# 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** 

Third 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-V**

Sl.	Subject	Subject	Types of	]	Period	s	Ev	aluati	on Schem	ies	En Seme		Total	Credit
No.	Codes	J.	Subjects	L	T	P	CT	TA	TOTAL	PS	TE	PE		
1	BBT0501	Bioprocess Engineering	Mandatory	3	1	0	30	20	50		100		150	4
2	BBT0502	Plant Biotechnology	Mandatory	3	0	0	30	20	50		100		150	3
3		Departmental Elective I	Departmental Elective	3	0	0	30	20	50		100		150	3
4		Departmental Elective II	Departmental Elective	3	0	0	30	20	50		100		150	3
5	BBT0553	r-DNA Technology	Mandatory	0	0	6				50		100	150	3
6	BCSCC0501	Design Thinking -II	Mandatory	2	1	0	30	20	50		100		150	3
7	BBT0551	Bioprocess Engineering Lab	Mandatory	0	0	2				25		25	50	1
8	BBT0552	Plant Biotechnology Lab	Mandatory	0	0	2				25		25	50	1
9	BBT0559	Internship Assessment	Mandatory	0	0	2				50			50	1
10	BNC0502/ BNC0501	Essence of Indian Traditional Knowledge/ Constitution of India, Law and Engineering	Compulsory Audit	2	0	0	30	20	50		50			NA
11		MOOCs (Essential for Hons. Degree)	*MOOCs											
		TOTAL		19	2	6	120	80	250	150	600	50	1050	22

### \* 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	BMC0045	Microsoft Power BI	Infosys Wingspan (Infosys Springboard)	11h 32m	0.5
2	BMC0098	Strategic management	Infosys Wingspan (Infosys Springboard)	18 h 6m	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 BNC0301/BNC0302)
  - 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 Electives**

Sl. No.	Subject Codes	Subject Name	Type of Subjects	Bucket Name	Branch	Semester
1	BBT0511	Biochemical Reaction Engineering	Departmental Elective-I	Core Biotech	ВТ	5
2	BBT0513	Bioenergy Technologies and Systems	Departmental Elective-II	Core Biotecti	ВТ	5
3	BBT0512	Artificial Intelligence in Biotechnology	Departmental Elective-I	Communication I Print of	ВТ	5
4	BBT0514	Data Science	Departmental Elective-II	Computational Biotech	ВТ	5

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

# Bachelor of Technology Biotechnology Evaluation Scheme

## SEMESTER-VI

Sl.	Subject	Subject	Types of	Po	eriods		Ev	valuatio	on Scheme	s	End Semester		Total	Credit
No.	Codes		Subjects	L	T	P	CT	TA	TOTAL	PS	TE	PE		
1	BBT0601	Bioseparation Engineering	Mandatory	3	1	0	30	20	50		100		150	4
2	BBT0602	Metabolic Engineering	Mandatory	3	0	0	30	20	50		100		150	3
3	BBT0603	Nanobiotechnology	Mandatory	3	0	0	30	20	50		100		150	3
4		Departmental Elective -III	Departmental Elective	3	0	0	30	20	50		100		150	3
5		Departmental Elective -IV	Departmental Elective	3	0	0	30	20	50		100		150	3
6		Open Elective I	Open Elective	3	0	0	30	20	50		100		150	3
7	BBT0651	Bioseparation Engineering Lab	Mandatory	0	0	2				25		25	50	1
8	BBT0652	Metabolic Engineering Lab	Mandatory	0	0	2				25		25	50	1
9	BBT0653	Nanobiotechnology Lab	Mandatory	0	0	2				25		25	50	1
10	BBT0659	Mini Project	Mandatory	0	0	2				50			50	1
11	BNC0602/ BNC0601	Essence of Indian Traditional Knowledge / Constitution of India, Law and Engineering	Compulsory Audit	2	0	0	30	20	50		50			NA
12		*Massive Open Online Courses (For B.Tech. Hons. Degree)	*MOOCs											
		GRAND TOTAL		20	1	8	270	160		125	600	75	1100	23

### \* 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	BMC0066	Artificial Intelligence	Infosys Wingspan (Infosys Springboard)	69h 39m	4
2	BMC0078	Explore Machine Learning using Python	Infosys Wingspan (Infosys Springboard)	17h 7m	1

### 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 BNC0401/BNC0402)
  - 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 Electives**

Sl. No.	Subject Codes	Subject Name	Types of Subjects	Bucket Name	Branch	Semester
1	BBT0611	Bioreactor Analysis and Design	Departmental Elective-III	Core Biotech	ВТ	6
2	BBT0613	Biofuels & Alcohol Technology	Departmental Elective-IV	Core Biotech	ВТ	6
3	BBT0612	Probability and Statistics using R in Biotechnology	Departmental Elective-III	Computational	ВТ	6
4	BBT0614	Machine Learning	Departmental Elective-IV	Biotech	ВТ	6

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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



## **GREATER NOIDA-201306**

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**Bioprocess Engineering** 

		BBT05		<u></u>	Co	urse Na	ame: Bi	oproce	ss Engi	neering	Course Name: Bioprocess Engineering							
		ed in: Bi		ology				- P			<b>-</b>		1 3	T 1	P 0	C 4		
		: Studen			v about	the ba	sics of	microb	iology.									
		ctives: To								les, inc	luding u	nstream	and r	nids	trean	 1		
	-	or the de		_		_	_				_	_						
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CO1	Dem	onstrate t	the eau	ation for	r microl	hial cel	l growth	1					201	VI (II	K3	<u> </u>		
CO2		erstand th							tion.						K2			
CO3		rate the s													K3			
CO4	Desc	ribe the 1	nanufa	cturing	process	es for a	ntibioti	c and pi	oteins.						K1			
CO5		ify senso						rement	and cor	trol.					K1			
CO-PC	) Map	ping (Sca	ale 1: L	ow, 2:	Mediur	n, 3: H	igh)	1	1	ı	•		1					
COs		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO:	L	SO2	PSO3		
CO1		3	2	2	2	2	1	1	1	1	1	2	3		3	2		
CO2		3	2	2	2	2	1	1	1	1	1	2	3		3	2		
CO3		3	3	3	2	3	1	1	2	2	1	2	3		3	2		
CO4		2	2	2	1	2	1	1	1	1	1	2	2		3	2		
CO5		3	2	2	2	3	1	1	2	2	2	3	3		3	3		
Course	e Conte	ents / Syl	labus															
Module	Module 1 Microbial Growth and Stoichiometry 8 hours									irs								
	Microbial growth kinetics, Parameters affecting microbial growth, substrate utilization and product formation kinetics,																	
	stoichiometry of growth and product formation, Yield coefficients of biomass and product formation, Quantitative																	
	analysis of microbial growth by direct and indirect methods.  Module 2 Enzymes and Ideal Reactor Operation 8 hours																	
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		enzyme o s bioreac						mobiliz	zea enzy	ymes ar	ia their i	types, bi	oreact	ors-	batci	ı, fed-batch		
Module		S DIOI Cac	1015, 11	Biorea				cm							8 hou	ırc		
		anzyma (	eatalve						od onz	mac ar	nd thair i	type hi	oroact			ı, fed-batch		
_		s bioreac	•				• /	шоюши	eu enz	ines ai	iu men	types, br	oreaci	015-	Datei	i, icu-patcii		
01 00110		, 2101 0410	,			2,500												
Solid-st	tate fe	rmentati	ions, ei	nergy b	alance	and m	ass trai	nsfer, o	peratio	n and	control	of biore	actors	(aeı	ation	, agitation,		
heat tra	ansfer,	, mass tr	ansfer	scale-u	p and s	cale-do	wn of l	oioreac	tors).									
Module							ocess E	_							8 hou			
_				_			_			otics, p	oroteins,	polysac	charic	les,	arom	a etc. Case		
		oduction	of ant	ibiotics,	, enzym	ies, ins	ulin, bio	o-ethan	ol.									
Module	e 5			Model	ling and	d Optir	nizatio	n in bio	proces	s Engin	eering				8 hou	ırs		
Instrum	nentatio	on and mo	onitorin	ıg, Conc	ept of s	teriliza	tion, Ty	pes of s	steriliza	tion, Ba	tch and o	continuo	us steri	lizat	ion, C	Optimization		
_				_	or enha	inced p	roduct f	ormatic	on, Type	es of ma	athematic	cal mode	ls in bi	iopro	cess e	engineering,		
examples of industrial bioprocesses.																		
											Tota	l Lectur	e Hou	rs	40 ho	urs		
Textbo																		
S.No	_	ok Title				• •					Author							
1	· ·	<i>process E</i> I/Pearsoi	_	_	isic Con	cepts (3	3rd ed.,	Prentic	e		Michael	Shuler; F	ikret K	(argi;	Matt	hew DeLisa		
2	Bio	process E	nginee	ring Pri	nciples	(2nd ed	I., Acade	emic Pr	ess, 201	L2)	Pauline <b>N</b>	M. Doran	)					
3		sic Biotec									Colin Rat	ledge; B	jorn Kr	istia	nsen			
		e Books:		•	-			•	-	·		<u> </u>	-					
	Reference Dooks.																	



S.No	Book Title with publication agency & year	Author				
1	<i>Bioseparations Science and Engineering</i> (Oxford University Press, 2003)	Roger G. Harrison; Paul W. Todd; Scott R. Rudge; Demetri P. Petrides				
2	Karl Schügerl (with D. A. John Wase)					
3 Introduction to Biochemical Engineering (Tata McGraw-Hill Education, New Delhi, 2005)  D. G. Rao (amazon.in, Google Boolibcat.iitd.ac.in)						
NPTEL/	Youtube/ Faculty Video Link:					
Module 1	https://www.youtube.com/watch?v= jiY8av92nM					
Module 2	https://www.youtube.com/watch?v=WeJeKwMUGXc					
Module 3	https://www.youtube.com/watch?v=S49ZhytFyZs					
Module 4	https://www.youtube.com/watch?v=E4mdKIWndHA					
Module 5	https://www.youtube.com/watch?v=NakBHy7HXPU					



### **GREATER NOIDA-201306**

(An Autonomous Institute)
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**Plant Biotechnology** 

Course Code: BBT0502 Course Name: Plant Biotechnology L T P								
Course	Offered in: Department of Bio	technology	3	0	0	3		
Pre-requisite: Student should have basic knowledge of Plant physiology, growth development and cell biology								
Course Objectives: To provide knowledge of genetic engineering, tissue culture, and molecular techniques for crop								
improvement and sustainable agricultural practices.								
Course	Course Outcome: After completion of the course, the student will be able to  Bloom's Knowledge							
			Lev	el (K	L)			
CO1	Remembering the fundamental	s of culturing plant cells and tissues.			K			
CO2	Understanding the Principles at	nd methods of genetic transformation.			K2	2		
CO3 Illustrate the process and mechanism of crop improvement through tissue culturing.								
CO4	CO4 Explain the different methods and techniques of Molecular Farming. K2							
CO5	Acquire knowledge on various	genome editing technologies.			K.	3		
CO DOM: 1 (C 1 4 T A M II A M II)								

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

COs	PO1	PO2	РО3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1	1	1	1	1	2	3	2	2
CO2	3	3	2	2	3	1	1	1	1	1	2	3	3	2
CO3	3	3	3	2	3	2	1	1	1	1	3	3	3	2
CO4	3	3	3	2	3	2	1	1	1	2	3	3	3	3
CO5	3	3	3	3	3	2	1	1	1	2	3	3	3	3

Course Contents / Syllabus

Module 1 Plant tissue culture 8 hours

History of plant tissue culture, plasticity and totipotency; Laboratory setup for a typical plant tissue culture facility; Sterilization methods used in plant tissue culture; Types of nutrient media and plant growth regulators in plant regeneration; Pathways for in vitro regeneration: organogenesis, somatic and gametic embryogenesis; protoplast isolation, culture, and regeneration; culture of other explants, somatic hybridization; Haploid and triploid production and their applications. Applications of micro-propagation, meristem culture, embryo rescue, somaclonal variations.

Module 2 Principles and methods of genetic transformation 8 hours

Introduction to Agrobacterium biology and biotechnology; Mechanism of T-DNA transfer to plants and Agro infection: A. rhizogenes and its application; Methods for direct gene transfer, Marker, and reporter genes; Plant viral vectors; Molecular techniques for analysis of transgenics (copy number, transgene stability, silencing; segregation); Marker-free transgenics and environmental, social, and legal issues associated with transgenic plants.

Module 3 Crop Improvement 8 hours

The need of crop improvement; Conventional methods of crop improvement: selection, mutation, polyploidy, and clonal selection; Green revolution in India; Introduction to marker assisted breeding and selection; Application of tissue culture for crop improvement.

