

Criterion 1 – Curricular Aspects

Key Indicator	1.1	Curriculum Design and Development
Metric	1.1.3	Average percentage of courses having focus on employability/ entrepreneurship/ skill Development offered by the Department of Biotechnology.

DEPARTMENT OF BIOTECHNOLOGY

SYLLABUS COPY OF THE COURSES HIGHLIGHTING THE FOCUS ON EMPLOYABILITY/ ENTREPRENEURSHIP/ SKILL DEVELOPMENT

1. List of courses for the programmes in order of

S. No.	Programme Name
1.	Bachelor of Technology (Biotechnology)
2.	Master of Science (Biotechnology)
3.	Master of Technology (Nanotechnology)

2. Syllabus of the courses as per the list.

Legend :	Words highlighted with Blue Color	-	Entrepreneurship
	Words highlighted with Red Color	-	Employability
	Words highlighted with Green Color	-	Skill Development

1.LIST OF THE COURSES

Name of the Course	Course Code	Year of Introduction	Activities/Content with direct bearing on Employability/ Entrepreneurship/ Skill development
Calculus and Linear Algebra	XMA101	2018-19	Skill Development
Programming for Problem Solving	XCP102	2021-22	Skill Development
Applied Physics for Engineers	XAP103	2018-19	****
Biology for Engineers	XBT104	2018-19	****
Speech Communication	XGS105	2021-22	Skill Development
Constitution of India	XUM106	2018-19	****
Programming for Problem Solving Laboratory	XCP107	2018-19	Skill Development
Applied Physics for Engineers Laboratory	XAP108	2018-19	Skill Development
Calculus, Ordinary Differential Equations and Complex Variable	XMA201	2018-19	Skill Development
Electrical and Electronic Engineering Systems	XBE202	2018-19	Skill Development
Applied Chemistry for Engineers	XAC203	2018-19	****
Technical Communication	XGS204	2018-19	Skill Development
Workshop Practices	XWP205	2018-19	Skill Development
Electrical and Electronic Engineering Systems Laboratory	XBE207	2018-19	Skill Development
Applied Chemistry for Engineers Laboratory	XAC208	2018-19	Skill Development
Probability and statistics	XPS301	2018-19	Skill Development
Biochemistry	XBT302	2021-22	Employability
Microbiology	XBT303	2021-22	Employability
Material and Energy Balances	XBT304	2019-20	Employability
Genetics and Evolutionary Biology	XBT305	2021-22	Employability
Entrepreneurship Development	XUM306	2016-17	Entrepreneurship
Biochemistry Laboratory	XBT308	2021-22	Employability
Microbiology Laboratory	XBT309	2021-22	Employability
In-plant Training - I	XBT310	2014-15	Employability
Basic Transport Processes	XBT401	2021-22	Skill Development
Bioenergetics and Metabolism	XBT402	2019-20	Employability
Cell Biology	XBT403	2021-22	Employability

Immunology	XBT404	2021-22	Employability		
Economics for Engineers	XUM405	2016-17	Employability		
Disaster Management	XUM406	2021-22	****		
Basic Transport Processes Laboratory	XBT407	2021-22	Employability		
Cell Biology Laboratory	XBT408	2021-22	Employability		
Immunology Laboratory	XBT409	2021-22	Employability		
Bio analytical Tools	XBT501	2018-19	Skill Development		
Molecular Biology	XBT502	2018-19	Employability		
Bio reaction Engineering	XBT503	2018-19	Employability		
Plant biotechnology	XBT504	2016-17	Employability		
Food Technology	XBT505A	2021-22	Employability		
Agricultural Biotechnology	XBT505B	2021-22	Employability		
Pharmaceutical Biotechnology	XBT505C	2021-22	Employability		
Bio analytical Tools Laboratory	XBT507	2021-22	Employability		
Bio reaction Engineering Laboratory	XBT508	2021-22	Employability		
In-Plant training-II	XBT509	2014-15	Employability		
Animal biotechnology	XBT601	2016-17	Employability		
Process Biotechnology – Upstream Processes	XBT602	2022-23	Skill Development		
Process Biotechnology – downstream Processes	XBT603	2022-23	Skill Development		
Mass Transfer Fundamentals	XBT604A	2018-19	Employability		
Fermentation Technology	XBT604B	2018-19	Employability		
Nano biotechnology	XBT604C	2016-17	Employability		
Cyber Security	XUM606	2018-19	Entrepreneurship		
Process Biotechnology Laboratory	XBT607	2021-22	Employability		
Protein engineering	XBT701A	2016-17	Employability		
Pharmaceutical biotechnology	XBT701B	2016-17	Employability		
Bioinformatics and Computational Biology	XBT702	2016-17	Employability		
Downstream processing	XBT703	2016-17	Employability		
Cancer biology	XBT704A	2016-17	Employability		
Stem cell biotechnology	XBT704B	2016-17	Employability		
Metabolic engineering	XBT704C	2016-17	Employability		
In-plant Training – III	XBT707	2014-15	Employability		
Project Work (Phase-II)	XBT804	2018-19	Employability		
M.Sc Biotechnology					
Cell Biology and Molecular Biology	YBT101	2023-24	Skill Development		

Biochemistry	YBT102	2023-24	Skill Development		
Microbiology	YBT103	2023-24	Skill Development		
Bio analytic technique	YBT104A	2023-24	Skill Development		
Nano biotechnology	YBT104B	2023-24	Skill Development		
Molecular Genetics	YBT104C	2023-24	Skill Development		
Molecular Biology and Microbiology Laboratory	YBT105	2023-24	Skill Development		
Biochemistry Laboratory	YBT106	2023-24	Employability		
Communication Skills and Scientific Writing	YBT107	2023-24	Skill Development		
Recombinant DNA Technology	YBT201	2023-24	Skill Development		
Immunology	YBT202	2023-24	Employability		
Biostatistics	YBT203	2023-24	Skill Development		
Animal and Plant Biotechnology	YBT204B	2023-24	Skill Development		
Pharmaceutical Biotechnology	YBT204C	2023-24	Skill Development		
Immunology lab	YBT205	2023-24	Employability		
Recombinant DNA Technology lab	YBT206	2023-24	Employability		
Research Methodology, Ethics, and IPR	YBT207	2023-24	Employability		
M Tech Nanotechnology					

Introduction to Nanotechnology	YNT101	2018-19	Skill development- Tutorials and Assignment			
Nanomaterials Fabrication Techniques	YNT102	2018-19	Skill Development- Assignment, Oral Presentation, Debate, Group Discussion			
Materials Science & Engineering	YNT103	2023-24	Skill Development- Assignment, Oral Presentation, Debate, Group Discussion			
Societal Implications of Nanotechnology	YNT104A	2018-19	Skill Development- Assignment, Oral Presentation, Debate, Group Discussion			
Nano chemistry	YNT104B	2018-19	Skill Development- Assignment, Seminar, Technical Report			
Nano medicine	YNT104C	2018-19	Skill Development- Assignment, Oral Presentation, Debate, Group Discussion			
Nanotechnology in Energy Conversion and Storage	YNT104D	2018-19	Skill development- Seminars Assignment, Oral Presentation, Debate, Group Discussion			

Nano fluid Dynamics	YNT104E	2023-24	Skill Development- Assignment, Seminar, Technical Report
Cell and Molecular Biology	YNT104F	2023-24	Skill Development- Assignment, Seminar, Technical Report
Nano scale Magnetic Materials and Devices	YNT105A	2018-19	Skill Development- Assignment, Seminar, Technical Report
Metallopolymer Nano composites	YNT105B	2018-19	Skill Development- Assignment, Seminar, Technical Report
Properties of Nano phase Materials	YNT105C	2018-19	Skill Development- Assignment, Seminar, Technical Report
Nano toxicology	YNT105D	2018-19	Skill Development- Assignment, Seminar, Technical Report
3D Printing	YNT105E	2023-24	Skill Development- Assignment, Seminar, Technical Report
Green Manufacturing Technology	YNT105F	2018-19	Skill Development- Assignment, Seminar, Technical Report
Simulation of Nanostructure & Nanomaterials Lab	YNT106	2018-19	Skill Development- Assignment, Seminar, Technical Report
Research Methodology and IPR	YRM107	2018-19	Skill Development- Assignment, Seminar, Technical Report
Nanomaterials Fabrication Techniques Lab	YNT107	2018-19	Employability- Quiz/Oral, Presentation, Seminar, Group
English for Research Paper Writing	YEGOE1	2018-19	Skill Development- Assignment, Seminar, Technical Report
Nanomaterials Characterization Techniques	YNT201	2018-19	Employability- Assignment, Quiz/Oral
Computational Nanotechnology	YNT202	2018-19	Skill Development- Assignment, Seminar, Technical Report
Nano composites	YNT203	2023-24	Skill Development- Assignment, Seminar, Technical Report
Polymer Engineering	YNT204A	2023-24	Skill Development- Assignment, Seminar, Technical Report
Advanced Crystal Growth Techniques	YNT204B	2018-19	Skill Development- Assignment, Seminar, Technical Report
Carbon Nanotube Electronics and Devices	YNT204C	2018-19	Skill Development- Assignment, Seminar, Technical Report
Nanoscale Integrated Computing	YNT204D	2018-19	Skill Development- Assignment, Seminar, Technical Report
Thin Film Science and Technology	YNT204E	2018-19	Skill Development- Assignment, Seminar, Technical Report

Micro and Nano Emulsions	YNT204F	2018-19	Skill Development- Assignment, Seminar, Technical Report
Graphene Nanotechnology	YNT205B	2023-24	Skill Development- Assignment, Seminar, Technical Report
Carbon Nanotube	YNT205C	2023-24	Skill Development- Assignment, Seminar, Technical Report
Quantum Dot	YNT205D	2023-24	Skill Development- Assignment, Seminar, Technical Report
Polymeric carrier	YNT205E	2023-24	Skill Development- Assignment, Seminar, Technical Report
Lithographic techniques	YNT205F	2023-24	Skill Development- Assignment, Seminar, Technical Report
Nanomaterials Characterization Techniques Lab	YNT206	2018-19	Employability- Mini Project
Computational Nanotechnology Lab	YNT207	2018-19	Skill Development- Presentation, Seminar, Group Discussion
Mini Project	YNT208	2018-19	Employability- Mini Project
Constitution of India	YPSOE1	2018-19	Skill Development- Assignment, Seminar, Technical Report

2. SYLLABUS

COURSE	CODE	C	XMA 101	L	Τ	Р	C	
COURSE	NAMI	E	Calculus and Linear Algebra	3	1	0	4	
С	P	Α		L	Т	Р	Н	
3	0.5	0.5		4	1	0	5	
PREREQ	UISITI	E: Diff	erentiation and Integration			1	•	
COURSE	OUTC	COME	5:					
Course ou	tcomes	5:		Domai	n	Lev	Level	
CO1	Apply	the o	rthogonal transformation to reduce quadratic form to	Cogniti	ve	Ap	plying	
	canoni	ical for	ms.					
CO2	Apply	power	series to tests the convergence of the Sequences	Cogniti	ve	Ap	plying	
	and set	ries and	Half range Fourier sine and cosine series.	Psycho	motor	Gu	ided	
						Res	sponse	
CO3	Find t	the der	vative of composite functions and implicit functions.	Cogniti	ve	Ap	plying	
	Euler's	s theore	em and Jacobian					
CO4 Explain the functions of two variables by Taylor's expansion, by Cog						ognitive Underst		
finding maxima and minima with and without constraints using					Receivin			
Lagrangian Method Directional derivatives, Gradient, Curl and Affective								
Divergence.								
CO5 Apply Differential and Integral calculus to notions of Cogni					ve	Ap	plying	
Curvature and to improper integrals.								
UNIT -I	Mat	rices		•			12	
Linear Transformation - Eigen values and Eigen vectors - Properties of Eigen values and Eigen vectors - Cayley-								
Hamilton	Theorer	n – Dia	agonalisation of Matrices – Real Matrices: Symmetric - Sl	kew-Sym	metric	and O	rthogonal	
Quadratic	form –	canoni	cal form - Nature of Quadratic form and Transformation	of Quadi	atic for	rm to C	Canonical	
form (Orthogonal only).								
UNIT -II	Image: Sequences and series 12						12	
Sequences: Definition and examples-Series: Types and convergence- Series of positive terms - Tests of								
convergen	ce: con	npariso	n test, Integral test and D'Alembert's ratio test Fouri	er series	: Half	range	sine and	
cosine series- Parseval's Theorem.								
UNIT -III	UNIT -IIIMultivariable Calculus: Partial Differentiation12						12	
Limits and	contin	uity –P	artial differentiation – Total Derivative – Partial differenti	ation of	Compo	site Fu	nctions:	
Change of	Variab	les – D	ifferentiation of an Implicit Function - Euler's Theorem- J	Jacobian				

Taylor's theorem for function of Two variables- Maxima, Minima of functions of two variables: with and without constraints - Lagrange's Method of Undetermined Multipliers – Directional Derivatives - Gradient, Divergence and Curl.

UNIT -V Differential and Integral Calculus

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

LECTURE	TUTORIAL	TOTAL
45	15	60

Text Books:

- Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint, 2015. (Unit-1, Unit-3 and Unit-4).
- N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2014. (Unit-2).

3. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 40th Edition, 2010. (Unit-5).

Reference Books:

- 1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint, 2002.
- 2. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
- 3. D. Poole, "Linear Algebra: A Modern Introduction", 2nd Edition, Brooks/Cole, 2005.
- **4.** Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.

						Cos v	versus	GA ma	pping				
						Gra	duates	s Attrib	utes				
	1	2	3	4	5	6	7	8	9	10	11	12	
CO1	3	2			2					1		2	
CO2	3	1								1		1	
CO3	3	1								1		1	
CO4	3	2								1		1	
CO5	3	2			1					1		2	
Total	15	8	0	0	3	0	0	0	0	5	0	7	
Scaled Value	3	2			1					1			
	0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation												
	$1-5 \rightarrow 1, \qquad 6-10 \rightarrow 2, \qquad 11-15 \rightarrow 3$												

12

12

Cours	e Code		:	XCP102		L	Т	Р	С
Cours	e Name		:	Programming ForProblem-Solving		3	0	0	3
Preree	quisite		:	Basic Understanding Skills		L	Т	Р	Н
С	Р	Α				3	0	0	3
3	0	0							
Cours	e Objec	tive	es						
• To	learn pi	ogr	amı	ning language basics and syntax					
• To	ignite l	ogic	cal t	hinking					
• To	underst	and	l stri	actured programming approach					
• To	deal wi	th u	iser	defined data types					
Course	e Outcor	ne:	Aft	er the completion of the course, students will be	Doma	in		Level	
able to)								
CO1	Define	•	prog	gramming fundamentals and Solve simple	Cognitiv	e	App	oly	
	progra	ms	usir	g I/O statements					
CO2	Explai	in j	prog	gramsusing control structures and arrays	Cognitiv	e	Unc	lerstar	nd
CO3	Explai	in (the	simple programs using functions and pointers	Cognitive Understa			erstan	d
CO4	Explai	in s	imp	le programs using structures and unions	Cognitiv	e	Unc	lerstar	nd
CO5	Explai	in s	imp	le programs using files and Buildsimple projects	Cognitiv	e	Und	lerstar	nd
COU	RSE CO	NT	'EN	Т					
UNIT	-I	PI	ROC	GRAMMING FUNDAMENTALS AND I/O STATE	EMENTS				9
Introdu	uction to	o co	mpo	onents of a computer system, Program–Flowchart –Pse	udo code-	Soft	ware		
– Intro	oduction	to	C la	nguage – Character set – Tokens: Identifiers, Keywo	rds, Const	ants,	and O	perato	ors –
sample	e progra	m st	truc	ture -Header files – Data Types- Variables - Output sta	atements –	Input	staten	nents.	1
UNIT	-II	C	ON'	TROL STRUCTURE AND ARRAYS					9
Contro	olStructu	res-	–Co	nditionalControlstatements:Branching,Looping-Uncor	nditionalco	ntrol	.		
structures:switch,break,continue,gotostatements–Arrays:OneDimensionalArray–Declaration–Initialization–									
Access	sıngArra	yEl	leme	ents-Searching-Sorting-TwoDimensionalarrays-Decla	aration–Ini	tializa	ation–		<i>.</i> .
Matrix		ons-		Introductional Arrays-Declaration-Initialization. Stora	ige classes	: auto) –ext	ern-st	atic.
Sunng		ope		TTIONS AND DOINTEDS					0
UNIT -III FUNCTIONS AND POINTERS 9 Functions: Built-in functions_User Defined Functions_Parameter passing methods_Passing arrays to									
runch	UIIS. BL	1111-	111	runchons-Oser Dermed Functions-Parameter passi	ing metho	JUS-Pa	issing	array	/s t0

functions-Recursion-Programs using arrays and functions. Pointers-Pointer declaration Address operator-Pointer expressions & pointer arithmetic-Pointers and function-CallbyvalueCall by Reference-Pointer to arrays-Use of Pointers itself-referential structures-Notion of linked list

9

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UNIT -IV STRUCTURES AND UNIONS

Structures and Unions-Giving values to members-Initializing structure-Functions and structures

-Passing structure to elements to functions-Passing entire function of unction's-Arrays of structure-Structure with in a structure and Union.

UNIT -V FILES

File management in C-File operation function sin C-Defining and opening a file-Closing a file-The get

and put functions-The print & scan functions-seek function-Files and Structures.

L	Т	Р	Total
45	0	0	45
	~		

TEXTBOOKS

1. ByronGottfried, "Programming with C", IIIE dition, (Indian Adapted Edition), TMH publications, 2010

2. Yeshwant Kanethker, "LetusC", BPBPublications, 2008

REFERENCEBOOKS

- 1. E.Balaguruswamy, Programming in ANSIC, Tata McGraw-Hill, 7th edition 2017.
- 2. Brian W.Kernighan and Dennis M.Ritchie,"TheCProgrammingLanguage",Pearson EducationInc.2005
- 3. Johnson baugh R. and Kalin M., "ApplicationsProgrammingin ANSIC", III Edition, Pearson EducationIndia, 2003

E-REFERENCES

- $1. \ https://www.indiabix.com/c-programming/questions-and-answers/$
- 2. https://www.javatpoint.com/c-programming-language-tutorial
- 3. https://www.w3schools.in/c-tutorial/

						P	ROG	RAM	OUT	COMES	5			
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	2	0	0	3	0	0	0	0	0	2	3	2	0
CO2	3	2	0	0	2	0	0	0	0	0	2	3	2	0
CO3	2	2	1	2	2	0	0	0	0	0	2	2	2	0
CO4	2	2	1	2	2	0	0	0	0	0	2	2	2	0
CO5	2	2	1	0	2	0	0	1	0	2	2	2	2	0
Total	12	10	3	4	11	0	0	1	0	2	10	12	10	0
ScaledValue	3	2	1	1	3	0	0	1	0	1	2	3	2	0
		1	-5 🗆	1,		6	- 10	□ 2,		1	1 – 13	5 🗆 3	•	•
	0-NoRelation,1-Low Relation,2-MediumRelation,3-HighRelation													

	XGS	105					L	Т	Р	SS	С
G				Speech Commu	nication		0	0	3	0	3
C 26	Р 0/	1	A 					T	Р 3	55	H 3
Cours	e Ou	tcor	nes			Domain		U	Le	vel	
After c	comp	letic	on of th	e course, students will be able to					-		
CO1		Abil	ity to r	ecall the types of speeches	С	ognitive		F	Reme	mber	
CO2		App	ly the t	echniques in public speaking	С	ognitive			App	oly	
CO3]	Iden	tify the	common patterns in organizing a sp	eech C	ognitive		F	Reme	mber	
CO4	(Con	struct t	he nature and style of speaking	С	ognitive			Cre	ate	
CO5]	Prac	ticing	he speaking skills	Р	sychomotor	G	uidec	Res	ponse	
UNIT	-I		Ty	bes of Speeches	I					9	
1.1 – F	Four t	ype	s of spe	eches							
1.2 – A	Analy	zing	g the au	dience							
1.3 - D	Develo	opin	ig ideas	and supporting materials							
UNIT	–II		Pu	olic Speaking						9	
2.1 - Ir	ntrod	uctio	on to P	ublic Speaking							
2.2 - C	Comp	eten	cies No	eded for successful speech making							
2.3 - 8	Speak	ting	about e	veryday life situations							
UNIT	-III		Or	ganization of Speech						9	
3.1 – I	Devel	opir	ng a spo	eech out line							
3.2 - 0	Orgar	nizin	ng the s	peech							
3.3 – I	ntrod	lucti	on - de	velopment – conclusion							
UNIT	-IV		Pr	esentation						9	
4.1 - '	Tips	for _l	prepari	ng the draft speech							
4.2 -	Prese	enta	tion tec	hniques using ICT tools							
4.3 –	Usin	g ex	ample	from different sources							
UNIT	-V		A	ctivities						9	
5.1 –	Read	ling	activit	es							
5.2 -	Crea	tive	presen	tations							
5.3 –	Med	ia pi	resenta	tion techniques							
	LEC	CTU	JRE	TUTORIAL	PRACT	ICAL]	ΓΟΤ	4L	
		0		0	45				45		
Sugge	sted	Rea	dings:								

1.Michael Swan. Practical English Usage.OUP. 1995

2. Sanjay Kumar and PushpLata.Communication Skills. Oxford University Press. 2011

						PI	ROGE	RAM (OUTC	OMES				
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2	0	0	0	0	0	2	0	1	0	0	0	0	0
CO2	2	0	0	0	0	0	2	0	1	0	0	0	0	0
CO3	1	0	0	0	0	0	1	0	1	0	0	0	0	0
CO4	2	0	0	0	0	0	1	0	1	0	0	0	0	0
CO5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	7	0	0	0	0	0	6	0	4	0	0	0	0	0
ScaledValue	2	0	0	0	0	0	2	0	1	0	0	0	0	0
		1	-5 🗆	1,		6 -	- 10 🗆	2,		11	- 15	3	•	
		0-NoRelation,1-Low Relation,2-MediumRelation,3-HighRelation												

Mapping Of Course Outcomes with Program Outcomes

COUR	SECOD	ЭE	XCP107		L	Т	Р	С	
COUR	SENAN	ſE	Programming For Problem Solving		0	0	1	1	
			Laboratory		U	U	1	I	
PRER	EQUISI	TES	Basic Understanding Skills		L	Т	Р	Н	
С	Р	Α			0	0	•		
0.75	1	0.25		U	U	2	3		
LEAR	NING C	BJEC					I		
• To	learn pro	ogramn							
• To	ignite lo	gical th	inking						
• To	understa	and stru	ctured programming approach						
• To	deal wit	h user c	lefined data types						
• To	know at	oout dat	a storage in secondary memory						
COUR	SEOUT	COME	DOMA	IN		LEVEL			
CO1	Solve	simple	Cognitiv		Appl	y			
				Psycomotor			Respond		
CO2	Solve	program	ms using control structures and arrays	Cognitiv	e		Appl	y	
				Psycome	omotor Respond				

CO3	Solve programs using functions and	pointers	Cognitive	Apply
			Psycomotor	Respond
CO4	Solve programs using structures		Cognitive	Apply
			Psycomotor	Respond
CO5	Solve programs using files		Cognitive	Apply
			Psycomotor	Respond
S.No.	List of	Experiments		COs
1	Program to display a Leave Letter as J	per proper format		CO1
2	i. Program for addition of two num	bers		CO1
	ii. Program to solve any mathematic	cal formula.		COI
3	Program to find greatest of 3numbers	using Branching	Statements	CO2
4	Programtodisplaydivisiblenumbersbet	igle ooping	CO2	
	Statement		02	
5	Program to search an array elementina		CO2	
6	Program to find largest/smallest eleme		CO2	
7	Program to perform string operations.			CO3
8	Program to find area of a rectangle of	a given number u	se four functiontypes.	CO3
9	Programs to pass and receive array an	d pointers using f	our functiontypes	CO3
10	Programs using Recursion for finding	factorial of a nun	ıber	CO3
11	Program to read and display student n	nark sheet of a stu	dent structures	CO4
	With variables			
12	Program to read and display student ma	arks of a class usi	ng structures	CO4
	With arrays	-		
13	Program to create linked list using stru	ctures with pointe	rs	CO4
14	Program for copying contents of one fi	le to an other file.		CO5
15	Program using files to store and display	y student mark lis	t of a class using	CO5
	Structures with array			
I	HOURS	TUTORIAL	PRACTICAL	TOTAL
		0	30	30

						P	ROG	RAM	OUT	COMES	5			
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	2	0	0	3	0	0	0	0	0	2	3	2	0
CO2	3	2	0	0	2	0	0	0	0	0	2	3	2	0
CO3	2	2	1	2	2	0	0	0	0	0	2	2	2	0
CO4	2	2	1	2	2	0	0	0	0	0	2	2	2	0
CO5	2	2	1	0	2	0	0	1	0	2	2	2	2	0
Total	12	10	3	4	11	0	0	1	0	2	10	12	10	0
ScaledValue	3	2	1	1	3	0	0	1	0	1	2	3	2	0
	$1-5 \Box 1$, $6-10 \Box 2$, $11-15 \Box 3$													
		0-1	NoRela	ation,	1-Low	Relati	on,2-1	Mediur	nRela	tion,3-H	lighRe	elation		

C	OURSI	E CODE	E XAF	P108				L T P C 0 0 2 2								
C	OURSE	E NAMI	E App	lied I	Physics For En	ginee	rs Laboratory	0 0 2 2 L T P H								
	C:P	P:A	0:2:	0					L	Т	Р	H				
PR	REREQ	UISITE	E: Basi	c Phy	sics in HSC le	vel			0	0	3	3				
COL	J RSE C	DUTCO	MES						Dor	nain		Level				
CO	D1 D sy	etermin ystems a	e the si nd technol	gnific ogica	ance of elast l advances.	ticity	in engineering	g	Psycho	omotor	: Me	chanism				
CO)2 us	se and lo	ocate basio	c appl	ications of elec	ctroma	ignetic induction	n	Psycho	omotor	: Me	chanism				
	to technology.								Af	fective	: Res	pond				
CO	03 D	escribe	the work	ting p	rinciple and a	applica	ation of variou	s	Psycho	omotor	: Me	chanism				
	la	asers and	fibre option	$\frac{cs.}{\cdot 1}$	<u> </u>		<u> </u>					1 .				
CO	04 us se	se phy emicond	vsics pri uctor device	nciple	es of latest	tec	hnology using	g	Psycho	omotor	: Me	chanism				
					LAB	ORA'	TORY									
1.	Torsic	onal Pen	dulum - de	etermi	nation of mom	ent of	inertia and rigid	lity m	ty modulus of the given material of							
	the wi	ire.														
2.	Unifo	rm Bend	ling - Dete	ermina	tion of the You	ung's I	Modulus of the r	mater	ial of th	e bean	1.					
3.	Non-U	Uniform	Bending -	Dete	rmination of th	e You	ng's Modulus of	f the r	naterial	of the	beam.					
4.	Meter	Bridge	- Determir	nation	of specific rest	istance	e of the material	of th	e wire.							
5.	Spect	rometer	- Determin	nation	of dispersive p	ower	of the give prisr	n.								
6.	Spect	rometer	- Determir	nation	of wavelength	of va	rious colours in	Hg so	ource us	ing gra	ating.					
7.	Air w	edge - D	eterminati	ion of	thickness of a	given	thin wire.									
8.	Laser	- Detern	nination of	f wave	elength of give	n lasei	r source and size	e of th	e given	micro	partic	le using				
	Laser	grating.														
9.	Post o	office Bo	ox - Detern	ninati	on of band gap	of a g	iven semicondu	ctor.								
10.	PN Ju	inction D	Diode - Det	termir	ation of V-I ch	naracte	eristics of the giv	ven d	iode.							
REF	EREN	CE BOO	OKS:													
1	1. Sam	nir Kuma	ar Ghosh, '	"A tex	t book of Adva	anced	Practical Physic	es", N	ew Cen	tral Ag	gency (P) Ltd,				
	200	8.														
2	2. Arc	ora C.L.,	"Practical	l Phys	ics", S. Chand	& Co	mpany Ltd., Nev	w Del	hi, 201	3.						
	3. Um	ayalSun	dari AR., '	'Appl	ed Physics Lat	oorato	ry Manual", PM	IU Pre	ess, Tha	njavur	, 2012.					
			LECTUR	RE	TUTORIA	L	PRACTICAI	_	T	OTAL	HOU	RS				
	Ног	urs	0		0		30				30					

						P	ROG	RAM	OUT	COMES	5			
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	2	2	2	1	-	-	-	1	-	-	1		
CO2	3		1		1	-	-	-		-	-	1		
CO3	3	2	2	2	1	-	-	-	1	-	-	1		
CO4	3	2	2	2	1	-	-	-	1	-	-	1		
Total	12	6	7	6	4				3			5		
ScaledValue	3	2	2	2	1				1			1		
		1	-5 🗆	1,		6	5 – 10	□ 2,		1	1 – 13	5 🗆 3		
		0-1	0-NoRelation,1-Low Relation,2-MediumRelation,3-HighRelation											

Mapping Of Course Outcomes with Program Outcomes

II Semester

CO	URSE	CODE	COURSE NAME		L	Т	Р	С			
XM	A201		Calculus, Ordinary Differential Equations and Complex		3	1	0	4			
			Variable								
C	Р	Α			L	Т	Р	Н			
3	0.5	0.5			3	1	0	4			
PRE	EREQ	UISITE:	Mathematics I (Calculus and Linear Algebra)								
CO	URSE	OUTCO	MES:								
Cou	rse ou	tcomes:		Do	main		Lev	el			
CO	l F	ind doubl	e and triple integrals and to find line, surface and volume of	Co	gnitiv	e A	Applyi	ng			
an integral by Applying Greens, Gauss divergence and Stokes theorem.											
CO2	2 S	olve first	order differential equations of different types which are	Co	gnitive	e A	Applyi	ng			
	so	lvable for	r p, y, x and Clairaut's type.								
CO3	3 S	olve Sec	ond order ordinary differential equations with variable	Co	gnitive	e A	Applyi	ng			
	С	oefficients	using various methods.								
CO4	4 U	se CR ec	uations to verify analytic functions and to find harmonic	Co	gnitive	e A	Applyi	ng			
	fı	inctions a	nd harmonic conjugate.	Psy	ychom	0 0	Guideo	1			
	C	onformal	mapping of translation and rotation. Mobius transformation.	tor		I	Respor	ıse			
CO	5 A	pply Cau	chy residue theorem to evaluate contour integrals involving	Co	gnitive	e A	Applying				
	si	ne and	cosine function and to state Cauchy integral formula,	Af	fective	F	Receiv	ing			
	L	iouvillestl	neorem. Taylor's series, zeros of analytic functions,								
	si	ngularitie	s, Laurent's series.								
Unit	t-I	Multiva	riable Calculus (Integration)				12	2			
Mul	tiple I	ntegration	: Double integrals (Cartesian) - change of order of integra	tion	in do	uble	integr	als -			
Cha	nge of	variables	(Cartesian to polar) - Triple integrals (Cartesian), Scalar li	ine i	integra	ıls -	vector	· line			
integ	grals -	scalar sur	Face integrals - vector surface integrals - Theorems of Green, C	Jaus	s and S	Stoke	s.				
Unit	hit -II First order ordinary differential equations 12										
Exac	ct - lii	near and	Bernoulli's equations - Euler's equations - Equations not	of f	irst de	gree	equa	tions			
solv	able fo	r p - equa	tions solvable for y- equations solvable for x and Clairaut's typ	pe.							
Unit	t -III	Ordina	ry differential equations of higher orders				12	2			
Seco	ond or	ler linear	differential equations with variable coefficients- method of	var	iation	of pa	aramet	ers -			
Cau	uchy-Euler equation- Power series solutions- Legendre polynomials- Bessel functions of the first kind and										

their pr	operti	es											
Unit -I	V	Comple	ex Var	iable	– Diffe	rentia	tion						12
Differen	ntiatio	n-Cau	chy-Rie	emanı	n equa	ations-	analy	ytic fu	nction	s-harmonic	fun	ctions-findin	g harmonic
conjuga	ate- e	lementa	ary an	alytic	functi	ons (e	xpone	ntial, t	rigono	metric, log	arithr	n) and their	r properties-
Conform	mal m	apping	s- Mot	oius tr	ansforn	nations	and th	neir proj	perties				
Unit -V	/	Comple	ex Var	iable	– Integ	gration							12
Contou	r integ	grals -	Cauch	y-Go	ursat th	neorem	(with	out pro	of) - (Cauchy Inte	gral	formula (wit	thout proof)-
Liouvil	le's tł	neorem	(with	out pi	roof)- T	Taylor'	s serie	es- zero	s of a	nalytic func	tions	- singularitie	es- Laurent's
series -	- Resi	dues- C	Cauchy	Resi	due the	orem (withou	ut proof)- Eva	luation of c	lefini	te integral ir	volving sine
and cos	ine- E	valuati	on of c	certair	n impro	per inte	grals	using th	e Bror	nwich conto	our.		
	L	ECTUI	RE				TUT	ORIAL	1			TOTAL	
		45						15				60	
Text B	ook: E	B.S. Gr	ewal, "	High	er Engi	neering	, Math	ematics	", Kha	nna Publish	ers, 4	40th th Edition	ı, 2008.
Refere	nce B	ooks:											
1.G.B. '	Thom	as and	R.L. Fi	inney,	, "Calcı	ulus and	d Anal	ytic geo	metry	", 9 th Editio	n, Pe	arson, Repr	int, 2002.
2. Erwi	n krey	vszig, "	Advan	ced E	ngineer	ring Ma	thema	tics", 9	^h Editi	on, John W	iley &	& Sons, 2006	
3.W. E.	. Boyo	ce and	R. C. 1	DiPri	ma, "El	lementa	ary Di	fferentia	al Equ	ations and I	Boun	dary Value	Problems",
9 th Edn.	Wiley	/ India,	2009.										
4. S. L.	Ross,	"Diffe	rential	Equa	tions",	3 rd Ed.	, Wile	y India,	1984.				
5.E. A.	Codd	ington,	"An Ir	ntrodu	action to	o Ordin	ary Di	ifferenti	al Equ	ations", Pre	entice	Hall India,	1995.
6. E. L.	Ince,	"Ordin	ary Di	fferer	tial Eq	uations	", Dov	ver Publ	icatior	ns, 1958.			
7.J. W.	Brow	n and F	R. V. C	hurch	uill, "Co	mplex	Varial	bles and	l Appli	cations", 7 th	^h Ed.,	McGraw 1	Hill, 2004.
8. N.P.	Bali a	and Ma	nish G	oyal,	"A text	t book	of Eng	gineerin	g Matl	hematics", I	Laxm	i Publicati	ons, Reprint,
2008.													
						Cos v	versus	GA ma	pping	Ş			
						Gra	aduat	es Attri	butes				
	1	2	3	4	5	6	7	8	9	10	11	12	
CO1	3	2			2					1		2	
CO2 CO3	3	1								1		1	
CO4	3	2								1		1	
CO5 Total	<u>3</u> 15	2 8	0	0	<u> </u>	0	0	0	0	<u> </u>	0	2 7	
Coolod	10									-		,	

Value32110 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation $1-5 \rightarrow 1$, $6-10 \rightarrow 2$, $11-15 \rightarrow 3$

COURS	SE CODE	COURSE NAME		L T P C							
XBE202	2	Electrical and Electronics Engineering Systems		3	1	0	4				
Prerequ	iisites	Physics		L	Т	Р	Н				
C:P: A		3:0:0		3	1	0	4				
Course	Outcomes		D	omain		L	evel				
CO1	Relate the fu	indamentals of electrical parameters and build and	Cogni	tive	Uno	lerstar	nd				
	explain AC, I	OC circuits by Using measuring devices									
CO2	Explain the o	peration of DC and AC machines.	Cogni	tive	Uno	lerstar	nd				
CO3	Illustrate var	ous semiconductor devices and their applications and	Cogni	tive	Uno	lerstar	nd				
	displays the	input output characteristics of basic semiconductor									
	devices.										
CO4	Explain the	number systems and logic gates. Construct the	Cogni	tive	Uno	lerstar	nd				
	different digit	al circuit.									
CO5	Outline the	different types of microprocessors and their	Cogni	tive	Uno	lerstar	nd				
	applications.										
UNIT-I	: FUNDAMEN	TALS OF DC AND AC CIRCUITS, MEASUREM	ENTS		9+3	•					
Fundam	entals of DC-	Ohm's Law – Kirchhoff's Laws - Sources - Voltage an	d Curre	ent Rel	ation	s –Sta	r/Delta				
Transfor	rmation - Fund	amentals of AC - Average Value, RMS Value, Form	Factor	- AC	powe	r and	Power				
Factor,	Phasor Repres	entation of sinusoidal quantities - Simple Series, Pa	rallel,	Series	Paral	lel Ci	rcuit -				
Operatir	ng Principles of	Moving coil and Moving Iron Instruments (Ammeter	, Voltn	neter) a	nd D	ynamo	ometer				
type me	ters (Watt mete	r and Energy meter).									
UNIT -	II: ELECTRIC	CAL MACHINES			9 + 3						
Constru	ction, Principle	of Operation, Basic Equations, Types and Application	of DC	Genera	tors,	DC m	otors -				
Basics	of Single-Phas	e Induction Motor and Three Phase Induction Mot	tor- Co	onstruct	ion,	Princi	ple of				
Operatio	on of Single-Ph	ase Transformer, Three phase transformers, Auto transfo	ormer.								
UNIT- I	III: SEMICON	DUCTOR DEVICES			9 + 3						
Classific	cation of Semic	onductors, Construction, Operation and Characteristics	: PN Ju	nction	Diod	e – Ze	ner Dio				
NPN Tr	ansistors, Field	Effect Transistors and Silicon Controlled Rectifier –									
Applicat	tions.										
UNIT-1	IV: DIGITAL	ELECTRONICS			9 + 3						
Basic of	f Concepts of	Number Systems, Logic Gates, Boolean Algebra, Ad	dders, S	Subtrac	tors,	multi	plexer,				
demultip	plexer, encoder	decoder, Flipflops, Up/Down counters, Shift Registers									
UNIT-	V: MICROPR	OCESSORS			9+3						

Architecture, 8085, pin diagram of 8085, ALU timing and control unit, registers, data and address bus, timing and control signals, Instruction types, classification of instructions, addressing modes, Interfacing Basics: Data transfer concepts – Simple Programming concepts.

LECTURE	TUTORIAL	TOTAL
45	15	60

TEXT BOOKS

1. Metha V.K, Rohit Mehta, 2020. Principles of Electronics, 12th ed, S Chand Publishing.

2. Albert Malvino, David J.Bates., 2017. Electronics Principles. 7th ed, Tata McGraw-Hill. New Delhi.

3. Rajakamal, 2014. Digital System-Principle & Design. 2nd ed. Pearson education.

4. Morris Mano, 2015. Digital Design. Prentice Hall of India.

5. Ramesh, S. Gaonkar, 2013, Microprocessor Architecture, Programming and its Applications with

the 8085, 6thed, India: Penram International Publications.

REFERENCE BOOKS

1. Corton, H.,2004 Electrical Technology. CBS Publishers & Distributors.

2. Syed, A. Nasar, 1998, Electrical Circuits. Schaum Series.

3 Mohammed Rafiquzzaman, 1999. Microprocessors - Theory and Applications: Intel and Motorola. Prentice Hall International.

E-REFERENCES

1. NTPEL, Basic Electrical Technology (Web Course), Prof. N. K. De, Prof. T. K. Bhattacharya and Prof.

G.D. Roy, IIT Kharagpur.

2. Prof.L.Umanand, http://freevideolectures.com/Course/2335/Basic-Electrical-Technology#, IISc Bangalore.

3. http://nptel.ac.in/Onlinecourses/Nagendra/, Dr. Nagendra Krishnapura, IIT Madras.

4. Dr.L.Umanand, http://www.nptelvideos.in/2012/11/basic-electrical-technology.html, IISC Bangalore.

						Р	ROG	RAM	OUT	COMES	5			
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	1	1	1	1			1	1	1		3	3
CO2	3	3	1	1	1	1			1	1	1		3	3
CO3	2	2	2	1	2	2	1	1	1	1	1		3	3
CO4	2	2	1	1	1	1	1	1	1	1	1		3	3
CO5	2	2	1	1	1	1	1	1	1	1	1		3	3
Total	12	12	6	5	6	6	3	3	5	5	5		15	15
ScaledValue	3	3	2	1	2	2	1	1	1	1	1		5	5
		1 -	-5 🗆	1,		6	5 – 10	□ 2,		1	1 – 15	5 🗆 3		
		0-N	NoRela	ation,	1-Low	Relati	on,2-1	Mediur	nRela	tion,3-H	lighRe	elation		

							L	Т	Р	SS	С
XG	S204			T 1 1 1 G 1 4			2	0	0	0	2
C	D			Technical Communicati	on		т	T	D	66	TT
	P		L					1	P 0	55	н 2
3	U	U		rse Outcomes	П	omain	2	0	Le	vel	Z
After comp	letion	of the	course	students will be able to	D	omam	•		Lt	ver	
		•				•,•			TT 1		1
			ate the	basic principles of Technical writing	g. C	ognitiv	e		Unde	erstan	a
CO2	10	dentit	y the S	pecial techniques in writing.	C	ognitiv	re		[A]	pply	
CO3	E	xplai	n the co	ommunicative styles of writing.	C	ognitiv	e		Eva	luate	
CO4	C	Classif	y the na	ature of Report writing.	C	ognitiv	e		Unde	erstan	d
Course Content H											
UNIT-I			Basic F	Principles							8
1.1 – Basic	Princi	ples o	f Techr	ical Writing							
1.2 – Styles	used i	in Tec	hnical `	Writing							
1.3 – Langu	age ar	nd Tor	ne								
UNIT –II			Techni	ques							8
2.1 – Specia	al Tech	hnique	es used	in writing							
2.2 – Defini	ition &	2 Desc	ription	of mechanism2.3 - Description- Cla	assification	n-Interp	oreta	tion			
UNIT-III			Comm	unication							7
3.1 – Mode	rn dev	elopm	ent in s	tyle of writing3.2 - New letter writing	ng formats	5					
UNIT-IV			Repor	t writing							7
4.1 – Types	of Re	port w	riting 4	4.2 – Project writing formats							
LI	ECTU	RE		TUTORIAL PR	RACTICA	L]	OTA	٩L	
	30			0	0				30		
TEXT BO	OKS:	Sugg	ested R	Readings:		D 11 -	•••	0			

- 1. John Sealy, Writing and Speaking Author; Oxford University Press, New Delhi, 2009
- 2. Williams K.S, Communicating Business. Engage Learning India Pvt Ltd, 2012

			PROGRAM OUTCOMES												
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	
CO1	3	2	0	0	3	0	0	0	0	0	2	3	2	0	
CO2	3	2	0	0	2	0	0	0	0	0	2	3	2	0	
CO3	2	2	1	2	2	0	0	0	0	0	2	2	2	0	
CO4	2	2	1	2	2	0	0	0	0	0	2	2	2	0	
CO5	2	2	1	0	2	0	0	1	0	2	2	2	2	0	
Total	12	10	3	4	11	0	0	1	0	2	10	12	10	0	
ScaledValue	3	2													
		1	$1-5 \Box 1$, $6-10 \Box 2$, $11-15 \Box 3$												
		0-1	0-NoRelation,1-Low Relation,2-MediumRelation,3-HighRelation												

0	COURS	E CODE	COURSE NAME		L	T P				
	XW	P205	Workshop Practices		1	0	2	3		
С	Р	Α			L	Т	Р	Н		
1.0	2.0	0			1	0	3	4		
PRE	REQU	ISITE: NIL								
		(Course outcomes:	Don	nain		Leve	I		
CO1	: Su	mmarize the	machining methods and Practice machining	Cognitiv	ve	Unc	lerstanc	ling		
	op	eration.		Psychor	motor	Gui	ded res	ponse		
CO2	: De	fining metal	casting process, moulding methods and	Cognitiv	ve	Ren	nember	ing		
	rel	ates Casting a	nd Smithy applications.	Psychor	motor	Perc	ception			
CO3	: Pla	an basic carp	entry and fitting operation and Practice	ve	App	olying				
	cai	rpentry and fit	motor	Gui	ded res	ponse				
CO4	: Su	mmarize met	al joining operation and Practice welding	Cognitiv	ve	Unc	lerstanc	ling		
	op	eration.		Psychor	motor	Gui	ded res	ponse		
CO5	: Illu	ustrate the, e	lectrical and electronics basics and Makes	Cognitiv	tive Understanding					
	apj	propriate elect	rical connections.	Psychor	motor	Gui	ded res	ponse		
COU	RSE C	ONTENT								
EXI	P.NO		TITLE		CC) REL	ATIO	N		
	1	Introduction	to machining process			CC	01			
	2	Plain turning	gusing lathe operation			CC	01			
	3	Introduction	about CNC machining and machines			CC	01			
	4	Demonstrati	on of plain turning using CNC			CC	01			
	5	Study of me	tal casting operation			CC	02			
	6	Demonstrati	on of moulding process			CC	02			
	7	Study of smi	thy operation			CC	02			
	8	Study of car	pentry tools			CC	03			
	9	Half lap join	t – Carpentry			CC	03			
1	10	Mortise and	Tenon joint – Carpentry			CC	03			
1	11	Study of fitti	ng tools		CO3					
1	12	Square fittin	g			CC	03			
]	13	Triangular fi	tting			CC	03			
]	14	Study of well	ding tools			CC	04			
]	15	Square butt j	oint - welding			CC	04			

16	Tee joint – Welding	CO4
17	Introduction to house wiring	CO5
18	One lamp controlled by one switch	CO5
19	Two lamps controlled by single switch	CO5
20	Staircase wiring	CO5

TEXT BOOKS

1. Workshop Technology I,II,III, by S K Hajra, Choudhary and A K Chaoudhary. Media Promoters and Publishers Pvt. Ltd., Bombay

2. Workshop Technology by Manchanda Vol. I,II,III India Publishing House, Jalandhar.

REFERENCES

1. Manual on Workshop Practice by K Venkata Reddy, KL Narayana et al; MacMillan India Ltd.

- 2. Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd., New Delhi
- 3. Workshop Technology by B.S. Raghuwanshi, Dhanpat Rai and Co., New Delhi.

