1	1	2	1	2	2	3	_		_	
CO2			2				1	1		1	2						
G0.2		-	-		_											-	_
CO3		3	2	2	2	2	-	-	-	-	1	2	3	2		3	
~~.		-								_	_	_					
CO4		3	2	-	-	-	-	-	1	1	2	2	3	-		-	
CO5		3	3	-	2	2	2	2	1	2	2	3	3	2		2	
Course	Contents / S	vllahus	<u> </u>										<u> </u>				
Module		Jimbu		erviev	v of the	e Immı	ine Sv	stem							1	3 hou	rs
								cules o									

organs, Structure, function and application of cytokines, Inflammation- features and Inflammatory response, Pro-inflammatory and anti-inflammatory cytokines, T and B cell maturation, activation and differentiation.

Module 2 **Antigen and Antibody Structure** 8 hours

Antigens: Characteristics and types of Antigens, Factors affecting immunogenicity, Haptens and adjuvants, Epitopes, Characteristics of T and B cell epitopes. Antibodies: Structure, functions and characteristics of different classes of antibodies, Antigenic Determinants on Immunoglobulins, Generation of antibody diversity, Somatic hyper-mutation, Monoclonal and polyclonal antibodies and their commercial preparation

Module 3 **Immuno- Techniques and Immunization** 8 hours

Antigen and antibody interactions cross reactivity, precipitation reactions, and Immunological techniques: serological techniques, Immuno-diffusion assay, ELISA, RIA, Western blotting. ELISPOT assay, Immuno-Histochemistry, Flow Cytometry, FACS sorting, Immuno-precipitation, Active immunization, passive immunization, Antibodies in diagnostics, Vaccines and their types.

Module 4	MHC and regulation of immune response	8 hours
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Structure and Function of MHC molecules, Antigen presenting cells, Exogenous and Endogenous pathways of antigen processing and presentation, Germinal centre, Plasma Cells, BCR signalling, Complement system and pathways, immune tolerance negative/positive selection, TCR rearrangement, co-stimulatory molecules. T cell subtypes: Th1, Th2, Th17, Tregs etc. Memory Band T cell responses, Immune checkpoints: PD1, CTLA4, TIM3 etc. CD4 and CD8 receptors.

Module	e 5	Immunity and Diseases		8 hours
Immuni	ity without infection:	autoimmunity, hypersensitivity, Trans	splantation immunology host vs graft reaction	Design of
recomb	inant antibodies, Immu	no-therapy in cancer, check point the	erapy. Immunity against infectious diseases (vin	rus, bacteria
and pro	tozoan), AIDS, Immun	e response in plants- an Overview		
			W 4 1 1 4 T	40.1
			Total Lecture Hours	40 hours
Textbo	·			
S.No	Book Title with pub	olication agency & year	Author	
1	Immunology and Imi	munotechnology Oxford University	Ashim K. Chakravarty	
	Press			
Referei	nce Books:			
S.No	Book Title with pub	lication agency & year	Author	
1	Immunology by. 8 th 6	edition	Kuby, Thomas J. Kindt, Barbara A. Osborne	, Richard
2	T . 1 .: . M !:	1 T 1 7th 1'.'	Goldsby	
2	Introduction to Medi	cal Immunology 7 th edition	Gabriel Virella.	
NPTEL	/ Youtube/ Faculty Vid	leo Link:		
Module	https://voutu.be/	1XfEK8G8CUI?si=31lzqyT4DZQlk0Q	I	
Module	https://youtu.be/	BSypUV6QUNw?si=uEY07sJyezf197	<u>'Ry</u>	
Module	https://youtu.be/	LmpuerlbJu0?si=TWVNfGAnMNsTb	U4w	
		*		
Module	https://youtu.be/	UZTf3OXJDWA?si=PJpxMyHieof48l	<u>RIE</u>	

https://youtu.be/23O8rRHgluA?si=by Yb1Qgpy5cMWfH

Module 5

Course	Code: BBT	0405			Cou	ırse Na	ıme: r-	DNA '	Fechno	ology				L	T	P	C
Course	Offered in:	Depart	ment (of Biot	echnol	ogy								3	0	0	3
Pre-req	uisite: Basic	unders	tandin	g of nu	cleic a	cids and	d mole	cular b	iology				L				
Course	Objectives:	This co	ourse p	rovides	funda	mental	knowle	edge of	molec	ular bi	ology ar	nd recom	binant D	NA te	echn	ology,	
focusing	g on gene clo	ning m	echanis	sms and	d techn	iques.]	It intro	duces r	ecent a	dvance	ements i	n rDNA	technolog	gy an	d far	niliari	zes
	with virtual		d in sil	ico clo	ning to	ols. Th	e cours	se also	trains s	student	s in scre	ening an	d selection	on me	ethod	s for	
	ing recombin											1					
	Outcome: A		•									Bloom	's Knowl	edge	Leve	el (KL)
CO1	Understand										îs .		**	K1			
CO2 CO3	Gain theore Learn PCR			_					olicatio	ns				1,K2 ,K2,k			
CO4	Acquire de								d scree	ning m	ethods			, KZ, F (1, K2			
CO5	Understand								0 50100					,K2,k			
CO-PO	Mapping (S	Scale 1:	Low,	2: Med	lium, 3	3: High	1)										
CO-PC) Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PS	O2	PS0	3
CO1		3	3	2	2	2	2	1	1	2	2	1	2	3		3	
CO2		3	3	2	2	2	2	1	1	2	2	1	2	3		3	
CO3		3	3	3	2	2	2	1	1	2	2	1	2	3		3	
CO4		3	3	2	2	2	2	1	1	3	2	1	2	3		3	
CO5		3	3	2	3	2	2	1	1	2	2	1	2	3		3	
Course	Contents / S	Syllabu	s		1					1	1			<u> </u>		<u> </u>	_
Module	1		Ba	asic Pr	inciple	es of rD	NA To	echnol	ogv						<u> </u>	8 hou	·s
isoschiz star acti	omers, heter vity, Homop phosphatase	otypic o olymer	enzyme tailing	es, Mo	dules a	ınd acti	vity of	restric	tion er	nzymes	; restric	tion dige	estion (pa	rtial	A po	compl olyme	ete as
Module				ectors												8 hou	
vectors (e.g., Ba	, expression, ,Phagemids, aculovirus, Pass, Vectoer S	cosmid ichia),P	ls, artif lant-ba	icial clused ve	hromos ctors (e	some ve e.g., Ti	ectors ((YACs plasmi	, BAC	s),Anir	nal viru	s-derive	d vectors:	; exp	ressi	on vec	to
Module						nain Re)							8 hou	·s
RACE,	nplification t DD-RTPCR cation of PCF	, deger	nerate	PCRT	A clon	ing and	d real-	time P	CR, P	rimer	design a	and enzy	yme fidel	lity,]	Prim	er des	ig
Module	4		Те	echniqu	ies in r	-DNA	technol	logy								8 hou	·s
	n and purific	ation of							Gel e	lectron	horesis	Ligation	ı technici	ies 7			
and trar	nsfection, Genal compleme	ene/gen	omic 1	ibrary	and c	DNA 1	ibrary	constr	action,	Scree	ning and	d selecti	on metho	ods:	funct	ional	an