Module 4 Molecular Farming 8 hours

Transgenic crops for production of antibodies, viral antigens, and peptide hormones in plants; Edible vaccines and Nutraceuticals; Plant Biotechnology for biofuels; Methods for Plant Conservation: Cryopreservation; Production of bioactive secondary metabolites by plant tissue culture.

Module 5 Genome Editing 8 hours

The history of targeted mutations in plants: Use of ZFNs and TALENs as early tools for genome editing; Discovery of CRISPR-Cas system and its applications; Recent innovations in the technology and case studies where CRISPR- Cas has been used for plant improvement.

		<b>Total Lecture Hours</b>	40 hours						
Textbook:									
S.No	Book Title with publication agency & year	Author							
1	Principles of Plant Genetics and Breeding, Wiley-Blackwell, 2022	Coorgo Agguegh							
1	(3rd Edition, latest)	George Acquaah							



2	An Introduction to Plant Tissue Culture, Oxford & IBH Publishing Co., 2003 (latest edition)	M. K. Razdan								
3	Plant Tissue and Organ Culture: Fundamental Methods, Springer, 1995 (latest edition)	O. L. Gamburg; G. C. Phillips								
Reference Books:										
S.No	Book Title with publication agency & year	Author								
1	Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press, 2008 (latest edition)	Adrian Slater; Nigel W. Scott; Mark R. Fowler								
2	Biochemistry & Molecular Biology of Plants, Wiley Blackwell, 2015 (2nd Edition, latest)	Bob Buchanan; Wilhelm Gruissem; Russell Jones								
3	Plant Biochemistry, Academic Press, 2021 (5th Edition, latest)	Hans-Walter Heldt; Birgit Piechulla; Donald Heldt								
NPTEL/	Youtube/ Faculty Video Link:									
Module 1	https://nptel.ac.in/courses/102103016/									
Module 2	https://youtu.be/ZqTGvSFbnxk									
Module 3	https://nptel.ac.in/courses/102106080/									
Module 4	https://nptel.ac.in/courses/107108011/									
Module 5	https://nptel.ac.in/courses/109105115/									



## **GREATER NOIDA-201306**

(An Autonomous Institute)
School of Biotechnology

**Biochemical Reaction Engineering** 

_	om's	s Know	PSO3 2 2						
Pre-requisite: Students should know about the basic microbiology and cell biology  Course Objectives:  To impart knowledge of kinetics, reactor design, and analysis of biochemical processes for efficient optimization in biotechnological industries.  Course Outcome: After completion of the course, the student will be able to  Explain the principles and kinetics of biochemical reaction engineering.  CO2 Analyze the kinetics of enzyme catalyzed reactions in free and immobilized states.  CO3 Evaluate the Kinetics of substrate utilization, product formation and biomass production.  CO4 Differentiate between types of reactors.  CO5 Understand the Kinetics of mixed cultures.  CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)  CO5 PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PSO5 PO1 PSO5 PSO5 PSO5 PSO5 PSO5 PSO5 PSO5 PSO5	scale om's	e-up and s Know (KL)	PSO3						
Course Objectives: To impart knowledge of kinetics, reactor design, and analysis of biochemical processes for efficient optimization in biotechnological industries.  Course Outcome: After completion of the course, the student will be able to Blo Lev  CO1 Explain the principles and kinetics of biochemical reaction engineering.  CO2 Analyze the kinetics of enzyme catalyzed reactions in free and immobilized states.  CO3 Evaluate the Kinetics of substrate utilization, product formation and biomass production.  CO4 Differentiate between types of reactors.  CO5 Understand the Kinetics of mixed cultures.  CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)  CO6 PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PSO2  CO1 3 2 1 2 2 1 1 1 1 1 1 2 3 3 CO2 3 3 3 2 3 3 1 1 2 2 1 1 2 2 3 CO3 3 3 3 3 3 3 3 1 1 2 2 1 1 2 2 3 CO3 3 3 3 3 3 3 3 1 1 2 2 1 1 2 2 3 CO3 CO3 CO3 CO3 CO3 CO3 CO3 CO3 CO3 C	om's	s Know KL) K2 K4 K5 K4 K2 PSO2	PSO3 2 2						
To impart knowledge of kinetics, reactor design, and analysis of biochemical processes for efficient optimization in biotechnological industries.  Course Outcome: After completion of the course, the student will be able to Blocker CO1 Explain the principles and kinetics of biochemical reaction engineering.  CO2 Analyze the kinetics of enzyme catalyzed reactions in free and immobilized states.  CO3 Evaluate the Kinetics of substrate utilization, product formation and biomass production.  CO4 Differentiate between types of reactors.  CO5 Understand the Kinetics of mixed cultures.  CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)  CO5 PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PSO2 PO3 SO3 SO3 SO3 SO3 SO3 SO3 SO3 SO3 SO3 S	om's	s Know KL) K2 K4 K5 K4 K2 PSO2	PSO3 2 2						
optimization in biotechnological industries.  Course Outcome: After completion of the course, the student will be able to Lev CO1 Explain the principles and kinetics of biochemical reaction engineering.  CO2 Analyze the kinetics of enzyme catalyzed reactions in free and immobilized states.  CO3 Evaluate the Kinetics of substrate utilization, product formation and biomass production.  CO4 Differentiate between types of reactors.  CO5 Understand the Kinetics of mixed cultures.  CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)  CO6 PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PSO2 PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PSO3 PO1 PO11 PSO3 PO1 PO11 PSO3 PSO3 PSO3 PSO3 PSO3 PSO3 PSO3 PSO3	om's	s Know KL) K2 K4 K5 K4 K2 PSO2	PSO3 2 2						
CO1 Explain the principles and kinetics of biochemical reaction engineering.  CO2 Analyze the kinetics of enzyme catalyzed reactions in free and immobilized states.  CO3 Evaluate the Kinetics of substrate utilization, product formation and biomass production.  CO4 Differentiate between types of reactors.  CO5 Understand the Kinetics of mixed cultures.  CO6 PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PSO5  CO1 3 2 1 2 2 1 1 1 1 1 1 1 2 3 3 CO2 3 3 3 2 3 3 1 1 2 2 1 1 2 3 3 CO3 3 3 3 3 3 3 3 1 1 2 1 2 1 1 2 3 3 CO4 3 3 3 2 2 2 3 1 1 2 2 1 1 2 2 3 3 CO4 3 3 3 2 2 2 3 1 1 2 2 1 1 2 2 3 3 CO4 3 3 3 2 2 2 3 1 1 2 2 1 1 1 2 3 3 CO4 3 3 3 2 2 2 3 1 1 1 2 1 1 1 1 1 1 2 3 3 CO5 2 2 2 1 2 2 1 1 1 1 1 1 1 1 2 2 3 3 CO5 2 2 2 1 2 2 2 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 3 2 3	rel (K	KL)  K2  K4  K5  K4  K2  PSO2  2  3  3	PSO3 2 2 2						
CO1 Explain the principles and kinetics of biochemical reaction engineering.  CO2 Analyze the kinetics of enzyme catalyzed reactions in free and immobilized states.  CO3 Evaluate the Kinetics of substrate utilization, product formation and biomass production.  CO4 Differentiate between types of reactors.  CO5 Understand the Kinetics of mixed cultures.  CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)  CO5 PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PSO2  CO1 3 2 1 2 2 1 1 1 1 1 1 1 2 3  CO2 3 3 3 2 3 3 1 1 2 1 1 2 3  CO3 3 3 3 3 3 3 3 1 1 2 1 1 2 1 1 2 3  CO4 3 3 3 2 2 3 1 1 2 2 1 1 2 3  CO4 3 3 3 2 2 1 2 2 3 1 1 2 1 1 2 3  CO5 2 2 1 2 1 1 1 1 1 1 1 1 2 3  CO5 Course Contents / Syllabus  Module 1 Introduction to Biochemical reaction engineering  Kinetics of homogeneous reactions, reaction mechanism, Temperature dependency from Arrhe prediction of rate constant: Interpretation of batch kinetic data.  Module 2 Kinetics of enzyme catalyzed reactions in free and immobilized states  Michaelis-Menten equation and its various modifications, Mechanism and application of Michaelis-Menten equation and its various modifications, Mechanism and application of Michaelis-Menten equation and its various modifications, Mechanism and application of Michaelis-Menten equation and its various modifications, Mechanism and application of Michaelis-Menten equation and its various modifications, Mechanism and application of Michaelis-Menten equation and its various modifications, Mechanism and application of Michaelis-Menten equation and its various modifications, Mechanism and application of Michaelis-Menten equation and its various modifications, Mechanism and application of Michaelis-Menten equation and its various modifications, Mechanism and application of Michaelis-Menten equation and its various modifications, Mechanism and application of Michaelis-Menten equation and its various modifications, Mechanism and application of Michaelis-Menten equation and its various modifications, Mechanism and application of Michaelis-Menten eq	rel (K	KL)  K2  K4  K5  K4  K2  PSO2  2  3  3	PSO3 2 2 2						
CO1 Explain the principles and kinetics of biochemical reaction engineering.  CO2 Analyze the kinetics of enzyme catalyzed reactions in free and immobilized states.  CO3 Evaluate the Kinetics of substrate utilization, product formation and biomass production.  CO4 Differentiate between types of reactors.  CO5 Understand the Kinetics of mixed cultures.  CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)  CO6 PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PSO2  CO1 3 2 1 2 2 1 1 1 1 1 1 1 2 3  CO2 3 3 3 2 3 3 1 1 2 1 1 2 3  CO3 3 3 3 3 3 3 3 1 1 2 1 1 2 1 1 2 3  CO4 3 3 3 2 2 3 3 1 1 2 1 1 2 3  CO5 D 2 2 1 2 2 1 1 1 1 1 1 1 2 3  CO5 CO1 SUBSTRACT OF SU		K2 K4 K5 K4 K2 PSO2	2 2						
CO2 Analyze the kinetics of enzyme catalyzed reactions in free and immobilized states.  CO3 Evaluate the Kinetics of substrate utilization, product formation and biomass production.  CO4 Differentiate between types of reactors.  CO5 Understand the Kinetics of mixed cultures.  CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)  CO5 PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PSO2 PO1	1	K4 K5 K4 K2 PSO2 2 3 3	2 2						
CO3         Evaluate the Kinetics of substrate utilization, product formation and biomass production.           CO4         Differentiate between types of reactors.         CO5         Understand the Kinetics of mixed cultures.         CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)           CO3         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PSO2           CO1         3         2         1         2         2         1         1         1         1         2         3           CO2         3         3         2         3         3         1         1         2         1         1         2         3           CO3         3         3         3         3         3         1         1         2         1         1         2         3           CO4         3         3         2         2         3         1         1         2         1         1         2         3           CO5         2         2         2         1         2         2         1         1         1         1         1         2         2	1   1	K5 K4 K2 PSO2 2 3 3	2 2						
CO4	1	K4 K2 PSO2 2 3 3	2 2						
CO5	1	PSO2  2 3 3	2 2						
CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)           COs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PSO2           CO1         3         2         1         2         2         1         1         1         1         1         2         3           CO2         3         3         2         3         3         1         1         2         1         1         2         3           CO3         3         3         3         3         3         1         1         2         1         1         2         3           CO4         3         3         2         2         3         1         1         2         1         1         2         3           CO5         2         2         1         2         2         1         1         1         1         1         1         2         2           Course Contents / Syllabus           Module 1         Introduction to Biochemical reaction engineering           Kinetics of enzyme catalyzed reactions in free and	1	PSO2 2 3 3 3	2 2						
COs         PO1         PO2         PO3         PO4         PO5         PO6         PO7         PO8         PO9         PO10         PO11         PSO2           CO1         3         2         1         2         2         1         1         1         1         1         1         2         3         3         1         1         2         1         1         2         3         3         2         3         3         3         1         1         2         1         1         2         3         3         2         3         3         3         1         1         2         1         1         2         3         3         2         2         3         3         1         1         2         1         1         2         3         3         2         2         3         3         1         1         2         1         1         2         3         3         2         2         2         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         <	1	2 3 3	2 2						
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CO4 3 3 3 2 2 3 1 1 2 2 1 1 2 2 2 1 2 2 2 2			3						
Course Contents / Syllabus         Module 1       Introduction to Biochemical reaction engineering         Kinetics of homogeneous reactions, reaction mechanism, Temperature dependency from Arrhe prediction of rate constant: Interpretation of batch kinetic data.         Module 2       Kinetics of enzyme catalyzed reactions in free and immobilized states         Michaelis-Menten equation and its various modifications, Mechanism and application of Michaelis			2						
Module 1         Introduction to Biochemical reaction engineering           Kinetics of homogeneous prediction of rate constant: Interpretation of batch kinetic data.         Temperature dependency from Arrhe prediction of rate constant: Interpretation of batch kinetic data.           Module 2         Kinetics of enzyme catalyzed reactions in free and immobilized states           Michaelis-Menten equation and its various modifications, Mechanism and application of Michaelis		2	2						
Kinetics of homogeneous reactions, reaction mechanism, Temperature dependency from Arrhe prediction of rate constant: Interpretation of batch kinetic data.  Module 2 Kinetics of enzyme catalyzed reactions in free and immobilized states  Michaelis-Menten equation and its various modifications, Mechanism and application of Michaelis									
module 2 Kinetics of enzyme catalyzed reactions in free and immobilized states  Michaelis-Menten equation and its various modifications, Mechanism and application of Michaelis-Menten equation and its various modifications, Mechanism and application of Michaelis-Menten equation of Michaelis-Menten equation and its various modifications, Mechanism and application of Michaelis-Menten equation in the constant interpretation of batch kinetic data.		8 hou	rs .						
Module 2 Kinetics of enzyme catalyzed reactions in free and immobilized states  Michaelis-Menten equation and its various modifications, Mechanism and application of Michaelises.	nius	law,	Theoretical						
Michaelis-Menten equation and its various modifications, Mechanism and application of Michael									
*		8 hou							
Lineweaver-Burk plot. Effects of External mass transfer in immobilized enzyme systems, analysis of intr			-						
	apart	ticle di	fusion and						
reaction.	1	0.1							
Module 3 Kinetics of substrate utilization, product formation and bioma	ISS	8 hou	.*S						
Monod growth model and its various modifications, structured and unstructured kinetic rate n	20 40	la Tha	man al da ath						
kinetics of cells & spores, Transport phenomena in bioprocess systems, gas-liquid mass transfer in									
transfer for bubbles swarms.	ccmu	iiai sys	CIIIS, IVIASS						
Module 4 Types of Reactors		8 hou							
Batch, plug flow reactor (PFR), continuous stirred rank reactors (CSTR), fluidized bed reactor, but									
fermenter etc., Concept and models of ideal and non-ideal reactor: Residence time distribution, Op									
in bioreactors for suspension and immobilized cultures, modifying batch and continuous reactors, imm		-							
solid state fermentation.									
Module 5 Kinetics of mixed cultures		8 hou	rs						
Major classes of interaction in mixed cultures, models describing mixed-culture interactions, r									
industrial application of mixed cultures. Inodess describing infixed-culture interactions, reaction dynamics, and									
Total Lecture Hours 48 hours									
Textbook:	1								
S.No Book Title with publication agency & year Author									
Chemical Reaction Engineering, John Wiley & Sons, 1999 (3rd Edition, latest)  Octave Levenspiel									
Bioprocess Engineering Principles, Academic Press, 2012 (2nd Edition, latest)  Pauline M. Doran	Edition, latest)  Bioprocess Engineering Principles, Academic Press, 2012 (2nd								