4. Workshop Technology by HS Bawa, Tata McGraw Hill Publishers, New Delhi.

E RESOURCES<u>http://nptel.ac.in/courses/112107145/</u>

Mapping of CO's with PO'S:

			PROGRAM OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2	1	1	1	1	1	-	1	1	-	1	2	0	0
CO2	2	1	1	1	1	1	-	1	1	-	1	2	0	0
CO3	2	1	1	1	1	1	-	1	1	-	1	2	0	0
CO4	2	1	1	1	1	1	-	1	1	-	1	2	0	0
CO5	2	1	1	1	1	1	-	1	1	-	1	2	0	0
Total	10	5	5	5	5	5	-	5	5	-	5	10	0	0
ScaledValue	2	1	1	1	1	1	-	1	1	-	1	2	0	0
$1-5 \Box 1, \qquad 6-10 \Box 2, \qquad 11-15 \Box 3$														
	0-NoRelation,1-Low Relation,2-MediumRelation,3-HighRelation													

COURS	SE CODE	COURSE NAME		L	Т	P	С				
VD	E307	ELECTRICAL AND ELECTRONICS EL	NGINEERING	•	0	1	1				
АВ	E207	SYSTEMS LABORATORY		U	U	1	1				
Prere	equisite	Physics		L	Т	Р	Н				
C :	P : A			0	0	3	3				
1.5 :	1:0.5					11					
COURS	E OBJEC	TIVES: The course helps toLearn the basic concepts	of electrical and	elect	ronics	compor	ents.				
a.	Understand	the basic wiring methods and connection.				-					
b	Study the cl	haracteristics of diodes, Zener diodes, NPN transisto	ors.								
Course	Outcomes:		Domai	n		Le	vel				
001	Apply the fundamental electrical concepts and Cognitive Psychomotor Understand										
COI	differen	differentiate the various electronic components. Set, Valu									
CO3	Implem	Implement and execute the different types of wiring Cognitive, Psychomotor									
02	connecti	ons.	Affective			Set, Valuing					
CO 2	Demons	trate the Fluorescent lamp connection with	Cognitive, Psyc	chom	otor	Unde	rstand				
COS	choke.					Set,					
004	Charact	terize and display the basic knowledge on the	Cognitive, Psyc	chom	otor	Unde	rstand				
CO4	working	of PN junction and Zener diode.	Affective			Set, V	aluing				
~~~	Implem	ent and execute the various digital electronic	Cognitive, Psyc	chom	otor	Unde	rstand				
CO5	circuits s	such as Adders and Subtractors.	Affective			Set, V	aluing				
List of H	Experiment	ts:	1								
1.	Study of El	ectrical Symbols, Tools and Safety Precautions, Pov	ver Supplies.								
2.	Study of Ac	ctive and Passive elements – Resistors, Inductors and	d Capacitors, Bre	ad Bo	oard.						
3. '	Testing of	DC Voltage and Current in series and parallel resis	stors which are co	onnec	ted in	breadbo	oard by				
1	using Voltn	neter, Ammeter and Multimeter.									
4.	Fluorescent	lamp connection with choke. Staircase Wiring									
5.	Forward an	d Reverse bias characteristics of PN junction diode.									
6.	Forward an	d Reverse bias characteristics of zener diode.									
7.	Input and C	output Characteristics of NPN transistor.									
8. (	Constructio	n and verification of simple logic gates.									

Construction and verification of simple logic gates.
 Construction and verification of adders and subtractors

PRACTICAL = 30 TOTAL = 30

	Cos versus GA mapping													
						Gra	duates	s Attrib	utes					
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1	3	3	1	1	1	1			1	1	1			
CO2	3	3	1	1	1	1			1	1	1			
CO3	2	2	2	1	2	2	1	1	1	1	1			
CO4	2	2	1	1	1	1	1	1	1	1	1			
CO5	2	2	1	1	1	1	1	1	1	1	1			
Total	12	12	6	5	6	6	3	3	5	5	5			
Scaled Value	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$													
	0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation													
	$1 - 5 \rightarrow 1, \qquad 6 - 10 \rightarrow 2, \qquad 11 - 15 \rightarrow 3$													

		XAC208	L	Т	Р	С						
COUH	RSE CODE											
COU	RSE NAME	Applied Chemistry For Engineers laboratory	0	0	1	1						
PRER	REQUISITES	Nil	L	Т	Р	Н						
C:P:A		3.5:1.0:0.5	0	0	3	3						
COU	RSE OUTCOM	ES	DOM	AIN	LEV	EL						
CO1	Identify the pe	eriodic properties such as ionization energy, electron	Cogni	tive	Unde	rstand						
	affinity, oxida	tion states and electro negativity. Describe the	Psyche	omotor	Perce	eption						
	various water of	quality parameters like hardness and alkalinity.										
CO2	Explain and N	Measure microscopic chemistry in terms of atomic,	Cogni	tive	Unde	rstand						
	molecular orbi	tals and intermolecular forces.	Psych	omotor	Set							
CO3	Interpret bulk	properties and processes using thermodynamic and	Cogni	tive	Appl	у						
	kinetic considerations. Psychomotor											
			Affect	ive	Rece	ive						
CO4	Describe, Illu	strate and Discuss the chemical reactions that are	Cogni	Cognitive Und								
	used in the syn	thesis of molecules.	Psych	Anal	yze							
			Affect	ive								
CO5	Apply, Mea	sure and Distinguish the ranges of the	Cogni	ive	Appl	у						
	electromagneti	c spectrum used for exciting different molecular	Psych	omotor	Mech	nanism						
	energy levels i	n various spectroscopic techniques										
Labor	atory Part			30 hrs								
Exper	iments :											
1.	Determination	of chloride ion present in the water sample by Argen	tometric	method.		CO1						
2.	Determination	of total, temporary and permanent hardness of wa	ter sam	ple by EI	OTA	CO1						
	method.					CO2						
3.	Determination	of cell constant and conductance of solutions.				CO2						
4.	Potentiometry	- determination of redox potentials and emfs.				CO2						
5.	Determination	of surface tension and viscosity.				CO3						
6.	Adsorption of	acetic acid by charcoal.				CO4						
7.	Determination	of the rate constant of a reaction.				CO4						
8.	Estimation of	iron by colorimetric method.				CO5						
9.	Synthesis of a	polymer/drug.				CO5						
10	. Saponification	n/acid value of oil.										

#### **REFERENCE BOOKS**

- 1. Mendham, Denney R.C,. Barnes J.D and Thomas N.J.K., "Vogel's Textbook of Quantitative Chemical Analysis", 6th Edition, Pearson Education, 2004.
- 2. Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. "Experiments in Physical Chemistry", 8th Ed.; McGraw-Hill: New York, 2003.
- 3. **E Resources -** MOOCs:

1.http://freevideolectures.com/Course/2380/Chemistry-Laboratory-Techniques

2. http://freevideolectures.com/Course/2941/Chemistry-1A-General-Chemistry-Fall-2011

3.http://ocw.mit.edu/courses/chemistry/5-301-chemistry-laboratory-techniques

LECTURE	TUTORIAL	PRACTICAL	TOTAL HOURS
0	0	45	45

						I	PROG	RAM	OUTO	COMES	5				
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	
CO1	3	0	0	0	0	0	2	3	3	0	0	0	0	0	
CO2	2	0	0	0	0	0	1	2	2	0	0	0	0	0	
CO3	3 0 0 0 0 0 2 3 3 0 0 0 0 0														
CO4	3	0	0	0	0	0	3	3	3	0	0	0	0	0	
CO5	3	0	0	0	0	0	2	2	3	0	0	0	0	0	
Total	14	0	0	0	0	0	10	13	14	0	0	0	0	0	
ScaledValue	ScaledValue         3         0         0         0         0         2         3         3         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0 <th< th=""></th<>														
$1-5 \Box 1$ , $6-10 \Box 2$ , $11-15 \Box 3$															
0-NoRelation,1-Low Relation,2-MediumRelation,3-HighRelation															

# **III Semester**

COU	RSE C	ODE	XPS301		L	Т	Р	C
COU	RSE N.	AME	PROBABILITY AND STATISTICS		3	0	0	3
С	Р	А			L	Т	Р	H
2.5	0.5	0			3	0	0	3
PRE	REQUI	SITE: N	il			1		
Lear	ning Ol	ojectives						
1	. Appr	reciate the	e importance of probability and statistics in computing and r	esearch.				
2	. Deve	lop skills	s in presenting quantitative data using appropriate diagrams,	tabulations an	nd sui	nma	ries a	and
	to us	e appropi	riate statistical method in the analysis of simple datasets.					
3	. Inter	pret and o	clearly present output from statistical analyses in a clear con	cise and unde	rstand	lable	•	
	manr	ner.						
4	. The	main obje	ective of this course is to provide students with the foundation	ons of probabi	lities	and		
	statis	tical anal	lysis mostly used in varied applications in engineering and s	cience like dis	sease	mod	eling	5,
	clima	ate predic	tion and computer networks etc.					
COU	RSE O	UTCOM	IES:					
Cour	se outc	omes:		Domain	Leve	el		
C01	Expl	ain con	ditional probability, independent events; find expected	Cognitive	Und	ersta	ndin	0d
	value	es and M	oments of Discrete random variables with properties.					
CO2	Find	distribu	ation function, Marginal density function, conditional	Cognitive	Rem	emb	ering	5
	dens	ity funct	ion, Define density function of conditional distribution					
	funct	tions nori	mal, exponential and gamma distributions.					
CO3	Find	measure	es of central tendency, statistical parameters of Binomial,	Cognitive	Rem	emb	ering	5
	Poiss	son and	Normal, correlation, regression. Rank Correlation					
	coeff	ficient of	two variables. Moments, Skewness and Kurtosis					
CO4	Expl	<b>ain</b> larg	ge sample test for single proportion, difference of	Cognitive	Und	ersta	ndin	Б
	prop	ortion, si	ngle mean, difference of means and difference of standard					
	devia	ations wit	th simple problems.					
CO5	Expl	<b>ain</b> sma	ll sample test for single mean, difference of mean and	Cognitive	Und	ersta	ndin	g
	corre	elation c	oefficients, variance test, chi-square test with simple					
	Prob	lems.						

**UNIT I: Basic Probability** 

9

Probability spaces, conditional probability, independence, Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Chebyshev's Inequality. 9 UNIT II: Continuous Probability Distributions & Bivariate Distributions Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities. UNIT III: Basic Statistics 9 Measures of Central tendency: Moments, Skewness and Kurtosis - Probability distributions: Binomial, Poisson and normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. **UNIT IV: Applied Statistics** 9 Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations. 9 **UNIT V: Small Samples** Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes. LECTURE TUTORIAL TOTAL 45 45 TEXTBOOKS 1. VeerarajanT., "Probability, Statistics and Random Processes", Tata McGraw-Hill, New Delhi, 2010. 2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2015. REFERENCES 1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006. 2. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book ,2003 3. S. Ross, "A First Course in Probability", 6th Ed., Pearson Education India, 2002. 4. W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, 3rd Ed., Wiley, 1968. 5. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2010. E – REFERENCE

Probability and Statistics by Prof.Someshkumar, Department of Mathematics, IIT Kharagpur.

(http://nptel.ac.in/noc/noc_courselist.php)

						Gra	duates	s Attrib	utes			
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2	1						1	1		1
CO2	3	2	1						1	1		1
CO3	3	2	1	1					1	1		1
CO4	3	2	1	1	1	1			1	1	1	1
CO5	3	2	1	1	1	1	1		1	1	1	1
Total	15	10	5	3	2	2	1		5	5	2	5
Scaled Value         3         2         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1 <t< th=""></t<>												
0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation												
$1 - 5 \rightarrow 1, \qquad 6 - 10 \rightarrow 2, \qquad 11 - 15 \rightarrow 3$												

Cos versus GA mapping

r							a			
				L	Т	Р	C			
	XBT3	802		2	1	0	3			
			BIOCHEMISTRY							
C	Р	Α		L	Т	Р	Η			
3	0	0		3	1	0	4			
Prer	equis	ite: -								
Lear	ning	Objecti	ves:							
Upor	n com	pletion	of this course, the students							
•	W	ould hav	e learn the fundamentals of biomolecules.							
•	W	ould hav	e learn the functions of proteins and biosignalling.							
			Course Outcomes	Domain		Leve	1			
After	the c	ompleti	on of the course, students will be able to							
CO1	Ex pro	<b>xplain</b> a	bout the structure and properties of water, amino acids and	Cognitive	U	nderst	and			
CO2	Understand									
CO3	Id	Cognitive	Remember							
CO4	Find the characteristics of different types of Nucleotides and Nucleic Cognitive acids									
COS	Ev	aluate	he types of transport can be applicable for different types of	Cognitive	,	Evolue	oto			
COS	bio	omolecu	les across the cell membrane			Lvalua	ue			
I – V	Vater	, Amino	acids and Proteins			6+3				
Wate	er, We	eak Inter	ractions in Aqueous Systems, Ionization of Water, Weak Acid	ls, and Weak I	Bases	, Buff	ering			
agair	ist pH	change	s in biological systems. Water as a reactant.							
Amir	10 aci	ds, struc	tures of 20 common acids and properties, Peptides, Proteins, Ge	netic codon.						
Struc	ture o	of Protei	ns- Primary, Secondary, Tertiary structure and Quaternary Struct	tures – Fibrous	Prote	eins.				
II – I	Prote	in Func	tion and Enzymes			6+3				
Rever	sible	Binding	of a Protein to a Ligand: Oxygen-Binding Proteins: Compl	ementary Inter	actio	ns bet	ween			
Protei	ns an	d Ligano	ls: Protein Interactions Modulated by Chemical Energy: Actin, I	Myosin, and M	olecu	ılar M	otors:			
An In	trodu	ction to	Enzymes: How Enzymes Work, Mechanism, Examples of En	zymatic React	ions,	Regul	atory			
Enzyn	nes.									
III –	Carb	oohydra	tes and Glycobiology			6+3				
Mon	osacc	harides	and Disaccharides: Polysaccharides: Glycoconjugates: Prote	eoglycans, Gly	copr	oteins,	and			
Glyc	olipid	ls: Carbo	hydrates as Informational Molecules: The Sugar Code: Working	g with Carbohy	drate	s.				
<u>.</u>										

IV – Nucleotides and Nucleic acids	6+3

Fundamentals of nucleotides and nucleic acids: Nucleic Acid Structure: Nucleic Acid Chemistry: Other Functions of Nucleotides.

#### V – Lipids, biological membranes and transport

6+3

Storage Lipids: Structural Lipids in Membranes: Lipids as Signals, Cofactors, and Pigments: Working with Lipids: Biological membranes and transport: Composition and architecture of membranes, membrane dynamics and solute transport across membranes.

Lecture	Tutorial	Practical	Total
30	15	0	45

## **Text Books:**

 Lehninger Principles of Biochemistry, David L. Nelson and Michael M. Cox, W. H. Freeman; 6th edition (13 February 2013), 1158 pages ISBN-10: 1464109621, ISBN-13: 978-1464109621.

2. Biochemistry, Donald Voet, Judith G. Voet 4th Edition, 2011, 1520 pages ISBN: 978-0-470-91410-6.

3. Branden C. and Tooze J., "Introduction to Protein Structured, Second Edition", Garland Publishing, NY, USA, 1999.

#### **Reference Books:**

- 1. Introduction to Protein structure, 2nd Ed by Carl Branden and John Tooze, Garland Press, 1999.
- 2. Structure and Mechanism in Protein Science, Alan Fersht, Freeman, 1999.
- 3. Protein engineering in Industrial Biotechnology, Ed. Lilia Alberghina, Harwood Academic Publishers, 2002.
- 4. Creighton T.E. Proteins, Freeman WH, Second Edition, 1993.

#### **E-References:**

- 1. http://vlab.amrita.edu/?sub=3&brch=63
- 2. https://www.youtube.com/channel/UCbWTmSK7bYM9kRZAdfy_gyg

			PROGRAM OUTCOMES												
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	
CO1	1	1	2	0	1	0	0	1	1	1	1	3	2	3	
CO2	1	1	2	0	1	0	0	1	1	1	1	0	3	2	
CO3	1	1         1         2         0         1         0         0         1         1         1         2         2         1													
CO4	1 1 2 0 1 0 0 1 1 1 1 0 1 0														
CO5	1	1	2	0	1	0	0	1	1	1	1	2	0	0	
Total	6	6	11	1	7	1	1	6	6	5	6	8	9	7	
ScaledValue         2         2         3         1         2         1         1         2         2         1         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2 <th< th=""><th>2</th></th<>													2		
$1-5 \square 1, \qquad 6-10 \square 2, \qquad 11-15 \square 3$															
	0-NoRelation,1-Low Relation,2-MediumRelation,3-HighRelation														

					L	Т	Р	С					
X	BT 3(	3			3	0	0	3					
			MICROBIOLOGY										
С	Р	А			L	T	Р	H					
3	0	0			3	0	0	3					
PRE	REQ	UISIT	E: Biology										
Lear	ning(	Objec	tives:										
Upor	n comj	oletior	of this course, the students will be able to understand the exi	stence	of micro	obial w	orld th	rough					
the st	udy o	f the c	haracteristics of microorganisms, their classification, their inte	raction	with var	rious er	nvironn	nents,					
grow	th in c	liffere	nt media and their control.	1									
			Course Outcomes	Don	nain	]	Level						
After	the c	omple	tion of the course, students will be able to										
COI	Ex	plain	the fundamental concepts in the structure and functioning of	Cogr	itive	Un	derstan	d					
a prokaryotic cell													
CO2		ustrat	Istrate microbial taxonomy and microbial classification methods										
CO3	Ar en	<b>alyze</b> vironn	microbial ecosystem and their interactions in different	Cogr	nitive	А	nalyze						
CO4	A I	<b>ply</b> the puirem	e bacterial growth, growth curve and microbial nutritional ents,	Cogr	nitive	1	Apply						
COS	, De par	<b>mons</b>	<b>trate</b> the mechanisms of various antimicrobial drugs against applications of microorganisms,	Cogr	nitive	1	Apply						
	Ι		INTRODUCTION TO MICROBIOLOGY				7						
Histo	ory an	d Sco	pe of Microbiology – Overview of Prokaryotic cell structu	ire: Ce	ll memt	orane,	Cytopla	asmic					
matri	x, Cel	ll wall	, Flagella, Capsule – Study of microbial structure: Microscopy	y (light	, dark-fi	eld, ph	ase cor	ntrast,					
elect	ron), S	Stainin	g techniques (simple and differential).										
	II		CLASSIFICATION OF MICROORGANISMS				9						
Microbial Taxonomy: Binomial Nomenclature - Five Kingdom classification system: Monera, Protista, Fungi,													
Plant	ae, Ai	nimali	a - Three Domain classification system: Bacteria, Archea, Eul	karya –	Method	ls of C	lassific	ation:					
Morp	holog	ical	characteristics, Physiological and metabolic characteristi	cs, Bi	ochemi	cal ch	aracter	istics,					
Ecole	ogical	charae	cteristics, Molecular characteristics – Viruses: Structure and Cl	assifica	tion.								
	III		MICROBIAL ECOLOGY AND MICROBIAL INTERAC	CTION	S		11						
Micr	obial	Ecolog	gy: Microorganisms in Marine Ecosystems, Freshwater Ecos	systems	, Terres	trial E	cosyste	ems –					

Microbial Growth: Growth curve (lag, exponential, stationary, death phase), Measurement (cell numbrass), Factors influencing growth (water activity, pH, temperature, oxygen, pressure, radiation) – M         Nutrition: Culture media (defined, complex), Culture techniques (spread plate, streak plate, pour plate).         V       ANTIBIOTICS AND ANTIMICROBIAL RESISTANCE       7         Antibiotics: Antibacterial, Antifungal, Antiviral, Antiprotozoan, Antihelminthic drugs – Antin       7         Resistance: Mechanisms of resistance, Prevention of resistance.       7         LECTURE       TUTORIAL       TOTAL         45       0       45         I. Prescott, L. M., Harley, J. P., and Klein, D. A. Microbiology. 5th. McGrawJ Hill Higher Education         REFERENCES:         1. Morcello, J. A., Mizer, H. E., & Granato, P. A. Laboratory manual and workbook in Microbiology: Application to patient care, 2003         2. Prescott, L. M., Harley, J. P., & Klein, D. A. Laboratory exercises in microbiology, 2002.         3. Black, Jacquelyn G. Microbiology: principles and explorations. John Wiley & Sons, 2008.         4. Tortora, Gerard J., Berdell R. Funke, Christine L. Case, and Ted R. Johnson. Microbiology: an introduction. Vol. 9. San Francisco, CA: Benjamin Cummings, 2004.	-	
<ul> <li>mass), Factors influencing growth (water activity, pH, temperature, oxygen, pressure, radiation) – M</li> <li>Nutrition: Culture media (defined, complex), Culture techniques (spread plate, streak plate, pour plate).</li> <li>V ANTIBIOTICS AND ANTIMICROBIAL RESISTANCE 7</li> <li>Antibiotics: Antibacterial, Antifungal, Antiviral, Antiprotozoan, Antihelminthic drugs – Antir</li> <li>Resistance: Mechanisms of resistance, Prevention of resistance.</li> <li>LECTURE TUTORIAL TOTAL 45</li> <li>0 45</li> <li>TEXT BOOKS:</li> <li>1. Prescott, L. M., Harley, J. P., and Klein, D. A. Microbiology. 5th. McGrawJ Hill Higher Education</li> <li>REFERENCES:</li> <li>1. Morcello, J. A., Mizer, H. E., &amp;Granato, P. A. Laboratory manual and workbook in Microbiology: Application to patient care, 2003</li> <li>2. Prescott, L. M., Harley, J. P., &amp; Klein, D. A. Laboratory exercises in microbiology, 2002.</li> <li>3. Black, Jacquelyn G. Microbiology: principles and explorations. John Wiley &amp; Sons, 2008.</li> <li>4. Tortora, Gerard J., Berdell R. Funke, Christine L. Case, and Ted R. Johnson. Microbiology: an introduction. Vol. 9. San Francisco, CA: Benjamin Cummings, 2004.</li> </ul>	ber, ce	
Nutrition: Culture media (defined, complex), Culture techniques (spread plate, streak plate, pour plate).         V       ANTIBIOTICS AND ANTIMICROBIAL RESISTANCE       7         Antibiotics: Antibacterial, Antifungal, Antiviral, Antiprotozoan, Antihelminthic drugs – Antim       Antim         Resistance: Mechanisms of resistance, Prevention of resistance.       TOTAL       45         LECTURE       TUTORIAL       TOTAL         45       0       45         TEXT BOOKS:       1       Prescott, L. M., Harley, J. P., and Klein, D. A. Microbiology. 5th. McGrawJ Hill Higher Education         REFERENCES:       1       Morcello, J. A., Mizer, H. E., &Granato, P. A. Laboratory manual and workbook in Microbiology: Application to patient care, 2003       2         Prescott, L. M., Harley, J. P., & Klein, D. A. Laboratory exercises in microbiology, 2002.       3       Black, Jacquelyn G. Microbiology: principles and explorations. John Wiley & Sons, 2008.         4.       Tortora, Gerard J., Berdell R. Funke, Christine L. Case, and Ted R. Johnson. Microbiology: an introduction. Vol. 9. San Francisco, CA: Benjamin Cummings, 2004.	licrobi	
V       ANTIBIOTICS AND ANTIMICROBIAL RESISTANCE       7         Antibiotics:       Antibacterial, Antifungal, Antiviral, Antiprotozoan, Antihelminthic drugs – Antim         Resistance:       Mechanisms of resistance, Prevention of resistance.         LECTURE       TUTORIAL       TOTAL         45       0       45         TEXT BOOKS:       1.       Prescott, L. M., Harley, J. P., and Klein, D. A. Microbiology. 5th. McGrawJ Hill Higher Education         REFERENCES:       1.       Morcello, J. A., Mizer, H. E., &Granato, P. A. Laboratory manual and workbook in Microbiology: Application to patient care, 2003       2.         Prescott, L. M., Harley, J. P., & Klein, D. A. Laboratory exercises in microbiology, 2002.       3.         Black, Jacquelyn G. Microbiology: principles and explorations. John Wiley & Sons, 2008.       4.         Tortora, Gerard J., Berdell R. Funke, Christine L. Case, and Ted R. Johnson. Microbiology: an introduction. Vol. 9. San Francisco, CA: Benjamin Cummings, 2004.		
Antibiotics:       Antibacterial, Antifungal, Antiviral, Antiprotozoan, Antihelminthic drugs       – Antim         Resistance:       Mechanisms of resistance, Prevention of resistance.       TOTAL         LECTURE       TUTORIAL       TOTAL         45       0       45         TEXT BOOKS:       1       Prescott, L. M., Harley, J. P., and Klein, D. A. Microbiology. 5th. McGrawJ Hill Higher Education         REFERENCES:       1       Morcello, J. A., Mizer, H. E., &Granato, P. A. Laboratory manual and workbook in Microbiology: Application to patient care, 2003       2       Prescott, L. M., Harley, J. P., & Klein, D. A. Laboratory exercises in microbiology, 2002.       3       Black, Jacquelyn G. Microbiology: principles and explorations. John Wiley & Sons, 2008.         4       Tortora, Gerard J., Berdell R. Funke, Christine L. Case, and Ted R. Johnson. Microbiology: an introduction. Vol. 9. San Francisco, CA: Benjamin Cummings, 2004.		
Resistance: Mechanisms of resistance, Prevention of resistance.         LECTURE       TUTORIAL       TOTAL         45       0       45         TEXT BOOKS:       1.       Prescott, L. M., Harley, J. P., and Klein, D. A. Microbiology. 5th. McGrawJ Hill Higher Education         REFERENCES:       1.       Morcello, J. A., Mizer, H. E., &Granato, P. A. Laboratory manual and workbook in Microbiology: Application to patient care, 2003       2.       Prescott, L. M., Harley, J. P., & Klein, D. A. Laboratory exercises in microbiology, 2002.         3.       Black, Jacquelyn G. Microbiology: principles and explorations. John Wiley & Sons, 2008.       4.         4.       Tortora, Gerard J., Berdell R. Funke, Christine L. Case, and Ted R. Johnson. Microbiology: an introduction. Vol. 9. San Francisco, CA: Benjamin Cummings, 2004.	nicrobi	
LECTURETUTORIALTOTAL45045TEXT BOOKS:1. Prescott, L. M., Harley, J. P., and Klein, D. A. Microbiology. 5th. McGrawJ Hill Higher EducationREFERENCES:1. Morcello, J. A., Mizer, H. E., &Granato, P. A. Laboratory manual and workbook in Microbiology: Application to patient care, 20032. Prescott, L. M., Harley, J. P., & Klein, D. A. Laboratory exercises in microbiology, 2002.3. Black, Jacquelyn G. Microbiology: principles and explorations. John Wiley & Sons, 2008.4. Tortora, Gerard J., Berdell R. Funke, Christine L. Case, and Ted R. Johnson. Microbiology: an introduction. Vol. 9. San Francisco, CA: Benjamin Cummings, 2004.		
45       0       45         TEXT BOOKS:         1. Prescott, L. M., Harley, J. P., and Klein, D. A. Microbiology. 5th. McGrawJ Hill Higher Education         REFERENCES:         1. Morcello, J. A., Mizer, H. E., &Granato, P. A. Laboratory manual and workbook in Microbiology: Application to patient care, 2003         2. Prescott, L. M., Harley, J. P., & Klein, D. A. Laboratory exercises in microbiology, 2002.         3. Black, Jacquelyn G. Microbiology: principles and explorations. John Wiley & Sons, 2008.         4. Tortora, Gerard J., Berdell R. Funke, Christine L. Case, and Ted R. Johnson. Microbiology: an introduction. Vol. 9. San Francisco, CA: Benjamin Cummings, 2004.		
<ol> <li>TEXT BOOKS:         <ol> <li>Prescott, L. M., Harley, J. P., and Klein, D. A. Microbiology. 5th. McGrawJ Hill Higher Education</li> </ol> </li> <li>REFERENCES:         <ol> <li>Morcello, J. A., Mizer, H. E., &amp;Granato, P. A. Laboratory manual and workbook in Microbiology: Application to patient care, 2003</li> <li>Prescott, L. M., Harley, J. P., &amp; Klein, D. A. Laboratory exercises in microbiology, 2002.</li> <li>Black, Jacquelyn G. Microbiology: principles and explorations. John Wiley &amp; Sons, 2008.</li> <li>Tortora, Gerard J., Berdell R. Funke, Christine L. Case, and Ted R. Johnson. Microbiology: an introduction. Vol. 9. San Francisco, CA: Benjamin Cummings, 2004.</li> </ol></li></ol>	45	
<ol> <li>Prescott, L. M., Harley, J. P., and Klein, D. A. Microbiology. 5th. McGrawJ Hill Higher Education REFERENCES:         <ol> <li>Morcello, J. A., Mizer, H. E., &amp;Granato, P. A. Laboratory manual and workbook in Microbiology: Application to patient care, 2003</li> <li>Prescott, L. M., Harley, J. P., &amp; Klein, D. A. Laboratory exercises in microbiology, 2002.</li> <li>Black, Jacquelyn G. Microbiology: principles and explorations. John Wiley &amp; Sons, 2008.</li> <li>Tortora, Gerard J., Berdell R. Funke, Christine L. Case, and Ted R. Johnson. Microbiology: an introduction. Vol. 9. San Francisco, CA: Benjamin Cummings, 2004.</li> </ol> </li> </ol>		
<ol> <li>REFERENCES:         <ol> <li>Morcello, J. A., Mizer, H. E., &amp;Granato, P. A. Laboratory manual and workbook in Microbiology: Application to patient care, 2003</li> <li>Prescott, L. M., Harley, J. P., &amp; Klein, D. A. Laboratory exercises in microbiology, 2002.</li> <li>Black, Jacquelyn G. Microbiology: principles and explorations. John Wiley &amp; Sons, 2008.</li> <li>Tortora, Gerard J., Berdell R. Funke, Christine L. Case, and Ted R. Johnson. Microbiology: an introduction. Vol. 9. San Francisco, CA: Benjamin Cummings, 2004.</li> </ol> </li> </ol>	n, 2005	
<ol> <li>Morcello, J. A., Mizer, H. E., &amp;Granato, P. A. Laboratory manual and workbook in Microbiology: Application to patient care, 2003</li> <li>Prescott, L. M., Harley, J. P., &amp; Klein, D. A. Laboratory exercises in microbiology, 2002.</li> <li>Black, Jacquelyn G. Microbiology: principles and explorations. John Wiley &amp; Sons, 2008.</li> <li>Tortora, Gerard J., Berdell R. Funke, Christine L. Case, and Ted R. Johnson. Microbiology: an introduction. Vol. 9. San Francisco, CA: Benjamin Cummings, 2004.</li> </ol>		
<ol> <li>Application to patient care, 2003</li> <li>Prescott, L. M., Harley, J. P., &amp; Klein, D. A. Laboratory exercises in microbiology, 2002.</li> <li>Black, Jacquelyn G. Microbiology: principles and explorations. John Wiley &amp; Sons, 2008.</li> <li>Tortora, Gerard J., Berdell R. Funke, Christine L. Case, and Ted R. Johnson. Microbiology: an introduction. Vol. 9. San Francisco, CA: Benjamin Cummings, 2004.</li> </ol>	:	
<ol> <li>Prescott, L. M., Harley, J. P., &amp; Klein, D. A. Laboratory exercises in microbiology, 2002.</li> <li>Black, Jacquelyn G. Microbiology: principles and explorations. John Wiley &amp; Sons, 2008.</li> <li>Tortora, Gerard J., Berdell R. Funke, Christine L. Case, and Ted R. Johnson. Microbiology: an introduction. Vol. 9. San Francisco, CA: Benjamin Cummings, 2004.</li> </ol>		
<ol> <li>Black, Jacquelyn G. Microbiology: principles and explorations. John Wiley &amp; Sons, 2008.</li> <li>Tortora, Gerard J., Berdell R. Funke, Christine L. Case, and Ted R. Johnson. Microbiology: an introduction. Vol. 9. San Francisco, CA: Benjamin Cummings, 2004.</li> </ol>		
4. Tortora, Gerard J., Berdell R. Funke, Christine L. Case, and Ted R. Johnson. Microbiology: an introduction. Vol. 9. San Francisco, CA: Benjamin Cummings, 2004.		
introduction. Vol. 9. San Francisco, CA: Benjamin Cummings, 2004.		
E-REFERENCES:		

- 2. http://www.uwyo.edu/molb2210_lect/lecture/lectures.html
- 3. http://nptel.ac.in/courses/102103012/

			PROGRAM OUTCOMES												
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	
CO1	3	3	1	1	1	0	1	0	1	1	1	1	0	0	
CO2	<b>CO2</b> 3 3 1 1 1 2 2 1 1 1 1 0 0														
CO3 3 1 2 3 1 2 1 0 1 1 1 1 2 0														0	
CO4	3	3	2	0	1	0	2	0	1	1	1	1	0	2	
CO5	3	2	2	3	1	2	2	1	1	0	1	1	2	2	
Total	16	14	9	10	6	8	8	2	5	4	6	6	5	5	
ScaledValue         3         3         2         2         2         2         1         1         1         2         2         1         1													1		
$1-5 \square 1, \qquad 6-10 \square 2, \qquad 11-15 \square 3$															
	0-NoRelation,1-Low Relation,2-MediumRelation,3-HighRelation														

							L	Т	Р	С
X	BT30	4					2	1	0	3
				MATERIAL AND ENERGY	Y BALANCEs					<u> </u>
С	Р	Α					L	Т	Р	Н
3	0	0					2	1	0	3
·									•	
				Course Outcomes		Domai	'n		Level	
After	r the c	omple	etion of the	course, students will be able to						
C01	In	terpr	et different	unit systems and composition of	of unit process	Cognitive		Unders	tand	
CO2	Co	mpu	te the mater	ial balances across different un	it operations	Cognitive		Apply		
CO3	Co	mpu	te the mater	ial balances across chemical rea	actors	Cognitive		Apply		
CO4	Ex wi	<b>plain</b> thout	the energ	v balance calculations for syst actions	ems with and	Cognitive		Unders	stand	
CO5	De	scrib	e the Biote	chnology stoichiometry system		Cognitive		Unders	tand	
				Course Conten	ıt				Ho	urs
Unit	Unit-IStoichiometric Principles and Basic Calculations6									5+3
Introd	luctory	con	cepts of un	its, physical quantities in che	emical engineeri	ing, dimens	sionless	s groups	, "basi	s" of
calcul	ations	– N	lethods of	expression, compositions of	mixture and so	olutions. Ga	ases, V	apors a	ind Lic	juids:
Equat	ions o	f state	e, Vapor pre	ssure, Clausius-Clapeyron equa	ation, Cox chart,	Duhring's	plot, R	aoult's la	aw.	
Unit	-II	Mat	terial Balaı	nces for Non-Reacting System					(	5+3
Mater	ial ba	lance	s to differe	nt unit operations -recycle -	bypass and put	rging. Disti	llation,	extract	ion, m	ixing,
drying	g, crys	talliza	ation, evapo	ration, adsorption and absorptio	on, Material bala	nce for mul	tiple u	nit		
Unit	-III	Mat	terial Balaı	nces for Reacting System					(	<del>5+3</del>
Mate	erial ba	alance	es with cher	nical reaction – Limiting and e	excess reactants	– Combusti	on – Y	'ield, co	nversio	n and
selec	tivity	calcu	lations, Ma	erial balance for multiple unit						
Unit	-IV	Ene	rgy Balanc	es					(	<del>5+3</del>
Heat capacity of solids, liquids, gases, and solutions, use of mean heat capacity in heat calculations, proble										olems
involving sensible heat and latent heats. Energy balances with chemical reaction: Heat of reaction, Heat of										
com	oustion	1.								
Unit	-V	Bio	logical Stoi	chiometry						<u>5</u> +3
Stoic	chiome	etry gi	rowth and p	roduct formation, Degree of rec	luction, Electror	n balance, T	heoreti	cal Oxy	gen der	nand.
	L	ectur	e	Tutorial	Practio	cal		Tot	al	
		30		15	0			45	5	

#### **Text Books:**

- 1. K.V. Narayanan and Lakshmikutty, Chemical Process Calculations, Prentice Hall, 2004.
- 2. D. M. Himmelblau and J. B. Riggs, **Basic Principles and Calculations in Chemical Engineering**, Pearson India Education Services, 8th Edition, 2015.
- 3. B. I. Bhatt and S.M. Vora, **Stoichiometry**, Tata McGraw Hill Publishing Company Ltd, 4th Edition, 2004.
- Richard M. Felder and Ronald W. Rousseau, Elementary Principles of Chemical Processes, John Wiley & Sons, INC. 3rd Edition, 2000.

#### **Reference Books:**

- V. Venkataramani, N. Anantharaman, and Begum, K. M. MeeraSheriffa, Process Calculations, Prentice Hall of India, 2nd Edition.
- 2. D. C. Sikdar, Chemical Process Calculations, Prentice Hall of India.
- 3. Bailey and Ollis, Biochemical Engineering Fundamentals, McGraw Hill, Co. 2004.

## **E-References:**

1. http://nptel.ac.in/syllabus/103106076/

		PROGRAM OUTCOMES												
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	2	3	2	0	2	0	0	0	0	0	2	2
CO2	3	3	2	3	2	0	2	0	0	0	0	0	2	2
CO3	3	3	2	3	2	0	2	0	0	0	0	0	2	2
CO4	3	3	2	3	2	0	2	0	0	0	0	0	2	2
CO5	3	3	2	3	2	0	2	0	0	0	0	0	2	2
Total	17	17	11	17	11	0	11	0	0	0	0	0	11	11
ScaledValue	3	3	3	3	3	0	3	0	0	0	0	2	3	3
$1-5 \Box 1$ ,					$6-10$ $\Box$ 2,				11 – 15 🗆 3					
0-NoRelation,1-Low Relation,2-MediumRelation,3-HighRelation														

Subject Code		Code	XUM 306	L	Т	F	•		С				
Subject Name		ame		2	0	0			2				
С	Р	Α	Entrepreneurship Development	L	Т	P	,	SS	Н				
2.7	0	0.3		2	0	0		0	2				
Prere	quisit	e	NIL										
Course	e Obj	ectives	Through this course the students will										
• Un	derst	and the	Entrepreneurial motivation and inclination										
• Ide	ea abo	out the r	narket assessment										
• To	get f	amiliar	in government policies and global opportunities f	or Entr	epreneu	rship D	evelo	pme	nt				
Course Outcome:					nain	Level							
CO1	Rec	ognize	and describe the role of innovation and	Cogni	tive	K2	2 Understand		and				
	motivation for an entrepreneur.												
CO2	Self	-assess	and appraise your entrepreneurship interest	Cognitive		K2	Understand						
	with your chosen entrepreneur.												
CO3	Out	tline the	e importance of the generation of new ideas for	Cogni	K2	Understand							
	entr	epreneu	urship and <b>illustrate</b> market assessment.										
CO4	Exp	olain	the competition in business and	Cogni	tive/	K2	Understand						
	sketch/demonstrate/comply business model for dealing					K3	Apply						
with competition.				Affect	tive	A3	Value						
						A2	Response						
CO5	<b>CO5 Describe</b> and <b>Explain</b> venture creation and launching o small business and its management.				tive	K1	Kemember		ber				
						K2	Understand						
	_					K2	Unc	lerst	and				
UNIT-I INNOVATION AND ENTREPRENEURSHIP						1 0			5				
		Defini	tion of Innovation, Creativity, and Entrep	reneurs	hip; ro	ole of	inno	ovati	on in				
	entrepreneurship development - Entrepreneurial motivation - Competencies and traits of an								s of an				
		entrep	reneur -Role of Family and Society; Entrepreneur	ship as	a caree	r and it	s role	ın n	ational				
¥ 75 7		develo				<b>T</b>							
UNIT	JNIT -II SELF-ASSESSMENT OF ENTREPRENEURIAL INCLINATION								4				
Sen-assessment of entrepreneurial inclination -Presentation by students on							on	their					
¥ 75 79		entrep	reneurial inclination rating -Case study of success	stul enti	repreneu	ırs							
UNIT	-111	NEŴ	IDEA GENERATION TO MARKET ASSESS	SMEN	Ľ				9				
		Importance of Idea generation-filtering-refin	ement -	opportu	unity rec	cognition	- Descri	ption of					
----------	----------	----------------------------------------------------------------------------------------------	-----------	-----------	-----------	------------	------------	----------	--	--	--	--	--
		chosen idea - value proposition, customer-pro	oblem-S	Solution	stateme	ent -benef	fits; deve	lopment					
		status; IP ownership -Market Validation- Tec	chnolog	y/ user/c	lecision	makers/	partners	-market					
		need; segmentation -market TAM,SAM and	i som	-case s	tudy on	market	segmenta	ation by					
		popular companies											
UNIT	[ _	<b>CUSTOMER – COMPETITION- BUSINI</b>	ESS MO	DDEL				9					
IV		Customer-Target primary customer researc	h, Deci	ision m	aking u	nit/ prod	cess-Bead	ch head					
		market; Cost of Customer Acquisition - C	Competi	tion- co	mparati	ive analy	ysis, com	petitive					
		advantages-; -Business model -Financial plan	ning -P	itch doc	umentat	tion and p	presentati	ion					
UNIT	[ _ ]	VENTURE CREATION AND LAUNCH	ING O	F SMA	LL BU	JSINESS	S AND	9					
v		ITS MANAGEMENT											
		New enterprise creation - organizational a	nd lega	l matte	rs -Ope	erational	plan -Sa	ales and					
		distribution plan - Accounting -Team rec	ruitmer	nt and	manage	ment -F	und raisi	ing and					
		management -Profile of a startup – case studi	es										
UNIT	[	GOVERNMENT INITIATIVES AND GL	OBAL	OPPOF	RTUNI	TIES		9					
VI		Incubators and accelerators - capacity building -Startup policies- Startup India-Support for											
		MSME; GeM Portal. Funding-national and	interna	ational s	sources-	Bilateral	program	mes by					
		Govt. of India -Global reach for promoting cr	oss-cul	tural ent	reprene	urship (1	)						
			L	Т	Р	SS	То	tal					
			30			15	4	5					
REFI	EREN	ICE BOOKS				<u> </u>							
1. 4	A.P.A	runa, "Lecture Notes on Entrepreneurship Dev	velopme	ent", ava	ilable as	s softcop	y @						
<u>v</u>	www.l	<u>orain.net</u>											
2.	Гhoma	as W. Zimmerer, Norman M. Scarborough, "Es	ssentials	s of Entr	epreneu	rship and	l Small B	Business					
ľ	Manag	gement", Pearson; 3rd edition, 2001.											
3. J	John E	Burnett, "Introducing Marketing", Open Text B	ook ava	ilable at	Į								
ł	nttp://s	solr.bccampus.ca:8001/bcc/file/ddbe3343-9796	5-4801-8	a0cb-									
7	7af7b(	)2e3191/1/Core%20Concepts%20of%20Marke	eting.pd	f									
4.	Гoubia	a, Olivier. "Idea Generation, Creativity, and Ind	centives	", Mark	eting Sc	cience. V	ol. 25. pp	0.411-					
2	425. 1	0.1287/mksc.1050.0166, 2006.											
5. 4	Alexa	nder Osterwalder and Yves Pigneur, "Business	Model	Generat	ion: A I	Handbool	k for Visi	onaries,					
	Game	Changers, and Challengers", Wiley; 1st edition	, 2010.										
6. (	Gerard	lus Blokdyk,"3C's model The Ultimate Step-B	y-Step (	Guide"5	starcool	ks, 2018.							

	PROGRAM OUTCOMES													
	1	2	3	4	5	6	7	8	9	10	11	12	PSO	PSO
													1	2
CO1	1	0	1	0	1	1	1	0	0	0	0	0	1	0
CO2	1	0	1	0	1	1	1	0	0	0	0	0	1	0
CO3	1	0	1	0	1	1	1	0	0	0	0	0	1	0
CO4	1	0	1	0	1	1	1	0	0	0	0	0	1	0
CO5	1	0	1	0	1	1	1	0	0	0	0	0	``1	0
Total	6	0	6	0	6	6	6	0	0	0	0	0	6	0
Scaled Value	2	0	2	0	2	2	2	0	0	0	0	0	2	0
		-	1 –	5 🗆 1	,	-	6 – 1	0 🗆 2,	•	11	l – 15	3	•	
			0-No	Relat	ion,1-Lo	ow Rel	ation,2	-Mediu	mRela	tion,3-Hi	ghRel	ation		

	COURSECOD	E	XBT308		L	Т	Р	С
(	COURSE NAM	ſE			Δ	Λ	2	2
I	PREREQUISI	ГЕ	<b>Biashamistry Laboutary</b>		U	U	2	2
С	Р	A	Biochemistry Laboratory		L	Т	Р	Н
0.5	2	0.5			0	0	2	6
COUF	RSE OBJECTI	VES The	course will provide					
Hands	on experience	in using B	iochemistry Lab					
Practic	e on handling c	chemicals,	Will help to make understanding on research.					
 		COU	RSE OUTCOMES	DOM	IAIN	]	LEVI	EL
CO1	Prepare a but	ffer and C	alculate the molar extinction coefficient	Cognit	ive,	App	oly	
				Psycho	omotor,	Me	chani	sm,
				Affect	ive	Res	pond	
CO2	Practice on	the Thin	Layer Chromatography by separating the	Cognit	ive,	App	oly	
	amino acids.			Psycho	omotor,	Me	chani	sm,
				Affect	ive	Res	pond	
CO3	<b>Perform</b> th	ne quali	tative/qualitative analysis of proteins,	Cognit	ive,	App	oly	
	Carbohydrate	s and seru	m cholesterol.	Psycho	omotor,	Me	chani	sm,
				Affect	ive	Res	pond	
CO4	Estimate the	purity of ]	DNA and Saponification Value of Fats/Oils.	Cognit	ive,	Арј	oly	
				Psycho	omotor,	Me	chani	sm,
				Affecti	ive	Res	pond	
CO5	<b>Determine</b> the	e β-carote	ene, Flavonoid	Cognit	ive,	Арј	oly	
				Psycho	omotor,	Me	chani	sm,
-				Affecti	ive	Res	pond	
1.	Butter prepar	ation and	calculation of molar extinction coefficient					
2.	Separation of	Amino A	cius by 1 nin Layer Unromatography					
з. л	Qualitative/Q		analysis of Corbobydrates					
4. 5	Determination		anarysis of Carbonyurates					
з. 6	Estimation an	d purity o	f DNA					
0. 7	Acid hydroly	sis and act	tion of salivary amylase on starch					
7. 8	Detection of A	Adulterati	on in Milk					
9.	Titration Curv	ves of Am	inoacids					
8. 9.	Detection of A	ves of Am	inoacids					

- 10. Quantitative estimation of serum cholesterol by Zak's method
- 11. Estimation of Saponification Value of Fats/Oils

HOURS	LECTURE	PRACTICAL	TUTORIAL	TOTAL
nound	0	30	0	30

# **REFERENCE BOOK**

1. Lehninger Principles of Biochemistry, David L. Nelson and Michael M. Cox, W. H. Freeman; 6th edition edition (13 February 2013), 1158 pages ISBN-10: 1464109621, ISBN-13: 978-1464109621.

## Mapping of COs with POs

						P	ROG	RAM	OUT	COMES	5			
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	1	1	2	0	1	0	0	1	1	1	1	3	2	3
CO2	1	1	2	0	1	0	0	1	1	1	1	0	3	2
CO3	1	1	2	0	1	0	0	1	1	1	1	2	2	1
CO4	1	1	2	0	1	0	0	1	1	1	1	0	1	0
CO5	1	1	2	0	1	0	0	1	1	1	1	2	0	0
Total	6	7	12	0	6	1	2	5	5	5	5	9	9	7
ScaledValue	2	2	3	0	2	1	1	1	1	1	1	2	2	2
	$1-5 \Box 1$ , $6-10 \Box 2$ , $11-15 \Box 3$													
		0-N	loRela	tion, 1	I-Low	Relatio	on,2-N	/ledium	nRelat	tion,3-H	ighRe	lation		

COUR	SE CODE	XBT 309		L	Т	Р	C
COUR	SE NAME			0	0	2	2
PRERI	EQUISITES	Microbiology Labor	atory	L	Т	Р	Н
C:P:A:	0.5:1:0.5	-		0	0	2	6
LEAR	NING OBJECTI	VES					
Upon c	completion of thi	is course, the students will be ab	le to apply t	heir know	ledge o	of microb	iology to
demons	trate aseptic micr	obiological techniques in the labora	tory		U		05
	(	COURSE OUTCOMES		DOMA	IN	LE	VEL
After th	e completion of c	ourse the students will be able to					
				Cognitive	,	Ap	ply
CO1	Demonstrate n	nedia preparation and sterilization te	chniques	Psychome	otor,	Mech	anism
				Affective		Resp	pond
CO2	Perform staini	ng techniques, antimicrobial and c	cell counting	Cognitive	,	Ap	ply
002	assays			Affective	olor,	Resi	nond
				Cognitive	,	Ap	ply
CO3	Practice the dif	ferent culturing techniques		Psychom	otor,	Mech	anism
				Affective		Resp	pond
CO4				Cognitive	,	Ар	ply
004	<b>Determine</b> the	characteristics of bacteria		Psychome	otor,	Mech	anism
				Cognitive		An	<u>jonu</u> nlv
CO5	Experiment of	on isolation of microbes for	metabolites	Psychome	, otor,	Mech	anism
	production			Affective		Resp	pond
S.No		List of Ex	periments				
1	Media preparati	on and Sterilization					
2	Preparation of s	lants /plates and aseptic transfer of	microbial cult	ures			
3	Staining and ide	entification of microbes using simpl	e and different	ial staining	g		
4	Isolation of mic	robes using spread plate method					
5	Isolation of mic	robes using streak plate method					
6	Isolation of mic	robes using pour plate method					
7	Microbial grow	th control using Kirby-Bauer metho	d				
8	Cell counting						
9	Biochemical ch	aracterization of microbes					
10	Screening of mi	croorganisms for enzyme production	n				
	1	UUIDE	TUTORIAL	PRAC	TICAI	L TO	ΓAL
		nouks	0		30		30

						P	ROG	RAM	OUT	COME	S			
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	1	1	1	0	1	0	1	1	1	1	0	0
CO2	3	3	1	1	1	2	2	1	1	1	1	1	0	0
CO3	3	1	2	3	1	2	1	0	1	1	1	1	2	0
CO4	3	3	2	0	1	0	2	0	1	1	1	1	0	2
CO5	3	2	2	3	1	2	2	1	1	0	1	1	2	2
Total	16	14	9	10	6	8	8	2	5	4	6	6	5	5
ScaledValue	3	3	2	2	2	2	2	1	1	1	2	2	1	1
	$1-5 \square 1$ , $6-10 \square 2$ , $11-15 \square 3$													
	0-NoRelation,1-Low Relation,2-MediumRelation,3-HighRelation													

# Mapping Of Course Outcomes with Program Outcomes

					L	Т	Р	SS	С
X	BT 31	10			0	0	0	0	1
			<b>INPLANT TRAINING - I</b>						
С	Р	Α			L	Т	Р	SS	Η
1	1	1			0	0	0	0	0
PRE	REQ	UISIT	E: Nil						
COL	JRSE	OUTO	COMES:						
			Course Outcomes	Dor	main		]	Level	
After	the c	omplet	ion of the course, students will be able to						
<b>CO1</b>	:Rela	t <b>e</b> clas	sroom theory with workplace practice	Cogniti	ve	J	Jndei	stand	
CO2 pract	:Com ices.	ply w	ith Factory discipline, management and business	Affeo	ctive	F	Respo	ond	
CO3	: Dem	onstr	ates teamwork and time management	Affe	ctive	1	/alue		
<b>CO4</b>	:Desc	ribe a	nd Display hands-on experience on practical skills	Psychon	notor	· I	Perce	ption	
obtai	ned du	iring t	he programme.			S	Set		
CO5 and c	<b>:Sum</b> oral pr	mariz esenta	Cogniti	ve	F	Evalu	ate		

# Mapping COs with POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	2													
CO2							1	3			1		1	1
CO3									3	1	3		3	3
<b>CO4</b>		1	2	1	3								1	1
CO5				3						3			1	1

r	Total       2       1       3       4       4       0       2       4       4       4       5       1       7       7         Scale       1       1       2       1       1       0       1       1       1       1       1       2       2															
-	Tota Scale	1 2	1	3	4	4	0	2	4	4	4	5	1	2	2	
	d		1	2	1	1	0	1	1	1	1	1	1	2	2	
								IV Sen	nester							
													T	T		0
		0.1												T	P	C
	XB14	01				D • 7	т	( D					2		0	3
						Basic	Frans	port Pro	ocesses	5				-	n	
	P	A												1	P	H 2
3																3
Course Outcomes     Domain     Level															1	
Afte	After the completion of the course, students will be able to															-
After the completion of the course, students will be able to         CO1       Apply the fluid transport properties in flow of fluids       Cognitive       Understand																
	CO1Apply the fluid transport properties in flow of fluidsCognitiveUnderstandCO2Apply the particle transport properties in flow of fluidsCognitiveApply															
CO	CO2AppryCognitiveAppryCO3Describe the heat and mass transfer equipmentsCognitiveUnderstand															
CO	J3Describe the heat and mass transfer equipmentsCognitiveUnderstandD4Compute the heat transport properties in flow of fluidsCognitiveApply															
CO	5 1	- Determi	ne the	mass ti	ansport	prope	rties in	flow o	f fluids		Cognitiv	e		Apply	7	
Unit	t-I	Fluid	l Tran	sport							-					6+3
Units	and	Dimens	ions, N	Newton	ian and	l non-	Newto	nian Fl	uids, l	Lami	nar and	turbule	ent flow,	Contin	uity e	quation,
Berno	oulli e	quation,	Hagen	-Poise	uille equ	uation,										
Unit	t-II	Part	icle Tr	anspor	rt											6+3
Chara	acteriz	ation of	partic	les shaj	pe and s	size, Si	ize red	uction,	settling	g and	sedimer	tation.	Agitation	n and M	lixing	- power
const	imptio	n in mix	king, M	lixing i	n biorea	actors,	Mixin	g time,	Centrif	ugati	on, Filtra	tion th	eory.			
Unit	t-III	Heat	Trans	sport												6+3
Con	ductiv	e and co	nvecti	ve heat	transfe	r, LM7	ſD, Ov	erall he	at tran	sfer c	oefficien	t, Heat	exchange	ers.		
Unit	t-IV	Mass	s Tran	sport												6+3
Mol	ecular	diffusio	on and	film th	eory, M	lass tra	insfer o	coefficie	ents, O	xyge	n transfe	r and u	ptake in l	oioreact	or, k _L a	and its
mea	surem	ent, Mas	ss trans	fer ope	rations.											
Unit	t-V	Com	putati	onal T	ools for	the T	ransp	ort Pro	cess							6+3
Intro	oductio	on to Co	mputat	tion – E	Excel – I	MATL	.AB – 1	Rprogra	.m - RS	Studi	C					
	]	Lecture				Tuto	rial			P	ractical			То	tal	
		30				15	;				-			4	5	

#### **Text Books:**

- 1. McCabe, Warren L., Julian C. Smith, and Peter Harriott, Unit Operations of Chemical Engineering,McGraw-Hill, 2010.
- Warren, L. M., C. S. Julian, and H. Peter, Unit operations of chemical engineering, McGraw Hill Book Company, 2005.
- 3. Geankoplis, Christie John, Allen H. Hersel, and Daniel H. Lepek, Transport processes and separation process principles, prentice hall, 2018.
- Welty J, Rorrer GL, Foster DG., Fundamentals of Momentum, Heat, and Mass Transfer, Wiley, Revised 6th Edition; 2014.

#### **Reference Books:**

- 1. Benitez, Jaime, Principles and modern applications of mass transfer operations, John Wiley & Sons, 2016.
- Ravi, R., R. Vinu, and Sathyanarayana N. Gummadi, eds. Coulson and Richardson's Chemical Engineering: Volume 3A: ,Chemical and Biochemical Reactors and Reaction Engineering, Butterworth-Heinemann, 2017.

## **E-References:**

- 1. https://nptel.ac.in/courses/103/103/103103037/
- 2. http://ce-iitb.vlabs.ac.in/List%20of%20experiments.html?domain=Chemical%20Engineering
- 3. http://uorepc-nitk.vlabs.ac.in/#
- 4. http://iitg.vlab.co.in/?sub=58

#### Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	<b>PO10</b>	PO11	PO12	PSO1	PSO2
CO	3	3	1	1	2	2	2	0	0	0	1	3	0	0
1														
CO	3	3	2	2	1	2	2	0	0	0	2	2	1	1
2														
CO	3	3	2	3	1	2	2	0	0	0	2	3	2	3
3														
CO	3	3	2	3	1	2	2	0	0	0	2	2	2	2
4														
CO	3	3	2	3	1	2	2	0	0	0	2	3	3	3
5														
	15	15	9	12	6	10	10	0	0	0	9	13	8	9

# Mapping of Subjects with POs

	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original	15	15	9	12	6	10	10	0	0	0	9	13	8	9
Value														
Scaled	3	3	2	3	2	2	2	0	0	0	2	3	2	2
Value														

 $1-5 \rightarrow 1$ ,  $6-10 \rightarrow 2$ ,  $11-15 \rightarrow 3$ 

	L T P C											
Х	КВТ	402		2	1	0	3					
			<b>BIOENERGETICS AND METABOLISM</b>		1							
С	Р	Α		L	Т	P	Н					
3	0	0		2	1	0	3					
Prei	requ	isite: -			1							
Learning Objectives:												
Upon completion of this course, the students												
• Would have learn various metabolic pathways.												
• Would have learn how all the metabolic pathways related to each other.												
Course Outcomes Domain Level												
Afte	After the completion of the course, students will be able to											
CO	1   I	<b>Discuss</b> t	he fundamental and metabolism pathways	Cognitive	Unders	stand						
CO2	2 1	dentify	the mechanism offatty acid and cholesterol Synthesis in	Cognitive	Remer	nber						
	i	n-vivo										
CO	3 1	Explain	oxidative phosphorylation and photophosphorylation	Cognitive	Unders	stand						
CO4         Illustrate biosynthesis of amino acids and nucleotides         Cognitive         Understand												
CO5Infer about the metabolic disorder and diseaseCognitiveAnalyze												
	Course content     Hours											
I – I	Bioer	neregeti	cs and Glycolytic pathways			6+3						
Bioer	nerge	etics and	1 Thermodynamics, Phosphoryl Group Transfers and	ATP, Biological	Oxidatio	on-Redu	uction					
Reactions, metabolic pathways: Glycolysis, Gluconeogenesis, and the Pentose Phosphate Pathway, The Citric Acid												

Cycle.

II – Fatty acid, Cholestrol, Lipid and amino acid metabolism 6+3 Biosynthesis of fatty acids, Oxidation of fatty acid – beta oxidation and omega oxidation, Ketone Bodies, Biosynthesis of Cholesterol, Biosynthesis of phospholipids and glycolipids, Metabolic Fates of Amino Groups, Pathways of Amino Acid Degradation. **III** – Oxidative phosphorylation and photophosphorylation 6+3 Electron-Transfer Reactions in Mitochondria, ATP Synthesis, Regulation of Oxidative Phosphorylation, General Features of Photophosphorylation – Photosystem I and II. IV – Biosynthesis of amino acids and nucleotides 6+3 Overview of Nitrogen Metabolism, Biosynthesis of amino acids, biosynthesis and degradation of nucleotides – De Novo Purine Nucleotide synthesis – Purine Nucleotide Biosynthesis – Pyrimidine Nucleotide-Nucleotide Monophosphates-Ribosomal – Purine and Pyrimidine bases are restricted by Salvage Pathways. V – Metabolic disorders and diseases 6+3 Overall view on enegetics of metabolic pathways - Qualitative and quantitative analysis of metabolism involving in disease and disorders. Report writing on metabolic disorders or diseases. Lecture Tutorial Practical Total 30 15 0 45 **Text Books:** 1. Lehninger Principles of Biochemistry, David L. Nelson and Michael M. Cox, W. H. Freeman; 6th edition edition (13 February 2013), 1158 pages ISBN-10: 1464109621, ISBN-13: 978-1464109621. 2. Biochemistry, Donald Voet, Judith G. Voet 4th Edition, 2011, 1520 pages ISBN: 978-0-470-91410-6. 3. Branden C. and Tooze J., "Introduction to Protein Structured, Second Edition", Garland Publishing, NY, USA, 1999. **Reference Books:** 1. Introduction to Protein structure, 2nd Ed by Carl Branden and John Tooze, Garland Press, 1999.

- 2. Structure and Mechanism in Protein Science, Alan Fersht, Freeman, 1999.
- 3. Protein engineering in Industrial biotechnology, Ed. Lilia Alberghina, Harwood Academic Publishers, 2002.
- 4. Creighton T.E. Proteins, Freeman WH, Second Edition, 1993.

### **E-References:**

1. https://nptel.ac.in/courses/102104063/

# Mapping of COs with POs

			PROGRAM OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	1	1	2	0	1	0	0	1	1	1	1	1	3	2
CO2	1	1	2	0	1	0	0	1	1	1	1	2	2	3
CO3	1	1	2	0	1	0	0	1	1	1	1	3	1	2
CO4         1         1         2         0         1         0         0         1         1         1         2         1									1					
CO5	1	1	2	0	1	0	0	1	1	1	1	1	1	1
Total	6	6	11	1	6	1	1	6	6	6	6	10	9	10
ScaledValue	ScaledValue         2         2         3         1         2         1         1         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2         2 <th< th=""></th<>													
$1-5 \square 1$ , $6-10 \square 2$ , $11-15 \square 3$														
0-NoRelation,1-Low Relation,2-MediumRelation,3-HighRelation														

				L	Т	Р	С			
X	BT 4(	)3		3	3					
			CELL BIOLOGY							
С	Р	Α		L	Т	Р	Н			
3	0	0		3	0	0	3			
Prerequisite:-										
Learning Objectives:										

Upon completion of this course, the students

- Would develop a deeper understanding of cell structure and how it relates to cell functions.
- Would understand how cells grow, divide, and die and how these important processes are regulated.
- Would understand cell signaling and how it regulates cellular functions.

Course Outcomes Domain										
After t	After the completion of the course, students will be able to									
CO1	Explain the origin of eukaryotic cells and cells specialization	Cognitive	Understand							
CO2	<b>Recall</b> the fundamental concepts in the structure and functioning of a eukaryotic cell.	Cognitive	Remember							

CO3	Analyze the tran compartments	isport of proteins between	intracellular	Cognitive	Analyze					
CO4	<b>Describe</b> the types	of cell division and its importar	nce	Cognitive	Understand					
CO5	Describe cellular si	gnaling and types of signaling r	receptors	Cognitive	Understand					
I – Ce	lls and Tissues				7					
Unity	and Diversity of Cell	s – Origin of Eukaryotic cells	– Plant cells –	Viruses – Cell spec	cialization: Epithelia,					
Conne	ctive tissue, Nervous	tissue, Muscle - Cells as exper	imental models	– Extracellular Ma	trix.					
II – Co	ellular Organization	and Membrane Transport			11					
Overvi	iew of Eukaryotic	cell structure: Cytoplasmic	matrix, Endo	plasmic Reticulu	m, Golgi complex,					
Mitoch	nondria, Chloroplast,	Nucleus – Functions of cell of	organelles – Me	embrane Transport	Passive and Active					
transpo	ort – Sodium/potassiu	m pumps, Ca2+, ATPase pump	os, Uniport, Syn	port and Antiport	system.					
III – I	ntracellular Protein	Trafficking			11					
Transp	port to and from the N	ucleus – Transport Across Mer	nbranes – Vesic	ular Trafficking Be	etween					
Intracellular Compartments										
IV – Cell Division and Control 9										
The cell cycle – General description and different stages of mitosis and meiosis (Interphase, Prophase, Metaphase,										
Anaph	ase, Telophase) – Cel	ll Growth Control: Apoptosis								
<b>V</b> – <b>C</b>	ell Signaling				7					
Cell S	ignaling: Types of Co	ell Signaling, General Principle	es of Cell Signal	ling – Receptors in	Signaling: Types of					
Recept	tors, Signaling via C	3-Protein-linked Cell Surface	Receptors, Sigr	naling via Enzyme	-linked Cell-Surface					
Recept	tors.									
	Lecture	Tutorial	Practi	cal	Total					
	45	0	0		45					
Text E	Books:									
	1. Bolsover, S. R., Shephard, E. A., White, H. A., and Hyams, J. S. Cell biology: a short course. John									
	Wiley & Sons, 2011.									
Refere	ences:									
	2. Sadava, D. E. C	ell biology: organelle structure	and function. J	ones & Bartlett Lea	arning, 1993.					
	3. Alberts, Bruce,	Dennis Bray, Karen Hopkin, A	lexander Johnso	on, Julian Lewis, M	lartin Raff, Keith					
	Roberts, and Pe	ter Walter. Essential cell biolog	gy. Garland Scie	ence, 2013.						
	4. Julio E. Celis. C	Cell biology: A Laboratory Han	dbook. 3 rd Editi	on, Vol. 1, Elsevier	r Academic Press,					
	2006.									

# **E-References:**

- 1. http://nptel.ac.in/courses/102103012/
- $2. \ https://cellbiology.med.unsw.edu.au/cellbiology/index.php/Cell_Biology_Introduction$

# Mapping of COs with POs

			PROGRAM OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	0	0	0	1	0	0	0	0	0	1	1	0	0
CO2	3	1	0	1	1	1	0	0	1	1	0	0	0	0
CO3	3	1	0	0	1	0	0	0	0	0	1	1	0	0
CO4	1	1	0	1	1	1	0	0	1	1	1	1	0	0
CO5	3	1	0	1	1	1	0	0	1	1	1	1	0	0
Total	15	5	1	4	6	5	0	0	3	3	5	5	2	1
ScaledValue	3	1	1	1	2	1	0	0	1	1	1	1	1	1
	$1-5 \Box 1, \qquad 6-10 \Box 2, \qquad 11-15 \Box 3$								•					

NDT 404					L	Т	P	С					
X	BT 4(	)4			3	0	0	3					
			IMMUNOLOGY										
С	Р	Α			L	Т	Р	Η					
3	0	0			3	0	0	3					
Prer	Prerequisite: Genetics												
Lear	ning(	Object	ives:										
Upor	ı com	mpletion of this course, the students											
•	W	Would be able to explain role of immune cells and their mechanism in preventing the body from											
	foreign attack and infectious disease, cancer and other disease development.												
•	W	ould ap	pply the knowledge of immune associated mechanisms in	medical biot	echnol	ogy re	esearc	ch.					
		-	Course Outcomes	Domain	1	L	Level						
After	the c	omplet	ion of the course, students will be able to										
CO	1 V	V <b>rite</b> tl	ne general concepts of immune system	Cognitive	]	Remer	nber						
CO2	2 E in	<b>Explain</b> the properties of antigens and antibodies and their interactions via various tests.											
CO.	$\begin{array}{c c} \mathbf{J} & \mathbf{D} \\ \mathbf{J} \\ \mathbf{M} \end{array}$	<b>escrib</b> IHC.	e various mechanisms of antigen presentation and	Cognitive	I	Unders	stand						
CO	4 C	ompa	re the different types of hypersensitive reactions	Cognitive	I	Unders	stand						

CO5 Summarize techniques	e various types vacci	nes and immunization	Cognitive	Understand						
I- Immune System				9						
Organization of the	immune system – Types	s of immune system: Inna	ate and adaptiv	e – Structure and						
functions of import	ant immune cells: T cell	, B cell development , M	lacrophage, Ne	utrophil, NK cell,						
Dendritic cell, Stem	cells – Immune organs:	Bone marrow, Spleen, Th	ymus, Lymph n	ode, Mucosal and						
II- Antigens and An	tibodies	a CALT).		9						
Antigons: Immunogo	nicity Antigonicity Enitor	no hontone and Adjuvante	Antibody: Str	Lotura Classes and						
Ringens. Initiatiog	Molecular basis of antiba	pe, napiens and Aujuvants	- Annouy. Sur	longl ontihodiog						
Antionenetile de		Affinite Anility Polyclonal a		tination neodies –						
Antigen-antibody re	action: Cross-Reactivity,	Affinity, Avidity, Precipit	ation and agglu	itination reactions.						
Immunotechniques:	ELISA, RIA, Flow cytomet	try, Immunoelectrophoresis	, Western Blotti	ng						
III- MHC and Anti	gen Presentation			9						
Major Histocompatibility Complex: Structure, Function and classes of MHC molecules, Immune										
responsiveness to MHC - Antigen processing and presentation: Endogenous antigens (The Cytosolic										
Pathway), Exogenous antigens (The Endocytic Pathway)										
IV- Complement, H	ypersensitivity and Autoi	mmunity		9						
Regulation of immur	e response; Complement S	System: Functions, Compor	ents, Activation	and Regulation of						
complement system -	- Allergy and hypersensitiv	vity: Types of hypersensitiv	ity – Autoimmu	nity, Auto immune						
disorders; immune to	lerance; Graft versus host	reaction.								
V- Vaccines and Ca	ancer Immunology			9						
Vaccines: Active a	nd Passive Immunization	, Whole-Organism Vaccin	nes, Purified M	facromolecules as						
Vaccines, Recombin	ant-Vector Vaccines, DNA	A and Multivalent Subunit	Vaccines. Tumo	ors of the Immune						
System - Tumor Anti	gens - Immune Response t	o Tumors – Cancer immun	otheraphy.							
Lecture	Tutorial	Practical		Total						
45	0	0		45						
Text Books:			·							
1. Janes Kuby., Imn	unology, WH Freeman and	d Company, Newyork.,7th	Edition, 2013.							
2. Roitt, I., Essential	Immunology, Blackwell So	cientific Publications, Oxfo	rd, 12 th Edition,	2011.						
$\frac{1}{1}  \text{Abbas } K  \text{A}  \text{Lite}$	hmon A U and Dohar I	S (2007) Callular and Ma	acular							
I. Aduas, K. A., Liu Immunology 4th	Fdn W B Saunders Co	S. $(2007)$ . Certular and Mo. Pennsylvania USA	leculai							
2. Tizard. R.I. (2007	). Immunology: An Introdu	ction 1st Edition (English)	4th Edition.							
Brooks/Cole publ	ishers.	ction 15t Edition (English)	tin Luition,							
E - References:										
1. http://www.raym	ondcheong.com/Year1/im	nuno.html								
2 http://ocsu mit ad	u/courses/health-sciences-	and technology/het 176 cel	ular and malage	1 ' 1						

# fall-2005/lecture-notes/

# 3. http://www.umich.edu/~bmsteach/lopatin/Immunology/Immunology.html

# Mapping of COs with POs

		PROGRAM OUTCOMES												
	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO1	3	2	2	1	1	1	1	0	1	0	1	1	3	3
CO2	3	2	2	1		1	1	0	1	0	1	1	2	2
CO3	2	1	1		1	1		0		0	1		2	1
CO4	2	2	1				1	0	1	0	1	1	1	2
CO5	2	2	2	1	1	1	1	0		0	1	1	1	1
Total	13	9	8	4	4	5	3	0	4	0	6	5	11	10
Scaled Value	Scaled Value         3         2         2         1         1         1         0         1         0         2         1         3         2													2
	$1-5 \square 1$ , $6-10 \square 2$ , $11-15 \square 3$													
	0-NoRelation,1-Low Relation,2-MediumRelation,3-HighRelation													

COURSE	CODE	XUM405	L	Т	Р	C				
COURSE	NAME	ECONOMICS FOR ENGINEERS	3	0	0	3				