Screening and Selection of Recombinants

10 hours

Module 5

Selectable markers, Screening techniques, Functional assays, Preparation of competent bacterial cells; transformation of recombinant DNA Screening techniques: colony PCR, DNA/RNA sequencing (Sanger, Maxam-Gilbert, automated, pyrosequencing)Genomic analysis: high-throughput sequencing, shotgun and clone contig cloning, microarray, Purification and spectroscopic characterization of recombinant proteins

		Total Lecture Hours 4	2 hours					
Textboo	ok:							
S.No	Book Title with publication agency & year	Author						
1	From Genes to Clones: Introduction to Gene Technology,	Ernst L. Winnacker						
	VCH Publishers. (1987)							
2	Genetic Engineering, Oxford University Press.	Smita Rastogi and Neelak Pathak						
3	Genetic Engineering: Principles and Practice, McGraw	Sandhya Mitra						
	Hill Education							
Referen	nce Books:							
S.No	Book Title with publication agency & year	Author						
1	Principles of Gene Manipulation and Genomics.	Primrose and Twyman						
2	Molecular Biology of the Cell, 4th Edition, Garland	Alberts et al.,						
	Science.	,						
3	Modern Genetic Analysis, W.H. Freeman	Griffiths et al.,						
NPTEL	/ Youtube/ Faculty Video Link:							
Module	1 https://www.youtube.com/watch?v=Yh9w fyvpUk							
Module	1 maps.//www.youtdoc.com/watch.v=111/w-1y-vpok							
Module	2 https://www.youtube.com/watch?v=VXkw_U6mJpc							
	2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1							
Module	3 <u>https://www.youtube.com/watch?v=</u>							
Module	4 https://www.youtube.com/watch?v=CgXtJ4ooaUU							
	https://www.youtube.com/watch?v=OK7 ReXhVaQ							
Module	5 https://www.voutube.com/wwt-b9v VwF1h W 200							
Module	5 <u>https://www.youtube.com/watch?v=YnF1b_Kqf88</u> https://www.youtube.com/watch?v=BIIWIZqWxKg							
	mups.//www.youtube.com/watch:v-bitWiZqWXKg							

Course	Code: BBT(0406			Bio	hysics	and B	ioinst	ument	ation				L	T	P	С
Course	Offered in:	Depart	ment o	of Bioto	echnol	ogy								3	1	0	4
Pre-rec	quisite: Stude	nts sho	uld kno	ow abo	ut the b	asics o	f biolo	gy.								1	
	Objectives:								nensive	under	standin	g of the p	rinciples	and	techi	niaues	
	the study of b		-					-				6 F					
	Outcome: A									O		Bloom's	Knowled	lge I	Level	(KL)	
CO1	Learn abou	t the ph	enome	na of v	vater tr	ansport	across	cellul	ar mem	branes				K1			
CO2	Understand												K1	, K2	,		
CO3	Explore the					al trans	duction	n pathv	vays in	volved	in a		K1, 1	K2, I	K3		
	wide range						. C	1.	. 1				17.1	17.0			
CO4	Understand Explore the									nhyeio	logy		K1, 1	, K2			
	Mapping (S							Jus III C	Ciruiai	physic	nogy		IX1, 1	112, 1	XJ		
				PO3	PO4	PO5	PO6	DO7	PO8	PO9	DO10	DO11	DCO1	D	202	PS	03
CO-PC	O Mapping	PO1	PO2	POS	PO4	POS	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	P	SO2	13	03
					-												
CO1		3	3	1	2	2	2	2	2	2	-	2	3	3		2	
					1												
CO2		3	2	2	2	3	2	2	2	2	-	2	3	3		2	
CO3		3	2	3	2	3	2	2	2	2	_	2	3	3		3	
CO4		3	3	2	2	2	2	2	2	2	_	2	3	3		3	
204					2		2										
005		2	2	2		1	12	12	2	3		3	2	2		1	
CO5		3	3	3	2	2	2	2	3	3	-	3	3	3		2	
<u> </u>	0 1 1 10																
	Contents / S	yllabus															
Module	e 1		W	ater ti	ranspo	rt acro	ss cell	memb	ranes							8 hou	rs
	ew of biophy																
	rt mechanism																/sis),
Module	orins: Structur	e, runci				enome		er trans	port in	arume	iai men	ibranes ai	na biomi	meno		tems 8 hou	re
	cally Excitable	e Cells						ectrica	1 Pheno	mena	in Evci	table Cel	ls Memb	rane			
	ypothesis and																
	al, Transmissi																
Module	e 3]	on Ch	annels	and T	ranspo	orters								8 hou	rs
	ls and Recept																
	eceptors, G-p									Ion pu	ımping	(Sodium	Potassiu	m Pu	ımp)	, Tran	sport
ATPase	e, Glucose trai	nsporte	r, Khod	lopsin a	and the	ir func	tion in	vision.									
Module	e 4		Pr	oteins	and N	ucleic a	acids									10 ho	urs
Hierarc	hical Structur	re of P	roteins	, Struc	ture of	Nucle	otides,	Sugar	Pucke	r, Tor	sional a	angles in	proteins	and	nuc	leic a	cids,
	nandran Plot,							_				-	_				
Functio	nal Design of	f Protei	ns, Mo	lecular	Chape	erons (l	Heat Sl	nock P	roteins)	, Char	acteriza	ation of se	econdary	stru	cture	using	g CD
spectros	scopy and X-1	ray crys	tallogr	aphy.													
Module	e 5		Co	ll Dyn	amice	and Fl	ectron	hvsiala	gical N	Method	de					10 ho	iire
MANUAL			Ce	пъущ	umits i	ana El	cen ob	11 y 51 O I C	gicai I	,1CHIO(a.o					10 110	ui 5