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3	Bioprocess Engineering: Basic Concepts, Pearson, 2017 (3rd	Michael L. Shuler; Fikret Kargi; Matthew					
3	Edition, latest)	DeLisa					
Ref	erence Books:						
S.No	Book Title with publication agency & year	Author					
1	Biochemical Engineering, Academic Press, 1973 (latest edition)	S. Aiba; A. E. Humphrey; N. F. Millis					
2	Bioreaction Engineering: Bioprocess Monitoring, Wiley-VCH, 1997 (latest edition)  Karl Schügerl						
3	Introduction to Biochemical Engineering, Tata McGraw-Hill Education, 2005 (latest edition)  D. G. Rao						
NPTEL/	Youtube/ Faculty Video Link:						
Module	1 https://www.youtube.com/watch?v=J4Kd392YSaI						
Module	2 https://www.youtube.com/watch?v=zHZBuXhq3Ug						
Module 3 https://www.youtube.com/watch?v=SLw7yOVoGls							
Module	Module 4 https://www.youtube.com/watch?v=kpLJ3ou-W0I						
Module 5 https://www.youtube.com/watch?v=GZVbXQzuAd8							



## **GREATER NOIDA-201306**

	Bioenergy Technologies and Systems															
Course	Code	: <b>BBT05</b>	13		Co	urse N	ame: Bi	ioenerg	y Tech	nologie	s and Sy	stems	L	T	P	C
Course	Course Offered in: 3 0 0 3									3						
Pre-rec	Pre-requisite: Basic knowledge of Biochemistry, Microbiology and Bioprocess Technology.															
Course Objectives: The course provides the students the basics of bioenergy technologies, importance of biomass																
feedstocks towards bioenergy generation, concept of biorefinery and the ability to understand bio and thermochemical																
conversion of biomass to generate biofuels.																
Course	Course Outcome: After completion of the course, the student will be able to  Bloom's Knowledge															
													Lev	el (K	L)	
CO1		ne the bio													K1	
CO2		ain the in	_												K2	
CO3		erstand the erstand th										2000			K2 K2	
		onstrate													K2 K3	
CO5		ways.	the tec	cimo ecc	Jiioiiiic	anarys	ns and	optimi	Lation	strategn	23 101 0	lochergy			IXS	
CO-PC		ping (Sca	ale 1: I	Low, 2: 1	Mediur	n, 3: H	igh)									
COs		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	L   I	PSO2	PSO3
CO1		3	2	1	1	1	3	2	1	1	1	2	3		2	2
CO2		3	3	2	1	2	3	2	1	1	1	2	3		3	2
CO3		2	2	2	2	2	3	2	2	1	1	3	3		3	2
CO4		3	3	2	2	3	3	2	1	1	1	3	3		3	3
CO5		3	3	3	3	3	3	3	2	2	2	3	3		3	3
Course	Course Contents / Syllabus															
Module	e 1			Bioene	rgy coi	cepts-	Introd	uction							8 houi	`s
Fundan	Fundamental definitions of biomass and biofuels, System thinking, Biopower, Bioheat, Biofuels, Advanced liquid fuels, drop in															
		d produc	ts, bior													
Module												edstock)			8 houi	
		•			-			_		-	-			•		arm waste,
_	_		of resid	ential, c	ommer	cial and	1 indust	rial wa	ste, Ad	vantage	s and Di	sadvanta	ges of	resi	dual fe	edstock as
biomas		ea ruer.		D:	C		Tooler	-l	т						8 houi	
Module		n Diomofin					Techn			Dionofin	our. Dion	1	Dioni			
	_	-	-	-		•	-		-			-	-	_		ilization of nance, Life
_		ent (LCA									ery, Evai	uating bi	oreim	ery į	eriorii	iance, Life
Module		ent (LCA	1), Faui				Techn			.5					8 houi	•6
		conversi	on: H							Farman	tation to	chnologi	ioc in			oroduction,
				-	-			-	-			_			_	conversion:
		Gasificati							-		-cstcriffc	ation, 1		CHCH	iicai c	onversion.
Module		Sustricuti	1011, 1 9					•			ion stra	tegv			8 houi	·s
		retanding	of TE										Aathar			delling and
		·				_				_	0. 1	•		manc	ai iiioc	ichnig and
Statistic	statistical optimization using Minitab/Design Expert, Machine learning based optimization strategy.  Total Leature Hours   48 hours															
Tevtho	Textbook: Total Lecture Hours 48 hours							11.5								
S.No		ok Title v	vith nu	blicatio	n agenc	v & ve	ar				Author					
5		ustrial Bi						Flsevi	er 201			andey; Ra	iner H	Infer	· Christ	tian
1		est editio		ines and	VVIIICE	Diotec	illiology	, LISCVI	CI, 201.		Larroche		illici i	ioici	, Ciliis	liaii
		ndamenta		anewah	la Enor	m/ Sour	ros Na	roca Dir	hliching		Larrociie	. (LU3)				
2		use, 2007				gy Jour	ces, IVd	i usa PU	אווווונווע	5	G. N. Tiv	/ari; M. K	. Ghos	al		
						d Task	nologii	Dringie	امد محدا							
3		newable		_	_		nology:	rrincip	ies and		Kishore \	V. V. N.				
	Practice, TERI, 2009 (latest edition)															



S.No	Book Title with publication agency & year	Author				
1	Biogas Technology, New Age International Publishers, 2002 (latest edition)	B. T. Nijaguna				
2	Bioenergy and Biofuel from Biowastes and Biomass, ASCE Publications, 2010 (latest edition)  Samir Kumar Khanal					
3	Bioenergy Engineering, CRC Press, 2022 (latest edition)  Mahendra S. Seveda; Pardeep Narale (Ed					
NPTEL/	Youtube/ Faculty Video Link:					
Module	1 https://www.youtube.com/watch?v=VBp0yUKmRaY					
Module	2 https://www.youtube.com/watch?v=Z2dPGn9Mwtk					
Module 3 <u>https://www.youtube.com/watch?v=YNqKyCtY2tc</u>						
Module 4 <u>https://www.youtube.com/watch?v=rFWRVXJgIbI</u>						
Module 5 https://www.youtube.com/watch?v=IxmlI7gnN0g&t=139s						



## **GREATER NOIDA-201306**

Artificial Intelligence in Biotechnology							
Course Code: BBT0512	Course Name: Artificial Intelligence in Biotechnology						

									L .	r				
Course O											3	(	0	0 3
Pre-requisite: Basic knowledge of data analysis and biotechnology areas														
Course Objectives														
To introduce AI concepts and tools for analyzing biological data, modeling bioprocesses, and enhancing decision-														
making in biotechnology applications.:														
Course O	urse Outcome: After completion of the course, the student will be able to Block									Bloo	oom's Knowledge			
												Leve	l (KL)	
CO1	Explain th		lamenta	1 conce	epts, hi	story,	and sco	ope of	AI, in	cluding	problem	ı	K2	
	formulatio		1 1		f A	T	1						17.4	
CO2	Analyze v						em-sorv	ing.					K4 K3	
CO4	Apply data						hlem-s	olving					K3	
CO5	Analyze th												K4	
	Iapping (Sca							. <u>J</u>				ı		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	1	1	1	1	2	2	1	2
CO2	3	3	2	2	3	1	1	1	1	1	2	3	2	2
CO3	2	2	2	1	2	1	1	2	2	1	2	2	2	2
CO4 CO5	3	3	3	2	3	2	2	1	2	1	3	3	3	3
	_	_		2	J					1	J	3		3
Course Contents / Syllabus  Module 1 Introduction to AI 8 hours														
	f AI history	curren	t status	scone	agents					ulations	Review	of tree :		
Concept of AI, history, current status, scope, agents, environments, Problem Formulations, Review of tree and graph structures, State space representation, Search graph and Search tree														
Module 2 Search Algorithms									8 hours					
Uniformed	l Search - D	epth an	d Bread	th first	search,	Inform	ed Sear	ch - Be	st first	search, A	A*algori	thm, Gra	aph Searc	h and Tree
Search, Ra	andom search	n, Searc	h with o	losed a	nd oper	ı list, He	euristic	search.						
Module 3						AII	Project	Life C	ycle				8 hours	}
AI Project	Cycle, Prob	lem sco	ping, D	ata acqı	uisition	, Data E	xplorat	ion, Mo	deling.					
Module 4						Dat	a Analy	ysis					8 hours	}
Sort and fi	lter data, Co	ndition	al forma	tting, cl	harts, p	ivot tabl	les, tabl	es, wha	t if anal	ysis, sol	ver, desc	riptive s	tatistics,	correlation,
regression														
Module 5						App	olicatio	n of AI	in Biot	echnolo	gy		8 hours	3
Application	n of AI and	ML in I	Biochen	nical En	gineeri	ng, ML	in Bior	eactor I	Enginee	ring, ML	for Bio	resource	and Bioe	energy, ML
for Enviro	nmental Bio	enginee	ring, M	L for M	letaboli	c and Pr	rotein E	ngineer	ring, MI	L for Bio	material	Engine	ering	
										Total 1	Lecture	Hours	48 hour	rs
Textbook						· · ·			· · ·			<u> </u>		
S.No	Book Title w	vith pub	olication	agenc	y & yea	r							Author	•
1	Artificial Intelligence Basics: A Non-Technical Introduction, Apress, 2019 (latest edition)									Tom Ta	nulli			
2	Artificial Intelligence: The Basics, Routledge, 2011 (latest edition)									Kevin \	Varwick			
3	Artificial Intelligence in Biotechnology, Arcler Education Incorporated, 2020 (latest edition)							on)	Preeth	i Kartan				
Refer	ence Books:													
S.No	S.No Book Title with publication agency & year Author							<u> </u>						
1	Artificial Int	telligen	ce – A N	Modern	Approa	nch, Pea	rson, 20	)21 (4th	Edition	n, latest)			Stuart 1 Peter N	Russell; lorvig
2	Artificial Int	telligen	се Ву Е	xample	, Packt	Publish	ing, 202	20 (2nd	Edition	, latest)				Rothman
<u> </u>														