PREREQ	UISITES	NIL	L	Т	Р	Н				
C:P:A		2.64:0.24:0.12	3	0	0	3				
COURSE	OUTCOME	5	DOMA	IN	LEVEI	⊿				
CO1	Explain the	concepts of economics in engineering and	Cognitiv	and						
identify element of cost to prepare cost sheet Psychomotor Perception										
CO2	CO2         Calculate and Explain the Break-even point and marginal         Cognitive         Understand									
	costing	Psychomotor & Apply								
				Percept	ion					
CO3	Summarize	and Use value engineering procedure for cost	Cognitiv	re	Underst	and				
	analysis		Affectiv	e	Receive	e				
CO4	Estimate rep	lacement problem	Cognitiv	re	Underst	and				
CO5	Compute, E	xplain and make Use of different methods of	Cognitiv	ve	Underst	and				
depreciation & Apply										
UNIT IINTRODUCTION TO ECONOMICS8										
Flow in an economy, Law of supply and demand, Concept of Engineering Economics - Engineering										
efficiency, Economic efficiency, Scope of engineering economics- types of costing, element of costs,										
preparation of cost sheet and estimation, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost										

Margin of Safety, Profit, Cost & Quantity analysis-Product Mix decisions and CVP analysis, Profit/Volume         Ratio (P/V Ratio), Application of Marginal costing, Limitations         Social Cost Benefit Analysis: compare different project alternatives, Calculate direct, indirect and externa         effects; Monetizing effects; Result of a social cost benefit analysis.         UNIT III VALUE ENGINEERING &COST ACCOUNTING:       10         Value engineering – Function, aims, Value engineering procedure - Make or buy decision         Business operating costs, Business overhead costs, Equipment operating costs         UNIT IV REPLACEMENT ANALYSIS       7         Replacement analysis –Types of replacement problem, determination of economic life of an asset         Replacement of an asset with a new asset.       8         UNIT V DEPRECIATION       8         Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation.       8         UNIT V DEPRECIATION       8         Depreciation- service output method of depreciation.       TOTAL:45         TEXT BOOKS       1.       Sp Gupta, Ajay Sharma & Satish Ahuja, "Cost Accounting", V K Global Publications, Faridabad Haryana, 2012.         3.       PanneerSelvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.       2001.         REFERENCES       International, New York, 2001.       REFERENCES         1.       Willia	UNIT I	IBREAK-EVE	N ANALYSIS&SOCIAL CO	OST BENEFIT ANALYSIS		12								
Ratio (P/V Ratio), Application of Marginal costing, Limitations         Social Cost Benefit Analysis: compare different project alternatives, Calculate direct, indirect and external effects; Monetizing effects; Result of a social cost benefit analysis.         UNIT III VALUE ENGINEERING &COST ACCOUNTING:       10         Value engineering – Function, aims, Value engineering procedure - Make or buy decision       10         Business operating costs, Business overhead costs, Equipment operating costs       7         Replacement analysis –Types of replacement problem, determination of economic life of an asset       7         Replacement of an asset with a new asset.       8         UNIT V DEPRECIATION       8         Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation.       10         Sum of the year's digits method of depreciation.       TOTAL:45         TEXT BOOKS       1.       Sp Gupta, Ajay Sharma & Satish Ahuja, "Cost Accounting", V K Global Publications, Faridabad Haryana, 2012.         3.       PanneerSelvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.       2001.         REFERENCES       1.       Luke M Froeb / Brian T Mccann, "Managerial Economics – A problem solving approach" Thomson learning 2007       2.         1.       Luke M Froeb / Brian T Mccann, "Managerial Economics", Prentice Hall of India, 2002.       4.         4.       William G.Sullivan, Jarnes A.Bontadelli&	Margin	of Safety, Profit	t, Cost & Quantity analysis-Pr	oduct Mix decisions and CVI	P analysis, Prof	it/Volume								
Social Cost Benefit Analysis: compare different project alternatives, Calculate direct, indirect and externa effects; Monetizing effects; Result of a social cost benefit analysis.         UNIT III VALUE ENGINEERING & COST ACCOUNTING:         10         Value engineering – Function, aims, Value engineering procedure - Make or buy decision         Business operating costs, Business overhead costs, Equipment operating costs         UNIT IV REPLACEMENT ANALYSIS         7         Replacement analysis – Types of replacement problem, determination of economic life of an asset         Replacement of an asset with a new asset.         UNIT V DEPRECIATION         8         Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation.         Sum of the year's digits method of depreciation.         LECTURE:45       TUTORIAL:0       PRACTICAL:0       TOTAL:45         TEXT BOOKS         1.       Sp Gupta, Ajay Sharma & Satish Ahuja, "Cost Accounting", V K Global Publications, Faridabad Haryana, 2012.         A. PanneerSelvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.         REFERENCES         I. Luke M Froeb / Brian T Mccann, "Managerial Economics – A problem solving approach" Thomson learning 2007<	Ratio (F	P/V Ratio), Appl	ication of Marginal costing, L	imitations										
effects; Monetizing effects; Result of a social cost benefit analysis. UNIT III VALUE ENGINEERING &COST ACCOUNTING: 10 Value engineering – Function, aims, Value engineering procedure - Make or buy decision Business operating costs, Business overhead costs, Equipment operating costs UNIT IV REPLACEMENT ANALYSIS 7 Replacement analysis –Types of replacement problem, determination of economic life of an asset Replacement of an asset with a new asset. UNIT V DEPRECIATION 8 Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation. Sum of the year's digits method of depreciation, sinking fund method of depreciation, Annuity method of depreciation, service output method of depreciation. LECTURE:45 1 Sp Gupta, Ajay Sharma & Satish Ahuja, "Cost Accounting", V K Global Publications, Faridabad Haryana, 2012. 2 S.P.Jain&Narang, "Cost accounting – Principles and Practice", Kalyani Publishers, Calcutta, 2012. 3 PanneerSelvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001. 4 William G.Sullivan, James A.Bontadelli& Elin M.Wicks, "Engineering Economy", Prentice Hall International, New York, 2001.  REFERENCES 1 Luke M Froeb / Brian T Mccann, "Managerial Economics – A problem solving approach' Thomson learning 2007 2 Luke M Froeb / Brian T Mccann, "Managerial Economics – A problem solving approach' Thomson learning 2007 3 Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002. 4 Donald G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press	Social Cost Benefit Analysis: compare different project alternatives, Calculate direct, indirect and external													
UNIT III VALUE ENGINEERING &COST ACCOUNTING:       10         Value engineering – Function, aims, Value engineering procedure - Make or buy decision       Business operating costs, Business overhead costs, Equipment operating costs         UNIT IV REPLACEMENT ANALYSIS       7         Replacement analysis –Types of replacement problem, determination of economic life of an asset       7         Replacement of an asset with a new asset.       8         UNIT V DEPRECIATION       8         Depreciation – Introduction, Straight line method of depreciation, declining balance method of depreciation.       8         LECTURE:45       TUTORIAL:0       PRACTICAL:0       TOTAL:45         TEXT BOOKS       1.       Sp Gupta, Ajay Sharma & Satish Ahuja, "Cost Accounting", V K Global Publications, Faridabad Haryana, 2012.       2.       S.P.Jain&Narang, "Cost accounting – Principles and Practice", Kalyani Publishers, Calcutta, 2012.       3.       PanneerSelvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.       2001.         4.       William G.Sullivan, James A.Bontadelli& Elin M.Wicks, "Engineering Economy", Prentice Hall International, New York, 2001.       FEFERENCES         1.       Luke M Froeb / Brian T Mccann, "Managerial Economics – A problem solving approach" Thomson learning 2007       2.       Truet&Truett, "Managerial economics- Analysis, problems & cases "Wiley India 8th edition 2004.       2004.       3.       Chan S Park, "Contemporary Engineering Economics", Prentice Hall of In	effects;	Monetizing effe	ects; Result of a social cost be	nefit analysis.										
Value engineering – Function, aims, Value engineering procedure - Make or buy decision         Business operating costs, Business overhead costs, Equipment operating costs         UNIT IV REPLACEMENT ANALYSIS       7         Replacement analysis –Types of replacement problem, determination of economic life of an asset       7         Replacement of an asset with a new asset.       8         UNIT V DEPRECIATION       8         Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation.       8         Sum of the year's digits method of depreciation, sinking fund method of depreciation, Annuity method of depreciation, service output method of depreciation.       TOTAL:45         TEXT BOOKS       1.       Sp Gupta, Ajay Sharma & Satish Ahuja, "Cost Accounting", V K Global Publications, Faridabad Haryana, 2012.       2.         3.       PanneerSelvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.       2001.         4.       William G.Sullivan, James A.Bontadelli& Elin M.Wicks, "Engineering Economy", Prentice Hall International, New York, 2001.       REFERENCES         1.       Luke M Froeb / Brian T Mccann, "Managerial Economics – A problem solving approach" Thomson learning 2007       2.         2.       Truett&Truett, "Managerial economics- Analysis, problems & cases "Wiley India 8th editior 2004.       3.         2.       Thomson learning 2007       2.       3.         3. </td <td>UNIT I</td> <td>II VALUE EN</td> <td>GINEERING &amp;COST ACC</td> <td>OUNTING:</td> <td></td> <td>10</td>	UNIT I	II VALUE EN	GINEERING &COST ACC	OUNTING:		10								
Business operating costs, Business overhead costs, Equipment operating costs         UNIT IV REPLACEMENT ANALYSIS         7         Replacement analysis –Types of replacement problem, determination of economic life of an asset         Replacement analysis –Types of replacement problem, determination of economic life of an asset         Replacement of an asset with a new asset.         UNIT V DEPRECIATION         8         Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the year's digits method of depreciation, sinking fund method of depreciation, Annuity method of depreciation, service output method of depreciation.         LECTURE:45         TUTORIAL:0         TOTAL:45         TEXT BOOKS         1.         Sp Gupta, Ajay Sharma & Satish Ahuja, "Cost Accounting", V K Global Publications, Faridabad Haryana, 2012.         3.         PanneerSelvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.         REFERENCES         1.         Luke M Froeb / Brian T Mccann, "Managerial Economics – A problem solving approach" Thomson learning 2007         2.004.         2.004. <td c<="" td=""><td>Value e</td><td colspan="12">Value engineering – Function, aims, Value engineering procedure - Make or buy decision</td></td>	<td>Value e</td> <td colspan="12">Value engineering – Function, aims, Value engineering procedure - Make or buy decision</td>	Value e	Value engineering – Function, aims, Value engineering procedure - Make or buy decision											
UNIT IV REPLACEMENT ANALYSIS       7         Replacement analysis –Types of replacement problem, determination of economic life of an asset         Replacement of an asset with a new asset.         UNIT V DEPRECIATION         8         Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation         Sum of the year's digits method of depreciation, sinking fund method of depreciation, Annuity method of depreciation, service output method of depreciation.         LECTURE:45         TUTORIAL:0         PRACTICAL:0         TOTAL:45         TEXT BOOKS         1.       Sp Gupta, Ajay Sharma & Satish Ahuja, "Cost Accounting", V K Global Publications, Faridabad Haryana, 2012.         2.       S.P.Jain&Narang, "Cost accounting – Principles and Practice", Kalyani Publishers, Calcutta, 2012.         Quoting         Quoting         Principles and Practice", Kalyani Publishers, Calcutta, 2012.         Quoting         Quoting         Quoting         Quoting         Quoting         Quoting         Quoting <td c<="" td=""><td colspan="12">Business operating costs, Business overhead costs, Equipment operating costs</td></td>	<td colspan="12">Business operating costs, Business overhead costs, Equipment operating costs</td>	Business operating costs, Business overhead costs, Equipment operating costs												
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Replacement of an asset with a new asset.         UNIT V DEPRECIATION       8         Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation.         Sum of the year's digits method of depreciation, sinking fund method of depreciation, Annuity method of depreciation, service output method of depreciation.         LECTURE:45       TUTORIAL:0       PRACTICAL:0       TOTAL:45         TEXT BOOKS         1.       Sp Gupta, Ajay Sharma & Satish Ahuja, "Cost Accounting", V K Global Publications, Faridabad Haryana, 2012.       S.P.Jain&Narang, "Cost accounting – Principles and Practice", Kalyani Publishers, Calcutta, 2012.       Calcutta, 2012.         3.       PanneerSelvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.       2001.         REFERENCES         1.       Luke M Froeb / Brian T Mccann, "Managerial Economics – A problem solving approach" Thomson learning 2007         2.       Truett&Truett, "Managerial economics- Analysis, problems & cases "Wiley India 8th edition 2004.         3.       Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.         4.       Donald.G, Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Eng. Press	Replace	ement analysis -Types of replacement problem, determination of economic life of an asset,												
<b>UNIT V DEPRECIATION</b> 8         Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation.         Sum of the year's digits method of depreciation, sinking fund method of depreciation, Annuity method of depreciation, service output method of depreciation. <b>LECTURE:45 TUTORIAL:0 PRACTICAL:0 TOTAL:45 TEXT BOOKS</b> 1.       Sp Gupta, Ajay Sharma & Satish Ahuja, "Cost Accounting", V K Global Publications, Faridabad Haryana, 2012.         2.       S.P.Jain&Narang, "Cost accounting – Principles and Practice", Kalyani Publishers, Calcutta, 2012.         3.       PanneerSelvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.         4.       William G.Sullivan, James A.Bontadelli& Elin M.Wicks, "Engineering Economy", Prentice Hall International, New York, 2001. <b>REFERENCES</b> 1.       Luke M Froeb / Brian T Mccann, "Managerial Economics – A problem solving approach" Thomson learning 2007         2.       Truett&Truett, "Managerial economics- Analysis, problems & cases "Wiley India 8th edition 2004.         3.       Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.         4.       Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Eng. Press	Replace	ement of an asset with a new asset.												
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Sum of the year's digits method of depreciation, sinking fund method of depreciation, Annuity method of depreciation.         LECTURE:45       TUTORIAL:0       PRACTICAL:0       TOTAL:45         TEXT BOOKS         1.       Sp Gupta, Ajay Sharma & Satish Ahuja, "Cost Accounting", V K Global Publications, Faridabad Haryana, 2012.         2.       S.P.Jain&Narang, "Cost accounting – Principles and Practice", Kalyani Publishers, Calcutta, 2012.         3.       PanneerSelvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.         4.       William G.Sullivan, James A.Bontadelli& Elin M.Wicks, "Engineering Economy", Prentice Hall International, New York, 2001.         REFERENCES       I.         1.       Luke M Froeb / Brian T Mccann, "Managerial Economics – A problem solving approach" Thomson learning 2007         2.       Truett&Truett, "Managerial economics- Analysis, problems & cases "Wiley India 8th editior 2004.         3.       Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.         4.       Donald, G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press	Depreci	ation- Introduct	ion, Straight line method of d	epreciation, declining balance	method of dep	preciation-								
Join of the year 5 digits method of appreciation, similing fund method of depreciation, service output method of depreciation.         LECTURE:45       TUTORIAL:0       PRACTICAL:0       TOTAL:45         TEXT BOOKS	Sum of	the year's digit	s method of depreciation sin	king fund method of deprecia	tion Annuity	method of								
LECTURE:45       TUTORIAL:0       PRACTICAL:0       TOTAL:45         TEXT BOOKS	depreci	ation. service ou	tput method of depreciation.											
<b>TEXT BOOKS 1.</b> Sp Gupta, Ajay Sharma & Satish Ahuja, "Cost Accounting", V K Global Publications, Faridabad Haryana, 2012. <b>2.</b> S.P.Jain&Narang, "Cost accounting – Principles and Practice", Kalyani Publishers, Calcutta, 2012. <b>3.</b> PanneerSelvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001. <b>4.</b> William G.Sullivan, James A.Bontadelli& Elin M.Wicks, "Engineering Economy", Prentice Hall International, New York, 2001. <b>REFERENCES 1. 1.</b> Luke M Froeb / Brian T Mccann, "Managerial Economics – A problem solving approach" Thomson learning 2007 <b>2.</b> Truett&Truett, "Managerial economics- Analysis, problems & cases "Wiley India 8th editior 2004. <b>3.</b> Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002. <b>4.</b> Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press	LECTI	JRE:45	TUTORIAL:0	PRACTICAL:0	ΤΟΤΑ	AL:45								
<ol> <li>Sp Gupta, Ajay Sharma &amp; Satish Ahuja, "Cost Accounting", V K Global Publications, Faridabad Haryana, 2012.</li> <li>S.P.Jain&amp;Narang, "Cost accounting – Principles and Practice", Kalyani Publishers, Calcutta, 2012.</li> <li>PanneerSelvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.</li> <li>William G.Sullivan, James A.Bontadelli&amp; Elin M.Wicks, "Engineering Economy", Prentice Hall International, New York, 2001.</li> <li>REFERENCES</li> <li>Luke M Froeb / Brian T Mccann, "Managerial Economics – A problem solving approach" Thomson learning 2007</li> <li>Truett&amp;Truett, "Managerial economics- Analysis, problems &amp; cases "Wiley India 8th edition 2004.</li> <li>Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.</li> </ol>														
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<ol> <li>S.P.Jain&amp;Narang, "Cost accounting – Principles and Practice", Kalyani Publishers, Calcutta, 2012.</li> <li>PanneerSelvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.</li> <li>William G.Sullivan, James A.Bontadelli&amp; Elin M.Wicks, "Engineering Economy", Prentice Hall International, New York, 2001.</li> <li>REFERENCES</li> <li>Luke M Froeb / Brian T Mccann, "Managerial Economics – A problem solving approach" Thomson learning 2007</li> <li>Truett&amp;Truett, "Managerial economics- Analysis, problems &amp; cases "Wiley India 8th edition 2004.</li> <li>Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.</li> <li>Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press.</li> </ol>	1.	Sp Gupta, Aja Haryana, 2012	y Sharma & Satish Ahuja, "C 2.	Cost Accounting", V K Global	Publications, 1	Faridabad,								
<ul> <li>Calcutta, 2012.</li> <li>PanneerSelvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.</li> <li>William G.Sullivan, James A.Bontadelli&amp; Elin M.Wicks, "Engineering Economy", Prentice Hall International, New York, 2001.</li> <li><b>REFERENCES</b> <ol> <li>Luke M Froeb / Brian T Mccann, "Managerial Economics – A problem solving approach" Thomson learning 2007</li> <li>Truett&amp;Truett, "Managerial economics- Analysis, problems &amp; cases "Wiley India 8th edition 2004.</li> <li>Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.</li> </ol> </li> </ul>	2.	S.P.Jain&Nara	ang, "Cost accounting – Princi	iples and Practice", Kalyani P	ublishers,									
<ul> <li>2001.</li> <li>4. William G.Sullivan, James A.Bontadelli&amp; Elin M.Wicks, "Engineering Economy", Prentice Hall International, New York, 2001.</li> <li>REFERENCES</li> <li>1. Luke M Froeb / Brian T Mccann, "Managerial Economics – A problem solving approach" Thomson learning 2007</li> <li>2. Truett&amp;Truett, "Managerial economics- Analysis, problems &amp; cases "Wiley India 8th edition 2004.</li> <li>3. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.</li> <li>4. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press.</li> </ul>	3.	PanneerSelvar	 n, R, "Engineering Economic	s", Prentice Hall of India Ltd.	New Delhi,									
<ol> <li>William G.Sullivan, James A.Bontadelli&amp; Elin M.Wicks, "Engineering Economy", Prentice Hall International, New York, 2001.</li> <li>REFERENCES         <ol> <li>Luke M Froeb / Brian T Mccann, "Managerial Economics – A problem solving approach" Thomson learning 2007</li> <li>Truett&amp;Truett, "Managerial economics- Analysis, problems &amp; cases "Wiley India 8th edition 2004.</li> <li>Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.</li> <li>Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press.</li> </ol> </li> </ol>		2001.		, ,	,									
<ul> <li>REFERENCES</li> <li>Luke M Froeb / Brian T Mccann, "Managerial Economics – A problem solving approach" Thomson learning 2007</li> <li>Truett&amp;Truett, "Managerial economics- Analysis, problems &amp; cases "Wiley India 8th edition 2004.</li> <li>Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.</li> <li>Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press. Taxas 2002</li> </ul>	4.	4. William G.Sullivan, James A.Bontadelli& Elin M.Wicks, "Engineering Economy",												
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<ol> <li>Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.</li> <li>Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press. Taxas 2002</li> </ol>	2.	Truett&Truett 2004.	, "Managerial economics- A	nalysis, problems & cases "	Wiley India 8	th edition								
4. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press	3.	Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.												
	4.	Donald.G. Ne	ewman, Jerome.P.Lavelle, "]	Engineering Economics and	analysis" Eng	gg. Press,								

# Mapping of CO with PO

CO Vs PO	CO1	CO2	CO3	CO4	CO5	Total	Scaled to 0,1,2 and 3
PO ₁	1	2	2	1	2	8	2
PO ₂	1	2	2	1	3	9	2
PO ₃	1	1	2	1	2	7	2
PO ₄	1	1	2	0	1	5	1
PO ₅	1	2	2	1	2	8	2
PO ₆	1	2	2	1	3	9	2
PO ₇	1	1	2	1	2	7	2
PO ₈	1	1	2	0	1	5	1
PO ₉	1	2	2	1	2	8	2
<b>PO</b> ₁₀	1	2	2	1	3	9	2
<b>PO</b> ₁₁	1	1	2	1	2	7	2
<b>PO</b> ₁₂	1	1	2	0	1	5	1
PSO ₁	1	2	2	1	2	8	2
PSO ₂	1	2	2	1	3	9	2
TOTAL	14	22	28	11	29	-	-

 $1-5 \rightarrow 1, 6-10 \rightarrow 2, 11-15 \rightarrow 3$ 0 - No Relation, 1 - Low Relation, 2 - Medium Relation, 3 - High Relation

COURSE CODE	XBT407	L	Т	Р	С						
COURSE NAME	Basic Transport Processes Laboratory	0	0	1	1						
PREREQUISITES	-	L	Т	Р	Н						
С:Р:А	0:0.5:0.5	0	0	1	4						
LEARNING OBJECTI	VES										
• To understand	the existence of transport processes involved in	unit ope	erations	throug	sh the						
experiments of the characteristics of fluid mechanics, particle mechanics, heat transfer, mass tra											
and process control system.											

COURS	SE OUTCOMES	DOMAIN	LEVEL
CO1	<b>Calculate</b> the co efficient of discharge the various flow meters.	Cognitive	Apply
		Psychomotor	Mechanism
		Affective	Respond
CO2	<b>Perform</b> the characteristics curve of the pumps	Cognitive	Apply

					Psychomotor	Mechanism
					Affective	Respond
CO3	Calcu	late the minimum area required	for thick	ener process	Cognitive	Apply
	and po	ower calculation by mixing process			Psychomotor	Mechanism
						Respond
CO4	Deter	mine the thermal conductivity	and h	eat transfer	Cognitive	Apply
	coeffi	cient by heat transfer equipments.			Psychomotor	Mechanism
						Respond
CO5	Plot t	he adsorption isotherm equilibria ar	nd identify	the suitable	Cognitive	Apply
	solver	nt for solvent extraction process			Psychomotor	Mechanism
					Affective	Respond
S.No	List o	f Experiments			(30 hours)	
1	I.	Experiment on fluid flow meter	ers (U tul	be manometer	, Orifice meter,	
			CO1 &CO2			
	II.					
2	I.	Settling and Sedimentation of the	e particles			
	II.	Experiment on Centrifugation pro	ocess			
	III.	Determination of mixing power c	consumpti	on.		CO3
	IV.	Study on Rotary Drum Filter, L	Leaf Filter	, Filter Press,	Size Reduction	
		Equipment and Sieve analysis]				
3	I.	Heat Transfer by Conduction, Co	onvection			CO4
	II.	Heat Exchanger				04
4	I.	Simple Extraction				CO5
	II.	Batch Adsorption				COS
5	CO5					
Referen	nce:					I
McCabe	e, Warı	en L., Julian C. Smith, and Per	ter Harrio	ott, Unit Ope	rations of Chemi	icalEngineering,
McGrav	v-Hill, 2	2010.				
Any Te	n Expe	riments may choose from all		TUTORIAL	PRACTICAI	L TOTAL
COs			HUUKS	0	30	30

# Mapping of COs with POs

						PF	ROGR	AM C	OUTC	COMES	5			
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	1	1	2	2	2	0	0	0	1	3	0	0
CO2	3	2	2	2	1	2	2	0	0	0	2	2	1	1
CO3	3	2	2	2	1	2	2	0	0	0	2	1	2	3
CO4	2	3	2	3	1	2	1	0	0	0	1	2	2	2
CO5	2	3	2	3	1	1	2	0	0	0	2	3	2	2
Total	14	14	10	12	6	10	10	0	0	0	9	13	8	9
ScaledValue	3	3	2	3	2	2	2	0	0	0	2	3	2	2
	$1-5 \Box 1$ , $6-10 \Box 2$ , $11-15 \Box 3$													
0-NoRelation,1-Low Relation,2-MediumRelation,3-HighRelation														

COUR	RSE CO	DE	XBT408	L	Т	Р	C
COUR PRER	RSE NA	ME ITE	Cell Biology Laboratory	0	0	2	2
С	Р	Α	Cen Diology Luboratory	L	Т	Р	H
0	1	1		0	0	2	8

# **COURSE OBJECTIVES**

# Upon completion of this course, the students

- Would develop a deeper understanding of cell structure and how it relates to cell functions.
- Would understand how cells grow, divide, and die and how these important processes are regulated.
- Would understand cell signaling and how it regulates cellular functions.

	COURSE OUTCOMES	DOMAIN	LEVEL
CO1	<b>Perform</b> the staining technique to identify the type of cells	Cognitive	Understand
		Psychomotor	Mechanism,
		Affective	Respond
CO2	<b>Identify</b> the cell viability by preferable staining method	Cognitive	Apply
		Psychomotor	Mechanism,
		Affective	Respond
CO3	<b>Practice</b> the feasible staining technique for acquire the knowledge	Cognitive	Apply
	about the stages of mitotic division	Psychomotor	Mechanism,

		0	30	0	30							
	HOURS	LECTURE	PRACTICAL	TUTORIAI	L TOTAL							
9.	Study of different stages of meiosis in	n grasshopper testis o	cells									
8.	Study of different stages of mitosis in	onion root tip cells.										
7.	Separation of proteins by SDS-PAGE	E electrophoresis										
6.	Extraction of proteins from tissues											
5.	Extraction of lipids from tissues											
4.	Osmosis and Tonicity											
3.	Isolation of chloroplasts from spinach	n leaves										
2.	Cell viability assay by trypan blue exclusion method.											
1.	1. Staining and observation of eukaryotic cells											
List O	f Practical Experiments											
			А	ffective	Respond							
	tissues		P	sychomotor	Mechanism,							
CO5	Apply the feasible method to separat	e the lipds and prote	ins from C	ognitive	Apply							
			А	ffective	Respond							
	separate the proteins		P	sychomotor	Mechanism,							
CO4	Apply the mechanism of SDS –PAG	E electrophoresis tec	chnique by C	ognitive	Apply							
			А	ffective	Respond							

# **REFERENCE BOOK**

1. Julio E. Celis. Cell biology: A Laboratory Handbook. 3rd Edition, Vol. 1, Elsevier Academic Press, 2006.

# Mapping of COs with Pos

			PROGRAM OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	0	0	0	1	0	0	0	0	0	1	1	0	0
CO2	3	1	0	1	1	1	0	0	1	1	0	0	0	0
CO3	3	1	0	0	1	0	0	0	0	0	1	1	0	0
CO4	2	1	0	1	1	1	0	0	1	1	1	1	0	0
CO5	3	1	0	1	1	1	0	0	1	1	1	1	0	0
Total	15	5	1	4	5	3	0	0	3	3	5	5	0	0

ScaledValue	3	1	1	1	1	1	0	0	1	1	1	1	0	0
		$6-10 \Box 2, \qquad 11-15 \Box 3$												
0-NoRelation,1-Low Relation,2-MediumRelation,3-HighRelation														

COUR	SE CODE	XBT 409	L	Т	Р	С
COUR	SE NAME	IMMUNOLOGY LABORATORY	0	0	1	1
PRER	EQUISITES		L	Т	Р	Η
C:P:A	= 0:1:1		0	0	1	4
LEAR	NING OBJECTI	VES				
•	To introduce the	different types of qualitative and quantitative immu	noassays.			
•	To expose the stu	idents to various immunological terms.				
•	To establish anal	ytical ability to interpret the real time experimental	results.			
COUR	SE OUTCOMES	DOMA	IN	LEV	EL	
CO1	Demonstrate se	Cognitive	e	Apply		
	using density gra	Psychom	otor	Mechan	nism,	
			Affective		Respond	
CO2	Practice the cour	nting of blood cells	Cognitive	e	Apply	
			Psychom	otor	Mechanism,	
			Affective		Respon	d
CO3	Demonstrate the	e ABO blood grouping system and blood group.	Cognitive	e	Apply	
			Psychom	otor	Mechan	nism,
			Affective	:	Respon	d
CO4	Carry out the	coupling technique to label the Antibody with	Cognitive	e	Apply	
	Enzyme HRP.		Psychom	otor	Mechan	nism,
			Affective	:	Respon	d
CO5	Demonstrate qu	alitative and quantitative assays for identifying	Cognitive	e	Apply	
	the reaction pat	tern, similarity pattern, unknown concentration,	Psychom	otor	Mechan	nism,
	separation of des	Affective	:	Respon	d	
S.No		List of Experiments		1		
1	Collection of Se	erum from Blood				
2	Isolation of lym	phocytes from whole blood				
3	Differential Leu	kocyte count				

4	Total Leukocyte count										
5	Total and differential count of RBC										
6	Blood Grouping Experiment										
7	Antibody Labelling with HRP										
8	Ouchterlony double diffusion										
9	Single radial immunodifussion										
10	Immunoelectrophoresis										
11.	DIRECT Elisa										
12.	Widal test										
13.	Latex Agglutination										
Referen	ce:1. Abbas, K. A., Litchman, A. H. and Pober, J. S.	(2007). Cellular	and Molecular								
Immunology, 4th Edn., W. B. Saunders Co., Pennsylvania, USA.											
	HOURS	TUTORIAL	PRACTICAL	TOTAL							
	поско	0	30	30							

# Mapping of COs with POs

						Р	ROG	RAM	OUT	COME	5			
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2	2	2	1	1	1	1				1	1	3	3
CO2	2	1	1	1		1	1				1	1	1	2
CO3	2				1								1	1
CO4	2	1	1										1	2
CO5	2	2	1	1	1	1	1				1	1	1	1
Total	12	9	7	4	4	4	4				4	4	8	10
ScaledValue	3	2	2	1	1	1	1	0	0	0	1	1	2	2
	$1-5 \Box 1$ , $6-10 \Box 2$ , $11-15 \Box 3$													
0-NoRelation,1-Low Relation,2-MediumRelation,3-HighRelation														

## **V** Semester

					L	Т	Р	С						
X	BT 5	01			3	0	0	3						
			<b>BIOANALYTICAL TOOLS</b>											
С	Р	Α			L	Т	Р	Н						
3	0	0			3	0	0	3						
Prer	equis	site: Pł	hysics, Applied Physics											
Lear	ning	Objec	tives:Upon completion of this course, the students											
Will	Will be able to understand the principles of instrumentation Will be able to impart the knowledge of different techniques and methods in biotechnology													
Will	Will be able to impart the knowledge of different techniques and methods in biotechnology Will be able to improve the understanding of applications of techniques in the field of biotechnology													
Will	Will be able to improve the understanding of applications of techniques in the field of biotechnology													
Course Outcomes     Domain     Level														
After	the	comple	etion of the course, students will be able to											
	E		Unders	tand										
C01	ar	nd <b>desc</b>	cribe the various calibration techniques Understand the	Cognitive		Remen	her							
	ba	asic me												
CO2		lustrat	Cognitive		Unders	tand								
	sp	ectros	Ũ	Remember										
CO3		nderst	and the immunological and radioactive techniques and	Cognitive		Unders	stand							
	un K	err app	on cations in biotechnology.			Unders	tond							
CO4	va va	arious i	maging techniques in biological field.	Cognitive										
COS	C	lassify	the various techniques of Chromatography, Elaborate	Generitien		Unders	tand							
0.05	th	e impo	ortance of electrophoresis	Cognitive		Remen	nber							
			Course content			]	Hours							
I – Iı	ntroc	luctior	1				9							
Class	sifica	tion of	instrumental methods - Concepts of accuracy, precision -	- Limits of de	tection	n (LOD)	– Type	es of						
error	s: Ra	ndom a	and Systematic – Calibration of instrumental methods: Ex	ternal, Interna	al and	standard	additio	on						
meth	ods -	-Signal	to Noise ratio.											
II – S	Spect	troscoj	pic Techniques				9							
Basic	es of	electro	magnetic radiation - Absorption, Transmittance and their	relationship -	- Beer	-Lamber	t's law	-						
Princ	iple,	Instru	mentation and applications of UV-Visible, IR, FTIR and C	Circular Dichr	oism S	Spectros	copy.							
III –	Imn	nunolo	gical and Radioactive Techniques				9							
Imm	unoa	ssays –	Enzyme-Linked Immunosorbent Assay (ELISA), Radioi	mmunoassay	(RIA)	– Immu	no							
histo	histochemistry – Immunoblotting – Flow cytommetry– Principle, Instrumentation and applications of Geiger-													
Mull	Muller counter, Solid & Liquid scintillation counters.													
<u> </u>														

|--|

Scanning Electron Microscope – Transmission Electron Microscope – Mass spectrometry and MALDI – TOF Analysis – Crystalline structure analysis: XRD and NMR.

### V – Separation Techniques

Affinity-based separations - Chromatography: Column chromatography, Thin-layer chromatography (TLC), Gas chromatography (GC) and High-performance liquid chromatography (HPLC) - Electrophoresis: Agarose Gel and SDS-Polyacrylamide Gel electrophoresis.

Lecture	Tutorial	Total	
45	0	45	

#### **Text Books:**

1. Robinson, J. W., Frame, E. M. S., Frame, G. M., Eileen, M., & Skelly, F. (2005). Undergraduate instrumental analysis.

2. Skoog, D. A., Holler, F. J., & Crouch, S. R. (2017). Principles of instrumental analysis. Cengage learning. **Reference Books:** 

- 1. Gordon, M. H., Macrae, R., & Mac Rae, R. (1987). Instrumental analysis in the biological sciences. Blackie.
- 2. Bisen, P. S., & Sharma, A. (2012). Introduction to instrumentation in life sciences. Crc Press.

#### **E-References:**

- 1. https://nptel.ac.in/courses/103/108/103108100/
- 2. https://nptel.ac.in/courses/103/108/103108100/
- 3. https://nptel.ac.in/courses/102/103/102103083/

#### Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	2	1	0	0	1	0	0	0	0	2	0	1
CO 2	3	3	2	2	0	0	1	0	0	0	0	0	0	1
CO 3	3	2	2	1	0	0	1	0	0	0	0	0	0	1
<b>CO 4</b>	2	3	2	2	0	0	0	0	0	0	0	1	0	1
CO 5	3	2	3	1	0	0	1	0	0	0	0	1	0	1
	14	12	11	7	0	0	4	0	0	0	0	4	0	5

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

#### Mapping of Subjects with POs

	2													
	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	<b>PO1</b>	PO1	PSO	PSO
	1	2	3	4	5	6	7	8	9	0	1	2	1	2
Origin														
al	14	12	11	7	0	0	4	0	0	0	0	4	0	5
Value														
Scaled	2	2	2	2	0	0	2	0	0	0	0	2	0	2
Value	3	3	3	2	0	0	2	0	0	0	0	2	0	2
$1-5 \rightarrow 1$		6 – 10	$\rightarrow 2$ ,	1	1 – 15	$\rightarrow 3$								

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

9

					L	Т	Р	С
X	BT 5	02			3	0	0	3
			MOLECULAR BIOLOGY					
С	Р	Α			L	Т	Р	Η
3	0	0			3	0	0	3
Lea	rning	g Objec	ctives:					
Upo	n cor	npletio	on of this course, the students					
Woi	ıld ha	ve lear	nt structures of DNA, RNA and its replication and repair					
Woi	ıld ha	ve lear	nt gene regulations					
			Course Outcomes	Domai	'n		Level	
Afte	r the	comple	etion of the course, students will be able to					
CO	1 R	elate a	nd Interpret DNA and RNA structure and its role	Cogniti	ve	Un	derstan	d
			- 6		Re	membe	er	
CO	2 E	xplain	Cogniti	ve	Understand			
		_		Apply				
CO	3 C	lassify	ve	A	nalyze			
	m	odifica	ations			* *	1 .	
CO	4 C	lassify	and <b>Dissect</b> translation and post translational processing	Cogniti	ve	Analyze		
				Cogniti		A	naryze	
CO	5 L	<b>ist</b> and	respond gene regulations	Cogniti	ve	Re	membe	er
			Course content			1	Hours	
I – I	ntro	luction	1				9	
Defi	nitior	ı of G	ene – Chromosomal organization of gene – Functional re	arrangemen	ts in cl	hromoso	mal D	NA –
Orga	nizir	ıg cellu	lar DNA into chromosome – Morphology and functional e	lements of e	eukaryo	otic chro	mosom	es.
II –	Repl	ication	and Repair				9	
Che	mistr	y of D	NA synthesis - Modes of DNA replication - Enzymes o	f replicatior	n – Mo	dels of a	replicat	ion –
Prok	aryot	ic repl	ication – Eukaryotic replication – DNA mutations – Types	of mutation	ns – Ty	pes of E	NA da	mage
- Dì	NA re	pair m	echanisms					
III -	- Tra	nscrip	tion and RNA processing				9	
Тур	es of	RNA	- RNA polymerase enzymes (prokaryotic & eukaryotic	c) – Transc	ription	initiatio	on fact	ors –
Trar	scrip	tional	elongation (prokaryotic & eukaryotic) – Transcriptional te	rmination (J	orokary	otic & e	ukaryo	tic) –
Prok	aryot	tic RN	A processing – Eukaryotic RNA processing (3'-polya	denylation,	5'-CA	P form	ation,	RNA

decapping, mRNA splicing).

IV – Translation and its regulation

Protein synthesis machinery (t-RNA, m-RNA, ribosomes, aminoacyl tRNA synthetases) – Initiation of protein translation (prokaryotic & eukaryotic) – Elongation of protein translation (prokaryotic & eukaryotic) – Termination of protein translation (prokaryotic & eukaryotic) – Regulation of translation.

9

9

#### V – Regulation of gene expression

Prokaryotic gene regulation (activator, inducer & repressor) – Eukaryotic gene regulation (histone modification, DNA modification & chromatin remodelling)

DNA modification & chromatin remodelling).

Lecture	Tutorial	Practical	Total	
45	0	0	45	

#### **Text Books:**

- 1. Verma P.S. (Author), Agarwal V.K. Molecular Biology, 2010.
- 2. Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press; Eighth edition, 2018.

#### **Reference Books:**

- 1. Molecular Biology of the Gene, James D. Watson, A. Baker Tania, P. Bell Stephen, Gann Alexander, Levine Michael, Losick Richard, Pearson Education; Seventh edition, 2017.
- 2. Molecular Biology Made Simple and Fun, David P. Clark (Author), Lonnie Dee Russell (Author), 2010.

#### **E-References:**

- 1. https://nptel.ac.in/courses/102106025/
- 2. https://www.embl.de/training/e-learning/
- 3. https://swayam.gov.in/course/5065-molecular-biology
- 4. https://www.ox.ac.uk/admissions/undergraduate/courses-listing/biochemistry-molecular-and-cellular?wssl=1
- 5. https://vlab.amrita.edu/?sub=3&brch=77
- 6. https://www.youtube.com/watch?v=V4CRCQfXUrg

# Mapping of COs with Pos

	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	1	2	0	1	0	0	1	1	1	1			
CO 2	1	1	2	0	1	0	0	1	1	1	1			
CO 3	1	1	2	0	1	0	0	1	1	1	1			
<b>CO 4</b>	1	1	2	0	1	0	0	1	1	1	1			
CO 5	1	1	2	0	1	0	0	1	1	1	1			
	5	5	10	0	5	0	0	5	5	5	5			

## Mapping of Subjects with POs

	PO 1	PO 2	PO 3	PO 4	РО 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
Origin al Value	5	5	10	0	5	0	0	5	5	5	5			
Scaled Value	1	1	2	0	1	0	0	1	1	1	1			

 $\begin{array}{ccc} 1-5 \rightarrow 1, & 6-10 \rightarrow 2, & 11-15 \rightarrow 3 \\ 0 \text{ - No Relation, } 1 \text{ - Low Relation, } 2\text{ - Medium Relation, } 3\text{- High Relation} \end{array}$ 

					L	Т	Р	С
X	BT 503	3			2	1	0	3
			<b>BIOREACTION ENGINEERING</b>					
С	P	A			L	Т	Р	Η
2	0	1			3	1	0	4
Lear	ning O	)bjec	tives:					
Upor	n comp	oletio	on of this course, the students					
Wou	ld able	to kr	nown about the basics of biochemical process.					
Wou	ld have	e und	erstood the concepts of enzyme kinetics.					
Wou	ld have	e kno	wledge on the kinetic model for biochemical reactions.					
Wou	ld able	to de	esign a bioreactor for a particular biochemical process.					
			Course Outcomes	Domai	n	]	Level	
After	the co	mple	tion of the course, students will be able to			1		
CO1	Арр	ply th	he fundamentals of reaction kinetics	Cognitive		Apply		
CO2	Cal	culat	te the M-M kinetics parameter.	Cognitive		Apply		
CO3	Clas	ssify	theenzyme immobilization method	Cognitive		Apply		
CO4	Esti	imate	e the Monod parameters of cell growth.	Cognitive		Apply		
CO5	imn	<b>ganiz</b> nobili	etypes of bioreactor reactors for suspension and ized culture.	Cognitive		Apply		
			Course content			I	Iours	
Unit	-I – Re	eactio	on Kinetics				6+3	
Rate	law – C	Orde	r of reaction kinetics: Zero, First and Second Order reaction	ons – Ideal re	eactors	: Batch,	Mixed	flow,
and I	Plug flo	ow - ]	Femperature effect on rate constant.					
Unit	-II – Ei	nzyn	nes Production and Its Kinetics				6+3	
M-M	kineti	ics –	enzyme inhibition - enzyme stability& specificity- fact	ors affecting	reacti	on rates	– indu	strial
L								

production process- Industrial production and applications of enzymes:  $\alpha$ -amylase – cellulase – protease – lipase.

#### **Unit-III – Immobilization System**

Enzyme Immobilization – Diffusion Effects – Thiele modulus, Effectiveness factor, Damkoehler number - Application of hydrolytic enzymes-Immobilized microbial cells, carrier binding, Entrapping, Cross linking, Advantages and disadvantages of immobilized cells.

#### **Unit-IV – Cell Growth Kinetics**

6+3

6+3

Kinetics of cell growth – Substrate utilization and product formation –Structured, Unstructured non segregated models to predict specific growth rate, cell growth in continuous cultures Definitions and stoichiometric calculations-elemental balances, Degree of reduction, Theoretical predictions of yield coefficients - Microbial, animal and plant cell cultivation –factors affecting the growth.

### Unit -V - Bioreactors

6+3

Microbial and enzyme reactors - Ideal Bioreactors-Type of bioreactor-Airlift bioreactors-Airlift pressure cycle bioreactors—Fluidized bed reactors-trickle bed reactors-loop reactor-Stirred tank reactors-Bubble column fermenter – Optimization and scale up.

Lecture	Tutorial	Practical	Total
30	15	0	45

#### **Text Books:**

- Bailey J.E. and Ollis D.F, Biochemical Engineering Fundamentals, Second edition, McGraw Hill Co, Newyork, 2010.
- 2. Rajiv Dutta, Fundamentals of Biochemical Engineering, First Edition, Springer, 2008.

### **Reference Books:**

- Jens Nielsen, John Villadsen and Gunnar Liden, Bioreaction Engineering Principles, Second edition, Kluwer Academic/Plenum Publishers, Newyork, 2003.
- 2. GhasemNajafpour, Biochemical Engineering and Biotechnology, Elsevier, 2007.

## **E-References:**

http://nptel.ac.in/courses/103105054/

### Mapping of COs with Pos

	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3										1	1	1	
CO 2	2	3		1					1			1	2	
CO 3		1	3									2	3	1
CO 4		1	2									3	1	2

CO 5	1	2	3	1								2	1	3
	6	7	8	2	0	0	0	0	1	0	1	9	8	6

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

# Mapping of Subjects with Pos

	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	6	7	8	2	0	0	0	0	1	0	1	9	8	6
Scaled Value	2	2	2	1	0	0	0	0	1	0	1	3	2	2

 $1-5 \rightarrow 1$ ,  $6-10 \rightarrow 2$ ,  $11-15 \rightarrow 3$ 0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

				L	Т	Р	С					
XB	Т 504			3	0	0	3					
		PLANT BIOTECHNOLOGY										
CI	P A			L	Т	Р	Н					
3	0 0			3	0	0	3					
Prerec	quisite: Co	ell biology, Genetics and Molecular biology		•								
Learn	ing Objec	tives:										
Upon	completio	on of this course, the students										
Would	Would have understand the fundamentals of plant cells.											
Would	Would have learn the techniques in Plant Tissue Culture.											
Would	Would have understood various techniques of gene transfer in plants.											
Would	Would have learn production of Biomolecules from plants for various applications.											
		Course Outcomes	Domai	n	]	Level						
After t	he comple	etion of the course, students will be able to		•								
CO1	Describe	e the plant genome and knows various terminology	Cognitive		Remen	ıber						
COI	related to	p plant tissue culture.	Cognitive		Unders	tand						
CO2	Describe	e Fundamentals of plant cells and plant tissue culture	Cognitive		Remem	ıber						
02	and <b>kno</b>	ws various media for tissue culture.			Unders	tand						
CO3	Compar	re the various gene transfer methods in plants and Relate	Cognitive		Remem	ber						
005	each oth	er with its pros and cons	coginave		Unders	tand						
CO4	Relate a	and Analyze various vectors and genetic manipulation	Cognitive		Unders	tand						
004	techniqu	es	coginave		Analyz	e						
CO5	Choose	and Apply Herbicide tolerance pesticide, GMOs and	Cognitive		Unders	tand						
005	molecular farming. Apply											
	Course content Hours											
Unit-I	– Introdu	action to Plant Tissue Culture				9						
Scope	of plant	biotechnology - Plasticity and totipotency - History	of plant ti	ssue c	ulture –	Types	and					
compo	composition of tissue culture media - Role of plant growth regulators and elicitors- Physiochemical conditions											

for tissue culture – kinetics of growth and nutrient optimization; viability in the tissue culture; somaclonal variation.

9

9

9

9

#### **Unit-II – In vitro Propagation**

Types of plant tissue culture –Regeneration of plants-Organogenesis and somatic embryogenesis - Culture types: Callus, cell-suspension culture, shoot and root tip culture, hairy root culture, Meristem culture, pollen culture, Anther culture and haploid production – protoplast culture: isolation, fusion-somatic hybrid and cybrid and regeneration of protoplast – Germplasm conservation and cryopreservation.

#### **Unit-III – Plant Breeding Techniques**

Simple and complex inheritance - back cross – selection marker and reporter gene; Molecular Markers: RFLP and PCR based SSR markers - Marker-Assisted selection, Hybrid seeds production - Herbicide tolerant plants: Different strategies to achieve, strategy to generate glyphosate tolerant plants and their related problems – Production of marker free transgenic plants; plastid transformation

#### **Unit-IV – Genetic Transformation of Plants**

Agrobacterium mediated gene transfer – Crown gall disease, Genes involved in DNA transfer, Ti plasmid, Ri plasmid - Binary vector system - Plant viruses and different types of Viral Vectors – Gemini virus, Cauliflower mosaic virus – Direct gene transfer methods – particle gun bombardment, electroporation. Indirect gene transfer techniques.

#### **Unit-V – Applications of Plant Biotechnology**

Molecular farming/ Pharming of proteins – Bioreactors for recombinant protein, Secondary metabolite production using plant cell culture. Antisense technology in crop improvement - Therapeutic/Industrial applications of plant products - Plant vaccines, custom-made antibodies, Transgenic plants - their issues and solutions.

Lecture	Tutorial	Practical	Total
45	0	0	45

#### **Text Books:**

- 1. Slater A., Nigel W., Scott, and Fowler MR., Plant biotechnology: The Genetic Manipulation of Plants, Oxford University Press, London, 2nd Edition, 2008.
- 2. Neal Stewart, Jr., Plant Biotechnology and Genetics: Principles, Techniques, and Applications. John Wiley & Sons Inc. USA, 2008.

#### **Reference Books:**

- 1. Chawla HS. Introduction to Plant Biotechnology, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, 2nd Edition, 2003.
- Neumann, Karl-Hermann, Ashwani Kumar, and Sudhir K. Sopory. Recent Advances in Plant Biotechnology and Its Applications: Prof. Dr. Karl-Hermann Neumann Commemorative Volume. IK International Pvt Ltd, 2008.
- 3. Hammond, John, Peter McGarvey, and VidadiYusibov, eds. Plant biotechnology: new products and applications. Vol. 240. Springer Science & Business Media, 2012.

## **E-References:**

http://www.ncbi.nlm.nih.gov/books/NBK26851/

# Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	<b>PO10</b>	PO11	PO12	PSO1	PSO2
CO 1	2	0	1	1	2	1	0	0	1	1	1	3	3	3
CO 2	3	2	2	2	3	2	1	1	2	1	1	2	2	2
CO 3	2	1	3	1	2	2	1	0	2	2	1	2	2	2
CO 4	3	2	2	2	2	2	1	1	1	1	0	3	2	2
CO 5	3	3	3	2	3	2	3	2	2	2	2	3	1	1
	13	8	11	8	14	9	5	4	8	7	5	13	10	10

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

# Mapping of Subjects with Pos

	PO	PO1	PO1	PO1	PSO	PSO								
	L		3	4	5	0	1	ð	9	U	L	2	L	2
Origin al Value	13	8	11	8	14	9	5	4	8	7	5	13	10	10
Scaled Value	3	2	3	2	3	2	1	1	2	2	1	3	2	2

 $1 - 5 \rightarrow 1, \qquad 6 - 10 \rightarrow 2, \qquad 11 - 15 \rightarrow 3$ 

				L	Т	Р	С					
X	BT 5	05A		3	0	0	3					
			FOOD BIOTECHNOLOGY									
С	Р	L	Т	Р	Н							
3	0	3	0	0	3							
PRI	EREC											
Lea	Learning Objectives:											
Upo	Upon completion of this course, the students											
Will	be al	ole to ur	nderstand the application of biotechnology in animal, plant and food plant	roduc	tion							
Will	be al	ole to de	escribe selected industrial food biotechnology processes									
Will	be al	ole to de	escribe selected classical fermentation processes and to describe how f	erme	ntatio	n can	l					
deliv	ver nu	ıtrition										
Will	Will be able to understand safety aspects of fermented food products											
			Course Outcomes Domain		]	Level						
Afte	r the	complet	ion of the course, students will be able to									

CO1. Know	the principles and	<b>defines</b> the concepts of food		
biotechnology.	the principies and	defines the concepts of food	Cognitive	Remember
CO2: Describe	e the role of microbes as	sociated with food products.	Cognitive	Understand
CO3: Outlines	the methods for Geneti	cally modified food production.	Cognitive	Analyze
CO4: Discuss	and compiles the varia	ous methods of food preservation	Cognitive	Understand
and packaging			Cognitive	
CO5: Describe	e the importance of food	quality and regulations	Cognitive	Evaluate
Unit-I	Introduction to food	biotechnology		9
Introduction -	Scope and importance	of food biotechnology - Biotechn	ological appro	paches to improve
nutritional qual	lity and shelf life of co	ommercialized fruits and vegetables	- Functional	foods: Concept of
Prebiotics, Prob	piotics and Nutraceutica	ls.		
Unit-II	Utilization of microo	rganisms in food industries		9
Fermented dain	ry products: Cheese, Y	Yoghurt -Fermented food products	– Natto, Miso	o, Sufu, meat and
sausages – Sing	gle cell protein production	on– Cocoa, Tea and Coffee fermenta	tion.	
Unit-III	Genetically modified	food products		9
Herbicide tolera	ant Soybean – Insect res	sistant Corn – Altered fatty acid com	position Cano	la – Virus resistant
Plum – Vitamir	n enriched Golden rice -	- Faster maturation Coho Salmon.		
Unit-IV	Food Preservation an	nd Packaging		9
Mechanisms of	food spoilage – Food p	preservation by low-temp: Refrigerat	ion, freezing a	nd freeze-drying –
Food preservat	ion by heating: drying,	osmotic dehydration, blanching, can	ning, pasteuriz	zation, sterilization
– Non-thermal	preservation: ionizing r	adiation, high hydrostatic pressure,	pulsed electric	field – Packaging
of foods: packa	ging materials, packagin	ng atmosphere		
Unit-V	Food safety and regu	lations		9
Safety of ferme	ented foods - Approval	process for food additives - Hazard	Analysis Crit	ical Control Points
(HACCP) – FS	SAI			
LECTURE	TUTORIAL	PRACTICAL		TOTAL
45	0	0		45
			1	
TEXT BOOK	8:			
Byong H. Lee.,	Fundamentals of food l	piotechnology. John Wiley & Sons, 2	2014.	
REFERENCE	BOOKS:			
1. Bhatia, S. C.	(2017). Food biotechno	logy. Wpi Publishing.		

2. Ray B., "Fundamental Food Microbiology", Third Edition, CRC Press LLC, 2003.

3. Shetty, Kalidas, et al., eds. Food biotechnology. CRC Taylor & Francis, 2006.

# **E- REFERENCES**

- 1. http://nptel.ac.in/courses/103107088/
- 2. http://nptel.ac.in/courses/103103029/34

## Mapping of COs with Pos

	PO1	PO 2	<b>PO</b> 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	1	3	1	2						3	3	3
CO 2	2	1	3	2	2	2						2	2	2
CO 3	2		3	2	3	1					2	2	2	2
<b>CO 4</b>	2		2	2	3	1					3	3	2	2
CO 5	2		3		3	3						3	1	1
	10	3	12	9	12	9					5	13	10	10

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

# Mapping of Subjects with Pos

	PO	<b>PO1</b>	<b>PO1</b>	<b>PO1</b>	PSO	PSO								
	1	2	3	4	5	6	7	8	9	0	1	2	1	2
Origin al Value	10	3	12	9	12	9	0	0	0	0	5	13	10	10
Scaled Value	2	1	3	2	3	2	0	0	0	0	1	3	2	2

 $1-5 \rightarrow 1$ ,  $6-10 \rightarrow 2$ ,  $\overline{11-15 \rightarrow 3}$ 

X	BT 5	05B			L 3	T 0	P 0	C 3			
C	р	Δ	- AGRICULTURAL BIOTECHNOLOGY		L	т	р	н			
3	0	0	-	·	3	0	0	3			
PRE	CREC	) UISI	[E: -		U	Ŭ	Ŭ				
Lea	rning	Obje	ctives:								
Upo	n con	npletio	n of this course, the students								
Will	be al	ble to u	inderstand the application of biotechnology in Agricultural	fields							
Will	Will be able to describe selected industrial agri biotechnology processes										
			Course Outcomes	Domain			Level				
Afte	r the	comple	etion of the course, students will be able to								
<b>CO</b> biote	l:Kno	owthe	principles and <b>defines</b> the concepts of Agricultural	Cognitive	•	Re	mem	ber			
CO	2:Des	cribet	he role of plant breeding in agriculture.	Cognitive	;	Un	derst	and			
CO	3:Out	t <b>lines</b> tł	tools and techniques of genetic engineering	Cognitive	;	Un	derst	and			
CO	4:Dis	cussan	d <b>compiles</b> the biodiversity in agricultural field	Cognitive	;	Un	derst	and			
CO	5:Des	cribet	he importance of IPR in agricultural products.	Cognitive	;	E	valua	te			
1	Unit-I	I	Genomes and Genes	-			9				
Chro	omati	n stru	cture, Karyotype analysis, Genome organization – C	-Value para	a, do	ox, (	Cot c	curves			
&sig	gnific	ance, C	Chromosome behaviour.								
τ	J <b>nit-I</b>	Ι	Agriculture and Plant Breeding				9				
Bree	eding	of cro	pps, Heterosis, Apomixis, Mutations, Polyploidy in crop	improvemen	nt, ar	nd Pr	incip	les of			
integ	grated	l Pest M	Management.								
τ	J <b>nit-I</b>	II	Tools and Techniques of Genetic Engineering				9				
Reco	ombir	nant I	DNA technology; Concept of Genetic makers; gene	interaction	, mı	ultiple	e all	elism,			
pleiotropism and multiple factor inheritance. Genetic, Chromosomal and Molecular map, Techniques in											
genetic engineering; Genome Analysis: Genome projects, Genome Annotation, Biological Data Bases, Data											
base search engines, Sequence Analysis and Molecular Phylogeny.											
U	nit-I	V	Biodiversity				9				
Gen	etic d	iversit	y, Molecular diversity; Species and Population biodiversity	, Collection	and	cons	ervati	ion of			
biod	iversi	ity, en	dangered plants, endemism and Red Data Book, Biodiv	ersity and o	centre	es of	origi	ins of			
plan	plants; Biodiversity hot spots.										

Unit-V	IPR on Agricultural Products									
IPR Introductio	IPR Introduction - IPR in relation to Indian Flora- Basmati Rice, Turmeric and Neem.									
LECTURE	TUTORIAL	PRACTICAL	TOTAL							
45	0	0	45							

## **TEXT BOOKS:**

1. Ahindra Nag., Text Book of Agricultural Biotechnology. PHI Learning Publisher New Delhi, 2008.

## **REFERENCE BOOKS:**

1. Anshuman Singh, Ashutosh Singh, Ashutosh Kumar Srivastava2. Ray B., "Agricultural Biotechnology"

Medtech Publisher, Edition-1, 2019

## **E- REFERENCES**

1. <u>https://nptel.ac.in/content/syllabus_pdf/102103016.pdf</u>

#### Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	1	3	1	2						3	3	3
CO 2	2	1	3	2	2	2						2	2	2
CO 3	2		3	2	3	1					2	2	2	2
CO 4	2		2	2	3	1					3	3	2	2
CO 5	2		3		3	3						3	3	1
	10	3	12	9	12	9					5	13	12	10

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

## Mapping of Subjects with POs

	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	<b>PO1</b>	PO1	PSO	PSO
	1	2	3	4	5	6	7	8	9	0	1	2	1	2
Origin														
al	10	3	12	9	12	9	0	0	0	0	5	13	12	10
Value														
Scaled	2	1	3	2	3	2	0	0	0	0	1	3	2	2
Value	2	1	5	2	5	2	0	0	0	0	1	5	2	2
$1-5 \rightarrow 1$		6 - 10	$\rightarrow 2$ .	. 1	1 – 15	$\rightarrow 3$	•	•	•	•	•	•	•	•

					L	Т	Р	С				
XBT505C						0	0	3				
С	Р	Α		L	Т	Р	Н					
3	0	3	0	0	3							
Prerequisite: Biochemistry, Immunology, r-DNA technology												
Lear	ning(	Object	ives:									
Upon	o com	pletio	n of this course, the students									
Woul	d able	e to un	derstand principles of biotechnology in pharmaceutical pr	oduct develo	opmen	t.						
Woul	d app	ly adv	anced biotechnology methods in novel drug development									
Woul	d able	e to rev	view the production processes for antibiotics, vitamins, all	caloids and s	teroid	S						
		Domain	1	Level								
After	the c	omplet	ion of the course, students will be able to									
COI	id	lentify	the potential avenues and requirements from the			Analyza						
CO	biotechnologists in pharmaceutical industries and <b>describe e</b> Cognit					Understand						
	th	ie scop	e and applications of biotechnology in pharmacy			Understand						
CO2	2	utline		Analyze								
		unne	the pharma codynamics, pharmacoknetics of drugs	Cognitive		Understand						
CO3	з D	escrib	e various adverse effects of drugs		Analyze							
000		eseris		coginare	Understand							
CO4	I E	xplain	the manufacturing process for various therapeutical	Cognitive		Analyze						
	p	roducts	s including vaccines, enzymes, interleukins, hormones	e og mar o		Understand						
COS	<b>CO5 Comprehend</b> the methods applied to test the quality of drugs						Analyze					
000	and other biopharmaceuticals											
I- Int	rodu		7									
Intro	luctio	n to P	harmaceutical industry & development of drugs; types o	f therapeutic	agent	is and	their	uses.				
Pharm	naceu	tical E	Biotechnology and Drug discovery. Scope and application	ons of biotec	hnolo	gy in j	oharn	nacy,				
biolog	gical	/resear	ch advances and approved biologicals for pharmaceutical	uses.								
II- D		10										
Physi	ocher	nical p	properties of drugs, factors modifying drug action. Phar	maco dynan	nics, p	harma	cokin	netics				
and d	rug m	netabol	ism.									
III- ]	Drug	s and [	Their Interaction			10						
Adverse effects of drugs and drug toxicology: Reproductive toxicity and Teratogenicity, Mutagenicity, Carcinogenicity, Drug tolerance, Drug intolerance, drug allergy, drug induced side effects. Tachyphylaxis, biological effects of drug abuse and drug dependence.

### **IV-** Production of Biopharmaceuticals

11

7

Biopharmaceutical and biological drug development, Manufacturing of biopharmaceutical, therapeutic proteins and peptides. Recombinant growth hormones, growth factors, therapeutic monoclonal antibodies, therapeutic enzymes and their application in health care.

#### V- Testing and Analysis of Biopharmaceuticals

Pharmaceutical Testing, Analysis and Control: Analysis of pharmaceuticals using physical, chemical and biological methods, quality assurance and control, stability of pharmaceutical products

Lecture	Tutorial	Practical	Total	
45	0	0	45	

#### **Text Books:**

- 1. Purohit, Kulkarni, Saluja—Pharmaceutical biotechnology, Agrobios publishers, 2003
- 2. Pharmaceutical biotechnology edition2 by crommel, Freeman publishers, 2004

#### **References:**

- 1. Crommelin.D.J.A, Robert D. Sindela, Bernd Meibohm "Pharmaceutical Biotechnology: fundamentals and applications", Informa Healthcare, 2008.
- 2. Pharmaceutical biotechnology:drug discovery and clinical applications by Kayser,Wiley publishers, 1st edition 2007
- 3. Katzung B.G. Basic and Clinical Pharmacology,(6th Ed) Prentice Hall of Intl., 1995

### **E- References:**

https://archive.org/details/PharmaceuticalBiotechnology/page/n111

### Mapping Of COs and POs

						Pr	ogram	Outco	nes					
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2	-	1	1	2	2	-	-	1	1	1	1	0	0
CO2	1	1	1	1	2	2	1	2	1	2	2	2	1	0
CO3	2	2	2	2	1	2	2	-	2	2	1	1	2	0
CO4	2	1	3	2	2	3	2	-	1	1	-	-	3	0
CO5	2	3	2	2	3	3	2	2	2	2	1	1	3	0
	9	7	9	8	10	12	7	4	7	8	5	5	9	0

### Mapping of Subject Vs Pos

	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original value	9	7	9	8	10	12	7	4	7	8	5	5	9	0
Scaled to 0,1,2,3 scale	2	2	2	2	2	3	2	0	2	2	0	0	2	0

Scale: 3- high, 2 - Medium, 1 - Low, 0 - not related

					L	Т	Р	С					
X	BT 5	07			0	0	1	1					
			<b>BIOANALYTICAL TOOLS LABORATORY</b>	ζ									
С	Р	Α		-	L	Т	Р	Η					
0.5	1	0.5			0	0	2	6					
Lear	ning	Objec	ctives:	I									
Upor	n con	npletio	n of this course, the students										
Will	be al	ole to u	nderstand the principles of instrumentation										
Will	be al	ole to in	mpart the knowledge of different techniques and methods in	n biotechnol	ogy								
			Course Outcomes	Domain	n	]	Level						
After	the	comple	ompletion of the course, students will be able to										
	F	vnlain	the basics and fundamentals of analytical techniques	Cognitiv	/e	Aj	pplying	ŗ,					
CO1	 	nd desc	ribe the various calibration techniques	Psychomo	otor	Guide	d Resp	onse					
	a	iu ucsu	the various canoration techniques.	Affectiv	ve	Respond							
	п	escrib	e the spectrophotometric methods and <b>perform</b> the	Cognitiv	ve	Aj	pplying	5					
CO2		vnerim	ents related to spectroscony	Psychomo	otor	Guided Response							
		sperm	ents related to specific scopy.	Affectiv	re	Respond							
	T	nderst	and the immunological techniques and annly it in	Cognitiv	ve	Aj	pplying	5					
CO3		arious	applications in biotechnology	Psychomo	otor	Guide	d Resp	onse					
	ve	11003	applications in biotechnology.	Affectiv	re	R	espond						
	ĸ	now f	he principle of instrumentation and applications of	Cognitiv	/e	Aj	pplying	5					
CO4		arious i	maging techniques in biological field	Psychomo	otor	Guide	d Resp	onse					
	~~~	110031	magnig teeninques in biological neid.	Affectiv	re	R	espond						
	п	istinor	ush the various separation techniques Classify the	Cognitiv	/e	Aj	pplying	5					
CO5		arious	rechniques of Chromatography and Electrophoresis	Psychomo	otor	Guide	d Resp	onse					
	v		configues of enromatography and Electrophotesis	Affectiv	ve	R	espond						
S.N	0		List of Experiments				CC)s					
1	1 Validation of accuracy and precision of an instrument used in the laboratory												