Molecular Motors: Actin, Myosin, Kinesin, Dynein, Intracellular movement, Cell migration: Types and mechanism, Mechanobiology and its importance in human health, Biophysics of Medical Imaging (computed tomography (CT), magnetic resonance imaging (MRI), Positron Emission Tomography (PET), Single neuron recording, patch-clamp recording, ECG, Brain activity recording

		Total Lecture Hours	44 nours
Textboo	ok:		
S.No	Book Title with publication agency & year	Author	
1	Introduction to Biophysics S. Chand Publishing, 2008	Pranab Kumar Banerjee	

S.No	Book Title with publication agency & year	Author					
D•1 10	book The with publication agency & year	ridiioi					
1	Principles of Biochemistry 8th edition, Nelson and Cox, McMillan Worth Publishers. A.L. Lehninger						
2	Basic Neurochemistry: Molecular, Cellular and Medical Aspects. 8th edition., et al., editors. Philadelphia:Lippincott-Raven; 1999.	Siegel GJ, Agranoff BW, Albers RW					
3	Molecular Biology of the Cell. 7th edition. New York: Garland Science; 2002.	Alberts B, Johnson A, Lewis J, et al.					
4	Molecular Cell Biology. 9th edition.New York: W. H. Freeman; 2000.	Lodish H, Berk A, Zipursky SL, et al					
5	Neuroscience. 7th edition. Purves, editors. Sunderland (MA): Sinauer Associates; 2001.	D, Augustine GJ, Fitzpatrick D, et al.					
NPTEL	/ Youtube/ Faculty Video Link:						
Module	https://www.youtu.be/eHV1s2g4s4o https://www.youtube.com/watch?v=J5pWH1r3pgU						
Module							
Module							
Module	https://www.youtube.com/watch?v=Y5JOW2eApUI						
Module	https://www.youtube.com/watch?v=wQID2zmeWTQ						

	Code: BBT04	411			Bios	<mark>imilar</mark> :	s Tech	nology						LT	P	C
Course	Offered in: D	eparti	nent o	f Biote	chnol	ogy								3 0	0	3
Pre-req	uisite: Funda	mentals	of Mo	olecula	r Biolo	gy, Ge	netic E	nginee	ring, B	ioproce	ess Tech	nology		I	l l	
	Objectives:				_						-	-			osimil	arity
	Outcome: Af										market a		n's Know		evel (k	(L)
CO1	Explain the reference bid	concep	t of bi								ugs and	21001		1, K2	(-	
CO2		analyt	ical an	nd preclinical approaches used in biosimilar development K2, K3												
CO3	Illustrate m			, forn	nulatio	n, and	qual	ty co	ntrol	process	ses for			K3		
CO4	biosimilars Analyze reg	ulatory	guidel	lines. g	lobal a	pprova	l nathy	avs. at	nd com	parabil	itv		K	3, K4		
CO5	Examine cha	allenge												3, K4		
CO-PO	Mapping (Sc		Low, 2	2: Med	ium, 3	: High)					1				
CO-PC) Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PS	03
CO1		3	2	-	-	-	2	1	-	-	2	2	3	-	-	
CO2		3	2	2	2	2	-	1	-	-	1	2	3	2	2	
CO3		3	3	3	2	3	1	1	-	-	-	2	2	3	1	
CO4		2	3	2	3	2	2	2	1	1	2	3	2	2	2	
CO5		2	3	2	3	-	3	3	2	2	2	3	1	2	2	
Course	Contents / Sv	llabus														
	Contents / Sy	llabus		roduc	tion to	Biosin	nilars								8 hou	rs
Module Definition develops		ification	Int	similar	s vs.	generio	s vs.	C		-				<i>U</i> ,	Histo	rical
Module Definition develops moleculo	on and classi ment and mark e generics	ification	Int n: bio rview	similar of bios	s vs. imilars	generio	rtance	and rat		-				<i>U</i> ,	Histo	rical mall
Module Definition development molecule Module Steps in	on and classiment and marke generics 2 biosimilar dev	ification	Interview Deent, Re	similar of bios velopn	s vs. imilars nent an	generic . Impo d Char act sele	es vs. rtance a	and ration	cing, A	for bios	similar d	evelopn cterizati	on: struct	nparison	History with s	rical mall
Module Definition development molecule Module Steps in	on and classiment and marke generics 2 biosimilar devan vitro bioass	ification	Interpretation: bioderview Department of the property of the	similar of bios velopn eferenc	s vs. imilars nent an e produ	generic . Impo d Char act sele	es vs. rtance acterization a Preclini	and ration nd sour	rcing, A	for bios	similar d	evelopn cterizati	on: struct	nparison	History with s	rical mall rs
Module Definition development molecule Module Steps in assays, I Module Upstream	on and classiment and marke generics 2 biosimilar devan vitro bioass	ification ket ove velopm ays and	De ent, Real immu	similar of bios velopmeference inogen anufac	s vs. imilars nent an e produ icity te turing	generic Limpo d Char act sele sting, F and Q levelopri	es vs. rtance acterizaction a Preclini uality	ntion nd sour cal stud Control	rcing, Adies and	Analytic d comp	similar d cal chara parability Formulati	evelopm acterizati studies	on: struct	ural and	Histor with s 8 hou 8 hou 8 hou	rs onal
Module Definition development molecule Module Steps in assays, I Module Upstream	on and classiment and marke generics 2 biosimilar development of the control assays	ification ket ove velopm ays and	De ent, Red immu	similar of bios velopm eference inogen anufactign, Cency, sai	s vs. imilars nent an e produ icity te turing Il line c fety, G	generic Limpo d Char act sele sting, F and Q levelopri	es vs. rtance a acteriza ction a Preclini uality ment an	ntion nd sour cal stud Control d expres	reing, Adies and	Analytic d comp es (GM	similar d cal chara parability Formulati	evelopm acterizati studies	on: struct	ural and	Histor with s 8 hou 8 hou 8 hou	rs onal