## **GREATER NOIDA-201306**

NPTEL/ Youtube/ Faculty Video Link:								
	T .							
Module 1	https://www.youtube.com/wa	<u>atch?v=C6YtPJxNULA&amp;pp=ygU</u>	XSW50cm9kdWN0aW9uIHRvIEFJICYgTUw%					
	<u>3D</u>		-					
Module 2	https://www.youtube.com/wa	atch?v=E0Hmnixke2g&pp=vgUul	U2VhcmNoIEFsZ29yaXRobXMgJiBMaW5lYX					
	IgQWxnZWJyYSBmb3IgQU	• 11 •						
Module 3								
Module 4	https://www.youtube.com/wa	atch?v=E0Hmnixke2g&pp=ygVbI	U2VhcmNoIEFsZ29yaXRobXMgJiBMaW5lYX					
	IgOWxnZWJyYSBmb3IgOU	UkgJiBNTE1hY2hpbmUgTGVhcr	m5pbmcgVGVjaG5pcXVlcyAmIE5ldXJhbCBO					
	ZXR3b3Jrcw%3D%3D							
Module 5	https://www.youtube.com/wa	atch?v=z18nw4adsx4&pp=ygUcR	GF0YSBBbmFseXNpcyAmIE1MIEFsZ29yaXR					
	obdIHCQmLCQGHKiGM7v							



#### **GREATER NOIDA-201306**

(An Autonomous Institute)
School of Biotechnology

#### **Data Science**

Course Code: BBT0514	Course Name: Data Science	L	Т	P	С	
Course Offered in: 3 0 0						
Pre-requisite: Basic knowledge of data analysis and	visualization					

Course Objectives: The goal is to grasp fundamental concepts of data science, encompassing data preprocessing and inferential statistics application to a provided dataset, followed by the utilization of linear and logistic regression models on the same dataset.

Course	Outcome: After completion of the course, the student will be able to	Bloom's Knowledge Level				
		(KL)				
CO1	Understand the basic concept of data science in biotechnology.	K2				
CO2	Analyze the dataset and perform Descriptive Statistics.	K4				
CO3	Analyze the dataset and perform an Inferential Statistics.	K4				
CO4	Apply linear regression on the given dataset.	K3				
CO5	Apply the logistic regression on the given dataset.	K3				

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

COs	PO1	PO2	РОЗ	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	2	1	1	1	1	2	3	2	2
CO2	3	3	2	2	3	2	1	1	1	1	2	3	3	2
CO3	3	3	2	3	3	2	1	1	1	1	3	3	3	2
CO4	3	3	3	3	3	2	1	1	1	2	3	3	3	3
CO5	3	3	3	3	3	2	1	1	1	2	3	3	3	3

Course Contents / Syllabus

Module 1 Basics of Data Science 8 hours

What is Data Science, Buzzwords of Data Science, Evolution of Data Science, Info-graphic representation of terminologies, DS Life Cycle, Difference between Analysis and Analytics, Application, Types of Data, Tools & Technologies, Future of Data Science, Security Issues, Use cases.

Module 2 Data Preprocessing 8 hours

Attributes & its types, Understanding and Extracting Useful variables, Handling Missing data, Data cleaning, removing redundant variables, Variable Selection, identifying outliers, removing outliers, removing rows with missing values and human error, Analyzing relation between variables, Data transformation and Dimensionality reduction.

Module 3 Correlation and Regression 8 hours

Population and Sample, Measurement Levels, Representation of categorical variables, Measures of Central Tendency (Mean, Median, Mode), Skewness, Variance, Standard Deviation, Coefficient of Variation, Covariance, Histogram Analysis, Introduction to Regression, Simple and Multiple Linear Regression, Correlation vs. Regression, SST (Sum of Squares Total), SSR (Sum of Squares Regression), SSE (Sum of Squares Error) R-Square, Adjusted R-Squared. Multiple Linear Regression, Significance of p-value.

Module 4 Data Analysis & Inferential Statistics 8 hours

Statistical analysis, hypothesis testing- Null and Alternative hypothesis, significance of p-value, F-value, chi-square, T-test, ANOVA, Correlation, Bayesian Probability, Distribution, Normal Distribution, Standard Normal Distribution, Central Limit Theorem, Standard Error, Estimators and Estimates, Confidence Interval, Students T Distribution, Margin of Error.

Module 5 Logistic Regression 8 hours

Logistic regression, Logit vs logistic, Applications of logistic regression Introduction to data visualization and various graphical ways of data representation, Case studies: DS in biotechnology.

		Total Lecture Hours 40 hours					
Textbook:							
S.No	Book Title with publication agency & year	Author					
1	The Art of Statistics: Learning from Data, Pelican Books, 2019 (latest edition)	David Spiegelhalter					
2	Principles of Statistics, Dover Publications Inc., 1979 (latest edition, reprint of 1965 original)	M. G. Bulmer					



	Statistics 101: From Data Analysis and Predictive Modeling to							
3	Measuring Distribution and Determining Probability, Adams Media,	David Borman						
	2016 (latest edition)							
Refe	rence Books:							
S.No	Book Title with publication agency & year	Author						
1	Information Dashboard Design: Displaying Data for At-a-Glance Monitoring, O'Reilly Media, 2020 (2nd Edition, latest)	Stephen Few						
2	Beautiful Visualization, O'Reilly Media, 2010 (latest edition)	Noah Iliinsky; Julie Steele (Eds)						
3								
NPTEL/	Youtube/ Faculty Video Link:							
Module 1	https://www.youtube.com/watch?v=tA42nHmmEKw							
Module 2	https://www.youtube.com/watch?v=ykZ- UGcYWg&list=PLEAY	/kSg4uSQ2XjkkD8FSB84p_nCkT1dKY						
Module 3	3 https://www.youtube.com/watch?v=SUXOFrhWsAQ&list=PLRueFtKLr0QN7MmQ8pdpQerOe_s8vGJG4&inde_x=10							
Module 4								
Module 5	fodule 5 https://www.youtube.com/watch?v=H4986KDZkeI							



## **GREATER NOIDA-201306**

ı	r-DN	A Techn	ology													
Course	Code	: BBT05	53		Co	urse Na	ame: r-	DNA T	<b>echnol</b>	ogy			L	T	P	C
Course	Offer	red in: D	epartm	ent of I	Biotech	nology							0	0	6	3
		: Studen									•					
Course	Obje	ctives: T	o provi	de four	dation	al knov	vledge (	of reco	mbinar	t DNA	techniq	ues, inclu	ıding g	gene	clonir	ıg, vector
design,	trans	formatio	n meth	ods, an	d their	applica	ations i	n resea	rch, m	edicine,	, and ind	lustry.				
Course	Outc	ome: Aft	er com	pletion o	of the co	ourse, tl	ne stude	ent will	be able	to			Bloo	m's	Know	ledge
													Leve	el (K	L)	
CO1	Und	erstand th	ne basic	concep	t and p	rocedur	e of ge	ne clon	ing and	the role	of enzy	mes and			K2	
		ors used f														
CO2		lain differ						tions in	genetic	engine	ering.				K2	
CO3 Demonstrate the PCR technique and applications.  K3 CO4 Perform in-silico cloning of the selected DNA.  K3																
CO4 Perform in-silico cloning of the selected DNA.  K3  Understand, the basic concept of genetic engineering techniques for selection of K2																
CO5 Understand the basic concept of genetic engineering techniques for selection of recombinants.																
CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)																
COs		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	F	SO2	PSO3
CO1		3	2	2	2	2	1	1	1	1	1	2	3		2	2
CO2		3	3	2	2	3	1	1	1	1	1	2	3		3	2
CO3		3	3	3	2	3	2	1	1	1	1	3	3		3	3
CO4		3	3	3	3	3	2	1	1	1	2	3	3		3	3
CO5		3	2	2	2	2	1	1	1	1	1	2	3		2	2
Course	Cont	ents / Syl	llabus	ı	ı		ı		I		I.					
Module				Basic I	Princip	les of r	DNA T	echnol	ogy						8 hour	'S
Nomeno activity:	clature ; Hom	e, Isoschi	zomers. r tailing	, Hetero g, Synth	hypeko	mers, U	Jnit of r	estricti	on enzy	mes, Re	estriction	digestion	n: parti	al aı	nd com	enzymes, nplete, Star nosphatase,
Module		criptase n	ii cioiiii	Vector	'S									1	8 hour	'S
		ession, a	nd pron			rs Plast	nids: Ba	acterior	hages:	Phage a	s a cloni	ng vector	r: Adva			sing phage
_	_		_					_	_	-		_				ent vectors;
		_	_				_		_					_		ovirus and
		s system,										-		,		
															8 hour	'S
									& appli	cations	of PCR:	RT PCR	Invers			ested PCR,
			-			_		-								Fidelity of
		enzymes;					•								_	·
Module	e 4			Techni	iques ir	rDNA	Techn	ology							8 hour	'S
Gene ba	ank / (	Genomic :	library	and cDl	NA libr	ary con	structio	n; Ove	rview o	technic	ques for	recombin	ant sel	ectio	on and	screening:
Function	nal a	nd nutrit	ional c	complen	nentatio	n, Col	ony/ p	laque 1	nybridiz	ation,	Blotting	techniqu	ies, Pl	us-N	Minus	screening,
Immuno	ologic	al screeni	ing, HA	RT, HA	ΥT											
Module	e 5			Screen	ing and	l Select	ion of l	Recom	binants						8 hour	's
Prepara	tion o	f bacteria	al comp	etent ce	ells, Tra	nsform	ation o	f ligate	d (reco	nbinant	t) DNA	in selecte	d host	(e.g	. Bact	erial host),
-			-					-								er method,
Maxam and Gilbert procedure, automated DNA sequencing, pyrosequencing; Genomics: High throughput Sequencing: shot gun																
		_				_	_		-	_		_		_		combinant
proteins		9	J.		-						-	• '		-		
											Tota	l Lectur	e Hour	·s	40 hou	irs
Textbo	ok:															
S.No		ok Title v	vith pu	blicatio	n agenc	y & yea	ar				Author					



		T
1	From Genes to Clones: Introduction to Gene Technology, VCH, 1987 (latest edition)	Ernst L. Winnacker
2	Genetic Engineering, Oxford University Press, 2017 (latest edition)	Smita Rastogi; Neelak Pathak
3	Genetic Engineering: Principles & Practice, McGraw Hill Education, 1992 (latest edition)	Sandhya Mitra
Refe	rence Books:	
S.No	Book Title with publication agency & year	Author
1	Principles of Gene Manipulation and Genomics, Wiley-Blackwell, 2006 (7th Edition, latest)	S. B. Primrose; R. M. Twyman
2	Molecular Biology of the Cell, Garland Science, 2022 (7th Edition, latest)	Bruce Alberts; Alexander Johnson; Julian Lewis; et al.
3	Modern Genetic Analysis, W. H. Freeman, 2002 (latest edition)	Anthony J. F. Griffiths; William M. Gelbart; Jeffrey H. Miller; Richard C. Lewontin
NPTEL/	Youtube/ Faculty Video Link:	
Module 1	https://www.youtube.com/watch?v=Yh9w_fyvpUk	
Module 2	https://www.youtube.com/watch?v=VXkw_U6mJpc	
Module 3	https://www.youtube.com/watch?v=BIIWIZqWxKg	
Module 4	https://www.youtube.com/watch?v=CgXtJ4ooaUU	
Module 5	https://www.youtube.com/watch?v=OK7 ReXhVaQ	



#### **GREATER NOIDA-201306**

(An Autonomous Institute)
School of Biotechnology

**Design Thinking II** 

Course Code: BCSCC0501	Course Name: Design Thinking II	L	T	P	C
Course Offered in: Biotechnology		2	1	0	3

Pre-requisite: Student must complete Design Thinking-I course

Course Objectives: The objective of this course is to upgrade Design Thinking skills by learning & applying advanced and contextual Design Thinking Tools. It aims to solve a Real-Life Problem by applying Design Thinking to create an impact for all the stakeholders

Course	Outcome: After completion of the course, the student will be able to	Bloom's Knowledge
		Level (KL)
CO1	Learn sophisticated design tools to sharpen their problem-solving skills.	K2
CO2	Generate innovative ideas using design thinking tools and converge to feasible idea for breakthrough solution.	K3, K4
CO3	Implement storytelling for persuasive articulation.	K3
CO4	Understanding the nature of leadership empowerment.	K2
CO5	Understand the role of a human being in ensuring harmony in society and nature.	K2