2	Preparation of calibration curve in spectrophotometry	CO1
3	Determination of drug components by Ultraviolet Spectrophotometry	CO2

		0	30	30						
	HOURS	TUTORIAL	PRACTICAL	TOTAL						
10	Separation of proteins by SDS-Polyacrylamide gel	Electrophoresis		CO5						
9	Separation of nucleic acids by Agarose gel Electrop	phoresis		CO5						
8	8 Separation of compounds using Column Chromatography									
7	Qualitative analysis of compounds by Thin Layer C	Chromatography		CO5						
6	Image analysis by electron microscopy			CO4						
5	Immuno diffusion assay			CO3						
4	Interpretation of FTIR spectra			CO2						

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	2	1	0	0	1	0	0	0	0	2	0	1
CO 2	3	3	2	2	0	0	1	0	0	0	0	0	0	1
CO 3	3	2	2	1	0	0	1	0	0	0	0	0	0	1
CO 4	2	3	2	2	0	0	0	0	0	0	0	1	0	1
CO 5	3	2	3	1	0	0	1	0	0	0	0	1	0	1
	14	12	11	7	0	0	4	0	0	0	0	4	0	5

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with POs

	РО	PO	PO	PO	РО	PO	PO	РО	PO	PO1	PO1	PO1	PSO	PSO
	1	2	3	4	5	6	7	8	9	0	1	2	1	2
Origin														
al	14	12	11	7	0	0	4	0	0	0	0	4	0	5
Value														
Scaled	3	3	3	2	0	0	2	0	0	0	0	2	0	2
Value	5	5	5	2	0	0	2	0	0	0	0	2	0	2

 $1-5 \rightarrow 1, \qquad 6-10 \rightarrow 2, \qquad 11-15 \rightarrow 3$

COURS	SE CODE			XBT	508		L	Т	Р	С		
COURS	SE NAME		Bio reac	tion Engine	ering Laborato	ory	0	0	2	2		
PRERE	EQUISITES			-			L	Т	Р	Н		
C:P:A		0.5:1:	:0.5				0	0	2	6		
LEARN	NING OBJECTI	IVES					1					
Upon co	ompletion of this	s course	, the stude	ents will be	able to apply th	neir know	ledge of	f Biore	action e	ngineering		
phenom	ena to demonstra	ate asep	tic enzym	e techniques	in the laborator	У						
	C	COURS	SE OUTC	COMES		D	OMAI	N	LE	VEL		
After th	e completion of c	course t	he student	ts will be abl	e to							
-						(Cognitiv	e	Apply			
CO1	Demonstrate en	enzyme	kinetics N	I-M and Ext	raction	Ps	chomo	tor	Guided	Response		
						A	Affective	e	Res	pond		
				(Cognitiv	e	Ap	oply				
CO2	Perform enzym	me activ	ity at diffe	Ps	chomo	tor	Guided Respons					
			Affective	e	Respond							
		Cognitiv	e	Aj	oply							
CO3	Demonstrate en	enzyme	immobiliz	Ps	chomo	tor	Guided	Response				
						A	Affective	e	Respond			
							Cognitiv	e	Al	oply		
CO4	Determine grow	owth kin	etics			Ps	chomo	tor	Guided	Response		
						F	Affective	e	Res	spond		
CO5	T • (1 1	1 /	,	1		ognitiv	e		oply		
COS	Experiment on	n alcono	ol concenti	ration in win	e production	PS	chomo	tor	Guidea	Response		
S No				List of Fr	marimants	I			Res			
1	Study of MAN 1	Irin at -	ond d-4.							<u>CO1</u>		
1	Study of MI-MI	kinetics	and deter	mination of	ivi-ivi constants.							
2	Extraction of enzyme from fruits and vegetable									CO1		
3	Effect of temper	erature o	on Enzyme	e Activity.						CO2		
4	Effect of pH on	n Enzyn	ne Activity	у.						CO2		
5	Effect of substra	rate con	centration	on Enzyme	Activity.					CO2		
6	Enzyme immob	bilizatio	n by phys	ical adsorpti	on.					CO3		
7	Enzyme immobilization by Gel Entrapment.									CO3		

8 Study of Production of growth and/or non-growth associated products.												
9 Study of Microbial Growth kinetics and estimation of Monod parameters.												
10	10 Estimation of alcohol concentration in wine production. CO5											
Referen	ce:1. Bailey J.E. and Ollis D.F, Biochemical Engin	eering Fundamer	ntals, Second edition	n, McGraw Hill								
Co, New	vyork, 2010.											
	HOURS	TUTORIAL	PRACTICAL	TOTAL								
	0 30 30											
		-										

Mapping of COs with Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3										1	1	1	
CO 2	2	3		1					1			1	2	
CO 3		1	3									2	3	1
CO 4		1	2									3	1	2
CO 5	1	2	3	1								2	1	3
	6	7	8	2	0	0	0	0	1	0	1	9	8	6

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subjects with Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Original Value	6	7	8	2	0	0	0	0	1	0	1	9	8	6
Scaled Value	2	2	2	1	0	0	0	0	1	0	1	3	2	2
$1-5 \rightarrow 1$,	•	6 - 10	$\rightarrow 2$,	1	1 – 15	$\rightarrow 3$	•		•					

				L	Т	Р	С
2	XBT 50	9		0	0	0	1
			INPLANT TRAINING - II				
С	Р	Α		L	Т	Р	Η
0.66	0.66	0.66		0	0	0	0

COURSE OUTCOMES:

	Course Outcomes	Domain	Level
On the	successful completion of the course, students will be able to		
CO1	Relate classroom theory with workplace practice	Cog	Understand
CO2	Comply with Factory discipline, management and business practices.	Aff	Response
CO3	Demonstrates teamwork and time management.	Aff	Value
CO4	Describe and display hands-on experience on practical skills obtained during the programme.	Phy	Perception Set
CO5	Summarize the tasks and activities done by technical documents and oral presentations.	Cog	Evaluate

Mapping COs with Pos

	PO	PO1	PO1	PO1	PSO	PSO								
	1	2	3	4	5	6	7	8	9	0	1	2	1	2
CO1	2													
CO2							1	3			1		1	1
CO3									3	1	3		3	3
CO4		1	2	1	3								1	1
CO5				3						3			1	1
Total	2	1	2	4	3	0	1	3	3	4	4		6	6
Scale	1	1	2	1	1	0	1	1	1	1	1	1	2	2
d														

1 - Low, 2 - Medium, 3 - High

VI Semester

					L	Т	Р	С
Χ	BT6	01			3	0	0	3
			ANIMAL BIOTECHNOLOGY					
С	P	Α			L	Т	Р	Η
2.5	0	0.5			3	0	0	3
Prer	equi	site: N	il					
Lear	ning	Objec	ctive: Upon completion of this course, the students					
Wou	ld ha	ve lear	nt animal cell culturing techniques					
Wou	ld ha	ve lear	nt designing animal cell culture lab					
Wou	ld ha	ve lear	nt knock-out mechanisms of genes					
Wou	ld ha	ve lear	nt techniques for production of transgenic animals and clo	ning				
			Course Outcomes	Domain		L	evel	
After	• the	comple	etion of the course, students will be able to					
CO1	: Ex	plain a	nimal cell culture media and animal cell culture	Cognitive	U	nders	tand	
techr	nique	s.						
CO2	: De	scribe	various gene transfer methods in animal cells.	Cognitive	E	valua	te	
CO3	:Ana	alyze v	arious micromanipulation techniques and reproduce	Cognitive	A	nalyz	e	
them	in fe	ertilizat	ion technology.	Affective	R	espor	nd	
CO4	:Dist	tinguis	h various methods and techniques for production of	Cognitive	U	nders	tand	
trans	genic	c anima	als and cloning.	<i>a</i>				
CO5	: De	scribe	manipulation strategies to improve livestock production	Cognitive	U	nders	tand	
inclu	ding	meat a	ind milk production					
Unit	-I- C	ell Cu	lture Techniques		9			
Cuin	ire n	iedia c	omposition and growth conditions; Animal cell and tissu	le preservati	on; P	inche	orage	and
non-a	ancho	orage o	ependent cell culture. Key events in the development of ce	and tissue	cultu	re		
Auva Extra	untag	e of us	sue cultures ubculture of continuous line growth and Cell atrix and its releCell Interaction and signalling path	une Characte		1011 f1	1 au	turo
EXU?	otor	Ilai IVI	a of CO incubator and laminar flow safety cabi	waysDesigiii	ng 0		r cui	biol
conts	min	ationD	2 $contamination techniques$		ation	01	mere	Julai
Unit	.II. (Cene T	ransfer Techniques			9		
Kine	tics of	of cell	growth: Micro & macro-carrier culture: Hybridoma tecl	nology: Ste	m ce	- 11. tec	hnol	ogy.
Anin	nal cl	oning.	Transgenic animals: Knock-out and knock-in animals Gre	with of anim	al ce	lls cu	lture	ogy,
Knoc	k-ou	it mech	anism using computation biology		ur ce		iture	
Unit		Invitr	o Fertilization and Embryo Transfer			9		
invit	ro fei	rtilizati	on and its limitations - Artificial insemination Super ovul	ation Embr	vo sn	littin	J Bio	onsv
and	Sexi	ng of	embryos and Embryo transfer- Embryo cryopreservatic	on technique	s - 1	Limit	ation	s in
embr	vo tr	ansfer	- Breeding of farm animals.Embryo transfer: https://www	v.uaex.edu/n	ublic	ation	s/pdf	/fsa-
3119	.pdf			P			· r · · · /	
Unit	-IV-	Manir	oulations for Product Improvement			9		
Mani	pula	tion of	Growth hormone; Role of Somatotropic and Thyroid hor	mone in gro	wth	- Pro	biotic	es as
grow	th pr	omote	rs; Ideal characteristics, Mode of action and uses of probi	otics; Manip	ulatio	on of	lacta	tion
				· 1				

	genesis a	and gai	actopoi	esis, w	ool gro	wth and	d rume	n micro	obial di	gestive	system	Growth	of anim	al
cells in t	he lab -	theoret	tical and	1 practi	cal							0		
Scope a	nd imp	ortance	e of tra	ansgeni	c anim	nal tecl	hnology	- Va	rious	strategie	es for t	the prod	luction	of
transgen	ic anim	als: pro	onuclea	r micro	injectio	on, emb	orvonic	stem of	cells ar	id soma	tic cell	nuclear	transfer	-
Gene kn	ock in a	and kno	ock out	model	s for st	udying	human	disor	lers - T	ransger	nic anin	hals as b	oioreacto	rs
for produ	ucing pl	narmace	euticall	y impoi	tant co	mpoun	ds and	therape	eutics.	C				
	Lectur	e			Tutor	rial			Pra	ctical		Total		
	45				0					0		45		
Text Bo	oks:		•											
 Frest Edition Rame Cher 	hney, R ion, 201 adoss, I nnai, 1s	. I., Cul 0. P., Anir t Editio	lture of nal Bio n, 2008	Anima technol	l Cells: logy: Re	A man ecent C	ual of I	Basic t s and I	echniqu Develop	ue, John oments, 1	, Wiley MJbPul	and sor	ns, 6th	
Referen	ces:													
1. Mas	ters, J.R	W., A	nimal C	Cell Cul	ture: Pi	ractical	Appro	ach, O	xford U	Iniversit	y Press	, New	York,	
3rd l	Edition,	2000.						·			•			
2. Holl	and, A.	and Jol	hnson, A	A., Ani	mal Bio	otechno	ology ar	nd Ethi	cs, Spr	inger Ve	erlag, N	ew York	x,1st	
Editi	ion, 199	8.												
	http://w	ww hio	technol	09v411	com/au	estion	bank o	mestio	n ansv	ver html				
2.	NPTEL	course	materia	al on Ti	ansgen	ic anim	als as	1405010	n_unov	01.11111				
1	bioreact	ors:http	os://npte	el.ac.in	courses	s/102/1	03/102	10001						
COs	Vs PO	S					03/102	10301.	3/					
	PU		DO	DO	DO	DO	DO	103013	3/	DO1	PO1	DO1	DEO	DEO
		PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	3/ PO 9	PO1	PO1	PO1 2	PSO 1	PSO
CO	3	PO 2 2	PO 3	PO 4 2	PO 5	PO 6	PO 7	PO 8	3/ PO 9 2	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2 2
CO 1	3	PO 2 2	PO 3	PO 4 2	PO 5 2	PO 6 0	PO 7 1	PO 8 1	PO 9 2	PO1 0 1	PO1 1	PO1 2 2	PSO 1	PSO 2 2
CO 1 CO	1 3 3	PO 2 2	PO 3 1 2	PO 4 2 1	PO 5 2 2	PO 6 0 0	PO 7 1 0	PO 8 1	PO 9 2 0	PO1 0 1 2	PO1 1 1	PO1 2 2 3	PSO 1 1	PSO 2 2
CO 1 CO 2	1 3 3	PO 2 2 1	PO 3 1 2	PO 4 2 1	PO 5 2 2	PO 6 0 0	PO 7 1 0	PO 8 1 1	PO 9 2 0	PO1 0 1 2	PO1 1 1	PO1 2 2 3	PSO 1 1 2	PSO 2 1
CO 1 CO 2 CO 3	1 3 3 3	PO 2 2 1 1 1	PO 3 1 1 2 2 2	PO 4 2 2 1 3	PO 5 2 2 2 2 2 3	PO 6 0 0 2	PO 7 1 0 2	PO 8 1 1 1	PO 9 2 0 2	PO1 0 1 2 2	PO1 1 1 2	PO1 2 2 3 3	PSO 1 1 2 3	PSO 2 2 1 3
CO 1 CO 2 CO 3 CO	1 3 3 3 3 3	PO 2 2 1 1 2	PO 3 1 2 2 2	PO 4 2 1 3 2	PO 5 2 2 2 3 3 3	PO 6 0 2 1	PO 7 1 0 2	PO 8 1 1 1	PO 9 2 0 2	PO1 0 1 2 2 2	PO1 1 1 2 2	PO1 2 2 3 3 2	PSO 1 1 2 3 1	PSO 2 2 1 3 2
CO 1 CO 2 CO 3 CO 4	1 3 3 3 3 3 3 3	PO 2 2 1 1 2	PO 3 1 2 2 2 2 2	PO 4 2 1 3 2	PO 5 2 2 2 3 3	PO 6 0 0 2 1	PO 7 1 0 2 1	PO 8 1 1 1 1 1 1 1	PO 9 2 0 2 0 1 1 1	PO1 0 1 2 2 2	PO1 1 1 2 2	PO1 2 3 3 2	PSO 1 1 2 3 1	PSO 2 2 1 3 2
CO 1 CO 2 CO 3 CO 4 CO	1 3 3 3 3 3 3 3	PO 2 2 1 1 2 2 2	PO 3 1 2 2 2 2 3	PO 4 2 1 3 2 1 <th1< th=""> 1 <th1< th=""> <th1< th=""></th1<></th1<></th1<>	PO 5 2 2 3 3 2 2	PO 6 0 0 2 1 2 2	PO 7 1 0 2 1 1 1	PO 8 1 1 1 1 1 1 1 1 1 1 1 1 1	PO 9 2 0 2 1 1 1 1	PO1 0 1 2 2 2 2 2	PO1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	PO1 2 3 3 2 2	PSO 1 1 2 3 1 1 1	PSO 2 2 1 3 2 1
CO 1 CO 2 CO 3 CO 4 CO 5	1 3 3 3 3 3 3 3 1 1	PO 2 2 1 2 2 2 2 2 2	PO 3 1 2 2 2 3 3	PO 4 2 1 3 2 1 1	PO 5 2 2 2 3 3 3 2 12 12	PO 6 0 2 1 2 5	PO 7 1 0 2 1 1	PO 8 1 1 1 1 1 1 1	PO 9 2 0 2 1 1	PO1 0 1 2 2 2 2 2	PO1 1 1 2 2 2	PO1 2 2 3 3 2 2 2	PSO 1 1 2 3 1 1 5	PSO 2 2 1 3 2 1
CO 1 CO 2 CO 3 CO 4 CO 5	1 3 3 3 3 3 15	PO 2 2 1 1 2 2 2 8 8	PO 3 1 2 2 3 10	PO 4 2 1 3 2 1 9	PO 5 2 2 3 3 2 12	PO 6 0 0 2 1 2 5	PO 7 1 0 2 1 1 4	PO 8 1 1 1 1 5 PO 8 1 1 1 1 1 1 1 1 1 1 1 1 1	PO 9 2 0 2 1 1 6	PO1 0 1 2 2 2 2 9	PO1 1 1 2 2 2 8	PO1 2 3 3 2 12	PSO 1 1 2 3 1 1 8	PSO 2 2 1 3 2 1 9
CO 1 CO 2 CO 3 CO 4 CO 5	1 3 3 3 3 3 15 PC 1	PO 2 2 1 1 2 2 2 2 2 8 0 PC 2 2 0 PC 2	PO 3 1 2 2 2 3 10 PO 3	PO 4 2 1 3 2 1 9 PO 4	PO 5 2 2 3 2 12 PO 5	PO 6 0 0 2 1 2 5 PO 6	PO 7 1 0 2 1 1 4 PO 7	PO 8 1 1 1 1 5 PO 8	PO 9 2 0 2 0 1 1 6 PO 9	PO1 0 1 2 2 2 2 9 PO1 0	PO1 1 1 2 2 2 8 PO1 1	PO1 2 2 3 3 2 2 2 12 PO1 2	PSO 1 1 2 3 1 1 8 PSO 1	PSO 2 2 1 3 2 1 9 PSO 2
CO 1 CO 2 CO 3 CO 4 CO 5 Origi	1 3 3 3 3 3 15 P(1 n 15	PO 2 2 2 1 1 2 2 8 0 PC 2 8 8	PO 3 1 2 2 3 10 PO 3 10	PO 4 2 1 3 2 1 9 PO 4 9	PO 5 2 2 3 3 2 12 PO 5 12 2	PO 6 0 2 1 2 5 PO 6 5	PO 7 1 0 2 1 1 1 4 PO 7 4	PO 8 1 1 1 1 1 1 PO 8 5 PO 8 5	PO 9 2 0 2 1 1 5 9 9 6	PO1 0 1 2 2 2 2 9 PO1 0 9	PO1 1 1 2 2 2 8 PO1 1 8	PO1 2 2 3 3 2 2 2 12 PO1 2 12	PSO 1 1 2 3 1 1 8 PSO 1 0	PSO 2 2 1 3 2 1 9 PSO 2 1
CO 1 CO 2 CO 3 CO 4 CO 5 Origi al	1 3 3 3 3 3 15 P(1 n 15	PO 2 2 2 1 1 2 2 8 PC 2 8 8 8	PO 3 1 2 2 2 3 10 PO 3 10 10 10 10	PO 4 2 1 3 2 1 9 PO 4 9 9	PO 5 2 2 3 3 2 12 PO 5 12 12	PO 6 0 0 2 1 2 5 PO 6 5 5	PO 7 1 0 2 1 1 1 4 PO 7 4	PO 8 1 1 1 1 1 5 PO 8 5 5	PO 9 2 0 2 1 6 90 9 6	PO1 0 1 2 2 2 2 9 PO1 0 9	PO1 1 1 2 2 2 8 PO1 1 8	PO1 2 2 3 3 2 2 12 PO1 2 12	PSO 1 1 2 3 1 1 8 PSO 1 0	PSO 2 2 1 3 2 1 9 PSO 2 1
CO 1 CO 2 CO 3 CO 4 CO 5 Origi al value	1 3 3 3 3 3 15 P(1 n 15	PO 2 2 1 1 2 8 0 2 8 1	PO 3 1 2 2 3 10 PO 3 10 PO 3 10	PO 4 2 1 3 2 1 9 PO 4 9	PO 5 2 2 3 3 2 12 PO 5 12 2	PO 6 0 0 2 1 2 5 PO 6 5 5 i 5 5 5	PO 7 1 0 2 1 1 1 4 PO 7 4	PO 8 1 1 1 1 1 1 5 PO 8 5 5 5 5	PO 9 2 0 2 1 1 1 6 9 6	PO1 0 1 2 2 2 2 9 PO1 0 9	PO1 1 1 2 2 2 8 PO1 1 8	PO1 2 3 3 2 12 PO1 2 12 PO1 2 12	PSO 1 1 2 3 1 1 8 PSO 1 0	PSO 2 1 3 2 1 9 PSO 2 1
CO 1 CO 2 CO 3 CO 4 CO 5 Origi al value Scale	1 3 3 3 3 3 3 15 P(1) 15 d	PO 2 2 2 1 1 2 2 8 2 2 8 2 2	PO 3 1 2 2 2 3 10 PO 3 10 2 3 10 2 2 3 10 2 2 3 10 2 2	PO 4 2 1 3 2 1 9 PO 4 9 2 2	PO 5 2 2 3 3 2 12 PO 5 12 3 3 3	PO 6 0 0 2 1 2 5 PO 6 5 1 1 1	PO 7 1 0 2 1 1 1 4 PO 7 4 1	PO 8 1 1 1 1 1 5 PO 8 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	PO 9 2 0 2 1 6 90 9 6 2 2	PO1 0 1 2 2 2 2 9 PO1 0 9 9 2	PO1 1 1 2 2 2 8 PO1 1 8 8 2	PO1 2 3 3 2 12 PO1 2 12 3 3	PSO 1 1 2 3 1 1 8 PSO 1 0 0	PSO 2 2 1 3 2 1 9 PSO 2 1 0

Scale: 3- high, 2 – Medium, 1 - Low, 0 – not related 0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

					T		D	C
Х	KBT (502			L	1	Ŷ	C
			XBT602 Process Biotechnology – Upstream Processes		1	1	0	2
~ [
С	Р	A			L	Т	Р	Н
3	0	0			1	2	0	3
Prei	requi	isite: -						
Lea	rnin	g Obje	ctives: Upon completion of this course, the students					
Wot	ild be	e able t	o identify the parts of a fermenter					
Wot	ıld kı	now ab	out the media components for fermentation process.					
Wot	ıld bo	e able t	o select the parts of a bioreactor for designing a particular produc	ction pro	cess.			
Wot	ıld bo	e able t	o design the scale up procedure of a bioreactor.					
			Course Outcomes	Dor	nain		Leve	l
CO	1 F	Recall t	he basic parts of a fermentor and its operations.	Cogni	ive	Ren	nember	
<u> </u>	I	Demons	strate the different media components involved in a	Cogni	ive		1	
CO	f f	erment	ation process.			Apply		
CO	3 I	Differe	ntiate various control systems involved in bioprocess system.	Cogni	ive	Apply		
CO	4 N	Aeasur	e the various transport phenomena involved in bioprocesses.	Cogni	tive	App	oly	
	F	Explain	the scale up procedure of mixing, aeration and know the	Cogni	ive	Unc	lerstanc	1
CO	5 a	pplicat	ions					
I – I	ntro	ductio	n to process Biotechnology				6+3	
Gen	eral 1	require	ments of fermentation processes - basic configuration of fermen	ter and a	ncillar	ies, mai	in parar	neters
to be	e mo	nitored	and controlled-; Kinetics of cell growth, substrate utilization and	d product	forma	ation; S	tructure	ed and
unst	ructu	red mo	dels; Batch, fed-batch and continuous processes.					
II –	Med	lia forn	nulation and optimization				6+3	
Ster	ilizat	ion of	air and media, medium requirements for fermentation proc	esses, ca	arbon,	nitrog	en, mir	nerals,
vitar	nins	and of	ther complex nutrients, oxygen requirements, simple and com-	plex me	dia, n	nedium	optimi	zation
tech	nique	es.						
III -	- Ins	trumer	ntation and Process Control:				6+3	
Instr	ume	ntation	, measurement and control of the bioprocess parameter such as to	emperatu	re, pre	ssure, j	oH, diss	olved
oxyg	gen,	redox,	microbial biomass, flow measurement-Agitation and aeration-	Detection	n and	prevent	ion of	foam,
UNYE	<u> </u>		merorial oronass, now measurement-regulation and acration-		i unu	Preven		1041

Feedback and feed forward control; Types of controllers – proportional, derivative and integral control, tuning of controllers.

IV -Transport Phenomena in Bioreactors

6+3

Flow properties of Fermentation Broths, Factors affecting broth viscosity. Mixing in a Bioreactor - Flow regimes -Power Requirements for Mixing, Un gassed Newtonian Fluids, Gassed Fluids, Improving Mixing in Fermenters, and Effect of Rheological Properties on Mixing. Application of heat transfer in bioprocessing, Heat transfer in Bioreactors, Oxygen requirements of microbial cultures. Determination of oxygen mass transfer coefficient by various methods.

V – Applications to Biological Systems

6+3

Scale up consideration for constant K₁a, shear forces, mixing time-Bioprocess considerations in using Animal and Plant cell cultures. Case studies on Single Cell protein Production, Bioethanol - Case studies on Applications of **Bioprocess Engineering**.

Lecture	Tutorial	Practical	Total	
30	15	0	45	

Text Books:

- 1. Schuler and Kargi, Bioprocess engineering. Prentice Hall
- 2. Najafpour, Ghasem. Biochemical engineering and biotechnology. Elsevier, 2015.
- 3. Bailey and Ollis, Biochemical Engineering Fundamentals, McGraw Hill, Co. 2004.

References:

- 1. Pauline Doran, Bioprocess Principles, Academic press, 2004.
- 2. Neilson J and Villadsen J, Biochemical Engineering Principles I ed, Plenum Press, 2000.
- 3. Stanbury P F Whitaker, A and Hall S.J, Principles of Fermentation Technology 2nd ed, Aditya Book Pvt Ltd. 2001.
- 4. Lee J.M, Biochemical Engineering 2nd ed, Prentice Hall, 2000.