Module Definition development of the content of the	on and classiment and marke generics 2 biosimilar development of the control assays	velopm ays and am process: purity	Deent, Relimmer Marcess desay, poten	similar of bios velopme ference inogen anufactign, Cency, sar	s vs. imilars nent an e produ icity te turing ll line c fety, G ry Gui	generical Imposition of Charact selesting, Fand Quevelopment of Market M	es vs. rtance acterizaction a Preclini uality ment an anufact s and A and int	and ration and sour cal stud Contro d expres uring F	rcing, Adies and Dl ssion sypractice ral Path	Analytic d composite (GM	similar d cal chara parability Formulati P) comp	evelopm ecterizati studies on devel- liance	on: struct	ural and	History with s 8 hour functions 8 hour fitty tes 8 hour fitty tes	rs ional rs iting,
Module Definition development of the content of the	on and classiment and marke generics 2 biosimilar devaluation bioass 3 n and downstreacontrol assays 4 USFDA, WHO sed comparabi	velopm ays and am process: purity	Deent, Red immu Macess des CO guio otocols	velopme ference inogen	s vs. imilars nent an e produ icity te turing Il line c fety, G ry Gui Biosin t and e	generical Imposition of Charact selesting, Fand Quevelopment of Market M	es vs. rtance acterizaction a Preclini uality ment an annufact s and A and int ity issu	and ration and sourcal stud Control d expresuring F	recing, Adies and blession system of the control of	Analytic d composite (GM	similar d cal chara parability Formulati P) comp	evelopm ecterizati studies on devel- liance	on: struct	ural and	History with s 8 hour functions 8 hour fitty tes 8 hour fitty tes	rs onal rs ting,
Module Definition development of the control of the	on and classiment and marke generics 2 biosimilar development and downstreaction assays 4 USFDA, WHO sed comparability 5 biosimilar materials and concerns, Substituting and concerns and	velopm ays and am proc purity	Deent, Real immu Maeess desay, poten Re CO guidotocols Mandscap	velopn eference inogen: anufactign, Cency, san deline, , Paten arket T	s vs. imilars nent an e produ icity te turing Il line c fety, G ry Gui Biosin t and e rends, key pl	d Charuct selesting, Fand Q leveloprood Madelines in a control of the control of	es vs. rtance acterizaction a Preclini uality ment an annufact s and A and int ity issu 7, and Pharma	and ration and sounced stud Control d expresuring F Approverchangues in b Challer	rcing, Adies and Dl ssion sypractice ral Path geabilitiosimil nges lance a	Analytic d composite (GM) hways ty requilars	cal chara parability Formulati P) comp	evelopm ecterizati studies on devel- liance , Clinica	opment ar	nparison Tural and stabilities for I	History with s 8 hour functions with s 8 hou	rs onal tring,
Module Definition development of the control of the	on and classiment and marke generics 2 biosimilar development and downstreacontrol assays 4 USFDA, WHO sed comparabiles biosimilar materials and concerns, Substantials	velopm ays and am proc purity	Deent, Real immu Maeess desay, poten Re CO guidotocols Mandscap	velopn eference inogen: anufactign, Cency, san deline, , Paten arket T	s vs. imilars nent an e produ icity te turing Il line c fety, G ry Gui Biosin t and e rends, key pl	d Charuct selesting, Fand Q leveloprood Madelines in a control of the control of	es vs. rtance acterizaction a Preclini uality ment an annufact s and A and int ity issu 7, and Pharma	and ration and sounced stud Control d expresuring F Approverchangues in b Challer	rcing, Adies and Dl ssion sypractice ral Path geabilitiosimil nges lance a	Analytic d composite (GM) hways ty requilars	cal chara parability Formulati P) comp	evelopm eterizati studies on devel- liance , Clinica	opment ar	ign for l	History with s 8 hour functions with s 8 hou	rs conal rs conal rs conal rs dilars, rs and and aetin,
Module Definition development	on and classiment and marke generics 2 biosimilar development and downstreacontrol assays 4 USFDA, WHO sed comparabiles biosimilar materials and concerns, Substantials	velopm ays and am proc :: purity	Int n: bion rview De ent, Re d immu Ma ress des r, poten Re CO guid otocols Ma ndscap n and	velopn eference inogen anufac ign, Ce ncy, sai gulato deline, , Paten arket T e and interch	s vs. imilars nent an e produ icity te turing Il line of fety, G ry Gui Biosin t and e rends, key planangea	d Charuct selesting, I and Q leveloprood Madelines with a clusive state of the control of the co	es vs. rtance acterizaction a Preclini uality ment an annufact s and A and int ity issu 7, and Pharma	and ration and sounced stud Control d expresuring F Approverchangues in b Challer	rcing, Adies and Dl ssion sypractice ral Path geabilitiosimil nges lance a	Analytic d compositems, les (GM hways ty requilars	cal chara parability Formulati P) comp	evelopm eterizati studies on devel- liance , Clinica	opment ar llance, In ilars (e.g	ign for l	History with s 8 hour function in the second secon	rs conal rs conal rs conal rs dilars, rs and and aetin,