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

CO\PO	PO1	PO2	РОЗ	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	1	3	1	1	2	2	1	3	2	2	1
CO2	3	3	3	2	3	1	1	2	2	2	3	2	3	2
CO3	1	1	2	1	2	1	1	2	3	2	2	1	1	2
CO4	1	1	1	1	1	1	1	3	3	2	2	1	1	1
CO5	1	1	1	1	1	3	3	2	2	1	2	1	1	1

**Course Contents / Syllabus** 

Module 1 Introduction .10. hours

Design thinking & Innovation, Design Thinking Mindset and Principles, recap of 5-Step Process of Design Thinking, Design Approaches, additional in-depth examples of each design approaches. Simon Sinek's – Start with Why, The Golden Circle, Asking the "Why" behind each example (an in-class activity of asking 5-WHYS), The Higher Purpose, in-class activity for LDO & sharing insights

Visualization and it's importance in design thinking, reflections on wheel of life (*in-class activity for visualization & Wheel of Life*), Linking it with Balancing Priorities (*in class activity*), *DBS* Singapore and Bank of Americas' Keep the Change Campaign. Litter of Light & Arvind Eye Care Examples, understanding practical application of design thinking tools and concepts, case study on McDonald's Milkshake / Amazon India's Rural Ecommerce & Gillette

Working on 1-hour Design problem, Applying RCA, and Brainstorm on innovative solutions. Main project allocation and expectations from the project

#### Module 2 Refinement and Prototyping

.08. hours

Refine and narrow down to the best idea, 10-100-1000gm, QBL, Design Tools for Convergence – SWOT Analysis for 1000gm discussion. *In-class activity for 10-100-1000gm & QBL* 

Prototyping (Convergence): Prototyping mindset, tools for prototyping – Sketching, paper models, pseudo- codes, physical mockups, Interaction flows, storyboards, acting/role-playing etc, importance of garnering user feedback for revisiting Brainstormed ideas,

Napkin Pitch, Usability, Minimum Viable Prototype, Connecting Prototype with 3 Laws, A/B Testing, Learning Launch. Decision Making Tools and Approaches – Vroom Yetton Matrix, Shift-Left,Up,Right, Value Proposition, Case study: Careerbuddy,You-Me-Health Story & IBM Learning Launch.

In-class activities on prototyping- paper-pen / physical prototype/ digital prototype of project's 1000gm idea

Module 3 Storytelling, Testing and Assessment ..08 hours

Storytelling: Elements of storytelling, Mapping personas with storytelling, Art of influencing, Elevator Pitch, Successful Campaigns of well-known examples, *in-class activity on storytelling*.

Testing of design with people, conducting usability test, testing as hypothesis, testing as empathy, observation and shadowing methods, Guerrilla Interviews, validation workshops, user feedback, record results, enhance, retest, and refine design, Software validation tools, design parameters, alpha &beta testing, Taguchi, defect classification, random sampling

Final Project Presentation and assessing the impact of using design thinking

### Module 4 Innovation, Quality and Leadership .06. hours

Innovation: Need & Importance, Principles of innovations, Asking the Right Questions for innovation, Rationale for innovation, Quality: Principles & Philosophies, Customer perception on quality, Kaizen, 6 Sigma. FinTech case study of Design Thinking



(An Autonomous Institute)
School of Biotechnology

application - CANVAS

Leadership, types, qualities and traits of leaders and leadership styles, Leaders vs Manager, Personas of Leaders & Managers, Connecting Leaders-Managers with 13 Musical Notes, Trait theory, LSM (Leadership Situational Model), Team Building Models: Tuckman's and Belbin's. Importance of Spatial elements for innovation

### Module 5 Understanding Human Desirability .08. hours

Program needed to achieve the comprehensive human goal: the five dimensions of human endeavor(ManaviyaVyavstha) are: Education- Right living (Sikhsa- Sanskar), Health – Self-regulation (SwasthyaSanyam), Justice – Preservation (Nyaya-Suraksha), Production – Work (Utpadan – Karya), Exchange – Storage (Vinimya – Kosh), Darshan-Gyan-Charitra (Shifting the Thinking)

Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation nature, thinking expansion for harmony: Self-exploration (Johari's window), group behaviour, interpersonal behaviour and skills, Myers-Briggs personality types (MBTI), FIRO-B test to repair relationships.

		Total Lecture Hours 48 hours
Textbool		
S.No	Book Title with publication agency & year	Author
1	UnMukt: Science and Art of Design Thinking (Polaris / School of Design Thinking, 2020)	Arun Jain
2	Basics Design 08: Design Thinking (AVA Publishing, 2010)	Gavin Ambrose; Paul Harris
3	A Foundation Course in Human Values and Professional Ethics (Excel Books, New Delhi, 2010)	R. R. Gaur; R. Sangal; G. P. Bagaria
S.No	Book Title with publication agency & year	Author
1	Solving Problems with Design Thinking: Ten Stories of What Works (Columbia Business School Publishing, 2013)	Jeanne Liedtka; Andrew King; Kevin Bennett
2	Universal Human Values and Professional Ethics (S. K. Kataria & Sons, New Delhi, 2022)	Dr. Ritu Soryan
3	101 Design Methods: A Structured Approach for Driving Innovation in Your Organization (John Wiley & Sons, 2013 per your data though first edition released Oct 2012)	Vijay Kumar
4	The Design of Business: Why Design Thinking Is the Next Competitive Advantage (Harvard Business Press, November 2009, Boston MA)	Roger L. Martin
5	Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation (Harper Business / HarperCollins, 2009)	Tim Brown
NPTEL/	Youtube/ Faculty Video Link:	
Module 1	https://www.youtube.com/watch?v=6 mHCOAAEI8 https://nptel.ac.in/courses/110106124 https://designthinking.ideo.com/ https://blog.experiencepoint.com/how-mcdonalds-evolved-with-de	esign-thinking
Module 2	https://www.coursera.org/lecture/uva-darden-design-thinking-in-https://www.coursera.org/lecture/uva-darden-design-thinking-innow6tTs https://onlinecourses.nptel.ac.in/noc19_mg60/preview	
Module 3	https://nptel.ac.in/courses/109/104/109104109/ https://www.d-thinking.com/2021/07/01/how-to-use-storytelling-in-	in-design-thinking/
Module 4	https://www.worldofinsights.co/2020/10/infographic-8-design-thin	nking-skills-for-leadership- development/
Module 5	https://www.youtube.com/watch?v=hFGVcx1Us5Y	





LAB Course Code: BBT0551

## **NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY**

## **GREATER NOIDA-201306**

(An Autonomous Institute)
School of Biotechnology

Total Hours: 48 hrs.

LAB Course Name: Bioprocess Engineering Lab

**Bioprocess Engineering Lab** 

Course Offered in: Department of Biotechnology 0 0 2 1																	
Pre-requisite:																	
	Course Objectives:																
	Γο provide hands-on experience with bioprocess techniques, equipment, and analytical methods essential for the design, operation, and optimization of biotechnological processes.																
operano	on, and o	pum	ızatıdıı	or piot	ecimon	ogicai p	rocess	es.									
Course	Outcom	e: Afi	ter com	nletion	of the c	ourse, t	he stud	ent will	be able	e to			В	loon	ı's Kn	owled	ge
	Course Outcome: After completion of the course, the student will be able to  Bloom's Knowledge Level (KL)													0			
CO1	` '																
CO2																	
CO3				ortance											K.	2	
CO4	Optim	ize th	e biore	actor sy	stem fo	r produ	ct form	ation.							K.	3	
GO D C		<b>4G</b>															
CO-PO	Mappin	g (Sc	ale 1: I	<u> 20w, 2:</u>	Mediu	m, 3: H	ligh)	1		I	1					_	
COs	PC	11	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	D	SO2	PSC	13
COS		· <b>-</b>	102	103	104	103	100	0,	100	103	1.010	1011	1301	'	302	130	,5
CO1		3	2	2	1	1	2	2	1	1	1	1	3		2	2	2
CO2		3	3	3	2	2	2	2	1	1	1	1	3		3	3	3
CO3		3	2	2	1	1	2	2	1	1	1	1	3		2	1	2
CO4		3	3	3	2	2	2	2	1	1	1	1	3		3	3	3
List Of	Practica	l's (I	ndicati	ve & N	ot Limi	ted To	)										
1.	To und	erstar	nd the	key p	arts, co	ontrol	systems	and	function	ning of	a ferme	enter.					
2.	To deter	mine	batch g	growth l	cinetics	of bact	eria.										
3.	To perfo	orm n	nedia op	otimizat	ion usir	ng Plack	kett-Bu	rmann ı	nethod.								
4.	To prod	uce e	thanol f	rom gra	pe juic	e using	yeast fe	ermenta	tion pro	ocess.					-		
5.																	
6. Production of amylase from microorganism using solid state fermentation.																	
7.	To estin		•			•											
8.								hod.									
9.																	
	Estimati																
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## **GREATER NOIDA-201306**

(An Autonomous Institute)
School of Biotechnology

C

Total Hours: 48 hrs.

LAB Course Name: Plant Biotechnology Lab

Plant Biotechnology Lab
LAB Course Code: BBT0552

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	Offered in:	••••••	• • • • • • • • • •	•									0	0	2	1
Pre-requ																
	Objectives:	alsilla in	mlont t		141140 0	anatia t	mon of on	matian	and m	م ا میامه	taahnian	og for ml	ont i			t and
research.	op practical	SKIIIS III	piani i	issue cu	nure, g	enetic t	ransior	mauon,	and me	oiecuiar	techniqu	ies for pi	ant n	пргоч	remen	t and
Course C	Outcome: A	fter com	pletion	of the c	ourse,	the stud	ent will	be able	e to			В	loom	's Kn	owled	lge
												L	evel	(KL)		
CO1			Е	xplain tl	he proc	ess of n	nedia fo	rmulati	on and s	sterilizati	ion prote	ocol.		K	2	
CO2 Implement the plant tissue culture techniques for crop											crop		K3	3		
improvement.																
CO3 Demonstrate the different techniques of culturing of explant.													K.			
CO4 Understanding the Initiation of callus culture from different explants.											K2	2				
CO-PO N	Mapping (S	cale 1· l			m 3· F	ligh)										
CO-1 0 1	viapping (D		1000, 20	liteara												
CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	P.	SO2	PSC	)3
CO1	3	2	2	1	3	1	1	1	2	1	2	3		2		1
CO2	3	3	3	2	3	2	2	3	3	2	2	3		3		2
CO3	3	2	3	2	3	2	2	3	2	1	2	3		3		2
CO4	3	2	2	2	3	1	1	2	2	1	2	3		2		2
I :-4 Of D		T., J 4.	0 N	[a4 T !	4.J T.											
	ractical's ( Preparation						na madi									
	Preparation															
	Sterilization															
	Γο learn cu								cted ex	plants						
	Initiation of					•	inductio	on								
	Initiation of					•										
	Plant Transf					•										
	Isolation of															
	Γo prepare l	•	•	tic seeds	in vitr	0										
10. l	Plant microl	oial inter	action.													