E-References:

- 5. http://www.nptel.ac.in/syllabus/syllabus.php?subjectId=102107029
- 6. http://users.ox.ac.uk/~dplb0149/publication/NPRBiocatalysisRev.pdf
- 7. http://link.springer.com/book/10.1007%2F978-1-4684-0324-4

Mapping of COs with POs

						F	ROG	GRAM	OUT	COME	S			
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3											1	2	2
CO2	2	3	2		1		1		1		3	2	3	3
CO3	1	2	2	1					1			1	0	0
CO4	1	3	2	3								1	0	0
CO5	1	3	2	3	1		1		2		2		1	1
Total	8	11	8	7	2	0	2	0	4	0	5	5	6	6
ScaledValue	2	3	2	2	1	0	1	0	1	0	1	1	2	2
	1 –	5 🗆 1	,			6	6 – 10	□ 2,			11 – 1	5 🗆 3	5	
	()-NoRe	elation	n,1-L	ow Rel	ation,	2-Mee	diumR	elatio	n,3-Hig	hRelat	tion		

					L	Т	Р	С
X	BT6	03		-	1	1	0	2
			XBT603 PROCESS BIOTECHNOLOGY – Downst	tream				
C	Р	Α	Processes	-	L	Т	Р	Н
3	0	0		_	1	2	0	3
Prer	equi	site: -						
Lear	rning	g Objec	ctives: Upon completion of this course, the students					
Wou	ıld be	able to	b identify the parts of a fermenter					
Wou	ıld kr	iow abo	out the media components for fermentation process.					
Wou	ıld be	able to	o select the parts of a bioreactor for designing a particular pro-	duction proces	ss.			
Wou	ıld be	able to	b design the scale up procedure of a bioreactor.					
			Course Outcomes	Domain]	Level	
Afte	r the	comple	etion of the course, students will be able to					
CO	R	ecall t	he fundamentals of downstream processing for product	Cognitive	1	Rememb)er	
	re	ecovery	7	Cognitive	1	Kemenn		
	C	omput	te the problem-solving techniques required in multi-factorial					
CO	2 m	nanufac	turing unit by physical methods. Apply principles of	Cognitive	1	Apply		
	v	arious	unit operations used in downstream processing					
CO3	3 A	nalyze	the different methods involved in isolation products.	Cognitive	1	Analyze		
CO	4 E	xplain	the principles of chromatography techniques	Cognitive	ι	Understa	and	
	C	alcula	te the drying time for various dryers used in the purification	Cognitive	1	Apply		
CO	5 0	f produ	icts.	C				
Unit	t —I D	OWN	STREAM PROCESSING				6+3	
Intro	oducti	ion to c	lownstream processing principles characteristics of biomolecu	les and biopro	oces	sses. Cel	ll disrup	otion
for p	orodu	ct relea	se - mechanical, enzymatic and chemical methods. Pretreatm	ent and stabili	izati	ion of bi	io produ	lcts
Unit	–II]	PHYS	ICAL METHODS OF SEPERATION				6+3	
Unit	oper	ations	for solid-liquid separation - filtration and centrifugation.					
Unit	i –III	ISOL	ATION OF PRODUCTS				6+3	
Adso	orptic	on, liqu	id-liquid extraction, aqueous two-phase extraction, membrane	e separation– u	ultra	afiltratio	n and	
reve	rse os	smosis,	dialysis, precipitation of proteins by different methods.					
Uni	t –IV	PRO	DUCT PURIFICATION				6+3	

Chromatography – principles, instruments (GC, HPLC and FPLC) and practice, adsorption, reverse phase, ion-											
exchange, size exclusion, hydrophobic interaction, and bioaffinity and pseudo affinity chromatographic techniques.											
T FORMULATION AND F	INISHING OPERATIONS	6+3									
yophilization in final product f	formulation.										
Tutorial	Practical	Total									
15	0	45									
	, instruments (GC, HPLC and lrophobic interaction, and bioa T FORMULATION AND F yophilization in final product f Tutorial 15	, instruments (GC, HPLC and FPLC) and practice, adsorption,Irophobic interaction, and bioaffinity and pseudo affinity chronT FORMULATION AND FINISHING OPERATIONSyophilization in final product formulation.TutorialPractical150									

Text Books:

- Nooralabettu Krishna Prasad, Downstream Process Technology, A New Horizon in Biotechnology, PHI Pvt Ltd,2nd Edition, 2012.
- 2. Sivasankar, B. Biosperations: Principles and Techniques. PHI Learning Pvt. Ltd., 2005.

References:

- 1. Hatti-Kaul, Rajni, and Bo Mattiasson. "Downstream processing in biotechnology." Basic biotechnology. Cambridge University Press, Cambridge, 2001.
- 2. Roger G. Harrison, Paul W. Todd, Scott R. Rudge, Demetri P. Petrides1, "Bioseparations Science and Engineering, oxford University Press, 2015.
- 3. J. A.Wesselingh, Johannes Krijgsman, "Downstream Processing in Biotechnology", Delft Academic Press/VSSD, 2013.

E-References:

http://vlab.amrita.edu/?sub=2&brch=191&sim=341&cnt=1

http://vlab.amrita.edu/?sub=2&brch=191&sim=1547&cnt=1

http://vlab.amrita.edu/?sub=2&brch=190&sim=606&cnt=1

vlab.amrita.edu/?sub=3&brch=273

Mapping of COs with POs

			PROGRAM OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3		2	1		1	1		1					1
CO2	2	3	2	1		1			1			1	1	1
CO3	2	3	1	2					1			1	1	2
CO4	2	1	3	2			3		1			1	2	1
CO5	2	2	3	1		2	1		1		2	2	3	3
Total	11	9	11	7		4	5		5		2	5	7	8

Scaled Value	3	2	3	2	0	1	1	0	1	0	1	1	2	2
	1 –	5 🗆 1	,			6	- 10	□ 2,			11 – 1	5 🗆 3		
0-NoRelation,1-Low Relation,2-MediumRelation,3-HighRelation														

XBT	604				L	Т	Р	C			
A	004				3	0	0	3			
			MASS TRANSFER FUNDAMENTALS								
С	Р	Α			L	Т	Р	Η			
2.5	0	0.5			3	0	0	3			
Prer	equi	sites:Nil									
Obje	ectiv	es:									
To fa	cilita	ate the lea	rners, understand the basic concepts and principles of mass t	ransfer	and	apply	then	n in			
distil	latio	n, absorpt	ion adsorption drying and humidification operations.								
Cour	se C	Outcomes	At the end of this course, the students should be able to	Doma	in	L	evel				
C01	F	E xplain th	e basic principles in diffusional mass transfer and	Cogni	tive	U	nder	stand			
	с	alculate t	he rate of the mass transfer under one dimensional steady	Affect	tive	А	nalys	se			
	state diffusion Receive										
CO2	I	Describe t	he operations of Distillation and absorption and Calculate	Cogni	tive	U	nder	stand			
	n	umber tra	ys for distillation and absorption tower	Affect	tive	А	nalys	se			
						R	eceiv	/e			
CO3	I	L ist situati	ons where liquid-liquid extraction might be preferred to	Cogni	tive	U	nder	stand			
	d	istillation				А	nalys	se			
CO4	I	Discuss	the salient features of Separation by adsorption,	Cogni	tive	U	nder	stand			
	c	hromatog	raphic separation process and explain the concept of			А	nalys	se			
	b	reakthrou	gh in fixed-bed adsorption.								
CO5	I	Describe t	ibe the salient features and mechanism involved in Drying Cognitive Understand								
						A	nalys	se			
			Course Content				I	Hours			
Unit	·I	Mass	Transfer and Diffusion				9	•			
Stead	ly s	tate mole	cular diffusion in fluids and solids. One dimensional st	eady st	tate	and u	inste	ady state			

molecular	diffusion through stationary m	edia – molecular	diffusion in lami	nar flow – diffusivity
measuremen	nts – overall mass transfer coef	ficients – Diffusio	on in multi compon	ent gaseous mixtures –
Diffusion in	solids.			
Unit-II	Distillation			9
Vapour liqu	id equilibrium – methods of disti	Illation – simple, st	team, flash distillatio	n, azeotropic, Extractive
and molecul	lar distillation – Continuous distill	ation – McCabe - T	hiele method, poncho	onsavarit method
Unit-III	Extraction and Leaching			9
L-L equilib	rium – staged and continuous ex	straction concepts,	Equipments for ext	raction – Solid – liquid
equilibria, le	eaching principles – Equipments for	or leaching		
Unit-IV	Absorption and Adsorption			9
Theory of a	bsorption – Factors affecting gas	absorption-Equilibre	rium and operating li	ne concept in absorption
stage deterr	nination - Adsorption and its typ	es -sorbents – equ	ilibrium consideratio	on- kinetic and transport
consideratio	ons.			
Unit-V	Humidification and drying			9
Basic termin	nologies in humidification – psych	rometric chart, con	struction and use. M	ethods of humidification
and dehumi	dification – equipments – spray cl	hamber- cooling to	ower principles, types	and operation – Theory
and mechan	ism of drying.			
	Lecture	Tutorial	Practicals	Total
	45	0	0	45
Text Books				
1. Treybal	R.E., "Mass Transfer Operations"	, Third Edition, Mo	Graw Hill, 1980.	
2. Anantha	araman, N. and K.M. MeeraSherifa	a Begum, ''Mass Tr	ansfer Theory and Pra	actice", PHI Learning
Private	Limited, New Delhi,2011			
3. Gavhan	e K.A "Mass Transfer" 8th Edition	, Nirali Prakashan,	2010.	
3. Gavhan References	e K.A "Mass Transfer" 8 th Edition	, Nirali Prakashan,	2010.	
 Gavhan References Dutta, E 	e K.A "Mass Transfer" 8 th Edition B. K., " Principles of mass transfer	, Nirali Prakashan, and separation pro-	2010. cesses", Prentice Hall	of India, Delhi, 2007
 Gavhan References Dutta, E Coulsor 	e K.A "Mass Transfer" 8 th Edition B. K., " Principles of mass transfer and Richardson, "Chemical Engi	, Nirali Prakashan, and separation pro- neering" Vol. I & I	2010. cesses", Prentice Hall I, Asian Books Pvt.ltd	of India, Delhi, 2007 1., 1998.

 McCabe, W.L., J.C. Smith and P. Harriott, "Unit Operations of Chemical Engineering", 7/e, McGraw-Hill International Edition, 2005.

Mapping of COs Vs Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	1	3	2	1	2	1	1	0	2	2	3	3
CO 2	3	3	1	3	2	1	2	1	1	0	2	2	3	3
CO 3	3	3	1	3	2	1	2	1	1	0	2	2	3	3
CO 4	2	1	1	1	1	1	1	1	1	0	1	1	1	1
CO 5	3	3	1	1	1	1	1	1	1	0	1	1	1	1
	14	13	5	11	8	5	8	5	5	0	8	8	11	11

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subject Vs Pos

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
Origin al value	14	13	5	11	8	5	8	5	5	0	8	8	11	11
Scaled Value	3	3	0	3	2	0	2	0	0	0	2	2	3	3

 $1-5 \rightarrow 1$, $6-10 \rightarrow 2$, $11-15 \rightarrow 3$

				1	r	T	D	C				
XBT	604]	B			3	0	0	3				
			FERMENTATION TECHNOLOGY									
С	Р	Α		I	L	Т	Р	Н				
3	0	0		•	3	0	0	3				
Prer	equi	sites :-	-									
Obje	ectiv	es:										
To er	ihan	ce the	student's ability of employability through study the core prime	targeted b	iop	roces	s, mi	crobial				
cum	bioc	hemica	al activities in the fermentation technology.	-	-							
Cou	rse (Dutcon	nes: At the end of this course, the students should be able to	Domai	n	Le	vel					
CO1	F	Ixnlaiı	the microbial for industries and List the applications	Cogniți	ve	Un	derst	and				
001				Cogina		U.	uerb.	unu				
CO2	T)oscrit	a the primary and secondary metabolism and Interpret the	Cogniți	VA	Un	deret	and				
	f	ormon	ention process	Coginti	ve	UI	lucisi	and				
CO2	T			Constitu		TL	1	1				
003	ľ	kecogn	ize the microbial culture and Describe the growth kinetics.	Cogniti	ve	Un	idersi	and				
				~								
CO4		Discuss	the isolation and characteristics of micro organismand	Cogniti	ve	Un	derst	and				
	Ι	nterpi	et the industrial significant.									
CO5	Ι	Descrit	be the salient features of industrial fermentation.	Cogniti	ve	Un	derst	and				
			Course Content				ł	Hours				
Unit	-I	In	troduction				6	5				
Micr	obia	l Biom	ass – Microbial Enzymes – Microbial Metabolites – Commerci	al Applica	atio	ns of	Enz	ymes.				
Unit	-II	Pr	imary and Secondary Metabolism				9)				
Inter	relat	ionship	b between primary and secondary metabolism – Recombinant pr	roducts –	Tra	nsfo	rmati	on				
proce	esses	– Hist	ory of fermentation industry – The component parts of a ferme	ntation pr	oce	ss.						
Unit	-III	Μ	icrobial Growth Kinetics				9)				
Batcl	h cul	ture –	Exponential phase – Declaration and stationary phases - Contin	uous cult	ure	– Fee	edbac	:k				
syste	ms –	- Comp	parison of batch and continuous culture in industrial processes									
Unit-IV Isolation and Improvement of Industrially Significant Microorganisms 9												
		1										

anu m	aAIIIIIZI	00	I		•				-					
Unit-V	V	Media f	for Ind	ustrial I	Fermer	ntation							12	
Introd	uction -	- Typica	al media	a and m	edia for	mulatio	on – Ene	ergy sou	urces –	Growth	factors –	Nutrient	Recycle	s –
Buffer	s – Pr	ecursors	s – Inh	ibitors	– Indu	icers –	Oxyge	n requi	irement	s – Fast	metabo	lism – I	Rheology	/ _
Antifo	ams – A	Animal	cell med	dia – De	evelopn	nent of l	basal m	edia.						
		Le	cture				Tutori	al	Pr	actical		To	tal	
			45				0			0		4	5	
Text I	Books													
1	Stanh	urv Pet	er F Al	lan Wh	itaker S	Stenhen	I Hall	"Princ	inles of	Ferment	ation Tec	hnology	" Third	
1.	Editio			2017	nunci, i	Jephen	5. 11an,	, 11110	10105 01	I erment		Jinology	, minu	
	Eanno	ո. ലക	IVER.	2017										
-	~	,												
2.	Grego	ory N. S	stephano	opoulos	, Aristo	s A. Ar	istidou.	, Metab	olic eng	gineering	: Princip	lesand		
2.	Grego Metho	ory N. S odologi	tephano es, Jens	opoulos Nielser	, Aristo 1 Acade	s A. Ar emic Pre	istidou. ess, 1st]	, Metab Edition	olic eng , 1998.	gineering	: Princip	lesand		
2. Refere	Grego Metho ences	ory N. S	tephano	opoulos Nielser	, Aristo 1 Acade	s A. Ar emic Pre	istidou. ess, 1st l	, Metab Edition	olic eng , 1998.	gineering	: Princip	lesand		
2. Refer o 1.	Grego Metho ences Sandł	ory N. S odologi nu, Sard	tephano es, Jens	opoulos Nielser h. Reco	, Aristo n Acade mbinan	s A. Ar emic Pre	istidou. ess, 1st technol	, Metab Edition	olic eng , 1998.	gineering	rt Ltd, 20	lesand		
2. Reference 1. E-Refe	Grego Methe ences Sandl erences	ory N. S odologie nu, Sard	tephano es, Jens lul Sing	nielser h. Reco	, Aristo n Acade mbinan	s A. Ar emic Pre t DNA	istidou. ess, 1st technol	, Metab Edition ogy. IK	olic eng , 1998.	gineering	: Princip	lesand)10.		
2. Reference 1. E-Reference 1	Grego Metho ences Sandl erences	ory N. S odologic nu, Sard	tephano es, Jens lul Sing	billion billio	, Aristo n Acade mbinan	s A. Ar emic Pre t DNA	istidou. ess, 1st technol	, Metab Edition ogy. IK	olic eng , 1998. I Interna	gineering tional Pv	rt Ltd, 20	lesand)10.		
2. Reference 1. E-Reference 1.	Grego Metho ences Sandh erences https:	ory N. S odologic nu, Sard //nptel.a	lul Sing	billing billin	, Aristo n Acade mbinan	s A. Ar emic Pre t DNA	istidou ess, 1st technol 058/	, Metab Edition ogy. IK	olic eng , 1998.	gineering ational Pv	: Princip	lesand)10.		
2. Reference 1. E-Reference 1. Map	Grego Metho ences Sandl erences https: ping of	ory N. S odologie nu, Sard //nptel.a	tephano es, Jens lul Sing ac.in/co /s POs	billing poulos Nielser h. Reco urses/10	, Aristo n Acade mbinan	s A. Ar emic Pro t DNA 1021050	istidou ess, 1st technol 058/	, Metab Edition ogy. IK	olic eng , 1998.	tional Pv	: Princip	010.	D 501	
2. Refere 1. E-Ref 1. Map	Grego Metho ences Sandh erences https: ping of PO1	ory N. S odologie nu, Sard //nptel.a COs V PO2	lul Sing ac.in/co 7s POs	bpoulos Nielser h. Reco urses/10	, Aristo n Acade mbinan 02/105/ PO5	s A. Ar emic Pre t DNA 1021050 PO6	istidou ess, 1st technol 058/ PO7	, Metab Edition ogy. IK PO8	olic eng , 1998. Interna	gineering ational Pv PO10	: Princip /t Ltd, 20 PO11	lesand 010. PO12	PSO1	PSC
2. Refere 1. E-Ref 1. Map O 1	Grego Metho ences Sandh erences https: ping of PO1 3	ory N. S odologic nu, Sard //nptel.a COs V PO2 3	tephano es, Jens lul Sing ac.in/co 7s POs PO3	billing billin	, Aristo n Acade mbinan 02/105/ PO5 2	s A. Ar emic Pre t DNA 1021050 PO6	istidou ess, 1st technol 058/ PO7 2	, Metab Edition ogy. IK PO8	olic eng , 1998. Interna PO9	gineering ational Pv PO10 0	: Princip rt Ltd, 20 PO11 2	esand 010. PO12 2	PSO1	PSC
2. Refere 1. E-Ref 1. Map O 1 2	Grego Metho ences Sandl erences https: ping of PO1 3 3	ory N. S odologic nu, Sard //nptel.a COs V PO2 3 3	tephano es, Jens lul Sing ac.in/co 7s POs PO3 1 1	h. Reco urses/10 PO4 3 3	, Aristo n Acade mbinan 02/105/ PO5 2 2	s A. Ar emic Pro t DNA 1021050 PO6 1 1	istidou ess, 1st technol 058/ PO7 2 2	, Metab Edition ogy. IK PO8	olic eng , 1998. Interna PO9	protection protection of the second s	Princip	PO12 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	PSO1 3 3 3	PSC 3 3
2. Refere 1. E-Ref 1. Map 0 1 2 3 4	Grego Metho ences Sandh erences https: ping of PO1 3 3 3 3	nu, Sard nu, Sard //nptel.a ? COs V PO2 3 3 3	lul Sing ac.in/co 7s POs 1 1 1	h. Reco urses/10 PO4 3 3 3	, Aristo n Acade mbinan 02/105/2 PO5 2 2 2	s A. Ar emic Pre t DNA 1021050 PO6 1 1	istidou ess, 1st 1 technol 058/ PO7 2 2 2	, Metab Edition ogy. IK PO8	olic eng , 1998. Interna PO9 1 1 1	provide the second seco	Princip	PO12 2 2 2 2 1	PSO1 3 3 3 1	PSC 3 3 3 3 3
2. Reference 1. E-Reference 1. Maper 0 1 2 3 4 5	Grego Metho ences Sandl erences https: ping of PO1 3 3 3 2 3	bry N. S odologic nu, Sard //nptel.a COs V PO2 3 3 3 1 3	tephano es, Jens lul Sing ac.in/co 7s POs PO3 1 1 1 1 1 1 1	poulos Nielser h. Reco urses/10 PO4 3 3 1 1	, Aristo n Acade mbinan 02/105/ PO5 2 2 2 1 1	s A. Ar emic Pre t DNA 1021050 PO6 1 1 1 1 1	istidou ess, 1st 1 technol 058/ PO7 2 2 2 1 1	, Metab Edition ogy. IK PO8 1 1 1 1 1 1	olic eng , 1998. Interna PO9 1 1 1 1 1 1	PO10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Princip	PO12 2 2 1 1	PSO1 3 3 3 1 1	PSC 3 3 3 3 1 1

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

Mapping of Subject Vs POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
Origin al value	14	13	5	11	8	5	8	5	5	0	8	8	11	11
Scaled Value	3	3	0	3	2	0	2	0	0	0	2	2	3	3

 $1-5 \rightarrow 1$, $6-10 \rightarrow 2, \qquad 11-15 \rightarrow 3$

		_	L	Т	Р	С					
XB	T 6 0	4C	NANOBIOTECHNOLOGY	-	3	0	0	3			
С	Р	A			L	Т	Р	H			
3	0	0			3	0	0	3			
Prer	equi	site: B	ioinstrumentation								
Lear	ning	Obje	ctive:								
Upor	ı con	npletio	on of this course, the students								
Wou	ld be	able to	o learn fundamentals of nano technology.								
Wou	ld be	able to	o learn the nano particle synthesis and its application	in biotechnology							
			Course Outcomes	Domain		L	evel				
After	the	comple	etion of the course, students will be able to	L	1						
CO1	: Ree	call the	e basic concepts characterization techniques and	Cognitive	Re	emen	nber				
illust	rate	the me	ethods of nanoparticles synthesis.		Uı	nders	stand				
CO2	: Co	nstruc	t microfluidic devices and relate its advantages.	Cognitive	Cı	eate					
					Uı	nders	stand				
CO3	: Des	s ign an	d Developtheranostics nanoparticles	Cognitive	Cı	eate					
CO4	: Ou	tlines	the environmental applications of nanoparticles	Cognitive	Uı	nders	stand				
CO5	: Un	dersta	nds the Fundamentals of Nanocarriers and design	Cognitive	Cı	eate					
a dru	g del	ivery s	system.								
Unit	I- Ir	trodu	ction to Nanoparticles Synthesis and Characteriz	ation			9				
Nanc	parti	cles-	physical, chemical and biological properties- S	Synthesis- Physica	al n	netho	ods:	laser			
vapo	rizati	on, las	ser Pyrolysis, ion implantation. Chemical methods for	or synthesis of Nan	oma	teria	ls: sc	ol-gel			
meth	od. 1	Biolog	ical synthesis: using microorganisms, plant extract	s. Characterization	n teo	chniq	ues:	UV-			
Spec	trosc	ору, І	Dynamic Light Scattering, Zeta potential, Energy	Dispersive X-Ray	An	alysi	s (E	DX),			
Selec	ted A	Area D	iffraction Pattern (SAED), SEM, TEM, AFM.								
Unit-II- Microfluidics Meets Nano: Lab-on-a-Chip Devices9											
Concepts and advantages of microfluidic devices - Fluid transport - Stacking and sealing - Materials and											
meth	methods for the manufacture of microfluidic component, fluidic structures, surface modifications.										
Unit	Unit-III- Nano particles As Theranostic Agents9										

Theranostic agents- properties- advantages- Carbon dots and Quantum dots- ability to cross across Blood Brain Barriers- theranostic approach for Cancer treatment and neurodegenerative disorders- Alzheimer's, Parkinson's disease.

Unit-IV- Environmental Applications of Nano particles

9

9

Role of iron oxide, biopolymers and metal nanoparticles in Wastewater treatment- heavy metal removal,

nanofilter devices. Role of antimicrobial coating in infectious disease prevention. Nanobiosensors for environmental monitoring.

Fundamentals of Nanocarriers - Size, Surface, Magnetic and Optical Properties, Pharmacokinetics and Pharmacodynamics of Nano drug carriers. Drug delivery systems- microcapsules and microsphereshydrogels- Polymers - Dendrimers- Dendritic Nanoscafold system. pH based targeted delivery- chitosan and alginate. Copolymers- PLA, PLGA. Lipid Based Nanocarriers - Liposomes, niosomes- Cubosomes. Hydrophobic drug delivery.

Lecture	Tutorial	Practical	Total
45	0	0	45

Text Books:

- 1. Niemeyer, Christof M., and Chad A. Mirkin. Nanobiotechnology: concepts, applications and perspectives. Vol. 1. John Wiley & Sons, 2004.
- 2. Mirkin, Chad A., and Christof M. Niemeyer, eds. Nanobiotechnology II: more concepts and applications. John Wiley & Sons, 2007.

References:

- 1. Goodsell, David S. Bionanotechnology: lessons from nature. John Wiley & Sons, 2013.
- 2. Freitas Jr. R.A., "Nanomedicine", First Edition, Volume IIA, Landes Biosciences, 2004.

E- References:

1. http://www.chem.latech.edu/~ramu/msnt505/lec_notes/Ji/MSNT505_Ji_notes.htm

2. http://nptel.ac.in/courses/118107015/

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO 5	PO 6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	3	2		2		2					2	1	2
CO 2	2	2	2	2	2	2	2				2	3	2	1
CO 3	1	2			3	3					2	3	3	3
CO 4	2	3	3	3	2	3	3				1	2	1	2
CO 5	1	2			3	2		1				2	1	1
	8	12	7	5	12	10	7	1			5	12	8	9

	PO1	PO2	PO 3	PO4	PO 5	PO6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PSO1	PSO2
Original value	8	12	7	5	12	10	7	2			5	12	8	9

Scale Value	dl e	2	3	2	1	3	2	2	1			1	3	2		2
L				S	cale: 3-	high, í	2 – Me	dium,	1 - Lo	w, $0 -$	- not rel	ated	alation			
COUR	SE C	CODI	<u>U - NU I</u> E		XGS606	LOW I	Celation	1, 2- N	lealui	li Kela	uioii, 5-	nigii K	L	Т	P	С
COUR	SE N	[AM]	E]	PROFE	SSIO	NAL S	KILL	S				1	0	2	3
PRER	EQU	ISIT	ES	I	NIL								L	Т	Р	H
C:P:A	= 2.6:	:0.4:0	0	-									1	0	4	5
COUR	SE C	OUTO	COMES	S						D	OMAIN	N		LEV	EL	
CO1	Abi	lity to	o under	stand	l commu	inicati	ons			С	ognitive	è]	Remen	nber	
CO2	App	oly th	e know	n ski	lls for c	areer				С	ognitive	è		App	ly	
CO3Identify inner strengthCognitiveRemember																
CO4Construct the attitude as a professionalCognitiveCreate																
CO5Practicing EtiquettesPsychomotorGuided Response											nse					
UNIT I COMMUNICATION											9					
1.1 – B	rains	tormi	ing													
1.2 – L	SRW															
UNIT	II	CA	REER	SKI	LLS											9
2.1 - R	lesum	e & (CV prep	parin	g Skills										•	
2.2 - Ir	ntervi	ew S	kills													
2.3 – E	xplor	ing C	Career C)ppo	rtunities											
UNIT	III	ТЕ	AM SK	KILI	S											9
3.1 – L	isteni	ng as	s a Tean	n Ski	11											
3.2 – T	'eam l	Build	ling at w	vork	place											
UNIT	IV	PR	OFESS	SION	JAL SK	ILLS										9
4.1 – A	ttitud	le and	d Goal S	Settir	ng											
4.2 – Verbal and Non Verbal Communications																
UNIT V PROFESSIONAL ETIQUEITES 9											9					
5.2 - Cultural Ethics at work place																
LECT	URE	: 45		T	UTORL	AL: 0		P	RACT	ICAI	.:0			ТО	TAL	.: 45
SUGG	ESTI	ED R	EADIN	IGS												
1. Er. A. K. Jain, Dr. Pravin S. R. Bhatia, Dr. A. M. Sheikh Professional Communication Skills S. Chand																

Publications, 2015

2. Alan Pannett. Key Skills for Professionals: How to Succeed in Professional Services, Kogan Page; 1st edition, 2013

Mapping of COs with Pos

	PO 1	PO 2	PO 3	PO 4	P 0 5	P 0 6	PO 7	P 0 8	P O 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	0	0	0	0	0	0	0	3	2	3	0	0	0	0
CO 2	0	0	0	0	0	0	0	3	2	3	0	0	0	0
CO 3	0	0	0	0	0	0	0	3	2	3	0	0	0	0
CO 4	0	0	0	0	0	0	0	3	2	3	0	0	0	0
CO 5	0	0	0	0	0	0	0	3	2	3	0	0	0	0
Total	0	0	0	0	0	0	0	15	10	15	0	0	0	0
Scale d to 0,1,2 and 3	0	0	0	0	0	0	0	3	2	3	0	0	0	0
					1-5	\rightarrow 1,	6-10 →	2, 11	-15 →	• 3				

					L	Т	Р	С
X	BT60	7	BRACESS BIOTECHNOLOGY I ABORATORY		0	0	4	4
			PROCESS BIOTECHNOLOGY LABORATORY					<u>I</u>
С	Р	Α			L	Т	Р	Н
0.5	2.5	1			0	0	8	8
Prer	equisi	ite: Pi	ocess biotechnology					
Lear	ning(Objec	tives: Upon completion of this course, the students					
Woul	ld be a	able to	o identify the parts of a fermenter					
Woul	ld be a	able to	design industrial media for fermentation process.					
Woul	ld be a	able d	esign a particular production process.					
			Course Outcomes	I	Domain		Leve	શ
				Cog	nitive	I	Apply	
C01	Inf	fer th	e basic parts of a fermentor and its operations.	Psyc	chomoto	or I	Mechanis	m
				Affe	ective	I	Respond	
	De	mons	trate the different media components involved in a	Cog	nitive	1	Apply	
CO2	fer	ment	tion process	Psyc	chomoto	or I	Mechanis	m
	101	monte		Affe	ective	I	Respond	
				Cog	nitive	I	Apply	
CO3	Int	terpro	et various control systems involved in bioreactor.	Psyc	chomoto	or I	Mechanis	m
				Affe	ective	I	Respond	
				Cog	nitive	Ι	Apply	
CO4	Me	easur	e the various transport phenomena involved in bioprocesses.	Psyc	chomoto	or I	Mechanis	m
				Affe	ective	I	Respond	
		_		Cog	nitive	Ι	Apply	
CO5	De	mosta	artethe scale up procedure of mixing ,aeration	Psyc	chomoto	or I	Mechanis	m
				Affe	ective	I	Respond	
List	of Pra	nctica	Experiments	_	_	_		_
Deter	rminat	tion o	f thermal death rate constant for a fermentation process. (CO1)					
Com	pariso	n of t	ioprocess efficiencies in synthetic and complex industrial media	. (CO2	2)			
Medi	um fo	ormula	tion and optimization studies. (CO2)					
Estin	nation	of bi	omass concentration for microbial production. (CO3)					
Deter	rminat	tion o	f oxygen mass transfer coefficient by Sulphite oxidation method.	(CO3	3)			
Yeas	t cell o	disrup	tion studies by sonication.					

High-resolution purification preparative liquid chromatographic techniques. (CO3)

Ammonium Sulfate precipitation of protein using yeast cell suspension. (CO4)

Crystallization of a product. (CO4)

Determination of drying time for the given sample in vacuum tray drier. (CO5)

Lyophilization (CO5

Lecture	Tutorial	Practical	Total	
0	0	30	30	

Text Books:

1. Schuler and Kargi, Bioprocess engineering. Prentice Hall

References:

2. Pauline Doran, Bioprocess Principles, Academic press, 2004.

E-References:

1. http://38.100.110.143/model/bb/theory.html

2. http://38.100.110.143/model/bb/procedure.html

Mapping of COs with Pos

			PROGRAM OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3		2	2								1	2	2
CO2	2	3	2	1	1		1		1		3	2	3	3
CO3	1	3	3	2					1			1	0	0
CO4	1	3	3	2								1	0	0
CO5	1	3	2	2	1		1		2		2		1	1
Total	9	12	12	9	2	0	2	0	4	0	5	5	6	6
ScaledValue	2	3	3	2	1	0	1	0	1	0	1	1	2	2
	1 -	-5 🗆	$5 \Box 1$, $6-10 \Box 2$, $11-15 \Box 3$											
	0-NoRelation,1-Low Relation,2-MediumRelation,3-HighRelation													

			T.	Т	Р	С			
XRT 701 A			3	0	0	3			
ADI /VIA	PROTFIN FNCINFFRINC		5	v	v	5			
			т	Т	р	н			
$\begin{array}{c c} C & I & A \\ \hline 25 & 0 & 05 \\ \end{array}$	-		3	1	1	3			
2.5 0 0.3 Proroquisito: Bio	chemistry Molecular Biology		3	U	U	3			
Learning Object	ive.								
Upon completion	of this course, the students								
Would lea	arn to make up of proteins, structure and function.								
Would ab	le to give mechanism of protein build up and function.								
Would lead	arn the strategy to engineer proteins for benefits of human be	ings							
	Course Outcomes	Doma	nin		Leve	1			
After the complet	ion of the course, students will be able to	Donne	••••		Leve	4			
CO1.Explain an	d understand the aminoacid characteristics and primary			Und	erstar	nding			
structure of protei	ns	Cognit	ive	Onu	cistai	lung			
structure of proton									
CO2:Explain an	d analyze the secondary and super secondary structural	Cognit	ive	Und	erstar	nding			
features Cognitive Analyzing									
CO3:Describe an	d compare the different level of protein structure and their	Cognit	ivo	Rem	nembe	ering			
folding mechanism	n.	Cogint	ive	Ana	lyzing	3			
CO4:Explain the	protein structure its functional relationship and relate that	Cognit	ive	App	lying				
in various exampl	es.	Affecti	ive	Orga	anizat	ion			
CO5:Explain the	e protein engineering concepts and assist that in various			App	lying				
engineered protein	n production.	Cognit	ive	Resp	ponds	to			
				pher	nomei	ıa			
I- Structure and	Functional Aspects of Amino acids				9+3	,			
Acid-base proper	ties of amino acids - Stereochemical representations of an	nino aci	ds -	Pepti	de bo	nds -			
chemical and phy	vsical properties of amino acids - Detection, identification	and qua	antifi	catior	n of a	mino			
acids and proteins	s – Stereoisomerism - Non-standard amino acids – Primary s	tructure	of pr	otein	s – pe	eptide			
mapping and pept	ide sequencing – Edman degradation method.								
II- Protein Arch	itecture				9+3	3			
Ramachandran pl	ot – Tertiary structure – Interactions that stabilize the tertiar	y structu	ıre –	Orga	nizati	on of			
Domains – Quate	rnary structure – Importance of quaternary structures in glob	in famil	y – h	aemo	globi	n and			
allosteric regulation	on – Methods to determine the three-dimensional structure of	proteins	5.						
III- Protein Fold	ling and Assembly		<i>a</i> :		9+3	3			
Protein folding: 1	Molten globule state – Role of hydrophobic residues in fo	olding –	Sing	le an	id mu	Itiple			
protein folding pa	thway – Role of disulphide bonds in protein folding – Invivo	protein	told	ing: S	structi	ure of			
Molecular chaper	rones and their role in protein folding – osmolyte assist	ed prote	ein fo	olding	g - A	mide			
exchange and me	asurement of protein folding – Membrane protein folding -	- Protei	n mis	stoldi	ng an	d the			
diseased state: am	yioidosis.				0 1				
IV - Protein Stru	icture and Function Relationship				9+3)			
The interview of the in	The fingers & Louise ginner. Marchana metains and euk	aryotic f	ransc	riptic	on fac	uors -			
rp repressor -	Zn ingers & Leucine zippers - Memorane proteins and rec	epiors :	Dact	enor	loaop	psin -			

Structure function relationship in Immunoglobulin – Enzymes: Serine proteases mechanism of action.V- Protein Engineering9 + 3Strategies for protein engineering: Effect of Disulfide bridges, Dipoles of α helices - Random and site-
directed mutagenesis in protein engineering - Role of low-fidelity enzymes in protein engineering - SNP –
Production of Peptide Vaccines – Protein microarray and its role on disease diagnosis.

Lecture	Tutorial	Practical	Total
45	15	0	60

Text Books:

- 1. Voet D., Voet G. Biochemistry, 4th edition, John Wiley & Sons, 2010.
- 2. Branden, C. and Tooze, R., Introduction of Protein structure, Garland, 2nd Edition, 1999.
- 3. Alan Fersht. Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding. 3rd revised edition, W.H.Freeman& Co Ltd, 1999.

References:

- 1. Creighton T.E. Proteins: Structure and Molecular Properties, , 2nd Edition, Freeman, WH, 1992.
- 2. Creighton T.E. Protein Structure: A Practical Approach, 2nd Edition, Oxford University Press, 1997.
- 3. Lilia Alberghina. Protein Engineering in Industrial Biotechnology, CRC press, Harwood Academic Publishers, 2003.

E- References:

- 1. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2763986/
- 2. www.niscair.res.in/sciencecommunication/ResearchJournals/rejour/ijbt/ijbt2k6/ijbt_july06.asp
- 3. http://books.google.co.in/books?id=x0UyTLIhWSAC&pg=PA227&source=gbs_toc_r&cad=3#v=one page&q&f=false

	PO	PO1	PO1	PO1	PSO	PSO	PO1								
	1	2	3	4	5	6	7	8	9	0	1	2	1	2	2
CO 1	1	1	0	1	2	2	1	1	0	2	2	3	1	1	3
CO 2	2	3	2	2	2	1	1	0	1	0	0	2	1	1	2
CO 3	3	1	2	1	2	0	0	0	1	1	1	3	2	3	3
CO 4	1	3	2	3	2	1	2	1	1	2	1	2	2	2	2
CO 5	3	2	3	3	3	2	2	2	3	2	2	3	3	3	3
	10	10	9	10	11	6	6	4	5	7	6	13	9	10	13

Mapping of COs with Pos

Mapping of Subject Vs Pos

	PO	PO1	PO1	PO1	PSO	PSO								
	1	2	3	4	5	6	7	8	9	0	1	2	1	2
Origin	10	10	9	10	11	6	6	4	5	7	6			
al												13	9	10
value														
Scaled	2	2	2	2	3	2	2	1	1	2	2	3	2	2
to														
0,1,2,3														
scale														

Scale: 3- high, 2 – Medium, 1 - Low, 0 – not related

				L	Т	Р	С
XI	BT 70	1B		3	0	0	3
			PHARMACEUTICAL BIOTECHNOLOGY				
С	Р	Α		L	Т	Р	Η
3	0	0		3	0	0	3
Prer	equisi	te: Bi	ochemistry, Immunology, r-DNA technology				
Lear	ning	Object	tives:				
Upor	ı com	pletio	n of this course, the students				
•	Wo	ould al	ble to understand principles of biotechnology in pharmaceutical produ	ct deve	lopme	ent.	
•	Wo	ould ap	oply advanced biotechnology methods in novel drug development				

• Would able to review the production processes for antibiotics, vitamins, alkaloids and steroids

	Course Outcomes	Domain	Level
After the	e completion of the course, students will be able to		
CO1	identify the potential avenues and requirements from the biotechnologists in pharmaceutical industries and describe the scope and applications of biotechnology in pharmacy	Cognitive	Analyzing Understanding
CO2	Outline thepharmacodynamics, pharmacokinetics of drugs	Cognitive	Analyzing Understanding
CO3	Describe various adverse effects of drugs	Cognitive	Analyzing Understanding
CO4	Explain the manufacturing process for various therapeutical products including vaccines, enzymes, interleukins, hormones	Cognitive	Analyzing Understanding

C05	Comprehen	Cognitive	Analyzing									
0.05	and other bi	opharmaceuticals		coginave	Understanding							
I- Intro	duction				7							
Introduc	ction to Pharr	naceutical industry & deve	elopment of drugs; types of	f therapeutic age	nts and their uses.							
Pharma	ceutical Biote	echnology and Drug disco	very. Scope and application	ons of biotechnol	logy in pharmacy,							
biologic	al /research a	dvances and approved biol	ogicals for pharmaceutical	uses.								
II- Dru	gs and Their	Metabolism			10							
Physioc	hemical prop	erties of drugs, factors m	odifying drug action. Pha	rmacodynamics,	pharmacokinetics							
and dru	and drug metabolism.											
III- Dr	ugs and The	ir Interaction			10							
Adverse	e effects of	drugs and drug toxicolog	y: Reproductive toxicity	and Teratogenic	ity, Mutagenicity,							
Carcino	genicity, Dru	g tolerance, Drug intolera	nce, drug allergy, drug in	duced side effect	ts. Tachyphylaxis,							
biologic	biological effects of drug abuse and drug dependence.											
IV- Production of Biopharmaceuticals 11												
Biophar	maceutical a	nd biological drug deve	lopment, Manufacturing	of biopharmaceu	itical, therapeutic							
proteins	and peptide	s. Recombinant growth he	ormones, growth factors, t	herapeutic mono	clonal antibodies,							
theraped	utic enzymes	and their application in hea	llth care.									
V- Test	ing and Ana	lysis of Biopharmaceutica	uls		7							
Pharma biologic	ceutical Testi cal methods, q	ng, Analysis and Control uality assurance and control	: Analysis of pharmaceuti ol, stability of pharmaceuti	cals using physi cal products	cal, chemical and							
L	ecture	Tutorial	Practical		Total							
	45	0	0		45							
Text Bo	Text Books:											
1. Purohit,Kulkarni,Saluja—Pharmaceutical biotechnology, Agrobios publishers, 2003												
2. Pharmaceutical biotechnology edition2 by crommel, Freeman publishers, 2004												
1 Crommelin DIA Robert D Sindela Bernd Meibohm "Pharmaceutical Biotechnology:												
1.	fundamentals	J.J.A, KODER D. SINC and applications" Inform	a Healthcare 2008	Pharmaceutical	Biotechnology:							
2.	Pharmaceutic	and applications, inform	covery and clinical application	ations by Kayser	Wiley publishers.							
	1st edition 20)07	,	,,,,	,, r,,							
3.	Katzung B.G	. Basic and Clinical Pharm	acology,(6th Ed) Prentice I	Hall of Intl., 1995	5							
E- Refe	rences:	:	:	11								
ł	1.nups://arch	ive.org/details/Pharmaceut	licarbiolechnology/page/n1	11								

Mapping Of COs and POs

		Program Outcomes												
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2	-	1	1	2	2	-	-	1	1	1	1	0	0
CO2	1	1	1	1	2	2	1	2	1	2	2	2	1	0
CO3	2	2	2	2	1	2	2	-	2	2	1	1	2	0
CO4	2	1	3	2	2	3	2	-	1	1	-	-	3	0
CO5	2	3	2	2	3	3	2	2	2	2	1	1	3	0
	9	7	9	8	10	12	7	4	7	8	5	5	9	0

Mapping of Subject Vs Pos

	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
Original value	9	7	9	8	10	12	7	4	7	8	5	5	9	0
Scaled to 0,1,2,3 scale	2	2	2	2	2	3	2	0	2	2	0	0	2	0

Scale: 3- high, 2 – Medium, 1 - Low, 0 – not related

				L	Т	Р	С
XB	Г 701	С		3	0	0	3
			MASS TRANSFER FUNDAMENTALS				
С	Р	A		L	Т	Р	Η
3	0	0		3	0	0	3
Pre	requi	sites :	Nil				

Objectives:

• To facilitate the learners understand the basic concepts and principles of mass transfer and apply them in distillation, absorption adsorption drying and humidification operations.

Course	e Outcomes: At the end of this course, the students should be able to	Domain	Level
CO1	Explain the basic principles in diffusional mass transfer and calculate	Cognitive	Understand
	the rate of the mass transfer under one dimensional steady state		Analysing
	diffusion		
CO2	Describe the operations of Distillation and absorption and calculate	Cognitive	Understand
	number trays for distillation and absorption tower		Analysing
CO3	List situations where liquid-liquid extraction might be preferred to	Cognitive	Understand
	distillation		Analysing
CO4	Discuss the salient features of Separation by adsorption,	Cognitive	Understand

I chromatographic separation process and Explain the concept of I At	nalvsing
breakthrough in fixed-bed adsorption.	iary sing
CO5 Describe the salient features and mechanism involved in Drying and Cognitive U	nderstand
Design cooling towers.	nalysing
I- Mass Transfer and Diffusion	9 hrs
Steady state molecular diffusion in fluids and solids. One dimensional steady state and u	nsteady state
molecular diffusion through stationary media – molecular diffusion in laminar flow	– diffusivity
measurements - mass transfer analogies - inter phase mass transfer, models of mass transfer at	t fluid – fluid
interface - two film theory and overall mass transfer coefficients - Diffusion in multi compo	onent gaseous
mixtures – Diffusion in solids.	
II- Distillation	9 hrs
Vapour liquid equilibrium – methods of distillation – simple, steam, flash distillation, azeotrop and molecular distillation – Continuous distillation – McCabe - Thiele method, ponchonsavarit m	ic, Extractive ethod
III - Extraction and Leaching	9 hrs
L-L equilibrium – staged and continuous extraction concepts, Equipments for extraction – g	eneral design
considerations. Solid – liquid equilibria, leaching principles – Equipments for leaching – equi	librium stage
model for leaching and washing - simple problems.	
IV- Absorption and Adsorption	9 hrs
Theory of absorption – Factors affecting gas absorption-Equilibrium and operating line concept	in absorption
stage determination – Pressure drop and limiting flow rates – weeping; coning; entrainme	ent; flooding;
channellingAdsorption and its types -sorbents – equilibrium consideration- kinetic and transport c	considerations
– sorption systems.	
V - Humidification and Drying	9 hrs
Basic terminologies in humidification – psychrometric chart, construction and use. Methods of h	umidification
and dehumidification - equipments - spray chamber- cooling tower principles, types and operat	ion – process
design of cooling tower. Theory and mechanism of drying - drying characteristics of materia	ls -batch and
continuous drying – drying equipment – design and performance of various drying equipments	
continuous arying carying equipment acoust and performance of various arying equipments.	
Lecture Tutorial Practicals 7	otal
45 0 0	45
Text Books	
1. Treybal R.E., "Mass Transfer Operations", Third Edition, McGraw Hill, 1980.	
2. Anantharaman, N. and K.M. MeeraSherifa Begum, "Mass Transfer Theory and Practice",	PHI
Learning Private Limited, New Delhi,2011	
3. Gavhane K.A "Mass Transfer" 8 th Edition, Nirali Prakashan, 2010.	
References	
References 4. Dutta, B. K., "Principles of mass transfer and separation processes", Prentice Hall of India 2007.	a, Delhi,

6. McCabe, W.L., J.C. Smith and P. Harriott, "Unit Operations of Chemical Engineering", 7/e, McGraw-Hill International Edition, 2005.

Mapping of COs Vs Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	3	2	1	2	1	1		2	2	3	3
CO 2	3	3	1	3	2	1	2	1	1		2	2	3	3
CO 3	3	3	1	3	2	1	2	1	1		2	2	3	3
CO 4	2	1	1	1	1	1	1	1	1		1	1	1	1
CO 5	3	3	1	1	1	1	1	1	1		1	1	1	1
	14	13	5	11	8	5	8	5	5		8	8	11	11

Mapping of Subject Vs Pos

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
Origina 1 value	14	13	5	11	8	5	8	5	5		8	8	11	11
Scaled to 0,1,2,3 scale	3	3	0	3	2	0	2	0	0	0	2	2	3	3

Scale: 3- high, 2 – Medium, 1 - Low, 0 – not related

					L	Т	Р	C		
X	BT 70)2			1	0	2	3		
			BIOINFORMATICS AND COMPUTATIONAL B	IOLOGY						
С	Р	Α			L	Т	Р	I		
1	0.5	0.5			2	0	2	4		
Prere	equisit	te: Co	mputer programming, biochemistry							
Learı	ning (Object	ives:							
Upon	com	pletion	of this course, the students							
•	Wil	ll be	able identify different databases and will be able t	to know ab	out the	applic	ation of	th :		
	b10	intorm	atics for data retrieval and for drug designing and develo	pment.						
A. C.	.1	1	Course Outcomes	Domai	n		Level			
After	the co	mplet	on of the course, students will be able to							
COI	Exp	plain t	he importance and basic concepts in bioinformatics	Cognitive		Underst	anding			
	and	anner	entiate various databases.	Psychomot	or	Percept	ion			
CO2	Un	dersta	nds the significance of sequence analysis and	Cognitive		Applyir	ıg			
	per	forms	sequence alignment.	Psychomot	or	Guided	response	e		
CO3	Exp	plain a	nd Construct phylogenetic trees to study phylogenetic	Cognitive		Underst	and			
	rela	tionsh	ips	Psychomot	or	Guided	response	e		
CO4	Pre	dict a	and Analysis the protein structure and molecular	Cognitive		Create				
	doc	king		Psychomot	or	ism				
CO5	Un	dersta	nd the steps involved in drug discovery process.	Affective		Receiving				
						phenom	ena			
I- In	trodu	ction t	o Bioinformatics				9+6			
Impoi	rtant o	contrib	utions - aims and tasks of Bioinformatics - application	ons of Bioi	nformat	ics - ch	allenges	ar		
oppor	rtunitie	es - B	iological databases- Classification of biological databa	ises- Primar	y and Σ	Seconda	ry datab	ase		
Seque	ence a	na stru	cture databases, Specialized databases- retrieval system-	Entrez-SKS).		0 (
II- Ir	ntrodu	uction	to Computational Biology and Sequence Analysis				9+6			
Seque	ence a	alignm	ent, Pairwise alignment, Multiple sequence alignme	nt its appli	cations,	Local	and Gl	lob		
align	ment,	Needle	man and Wunsch algorithm, Smith Waterman algorithm	n, Database s	similarit	y search	ung -FA	SI		
	DLAS I									
III- P	hylog	genetic	s				9+6			
Introc	luction	n to Ph	ylogenetics, Molecular Evolution and Molecular Phylog	enetics, Phyl	ogeneti	c tree, F	forms of	Tr		
Repre	esentat	tion, R	ooted and un-rooted trees, Phylogenetic Tree Construc	tion Method	ls: Dista	ance bas	sed meth	ıod		
NJ, U	PGM	A, Cha	aracter based methods –Maximum Parsimony, Phylogene	etic programs	s, Boots	trapping				
IV. P	Proteir	Strue	cture Modelling and Simulations				9+3+3			
Drote	noten		basics. Protain structural visualization and comparison	Sacandar	structu	ura prod	iction (⁷ ho		
Fiou	an C		Jasics, Floteni structural visualization and comparison	omology m	- su ucu odeling	Thread	ing and	Fo		
reco	gnition	лок, т 1	venai networks, riotem tertiary structure prediction ri	omology m	Juening,	Threau	ing and	1.0		
V- R	ole of	Bioinf	ormatics in Drug Discovery				9+3+3			
, 10	desig	ming_	objectives- Rational drug design- Computer assisted	l drug deci	on and	drug d	levelopn	nen		
Druo	UESIO			a where $uvol$						

Molecular docking and its applications- QSAR, In Silico drug design- role of structural bioinformatics in drug design and development- Pharmacogenomics- prospects and uses.

List of Experiments

- 1. Accession and retrieval of data from various biological databases.
- 2. Unix/Linux basic operations and working with terminal.
- 3. Perl programming Simple programs using Operators, Control Structures, Subroutines, Hash, Creating a static HTML file by a Perl Program.
- 4. Heuristic methods (BLAST, FASTA) of searching for homologous sequences
- 5. Pair-wise (Needleman Wunch Algorithm & Smith waterman Algoritghm) and Multiple sequence alignment.
- 6. Gene prediction methods (ORF Finder).
- 7. Phylogenetic tree building using Phylip.
- 8. Protein Secondary structure prediction.
- 9. Homology Modeling.
- 10. Molecular Visualization and 3D structural studies using Rasmol Commands, Domain identification.
- 11. Molecular Visualization and 3D structural studies using Chimera.
- 12. Small molecule building, using ISIS Draw and CHEM SKETCH Tutorial

Lecture	Tutorial	Practical	Total
45	0	30	75
Text Books:			

- 1. David W. Mount Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, Second Edition, 2004
- 2. Ghosh, Zhumur, and Bibekanand Mallick. Bioinformatics: Principles and Applications. Oxford University Press, 2008.
- 3. S. Harisha, "Fundamentals of Bioinformatics", I. K. International Pvt Ltd, 2010

References:

- 1. Arthur M. Lesk, Introduction to Bioinformatics by Oxford University Press, 2008
- T K Attwood, D J parry-Smith, Introduction to Bioinformatics, Pearson Education, 1st Edition, 11th Reprint 2005
- 3. Stephen A. Krawetz, David D. Womble, Introduction To Bioinformatics A Theoretical and Practical Approach, Humana Press, 2003

E-References:

- 1. http://nptel.ac.in/courses/102103044/40
- 2. <u>vlab.amrita.edu/?sub=3&brch=273</u>

Mapping of Cos Vs PO s

	101	P02	PO3	P04	P05	P06	P07	80d	60d	P010	1104	P012	PS01	PSO2
CO 1			1		2				2					
CO 2		2	2	1	3								1	
CO 3		2	1	1	2							3	3	1
CO 4	1	3	3	1	3						3	1	2	3
CO 5	1	2	3		3						2	1	1	1
	2	9	10	3	13				2		5	4	7	5

Mapping of Subject Vs Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Original value	2	9	10	3	13	0	0	0	4	0	0
Scaled to 0,1,2,3 scale	1	2	2	1	3	0	0	0	1	0	0

Scale: 3- high, 2 – Medium, 1 - Low, 0 – not related

							1			
					L	Т	P	C		
XB	T 703				3	1	1	5		
			DOWNSTREAM PROCESS	ING						
С	Р	Α			L	Т	Р	H		
1	0.5	0.5			4	1	2	6		
Prerequi	site:M	icrobi	ology, Bioprocess Engineering, Biochemica	l Engineering						
Learning	g Obje	ctives:								
Upon con	npleti	o <mark>n of t</mark>	his course, the students							
• V	Vill be	e able	understand the principle behind the differ	ent processes invo	olved in	n the d	ownstr	eam		
р	rocessi	ing.								
Course (Outcon	nes:								
			Course Outcomes	Domain			Level			
After the	compl	etion o	f the course, students will be able to	I						
CO1	Rec	call a	nd describe the basics of bioseparation	Comitivo		Ren	nember	ring		
	pro	cess.		Lognitive Affanting	Rec	Receiving				
				Affective	Phe	Phenomena				
CO2	Ou	tline a	and differentiate the different methods of	Cognitive	Und	Understanding				
	dov	vnstrea	m processing.	Affective	Valu	Valuing				
				Psychomotor		Perc	Perception			
CO3	Ide	ntify,	locate and select a specific method for a	Comitivo		Und	Understandin			
	pro	duction	n process.	Affactive		Rec	eiving			
				Affective		Phe	nomen	a		
				Psychomotor		Perc	eption	L		
CO4	Rec	cogniz	e, perform and detect various separation	<u>Constitute</u>		Und	erstan	ding		
	tech	nnique	for a bioproduct development	Lognitive		Res	pondin	g		
				Affective		pher	nomen	a		
				Psychomotor		Perc	eption	L		
CO5	Ide	ntify,c	hoose and follow the different methods for			Und	erstan	ding		
	the	purific	ation of a particular product.	Cognitive		Rec	eiving			
				Affective		Phe	nomen	a		
				Psychomotor	Guided					
						resp	onse			
I- Intro	luction	n to Do	ownstream Processing Processes	1			9+3+3	5		
			=							

Scope and overview-Economics, strategies for initiation of project, Process Design Criteria cost reduction strategies, upstream and downstream processing in biotechnology, various biotechnology products and their biological properties, fundamentals of bioseparation. Separation process design criteria-Characteristics of biological mixtures, Morphological features of the cell, Concentration of product of interest and impurities, physical and rheological characteristics.