1	Biotechnology and Biopharmaceuticals: Transforming	Ho, R. J. Y., and Gibaldi, M.
	Proteins and Genes into Drugs (Indian Ed.). New Delhi:	
	Wiley India (2003).	
Referen	ice Books:	
S.No	Book Title with publication agency & year	Author
1	Biosimilars and Interchangeable Biologics – Academic Press, 1st Edition (2021)	Ajaz Hussain
2	Biopharmaceuticals and Biosimilars – Elsevier, 1st Edition (2023)	M. N. Bawa,
3	Current Regulatory Guidance Documents (EMA, USFDA, CDSCO). The EMA's "Guideline on Similar Biological Medicinal Products"	
4	Handbook of Biogeneric Therapeutic Proteins – CRC Press	Sarfaraz K. Niazi,
NPTEL	Youtube/ Faculty Video Link:	
Module	1 https://www.youtube.com/watch?v=1s7W1EKUekk	
Module	2 https://www.youtube.com/watch?v=ll0R_tvtMkI	
Module	3 https://www.youtube.com/watch?v=oyTE3xHwDnY	
Module	4 https://www.youtube.com/watch?v=W5xLU_lhoag	
Module	5 https://www.youtube.com/watch?v=vGyU3XOEQ0M	

Course Code: BB7	rn412					Envir	onment	al Riot	echnol	ogv		L	T	P	C
Course Offered in		tmont	of Riot	oohnole) (TV	Lilvii	OHIHCH	ai Diot	cciiioi	ogy		3		0	3
						1-1-1		1 £			:	3	U	U	
Pre-requisite: Stud													•.	C	
Course Objectives advanced and biolo	gical te	chnolog	ies for	its miti	gation.	It provi	des an	overvie	w of bi	otechnol	ogical a	approache	s for poll	utan	t
conversion and env														uce	
pollution, educates				y from	industri	al wast	es, and	introdu	ices nov	el techn	ologies	for effect	ive		
environmental pollu					.1 .	1 1	'11 1	11 .			1,	D1 1 1	7 1 1	т	
Course Outcome:	After co	ompieu	on or tn	e cours	e, the si	iudeni v	wiii be a	ible to				Bloom's I (KL)	knowied	ge Le	;vei
CO1	liqu	id and	solid wa	astes	_					of indus			K2		
CO2	tech	nologi	es							al treatn			K2		
CO3	mar	nageme	nt							tal pollu			K2		
CO4		derstanc obiotic			ersion p	oathway	s for t	ne deg	radatio	n of var	ious		K2		
CO5	Gai		ledge (recover	y of hi	gh valu	ıe-adde	d biopı	oducts f	rom		K2, K3		
CO-PO Mapping										•					
CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PS	03
CO1	3	2	2	2	2	3	3	1	1	1	_	2	3	2	
CO2	3	3	2	2	3	3	2	1	2	2	_	2	3	2	
CO3	3	3	3	3	3	2	2	1	2	2	1	3	3	3	
CO4	3	3	3	3	3	2	1	2	2	2	2	3	3	3	
CO5	3	3	3	2	2	3	3	3	3	3	2	3	3	2	
Course Contents /	Syllabı	1S											_		
Module 1		Enviro	nmenta	l Pollut	ants an	d Biote	chnolog	gical Ap	proach	es for W	aste Tr	eatment	8 hour	rs	
Introduction to Env Primary, Secondar precipitation – pros applications, Solid Incineration and py	y, Tert and co waste d	iary, P ons, Filt isposal	hysicoc ration r method	themica nethods ls – effe	l treati s and ty ects and	ment n pes, Ad l types,	nethods dsorptic Secure	: Coag on using d landf	ulation g activa ill, Con	, Floccu ted carbon posting	lation, on – ap – bacte	Sedimen oplications	tation, C s, Ion exc	Chem chang	ical ge -
Module 2										Technolo			8 hou		
Overview of biolog advantages, Microo	organisn	ns in an	aerobio	digest	ers, Fac	ctors af	fecting	digestic	on effic	iency, B	iofilms	- develo	pment ar	ıd us	e ir
pollution control, (methods for nitroge														uvan	ceo
Module 3										nental Po			8 hour	rs	
Introduction to xe oxidative, hydroly transformation, Oil	tic, De	gradati	on of	alipha	tic and	l arom	atic h								
	1	1				r									

Biodegradation of industrial waste — recent developments, Role of biotechnology in industrial waste management, Microbial enzymes — uses in pollution control, Free vs. immobilized enzymes/cells, Applications of immobilized systems, Types and effects of dyes, Microbial and enzyme-based dye decolourization, Textile dye degradation, Laccases in industrial bioremediation, Heavy metal toxicity and microbial removal methods, Use of biosurfactants, polysaccharides, and siderophores in metal removal.

Module 5	Waste to Wealth: Resource Recovery and Sustainable Wast	e 8 hours
	Utilization	

Waste to Wealth, Industrial waste as a source of enzymes and valuable metabolites, Slaughterhouse waste – enzyme and metabolite recovery, Leather industry waste – types and recovery methods, Plastic waste – environmental impact and recycling, Bioplastics and renewable energy sources, Technologies for energy recovery from waste, Using biomass residue as fertilizer.

		,				
Book Title with pul	olication agency & year	Author				
Environmental Biote	echnology: Principles and Applications,	Bruce E. Rittmann and Perry L.				
McGraw Hill, 2001.		McCarty,				
Environmental Biote	echnology, Oxford University Press, 2007.	Bimal C. Bhattacharyya,				
KS:						
Dools Title with mul	aliantian agamay for year	Author				
Book Tiue with pur	oncation agency & year	Author				
An Introduction to E	Invironmental Biotechnology, Springer,	Milton Wainwright				
1999.						
Microbial Bioremed	iation, MJP Publishers, India, 2006.	P. Rajendran, P. Gunasekaran,				
		Ram Chandra				
	Taylor & Francis, 2015.					
be/ Faculty Video Link:						
		itro-plant-tissue-culture-and-genetic-				
https://wy	ww.learninsta.com/applications-of-plant-tiss	sue-culture/				
https://ww	vw.youtube.com/watch?v=8zZsJxjKjwQ					
https://wv	vw.researchgate.net/publication/387476821	The Application of Transgenic Tech				
nology/fu	lltext/676f9a56894c55208530acbe/The-Ap	plication-of-Transgenic-Technology.pd				
https://wv	vw.youtube.com/watch?v=2PP4IVH8N2Q					
	Environmental Biote McGraw Hill, 2001. Environmental Biote KS: Book Title with pul An Introduction to E 1999. Microbial Bioremed Advances in Biodegr Wastes, CRC Press, pe/ Faculty Video Link: https://ww https://ww nology/fu	Book Title with publication agency & year An Introduction to Environmental Biotechnology, Springer, 1999. Microbial Bioremediation, MJP Publishers, India, 2006. Advances in Biodegradation and Bioremediation of Industrial Wastes, CRC Press, Taylor & Francis, 2015.				

Course Code: BBT0413	L	T	P	C								
Course Offered in: Department of Biotechnology 3 0 0												
Pre-requisite: Basic Biology and Genetics, Biochemistry, Mathematics, Computational and Data Analysis Skills.												
-	-	-										
Course Objectives: This course aims to provide a foundational understanding of systems biology by integrating molecular												
biology, biochemistry, and computational modeling to analyze complex biological systems. It covers gene regulation, genetic												
			_	_								

Course Objectives: This course aims to provide a foundational understanding of systems be	ology by integrating molecular
biology, biochemistry, and computational modeling to analyze complex biological systems. It	covers gene regulation, genetic
switches, biochemical kinetics, and cellular signaling, with applications in development, synthetic	e biology, and disease modeling.
Students will gain a systems-level perspective essential for modern biological research and innov	vation.
Course Outcome: After completion of the course, the student will be able to	Bloom's Knowledge Level

Course C	Dutcome: After completion of the course, the student will be able to	Bloom's Knowledge Level
		(KL)
CO1	Recall and explain the fundamentals of systems biology, including genetic switches, and different biological paradigms	K1
CO2	Interpret kinetic models such as equilibrium binding, cooperativity, and Michaelis-Menten kinetics relevant to gene regulation.	K2, K3
CO3	Apply concepts of genetic switches, noise in gene expression, and oscillators to model gene regulatory mechanisms.	K3
CO4	Describe the developmental processes and mechanisms of cell communication using examples like quorum sensing and Drosophila development	K2, K3
CO5	Apply knowledge of gene expression networks, synthetic biology, and computational tools in analyzing biological systems and their applications in health and disease.	К3

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

11 0				,	0 /									
CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PS03
CO1	3	2	1	-	-	-	-	-	-	-	2	1	2	3
CO2	3	3	2	2	1	-	-	-	-	-	2	2	2	3
CO3	3	3	2	2	2	-	-	-	-	-	2	2	2	3
CO4	2	2	1	1	-	1	-	-	-	-	2	1	2	3
CO5	3	3	3	2	3	2	2	2	2	2	3	1	2	3

Course Contents / Syllabus

Module 1 Systems Biology 8 hours

Fundamentals Overview of Gene Control –Working of Genetic Switches – Introductory Systems Biology The biochemical paradigm, genetic paradigm and the systems paradigm.