## **GREATER NOIDA-201306**

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Course (	Code: BNC05	502				ame: Es	ssence (	of India	ın Trad	litional		L	T	P	C
G 4	0.00 11 70	4			owledg	_									
	Offered in: D	epartm	ient of E	310tech	nology							2	0	0	1
Pre-requ															
	Objectives: T			-			-								
	terature, cultur									al herita	ge and di				
Course (	Outcome: Aft	er com	pletion o	of the co	ourse, t	he stude	ent will	be able	to					s Know	ledge
												Lev	el (F		
CO1	Understand th													K2	
CO2	Understand th								ian soci	ety.				K2	
CO3	Know the diff								£ T	J:	.:14			K4	
	Identify and escience & tec					about th	ie ancie	ent niste	ry or in	idian agr	icuiture,			K4	
	Identify India					d cinem	na							K1	
	Mapping (Sca						ıu.					I .		111	
	TI g (===				,	<u> </u>									
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO:	L	PSO2	PSO3
601		2	1	1	1	1	-	2	1	- 1	2	2			1
CO1	3	2	1	1	1	2	3	2	1	1	2	2	-	<u>1</u>	1 1
CO3	3	3	2	1	1	3	3	3	1	1	2	2	+	1	1
CO4	3	3	2	2	2	3	3	3	2	2	2	2	+	2	2
						3			2	2	2	2		2	2
COE	1 2	2	2	2	, ,			1 2							
CO5	Contents / Sv	3 labus	2	2	2	3	3	3							1
Course (	Contents / Sy	_				ı	l								e e
Course ( Module State in Ancient	Contents / Sy	llabus : Evolu	Basic I	Princip Theory Ministe	les of r	DNA T e Theory	echnolo y, Myst tion Po	ogy tical Th	eory Co	ontract T	Theory, S	tages onditio	ons'	8 hour tate For	rmation i Welfare o
Module State in Ancient Societies Life, Ma faced by	Contents / Syl 1 Ancient India India, Kingsh s, The Seven I arriage, Underst	llabus : Evolu ip , Con	Basic Intionary uncil of the Stag Gender	Princip Theory Ministe ate, Soc er as a s	les of r v, Force ers Adr	DNA T e Theory ninistra Ancien	echnology, Myston Pottion Pottion	ogy tical Th litical I Purusā	eory Co	ontract T Ancient	Theory, S t India C na Syste	tages ondition, Āsl	ons' iram trad	8 hour tate For of the 'na or the itions, (	rmation i Welfare of Stages of Challenge
Course ( Module State in Ancient Societies Life, Ma faced by Module	Contents / Syl  Ancient India India, Kingshis, The Seven India, Understand Women.  2	: Evolution of the control of the co	Basic Intionary uncil of the Stag Gender	Princip Theory Ministe ate, Soc er as a s	les of r y, Force ers Adr ciety in social c	DNA T e Theory ministra Ancien category	echnology, Myst tion Po t India, , The re	ogy tical Th litical I Purusā epresen	eory Co deals in rtha, Va tation o	ontract T Ancient Irnāshrar f Wome	Theory, S t India C na Systen n in Hist	stages ondition m, Āsh orical	ons' nram trad	8 hour tate For of the value or the itions, (	rmation i Welfare of Stages of Challenge
Course ( Module State in Ancient Societies Life, Mafaced by Module Evolution	Contents / Syl  Ancient India India, Kingsh s, The Seven I arriage, Unders Women.  2 on of script and	: Evoluip , Coo	Basic Intionary uncil of the Stag Gender Vector ages in I	Princip Theory Ministe ate, Socer as a ser er as a ser	les of r y, Force ers Adr siety in social c	DNA T e Theory ministra Ancien category	echnology, Myst tion Po t India, , The re	ogy tical Th litical I Purusā epresen	eory Codeals in rtha, Vatation o	Ontract T Ancient Irnāshrar f Wome	Theory, S t India C ma System in Hist	stages ondition, Āsk orical	ons' nram trad ds, t	8 hour tate For of the state of the state itions, (State State Sta	rmation i Welfare of Stages of Challenge s
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2	Indian Art and Culture, Oxford University Press, latest edition (year not clearly specified, likely after 2015)	S. Baliyan
3	Indian Art and Culture: For Civil Services and Other Competitive	Nitin Singhania
Refe	Examinations, McGraw Hill, 2021 (3rd Edition, latest) rence Books:	
S.No	Book Title with publication agency & year	Author
1	Readings in Early Indian History, Oxford University Press, 2013 (latest edition)	Romila Thapar
2	The Wonder That Was India, Rupa & Co., 2014 (latest impression)	A. L. Basham
3		
NPTEL/	Youtube/ Faculty Video Link:	
Module 1		
Module 2	2	
Module 3	3	
Module 4	1	
Module 5	5	



### **GREATER NOIDA-201306**

(An Autonomous Institute)
School of Biotechnology

Constitution of India, Law and Engineering

Course	e Code: B	BNC05	01		Co	urse Na	ame: C	onstitu	tion of	India, l	Law and		L	T	P	$\mathbf{C}$
					En	gineeri	ng									
Course	e Offered	l in: Do	epartm	ent of I	Biotech	nology							2	0	0	1
Pre-re	quisite:															
Course	e Objecti	ves: To	o acqua	int the s	students	with le	egacies	of const	titution	al devel	opment i	n India aı	nd helj	p the	m to u	nderstan
the mos	st diversif	fied leg	gal docı	ıment o	f India	and phi	losophy	behind	l it.							
Course	e Outcom	ne: Aft	er comp	pletion o	of the co	ourse, t	he stude	ent will	be able	to			Bloo	om's	Know	ledge
													Leve	el (K	L)	
CO1	Identify	y and e	xplore	the basi	c featur	es and	modalit	ies abor	ıt India	n consti	tution.				K1	
CO2	Differe state le		and rela	ate the	function	ning of	Indian	parliam	entary	system	at the ce	nter and			K2	
CO3				it aspect											K4	
CO4											practices				K4	
CO5				ineers w				tions an	d gover	nance r	nodels.				K4	
CO-PC	O Mappir	ng (Sca	ale 1: L	ow, 2:	Mediur	n, 3: H	igh)		ı	1	Г	T				_
COs	P	01	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	L	PSO2	PSO3
CO1		3	2	1	1	1	2	3	2	1	1	2	2		1	1
CO2		3	2	1	1	1	2	3	2	1	1	2	2		1	1
CO3		3	3	2	1	1	3	3	3	1	1	2	2 1 1			1
CO4		3	3	2	2	2	3	3	3	2	2	2	2		2	2

#### **Course Contents / Syllabus**

3

**CO5** 

Module 1 Introduction and Basic Information About Indian Constitution 8 hours

Meaning of the constitution law and constitutionalism, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947, Enforcement of the Constitution, Indian Constitution and its Salient Features, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India.

### Module 2 Union Executive and State Executive 8 hours

Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, Powers and Functions of Vice-President, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Judicial Activism, LokPal, Lok Ayukta, The Lokpal and Lok ayuktas Act 2013, State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts.

### Module 3 Introduction and Basic Information About Legal System 8 hours

The Legal System: Sources of Law and the Court Structure: Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law, Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court). Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration. Contract law, Tort, Law at workplace.

#### Module 4 Intellectual Property Laws and Regulation to Information 8 hours

Intellectual Property Laws: Introduction, Legal Aspects of Patents, Filing of Patent Applications, Rights from Patents, Infringement of Patents, Copyright and its Ownership, Infringement of Copyright, Civil Remedies for Infringement, Regulation to Information, Introduction, Right to Information Act, 2005, Information Technology Act, 2000, Electronic Governance, Secure Electronic Records and Digital Signatures, Digital Signature Certificates, Cyber Regulations Appellate Tribunal, Offences, Limitations of the Information Technology Act.

Module 5	Business Organizations and E Governance	8 hours

Sole Traders, Partnerships: Companies: The Company's Act: Introduction, Formation of a Company, Memorandum of Association, Articles of Association, Prospectus, Shares, Directors, General Meetings and Proceedings, Auditor, Winding up. E-



(An Autonomous Institute) School of Biotechnology

Governance and role of engineers in E-Governance, Need for reformed engineering serving at the Union and State level, Role of

		Total Lecture Hours 40 hours					
Textboo	ok:	·					
S.No	Book Title with publication agency & year	Author					
1	Indian Polity for Civil Services and Other State Examinations,	NA Laurella oth					
1	McGraw Hill, 2020 (6th Edition, latest)	M. Laxmikanth					
2	Introduction to the Indian Constitution, PHI Learning Pvt. Ltd., 2018	Brij Kishore Sharma					
2	(8th Edition, latest)	Brij Kishore Sharma					
2	The Indian Constitution: Cornerstone of a Nation (Classic Reissue),	Cranvilla Avatin					
3	Oxford University Press, 2019 (latest edition)	Granville Austin					
Ref	erence Books:						
S.No	Book Title with publication agency & year	Author					
1	The Indian Constitution, Oxford University Press, 2012 (latest	Madhav Khosla					
	edition)						
2	The Constitution of India, Universal Law Publishing, 2024 (latest edition)	P. M. Bakshi					
3	Law Relating to Intellectual Property Rights, LexisNexis, 2017 (2nd	V. K. Ahuja					
	Edition, latest)	V. K. Aliuja					
NPTEL/	Youtube/ Faculty Video Link:						
Module	1						
Module	2						
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Moaule							
Module Module	4						



## **GREATER NOIDA-201306**

(An Autonomous Institute) **School of Biotechnology** 

**Bioseparation Engineering** 

1988 (latest edition)

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	se Code: BBT0601 Course Name: Bioseparation Engineering L T P												C			
													4			
Pre-requisite: Knowledge of basic cell structure																
<b>Course Objectives:</b> The course aims to provide students with comprehensive knowledge of various separation techniques used for biomolecules, including chromatography and membrane-based methods. It also focuses on optimizing these processes for																
for bion	nolecu	les, inclu	ding ch	romato	graphy	and me	mbrane	-based	method	s. It also	o focuses	on optir	nizing	these	proce	esses for
effective	e sepai	ration and	d highli	ghts the	signifi	cance o	of enzyn	nes in b	ioproce	ssing a	nd purific	cation str	ategies			
Course Outcome: After completion of the course, the student will be able to Bloom's Knowledge												ledge				
	Level (KL)															
CO1	Understand separation techniques of biomolecules. K2															
CO2	Demonstrate the different separation techniques of Nucleic Acids.												К3			
CO3	Estin	nate the b	oiomole	cules w	ith qua	litative	method	s using	membr	ane-bas	ed techn	iques.			K2	
CO4		yze the s								ograph	у.				K4	
CO5		onstrate t						olishing	5						K3	
CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)																
CO No													. Р	SO2	PSO3	
CO1		3	2	2	2	3	1	1	1	2	1	2	3		2	1
CO2		3	3	3	2	3	1	1	2	3	1	2	3		3	2
CO3		3	2	2	2	3	1	1	2	2	1	2	3		3	2
CO4		3	3	3	3	3	1	1	2	3	1	2	3		3	2
CO5		3	2	3	2	3	1	1	2	3	1	2	3		3	2
	Conte	ents / Syl	labus	_					<u> </u>							
Module				Introd	uction	to Bios	eperati	on							8 hou	rs
Introduc	ction to	separati	ion of b	iomole	cules an	d its im	portanc	e in Bi	otechno	logy, W	Vorking p	orinciples	s of cer	ıtrifu	gation	, filtration,
		, floccula					1				01	•			U	
Module	e 2			Produc	t Recov	ery								- 1	8 hou	rs
Extracti	on, ad	sorption,	membi	rane-bas	sed sepa	aration,	Separat	ion of c	lifferen	t types (	of DNA	from cell	s, Sepa	ratio	n of tl	ne different
		from bio														
Module				Produc											8 hou	
							-		ads for	immob	ilization	of biomo	olecules	s, Ma	agnetio	e Beads for
		n, Cell So					paration	•						П.	2.	
Module				Produc											8 hou	
								lecules,	TLC, F	IPLC, C	GC etc., I	Methods	for sep	arati	on of t	he proteins
Module		charge a		Produc			tems.							Τ,	8 hou	rc ·
		•					11		. 1							
							es: illust	rative e	xample	s pertan	ning to do	ownstrea	m proc	essin	ig of b	ioproducts,
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2		separatio									C. A. Hea	th; A. L.	Nguvei	n		
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3	Bio	separatio	on Engii	neering:	A Com	prehen	sive DS	P Volun	ne, Wile	ey-	Ahhichal	k Awasth	i. Aiau	Kum	ar	
3	Scri	ivener, 20	022 (lat	est edit	ion)						ADITISTICE	Awasill	ı, Ajay	Kulli	aı	
Ref	ference	e Books:								Г						
										1						
S.No	_	ok Title									Author					
	Bio	separatio	ons: Do	wnstrea	m Proc	essing f	or Bioto	echnolo	gy, Wil	ey,	Paul A. l	Relter: F	I Cu	ssler	Wei	Shou Hu



2	Bioseparations Science and Engineering, Oxford University Press, 2015 (2nd Edition, latest)	Roger G. Harrison; Paul W. Todd; Scott R. Rudge; Demetri P. Petrides						
3	Bioseparations Engineering: Principles, Practice, and Economics, Wiley, 2017 (2nd Edition, latest)  Michael R. Ladisch							
NPTEL/	Youtube/ Faculty Video Link:							
Module 1 https://www.youtube.com/watch?v=_8gsbHzWMUU								
Module	2 https://www.youtube.com/watch?v=aizKUoD-kYk							
Module	https://www.youtube.com/watch?v=ZN7euA1fS4Y							
Module	https://www.youtube.com/watch?v=e3IRt9XdV0s							
Module	https://www.youtube.com/watch?v=PVvpEKeOzEM							



### **GREATER NOIDA-201306**

(An Autonomous Institute)
School of Biotechnology

**Metabolic Engineering** 

Course Offered in: Department of Biotechnology 3 0 0 3	Course Code: BBT0602	L	T	P	С			
	Course Offered in: Department of Biot	Course Offered in: Department of Biotechnology						

#### Pre-requisite: Basics of Microbiology, Biochemistry and Genetics.

**Course Objectives:** This course aims to introduce students to the fundamentals of metabolic engineering and its significance in biotechnology. It provides foundational knowledge on metabolic flux analysis, experimental approaches for flux determination, and computational modeling of biological networks. The course also emphasizes the industrial applications of primary and secondary metabolites in various bioprocesses.