II- Downstream Processing Methods

9+3+3

Cell disruption Techniques, types of cells, location of products inside the cells and products, cell distruption Methods, Mechanical and Non mechanical methods- Filtration, types of filtration equipments, filter media and filter aids, basic theory of filtration, principle of rotary drum filter- centrifugation-principle of sedimentation , types of centrifuges, flocculation and sedimentation.

III- Product Identification Techniques

9+3+3

9+3+3

Characterization of product- Electrophoresis, Principle and methods-Analysis of product purity-Chromatography,Enzyme Linked Immuno Sorbent Assay (ELISA),Ion exchange chromatography, Reverse phase chromatography, Affinity Ligand Technology HPLC Radial Flow Chromatography.

Experiment No 4: Extraction of pigments from spinach and estimation by thin layer chromatography.

IV- Product Separation Techniques

Distillation- Principle and types, Extractive distillation, Steam Distillation, Vaccum Distillation-Extraction-Solvent extraction principles, Extraction methods, modes of aqueous two-phase extraction, Super critical fluid extraction -Adsorption, principle, Isotherms, different types of adsorption- Evaporation, principle, factors influencing rate of evaporation, types of evaporators.

V- Product Purification and Resolution

9+3+3

Precipitation methods (with salt, organic solvents, and polymers, extractive separations, aqueous two-phase extraction)- Membrane based separation process, Types of membranes, Membrane process, theory and types of membrane-Application of ultrafiltration- Application of microfiltration - Crystallization, theory of crystallization-Freeze drying- Principle, process and application of freeze drying integrated bio-processing- product polishing stages

List of Experiments:

- 1: Yeast cell disruption studies by sonication.
- 2: Design of thickener for batch sedimentation using yeast by Kynch's theory.
- 3: Determine the specific cake resistance of a media by filtration.
- 4: Centrifugation studies during the settling of E.coli cells.
- 5: Determination of partition coefficient and yield of yeast cells using aqueous two phase extraction.
- 6: High-resolution purification preparative liquid chromatographic techniques.

7: Ammonium Sulfate precipitation of protein using yeast cell suspension.

8: Crystallization of a product.

9. Determination of drying time for the given sample in vacuum tray drier.

10:Lyophillization

Lecture	Τι	ıtorial	Practical	Total						
45		15	15	75						
Text Books:			1							
1. Nooralabettu Krishna Prasad, Downstream Process Technology, A New Horizon in Biotechnology, PHI										
Pvt Ltd,2 nd Edition, 201	2.									
2. Sivasankar, B. Biosperations: Principles and Techniques. PHI Learning Pvt. Ltd., 2005										
References:										
1. Hatti-Kaul, Rajni, and Bo Mattiasson. "Downstream processing in biotechnology." Basic biotechnology.										
Cambridge University Press, Cambridge ,2001.										
2. Roger G. Harrison, Paul W. Todd, Scott R. Rudge, Demetri P. Petrides1, "Bioseparations Science and										
Engineering, oxford University Press, 2015.										
3. J. A. Wesselingh, Johannes Krijgsman, "Downstream Processing in Biotechnology", Delft Academic										
Press/VSSD, 2013.										
E-References:										
1. http://vlab.amrita.edu/?sub=2&brch=191∼=341&cnt=1										
2. http://vlab.amrita.edu/?sub=2&brch=191∼=1547&cnt=1										
3. http://vlab.amrita.edu/?sub=2&brch=190∼=606&cnt=1										

4. vlab.amrita.edu/?sub=3&brch=273

Mapping of Cos Vs Pos

	P01	P02	P03	P04	PO5	P06	P07	P08	P09	P010	P011	P012	PS01	PSO2
CO 1	3		2	1		1	1		1					1
CO 2	2	3	2	1		1			1			1	1	1
CO 3	2	3	1	2					1			1	1	2
CO 4	2	1	3	2			3		1			1	2	1
CO 5	2	2	3	1		2	1		1		2	2	3	3
	11	9	11	7		4	5		5		2	5	7	8
Mapping of Subject Vs Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
Original value	11	9	11	7	0	4	5	0	5	0	2	5	7	8
Scaled to 0,1,2,3 scale	3	2	3	2	0	1	1	0	1	0	1	1	2	2

Scale: 3- high, 2 – Medium, 1 - Low, 0 – not related

				L	Т				
XB	ST 70 4	A			3	0	0	3	
			CANCER BIOLOGY						
С	Р	Α			L	Т	Р	Н	
2.5	0	0.5			3	0	0	3	
Prer	equisi	te: Ce	ll biology molecular biology				1		
Lear	ning	Object	ive:						
Upor	n com	pletior	n of this course, the students						
•	Wo	ould ha	we learn about carcinogenesis.						
•	Wo	ould ha	ave learn about a comparative approach to understand the	e difference	s in 1	nech	anisn	ns and	
	sig	naling							
			Course Outcomes	Domain		•	Leve	l	
After	the c	omplet	ion of the course, students will be able to	I	1				
CO1	:Outli	i ne the	e regulation and modulation of cell cycle in cancer by	Cognitive	τ	Jnder	rstand	ling	
v	various	signa	l switches						
CO2	:Expl	ain ar	d compare various types of carcinogenesis and its	Cognitive	τ	Jnder	rstanc	ling	
n	netabo	olism			A	Analy	zing		
CO3	:Illust	rate	the role of activation of kinases, identification of	Cognitive	τ	Jnder	rstand	ling	
C	oncoge	enes, ar	nd conforms the role of telomere.	Affective	A	Analy	zing		
					F	Respo	onds t	0	

		Phenomena
CO4:Explain metastasis and its significant clinical markers for invasion	Cognitive	Understanding
and metastasis		
CO5:Describe and compiles molecular tool for early diagnosis of	Cognitive	Understanding
cancer, different forms of cancer therapy.	Affective	Responds to
		Phenomena
I- Cell Cycle and Cancer		9

Cancer: Causes, characteristics and types – Cell cycle phases, cyclins and CDKs, check points, modulation of cell cycle in cancer - Effects on receptor, signal switches, signaling pathways – Telomerase and its role in cancer – Apoptosis, Extrinsic and intrinsic pathways, apoptosome and caspases - mutations that leads to cancer.

9

9

9

9

II- Carcinogenesis

Theory of carcinogenesis – Types: Physical, chemical and radiation carcinogenesis, Direct acting and indirect acting carcinogens, Metabolism of carcinogens, CYP450 reductase mechanism; Mechanism of radiation carcinogenesis, ionizing and non ionizing radiation, Retroviruses - RSV life cycle and its role in cancer, Identification of carcinogens, Long and short term bioassays.

III- Molecular and Cell Biology of Cancer

Signal targets and cancer, activation of kinases – Oncogenes - types, c-Myc, Ras, Bcl-2 family - identification and detection of oncogenes, oncogenes and proto oncogene activity - Growth factors related to transformation - epidermal growth factor (EGF), platelet derived growth factor (PDGF), transforming growth factor (TGF), src and myc; RAS cycle – Tumor suppressor genes.

IV- Invasion and Metastasis

Clinical significances and three step theory of Invasion, Metastasis – Introduction and cascade, heterogeneity of metastatic phenotype, Significance of proteases in basement membrane disruption, Epithelial- mesenchymal transition, stromal signals, Role of cadherin and integrin, metalloproteinases in cell invasion, Ras like GTPases.

V- Diagnosis and Therapy

Diagnosis: Detection using biochemical assays, tumor markers - Molecular tools for early diagnosis of cancer, Disease staging - FISH, DNA microarrays, SNPs, CGH and imaging techniques.

Treatment: Chemotherapy – Topoisomerase inhibitors – Radiotherapy – Gene therapy – Immuno therapy – Antigen specific and Adaptive therapy – Stem cell therapy - Use of signal targets towards therapy of cancer – New Genomic and proteomic technologies.

45	0	0	45
Text Books:			
1. Weinberg, R.A.,	The Biology of Cancer, G	arland Science Taylor and Franc	cis Group,
New York, 1st Editio	n, 2007.		
2. Kleinsmith. L.J.,	Principles of Cancer Biol	ogy, Pearson Education Inc., San	n
Francisco, CA, 1st Ec	lition, 2006.		
References:			
1. DeVita Jr, V.T., La	awrence, T.S., Rosenberg,	S.A., DePinho, R.A. and Weint	berg, R.A., DeVita, Hellman,
and Rosenberg's Cano	cer: Principles and Practic	e of Oncology, Lippincott Willia	ams & Wilkins Philadelphia,
PA, 9th Edition, 2011			
2 Jan F Tannock Ric	chard P Hill Robert G Br	istow and Lea Harrington The	Basic Sciences of Oncology

Practical

Total

4th Edition, The McGraw-Hill Companies, Inc. New Jersey, 2005.

Tutorial

3. PelengarisA.,and M. Khan (Eds)., The Molecular Biology of Cancer, Wiley - Blackwell Publishing, USA. 2006.

4. Gareth Thomas., Medicinal Chemistry – An Introduction, 1st Edition, John Wiley and Sons, USA, 2004.

5. Benjamin Lewin., Genes VIII, International Edition, Pearson Prentice Hall, New Delhi. 2004.

E References:

Lecture

1. www.nhri.org.tw/NHRI_ADM/userfiles/file/1010510.pdf

Mapping of Cos Vs Pos

	P01	P02	P03	P04	P05	P06	P07	PO8	P09	P010	P011	P012	PS01	PSO2
CO 1	3	2	2	1	2	1			2	2	2	2	3	2
CO 2	2	2	2	2	3	3	2	1				3	1	1
CO 3	3	3	2	2	2				1	1	2	2	2	3
CO 4	2			3	2							1	1	2
CO 5	3	3	2	3	2	2	2	1	2	2	1	1	1	1
	1	10	8	11	11	6	4	2	5	5	5	9	8	7

Mapping of Subject Vs POs

	DO1	DOJ	DO3	DO 4	DO5	DOC	DO7	DOP	DOO	PO1	PO1	PO1	PSO	PSO
	POI	PO2	PUS	r04	PUS	PUO	PU/	PUð	PU9	0	1	2	1	2
Original	13	10	8	11	11	6	4	2	5	5	5	9	8	7
value														
Scaled to	3	2	2	3	3	2	1	1	1	1	1	2	2	2
0,1,2,3 scale														

Scale: 3- high, 2 - Medium, 1 - Low, 0 - not related

					L	Т	Р	С
VB	т 70	1 R			3	0	0	3
AD	1 /0	U P			5	U	v	5
			STEM CELL BIOTECHNOLOGY					
С	Р	Α			L	Т	Р	Η
3	0	0			3	0	0	3
Prei	requi	site: -	Cell biology, Immunology					
Lea	rning	g Obje	ective:					
Upo	n coi	nplet	ion of this course, the students					
	• V	Vould	able to explain about various categories of stem cells.					
	• V	Vould	have learned the application of stem cell technology.					
			Course Outcomes	Doma	in]	Level	
On	the su	access	ful completion of the course, students will be able to					
CO	l:Ab	le to r	recall and interpret the biology of stem cells.	Cognitiv	/e	Reme	mber	ing
						Under	rstand	ling
CO2	2: Ex	plain	and develop the embryonic stem cell culturing.	Cognitiv	ve .	Under	rstand	ling
						Apply	ving	
CO3	3:Dis	cuss a	and analyze the differentiation of stem cells	Cognitiv	/e	Under	rstand	ling
						Analy	zing	
CO ²	4:Exp	olain	and evaluate the various techniques involved in stem cell	Cognitiv	ve	Under	rstand	ling
assa	у.					Evalu	ating	

CO5: Discuss and apply th	CO5: Discuss and apply the various applications of stam calls										
	le various applications of sten		Cognitive	onderstanding							
I- Basics of Stem Cell				9							
Unique properties of stem	cells - embryonic stem cells	, history and dev	velopment, cha	aracteristics,-Adult							
stem cells ,Properies, types	s, clinical applications umbil	ical cord stem ce	ells– Similariti	es and differences							
between embryonic and adu	between embryonic and adult stem cells - Properties of stem cells – pluripotency – totipotency.										
II- Embryonic Stem Cells				8							
In vitro fertilization -cultur	ring of embryos-isolation of	human embryoni	c stem cells –	blastocyst – inner							
cell mass - growing ES c	ells in lab – laboratory tests	s to identify ES	cells – stimul	ation ES cells for							
differentiation – properties	of ES cells.										
III - Adult Stem Cells , iPs	SCs			7							
Somatic stem cells - test	for identification of adult ste	em cells – adult	stem cell diff	erentiation – trans							
differentiation – plasticity –	- different types of adult stem	cells.									
IV- Stem Cell in Drug Dis	scovery and Assay			9							
Target identification – Ma	nipulating differentiation participation par	thways – stem co	ell therapy Vs	s cell protection –							
Hematopoietic colony form	ing cell assay- stem cell in co	ellular assays for	screening – ste	em cell based drug							
discovery, drug screening a	nd toxicology.										
V- Applications of Stem (Cells			12							
Stem cell therapy for Menta	al disabilities, Diabetes Mellit	us – Therapeutic	applications –	Parkinsondisease -							
Neurological disorder – lin	nb amputation – heart diseas	e - spinal cord in	njuries – diabe	etes –burns - HLA							
typing- Alzheimer's diseas	typing- Alzheimer's disease -tissue engineering application - production of complete organ - kidney -										
eyes - heart – brain.											
Lecture	Tutorial	Practi	cal	Total							
45	0	0		45							

Text Books

1. Kursad and Turksen, Embryonic Stem Cells; Humana Press; 2002.

2. Dr. Logeswari Selvaraj, Stem Cells MJP Publishers, 2015.

References

1. Mohan C. Vemuri, Stem Cell Assays, Springer International Edition; 2010.

2. Stem cell and future of regenerative medicine. By committee on the Biological and Biomedical applications of Stem cell Research. 2002.National Academic press.

E References

1. http://nptel.ac.in/courses/102103012/41

Mapping of COs Vs POs

	PO1	P02	P03	P04	PO5	P06	P07	PO8	P09	PO10	P011	P012	PS01	PSO2
CO 1	3	2	2	1	2	1			2	2	2	2	3	2
CO 2	2	2	2	2	3	3	2	1				3	1	1
CO3	3	3	2	2	2				1	1	2	2	2	3
CO4	2			3	2							1	1	2
CO5	3	3	2	3	2	2	2	1	2	2	1	1	1	1
	13	10	8	11	11	6	4	2	5	5	5	9	8	7

Mapping of Subject Vs Pos

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1	PO1 1	PO1 2	PSO 1	PSO 2
Origin	13	10	8	11	11	6	4	2	5	5	5	9	8	7
al														
value														
Scaled												2	2	2
to	3	2	2	3	3	2	0	0	0	0	0			
0,1,2,3	5	-	_	5	5	-	Ŭ	Ŭ	Ŭ	Ű	Ũ			
scale														

Scale: 3- high, 2 - Medium, 1 - Low, 0 - not related

					L	Т	Р	С		
XI	BT 704	4 C			3	0	0	3		
			METABOLIC ENGINEERING			•				
С	P	Α			L	Т	Р	Н		
3	0	0			3	0	0	3		
Prer	equisi	te: Er	zyme engineering, Biochemistry			1	11			
Lear	ning	Objec	tive:							
Upor	n com	pletio	n of this course, the students							
•	W	ould h	ave learn about regulation of various metabolic processes.							
•	W	ould h	ave learn about Metabolic Flux Analysis and Its Application	on.						
			Course Outcomes	Domain			Le	vel		
After	r the c	omple	tion of the course, students will be able to							
CO1	: State	e and u	understands the role of transport processes in metabolic	Cognitive]	Reme	mberi	ng		
ľ	bathwa	iys and	d material balance		l	Under	rstand	ing		
CO2	: Anal	yze th	e regulation of enzymes involved in metabolic pathways	Cognitive	1	Analyzing				
CO3	: Buil	d algo	rithms for biosynthesis pathways	Cognitive	1	Apply	ving			
CO4	: Exp	lain n	netabolic flux analysis and its role in manipulation of	Cognitive	I	Under	rstand	ing		
r	netabo	olite pr	oduction.							
CO5	: Exp	olain	and compiles various strategies to manipulate the	Cognitive	1	Respo	onds to)		
F	oroduc	tion of	f industrially important Metabolites		1	Pheno	omena			
I- Ir	ntrodu	iction						9		
Imp	ortanc	e Of	Metabolic Engineering – Overview Of Cellular Metabo	lism – Vari	ous '	Гурея	s Of 1	Reactions -		
Stoi	chiom	etry (Of Cellular Reactions – Dynamic Mass Balance – Yield	Coefficient A	And	Linea	ar Rat	e Equation		
Met	tabolic	Mode	el Of Penicillium Chrysogenum – Black Box Model – Ele	emental And	Hea	t Bala	ance U	Jsing Black		
Box	Mode	el.								
Ii- F	Regula	tion o	f Metabolic Pathways					9		
Regu	ilation	of en	zyme activity: Overview of enzyme kinetics and inhibition	n – Feed bacl	c inh	ibitio	n and	Activation		
Feed	back	contr	ol architecture in aspartate pathway – Allosteric enzyr	ne regulation	n - 1	Regul	ation	of enzyme		
conc	entrati	on: C	ontrol of transcription and translation - Genetic regulat	ory network	cho:	leste	rol sy	nthesis and		
elimi	inatior	ı - Reg	gulation of at the whole cell level - Regulation of metabol	ic networks	– Re	gulat	ion of	eukaryotes		
versu	ıs prol	caryot	es.							

III- Synthesis of Metabolic Pathways	9	
Metabolic pathway synthesis algorithm - Overview of the algorithm - Pathway for synthesis	s of alanine and se	rine

- Case study: Lysine biosynthesis

IV- Metabolic Flux Analysis and Its Application

9

9

Metabolic flux analysis - Overdetermined systems - Underdetermined systems; Linear Programming - Sensitivity analysis – Introduction to experimental determination of metabolic fluxes by isotope labeling: Distribution of TCA cycle Metabolite isotopomers from labeled pyruvate - Applications of metabolic flux analysis; Metabolic fluxes in mammalian cell culture – Determination, validation and application.

V- Applications of Metabolic	e Engineering
------------------------------	---------------

Enhancement of Product yield and Productivity: Amino acids – Metabolic engineering of pentose metabolism for ethanol production – Extension of product spectrum by metabolic engineering : Antibiotics , vitamins, biopolymers – Improvement of cellular properties: Alteration of substrate uptake and maintenance of genetic stability – Xenobiotic degradation

Lecture	Tutorial	Practical	Total
45	0	0	45

Text Books:

1. Gregory N. Stephanopoulos, Aristos A. Aristidou., Metabolic engineering: Principlesand Methodologies, Jens Nielsen Academic Press, 1st Edition, 1998.

2. Christina D. Smolke., The Metabolic Pathway Engineering Handbook: Fundamentals, CRC Press, New York, London, 1st Edition, 2010.

References:

1. Wang.D.I.C Cooney C.L., Demain A.L., Dunnil.P. Humphrey A.E. Lilly M.D., Fermentation and Enzyme Technology, John Wiley and sons, 1980.

2. Stanbury P.F and Whitaker A., Principles of Fermentation Technology, Pergamon Press, 1984.

3. Cortassa S., Aon M.A., Iglesias A.A and LioydDAn Introduction to Metabolic andCellular Engineering, World Scientific Publishing Co., Singapore, 1st Edition, 2002.

E References:

1. https://gcep.stanford.edu/pdfs/energy_workshops_04_04/biomass_shanmugam.pdf

Mapping of COs with Pos

	PO	PO1	PO1	PO1	PS	PS								
	1	2	3	4	5	6	7	8	9	0	1	2	01	O 2
CO 1	3	2	2	1	2	1			2	2	2	2	3	2
CO 2	2	2	2	2	3	3	2	1				3	1	1
CO 3	3	3	2	2	2				1	1	2	2	2	3
CO 4	2			3	2							1	1	2
CO 5	3	3	2	3	2	2	2	1	2	2	1	1	1	1
Tota 1	13	10	8	11	11	6	4	2	5	5	5	9	8	7

Mapping of Subject Vs POs

	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO1	PSO2
Original value	13	10	8	11	11	6	4	2	5	5	5	9	8	7
Scaled to 0,1,2,3 scale	3	2	2	3	3	2	1	1	1	1	1	2	2	2

Scale: 3- high, 2 – Medium, 1 - Low, 0 – not related

				L	Т	Р	С
	XBT 70	7		0	0	2	2
			INPLANT TRAINING - III				
С	Р	Α		L	Τ	Р	Η
1.33	1.33	1.33		0	0	2	2
PRER	REQUIS	SITE: - I	Nil				
		TCOM					
COU	KSE UU		ES:		-		
COU	KSE UU		ES: Course Outcomes	Domain		Leve	1
COUI On th	e succes	sful con	ES: <u>Course Outcomes</u> npletion of the course, students will be able to	Domain		Leve	1
COUI On th CO1	e succes Rela	ssful con	ES: Course Outcomes npletion of the course, students will be able to room theory with workplace practice	Domain Cog	Ur	Leve nderst	l and
On th CO1 CO2	e succes Rela Con	ssful con te classi ply with	ES: Course Outcomes npletion of the course, students will be able to room theory with workplace practice in factory discipline, management and business practices.	Domain Cog Aff	Ur	Leve nderst	and use
COUI On th CO1 CO2 CO3	e succes Rela Con Den	ssful con te class ply with tonstrat	ES: Course Outcomes npletion of the course, students will be able to room theory with workplace practice in factory discipline, management and business practices. es teamwork and time management.	Domain Cog Aff Aff	Ur R	Leve nderst espor Value	and use
On th CO1 CO2 CO3 CO4	e succes Rela Con Den Des	sful con te classi ply with onstrat cribe an	ES: Course Outcomes npletion of the course, students will be able to room theory with workplace practice in factory discipline, management and business practices. es teamwork and time management. d display hands-on experience on practical skills obtained	Domain Cog Aff Aff Phy	Ur R Pe	Leve nderst espor Value ercept	and use e ion
COUI On th CO1 CO2 CO3 CO4	e succes Rela Con Den Des duri	ssful con te classi aply with cribe and ng the pi	ES: Course Outcomes npletion of the course, students will be able to room theory with workplace practice in factory discipline, management and business practices. es teamwork and time management. d display hands-on experience on practical skills obtained rogramme.	Domain Cog Aff Aff Phy	Ur R Pe	Leve nderst espor Value ercept Set	and ise e ion
COUI On th CO1 CO2 CO3 CO4 CO5	e succes Rela Con Den Deso durit Sum	ssful com te classi pply with constrat cribe and ng the pr marize	ES: Course Outcomes npletion of the course, students will be able to room theory with workplace practice in factory discipline, management and business practices. es teamwork and time management. d display hands-on experience on practical skills obtained rogramme. the tasks and activities done by technical documents and	Domain Cog Aff Aff Phy Cog	Ur R Pe	Leve nderst espor Value ercept Set Evalua	l and ise è ion te

Mapping COs with Pos

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	2													
CO2							1	3			1		1	1
CO3									3	1	3		3	3
CO4		1	2	1	3								1	1
CO5				3						3			1	1
Total	2	1	2	4	3	0	1	3	3	4	4	0	6	6
Scale d	1	1	2	1	1	0	1	1	1	1	1	1	2	2

				т		D	C				
x	RT 80)1		L	I	P	C				
21	DIU	,	PROJECT WORK	0	0	12	12				
С	Р	Α	I KOJECI WORK	L	Т	Р	Н				
6	3	3		0	0	24	24				
PRE	PREREQUISITE: - Nil										
COU	RSE	OUTO	COMES:								
			Course Outcomes	Dom	ain		Level				
On t	he su	cessfu	l completion of the course, students will be able to								
CO1	Ide	entify (he Engineering Problem relevant to the domain interest.	Co	5		Analyze				
CO2	Int	erpret	and Infer Literature survey for its worthiness.	Cog	5		Analyze				
							Apply				
CO3	A	nalyse	and identify an appropriate technique for solve the	Cog	g		Analyze				
	pro	oblem.					Apply				
CO4	Pe	rform	experimentation /Simulation/Programming/Fabrication,	Phy	Y	Co	omp. Overt				
	Co	ollect a	nd interpret data.	Cog	g		Resp.,				
						Cr	eate, Apply				
CO5	Re	cord a	nd Report the technical findings as a document.	Cog	9	R	emember,				
						U	nderstand				

Mapping COs with POs

	PO	PO1	PO1	PO1	PSO	PSO								
	1	2	3	4	5	6	7	8	9	0	1	2	1	2
CO1	3	3				1	1	1				1	1	1
CO2	2	2		1									1	1
CO3	1	1	1	2	2	1	1	1					1	1
CO4	2	2	3	3	3	1	1	1					1	1
CO5	1	1	1	1	1				2	3	2	3	1	1
Total	9	9	5	7	6	3	3	3	2	3	2	4	5	5
Scale	2	2	1	2	2	1	1	1	1	1	1	1	1	1

	YBT	101		`L	Т	Р	С	
С	Р	Α		3	0	0	3	
			Cell Biology and Molecular Biology					
3	0	0		L	Т	Р	Н	
				3	0	0	3	
Pre	requ	isite: Nil					I	
Lea	rnin	g Object	ives:					
Сог	irse	Outcome	es	Do	main	Lev	el	
Afte	er the	e complet	ion of the course, students will be able to					
C)1	Summa	rize the organization, morphology, and function of Cell	's	mitive	Under	stand	
	,,	plasma	membrane and its organelles	0.05	sinuve	onder	stand	
C	72	Discuss	the Prokaryotic and Eukaryotic Replication and DNA	Coe	mitive	Unders	stand	
		Damage	and repair mechanisms.	002	5			
CO)3	Describ	\mathbf{e} Transcription and Translation of prokaryotes and	Cos	nitive	Unders	stand	
		Eukaryo	otes	2				
CO)4	Correla	te gene regulation in prokaryotes and Eukaryotes	Cog	gnitive	Understand		
CC)5	Investig	gate Cell signalling	Cog	gnitive	App	oly	
			COURSE CONTENT			Hou	irs	
UN	ITI					6		
		Comp	ponents of a cell- Molecular organization and func-	tions of	cell men	nbranes a	and	
		organ	elles. Cytoskeleton and its role in cell organization a	nd motil	ity – Cel	lular ener	rgy	
		transa	actions in mitochondria – Protein sorting – Vesicular tra	affic in se	ecretion (endoplasr	nic	
		reticu	lum through Golgi to lysosome; from plasma	membran	es via	endosome	es).	
		Orgar	mization of nucleus – cell division – cell cycle – mitosis	and meio	S1S	-		
UN	IT II		~~~~~			9		
		DNA	structure – types, Sequence organization of prokary	yotic and	eukaryo	tic DNA	, DNA	
		modif	fication in specialized chromosomes, Mitochondria	I and C	Chloroplas	st DNA,	DNA	
		replic	ation: Types of DNA replication. Enzymes of D	NA rep	lication,	Denatura	tion –	
		Renat	uration kinetics, Types of DNA mutations – Dete	ction of	mutation	is. DNA	repair	
		mecha	anisms, KNA binding proteins, Ribonucleoprotein– c	complexe	s and fu	nctions, I	KNA –	
		protei	n recognition and interactions					
	1,1,	<u> </u>			. 111	9 		
ш		Struct	ture of a transcriptional unit – Regulatory signal elemen	ts: promo	ter, hl.hn	notifs, Pos	st	

	transcriptional modification of RNAs, mRNA and coding sequence, Transcript	tion factors,						
	Genetic code, Properties and Wobble hypothesis. Translation, ribosomes and t	RNAs.						
	Mechanism and regulation of protein synthesis. Post Translational modificatio	n of proteins,						
	inhibitors of protein synthesis, Non-coding RNAs - structure and function; RN	A interference:						
	siRNA and miRNAs.							
UNIT		9						
IV	Genetic fine structure -cistron, muton and recon - exons and introns. Ge	ene Regulation in						
	Prokaryotes: Types of gene regulation, Operon concept - Lac Trp and Ara	a operons – Gene						
	regulation in eukaryotes - Downstream regulation. DNA re-arrangement	t: Expression of						
	immunoglobulin gene, antibody diversity. Insertional elements and Transposons - Structural							
	organization and transposition, Plant, Bacterial and Animal Transposons	- Classification,						
	Structure, Overlapping genes. Homologous recombination of genes - Holiday	junction – Rec A						
	and other recombinases.							
UNIT V		12						
	Cell signaling: hormones and growth factors, hormone receptors and signal	transduction. Cell						
	differentiation: cortical differentiation, Nuclear differentiation, tumorige	nesis – theories						
	regarding tumor formation aging theories -cellular, systems, pace maker, Bio	ological clock and						
	Mutation theory, The transformed cancer cell – oncogenes. Cell Senescence	and Programmed						
	Cell Death - Apoptosis and necrosis. Genetic pathways for PCD Anti-	andpro-apoptotic						
	proteins.							
	Total Hours	45						
TEXT B	DOKS	I						
1. Fr	eifelder. D. (2003) - Essentials of molecular Biology - fourth edition, Jones and	Bartlett						
Pu	blications Inc							
Referenc	es:							
1. Le	win.B. (2007) – Genes IX, Jones and Bartlett Publishers							
2. Tu	rrner, P.C., Mclennan, A.D. Bates, A.D. (2005) – Instant notes Molecular Bio	ology – III						
Ed	lition, Routledge, UK							
Online R	eferences:							
i) www.b	io12.com/ch3/RaycroftNotes.pdf							
ii) www.engineering.uiowa.edu/bme050/cvb-solids.pdf								
iii) www.biologyiunction.com/mendelian_genetics.html								
m) www.	biologyjunetion.com/mendenan_genetics.ntm							

	YBT	102		`L	Т	Р	С						
С	Р	A		4	0	0	4						
			Biochemistry										
4	0	0		L	Т	P	Н						
				4	0	0	4						
Cou	ırse	Outcon	nes	Dor	nain	Level							
Aft	er the	compl	etion of the course, students will be able to			1							
CO	D1	Mentio	on the role of water and amino acids	Cognit	tive	Ren	nember						
CO2 Exp		Explai	n protein and their structure.	Cognit	tive	Und	erstand						
CO3 Clast path		Classif pathwa	fy the carbohydrate and glycobiology metabolism ay.	Cognit	tive	Und	erstand						
CO	4	Descri	be the nucleotides and nucleic acid	Cognit	ive	Unde	rstand						
CO	5	Demor	nstrate the DNA-Based Information Technologies	Cognit	ive	Und	erstand						
			COURSE CONTENT			Hou	rs						
UN	IT I					12							
		pH,	pH, pK, acid-baseBuffers- Henderson- Haselbach equation, biological buffer system -										
		Phos	sphate buffer system, protein buffer system, bicarbonate	buffer s	system,	amino	acid						
		buff	er system and Hb buffer system, water. Carbohydrates: N	Nomencla	ature, cla	assifica	tion,						
		struc	cture, chemical and physical properties of carbohydrates.	Metabol	isms: gl	ycoger	lesis,						
		glyc	ogenolysis, gluconeogenesis, pentose phosphate pathway.										
UN	IT II	[12							
		Lipi	ds: nomenclature, classification, structure, chemical and pl	hysical p	roperties	s. Meta	abolisms:						
		bios	ynthesis of fatty acids,Krebcycle,triglycerols, phospholi	pids, gly	col lipi	ds. Ch	olesterol						
		bios	ynthesis, bile acids and salt formation. Eicosanoids, sphinge	olipids an	d steroio	l horm	ones.						
UN	IT					12							
III		Con	cept of energy, Principle of thermodynamics, Relationshi	p betwee	en stand	ard fre	e energy						
		and	Equilibrium constant, ATP ads universal unit of free	energy	in Biol	ogical	systems.						
	Biological oxidation: Electron transport chain, oxidative phosphorylation, glyc						itric acid						
	cycle, cori.s cycle, glyoxalate pathway. Oxidation of fatty acids- mitochondri					ial and peroxisomal							
		ß-ox	idation, alpha and beta oxidation, oxidation of unsaturated	and odd o	chain fat	in fatty acids, ketone							
		bodi	bodies. Photosynthesis, urea cycle, hormonal regulation of fatty acids and carbohydrates										
		metabolisms, Mineral metabolism											
UNIT						12							

IV	Nomenclature, Classification, structure, chemical and physical properties of amine proteins. Metabolisms: Biosynthesis of amino acids. Degradation of protein metabolisms and carbon skeleton of amino acids. Over all in born error metabolisms Carbohydrates: monosaccharides, disaccharides, oligosaccharides and polys Bioenergetics: Glycolysis, TCA, Gluconeogenesis, Glycogenolysis, Oxidative Phosp	o acids and s, nitrogen saccharides. phorylation,
	ATP synthesis, Photosynthesis coupled reaction, group transfer, biologi	cal energy
	transducers.Biosynthesis and degradation of glycogen and its regulation. Starch and	nd cellulose
	biosynthesis	
UNIT V		12
	Nomenclature, Classification, structure, chemical and physical properties of	purine and
	pyrimidines. In de novo and salvage synthesis of purines, pyrimidine bases, nucl	eosides and
	nucleotides. Catabolisms of purines and pyrimidines bases. Synthetic analogues of	nitrogenous
	bases	
	TOTAL HOURS	60
Textbool	ks	
1. Harp	er's Illustrated Biochemistry, 27th Edition (2006.) Robert K. Murray, Daryl K. Granner	r, Victor W.
Rodv	vell. McGraw-Hills.	
2. Lehn	inger, Principles of Biochemistry. 4th edition. David.L.Nelson and Michael.M.Cox.	
3. Bioch	hemistry. 5th Edition (1999) LupertStyrer. W.H.Freeman& Co	
4. Princ	iples of Biochemistry. 4thEdition (1995). Geoffrey Zubay.	
Reference	ze Books	
1. 0	Dutlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley	and Sons
2. P	Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman	n and
C	Company	
3. N	Aolecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and c	ompany,
E	Distributed by Satish Kumar Jain for CBS Publisher	
4. N	Aicrobiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brow	wn
P	Publishers	
Online R	References:	
1. n	ncdb-webarchive.mcdb.ucsb.edu//biochemistry//website-tourf.htm	
2. w	vww.biochemweb.org/	
3. h	ttp://golgi.harvard.edu/biopages.html	

Y	BT1	03		`L	Т	Р	C				
С	P	Α		4	0	0	4				
			Microbiology				L				
4	0	0		L	Т	Р	H				
				4	0	0	4				
PRI	PREREQUISITE: Biology										
Lea	rnin	g Ob	jectives:								
To	prov	ide fu	indamental understanding of the microbial world, basic st	ructure a	and functio	ns of mi	icrobes,				
met	abol	ism, n	utrition, their diversity, physiology and relationship to envi	ronment	and humar	health.					
			Course Outcomes		Domain	L	evel				
Afte	er the	e com	pletion of the course, students will be able to			•					
		List o	out historical perspective of microbiology and its develop	ments.		Unde	erstand				
CO	1	Acqu	ire knowledge on the microbial taxonomy, classification	on and	Cognitive	Rem	ember				
		growt	h curve								
CO	2	Desci	ribe about microbial nutritional requirements, cu	lturing	Cognitive	Unde	erstand				
		techn	iques, their morphological studies and their control.			Rem	lember				
СО	3	Discu	uss about human-microbe interactions and disease epidemio	logy	Cognitive	Unde	erstand				
			•	1 1		Rem	lember				
CO	4	Expla	ain the consequences of various diseases and their mi	crobial	Cognitive	Dam	Dinderstand				
		Doma	live agents	nmont		Und	arstand				
CO	5	and a	griculture	Jiment	Cognitive	Rem	ember				
			COURSE CONTENT			Ken	Hours				
UN	птт	T	ntroduction				12				
		H	listory and microbial taxonomy: Major discoveries related	to the	field of mi	crobiolo	gy:				
		А	ntony Von Leeuwenhoek, Louis Pasteur, Robert Koch a	nd Edw	ard Jenner	Microl	bial				
		ta	axonomy: Bacteria, viruses, fungi, algae and protozoa,	Microbi	al diversity	: Biowa	ars,				
		S	erovars and Prions, Microbial growth and metabolism: Mi	crobial g	growth: Gro	owth cur	ve,				
		fa	actors affecting growth, Microbial metabolism- Metha	anogenes	sis, acetog	enesis a	and				
		a	uxotrophs								
UN	ITI	[N	Iicrobial culture, identification, and control				12				
		Ν	lutritional requirements for growth - Growth media and typ	pes, Pure	e culture te	chniques	: Serial				
		d	ilution and plating methods, Staining methods - Principles	and typ	bes of stain	ng (sim	ple and				
		d	ifferential), Identification of bacteria – Biochemical –	IMViC	, 16s rRN	A sequ	encing.				
		N	ncroscopy: principles and applications of Bright field,	tloresce	nt and Sca	anning e	ectron				
		m	ncroscopes, Microbial growth control: Physical Me	thods -	- Heat, H	iltration	, Low				
TINT	דידרי די		emperatures, High Pressure, Desiccation, Osmotic Pressure	, Kadiati	ion; Chemi	cai Meth	IOUS				
	111		luman miarahiama, Shin, Castraintastinal trast. Oral assist	u Inne	Sumbiatio	rolation	14				
			uman microbiome, Skill, Gastrointestinal tract, Oral cavit	y, Lung.	Sympion dophyta	nidomia	sinp of				
		11. m	neroues. Symptosis, intrutuanish, Farashushi, Commensatish	n and en	andemic di	piùciiii) seases	nogy of				
TIN	тт т	V N	fierobial Diseases	ne anu p		scuses	12				
			ficrohial diseases - General characteristics nathogenesis	laborat	ory diagno	sis and	control				
	Microbial diseases - General characteristics, pathogenesis, laboratory diagnosis and control										

		measures of Pandemic and Epidemic diseases: Tuberculosis, Leprosy, Cholera, T	yphoid,				
		COVID-19, Yellow Fever, Flu, AIDS, Ebola, Zika Virus, Small Pox, Dengue, Chickur	ngunya,				
	Malaria, filariasis, Candidiasis, superficial mycosis						
UNI	UNIT VAgricultural and Environmental Microbiology12						
	Biological nitrogen fixation, free living, symbiotic nitrogen fixation, mechanism of Nitrogen,						
		Biofertilizers- types and applications; Rhizosphere effect. Biogeochemical cycles-	Carbon,				
		Nitrogen, Sulphur and Phosphorous; Methanogenic bacteria Extremphiles- Therm	nophiles				
		Acidophiles, Halophiles and alkalophiles; Biotechnological application of extremophiles	s.				
		Total Hours	60				
TEX	T BO	OKS/REFERENCE BOOKS					
1.	Joani	ne Willey, Linda Sherwood, Christopher J. Woolverton, (2017). Prescott's Microbiology, ((10th				
	editio	on), McGraw-Hill Education, ISBN: 978-1259281594.					
2.	Mahe	eshwari D K, Dubey R C 2013. A Textbook of Microbiology.4thEdn S Chand Publishing I	India.				
3.	Anan	nthanarayan and Paniker's (2017) Textbook of Microbiology, (10th edition), The Orient					
	Blacl	kswan. ISBN: 978-9386235251					
Refe	rences	s:					
1.	Bens	son HJ. (1999). Microbiological Applications: A Laboratory manual in General Microbiological	ogy, 7th				
	Editi	ion. McGraw Hill. 5	- 8, , ,				
2.	Mana	aging epidemics- Key facts about major deadly diseases. World Health Organization (WH	(O)				
	2018	3. 9. O'Flaherty, Vincent & Collins, Gavin & Mahony, Thérèse, (2010), Environmental	- /				
	Micr	obiology, Second Edition, 10.1002/9780470495117.ch11.					
3.	Agric	culture Microbiology, 2016. E-Course Developed By TNAU (ICAR)					
Onli	ne Ref	ferences:					
1	httn	ns://www.who.int/emergencies/diseases/managing-enidemics-interactive.ndf ISBN 978-92	-4-				
1.	156	5553-0 https://doi.org/10.3389/fmich.2020.631736					
2	httn	os://www.agrimoon.com/wp-content/uploads/AGRICUILTURAL-Microbiology.pdf					
2.	2. https://www.agrimoon.com/wp-content/uploads/AOKICOLTOKAL-interobiology.pdf						

Y	BT 1	104A		`L	Т	Р	С	
С	Р	Α		3	0	0	3	
			Bioanalytical Techniques		I		I	
3	0	0		L	Т	Р	H	
				3	0	0	3	
			Course Outcomes	Doma	in	Level		
Afte	er the	e comple	tion of the course, students will be able to					
CO	1	Remen	iber the fundamentals of analytical techniques	Cogni	tive	Reme	mber	
со	2	Unders measur	stand various calibration techniques and basic ement methods.	Cognit	tive	Under	rstand	
		Demon	strate the principles of instrumentation and	Cogni	tive			
CO	3	applicat radioac	tions of different spectroscopic, immunological, and tive techniques	oscopic, immunological, and			1	
СО	4	Interp	ret the applications of all the bio-instrumental	Cogni	Cognitive Apply			
		techniq	ues in biotechnology.					
CO	5	Catego	rize the principles of instrumentation and its	Cogni	tive	Analy	Analyze	
		applica	tion in a biological field					
			COURSE CONTENT			H	ours	
UN	IT I					9		
		Princ	iples and applications, simple, compound, phase-contra	st and fl	uorescent	microsco	pes.	
		Elect	ron microscopy: SEM and TEM.Centrifugatio	nTechni	ques:Princ	iples,	type	
		biom	olecules.	of cell	s, cell or	ganelles	and	
UN	IT II	[9		
		The e	electromagnetic spectrum, Beer Lambert's Law. Photor	netry, U	V/VIS Sp	ectropho	tometry,	
		Infra	red spectroscopy, Atomic absorption spectroscopy, E	SR and	NMR spe	ctroscop	y. Mass	
		spect	roscopy (LC-MS, GC-MS). Fluorescent spectros	copy. A	Application	ns of o	different	
		Spect	troscopic techniques in Biology.					
UN	IT					9		
III		Intro	duction and types of chromatography, paper, thin layer,	gas, Gel	permeation	on, ion-ex	kchange,	
		HPLO	C, FPLC and affinity chromatography and instrument	al detail	s of each.	Applica	tions of	
		Chro	matographic techniques in Biology.					

UNIT		9
IV	Paper and gel electrophoresis, Polyacrylamide gel electrophoresis (native and	SDS), Agarose
	gel electrophoresis, Blotting- Southern, Western and Northern blotting, I	mmunoblotting,
	Immunoelectrophoresis, DNA finger printing and ELISA	
UNIT	/	9
	Nature and types of radiations, preparation of labelled biological samples.	Detection and
	measurement of radioactivity, GM counter, Scintillation counter, Autoradi	ography, Flow
	cytometry. Safety measures in handling radioisotopes. RIA, non radiolabelling.	
Total H	lours	45
TEXT	BOOKS/REFERENCE BOOKS	
1.	Nuclear Magnetic Resonance: Williams	
2.	Biochemical Techniques theory and practice : White R	
3.	Analytical Chemistry: Christion G. D	
Refere	nces:	
1.	A Biologist Guide to Principle and Techniques: Willson K. and Gounding K.H.	
2.	An Introduction to Practical Biochemistry: Plummer D. T.	
3.	David Holm, Hazel Peck. (1998). Analytical Biochemistry. Prentice Hall. New Jerse	ey, USA.
4.	5. Donald Voet and Judith Voet. Biochemistry, 4th Edition. (2010). John Wiley and	Sons. New
	Jersey, USA.	
5.	6. Abhilasha Shourie and Shilpa S Chapadgaonkar. Bioanalytical Techniques. (2004). Teri Press,
	New Delhi. India.	
6.	7. Rashmi A. Joshi. A Textbook of Practical Biochemistry. (2002). B. Jain Publisher	s. India.
Online	References:	
1.	www.bio12.com/ch3/RaycroftNotes.pdf	
2.	www.engineering.uiowa.edu/bme050/cvb-solids.pdf	
3.	iii) www.biologyjunction.com/mendelian_genetics.html	

YB	YBT104B			`L	Т	P	С			
С	Р	Α		3	0	0	3			
			Nanobiotechnology							
3	0	0		L T						
				3	0	0	3			
			Course Outcomes	Domai	n	Leve	1			
Afte	er the	e com	pletion of the course, students will be able to			·				
CO	1	Infe	er the introduction, types, and fabrication of nanomaterial	Cognit	ive	Unde	erstand			
CO	CO2 Different synthesis, the process of preparation of Cognitive		ive	Appl	у					
CO	3	Prec	dict the application of nanomaterial for different devices	Cognit	ive	Appl	у			
CO	4	App app	bly Nanomaterial for therapeutics and diagnostics lications	Cognitive		Cognitive Ana		Cognitive Analyze		yze
CO	5	App	bly the nanomaterial as a carrier and drug delivery systems	Cognit	ive	Appl	Apply			
			COURSE CONTENT				Hours			
UN	IT I						9			
		S	cientific revolution, Feynman's vision, Classification of	nanobio	omaterial	s -Types	of			
		n:	anomaterials – nanoparticles, nanotubes, nanowires, Nanofi	bers, Siz	e deoend	ent variat	tion			
		11	the properties of Nanomaterials, Nature's Nanophenomena	•						
UN	IT II						9			
			reparation of Nanomaterials, lop down and bottom	i up aj	oproache	s, Biosy	nthesis,			
			lanopiomaterials. Polymer, Ceramic, Metal based N		aterials,	Cardon	based			
			Agnetic Nanoparticles Nanofibres Hydrogels Films and So	raffolds	incluies,	Quantu	ili uots,			
UN	ГТ	10	lagnetie Tvanopartieles, Tvanonores, Tryutogers, Trinis and Sc	anolus.			9			
		A	polication of Nanomaterials in Bone substitutes and	Dentist	v. Food	and C	osmetic			
		a	pplications, Bio-sensors and Lab-on-a-chip, Bio-devi	ices an	d impla	intable	devices.			
		B	ioremediation, Nanomaterials for anti-microbial coating	– medi	cal impl	ants and	paints,			
		A	pplication of Nanotechnology in textile industry.		•					
UN	IT IV	V					9			
		Ir	nplications of drug delivery, Nano-carriers for appli	ication	in medi	cine, po	lymeric			

	Personalized medicine, Magnetic nanoparticles for imaging and Hyperthermia.	
JNIT V	7	9
	Portals of Entry of the nanoparticles into the Human Body, Bio-toxicity of Nanop	article
	Nanoparticles in Mammalian systems and Health threats, Biological response and interaction of implant materials and coeffolds. Biological response and Safety Pagula	cellul
	nanoparticles.	ation
	Total Hours	45
TEXT I	BOOKS	
1.	Nanotechnology, S.Shanmugam, Mjp publication. 2011.	
2.	Advanced nanomaterials, kurt E. geckeler, Hiroyuki Nishide , Wiley VHC.2010.	
3.	Nanotechnology and tissue engineering. T.Laurencin, Lakshmi S. Nair, CRC press. 2012.	
4.	Handbook of carbon nanomaterials. Francis D souza, Karl M. Kadish.World scientific publis	shing
	co. pte.ltd. 2011.	
5.	OdedShoseyov (Editor), Ilan Levy, 2010. NanoBioTechnology: BioInspired Devices and Ma	ateria
	of the Future, Humana Press.	
6.	Chad A. Mirkin and Christof M. Niemeyer, 2007. Nanobiotechnology II: More Concepts and	d
	Applications, Wiley-VCH.	
Referen	ices:	
1.	ChallaS.S.R.Kumar (Ed). 2006. Biologicals and pharmaceutical nanomaterials, Wiley-VCH	
	VerlagGmbh& Co, KgaA.	
2.	K.K.K.Jain 2006. Nanobiotechnology in Molecualr Diagnostics: Current Techniques and	
	Applications Horizon Bioscience	
3.	Niemeyer, C.M., Mirkin, C.A. (Eds). 2004. Nanobiotechnology Concepts, Applications and	
	Perspectives, Wiley-VCH, Weinheim.	
4.	Andrze w. Miziolek, ShashiP.Karna, J malthew Mauro and Richard A.Vaia. 2005 Defense	
	Applications of Nanomaterials :	
5.	Springer Handbook of Nanotechnology- Ed. by B. Bhushan, Springer-Verlag (2004)	
6.	The Chemistry of Nanomaterials: Synthesis, Properties and Applications, C.N.R. Rao, A. M	uller,
	A. K. Cheetham (Eds), Wiley-VCH Verlag (2004)	
7.	Nanomaterials for medical diagnosis and therapy, Challa Kumar, Wiley-VCH, 2007.	
8.	Nanotechnology for cancer therapy, Mansoor M. Amiji, CRC Press, 2007.	