Module 2 Kinetics 8 hours

Equilibrium Binding and Co-operativity – Michaelis Menten Kinetics –identical and independent binding sites – Identical and interacting binding sites, noninteracting binding sites. Genetic switch in Lambda Phage -Noise-based Switches and Amplifiers for Gene Expression. Synthetic genetic switches –Ecoli chemotaxis – biological oscillators- genetic oscillators -The Origin and Consequences of Noise in Biochemical Systems.

Module 3 Developmental Systems Biology 8 hours

Building an Organism Starting from a Single Cell -Quorum Sensing – Programmed Population Control by Cell-Cell Communication and Regulated Killing Drosophila Development. Establishment of Developmental Precision and Proportions in the Early Drosophila embryo.

Module 4 Gene expression networks 8 hours

Gene regulation at a single cell level- Transcription Networks -basic concepts -coherent Feed Forward Loop (FFL) and delay gate -The incoherent FFL - Temporal order, Signaling networks and neuron circuits -Aspects of multi-stability in gene networks.

Module 5	Applications and Future Perspectives in Systems Biology	8 hours

Synthetic Biology and Gene Circuit Design, Computational Biology Tools for Systems Biology, Systems Biology in Disease Modeling and Drug Discovery, Integrative Approaches: Omics Data and Personalized Medicine

		Total L	ecture Hours	40 hours
Textbook	x:			
S.No	Book Title with publication agency & year	Author		
1	Tissue Engineering	Bernhard O.	Palsson and Sar	geeta N. Bhati
Referenc	e Books:	·		
S.No	Book Title with publication agency & year		Author	
1	An Introduction to Systems Biology: Design Principles of Biologic Chapman and Hall/CRC Press, Mathematical and Computational I edition, 2006.		Uri Alon	
NPTEL/ '	Youtube/ Faculty Video Link:			
Module 1	https://www.youtube.com/watch?v=yWPdlTV_ny0andpp=ygFtZW50YWxzIE92ZXJ2aWV3IG9mIEdlbmUgQ29udHJvb0dGNoZXMg4oCTIEludHJvZHVjdG9yeSBTeXN0ZW1zIEJkaWdtLCBnZW5ldGljIHBhcmFkaWdtIGFuZCB0aGUgc3lz	CDigJNXb3JraW5 pb2xvZ3kgVGhlI	5nIG9mIEdlbm GJpb2NoZW1p	V0aWMgU3dp
Module 2	https://www.youtube.com/watch?v=3kLHz9u2rzEandpp=ygleXN0ZW1z	Uea2luZXRpY3M	IgaW4gYmlvbC	69naWNhbCB
Module 3	https://www.youtube.com/watch?v=gFjU_fW-dSwandpp=ygUeRGV2ZWxvcG1lbnRhbCBTeXN0ZW1zIE	EJpb2xvZ3kg		
Module 4	https://www.youtube.com/watch?v=So6MK FcP4Eandpp=y IA%3D%3D	gUZR2VuZSBleF	HByZXNzaW9u	IG5ldHdvcmt
Module 5	https://www.youtube.com/watch?v=2DGcOza087Aandpp=ygnNwZWN0aXZlcvBpbiBTeXN0ZW1zIEJpb2xvZ3k%3D	gU1QXBwbGljY2	XRpb25zICYgF	RnV0dXJlIFBlo

LAB Cour	se Code	e: BBT0	453N	ering Lal	b L	T	P	C							
Course Of	fered in	: Depar	tment o	of Biote	chnolog	y					0	0	4	2	
Pre-requis	ite:														
Course Ob equipment															
					Braden	ts will s	tudy IIII	eroorar g	,10 wui k	meties, ai	iaiyze pi	oduct for	munon, u	14	
	nterpret critical fermentation parameters. Course Outcome: After completion of the course, the student will be able to Bloom's Knowledge Level (KL)														
CO1		Operat effective		cale fe	rmenter	s and	apply	sterilizat	ion tec	hniques		k	K 1		
CO2		Measu	re micro	bial gro	wth and	analyz	e biopro	cess kind	etic para	meters.		k	(2		
CO3						and yie	eld optir	nization	of prim	ary and		K1	,K2		
CO4	secondary metabolites. Evaluate and apply bioprocess monitoring and control strategies to enhance fermentation productivity. K2.K3											K2	.K3		
CO4		enhanc	e terme	CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)											
	apping									•					
	apping						PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	
СО-РО М		(Scale 1	: Low,	2: Medi	um, 3:	High)	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	

List of Practical's (Indicative & Not Limited To)

CO₂

CO3

CO4

- 1. To study the design, construction, and control systems of a fermenter
- 2. To prepare dhokla for the understanding of lactic acid fermentation in traditional Indian fermented food

3. To measure the quantity of lactic acid produced by *Lactobacillus* during curd fermentation.

4. To produce citric acid from whey supplemented with glucose

- 5. To produce wine using oranges
- 6. To produce ethanol from grapefruit through yeast fermentation
- 7. To produce microbial Amylase/Protease Enzyme by Submerged Fermentation
- 8. To produce biopolymers using a suitable microbial strain
- 9. To isolate protease-producing microorganisms from soil or food waste
- 10. To produce antibiotics using the principles of fermentation.