Course	Outcome: After completion of the course, the student will be able to	Bloom's Knowledge
		Level (KL)
CO1	Understand the metabolic engineering and its importance	K2
CO2	Evaluate the metabolic flux analysis.	K5
CO3	Design metabolic flux by using different analytic techniques.	K6
CO4	Illustrate the Computational modelling of biological networks	K3
CO5	Explain various Industrial Applications of Metabolic engineering.	K2

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

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CO No	PO1	PO2	РО3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	1	1	2	1	2	3	2	1
CO2	3	3	3	3	2	1	1	1	2	1	2	3	3	2
CO3	3	3	3	3	2	1	1	1	2	1	2	3	3	2
CO4	3	3	3	3	3	1	1	1	3	1	2	3	3	2
CO5	3	2	3	2	2	1	1	1	3	1	2	3	3	2

#### Course Contents / Syllabus

#### Module 1 Introduction to Metabolic Engineering and its importance 8 hour

Introduction to Enzymes and metabolism, Stoichiometry of cellular reactions, dynamic mass balance, yield coefficients and linear rate equations, Black box model, Heat balance, Different models for cellular Reactions-Induction-Jacob Monod Model and its regulation, Differential regulation by isoenzymes, Concerted or cumulative feedback regulation. Regulation in branched pathways, Permeability, and transport of metabolites.

Module 2 Metabolic flux analysis 8 hours

Introduction to Metabolic flux analysis (MFA), Isotopic steady state methods (13C MFA) and Isotopic non- steady state methods, Dynamic metabolic flux analysis, Building stoichiometric matrix; Steady state and pseudo steady state assumptions; Using different optimizing functions to solve linear programming problem; understanding flux cone and constraints; Introducing additional constraints from thermodynamics.

# Module 3 Experimental determination of metabolic fluxes 8 hours Technical developments in labels distribution analysis; Nuclear Magnetic Resonance spectroscopy (NMR) and Gas chromatography along with mass spectroscopy (GC-MS) based methods for flux determination, C13 labelling.

Module 4Computational modelling of biological networks8 hours

Introduction to MATLAB, Creating MATLAB variables, Using MATLAB as a calculator, Main features of MATLAB and capabilities of MATLAB, Synthetic circuit design, MOMA (Minimization of Metabolic Adjustment), iFBA (Integrated Flux Balance Analysis), dFBA; Enhancement of product yield and productivity.

#### Module 5 Industrial Applications 8 hours

Pathway engineering strategies for overproduction of some commercially important primary and secondary metabolites or industrially relevant enzymes and recombinant proteins, bioconversion- applications and factors affecting bioconversion, mixed or sequential bioconversions, regulation of enzyme production, strain selection and improvement, the modification of existing or the introduction of entirely new metabolic pathways.

Textboo	ok:	Total Lecture Hours 40 hours					
S.No	Book Title with publication agency & year	Author					
1	Metabolic Engineering: Principles and Methodologies, Academic	Gregory N. Stephanopoulos; Aristos A.					
1	Press, 1998 (latest edition)	Aristidou; Jens Nielsen					
2	Pathway Analysis and Optimization in Metabolic Engineering,	Néstor V. Torres; Eberhard O. Voit					
	Cambridge University Press, 2002 (latest edition)	Nestor V. Torres, Eperhard O. Voit					



# **GREATER NOIDA-201306**

3	The Metabolic Pathway Engineering Handbook, CRC Press, 2010	Christina D. Smolke						
	(latest edition)	Christina D. Smorke						
Refe	rence Books:							
S.No	Book Title with publication agency & year	Author						
1	Biochemical Engineering, CRC Press, 1997 (latest edition)	Harvey W. Blanch; Douglas S. Clark						
2	Principles of Fermentation Technology, Elsevier, 2016 (3rd Edition, latest)	Peter F. Stanbury; Allan Whitaker; Stephen J. Hall						
3	Fermentation and Enzyme Technology, Wiley, 1979 (latest edition)	Daniel I. C. Wang; Cooney, Demain, Dunnill, Humphrey, Lilly						
NPTEL/	Youtube/ Faculty Video Link:							
Module	https://www.youtube.com/watch?v=xF_WotEWJA0							
Module	https://www.youtube.com/watch?v=x2URHbJfHDk							
Module 3	https://www.youtube.com/watch?v=ndThuqVumAk							
Module 4	https://www.youtube.com/watch?v=ndThuqVumAk							
Module :	https://www.youtube.com/watch?v=ndThuqVumAk							



## **GREATER NOIDA-201306**

(An Autonomous Institute)
School of Biotechnology

Nanobiotechnology

Course	Course Code: BBT0603 Course Name: Nanobiotechnology L T P C											C				
Course	Course Offered in: Department of Biotechnology 3 0 0 3												3			
Pre-requisite: Students should know about the basic molecular and cell biology																
Course Objectives: This course aims to provide students with a foundational understanding of nanobiotechnology and																
nanofabrication techniques, along with the synthesis of nanomaterials. It emphasizes the tools and methods used for nano-												nano-				
characterization and their practical applications, explores various biomedical polymers and their roles, and highlights the use of nanotechnology in diagnosis, imaging, and disease treatment.												s the use of				
nanotec	chnolo	gy in diag	gnosis, i	imaging	, and di	isease tı	reatmen	t.								
Course Outcome: After completion of the course, the student will be able to  Bloom's Knowledge of the course of th											wledge					
		Level (KL)  Explain the basics of panescience, panehiotechnology, panetechnology and its techniques  K2														
CO1		Explain the basics of nanoscience, nanobiotechnology, nanotechnology and its techniques.  K2  Devise effective strategies of nanomaterials synthesis  K6												2		
CO2													Ke			
CO3		Compare potential tools and techniques for nano material characterization.  K2														
CO4	Differentiate the synthesis process of different classes of biomaterial.  K4  Conclude the concept of diagnosis imagining and treatment of disease through												-			
CO5	Conclude the concept of diagnosis, imagining and treatment of disease through												<u> </u>			
CO-PO	nanotechnology tools and techniques. K5  CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)															
CO No	)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO:	L   F	PSO2	PSO3
CO1		3	2	2	1	3	1	1	1	2	1	2	3		2	1
CO2		3	3	3	2	3	1	1	1	2	1	2	3		3	2
CO3		3	2	2	2	3	1	1	1	2	1	2	3		2	2
CO4		3	3	3	3	3	1	1	1	2	1	2	3		3	2
CO5		3	2	3	3	3	1	1	1	3	1	2	3		3	2
Course	Cont	tents / Syl	llabus													
Module	e 1	Intro	duction	to Nan	obiotecl	hnology	7								8 hou	irs
Nanobi	otechr	nology, H	istory,	Origin,	Fundan	nental C	Concepts	s, Appro	oaches,	Curren	t research	n, Moore	's Law	, Dis	cussio	on on Micro
		rication pr														
Module				terizatio											8 hou	
			terials	types, S	Synthesi	is, Prop	erties, a	Applica	tions, I	norgan	ic nanom	aterials	types,	Synt	hesis	properties,
Applica Module			ication	of Nanc	hiotech	nology	in Riol	ogical (	and Ma	dical Sc	iancas:				8 hou	ırc
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Module	e 4	Nano	materia	als syntl	nesis an	d appli	cations								8 hou	ırs
						sses of	biomate	erials an	d polyr	ners, an	d their us	ses in Pha	ırmace	utica	ıl, Caı	diovascular
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		02 (latest		1)												
Ref	tereno	ce Books:	:													



S.No	Book Title with publication agency & year	Author								
1	Microfabrication and Nanomanufacturing, CRC Press, 2018 (latest edition)	Mark James Jackson								
2	MEMS and Nanotechnology-Based Sensors and Devices: Applications in Communication, Medicine, and Aerospace, CRC Press, 2008 (latest edition)	A. R. Jha								
3	Drug Delivery: Engineering Principles for Drug Therapy, Oxford University Press, 2001 (latest edition)  Mark Saltzman									
NPTEL/	Youtube/ Faculty Video Link:									
Module 1	https://nptel.ac.in/courses/117101003									
Module 2	https://nptel.ac.in/courses/113102017									
Module 3	https://www.youtube.com/watch?v=9eRJ6NOrZqY									
Module 4	https://nptel.ac.in/courses/123106008									
Module 5	https://www.youtube.com/watch?v=5hVA6TWQEd4									



# **GREATER NOIDA-201306**

(An Autonomous Institute)
School of Biotechnology

**Bioreactor Analysis and Design** 

Course	Code	: <b>BBT06</b>	11		Co	urse Na	ame: Bi	oreact	or Ana	l <mark>ysis an</mark>	<mark>d Desig</mark> r	1	L	T	P	C	
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Course	Outc	ome: Aft	er comp	pletion o	of the co	ourse, tl	he stude	ent will	be able	to						ledge	
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CO1		erstand th													K2		
CO2															K3		
CO3		erstand tr ionstrate 1						onents 1	or biore	actor					K2 K3		
CO5		trate the						etor							K3		
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CO3		3	2	2	2	3	1	1	1	2	1	2	3		2	1	
CO4		3	3	3	3	3	1	1	2	2	1	2	3		3	2	
CO5		3	3	3	3	3	1	1	2	3	1	2	3		3	2	
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Kei	ierenc	e Books:															
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1		ochemica						v Hill, 1	1986 (2	nd		D "	D	F ^	11.		
1		ition, late	_						`	,	james E.	Bailey;	David	r. O	IIIS		



2	Bioreaction Engineering: Bioprocess Monitoring, Wiley-VCH, 1997 (latest edition)	Karl Schügerl									
3	Introduction to Biochemical Engineering, Tata McGraw-Hill Education, 2005 (latest edition)	D. G. Rao									
NPTEL/ Youtube/ Faculty Video Link:											
Module 1 https://www.youtube.com/watch?v=tLE0aibuYX8											
Module 2	https://www.youtube.com/watch?v=2XQ2nuyD8Gg										
Module 3	https://www.youtube.com/watch?v=YCfnDpq8tYM										
Module 4	https://www.youtube.com/watch?v=8LEUksrrEfw										
Module 5	https://www.youtube.com/watch?v=Ndu3jpMzH14										



#### **GREATER NOIDA-201306**

(An Autonomous Institute)
School of Biotechnology

### **Biofuels & Alcohol Technology**

Course Code: BBT0613	L	T	P	C	
Course Offered in: Department of Bio	3	0	0	3	

#### Pre-requisite: General biology and basic knowledge of Fermentation and Bioconversion

**Course Objectives:** This course is designed to introduce students to the concepts and applications of biofuels and alcohol technology. It covers various alcoholic fermentation techniques, the biochemistry of alcohol production, recycling methods, and quality control measures. Additionally, it focuses on biomass conversion for energy generation and explores clean fuel technologies and fermentation criteria for molasses.

Course	Outcome: After completion of the course, the student will be able to	Bloom's Knowledge
		Level (KL)
CO1	Explain basic concepts and importance of metabolic engineering.	K2
CO2	Understand the production of metabolites and its regulatory mechanism.	K2
CO3	Explain the applications, specificity and product inhibition of bioconversion.	K2
CO4	Understand regulation of enzyme production and strain improvement.	K2
CO5	Understand fermentation section of alcohol technology	K2

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

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CO No	PO1	PO2	РО3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	2	2	1	2	1	2	3	2	1
CO2	3	2	2	2	2	2	2	1	2	1	2	3	2	1
CO3	3	2	2	2	2	2	2	1	2	1	2	3	2	2
CO4	3	2	2	2	2	3	2	1	2	1	2	3	2	2
CO5	3	2	2	2	2	3	2	1	2	1	2	3	2	2

### Course Contents / Syllabus

Module 1 Introduction 8 hours

Introduction to Alcohol Technology, Raw Material of Alcohol Industry, Storage & handling of Raw material in detail, Study of different yeast strains used in alcohol industries, Study of yeast production as single protein cell.

#### Module 2 Fermentation Techniques 8 hours

Study of different alcoholic fermentation techniques, Batch fermentation, Continuous fermentation, Modern techniques of Continuous fermentation, Bio still fermentation, Encilium process, Wet milling of grain for alcohol production, Grain dry milling cooking for alcohol production, Use of cellulosic feed stocks for alcohol production, Scaling in distilleries, Fusel oil separation.

# Module 3 Process and parameters of Alcohol Production 8 hours

Study of different recycling process, Biochemistry of alcohol production, The management of fermentation in the production of alcohol. Alcohol distillation- The fundamental, Parameters & affecting alcoholic fermentations, By product of alcoholic fermentation, Distillery quality control, Alcoholometry.

## Module 4 Types of Biofuels 8 hours

Various biofuels/ bioenergy from biomass. Biomass conversion to heat and power: thermal gasification of biomass, anaerobic digestion. Biomass conversion to biofuel: thermochemical conversion, syngas fermentation.