YE	BT10	4C		`L	Т	Р	С	
С	Р	A		3	0	0	3	
			Molecular Genetics					
3	0	0		L	Т	Р	Н	
				3	0	0	3	
		•	Course Outcomes	Doma	in	Lev	el	
Afte	er the	e com	pletion of the course, students will be able to			·		
CO	1	Inte	erpret DNA and RNA structure and its role	Cogni	tive	Unc	lerstand	
СО	2	Exp	blain transcription and post-transcriptional modifications	Cogni	tive	Und	lerstand	
CO	3	Ар	ply and its replication and repair	Cogni	tive	App	oly	
СО	4	Inte	erpret Reproduction as the basis of heredity and Gene	Cognitive Understa			lerstand	
		inte	ractions					
со	5	Des	cribe linking the inheritance of genes to chromosomes	Cognitive Understan			lerstand	
		and	chromosomes as arrays of genes					
			COURSE CONTENT				Hours	
UN	ITI						9	
		G	enes and chromosomes, Colinearity of Genes and Proteins,	Genetic	code, Ide	ntificati	on of	
		D	ONA as the genetic material. The complexity of eukary	otic gei	nome (in	trons, e	xons,	
		re	epetitive DNA sequence, gene duplication and pseudogenes)). DNA	markers -	VNTR,	STR,	
		n	hicrosatellite, SNP and their detection techniques					
UN	IT II						9	
		R	eplication of DNA, Gene expression and regulation in prok	aryotes	and euka	ryotes.]	Mutation:	
		S	pontaneous and virus induced mutation, Radiation induced	l mutatio	on. Ionizi	ng radia	tion, UV	
		ra	adiation. Chromosomal Abnormalities and associated genetic	c disease	es, Techn	iques in	the study	
		0	f chromosomes and their applications, Recombination – mod	dels				
UN	IT						9	
ш			NA Damage and Repair-Internal and external agents causin	ng DNA	damages	, DNA	damages	
			Jxidative damages, Depurinations, Depyrimidinations	, U6-n	nethylgua	nines,	Cytosine	
		d	eamination, single and double strand breaks) 3.3. Mechan	isms of	DNA da	mage (t	ransition,	
	transversion, frameshift, nonsense mutations) 3.4. Repair mechanisms (Photo reactiva							

	excision repair, mismatch repair, post replication repair, SOS repair) 3.5. Discovery: Early
	experiments of McClintock in maize. Insertion sequences in prokaryotes. Complex transposons
	(ex. Tn3, Tn5, Tn9 and Tn10). Mechanisms, control consequences and application of
	transposition by simple and complex elements
UNIT	V 9
	Allele frequencies and genotype frequencies, Random mating population, Hardy-Weinberg
	principle, complications of dominance, special cases of random mating - multiple alleles,
	different frequencies between sexes (autosomal and X-linked) inbreeding, genetics and
	evolution, random genetic drift, Karyotyping and usefulness of chromosomes in understanding
	Genetic variation, Genetics of eukaryotes gene linkage and chromosome mapping
UNIT	V 9
	Extrachromosomal heredity: Biology of Plasmids, their discovery, types and structure of
	F.RTH. col factors and Ti - Replication and partitioning, Incompatibility and copy number
	control-natural and artificial plasmid transfer and their applications- Human Genome Project,
	Genomics and Modern methodologies in understanding genome.
	Total Hours 45
TEXT	BOOKS
1.	Principles of Genetics- 8th Edition, Gardner, Simmons and Snustad, 2002.
2.	The Cell- A Molecular Approach. 3rd Edition. Geoffrey M. Cooper, Robert E. Hausman, 2003.
3.	Genetics- Kavitha B. Ahluwalia, New Age International Pvt Ltd and Publishers, New Delhi, 2010
4.	Genetics – P.S Verma and A.K Agarwal (Rack 3, Central Library)
5.	Robert Brooker.2011. Genetics- Analysis and Principles. 4th edition. McGraw Hill.
1.	Rastogi Smita and Neelam Pathak., 2010. Genetic Engineering, Oxford University Press, New
	Delhi. (Rack 3, Central Library)
2.	Watson, Hopkins, Roberts, Steitz, Weiner, 2004. Molecular Biology of Genes, 4th Edition.
3.	DNA markers Protocols, applications and overviews Anolles G. C. & Gresshoff P. M. Wiley-Liss
4.	Molecular markers in Plant Genetics and Biotechnology Vienne De. D. Science Publishers
5.	Genetics of Population Hedrick P.W. Jones & Bartlett 4 Principle of Population Genetics Hartl D.
	L. and Clark A. G. Sinauer Associates

YB	T1 0	5					Т	P	С
C	P	A			_	3	0	0	3
			Molecular Biology and	l Microbiology La	ab			_	
3	0	0			-		T	P	H
						0	0	6	6
<u>C</u> (1		1	Course O	outcomes		Domain	1	Level	
iter the		mple	etion of the course, studen	its will be able to		<u> </u>			
201	F te	Practi echni	ce different media prepara iques	ation and sterilizat	ion	Psychor	notor	Guide Respo	d nse
202	Po m	erfor icroo	m the staining techniques organisms	s to identify the mo	orphology of	Psychor	notor	Guide Respo	d nse
202	P	Practi	ce different culturing tech	nniques for the isol	ation and	Psychor	notor	Guide	d
.03	с	ultiv	ation of microorganisms					Respo	nse
CO4	г) a urf a c	un the staining to shall and	to identify the true	a of colla	Psychor	notor	Guide	d
	ľ	C1101	in the stanning technique	to identify the type	e of cells			Respo	nse
205	A	Apply	the feasible method to s	separate the lipids	and proteins	Psychor	notor	Guide	d
	f	rom t	tissues					Respo	nse
				COURSE CO	ONTENT				
ist of (Cell	Bio	logy Experiments						
1.	Sta	ining	and observation of eukar	yotic cells					
2.	Cel	l via	bility assay by trypan blue	e exclusion method	1.				
3.	Iso	latior	n of chloroplasts from spin	nach leaves					
4.	Osi	nosis	s and Tonicity						
5.	Ext	racti	on of lipids from tissues						
6.	Ext	racti	on of proteins from tissue	S					
7.	Sep	oarati	on of proteins by SDS-PA	AGE electrophores	is				
8.	Stu	dy of	f different stages of mitos	is in onion root tip	cells.				
9.	Stu	dy of	f different stages of meios	sis in grasshopper t	estis cells				
ist of I	Mic	robi	ology Experiments						
1.	Me	edia p	preparation and Sterilizati	on					
2.	Pre	epara	tion of slants /plates and a	aseptic transfer of	microbial cult	ures			
3.	Sta	aining	g and identification of mic	crobes using simpl	e and different	tial staini	ng		
4.	Isc	latio	n of microbes using sprea	a plate method					
5.	Isc	latio	n of microbes using streat	k plate method					
6.	Isc	olatio	n of microbes using pour	plate method	1 10 1				
7.	Mi		al growth control using k	Sirby-Bauer metho	d and Cell cou	inting			
8.	Bi	ochei	mical characterization of i	microbes					
9.	Sc	reeni	ng of microorganisms for	enzyme productio	on DD 4 CTT C 4 1		TODIA		
					PRACTICA	LITU	TORIAL	/ TO	
			HOURS		20		Δ		20 IAL

YB	T106	5				`L	Т	Р	C
С	P	A				3	0	0	3
			Bioc	chemistry Lab				•	
3	0	0				L	Т	Р	Н
				0	0	6	6		
			Cou		Domai	n	Level		
After t	he co	ompl	etion of the course, s	tudents will be a	ble to				
CO1	Ca	lcula	ate the molar extincti	on coefficient		Psycho	omotor	Guide	ed Response
CO2	Es	tima	tecolor pigments from	m plant sources		Psycho	omotor	Guide	ed Response
CO3	Est pro	tima otein-	te the qualitative carbohydrate and set	and quantitativ	e analysis of	Psycho	omotor	Guide	ed Response
CO4	De	term	the Saponification	on value for oil o	r fat	Psycho	omotor	Guide	ed Response
CO5	De	term	ninethe amylase activ	rity		Psycho	omotor	Guide	ed Response
	•		(COURSE CONT	ENT				Hours
1. Basi	ic cal	lcula	tions in Biochemistry	/ - Normality, M	olarity, Molality	y percent	solution	s	
2. Cali	brati	on of	f pH meter						
3. Tran	nsitic	on int	erval of commonly u	sed pH indicator	S				
4. Prep	oarati	ion o	f biological buffer - J	phosphate buffer					
5a. Ext	tracti	ion o	f Proteins from biolo	gical materials					
5b Pro	tein	separ	ration methods:-Amn	nonium sulphate	Precipitation,				
5c. Me	embra	ane I	Dialysis, 5d. SDS PA	GE					
6. Urea	a-SD	S PA	GE for separation of	f low molecular v	weight proteins				
7. Esti	matio	on of	Proteins by Lowry's	method					
8. Esti	matio	on of	Proteins by Biuret n	nethod					
9. Estin	matio	on of	Proteins by Bradfor	d method					
10. Est	timat	10n (of RNA by orcinol m	ethod					
11. Est	timat		of DNA by diphenyla	mine method					
12. Est	timat	10n (or Carbohydrate by A	Inthrone method		200			
13 Pur	ity c	heck	of DNA & RNA by	UV Spectrophoto	ometry - A260/2	280			
14. Sep	parat	10n C	of amino acids by Pap	ber Chromatogra	phy				
15. Sep	parat	10n C	of sugars by Paper Ch	iromatography					
16. Sep	parat	10n C	or amino acids by Th	in layer chromato	ography				
17. Sep	parat	101 C	or sugars by Thin lay	er chromatograph	iy				
18. Th	erma	u De	naturation of DNA a	a UV absorption			TODIA		
		H	OURS		PKAUIICA			L 10	
				0			U		30

1.Principles of Biochemistry, Lehninger, David L. Nelson and Michael M. Cox, 6th edition,2013 W. H. Freeman, New York.

Y	BT1	07		`L	Т	Р	С		
С	Р	Α	Communication Skills and Scientific Writing	2	0	0	1		
4	Δ	Δ	Communication Skins and Scientific writing	L	Т	Р	Н		
4	U	U		2	0	0	2		
		1	Domain	Lev	vel				
Afte	er the	com	pletion of the course, students will be able to						
CO	1	Exp	lain the fundamentals of communication to classify d	lifferent	Cognitive	Uno	derstand		
00	-	mod	els and types of communication.						
co	2	Illus	strate the structure of scientific papers to analyze research	articles	Cognitive	Uno	derstand		
001	_	for e	effective organization.						
CO	3	Арр	ly techniques of data presentation to create and format tab	oles and	Cognitive	Und	derstand		
	_	grap	hs in scientific reports.						
CO4	4	Dev	elop research proposals to organize sections like Metho	ods and	Cognitive	Unc	derstand		
		Res	ults in a structured scientific document.						
CO	5	Util	ize scientific writing and editing methods to revise and i	mprove	Cognitive	Unc	derstand		
		clari	ity in scientific documents.						
			COURSE CONTENT				Hours		
UN	IT.	FUP	NDAMENTALS OF COMMUNICATION	· (N	1 1 1 1	1 1	6 		
1		Introduction to Communication Models - Types of Communication (Verbal, Non-verbal, Writt							
		- Active Listening - Communication Barriers and Solutions - Cultural Sensitivity							
		- Corr	Active Listening - Communication Barriers and Sol	utions -	Cultural	Sensi	tivity in		
LINI	гт	- Con	Active Listening - Communication Barriers and Sol munication - Effective Feedback Mechanisms	utions -	Cultural	Sensi	tivity in		
UNI	IT	- Com SCI	Active Listening - Communication Barriers and Sol munication - Effective Feedback Mechanisms ENTIFIC WRITING ESSENTIALS	utions -	Cultural	Sensi	tivity in 6		
UNI II	IT	- Com SCI	Active Listening - Communication Barriers and Sol munication - Effective Feedback Mechanisms ENTIFIC WRITING ESSENTIALS oduction to Scientific Writing: Analyze and critique samp ntific Papers: Analyzing research articles for structure and	utions -	Cultural	Sensi	tivity in 6 ucture of		
UNI II	IT	- Com SCI Intro Scie	Active Listening - Communication Barriers and Solumunication - Effective Feedback Mechanisms ENTIFIC WRITING ESSENTIALS oduction to Scientific Writing: Analyze and critique samples ntific Papers: Analyzing research articles for structure and cise Sentences: Sentence restructuring exercises to impro-	utions - ple resea l organiz ve clarity	Cultural rch papers ation - Wr	Sensi - Stru iting C g - Or	tivity in 6 ucture of Clear and sganizing		
UNI II	IT	- Con SCI Intro Scie Con Reso	Active Listening - Communication Barriers and Sol munication - Effective Feedback Mechanisms ENTIFIC WRITING ESSENTIALS oduction to Scientific Writing: Analyze and critique samp ntific Papers: Analyzing research articles for structure and cise Sentences: Sentence restructuring exercises to impro- earch Papers (IMRAD): Practice structuring sections	utions - ple resea l organiz ve clarity (Introduc	Cultural rch papers ation - Wr y in writin ction, Met	Sensi - Stru iting C g - Or hods,	tivity in 6 ucture of Clear and ganizing Results,		
UNI II	IT	- Com SCI Intro Scie Con Reso Disc	Active Listening - Communication Barriers and Solumunication - Effective Feedback Mechanisms ENTIFIC WRITING ESSENTIALS oduction to Scientific Writing: Analyze and critique samples and critique samples and critical sectors for structure and critical sectors and critical sectors for structure sectors for structure sectors for structuring sections for structure sectors for s	utions - ple resea l organiz ve clarity (Introduc	Cultural rch papers ation - Wr y in writin ction, Met	Sensi - Stru iting C g - Or hods,	tivity in 6 ucture of Clear and cganizing Results,		
UNI II UNI	IT	- Com SCI Intro Scie Com Reso Disc	Active Listening - Communication Barriers and Solumunication - Effective Feedback Mechanisms ENTIFIC WRITING ESSENTIALS oduction to Scientific Writing: Analyze and critique samples and critique samples for structure and critice Sentences: Sentence restructuring exercises to improve arch Papers (IMRAD): Practice structuring sections reussion) of research papers. FA PRESENTATION IN SCIENTIFIC WRITING	utions - ple resea l organiz ve clarity (Introduc	Cultural rch papers ation - Wr y in writin ction, Met	Sensi - Stru iting C g - Or hods,	tivity in 6 ucture of Clear and cganizing Results, 6		
UNI II UNI III	IT IT	- Com SCI Intro Scie Con Reso Disc DAT	Active Listening - Communication Barriers and Sol munication - Effective Feedback Mechanisms ENTIFIC WRITING ESSENTIALS oduction to Scientific Writing: Analyze and critique same ntific Papers: Analyzing research articles for structure and cise Sentences: Sentence restructuring exercises to impro- earch Papers (IMRAD): Practice structuring sections russion) of research papers. TA PRESENTATION IN SCIENTIFIC WRITING enting Data through Tables and Graphs: Create tables a	utions - ple resea l organiz ve clarity (Introduc	Cultural rch papers ation - Wr y in writin ction, Met	Sensi - Stru iting C g - Or hods, ven da	tivity in 6 ucture of Clear and cganizing Results, 6 ta sets -		
UNI II UNI III	IT	- Com SCI Scie Con Reso Disc Disc Dres Form	Active Listening - Communication Barriers and Sol munication - Effective Feedback Mechanisms ENTIFIC WRITING ESSENTIALS oduction to Scientific Writing: Analyze and critique same ntific Papers: Analyzing research articles for structure and cise Sentences: Sentence restructuring exercises to impro- earch Papers (IMRAD): Practice structuring sections sussion) of research papers. TA PRESENTATION IN SCIENTIFIC WRITING enting Data through Tables and Graphs: Create tables a natting and Labeling Figures and Tables: Formatting e	utions - ple resea d organiz ve clarity (Introduc nd graph exercises	Cultural rch papers ation - Wr y in writin ction, Met	Sensi - Stru iting C g - Or hods, ven da ute tab	tivity in 6 ucture of Clear and cganizing Results, 6 ta sets - ble/figure		
UNI II UNI III	IT	- Com SCI Scie Con Reso Disc Disc Disc Forr pres	Active Listening - Communication Barriers and Solumunication - Effective Feedback Mechanisms ENTIFIC WRITING ESSENTIALS oduction to Scientific Writing: Analyze and critique samples ntific Papers: Analyzing research articles for structure and cise Sentences: Sentence restructuring exercises to impro- earch Papers (IMRAD): Practice structuring sections russion) of research papers. TA PRESENTATION IN SCIENTIFIC WRITING enting Data through Tables and Graphs: Create tables a natting and Labeling Figures and Tables: Formatting e entation - Interpreting Data in Written Form: Write brief ex-	utions - ple resea d organiz ve clarity (Introduc nd graph exercises planation	Cultural rch papers ation - Wr y in writin ction, Met as from giv for accura	Sensi - Stru iting C g - Or hods, ven da ute tab	tivity in 6 ucture of Clear and cganizing Results, 6 ita sets - ble/figure sets.		
UNI II UNI III		- Com SCI Scie Com Reso Disc Disc Disc Forr pres SCI	Active Listening - Communication Barriers and Solumunication - Effective Feedback Mechanisms ENTIFIC WRITING ESSENTIALS oduction to Scientific Writing: Analyze and critique samples ntific Papers: Analyzing research articles for structure and cise Sentences: Sentence restructuring exercises to impro- earch Papers (IMRAD): Practice structuring sections russion) of research papers. TA PRESENTATION IN SCIENTIFIC WRITING enting Data through Tables and Graphs: Create tables a natting and Labeling Figures and Tables: Formatting e entation - Interpreting Data in Written Form: Write brief ex ENTIFIC REPORT AND PROPOSAL WRITING	utions - ple resea d organiz ve clarity (Introduc nd graph exercises planation	Cultural rch papers ation - Wr y in writin ction, Met as from giv for accura	Sensi - Stru iting C g - Or hods, ven da ute tab	tivity in 6 ucture of Clear and cganizing Results, 6 uta sets - ble/figure sets. 6		

	Results Sections: Practice writing these sections based on provided experimental data - Re	evising
	and Editing Scientific Documents: Peer-review sessions and revision exercises on draft re	eports
UNIT	PUBLISHING AND PRESENTING SCIENTIFIC WORK	6
V	Basics of Manuscript Submission and Review Process: Simulate manuscript submission	and peer
	review - Preparing Scientific Presentations: Create and deliver a 5-minute presentat	ion on a
	research topic - Ethical Considerations in Scientific Writing: Group discussions on pl	agiarism,
	authorship, and publication ethics	
	Total Hours	30
TEXT	BOOKS	
1.	Alley, Michael. The Craft of Scientific Writing. 4th ed., Springer, 2018.	
2.	Day, Robert A., and Barbara Gastel. How to Write and Publish a Scientific Paper.	8th ed.,
	Cambridge University Press, 2016.	
3.	Derntl, Michael. "Basics of Research Paper Writing and Publishing." International Je	ournal of
	Technology Enhanced Learning, vol. 6, no. 2, 2014, pp. 105-123.	
4.	Gopen, George D., and Judith A. Swan. "The Science of Scientific Writing." American	Scientist,
	vol. 78, no. 6, 1990, pp. 550-558.	
5.	Hartley, James. Academic Writing and Publishing: A Practical Handbook. Routledge, 2008	3.

Y	BT2	01		`L	Т	Р	С			
С	Р	Α		4	0	0	4			
			Recombinant DNA Technology				<u></u>			
4	0	0		L	Т	Р	Н			
				4	0	0	4			
		1	Course Outcomes	Domai	n	Leve	:l			
Afte	er the	e con	pletion of the course, students will be able to							
co	1	Rec	call the basic concepts of gene cloning and various	Cognit	ive	Unde	derstand			
	1	Res	striction and modification enzymes	Cognitive		Chie	derstand			
CO	2	Dis	tinguish various vector systems	Cognit	ive	Unde	erstand			
CO	3	Co	mpare various techniques involved DNA Sequencing	Cognit	ive	Unde	erstand			
CO	4	Des	scribes various screening and selection methods	Cognitive Un			derstand			
CO	5	Inf	er the PCR principle and applications.	Cognitive Ap			ply			
			COURSE CONTENT				Hours			
UN	IT I						12			
		I	Introduction to recombinant DNA technology - Restriction & modification enzymes							
	(restriction endonuclease II, DNA polymerases, Polynucleotide kinases and					and alka	line			
		p	hosphatases, DNA ligases and RNase)- Restriction map	oping, Do	esign of	linkers	and			
		a	daptors							
UN	IT II	[12			
		C	Characteristics of cloning vectors, types of bacterial plasmid vectors (pBR322, pUC57,							
		p	pSC101), λ vectors, M13 vectors, cosmids, phagemids, yeast artificial chromosome, bacterial							
		a	artificial chromosome and Mammalian artificial chromosomes as cloning vector. Expression							
		v	ectors: pET vectors, Baculovirus vectors.							
UN	IT						12			
III		Γ	DNA labelling (radioactive and non-radioactive method); DI	NA seque	ncing (M	laxum &	Gilbert,			
		S	Sangers, pyro-sequencing, shotgun sequencing method)'; Southern, northern and western							
		b	lotting- PCR – Principle- types- applications- DNA fing	erprinting	g (RAPD	; RFLP,	AFLP).			
		b	iosensing							
UN	IT IV	V					12			
			Transfer of rDNA into cells- transformation, transfection, Sonoporation, Microinjection and							
	Calcium phosphate methods- Genomic and cDNA library construction- Selection a									

screening of recombinants - nucleic acid hybridization- Grunsteinhogness and benten- Davis							
	plaque method, immunological screening- Blue - white selection- Reporter gene based						
	selection- GUS, GFP and Luciferase.						
UNIT V		12					
	Production of recombinant- insulin, human growth factor, vaccine and gene thera	py- gene					
	silencing using RNAi. Genetic manipulation of animal cells – early methods and Cri	spr-Cas9.					
	Transgenic plants and animals. Bioethics regarding rDNA techniques						
	Total Hours 60						
TEXT BO	OKS						
1. Primro	se S.B. and Twymann R.H., "Principles of Gene Manipulation: An Introduction to Gene	etic					
Engine	ering", Sixth Edition, Blackwell Scientific Publications, 2004						
2. Brown	T.A., "GeneCloning and DNA Analysis", Fourth Edition, Blackwell Scientific Pub	lications,					
2003.							
3. Glick I	B.R. and Pasternak J.J., "Molecular Biotechnology", Third Edition, ASM Press, 2003.						
4. Sandhu, Sardul Singh. Recombinant DNA technology. IK International Pvt Ltd, 2010.							
Online References:							
http://nptel.ac.in/courses/102103013/							

Y	YBT2			`L	Т	Р	С			
С	Р	Α	-	4	0	0	4			
4	0	•	Immunology	L	Т	Р	Н			
4	U			4	0	0	4			
	1	1	Course Outcomes	Domai	in	Lev	el			
Afte	After the completion of the course, students will be able to									
CO	1	Wr	ite the general concepts of the immune system	Cognit	ive	App	oly			
CO	2	Exp	lain the properties of antigens and antibodies and their ractions via various tests	Cognit	ive	App	Apply			
		Don	nonstrate principles and applications of immunochemical	Cognit	ivo	A.m.	1			
CO	3	tech	niques	Cognitive		Арр	Apply			
CO	4	Des	cribe various mechanisms of antigen presentation and	Cognit	ive	App	oly			
		MH	C							
CO	5	Cor	npare the different types of hypersensitive reactions;	Cognit	ive	App	oly			
		Exp	lain the autoimmune diseases							
			COURSE CONTENT				Hours			
UN	IT I						12			
		С	organization of the immune system - Types of immune sy	/stem: I	nnate and	adaptiv	ve –			
		S	tructure and functions of important immune cells: T	cell, E	B cell de	evelopm	nent,			
		Ν	lacrophage, Neutrophil, NK cell, Dendritic cell, Stem ce	lls – In	nmune or	gans: E	Bone			
		n	marrow, Spleen, Thymus, Lymph node, Mucosal, and Cutaneous associated Lymphoid							
		ti	ssue (MALT & CALT).							
UN	IT II						12			
		A	ntigens: Immunogenicity, Antigenicity, Epitope, hapter	is and	Adjuvant	s – A	ntibody:			
		S	tructure, Classes and Biological Activities; Molecular basis	of antib	ody diver	sity; Po	olyclonal			
		a	ntibiotics, Monoclonal antibodies - Antigen-antibody read	ction: C	ross-Reac	tivity,	Affinity,			
		A	vidity, Precipitation and agglutination reactions. Immuno	techniq	ues: ELI	SA, RL	A, Flow			
	cytometry, Immuno electrophoresis, Western Blotting									
UN	IT II	I	τ							
		Ν	lajor Histocompatibility Complex: Structure, Function a	nd class	ses of M	HC mo	olecules,			
		Ir	nmune responsiveness to MHC – Antigen processing and p	resentati	on: Endo	genous	antigens			
		(7	The Cytosolic Pathway), Exogenous antigens (The Endocytic	e Pathwa	y)					
UN	IT IN	V					12			

[Desculation of immune regrouped Complement Systems Fund	tions Components Active	tion and						
	Regulation of minune response, complement system. Functions, components, Activation and								
	Regulation of complement system – Allergy and hypersensitivity: Types of hypersensitivity –								
	Autoimmunity, Auto immune disorders; immune tolerance; Graft versus host reaction.								
UNIT	UNIT V								
	Vaccines: Active and Passive Immunization, Whole-Organis	m Vaccines, Purified							
	Macromolecules as Vaccines, Recombinant-Vector Vaccines	s, DNA and Multivalent S	ubunit						
	Vaccines. Tumors of the Immune System - Tumor Antigens - Immune Response to Tumors -								
	Cancer immunotheraphy.								
	Total Hours		60						
TEXT	BOOKS								
1.	Janes Kuby., Immunology, WH Freeman and Company, Newyor	k.,7th Edition, 2013.							
2.	Roitt, I., Essential Immunology, Blackwell Scientific Publication	s, Oxford, 12th Edition, 2	011.						
3.	Abbas, K. A., Litchman, A. H. and Pober, J. S. (2007). Cellular a	nd Molecular Immunolog	y, 4th						
	Edn., W. B. Saunders Co., Pennsylvania, USA.								
4.	http://www.raymondcheong.com/Year1/immuno.html								
5.	http://ocw.mit.edu/courses/health-sciences-and-technology/hst-176-cellular-andmolecular								
	immunology-fall-2005/lecture-notes/								

YBT203		03		`L	Т	P	С			
С	Р	A		4	0	0	4			
			Biostatistics							
4	0	0		L	Т	P	H			
				4	0	0	4			
			Course Outcomes	Doma	in	Lev	el			
Afte	er the	e con	npletion of the course, students will be able to			1				
со	1	Ou	tline the basic statistics concepts	Cognitive Ren			nember			
CO	2	Cla	ssify the data, collection, and graphical presentation	Cognit	tive	Und	erstand			
CO	3	Int	erpret the biological data with the statistics concepts	Cogni	tive	Und	erstand			
CO	4	Pre	edict the biological inferences from the collected data	Cogni	tive	App	ly			
CO	5	Sol	ve the biotechnology problems from the biostatistics	Cognitive		ly				
		con	acepts							
			COURSE CONTENT				Hours			
UN	IT I						12			
		S	Statistics – Scope –collection, classification, tabulation of Statistical Data – Diagrammatic							
		r	representation - graphs - graph drawing - graph paper - plotted curve -Sampling method							
		a	and standard errors -random sampling - use of random numbers -expectation of sample							
		e	estimates - means - confidence limits - standard errors - variance. Measures of central							
		te	endency – measures of dispersion – skewness, kurtosis, mon	nents						
UN	IT II	[12			
		C	Correlation and regression – correlation table – coefficient of correlation – Z transformation –							
		r	regression - relation between regression and correlation. Probability - Markov chains							
		a	applications - Probability distributions - Binomial (Gaussian distribution) and negative							
	binomial, compound and multinomial distributions – Poisson distribution									
UN	IT						12			
III		N	Normal distribution – graphic representation.– frequency	curve	and its	charact	eristics –			
			measures of central value, dispersion, coefficient of variation and methods of computation -							
	Basis of Statistical Inference – Sampling Distribution – Standard error – Testing of I					ng of hy	pothesis –			
	Null Hypothesis –Type I and Type II errors									
UN	IT						12			

IV	Tests of significance for large and small samples based on Normal, t. z distributions with regard							
	to mean, variance, proportions and correlation coefficient – chi-square test of goodness of fit –							
	contingency tables $-c^2$ test for independence of two attributes $-$ Fisher and Behrens 'd' test $-$							
	contingency tables – c2 test for independence of two autobutes – risher and beniens 'd'test –							
	2×2 table – testing heterogeneity – r X c table – chi-square test in genetic experiments –							
	partition X 2 – Emerson's method							
UNIT V	12							
	Tests of significance -t tests - F tests - Analysis of variance - one way classification - Two							
	way classification, CRD, RBD, LSD. Spreadsheets - Data entry -mathematical functions -							
	statistical function – Graphics display – printing spreadsheets – use as a database word							
	processes – databases – statistical analysis packages graphics/presentation packages							
	Total Hours 60							
TEXT	BOOKS							
1.	Veer balaRastogi. 2011. Fundamentals of Biostatistics. Ane books Pvt Ltd, Chennai.							
2.	Rosner, B (2005), "Fundamentals of Biostatistics", Duxbury Press.							
3.	Warren, J; Gregory, E; Grant, R (2004), "Statistical Methods in Bioinformatics", 1st edition, Springer							
4.	Milton, J.S. (1992),. "Statistical methods in the Biological and Health Sciences", 2 nd edition, Mc							
	Graw Hill							
5.	Sundar Rao P. S.S., Jesudian G. & Richard J. (1987), "An Introduction toBiostatistics", 2nd							
	edition,.Prestographik, Vellore, India,.							
6.	Zar, J.H. (1984) "Bio Statistical Methods", Prentice Hall, International Edition							
Online	References:							
1.	www.statsoft.com/textbook/ biosun1.harvard.edu/							
2.	www.bettycjung.net/Statsites.htm							
3.	www.ucl.ac.uk/statistics/biostatistics							

YE	BT20	4A		`L		Т	Р	С		
С	Р	Α		3		0	0	3		
			Stem Cell Biology and Tissue Engineering							
3	0	0		L		Т	Р	Η		
				3		0	0	3		
		1	Course Outcomes]	Don	nain	Leve	el		
After the completion of the course, students will be able to										
co	1	Rer	nember the basics and fundamentals of Stem cells and tiss	ue	റ്റം	nitive	Rem	Remember		
	-	cult	ure		005	intro e	item			
co	2	Sun	nmarize various types of stem cells, methods of isolation a	nd	Cog	nitive	Unde	erstand		
00	-	cult	ure techniques and their characterization					laorstand		
CO	3	Exp	Explain the process of stem cell cycle and the cell signaling		Cog	nitive	Apply			
	-	patł	pathways.				11			
CO	4	Identify the applications of tissue engineering in biotechnology Cognitive		Anal	Analyze					
CO	5	Der	nonstrate the principle and applications of tissue engineeri	ng	g Cognitive Apply			V		
		in n	nedicine					. j		
			COURSE CONTENT					Hours		
UN	IT I							9		
		S	Stem cells - Definition, Characterization, Pluripotency, Self-renewal and differentiation.							
		T	Types of stem cells- Embryonic stem cells, Adult stem cells and mesenchymal stem Cells,							
		A	dipose stem cells							
UN	IT II							9		
		S	Stem cell niche, Niche specification - Drosophila germ line stem cells. Receptors, genes and							
		n	harkers of stem cells. Stem cell isolation and culture techniq	ues. C	hara	acterizati	on of ste	m cells.		
	LT.	C	9							
111		S	Stem cell cycle. Chromatin modification and transcriptional regulation, chromatin modifying							
		18	factors, Chromosomal inactivation. JAK -STAT pathway, Ras\Raf pathway, PI3K cell							
signaling, p53 check points, Role of LIF pathway in cell cycle control				Applica	uons of					
	Embryonic stem cells, Bone marrow stem cells, Adipose derived stem cells and I				iu nemat	opoietic				
TINT	<u>гт 13</u>	7	em cens. Eunes in numan stem cen research				<u> </u>	0		
		ר ב	asic biology of tissue engineering. The basis of growth and	diffe	renti	ation m	ornhogen	Pasis and		
		D	asic biology of ussue engineering. The basis of growth and	uniel	CIIII	at1011-1110	Jphogen	USIS and		

	tissue engineering. Biomaterials in tissue engineering-Scaffolds, extracellular ma	trix, polymers
UNIT V		9
	Structural tissue engineering-Bone regeneration through cellular engineering	. Skin tissue
	engineering. Brain implants-Neural stem cells. Periodontal applications. Bioartifi	cialpancrease
	Hepatassist liver support system. Artificial Womb, Heamatopoietic system: R	ed blood cel
	substitutes, Renal replacement devices	
	Total Hours	45
TEXTBO	OKS	I
1. Ste	em Cell Biology, Daniel Marshak, Richard L. Gardener and David Gottlieb, Cold S	pring Harbour
La	boratory Press	
2. Ste	em cell biology and gene therapy, Booth C., Cell Biology International, Academic F	Press
3. Ste	em Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine, Alexander F	Battler,
Jor	nathan Leo, Springer, STEM CELL TECHNOLOGY Syllabus - Semester First Ref	erences:
4. Sy	lvia, S. Mader, 2011, Human Biology, Twelfth edition, Mc Graw Hill, USA.	
5. Ro	bert P. Lanaza, Robert Langer and Joseph Vacanti, 2007. Principles of Tissue Engi	neering. Thir
edi	tion Academic Press.	
1. Ste	em Cell Biology and Gene Therapy. Quesenberry PJ, Stein GS, eds. (£65.00.) Wiley	, 1998.
2. Pro	ogress in gene therapy, Volume 2, Pioneering stem cell/gene therapy trials, Roger Be	ertolotti,
Ke	iya Ozawa and H. Kirk Hammond, VSP international science publishers	
3. Ste	em Cells Handbook: Stewart Sell, Humana Press; Totowa NJ, USA; Oct. 2003,	
4. Hu	man Embryonic Stem Cells: The Practical Handbook by Stephen Sullivan and Cha	d A Cowan
5. Mi	cklem.H.S.,LoutitJohn.F., 2004, Tissue grafting and radiation, Academic Press, Ne	w York
6. Pe	nso.G., Balducci.D., 2004.Tissue cultures in biological research, Elsevier, Amsterda	m

YB	BT20	4B		`L	Т	Р	С			
С	Р	Α	Animal And Plant Biotechnology	3	0	0	3			
						L				
3	0	0		L	Т	Р	H			
				3	0	0	3			
			Course Outcomes	Domai	n	Level				
Afte	er the	e com	pletion of the course, students will be able to			·				
CO	1	app	ly to produce biotechnology products.	Cognit	ive	Appl	ly			
CO	2	App	ly the various markers of metabolic pathways	Cognit	ive	Appl	ly			
CO	3	Und (GN	lerstand the concepts of Genetically Modified ng organis IO)	Cognit	ive	Unde	Understand			
CO	4	Unc	lerstand the knowledge in the production of vaccines	Cognit	ive	Unde	erstand			
CO	5	Un	derstand the various techniques of plant and animal protein	Cognit	ive	Unde	erstand			
			COURSE CONTENT	1			Hours			
UN	IT I	6								
		Introduction of plant tissue culture, composition of media, Micropropagation,								
		organogenesis, somatic embryogenesis, haploid and triploid production, protoplast isolation								
		and fusion, hybrid and cybrid, synthetic seed production. Secondary metabolites in plants -								
		Phytochemicals- Glycosides and Flavonoids; Anthocyanins and Coumarins - Lignans,								
		Terpenes, Volatile oils and Saponins; Carotenoids and Alkaloids: biogenesis, therapeutic applications								
UN	IT II		•				9			
		Plant Transformation Direct transformation by electroporation and particle gun bombardment.								
		Agrobacterium, Ti plasmid vector. Theory and techniques for the development of new genetic								
		tr	aits, conferring resistance to biotic and abiotic. Plant engine	ering to	wards the	develop	ment of			
		enriched food products, plant growth regulators; Molecular Marker aided breeding: RFLP								
		maps, Linkage analysis, RAPD markers, STS Mirco satellite, SCAR, SSCP, QTL, Map based								
	cloning and Molecular marker assisted selection.									
UN	IT						9			
III	III Animal health disease diagnosis, hybridoma technique, monoclonal antibodies, application probes for disease diagnosis of existing and emerging animal diseases. Prophylaxis - Vacci Oral vaccines DNA Vaccines in animal disease. Cell culture: primary and established cult organ culture; tissue culture						cation of accines, culture;			
UNI	ΓΙ	9								
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	Disaggregation of tissue and primary culture; cell separation, Slide and coverslip of	cultures, flask								
	culture, test tube culture techniques, cell synchronization, cryo preservation. S	caling up of								
	animal cell culture, cell line and cloning micromanipulation and cloning, somatic	cell cloning.								
	Karyotyping; measuring parameters for growth, measurement of cell death, apop	ptosis and its								
	determination, cytotoxicity assays									
UNI	Г V	12								
	Nuclear magnetic resonance methods of monitoring cell metabolism culturing ar	nimal cells in								
	fluidised bed reactors. Application of animal cell culture for in vitro testing	of drugs, in								
	production of human and animal viral vaccines and pharmaceutical proteins. Cul	ture Scale up								
	and mass production of biologically important compounds. Harvesting of products	, purification								
	improvement transgenic animals as model for human diseases: Stem Cells- Prop	erties Types								
	Therapy, Prospects and Ethics in stem cell research.	erdes, Types,								
	Total Hours	45								
TEX	T BOOKS									
1.	Razdan. M. K., 2011. Plant tissue culture. Oxford and IBH publishing Company Pvt. Ltd	, New Delhi.								
2.	Chawla. H. S., 2010. Introduction to plant biotechnology. Oxford and IBH publishing con	mpany pvt.								
	Ltd, New Delhi.									
3.	Ian Freshney, 2010. Culture of animal cells. 6th edition, Wiley-Blackwell publishers.									
4.	Slater, 2008. Plant Biotechnology: The Genetic manipulation of plants, Second Edition, G	Oxford								
	University Press, USA.									
5.	J.D.Watson, Gillman, J.Witknowski and M.Zoller, 2006. Recombinant DNA. 3rd ed.									
6.	W.H.Freeman. 26 K. Dass. 2005, Textbook of Biotechnology, Second Edition, Wiley Dre	eamtech,								
	India (P) Ltd.									
7.	H.Kreuzer&A.Massey. 2001. Recombinant DNA and Biotechnology: A guide for teacher	rs Second								
	Edition. ASM press, Washington.									
8.	M.Sudhir. 2000. Applied Biotechnology & Plant Genetics. Dominant publishers & Distri	butors.								
9.	Genetic Engineering of Animals by (Ed) A.Puhler, VCH Publishers, Weinheim, FRG, 19	93.								
10.	Animal Cell culture Practical approach. Ed. John R.W.Masters, Oxford.2004.									
Onli	ne References:									
ι.	• • • / . / . • • • • • •									

i. <u>www.nuigalway.ie/anatomy/tissue_engineering.html</u>

YB	BT204	4C		`L	Т	Р	С		
С	Р	Α		3	0	0	3		
			Pharmaceutical Biotechnology						
3	0	0		L	Т	Р	H		
				3	0	0	3		
			Course Outcomes	Domai	'n	Leve	1		
Afte	er the	com	pletion of the course, students will be able to						
CO	CO1		er the potential avenues and requirements from the	Cognit	ive	Unde	erstand		
CO	COI		echnologists in pharmaceutical industries and	Cogint	Ive	Onde	// stand		
CO	2	Out	tline the pharmacodynamics and pharmacokinetics of	Cognit	ive	Unde	erstand		
00	-	drug	gs			Chu			
CO	3	Des	cribe various adverse effects of drugs	Cognit	ive	Unde	erstand		
CO	4	Exp	blain the manufacturing process for various therapeutical	Cognit	ive	Unde	erstand		
CO	O5 Summarize the methods applied to test the quality of drugs Cognitive		Unde	Understand					
		and	other biopharmaceuticals			Chick	15tund		
			COURSE CONTENT				Hours		
UN	IT I						9		
		Ir	ntroduction to Pharmaceutical industry & development of	f drugs;	types of	therape	utic		
		ag	gents and their uses. Pharmaceutical Biotechnology and	Drug d	iscovery.	Scope	and		
		aj	pplications of biotechnology in pharmacy, biological /res	earch ad	vances a	nd appro	oved		
		bi	iologicals for pharmaceutical						
UN	IT II						9		
		P	hysiochemical properties of drugs, factors modifying drug a	ction. Ph	armacody	ynamics,			
		p	harmacokinetics and drug metabolism.						
UN	IT						9		
III		A	dverse effects of drugs and drug toxicology: Reproduce	ctive tox	icity and	Teratog	genicity,		
		N	Iutagenicity, Carcinogenicity, Drug tolerance, Drug intole	rance, di	rug allerg	gy, drug	induced		
		si	de effects. Tachyphylaxis, biological effects of drug abuse a	and drug	dependen	ice			
UN	IT IN	V	· · · · · · · · · · · · · · · · · · ·			9	9		
		B	iopharmaceutical and biological drug development, Man	nufacturi	ng of bi	opharma	ceutical,		
		th	nerapeutic proteins and peptides. Recombinant growth horn	nones, g	rowth fac	ctors, the	rapeutic		
		m	nonoclonal antibodies, therapeutic enzymes and their applica	ttion in h	ealth care	×.			
UN	IT V						9		

	Pharmaceutical Testing, Analysis and Control: Analysis of pharmaceuticals using physical,						
	chemical and biological methods, quality assurance and control, stability of pharmaceutic	al					
	products						
	Total Hours	45					
TEXT I	BOOKS						
1.	Purohit,Kulkarni,Saluja—Pharmaceutical biotechnology, Agrobios publishers, 2003						
2.	2. Pharmaceutical biotechnology edition2 by crommel, Freeman publishers, 2004						
3.	3. Crommelin.D.J.A, Robert D. Sindela, Bernd Meibohm "Pharmaceutical Biotechnology:						
	fundamentals and applications", Informa Healthcare, 2008.						
4.	Pharmaceutical biotechnology:drug discovery and clinical applications by Kayser,Wiley						
	publishers, 1st edition 2007						
5.	Katzung B.G. Basic and Clinical Pharmacology,(6th Ed) Prentice Hall of Intl., 1995						
Online	References:						
i.	https://archive.org/details/PharmaceuticalBiotechnology/page/n111						

YE	BT205					`L	Т	Р	С	
С	Р	Α				0	0	3	3	
			Immı	inology Labora	tory					
0	2	1				L	Т	Р	H	
						0	0	4	4	
			Co	ourse Outcomes		Domain		Level		
After th	e comp	letio	n of the course, stud	ents will be able	to					
	Dem	onstr	rate antigen-antib	ody interacti	on through	Psychom	otor			
CO1	agglu	glutination reaction								
	Diffe	renti	iate the blood group	s based on red l	blood cell and					
	Rh ar	ntigei			1 1 1 1 11	D 1				
CO2	Diffe	rent	late various white b	lood cells and re	ed blood cells	Psychom	otor	Imit	ation	
	Dasec	anatr	neir morphological (adv interacti	on through	Davahom	otor			
	preci	onsu nitati	on reaction	interacti	on unough	rsycholi	0101			
CO3	Disti	nonie	sh between Single	Radial Immuno	diffusion and			Manipulation		
	Doub	ole Ra	adial Immunodiffusi	on						
CO4	Dete	rmin	e the concentration	of antigens and	antibodies in	Psychom	otor	1		
	the s	samp	le through Rocket	Immunoelectro	phoresis and	·	Manipulatior			
	Coun	ter ci	urrent Immunoelectr	ophoresis						
CO5	Ident	tify tl	he antigens using the	e ELISA techniq	ue	Psychom	Manipulation			
			CO	OURSE CONT	ENT				Hours	
1.	Collec	ction	of Serum from Bloo	d						
2.	Isolati	on of	f lymphocytes from	whole blood						
3.	Differ	entia	l Leukocyte count							
4.	Total	Leuk	ocyte count							
5.	Total	and d	lifferential count of I	RBC						
6. 7	Blood	Grou	uping Experiment							
/. Q	Anub	ouy L	Labelling with HKP							
0. Q	Single	erion radi	al immunodifussion							
10	Immu	noele	ar minumount assion							
11.	DIRE	CT E	llisa							
12.	Widal	test	and Latex Agglutina	tion						
		1101		LECTURE	PRACTICA	L TUTO	RIAL	ТОТ	'AL	
		HUU	JKS	0	30		0		30	
TEXTE	BOOKS	5			•	I		I		
1.	Idris A	dewa	ale Ahmed. Laborate	ory Manual – Ba	sic Immunolog	y. Lincoln Ur	niversity	College	e.	
	Malavs	sia. 2	018.							

2. Tobili Y. Sam-Yellowe. Immunology – Overview and Laboratory Manual. Springer publications. 2021.

YB	T20	6				`L	Т		Р	С	
С	P	A				0	0		3	3	
			Recombinant	DNA Technolog	y Laboratory		I			L	
0	2	1				L	Т		Р	Η	
						0	0		4	4	
	Course Outcomes Domain								Lev	el	
After	the o	com	pletion of the cours	se, students will b	be able to						
CO1	CO1 Demonstrate the isolation of chromosomal DNA from bacteria & Drosophila and plasmid DNA from bacteria Psychomotor							Imit	ation		
CO2	As ele	ssem ectro	able Electroph phoresis	oretic set-uj	p and Perfor	ngel	Psychom	otor	Imit	ation	
CO3	Pe di	e rfo r geste	m the restriction ed products based of	digestion of DN on their size	IA and Compare	e the	Psychom	otor	Imit	ation	
CO4	Design a polymerase chain reaction set up to amplify the DNA Psychomotor							otor	Manipulation		
CO5	Pe	erfor	m the Randomly a	amplified polymo	orphic DNA techn	ique	Psychom	otor			
	an	dint	erpret the results						Man	iipulation	
				COURSE CON	NTENT	I				Hours	
1	. I	solat	tion of Plasmid and	Genomic DNA							
2	. R	Restr	iction enzyme dige	estion.							
3	. A	Agar	ose gel Electropho	cesis.							
4	. S	South	nern blotting								
5	. S	SDS	PAGE								
6	. V	Vest	ern blotting								
7	. P	Purifi	ication of digested	DNA.							
8	. L	Ligat	ion of restricted ve	ctor and genomic	c DNA						
9	. (Com	petent cell preparat	ion- calcium chlo	oride method						
1	0.]	PCR								<u></u>	
		HC	OURS	LECTURE	PRACTICAL	TUT	ORIAL	TO	ГAL		
				0	30		0		3	0	
TEX B	00	KS									

 Judith W. Zyskind, Sanford I. Bernstein. Recombinant DNA Laboratory Manual. Elsevier Publications. 2014.

Y	BT2	07		`L	Т	Р	С		
С	Р	A		3	0	0	3		
			Research Methodology and IPR		-II				
3	0	0		L	T	Р	Н		
				3	0	0	3		
		L	Course Outcomes		Domain	Level			
Aft	er th	ne co	ompletion of the course, students will be able to			1			
СС	01	Apply the bloom's taxonomy in research and methodology Cognitive App							
CC	02	Ap	ply to follow the principle of research ethics		Cognitive	Apply			
CC)3	Ap	plyto become proficient in data analysis and statistical to	ols	Cognitive	Apply			
CC	94	Ide	entify the research problem in society by searching variou	S	Cognitive	Create			
CC	95	scientific databases Would have become proficient in the art and science of scientific			Cognitive	Cognitive Analyze & Cre			
		wri	iting			1 mary 2			
			COURSE CONTENT				Hours		
TIN	TTEN						0		
UI	NLL						9		
I	NIT	N	Meaning of research problem, Sources of research prob	lem, Cri	iteria-Charac	teristics	of a good		
Ι	NIT	N r	Meaning of research problem, Sources of research problemsesearch problem, Errors in selecting a research problem	lem, Cri em, Sco	iteria-Charac	eteristics ectives o	of a good f research		
I	NIT	N r p	Meaning of research problem, Sources of research prob research problem, Errors in selecting a research proble problem. Approaches of investigation of solutions for res	lem, Cri em, Sco earch pr	iteria-Charac pe and obje oblem, data	cteristics ectives o collection	of a good f research n,analysis,		
Ι	NII	N r p in	Meaning of research problem, Sources of research prob research problem, Errors in selecting a research proble problem. Approaches of investigation of solutions for res nterpretation, Necessary instrumentations	lem, Cri em, Sco earch pr	iteria-Charac pe and obje oblem, data	eteristics ectives o collection	of a good f research n,analysis,		
I		N r p ii	Meaning of research problem, Sources of research prob research problem, Errors in selecting a research proble problem. Approaches of investigation of solutions for res nterpretation, Necessary instrumentations	lem, Cri em, Sco earch pr	iteria-Charac pe and obje oblem, data	ectives o collection	of a good f research n,analysis, 9		
I UN II		N r p in	Meaning of research problem, Sources of research problems research problem, Errors in selecting a research problem problem. Approaches of investigation of solutions for research nterpretation, Necessary instrumentations	lem, Cri em, Sco earch pr	iteria-Charac pe and obje oblem, data rch ethics, E	cteristics ectives o collection	of a good f research n,analysis, 9 echnical		
I UN II		N r p ii E v	Meaning of research problem, Sources of research problems research problem, Errors in selecting a research problem problem. Approaches of investigation of solutions for resonance interpretation, Necessary instrumentations Effective literature studies approaches, analysis Plagiarism writing, how to write report, Paper Developing a Research	lem, Cri em, Sco earch pr n, Resea	iteria-Charac ope and obje oblem, data rch ethics, E al, Format of	cteristics ectives o collection ffective t	of a good f research n,analysis, 9 echnical n proposal,		
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UN II UN III UN IV		N r p ii F v a E v a F	Meaning of research problem, Sources of research problems research problem, Errors in selecting a research problem oroblem. Approaches of investigation of solutions for resenterpretation, Necessary instrumentations Effective literature studies approaches, analysis Plagiarism writing, how to write report, Paper Developing a Research a presentation and assessment by a review committee. Effective literature studies approaches, analysis Plagiarism writing, how to write report, Paper Developing a Research a presentation and assessment by a review committee. Effective literature studies approaches, analysis Plagiarism writing, how to write report, Paper Developing a Research a presentation and assessment by a review committee.	lem, Cri em, Sco earch pr n, Resea n Proposi m, Rese n Proposi	iteria-Characo ope and object oblem, data rch ethics, E al, Format of arch ethics, al, Format of technology.	cteristics ectives o collection ffective t fresearch Effective f research Patent ir	of a good f research n,analysis, 9 echnical n proposal, 9 e technical n proposal, 9 nformation		
UN II UN III UN IV		M r P in F v a E v a F a	Meaning of research problem, Sources of research problem research problem, Errors in selecting a research problem oroblem. Approaches of investigation of solutions for resenterpretation, Necessary instrumentations Effective literature studies approaches, analysis Plagiarism writing, how to write report, Paper Developing a Research a presentation and assessment by a review committee. Effective literature studies approaches, analysis Plagiarism writing, how to write report, Paper Developing a Research a presentation and assessment by a review committee. Effective literature studies approaches, analysis Plagiarism writing, how to write report, Paper Developing a Research a presentation and assessment by a review committee.	lem, Cri em, Sco earch pr n, Resea n Proposi m, Rese n Proposi	iteria-Charac ope and object oblem, data rch ethics, E al, Format of arch ethics, al, Format of technology.	cteristics ectives o collection ffective t f research Effective f research Patent ir	of a good f research n,analysis, 9 ecchnical n proposal, 9 e technical n proposal, 9 formation		

UNIT		9
V	Patent Rights: Scope of Patent Rights. Licensing and tran	sfer of technology. Patent information
	and databases. Geographical Indications.	
	Total Hours	45
FEX B	OOKS	
1.	Stuart Melville and Wayne Goddard, "Research methodolog	y: an introduction for science &
	engineering students""	
2.	Wayne Goddard and Stuart Melville, "Research Methodolog	gy: An Introduction"
3.	Ranjit Kumar, 2nd Edition, "Research Methodology: A Step	by Step Guide for beginners"
4.	Halbert, "Resisting Intellectual Property", Taylor & Francis	Ltd ,2007.
5.	Mayall, "Industrial Design", McGraw Hill, 1992.	
Referer	nce Book	
. Stua	art Melville and Wayne Goddard, "Research methodology: a	n introduction for science &
eng	ineering students"	
2. Way	yne Goddard and Stuart Melville, "Research Methodology: A	In Introduction"
8. Ran	jit Kumar, 2nd Edition, "Research Methodology: A Step by	Step Guide for beginners"
. Hal	bert, "Resisting Intellectual Property", Taylor & Francis Ltd	,2007.
. Ma	yall, "Industrial Design", McGraw Hill, 1992.	

M.TECH – NANOTECHNOLOGY - SYLLABUS

Semester I

COURSI	E L T P C				С	
CODE	YNT101					
COURSI		3	0	0	3	
NAME	Introduction To Nanotechnology					
PREREC	Applied Physics and Applied Chemistry	L	Т	Р	Н	
UISITES						
C:P:A	2:1:1	3	0	0	3	
COURSE OUTCOMES			IAIN	LEV	EL	
CO1 Define the concept on emergence of the nanotechnology and its		Com	itivo	Rome	ambar	
	opportunities.	Cogn	luve	Kenk	linder	
CO2	Discuss the mechanism of nanoscale phenomena properties	Cogn	itive	Unde	erstand	
CO3	Generalize the concept of structural characterization for the	Com	itivo	Undo	retand	
	functional nanomaterial	Cogn	luve	Understand		
CO4	Demonstrate the crystalline nature of the nanomaterials	Cognitive Anal			ysis	
CO5	Investigate the application of the nano materials in healthcare and	Psych	nomot	Unde	Understand	
	industrial needs.	or		Understand		
UNIT I	Emergence of Nanotechnology	9				
Historical	Development: ancient works on Nanomaterials; emergence of na	anotech	nology	with	special	
reference	to Feynman. Size & Scales: definition of nanostructures; insight into t	he nan	o world	l; interv	vention	
into the n	ano world; building blocks of nanotechnology. Scientific revolutions;	types of	of nano	technol	logy &	
nano mao	hines; basic problems & limitations; opportunities at the nanoscale	e; time	and le	ength s	cale in	
structures	; energy landscapes.					
UNIT II	Nanoscale Phenomena				9	
Density of	f states; tunnelling; chemical bonds (types & strength). Intermolecu	ılar &	inter-p	article	forces.	
Molecula	r & crystalline structures; particles & grain boundaries. Covalen	t & co	oulomb	intera	ctions;	
interactio	ns involving polar molecules & polarization; weak intermolecular for	orces &	total i	ntermo	lecular	
pair poter	ntials. Forces between solvation, hydration; polymers at surfaces; adl	nesion.	Therm	odynar	nics of	
self-asser	ably. Hierarchical structures & Functionality. Bulk to surface transition	n. Spati	al & te	mporal	scales;	
concept o	f confinement; role of surfaces in nanotechnology devices; surface rec	onstruc	ction; d	angling	bonds	

& surface states; interfaces & Casmir force.