LAB Co	B Course Code: BBT0452N LAB Course Name: Immunology and Immunotechnology Lab										
Course	Offered in: Department of Biotechnology		0	0	2	1					
Pre-requ	uisite:										
	Objectives: The course aims to equip students wit technology, fostering proficiency in experimental		in in	nmuno	ology a	ınd					
Course	Outcome: After completion of the course, the stud	dent will be able to		Bloom	ı's						
				Know	ledge l	Leve					
				(KL)							
CO1	Gain a comprehensive understanding of funda immune system's components, mechanisms, and	1 0,	he		K1						
CO2	Analyze, and interpret experimental data obtain quantitative analysis of antigen-antibody interac	<u> </u>	ng		K4						
CO3	Develop practical skills in performing a variety	of immunological assays and experiments.			K6						
CO4	Apply immunological methods and technique function, disease pathology, and therapeutic inte	<u> </u>	ne		K5						

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	1	-	1	1	2	3	-	-
CO2	3	3	-	3	2	-	-	-	2	1	3	3	-	3
CO3	2	2	2	2	3	-	-	1	2	1	2	3	2	2
CO4	3	3	3	2	3	2	1	1	2	2	3	3	2	3

List Of Practical's (Indicative & Not Limited To)

- 1. To identify the blood cells/ immune cell with the help of leishman stain.
- To determine the blood group and Rh factor of given blood
- To perform single radial immunodiffusion
- 4. To perform double immunodiffusion
- 5. To perform counter current immune electrophoresis
- To perform Sand-witch ELISA
- 7. To determination of binding affinity of antigen-antibody complex.
- To Isolate and perform microscopic visualization of T-cells and B-cells
- To perform western blotting.
- 10. Histological examination of immune organs.

Course Code: BBT0407	Course Name : Structural Bioinformatics (workshop mode)	L	T	P	С
Course Offered in: Biotechnolog	gy	0	0	6	3

Pre-requisite: Bioinformatics

Course Objectives: To exhibit depth and breadth of knowledge by demonstrating a well-developed understanding of biological sciences and able to critically analyse and solve problems in biotechnology by gathering, synthesizing and critically evaluating information from a range of sources.

Course	Outcome: After completion of the course, the student will be able to	Bloom's
		Knowledge Level
		(KL)
CO1	Understand the various tools and techniques related to in-silico modeling of biomolecules.	K2, K3
CO2	Analyze problems related to collection and Speculate RNA Structure by different methods	K3, K4
CO2	and its limitations	
CO3	Understand different Machine algorithms and capable to evaluate and validate by statistical	K2
COS	significance	
CO4	Understand the application of molecular dynamics, molecular mechanism and its application	K2
CO4	in protein folding	
CO5	Apply the knowledge of molecular modeling in drug designing and development	K3, K4

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2		PO4	PO5		PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	2	-	-	-	-	2	3	2	_	3
CO2	2	2	-	-	3	-	-	-	2	3	2	2	-	3
CO3	3	2	_	2	2	-	-	-	-	2	3	2	-	3
CO4	3	3	-	2	2	1	-	1	-	2	2	2	-	3
CO5	3	3	2	3	3	1	1	ı	2	3	3	2	1	3

Course Contents / Syllabus

Module 1 Sequence Alignment 16 hours	
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Exercise 1: Homology identification

Exercise 2: Genomic sequence annotation (Genes and ORFs identification)

Exercise 3: Protein structure prediction (Secondary structure prediction)

Exercise 4: Protein structure prediction (Tertiary structure prediction)

Exercise 5: Protein function prediction.

Exercise 6: Biological network identification

Exercise 7: Next generation sequencing

Exercise 8: Microarray data analysis

Module 2	RNA Structure and Function	16 hours

Exercise 9 Basics of RNA Structure prediction and its limitations.

Exercise 10: Database Searching: Introduction, Evolutionary Basis of Sequence Alignment

Exercise 11: Features of RNA Secondary Structure

Exercise 12: RNA structure prediction methods: Based on self- complementary regions in RNA sequence

Exercise 13: RNA structure prediction methods: Minimum free energy methods Exercise 14: Suboptimal structure prediction by MFOLD Exercise 15: Prediction based on finding most probable structure and Sequence co-variance method Exercise 16: Application of RNA structure modeling Module 3 **High Throughput Sequencing** 16 hours Exercise 17: Basic concept of Databases and file formats:, Fastq, VCF, BED and SRA Exercise 18: - Mapping data formats: SAM, BAM- General Feature Format/General Transfer Format for Genes, DNA and RNA, and Protein sequences Exercise 19: Data preprocessing and Quality Controlling, - Whole genome sequencing, transcriptome and exome sequencing Exercise 20: Single cell RNA sequencing, ChipSeq, Personalized Medicine, Application of NGS in Human diseases: Cancer and neurodegenerative diseases.. Module 4 Phylogenetic analysis 16 hours Exercise 21: Phylogeny and concepts in molecular evolution; nature of data used in taxonomy and phylogeny Exercise 22: Definition and description of Phylogenetic trees Exercise 23: Various types of Phylogenetic trees Exercise 24: Phylogenetic tree construction through UPGMA Exercise 25: Phylogenetic tree construction through Fitch-Margoliash Algorithm Exercise 26: case studies in phylogenetic sequence analysis Module 5 Metagenomics 16 hours Exercise 27: Introduction to Metagenomics, Microbial CommModuleies, Taxonomic classification and functional annotation Exercise 28: Novel Gene Prediction, Different metagenomic milieu; Viral, bacterial, fungal, algal and protozoan Exercise 29: Techniques for metagenomics study: Shotgun metagenomics, Amplicon sequencing (16S/18S rRNA, ITS) Exercise 30: third-generation sequencing (Nanopore, PacBio), Comparative Metagenomics, Microbiome-based disease diagnostics, Biosafety and IPR issues in metagenomics. Application of metagenomics to the study of human microbiome, Bioremediation and Industrial Bioproducts **Total Lecture Hours** 80 hours Textbook: S.No Book Title with publication agency & year Author 1 Bioinformatics: Sequence and Genome Analysis 2ND EDITION David W. Mount Bioinformatics: A Practical Guide to the Analysis of Genes and Protein. Reference books S.No Book Title with publication agency & year Author Bioinformatics for Dummies by, 2ND EDITION Jean-Michel Claverie 1 and Cedric Notredame NPTEL/ Youtube/ Faculty Video Link:

Module 1 https://www.youtube.com/watch?v=zvyv_snBih8andpp=ygUmR2VuZXJhbCBJbnRyb2R1Y3Rpb24gb2YgYmlvaW5mb3JtYXRpY3M%3D

Module 2	https://www.youtube.com/watch?v=rDhElW5ox6wandpp=ygUkRGF0YWJhc2UgU2VhcmNoaW5nIG9mIGJpb2luZm9ybWF0aWNz
Module 3	https://www.youtube.com/watch?v=AgIMm4B Ticandpp=ygUeU2NvcmluZyBNYXRyaWNzIEJpb2luZm9y bWF0aWNz
Module 4	https://www.youtube.com/watch?v=Wj0OV2jf1VQandpp=ygUkUGh5bG9nZW5ldGljIGFuYWx5c2lzIEJpb2 luZm9ybWF0aWNz0gcJCYsJAYcqIYzv
Module 5	https://www.youtube.com/watch?v=z2XvrbRw7y8andpp=ygUeQXBwbGljYXRpb25zIG9mIEJpb2luZm9yb WF0aWNz

Course Code: BNC0402Y	Course Name: Environmental Science	L	T	P	C
Course Offered in: Department of Biotechnology		2	0	0	NA

Pre-requisite: Basic knowledge of biology, chemistry, ecology, geology, mathematics, and understanding of human impacts on natural systems.