#### Module 5 Lab concept of clean fuels 8 hours

Biodiesel production from oil seeds, waste oils and algae; microalgae cultivation, biomass harvesting/concentration, processing and extraction of value-added products (cell disruption and lipid extraction); and transesterification of the lipids to produce biodiesel; World biomass/bioenergy use. US, EU, Developing countries, etc.; the environmental aspects of biomass energy, economics and life-cycle analysis with case studies on biomass energy production.

		Total Lecture Hours   40 hours
Textboo	k:	
S.No	Book Title with publication agency & year	Author
1	Chemical Process Principles – Part I: Material and Energy Balances,	Olaf A. Hougen; Kenneth M. Watson; Roland
1	CBS Publishers & Distributors, 1995 (latest Indian reprint)	A. Ragatz
2	The Alcohol Textbook, Nottingham University Press, 2003 (4th	Kathryn Ann Jacques; T. P. Lyons; D. R.
2	Edition, latest widely used)	Kelsall



# GREATER NOIDA-201306

3	Product Recovery in Bioprocess Technology, VCH, 1990 (latest	BIOTOL Series Editors					
3	edition)	BIOTOL Series Editors					
Refe	rence Books:						
S.No	Book Title with publication agency & year	Author					
1	Shreve's Chemical Process Industries, McGraw Hill, 1984 (5th Edition, latest)	George T. Austin (based on R. Norris Shreve)					
2	Outlines of Chemical Technology, Affiliated East-West Press, 2008 (3rd Edition, latest revised by M. Gopala Rao & Marshall Sittig)	I Charles H. Drygen					
3							
NPTEL/	Youtube/ Faculty Video Link:						
Module 1	https://www.youtube.com/watch?v=niZls2dpHjM						
Module 2	https://www.youtube.com/watch?v=mhwUc84xBZA						
Module 3	https://www.youtube.com/watch?v=D6mRPgvAEOc						
Module 4	https://www.youtube.com/watch?v=YbdkbCU20_M						
Module 5	https://www.youtube.com/watch?v=GO1vk_fJ27Y						



# **GREATER NOIDA-201306**

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CO2	Understand R programming K2 Apply R in regression and distribution K3														
CO3					oution										
CO4 CO5	Interpret t				hnoloo									K2 K3	
	Apply R plapping (Sc.													KS	
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CO2	3	2	2	2	3	1	1	1	2	1	3	3		2	2
CO3	3	3	3	3	3	1	1	1	2	1	3	3		3	2
CO4	3	2	2	3	3	1	1	1	2	1	3	3		2	2
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	in a Nutshel		lly Med	ia, 2012	2 (2nd E	dition,	latest)			Joseph A	dler				
	ence Books		· ·	-	•					•					
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S.No	Book Title with publication agency	y & year	Author							
1	Machine Learning, McGraw-Hill, 19	997 (latest edition)	Tom M. Mitchell							
2	The Elements of Statistical Learning corrected 12th printing, latest)	s, Springer, 2017 (2nd Edition,	Trevor Hastie; Robert Tibshirani; Jerome Friedman							
3										
NPTEL/ Youtube/ Faculty Video Link:										
Modul	le 1	https://www.youtube.com/watch?v=xbYgKoG4x2g&list=PL53BE265CE4A6 C056								
Modul	le 2	https://www.youtube.com/watch?v=3iSKFCKLUsI								
Modul	le 3	https://www.youtube.com/watch?v=COI0BUmNHT8&list=PLyqSpQzTE6M JcleDbrVvPnE0PixKs2JE								
Modul	e 4	https://www.youtube.com/watch?v=4Uj5hhnX4hs&list=PLyqSpQzTE6M_JcleDbrVyPnE0PixKs2JE&index=14								
Modul	e 5	https://www.youtube.com/watch?v=rjl34x9TqAQ&list=PLwdnzlV3ogoXmoC XczKiu6WGW0r05Zw02&index=18								



# **GREATER NOIDA-201306**

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Course	Code	: <b>BBT06</b>	14		Co	urse Na	ame: M	<b>achine</b>	learni	ng			L	T P	С	
Course	Offer	ed in: D	epartm	ent of I	Biotech	nology							3	0 0	3	
		: Basic k														
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and the	essen	tial linear	algebra	a underl	ying M	L mode	els. It pr	ovides	in-deptl	n knowl	ledge of	various n	nachine	learning	techniques	
and alg	orithm	ıs, along v	with pra	actical in	nsights	into ap <sub>l</sub>	plying N	AL to re	eal-wor	ld probl	ems.					
Course	Outc	ome: Aft	er com	pletion o	of the co	ourse, t	he stude	ent will	be able	to			Bloo	m's Kno	wledge	
													Level (KL)			
CO1		erstand b		•		e learn	ing (MI	رـ)						K		
CO2		onstrate												K		
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CO2		3	3	3	2	3	1	1	1	2	1	3	3	3	2	
CO3		3	3	3	3	3	1	1	2	2	1	3	3	3	3	
CO4		3	2	2	3	3	1	1	1	2	1	3	3	2	2	
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3	Ma	Machine Learning, McGraw Hill Education, 1997 (1st Edition, I									) Tom M. Mitchell					



S.No	Book Title with publication agency & year	Author
1	Introduction to Machine Learning, MIT Press, 2020 (4th Edition, latest)	Ethem Alpaydin
2	Machine Learning, Khanna Book Publishing Co., 2019 (latest edition)	Rajiv Chopra
3	Pattern Recognition and Machine Learning, Springer, 2006 (latest edition)	Christopher M. Bishop
NPTEL/	Youtube/ Faculty Video Link:	
Module	1 https://youtu.be/ukzFI9rgwfU?si=FX01GftRdyIzqoGH	
Module	https://youtu.be/SioiFuMRiv4?si=xRGj9qzhd35S-H8p	
Module	3 https://youtu.be/NUXdtN1W1FE?si=alAvyccuSubZhG1r	
Module	4 https://youtu.be/eM4uJ6XGnSM?si=iOTWYopnESnV-P4b	



### **GREATER NOIDA-201306**

(An Autonomous Institute)
School of Biotechnology

**Bioseparation Engineering Lab** 

LAB Course Code: BBT0651	LAB Course Name: Bioseparation Engineering Lab	L	T	P	C	
Course Offered in:		0	0	2	1	1
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#### **Pre-requisite:**

#### **Course Objectives:**

This course aims to equip students with a comprehensive understanding of protein separation processes using various chromatographic techniques. It includes hands-on training in extracting intracellular and extracellular proteins from biological samples, estimating lipids through chromatography, and analyzing diverse biomolecule separation methods for practical applications in biotechnology.

Course Outcome: After comp	pletion of the course, the student will be able to	Bloom's Knowledge
		Level (KL)
CO1	Understand the separation process of proteins using chromatographic techniques.	K2
CO2	K3	
CO3	Estimate the lipids through chromatographic techniques.	K2
CO4	Analyse the separation techniques of biomolecules using chromatography.	K4

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	PSO3
CO1	3	3	3	2	3	2	1	-	2	1	-	3	3	3
CO2	3	3	3	2	3	2	2	2	3	2	2	3	3	3
CO3	3	3	3	2	3	2	2	2	3	2	2	3	3	3
CO4	3	3	3	2	3	2	2	2	3	2	3	3	3	3

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

- 1. Isolation of the plant cell organelles using centrifugation methods.
- 2. Isolation and separation of plant/bacterial DNA using centrifugation and biochemical methods.
- 3. Separation of the proteins with suitable chromatography methods.
- 4. Apply filtration and ultrafiltration method for separation of proteins.
- 5. Use TLC for separation of the biolipids
- 6. Isolation of the photosynthetic pigments using centrifugation methods
- 7. Isolation and separation of plant/bacterial RNA using centrifugation and biochemical methods.
- 8. Isolation and separation of plant/bacterial protein using centrifugation and biochemical methods.
- 9. Extraction of lactose from milk.
- 10. Metabolic engineering of E. coli for high yield production of 1,3-butanediol

Total Hours: 48 hrs.



#### **GREATER NOIDA-201306**

(An Autonomous Institute)
School of Biotechnology

**Metabolic Engineering Lab** 

LAB Course Code: BBT0652	LAB Course Name: Metabolic Engineering Lab	L	T	P	C
Course Offered in:		0	0	2	1
Pre-requisite:					
Course Objectives:					
techniques to enhance microbial production of v	with practical and theoretical knowledge of metabolic and valuable compounds. It covers modeling metabolic fluxes, application strategies for industrial applications like antibiotics and	plyi	ng ge	netic	tools

**Course Outcome:** After completion of the course, the student will be able to Bloom's Knowledge Level (KL) Demonstrate strain engineering techniques to enhance microbial **K**3 CO<sub>1</sub> production of target compounds. Analyze metabolic flux models for correlating experimental data with K4 CO<sub>2</sub> predicted pathways. Illustrate metabolic engineering for cost-effective production of K2 **CO3** antibiotics and biofuels. Demonstrate cloning and heterologous expression for secondary K3

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

**CO4** 

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

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

- 1. Develop engineering strategies to boost production of industrially relevant compound in E. coli.
- 2. Strain engineering (deletion or overexpression of genes) to boost production of target compound followed by metabolite extraction and quantification.
- 3. Demonstration of feed-back regulation and product inhibition.
- 4. Development of a flux model and correlation of the model with experimental data.
- 5. Demonstration of effect of addition of supplement to enhance enzyme activity in fungal strain.
- 6. Demonstration of metabolic engineering approach for low cost antibiotics

metabolite biosynthesis.

- 7. Demonstration of metabolic engineering approach for low cost biofuel production
- 8. To build stoichiometric matrix for glycolytic reactions
- 9. Redirecting the metabolic pathway in E.coli towards increased succinic acid production as well as reducing formation of other metabolites.
- 10. Bioprospecting of microbial strain to enhance bioethanol production

Total Hours: 48 hrs.



by curve fitting.

diffusion method

Nanoparticles toxicity estimation in percentage as in vitro methods Synthesis of carbon dots from microwave pyrolysis method.

Demonstration of nano characterization tools and techniques.

Nature of Interaction between nanoparticles & Bacterial Cell (E. coli and B. subtilis).

Sol gel synthesis of zinc oxide nanoparticles.

# NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY

### **GREATER NOIDA-201306**

(An Autonomous Institute) School of Biotechnology

Nand	obiotec	nnolog	ду Lab															
LAB Course	Code: 1	BBT065	53			LAB C	ourse l	Name: 1	Nanobi	otechnol	ogy Lab	)	L	T	P	C		
Course Offe	red in: .												0	0	2	1		
Pre-requisit													10	1 0				
Course Obje																		
This course a	ims to ir	itroduce	studen	ts to the	found	ational	concept	s of nai	oscien	ce, nanot	oiotechno	ology,	and n	anotec	hnolo	gy.		
overs vario																		
haracterizat	ion, and	focuses	on deve	eloping	practica	al labora	atory sk	ills esse	ential fo	r workin	g in the	field o	fnan	otechno	ology.			
Course Outo	come: A	fter com	pletion	of the c	course,	the stud	ent will	be able	e to				Bloo	m's Kn	owle	lge		
													Leve	1 (KL)				
CO1 Lear	n the bas	sics of n	anoscie	nce, na	nobiote	chnolog	gy, nanc	otechno	logy.					K	1			
	erstandii													K.	2			
CO3 Gair	n knowle	dge of t	ools and	d techni	ques us	sed for r	ano-ch	aracteri	zation				K1					
CO4 Dev	elop the	hands-o	n skills	for wo	rking in	to labor	atories						K6					
CO-PO Map	pping (Se	cale 1: l	Low, 2:	Mediu	m, 3: H	ligh)												
СО-РО	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO:	L	PSO2	PS	<b>D3</b>		
Mapping																		
CO1	3	3	3	2	3	2	2	2	2	3	2	3		3		3		
CO2	3	3	3	2	3	2	2	2	2	3	2	2		2		2		
CO3	3	3	3	2	3	2	2	2	2	3	2	2		3		2		
CO4	3	3	3	2	3	3	3	2	2	2	2	3		3		2		
List Of Prac	,						hnology	y (Size	compa	rative an	alysis)							
2. Syn	thesis of	carbon	nanotul	es fron	n carboi	n source	·											
	mical sy urve fitti		of met	allic na	noparti	cles; U	V-Visit	ole abso	rption	of the co	olloidal s	olution	and	estima	tion o	f siz		

Biological synthesis of metallic nanoparticles; UV-Visible absorption of the colloidal solution and estimation of size

10. Antibacterial activities of silver and zinc nanoparticles, against bacterial cultures performed by standard disc

Total Hours: 48 hrs.