Course Objectives: This course aims to equip students with a basic understanding of the interrelationship between humans and the environment, fostering awareness of environmental issues and promoting a positive attitude toward sustainability. It also seeks to develop the necessary skills and capabilities to address and solve environmental problems through social, political, cultural, and educational approaches.

Course	Bloom's Knowledge	
		Level (KL)
CO1	Understand the basic principles of ecology and environment. Ecosystem: Basic concepts, components of ecosystem, food chains and foodwebs. Ecological pyramids	K1,K2
CO2	Understand the different types of natural recourses like food, forest, Minerals and energy and their conservation	K1,K2
CO3	Understand the importance of biodiversity, Threats of biodiversity and different methods of biodiversity conservation.	K1,K2
CO4	Understand the different types of pollution, pollutants, their sources, effects and their control methods.	K1,K2
CO5	Understand the basic concepts of sustainable development, Environmental Impact Assessment (EIA) and different acts related to environment	K1,K2

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

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СО/РО	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	3	3	2	-	2	2	3	2	2
CO2	3	3	2	2	1	3	3	2	2	2	2	2	2	2
соз	3	3	2	2	1	3	3	2	2	2	2	2	2	2
CO4	3	3	2	2	-	3	3	3	2	2	2	2	2	2
CO5	3	3	2	2	-	3	3	2	2	2	2	2	2	2

Course Contents / Syllabus

Module 1 Basic Principle of Ecology 4 hours

Definition, Scope and basic principles of ecology and environment. Ecosystem: Basic concepts, components of ecosystem. Food chains and food. Webs. Ecological pyramids, Energy flow in ecological systems, Characteristics of different ecosystems. Biogeochemical Cycles: Importance, gaseous and sedimentary cycles. Carbon, Nitrogen, Phosphorus and Sulphur Cycles. Basic concepts of sustainable development, SDGs, Ecosystem services, UN Decade for Eco restoration ,

Module 2 Natural Resources and Associated Problems 4 hours

Natural resources and associated problems. Forest resources: Use and over- exploitation, deforestation. Timber extraction, mining, dams and their effects on forest and tribal people. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. Food resources: World food problems, changes caused by agriculture and over- grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. Land resources: Land as a resource, land degradation, man induced landslides. Equitable use of resources for sustainable lifestyles. Non-Renewable Energy Resources: Fossil fuels and their reserves, Nuclear energy, types, uses and effects, Renewable Energy Resources: hydropower, Solar energy, geothermal, tidal and wind energy, Biomass energy, biogas and its advantages.

Module 3 Biodiversity Succession and Non-Renewable Energy Resources 4 hours

Biodiversity and their importance, Threats to biodiversity, major causes, extinction's, vulnerability of species to extinction, IUCN threat categories, Red data book. Strategies for biodiversity conservation, principles of biodiversity conservation in-situ and exsitu conservation strategies Mega diversity zones and Hot spots, concepts, distribution and importance. Succession: Concepts of succession, Types of Succession. Trends in succession. Climax and stability.

Module 4	Pollution and Solid Waste Management	4 hours

Air pollution: sources of air pollution, Primary and secondary air pollutants. Origin and effects of SOX, NOX, Cox,CFC, Hydrocarbon, control of air pollution. Water pollution: sources and types of water pollution, Effects of water pollution, Eutrophication, Soil pollution: Causes of soil pollution, Effects of soil pollution, Major sources of and effects of noise pollution on health, Radioactive and thermal pollution sources and their effects on surrounding environment. Solid waste disposal and its effects on surrounding environment, Climate change, global warming, acid rain, ozone layer depletion.

Module 5 Role of CommModuley and Environmental Protection Acts	4 hours
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Role of community, women and NGOs in environmental protection, Bio indicators and their role, Natural hazards, Chemical accidents and disasters risk management, Environmental Impact Assessment (EIA), Salient features, of following Acts: a. Environmental Protection Act, 1986, Wildlife (Protection) Act, 1972.b. Water (Prevention and control of pollution) Act, 1974.c. Air (Prevention and control of pollution) Act, 1981. Forest (Conservation) Act, 1980. Wetlands (Conservation and Management) Rules, 2017; Chemical safety and Disaster Management law. District Environmental Action Plan. Climate action plans.

	Total Lecture Hours 20 hours						
Textboo	k:						
S.No	Book Title with publication agency & year	Author					
1	The nature and properties of Soils, Tenth Edition. Mac Millan	Brady, N.C.					
	Publishing Co., New York. 1990.						
Referen	ce Books:						
S.No	Book Title with publication agency & year	Author					
1	Air Pollution, Tata McGraw Hill Publishing Co. Ltd., New Delhi 1989	Rao M.N. and H.V.N. Rao					
2	A Text Book of environmental Science	Shashi Chawla					
3	Environmental studies- Oxford Publication	R, Rajagopalan					
4	Environmental Science: Toward a Sustainable Future"	Richard T. Wright and Dorothy F. Boorse					
5	"Living in the Environment"	G. Tyler Miller and Scott Spoolman					
NPTEL/	Youtube/ Faculty Video Link:						
Module	https://www.youtube.com/watch?v=qt8AMjKKPDohttps https://www.youtube.com/watch?v=brF0RWJyx9w https://www.youtube.com/watch?v=GK_vRtHJZu4, https://www.youtube.com/watch?v=b6Ua_zWDH6U, https://www.youtube.com/watch?v=7tgNamjTRkk, https://www.youtube.com/watch?v=ErATB1aMiS	i <u>://</u>					
Module	https://www.youtube.com/watch?v=mOwyPENHhbc, https://www.youtube.com/watch?v=yqev1G2iy20, https://www.youtube.com/watch?v= 74S3z3IO I, https://www.youtube.com/watch?v=jXVw6M6m2g0						
Module	https://www.youtube.com/watch?v=GK_vRtHJZu4,						
Module 4	https://www.youtube.com/watch?v=b6Ua_zWDH6U, https://www.youtube.com/watch?v=7tgNamjTRkk,						
Module	https://www.youtube.com/watch?v=ErATB1aMiS						