	Functional Na	anomaterials			9		
Fullerenes, ca	rbon nanotube	, graphene. Monomers	& polymers. Amorr	bhous, crystalline, semi-crysta	alline;		
crystals, polyc	crystals, polycrystals. Composite materials; ceramics, alloys, silicates. Quantum hetero-structures: quantum						
well, quantum wire, quantum dot, nanofossils, smart dust, porous & nonporous inorganic materials, hydro							
gel & aerosols. Bio nanomaterials: bio mimetic systems, bio ceramics, dendrimers, micelles, liposome's,							
block copolyn	ners. Nanomat	erials for molecular ele	ectronics & optoelect	conics: thin-film transistors, s	ingle-		
electron trans	sistors light-e	mitting devices phot	tovoltaic materials	nanomagnetic materials &	nano		
superconducto	ors	initiang devices, prior			mano		
	Structures o	f Nonomotoriola			0		
	Structures o			1 1 0 1	9		
Crystal structu	are: crystal plai	nes, Miller indices, cry	stal orientation. Morr	phology of materials, nanopart	ticles,		
nanowires, na	norods, nanocl	lusters, powders of nar	o crystalline materia	ls, solid disordered nanostruc	tures.		
Imperfection i	in solids: disloc	cations in single crystal	ls (linear defects & so	crew dislocation) and imperfe	ction-		
dependent pro	perties of cryst	tals.					
UNIT V		ations of Nanomateria	als		9		
Applications	of nanomateria	als in electronics & c	ommunication, healt	ncare, sensors, clothes, paint	s and		
other industria	al as well as co	onsumer products. Ener	rgy and Environment	al applications. (This unit is a	aimed		
to provide an	overview of va	rious possible applicati	ons of nanomaterials)).			
IECT	TIDE	THEODIAL					
LEUI	UKL	TUTORIAL	PRACTICAL	TOTAL			
LEC1	5	0	PRACTICAL 0	TOTAL 45			
TEXT	5	0	PRACTICAL 0	TOTAL 45			
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COURSI	E CODE	YNT1	YNT102					С	
COURSI	E NAME	Nanor	naterials Fabrication Techniques		3	0	0	3	
PREREC	QUISITES	Mater	ial Science, Applied Physics And Chemistry	,	L	Т	Р	Η	
C:P:A			1.5:1.5:1		3	0	0	3	
COURSI	E OUTCON	1ES		DOMAIN	LEVEL				
CO1	Define the	concep	of the nanofabrication techniques	Cognitive	Remember				
CO2Discuss the detailed outline of the physical techniqueCognitive				Un	ders	stand	1		
CO3	Describe	the var	ous chemical methods to synthesize the	Cognitive	Ur	ders	stand	1	
	nanomater	ials							
CO4	Demonstra	te the fa	brication of self-assembly techniques	Cognitive	Ap	ply			
CO5	Revise the	concep	of the lithographic technique in the	Psychomotor	Un	ders	stand	1,	
	nanofabric	ation pr	ocess	Affective	Ev	alua	tion		
UNIT I	Basic	Conce	ots of Nano Fabrication					9	
Drexler-S	malley deb	ate; rea	istic projections; outline of various preparati	on techniques; b	asic	cor	icep	ts of	
nano-stru	ctured mate	erials; r	ucleation: surface nucleation, growth, grain	n size distributio	on; 1	nanc	-pai	ticle	
transport	in low der	nsity m	edia; 154unnel nano phase thermodynamics	; coagulation of	na	no j	parti	cles;	
determina	tion of gra	in size;	aggregate formation; mass fractal morphole	ogies. Requireme	ents	for	an	ideal	
semicond	uctor nano s	structure	; clean room technology						
UNIT II	Physi	cal Tec	hniques					9	
Physical	processes	in sen	iconductor nano structures. Introduction;	thin film depo	sitic	n 1	neth	iods;	
fundamer	itals of film	1 depos	ition; thermal evaporation; spray pyrolysis;	tlame pyrolysis;	mol	ecul	ar t	eam	
epitaxy; j	pulsed laser	deposi	ion; sputter deposition; different types sputt	ering processes;	ther	mal	for	nıng	
processes	; plasma pro	ocesses;	physical methods for the preparation of nano	tubes; types of	nan	o tul	bes;	new .	
iorms of	carbon nan	o tubes	properties of nano tubes; plasma arcing; la	ser methods; pyr	olyt	1C S	yntn	esis;	
febricatio	n technique		; layered sincates; soft chemical & combust	hy loser obletion	ser .	lusi	on u	arget	
	I technique		the capsule fabrication, and cluster formation					0	
Chemical			enous	sure plasma CVI	D· n	natal	ore	y Tanic	
CVD (M	CVD): ph	to enh	nced CVD; plasma-emianced CVD; loser in	duced CVD: atmo	o, n	oric	nros	;anne	
CVD (IVI)	$(\mathbf{U}, \mathbf{U}), \mathbf{U}$	ching (RIE) molecular-beam enitaxy (MBE): chemic	al beam enitaxy	(CR	F).	pres	nical	
bath depo	osition: elec	trochen	ical synthesis of nano structures. Sol-gel pr	ar ocarr opraxy	enta	L), 1	f so	l_gel	
process: o	sol-gel syntl	nesis m	thods for oxides: other inorganics and pape	composites the	Pect	neni	met	hod	
silica gel	: zirconia a	nd Yttr	ium gel: aluminosilicate gel: polymer nano	composites. Me	echa	nocł	nemi	strv:	
Sinca goi	, meenia a		ere ger, mannen ger, portiner nuno	- stip solico. The			111	J •	

grinding and milling devices

UNIT IV Self-Assembly

Bottom-up approach. Self-assembly; self-assembled mono layers; directed assembly; layer-by-layer assembly; spontaneous formation & ordering of nano structures; nano-fluidics to build silicon devices with features comparable in size to DNA, proteins & other biological molecules; control and manipulation of microfluidic and nanofluidic processes for lab-on-a-chip devices. Langmuir Blodgett films; electrochemical self-assembly of oxide/dye composites.Self-assembled nanobiomaterials; pattern definition; pallsin transfer; atomic & molecular manipulation; biomineralization; colloidal quantum dots; self-assembly techniques

UNIT V Lithographic Techniques

Top-down approach to nanolithography; immersion lithography, EUV photolithography; phase shifting masks; x-ray lithography, including plasma x-ray sources; e-beam and focused ion-beam lithography; photo resist technologies for the nano scale; metrology and defect inspection. Soft lithography; nano imprint lithography; wet etching, dry etching (isotropic, anisotropic), pattern growth techniques (polymerization, directed assembly). Proximal probe nano lithography; STM; AFM; resists & imaging layers for proximal probes

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	0	45

TEXT

1. "Introduction to Nanotechnology," Frank J. Owens & Charles P. Poole, Wiley-IEEE, 2003.

2. "Encyclopedia of Nanoscience & Nanotechnology," H. S. Nalwa, American Scientific Publishers, 2004.

3. "The Powder Method," L.V. Azaroff& M. J. Buerger, McGraw-Hill, 1958

REFERENCES

1. "Introduction to Nanotechnology," Frank J. Owens & Charles P. Poole, Wiley-IEEE, 2003.

 Encyclopedia of Nanoscience & Nanotechnology," H. S. Nalwa, American Scientific Publishers, 2004.

E REFERENCES

1. www.nptel.ac.in

2.www.mit.co.in

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COURS	E CODE	YNT103				Т	P	C
COURS	E NAME	Materials Science & Engineerin	g		3	1	0	4
PRERE	QUISITES	Applied Physics And Chemistry			L	Т	Р	Н
C:P:A			2:1:1		3	1	0	4
COURS	E OUTCOMES		DOMAIN	LEV	VEL	•		
CO1	Describe the concept of engineering material and its characteristic properties Unc			Understanding				
CO2	Discuss the nanostructu	re of solids	Cognitive	Ana	lysis			
CO3	Outline the facts of pha kinetics	se diagram and transformation	Cognitive	Und Ana	lerstan Ilysis	ding	,	
CO4	Demonstrate the charac	teristic behavior of the model	Cognitive	App	oly			
CO5	Relate the concept of or materials	kidation, corrosion and dielectric	Psychomotor	Eva	luatio	n		
UNIT I	Introduction					9		
classification of engineering materials; levels of structure; structure-property relationship.EquiliKinetics: stability & meta-stability; statistical nature of entropy; kinetics of thermally activated prCrystal Geometry & Structure Determination.Atomic Structure & Chemical Bonding: ionization pelectron affinity & electro-negativity; bond energy, bond type & bond length; primary bonding; sebonding; variation in bonding character & properties.UNIT IIStructure of Solids9Crystalline & non-crystalline states; covalent solids, metals & alloys, ionic solids, silicates; classificpolymersstructure & crystallinity of long-chain polymers Crystal Imperfections: 0D1D21					quili ed pro on po g; sec g; sec 9 ssific , 2D	briu oces oten conc	m& ses. tial, lary n of 3D	
imperfec	ctions; geometry & other	properties of dislocations				-		
	II Phase Diagram	ms	and the state of the	1	1	9 		
Phase ru lever rul Diffusio solutions transforr	Phase rule; single-component systems; binary phase diagrams; micro-structural changes during cooling; lever rule; typical phase diagrams; applications of phase diagrams. Diffusion in Solids: Fick's laws; solution to Fick's second law; applications based on the second law solutions.Phase Transformations: time scale for phase changes; nucleation kinetics, growth kinetics, overall transformation kinetics; solid-state transformations; precipitation processes; glass transition							
UNIT I	V Elastic, Anela	stic & Visco elastic Behaviour				9		
Atomic models.I perfect	model of elastic be Plastic Deformation & C & real crystals; stress	haviour; rubber-like elasticity; reep in Crystalline Materials: tensi to move a dislocation; streng	relaxation pro le stress-strain d thening mechan	cesse curve nisms	s; sp ; shea ; mec	ring- r stre chani	dasł engtl isms	ipot 1 of of

fracture UNIT V Oxidation & Corrosion 9 Mechanism of oxidation; oxidation resistance; principles of corrosion; protection aga corrosion.Conductors& Resistors: super-conducting materials.Semiconductors. Magnetic Materials Dielectric Materials
UNIT V Oxidation & Corrosion 9 Mechanism of oxidation; oxidation resistance; principles of corrosion; protection aga corrosion.Conductors& Resistors: super-conducting materials.Semiconductors. Magnetic Materials 9
Mechanism of oxidation; oxidation resistance; principles of corrosion; protection aga corrosion.Conductors& Resistors: super-conducting materials.Semiconductors. Magnetic Materials
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Dielectric Materials
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LECTURE TUTORIAL PRACTICAL TOTA
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TEXT
1. Askeland D.R., & P. P. Fullay (2007), The Science and Engineering of Materials –
7 th Cengage Learning Publishers.
2. William D. Callister, Jr (2008), Callister"s Materials Science and Engineering, (Adopted by R.
Balasubramaniam) Wiley-Eastern
3. Raghavan V (2007), Materials Science and Engineering - A First Course, Prentice Hall, India.
4. Raghavan V (2007), Materials Science and Engineering - A First Course, Prentice Hall, India
REFERENCE
1. A.S. Edelstein and R.C. Cammarata Ed.(1998), Nano Materials: Synthesis, Properties and
Applications, Inst. Of Physics Publishing, UK.
2. James F. Shackelford (1996), Introduction to Materials Science for Engineers, Prentice
Hall, India.
E REFERENCES
www.nptel.ac.in
www.mit.co.in

COUI	RSE CODE	YNT106		L	Т	Р	C
COUI	RSE NAME	Simulation of Nanostructure & Nano	omaterials Lab	0	0	2	2
PRER	REQUISITES	Applied Physics, Applied Chemistry, In	ntroduction To	L	Т	Р	Н
Nanotechnology And Materials Science							
C:P:A				0	0	4	4
COURSE OUTCOMES DOMAIN				LEVEL			
CO1	Demonstrate the	Cognitive		Apply			
CO2	Relate the conce	pt of electrical and heat properties	Cognitive		Evaluate		
CO3	Demonstrate the	optical properties of nanomaterial	Cognitive		Appl	у	
CO4	Demonstrate the	study of insulating material	Cognitive		Appl	у	
CO5	Articulate the na	Psychomotor		Evalı	ıate		
	application						
Listo	f Experiments						

- 1. Calculate the band structure of a crystal
- 2. Transport calculations with ATK
- 3. Phonon Band Structure, Electrical and Heat Transport of a Graphene Nanoribbon
- 4. Electron-phonon coupling properties of a Graphene Nanoribbon
- 5. Optical Properties of Silicon
- 6. Study of NiSi₂–Si interface
- 7. Study of Bi₂Se₃ topological insulator
- 8. Study of Effective band structure of random alloy InGaAs
- 9. Study of Li-air battery interface
- **10.** Study of Li-ion diffusion in $LiFePO_4$ for battery applications

Y	RM1	07		`L	Т	P	С				
С	Р	Α		2	0	0	2				
			RESEARCH METHODOLOGY AND IPR								
2	0	0		L	Т	P	H				
				3	0	0	3				
	1		Course Outcomes	Domai	n	Lev	'el				
Afte	er the	com	pletion of the course, students will be able to								
со	1	Арр	bly the bloom's taxonomy in research and methodology	Cognit	ive	App	ply				
CO	2	Арр	bly to follow the principle of research ethics	Cognit	ive	App	oly				
CO	3	App tool	bly to become proficient in data analysis and statistical s	Cognit	ive	App	oly				
CO	4	Ide scie	lentify the research problem in society by searching various Cognitive cientific databases and								
CO	5	Wo scie	uld have become proficient in the art and science of ntific writing	Cognit	Cognitive Create						
			COURSE CONTENT				Hours				
UN	IT I	F	undamentals of scientific research				5				
		C	boals and cornerstones of research, applications of Bloom's	s Taxono	my in re	search,	steps for				
		SI	uccessful research initiatives, research gap identification	, researc	h questi	on form	nulation,				
		h	ypothesis generation, protocol designing, benefits of research	h to the s	ociety						
UN	IT II	P	ublication ethics				7				
		P	ublication ethics: definition, introduction, and importance, b	est pract	ices of re	search,	conflicts				
		0	f interest, publication misconducts: falsification, fabr	ication,	plagiaris	sm, gu	est/ghost				
		a	uthorship, sabotage, salami slicing, etc., violation of publica	tion ethi	cs, tools	for chec	king the				
		p	lagiarism, predatory and misleading publishers and journals	s, researc	h metric	s: impac	ct factor,				
		S	NIP, SJR, cite score, FWCI, Scopus percentile, h-index, g-	index, ar	ticle infl	uence so	core, h5-				
		ir	ndex, i10-index and citations, etc., obtaining permission to	reuse fi	gures/tab	les/imag	ges from				
		p	ublished resources.								
UN	IT II	IL	iterature search and review				7				
		P	rinciples of literature search and review, methods of literat	ure searc	ch (snow	balling,	protocol				
		d	riven, etc.), empowering efficient literature search using var	ious sear	ch engine	es and da	atabases:				
		S	cienceDirect, JANE, PubMed/Medline, MeSH, Web of Sc	ience, B	ibliMed,	Scopus	, Google				
		S	Scholar, ProQuest, Inflibnet, zbMATH, etc.								

UNIT IV	Data analysis and statistical tools	11					
	Basics of descriptive and inferential statistics, measures of central tendency, types of	data and					
	scales of measurement, correlation coefficient, Gaussian and non-Gaussian dis	tribution,					
	parametric and non-parametric statistics, confidence interval, hypothesis testing, S	Statistical					
	tests of significance, sample size calculation, null and alternative hypothesis, types	of error,					
	level of significance, one-tailed and two-tailed tests, conceptual framework for	statistical					
	analyses of data: Student's t-test, ANOVA, Post-hoc statistical tests, Chi-square test,						
	Wilcoxon-matched-pairs signed-ranks test, Mann-Whitney test, Friedman test, Krusk	al-Wallis					
	test, etc., Use of statistical tools.						
UNIT V	Structuring the scientific article and scholarly communication	15					
	Fundamentals of scientific writing, mechanics of writing a research report, strue	cturing a					
	research article: title, running title, abstract, keywords, list of abbreviations, h	ighlights,					
	graphical abstract, introduction, materials and methods, results, discussion, summary and						
	conclusions, conflict of interest statement, CRediT author statement, funding source,						
	acknowledgements, references, legends for figures and tables, etc., writing a review article,						
	identifying legitimate journals, journal selection, cover letter, checklist for submission,						
	gatekeepers and peer-review process, responding to reviewers, and successful submis	ssion and					
	publications.Various types of IPR, rules and regulations of IPR, filing procedure of	of IPR in					
	India and overseas, World Intellectual Property Organization (WIPO), search and	d service					
	portals of IPR, commercialization of IPR, case studies on IPR disputes, scholars	ships and					
	funding agencies for research: national and international perspectives.						
	Total Hours	45					
TEXTBO	OKS	1					
1. Jag	adeesh G, Balakumar P, Senatore F (editors). The Quintessence of Basic and Clinical Re	esearch					
and	Scientific Publishing. Springer Singapore; 1st ed. 2023 edition, DOI:						
	is://doi.org/10.100//9/8-981-99-1284-1.	ation to					
Puł	lication. New Delhi: Wolters Kluwer Health Lippincott Williams and Wilkins: 2010.						
3. 3.0	C.R. Kothari, Gaurav Garg, Research Methodology: Methods and Techniques, 4th edition	n, New					
Age	e International Publisher (2019).						
4. 4. N	M. Gurumani, Research Methodology for Biological Science, MJP Publishers, Chennai (2	2021).					
5. 5. F	Chaddah, (2018) Ethics in Competitive Research: Do not get scooped do not get plagia N: 978-9387480865	arized,					
6. 6. I	ndian National Science Academy (INSA), Ethics in Science Education, Research and						
Gov	vernance (2019), ISBN: 978-81-939482-1-7; https://www.insaindia.res.in/pdf/Ethics_Bo	ok.pdf					

COUR	SE CODE	YNT	Г107							L	T		Р	С
COUR	SE NAME	Nano	omater	erials	s Fabrica	cation T	Fechnique	es Lab		0	0		2	2
PRER	EQUISITES	Mate	erial S	Scien	ice , Nan	nofabri	ication Te	echniq	ues	L	Т		Р	Н
		And	Intro	ducti	tion To N	Nanote	echnology							
C:P:A										0	0		4	4
COUR	SE OUTCOMES	S							DOM	IAIN		LEVEL		
CO1	Prepare the synt	thesis o	of nano	oparti	ticles				Cogni	itive		Ev	valuate	;
CO2	Relate the conce	ept of fa	fabricat	ation	techniqu	ues			Cogni	itive		Ev	valuate	;
CO3	Demonstrate the	e synthe	nesis by	y vari	rious wet	et proces	ss method		Cogni	itive		A	pply	
CO4	Demonstrate the	e study	of the	e nano	ofabrica	ation co	ating met	hod	Cogni	itive		A	pply	
CO5	Articulate the na	anomat	terial s	synth	nesis by c	chemic	al method	l	Psych	omotor		Ev	valuate	;
List of	Experiments													
Any T	welve Experimen	nts :												
1.	Synthesis of zno	o nanop	particle	es by	Wet Ch	hemical	l Precipita	tion						
2.	Synthesis of zero	ovalent	it iron r	nanoj	particles	$es(fe^{3+})$	by Wet Cl	nemica	l Precip	oitation				
3.	Synthesis of Poly	lymeros	osomes	s by V	Water Oi	oil emul	sification	Techni	que					
4.	Synthesis of cad	lmium	sulphi	ide na	anoparti	icles by	Sol-Gel l	Method	l					
5.	Synthesis of PV.	A/PEG	G film b	by Sp	pin Coat	ating								
6.	ZnO thin film fa	abricatio	ion by 1	Dip	Coating	g Metho	od							
7.	Synthesis of silv	ver nano	opartic	cles										
8.	Synthesis of ZnS	S nanoj	particle	les										
9.	Fabrication of co	opper n	nanopa	article	les by El	lectrode	eposition [Fechnie	ques					
10.	Synthesis of cu/I	'pva nai	nofiber	ers by	y Electro	ospinnir	ng							
11.	Nanoarray Fabri	ication	by Ox	xide I	Dot Fabi	orication	1							
12.	Synthesis of silv	ver nano	ofibers	S										
13.	Herbal nano pow	wder fa	abricati	tion b	oy Ball N	Milling								
14.	Circuit fabricatio	on by N	Manua	al Litl	hograph	ny Tech	iniques							
15.	Thin film Fabric	cation b	by Spra	ay Py	yrolysis	5								
16.	Thin film fabrica	ation B	By Phys	sical	l Vapour	r Depos	sition							
17.	Nano powder fal	bricatio	on by (Chen	mical Va	apour D	Deposition							

YE	GOE	21		`L	Т	Р	C	
С	Р	Α		0	0	0	0	
			ENGLISH FOR RESEARCH PAPER WRITING					
0	0	0		L	Τ	Р	H	
				2	0	0	2	
			Course Outcomes	Domai	n	Leve	el	
Aft	er the	e com	pletion of the course, students will be able to	1				
co	1	Exp	lain the fundamentals of communication to classify	Cognit	ive	Und	lerstand	
	1	diffe	erent models and types of communication.			One	ierstand	
co	2	Illus	strate the structure of scientific papers to analyze research	Cognit	ive	Und	erstand	
		artic	eles for effective organization.			Ond	cristand	
co	3	App	ly techniques of data presentation to create and format	Cognit	ive	App	ly	
	J	tabl	es and graphs in scientific reports.					
CO	94	Dev	elop research proposals to organize sections like Methods	Cognit	ive	Apply		
		and Results in a structured scientific document.						
CO	5	Utilize scientific writing and editing methods to revise and Cognitive						
		imp	rove clarity in scientific documents.					
CO	URS	E CC	DNTENT				Hours	
UN	I TI	F	UNDAMENTALS OF COMMUNICATION				6	
		Iı	ntroduction to Communication Models - Types of Com	municati	on (Vert	oal, Non	-verbal,	
		V	Vritten) - Active Listening - Communication Barriers and	Solutions	s - Cultur	al Sensi	tivity in	
		C	Communication - Effective Feedback Mechanisms					
UN	IT II		CIENTIFIC WRITING ESSENTIALS				6	
		lı a	ntroduction to Scientific Writing: Analyze and critique san	ple resea	arch pape	rs - Stru	cture of	
		S	cientific Papers: Analysing research articles for structure an	d organiz	ation - W	/riting C	lear and	
			Concise Sentences: Sentence restructuring exercises to impro	ove clarit	y in writi	ing - Org	ganizing	
		R	lesearch Papers (IMRAD): Practice structuring sections	(Introdu	ction, M	ethods,	Results,	
			Discussion) of research papers.					
UN	1.1, 11		DATA PRESENTATION IN SCIENTIFIC WRITING		C		D	
			resenting Data through Tables and Graphs: Create tables	and grapl	ns from g	given dat	ta sets -	
		F	ormatting and Labeling Figures and Tables: Formatting e	exercises	ior accu	rate tabl	e/figure	
		p	resentation - interpreting Data in Written Form: Write brief	explanati	ons for g	iven data	i sets.	

UNIT I	V SCIENTIFIC REPORT AND PROPOSAL WRITING	6
	Writing Research Proposals: Draft a research proposal for a chosen topic - Writing	Methods
	and Results Sections: Practice writing these sections based on provided experiment	tal data -
	Revising and Editing Scientific Documents: Peer-review sessions and revision exe	rcises on
	draft reports	
UNIT	V PUBLISHING AND PRESENTING SCIENTIFIC WORK	6
	Basics of Manuscript Submission and Review Process: Simulate manuscript submission	ssion and
	peer review - Preparing Scientific Presentations: Create and deliver a 5-minute present	itation on
	a research topic - Ethical Considerations in Scientific Writing: Group discus	sions on
1	plagiarism, authorship, and publication ethics	
Total H	Iours	30
TEXT	BOOKS	
1.	Alley, Michael. The Craft of Scientific Writing. 4th ed., Springer, 2018.	
2.	Day, Robert A., and Barbara Gastel. How to Write and Publish a Scientific Paper. 8th ed.,	
	Cambridge University Press, 2016.	
3.	Derntl, Michael. "Basics of Research Paper Writing and Publishing." International Journal	of
	Technology Enhanced Learning, vol. 6, no. 2, 2014, pp. 105-123.	
4.	Gopen, George D., and Judith A. Swan. "The Science of Scientific Writing." American Sci	entist,
	vol. 78, no. 6, 1990, pp. 550-558.	
5.	Hartley, James. Academic Writing and Publishing: A Practical Handbook. Routledge, 2008	3.
6.	Katz, Michael Jay. From Research to Manuscript: A Guide to Scientific Writing. 2nd ed., S	pringer,
	2009.	
7.	Peat, Jennifer, et al. Scientific Writing: Easy When You Know How. BMJ Books, 2002.	
8.	Silyn-Roberts, Heather. Writing for Science and Engineering: Papers, Presentations and Re	ports.
	2nd ed., Elsevier, 2012.	
9.	Turabian, Kate L. A Manual for Writers of Research Papers, Theses, and Dissertations. 9th	ed.,
	University of Chicago Press, 2018.	
10.	Zinsser, William. On Writing Well: The Classic Guide to Writing Nonfiction. 30th Anniver	rsary ed.,
1	Harper Perennial, 2006.	

COURSE NAME Nanomaterials Characterization Techniques 3 0 0 2 PREREQUISITES I.I.T PI I.T PI C2P:A 2:1:1 3 0 0 0 0 COURSE OUTCOMES DOMAIN LEVEL Cognitive Understanding CO2 Discuss the different X-ray techniques for nanomaterial characterization Cognitive Understanding CO3 Investigate the measurement of the magnetic and electrical properties of nanomaterials. Cognitive Analysis CO4 Analyze the models for interpretation of nanoindentation Load displacement curves Psychomot or Psychomot or Fevaluation UNIT I Introduction to spectroscopy 9 9 Basic principles and applications of UV-Vis-NIR, FTIR, FT-Raman, Photoluminescence, NMR, ESR, Light Scattering methods. 9 UNIT II X - ray techniques 9 X-ray powder diffraction -Quantitative determination of phases; Structure analysis, single crystal diffrac techniques - Determination of accurate latice parameters - structure analysis, single crystal diffrac techniques - Determination of accurate latice parameters - structure analysis, single crystal diffrac techniques - Determination of accurate latice parameters - structure analysis, single crystal diffrac techniques - Determination of accurate latice parameters - str	COURS	SE CODE	YNT201			L	Т	Р	С
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CiP:A 2:1:1 3 0 0 0 3 COURSE OUTCOMES DOMAIN LEVEL Cognitive Understanding CO2 Discuss the different X-ray techniques for nanomaterial characterization Cognitive Understanding CO3 Investigate the measurement of the magnetic and electrical properties of nanomaterials. Cognitive Analysis. CO4 Analyze the models for interpretation of nanoindentation Load displacement curves Cognitive Analysis. CO5 Compare the different electrometric methods of analysis Psychomot or Psychomot or Psychomot or CO5 Compare the different electrometric methods of analysis Psychomot or Psychomot or Psychomot or Light Scattering methods. Outrothe spectroscopy 9 Psychomot or Psychomot or UNIT I Introduction to spectroscopy 9 Psychomot or Psychomot or Psychomot or UNIT II X - ray techniques 9 X-ray nowled diffraction -Quantitative determination of phases; Structure analysis, single crystal diffractenhiques - Determination of accurate lattice parameters - structure analysis, single crystal diffractenhiques - Determination of accurate lattice parameters - structure analysis, showed analysis - particle analysis using Scherer formula- Particle Size Analyz	PRERE	QUISITES				L	Т	Р	Н
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CO1 Define the basic principles and application of various spectroscopic methods Cognitive Understanding CO2 Discuss the different X-ray techniques for nanomaterial properties of nanomaterials. Cognitive Understanding CO3 Investigate the measurement of the magnetic and electrical properties of nanomaterials. Cognitive Analysis CO4 Analyze the models for interpretation of nanoindentation Load displacement curves Psychomot or Psychomot or CO5 Compare the different electrometric methods of analysis Psychomot or Psychomot or Psychomot or UNIT I Introduction to spectroscopy 9 9 Basic principles and applications of UV-Vis-NIR, FTIR, FT-Raman, Photoluminescence, NMR, ESR, Light Scattering methods. 9 UNIT II X - ray techniques 9 9 X-ray powder diffraction -Quantitative determination of phases; Structure analysis, single crystal diffractechniques - Determination of accurate lattice parameters - structure analysis, single crystal diffractechniques - Determination of accurate lattice parameters - structure analysis, single crystal diffractechniques - Determination of pactroscopy 9 X-ray poked diffraction -Quantitative determination to nanomaterial characterization 9 VNIT III Electron Spectroscopy, Auger Electron Spectroscopy, X-ray characterization 9	COURS	SE OUTCOMES			DOMAIN	L	EVE	L	
CO2 Discuss the different X-ray techniques for nanomaterial characterization Cognitive Understanding CO3 Investigate the measurement of the magnetic and electrical properties of nanomaterials. Cognitive Analysis CO4 Analyze the models for interpretation of nanoindentation Load displacement curves Cognitive Analysis, Understanding CO5 Compare the different electrometric methods of analysis Psychomot or Psychomot or <td>CO1</td> <td>Define the basi spectroscopic meth</td> <td>c principles and applic ods</td> <th>ation of various</th> <td>Cognitive</td> <td>U</td> <td>nder</td> <td>stand</td> <td>ing</td>	CO1	Define the basi spectroscopic meth	c principles and applic ods	ation of various	Cognitive	U	nder	stand	ing
CO3 Investigate the measurement of the magnetic and electrical properties of nanomaterials. Cognitive Analysis CO4 Analyze the models for interpretation of nanoindentation Load displacement curves Cognitive Analysis, Understanding CO5 Compare the different electrometric methods of analysis Psychomot or Evaluation UNIT I Introduction to spectroscopy 9 Pasic principles and applications of UV-Vis-NIR, FTIR, FT-Raman, Photoluminescence, NMR, ESR, Light Scattering methods. 9 VNIT II X - ray techniques 9 Y Y 9 X-ray powder diffraction –Quantitative determination of phases; Structure analysis, single crystal diffract techniques - Determination of accurate lattice parameters - structure analysis-profile analysis - particle analysis using Scherer formula - Particle Size Analyzer - Ellipsometry- thickness measurements 9 X-ray photoelectron Spectroscopy 9 9 X-ray photoelectron Spectroscopy, Auger Electron Spectroscopy, X-ray characterization 9 V-ray photoelectron Spectroscopy, Auger Electron Spectroscopy, X-ray characterization 9 Nanoindentation principles - elastic and plastic deformation -mechanical properties of materials in si dimensions - models for interpretation of Nanoindentation load-displacement curves - Nanoindentation. Vibra Sample Magnetometer, Impedance Spectroscopy - PPMS, - Measurement of Magnetic and electrical properties of anomaterial	CO2	CO2 Discuss the different X-ray techniques for nanomaterial Cognitive Understanding							ing
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CO5 Compare the different electrometric methods of analysis Psychomot or Psychomot or Evaluation UNIT I Introduction to spectroscopy 9 Basic principles and applications of UV-Vis-NIR, FTIR, FT-Raman, Photoluminescence, NMR, ESR, Light Scattering methods. 9 VAray powder diffraction –Quantitative determination of phases; Structure analysis, single crystal diffract techniques - Determination of accurate lattice parameters - structure analysis-profile analysis - particle analysis using Scherer formula- Particle Size Analyzer- Ellipsometry- thickness measurements 9 VAray photoelectron Spectroscopy 9 9 X-ray photoelectron Spectroscopy, Auger Electron Spectroscopy, X-ray characterization of Nanomateria EDAX and WDA analysis – EPMA - Applications to nanomaterials characterization 9 UNIT IV Mechanical, Magnetic and electrical properties measurement 9 Nanoindentation principles- elastic and plastic deformation -mechanical properties of materials in su dimensions- models for interpretation of Nanoindentation load-displacement curves- Nanoindentation analysis methods-Hardness testing of thin films and coatings- MD simulation of nanoindentation. Vibra Sample Magnetometer, Impedance Spectroscopy - PPMS, - Measurement; Quantum Hall Measurement; Dyna and static Current-Voltage (I-V) characteristics; capacitance; voltage measurement; I-V analysis by AFM STM (STS); electron beam induced current measurement (EBIC) 1 ILECTURE1UTORIALPRACTICALTOTAL 45 <t< td=""><td>CO4</td><td>Analyze the model displacement curve</td><td>s for interpretation of nanoi es</td><th>ndentation Load</th><td>Cognitive</td><td>A U</td><td>nalys</td><td>sis, stand</td><td>ing</td></t<>	CO4	Analyze the model displacement curve	s for interpretation of nanoi es	ndentation Load	Cognitive	A U	nalys	sis, stand	ing
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techniques - Determination of accurate lattice parameters - structure analysis-profile analysis - particle analysis using Scherer formula- Particle Size Analyzer - Ellipsometry- thickness measurements UNIT III Electron Spectroscopy	X-ray p	owder diffraction –	Quantitative determination	of phases; Structur	e analysis, single	e cr	ystal	diff	action
analysis using Scherer formula- Particle Size Analyzer- Ellipsometry- thickness measurements UNIT III Electron Spectroscopy 9 X-ray photo=lectron Spectroscopy, Auger Electron Spectroscopy, X-ray characterization of Nanomateria 9 UNIT IV Mechanical, Magnetic and electrical properties measurement 9 Nanoindentation principles- elastic and plastic deformation -mechanical properties of materials in sidimensions- models for interpretation of Nanoindentation load-displacement curves- Nanoindentation analysis methods-Hardness testing of thin films and coatings- MD simulation of nanoindentation. Vibra Sample Magnetometer, Impedance Spectroscopy- PPMS, - Measurement of Magnetic and electrical properof nanomaterials. 9 UNIT V Electrometric Methods of Analysis 9 Types of electrochemical cells; electrode potentials Hall measurement; Quantum Hall Measurement; Dyna and static Current-Voltage (I-V) characteristics; capacitance; voltage measurements; I-V analysis by AFM STM (STS); electron beam induced current measurement (EBIC) PRACTICAL TOTAL 1. Skoog, Holler, Nieman "Principles of Instrumental Analysis" REFERENCES I. Skoog, Holler, Nieman "Principles of Instrumental Analysis" 1.5, H. S. Nalwa (Ed.), Acade Press, 2000. 2. Electron Microscopy and Analysis," P. J. Goodhews& F. J. Humphreys, Taylor and Francis.	techniqu	es - Determination	of accurate lattice parame	ters - structure and	alysis-profile ana	lysi	s - I	oartic	le size
UNIT III Electron Spectroscopy 9 X-ray photoelectron Spectroscopy, Auger Electron Spectroscopy, X-ray characterization of Nanomateria EDAX and WDA analysis – EPMA - Applications to nanomaterials characterization 9 UNIT IV Mechanical, Magnetic and electrical properties measurement 9 Nanoindentation principles- elastic and plastic deformation -mechanical properties of materials in st dimensions- models for interpretation of Nanoindentation load-displacement curves- Nanoindentation analysis methods-Hardness testing of thin films and coatings- MD simulation of nanoindentation. Vibra Sample Magnetometer, Impedance Spectroscopy- PPMS, - Measurement of Magnetic and electrical properof nanomaterials. 9 UNIT V Electrometric Methods of Analysis 9 Types of electrochemical cells; electrode potentials Hall measurement; Quantum Hall Measurement; Dyna and static Current-Voltage (I-V) characteristics; capacitance; voltage measurements; I-V analysis by AFM STM (STS); electron beam induced current measurement (EBIC) TOTAL 1. Skoog, Holler, Nieman "Principles of Instrumental Analysis" REFERENCES 1. Handbook of Nanostructured Materials and Nanotechnology," vols. 1-5,H. S. Nalwa (Ed.), Acade Press, 2000. Press, 2000. 2. Electron Microscopy and Analysis," P. J. Goodhews& F. J. Humphreys, Taylor and Francis. Pancrical	analysis	using Scherer form	ula- Particle Size Analyzer-	Ellipsometry- thic	kness measureme	nts			
X-ray photoelectron Spectroscopy, Auger Electron Spectroscopy, X-ray characterization of Nanomateria EDAX and WDA analysis – EPMA - Applications to nanomaterials characterization UNIT IV Mechanical, Magnetic and electrical properties measurement 9 Nanoindentation principles- elastic and plastic deformation -mechanical properties of materials in sidimensions- models for interpretation of Nanoindentation load-displacement curves- Nanoindentation analysis methods-Hardness testing of thin films and coatings- MD simulation of nanoindentation. Vibra Sample Magnetometer, Impedance Spectroscopy- PPMS, - Measurement of Magnetic and electrical properoi nanomaterials. 9 UNIT V Electrometric Methods of Analysis 9 Types of electrochemical cells; electrode potentials Hall measurement; Quantum Hall Measurement; Dyna and static Current-Voltage (I-V) characteristics; capacitance; voltage measurements; I-V analysis by AFM STM (STS); electron beam induced current measurement (EBIC) Image: test of the principles of Instrumental Analysis" REFERENCES 1. Skoog, Holler, Nieman "Principles of Instrumental Analysis" 1.5,H. S. Nalwa (Ed.), Acade Press, 2000. 2. Electron Microscopy and Analysis," P. J. Goodhews& F. J. Humphreys, Taylor and Francis.	UNIT I	II Electron Spe	ctroscopy				Ŧ	9	• •
EDAX and WDA analysis – EPMA - Applications to nanomaterials characterization UNIT IV Mechanical, Magnetic and electrical properties measurement 9 Nanoindentation principles- elastic and plastic deformation -mechanical properties of materials in st dimensions- models for interpretation of Nanoindentation load-displacement curves- Nanoindentation analysis methods-Hardness testing of thin films and coatings- MD simulation of nanoindentation. Vibra Sample Magnetometer, Impedance Spectroscopy- PPMS, - Measurement of Magnetic and electrical properoid nanomaterials. 9 UNIT V Electrometric Methods of Analysis 9 Types of electrochemical cells; electrode potentials Hall measurement; Quantum Hall Measurement; Dyna and static Current-Voltage (I-V) characteristics; capacitance; voltage measurements; I-V analysis by AFM STM (STS); electron beam induced current measurement (EBIC) 9 TEXT LECTURE TUTORIAL PRACTICAL TOTAL 1. Skoog, Holler, Nieman "Principles of Instrumental Analysis" 9 0 45 0 0 45 1. Handbook of Nanostructured Materials and Nanotechnology," vols. 1-5, H. S. Nalwa (Ed.), Acade Press, 2000. 2. Electron Microscopy and Analysis," P. J. Goodhews& F. J. Humphreys, Taylor and Francis.	X-ray p	hotoelectron Spectro	oscopy, Auger Electron Sp	ectroscopy, X-ray	characterization	1 10	Nanc	mate	rials –
UNIT IV Mechanical, Magnetic and electrical properties measurement 9 Nanoindentation principles- elastic and plastic deformation -mechanical properties of materials in s. dimensions- models for interpretation of Nanoindentation load-displacement curves- Nanoindentation analysis methods-Hardness testing of thin films and coatings- MD simulation of nanoindentation. Vibra Sample Magnetometer, Impedance Spectroscopy- PPMS, - Measurement of Magnetic and electrical proper of nanomaterials. 9 UNIT V Electrometric Methods of Analysis 9 Types of electrochemical cells; electrode potentials Hall measurement; Quantum Hall Measurement; Dyna and static Current-Voltage (I-V) characteristics; capacitance; voltage measurements; I-V analysis by AFM STM (STS); electron beam induced current measurement (EBIC) Image: Current Principles of Instrumental Analysis PRACTICAL TOTAL 1. Skoog, Holler, Nieman "Principles of Instrumental Analysis" REFERENCES 1. Handbook of Nanostructured Materials and Nanotechnology," vols. 1-5,H. S. Nalwa (Ed.), Acade Press, 2000. 2. Electron Microscopy and Analysis," P. J. Goodhews& F. J. Humphreys, Taylor and Francis.		and wDA analysis –	- EPMA - Applications to na	anomaterials charac		1		0	
Nanonidentation principles- etastic and plastic deformation -mechanical properties of materials in s dimensions- models for interpretation of Nanoindentation load-displacement curves- Nanoindentation analysis methods-Hardness testing of thin films and coatings- MD simulation of nanoindentation. Vibra Sample Magnetometer, Impedance Spectroscopy- PPMS, - Measurement of Magnetic and electrical properoid nanomaterials. UNIT V Electrometric Methods of Analysis 9 Types of electrochemical cells; electrode potentials Hall measurement; Quantum Hall Measurement; Dyna and static Current-Voltage (I-V) characteristics; capacitance; voltage measurements; I-V analysis by AFM STM (STS); electron beam induced current measurement (EBIC) Image: test of the system of the	UNII I	Iv Mechanical,	Magnetic and electrical pr	operties measured	nent		tomio	9 10 in	cmo11
UNIT V Electrometric Methods of Analysis 9 Types of electrochemical cells; electrode potentials Hall measurement; Quantum Hall Measurement; Dyna and static Current-Voltage (I-V) characteristics; capacitance; voltage measurements; I-V analysis by AFM STM (STS); electron beam induced current measurement (EBIC) LECTURE TUTORIAL PRACTICAL TOTAL 45 0 0 45 TEXT I. Skoog, Holler, Nieman "Principles of Instrumental Analysis" REFERENCES 1. Handbook of Nanostructured Materials and Nanotechnology," vols. 1-5,H. S. Nalwa (Ed.), Acade Press, 2000. 2. Electron Microscopy and Analysis," P. J. Goodhews& F. J. Humphreys, Taylor and Francis.	dimension analysis Sample of nanon	ons- models for int methods-Hardness Magnetometer, Imp materials.	terpretation of Nanoindenta testing of thin films and c edance Spectroscopy- PPM	ation load-displace oatings- MD simu S, - Measurement	ement curves- Na lation of nanoing of Magnetic and	anoi lent elec	inder atior trica	ntatio n. Vil 1 pro	n data pration perties
Types of electrochemical cells; electrode potentials Hall measurement; Quantum Hall Measurement; Dyna and static Current-Voltage (I-V) characteristics; capacitance; voltage measurements; I-V analysis by AFM STM (STS); electron beam induced current measurement (EBIC) LECTURE TUTORIAL PRACTICAL TOTAL 45 45 0 0 45 TEXT 1. Skoog, Holler, Nieman "Principles of Instrumental Analysis" REFERENCES 1. Handbook of Nanostructured Materials and Nanotechnology," vols. 1-5,H. S. Nalwa (Ed.), Acade Press, 2000. 2. Electron Microscopy and Analysis," P. J. Goodhews& F. J. Humphreys, Taylor and Francis.	UNIT	V Electrometri	c Methods of Analysis					9	
LECTURE TUTORIAL PRACTICAL TOTAL 45 0 0 45 TEXT 1. Skoog, Holler, Nieman "Principles of Instrumental Analysis" REFERENCES 1. 1. Handbook of Nanostructured Materials and Nanotechnology," vols. 1-5,H. S. Nalwa (Ed.), Acade Press, 2000. 2. Electron Microscopy and Analysis," P. J. Goodhews& F. J. Humphreys, Taylor and Francis.	and stati	f electrochemical ce ic Current-Voltage (TS); electron beam i	ells; electrode potentials Ha I-V) characteristics; capacit induced current measurement	Il measurement; Qu ance; voltage meas nt (EBIC)	antum Hall Mea surements; I-V ar	sure naly	emen sis b	it; Dy y AF	namic M and
450045TEXT1. Skoog, Holler, Nieman "Principles of Instrumental Analysis"REFERENCES1. Handbook of Nanostructured Materials and Nanotechnology," vols. 1-5,H. S. Nalwa (Ed.), Acade Press, 2000.2. Electron Microscopy and Analysis," P. J. Goodhews& F. J. Humphreys, Taylor and Francis.			LECTURE	TUTORIAL	PRACTICAL]	ΓΟΤΑ	\L
 TEXT Skoog, Holler, Nieman "Principles of Instrumental Analysis" REFERENCES Handbook of Nanostructured Materials and Nanotechnology," vols. 1-5,H. S. Nalwa (Ed.), Acade Press, 2000. Electron Microscopy and Analysis," P. J. Goodhews& F. J. Humphreys, Taylor and Francis. 			45	0	0			45	
 Skoog, Holler, Nieman "Principles of Instrumental Analysis" REFERENCES Handbook of Nanostructured Materials and Nanotechnology," vols. 1-5,H. S. Nalwa (Ed.), Acade Press, 2000. Electron Microscopy and Analysis," P. J. Goodhews& F. J. Humphreys, Taylor and Francis. 	TEXT								
 REFERENCES 1. Handbook of Nanostructured Materials and Nanotechnology," vols. 1-5,H. S. Nalwa (Ed.), Acade Press, 2000. 2. Electron Microscopy and Analysis," P. J. Goodhews& F. J. Humphreys, Taylor and Francis. 	1.	Skoog, Holler, Nien	nan "Principles of Instrume	ntal Analysis"					
 Handbook of Nanostructured Materials and Nanotechnology," vols. 1-5,H. S. Nalwa (Ed.), Acade Press, 2000. Electron Microscopy and Analysis," P. J. Goodhews& F. J. Humphreys, Taylor and Francis. 	REFER	RENCES							
	 Handbook of Nanostructured Materials and Nanotechnology," vols. 1-5,H. S. Nalwa (Ed.), Academic Press, 2000. Electron Microscopy and Analysis," P. J. Goodhews& F. J. Humphreys, Taylor and Francis. 								

3. Modern Techniques of Surface Science," D. P. Woodruff & T. A. Delchar, Cambridge Solid State Science.

COURSE NAMEComputational Nanotechnology3003PREREQUISITESMaterial Science, ATKLTPHC:P:A2:1:13003COURSE OUTCOMESDOMAINLEVELCO1Introduce concepts of Scientific ComputingCognitiveUnderstandingCO2Infer about the numerical methodCognitiveUnderstanding,CO3Highlight Calculus in nano computingCognitiveUnderstanding,CO4Examine iterative methodsCognitiveUnderstanding,							
PREREQUISITESMaterial Science, ATKLTPHC:P:A2:1:13003COURSE OUTCOMESDOMAINLEVELCO1Introduce concepts of Scientific ComputingCognitiveUnderstanding,CO2Infer about the numerical methodCognitiveUnderstanding,CO3Highlight Calculus in nano computingCognitiveUnderstanding,CO4Examine iterative methodsCognitiveUnderstanding,							
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CO3Highlight Calculus in nano computingCognitiveUnderstanding,CO4Examine iterative methodsCognitiveUnderstanding,CO5Examine Monte Corlo methodDaugh emotorUnderstanding,							
CO4 Examine iterative methods Cognitive Understanding, CO5 Examine Monte Corlo method Databaset of the databaset of t							
CO5 Eventing Monte Corle method Developmentary Understand							
COS Examine Monte-Carlo metriod Psychomotor Understanding,							
UNIT IPhysical modeling9							
Basics of simulation and modeling - Role of simulation in model evaluation and studies - principles used in							
modeling - Concept of system and environment - continuous and discrete system - linear and nonlinear							
system - stochastic activities - static and dynamic models - Advantages and Disadvantages of simulation.							
UNIT IIComputation Based Simulation9							
Technique of simulation - calumnious system models - experimental nature of simulation - numerical							
computation techniques - Monte Carlo method - analog and hybrid simulation - feedback systems.							
UNIT IIIProbability Concepts in Simulation9							
Stochastic variables - discrete and continuous probability functions - random numbers - generation of							
random numbers - variance reduction techniques - determination of the length of simulation runs - Output							
analysis.							
UNIT IVMolecular Modelling9							
Introduction to molecular modelling - molecular mechanics- molecular dynamics basic principles -							
Computing transport in materials - Simulation of crystals with the chemical disorder at lattice sites - Design							
of compound semiconductor alloys using molecular simulations - Optical, electrical, and structural property							
by first principle calculations.							
UNIT VMicro and Nanostructure modeling9							
Studies on microstructure systems using atomistic and mesoscale simulations - Solid-liquid phase transition							
under confinement - Modelling of metals - Simulation protocol - Semiempirical methods - Density							
functional theory methods (DFT) - Visualization and analysis.							
LECTURE TUTORIAL PRACTICAL TOTAL							
45 0 0 45							
TEXT							
1. Erwin Kreyzig, "Advanced Engineering Mathematics", John Wiley & Sons, 2004							
REFERENCES							
1. Ramachandran K.I., G. Deepa, K.Namboori "Computational chemistry and molecular modeling –							
Principles and applications", Springer, 2008.							
2. BeenaRai, "Molecular modeling for the design of Novel performance chemicals and materials".							
2. Decharcar, Morecular modering for the design of Novel performance chemicals and materials, Taylor& Francis group, 2012							
Taylor& Francis group, 2012.							
Taylor& Francis group, 2012.3. Chistopher.J. Cramer "Essentials of Computational Chemistry- Theories and models". John wiley&							

COURSE	CODE	YNT203		L	Т	P	С	
COURSE	NAME	NANOCOMPOSITES		3	0	0	3	
PREREQU	JISITES			L	Т	Р	H	
C:P:A				3	0	0	3	
COURSE	OUTCOME	S	DOMAIN	LEVI	EL			
CO1	Define t	he concepts and fundamental of osites	Cognitive	Understanding				
CO2	Understand its preparat	the utility of types of nanocomposites and tion	Cognitive	Understanding, Analysis				
CO3	Discuss the process	e different methods of the preparation	Cognitive	Understanding Analysis				
CO4	Forecast th analysis	e types of nanocomposites and their	Cognitive	Understanding Analysi				
CO5	CO5 Explain the biocompatible and implants of composites Psychomotor Analysis,E						ition	
UNIT I Introduction to nanocomposites						9	9	
Advantage	of composit	te materials, mechanical properties, Thermal	l, electrical and e	electron	ic an	d op	tical	
properties.	Mechanical	properties - stress-strain relationship, toughne	ss, strength, and p	lasticit	у.			
UNIT II	Cerami	e metal nano-composites				9	9	
Ceramic ba	ased nano j	porous composites, metal matrix nanocomp	posites, bio-mime	etic na	10-c0	ompo	sites	
nanocompo	sites for h	ard coatings, DLC coatings, thin film n	anocomposites, s	synthes	is of	var	ious	
nanocompo	sites materia	lls, sputtering, and mechanical alloying.						
UNIT III	Polymer	r nanocomposites:					9	
Introduction	n to polyme	r composites, Processing of nanoparticles,	binding mechanis	sms in	nano	parti	cles,	
dispersion	of nanopart	icles, and stabilization of nanoparticles. Pr	rocessing and fal	oricatio	n of	poly	mer	
nanocompo	sites, templa	te synthesis. Homogeneous/heterogenous nuc	cleation. Polymer	nanoco	mpos	sites	with	
structural, g	gas barrier a	and flame-retardant properties, carbon fiber	reinforced polym	er com	posit	es, w	/ater	
borne fire-	retardant nar	no-composites, hybrid composites for cosmeti	cs, protective and	decora	tive c	coatir	ıgs	
UNIT IV	Natural	nanocomposite systems					9	
Spider silk,	bones, shel	ls; organic-inorganic nanocomposite formati	on through self-a	ssembl	y. Bi	omin	netic	
synthesis of	fnanocompo	site material; use of synthetic nanocomposite	s for bone teeth re	eplacem	ent. l	Bioad	ctive	
nanocompo	sites in bor	e grafting and tissue engineering, inorgani	ic/polymer nanoc	omposi	tes fo	or de	ental	
restoration	and bone rep	placement applications.						
UNIT V	Bio cera	mics for implant coating				9	•	

Biomedical alloys, Implant tissue interfacing-metal organic CVD use, biomimetic and solution-based processing- osteo porosis- osteo plastic, regeneration of bones by using bio compatible ceramics, PEG hydrogels patterned on surfaces- PEG based hydrogels

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45
TENT				

TEXT

- Nanocomposite science and technology by P.M.Ajayan, L.S. Schadler and P.V. Braun, Wiley-VCH GmbH Co. 2003.
- 2. Encyclopedia of Nanotechnology by H.S.Nalwa, American Scientific Publishers, 2003.
- Metalopolymer nanocomposites, Ed A.D. Pomogailo and V.N.Kestelman, Springer-Verlag, 2005

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- 1. Biomedical nanostructures by Kenneth E.Gonsalves, Craig R. Halberstadt, Cato T.
 - Laurencin, Lakshmi S. Nair. John-Wiley & Sons, 2008.
- 2. Nanobiotechnology II: Edited by Chad A. Mirkin and Christof M. Niemeyer, Wiley-VCH, 2006.
- 3. Handbook of Biomineralization: Biomimetic and Bioinspired, Chemistry edited by Peter Behrens, EdmundBäuerlein John-Wiley Sons, 2006.

E REFERENCES 1. www.nptel.ac.in

2. <u>www.mit.co.in</u>

COURS	SE CODE	YNT206		L	Т	Р	С	
COURS	SE NAME	Nanomaterials Characterization Techniques	Lab	0	0	1	1	
PRERE	EQUISITES	Applied Physics, Applied Chemistry, Introduction	ion to	L	Т	Р	Н	
		nanotechnology and Materials Science						
C:P:A	C:P:A			0	0	2	2	
COURSE OUTCOMES DOMAIN						LEVEL		
CO1	Prepare the solution for spectral analysis Cognitive					Evaluate		
CO2	Relate the con	cept of food quality analysis	Cognitive	Evaluate				
CO3	Demonstrate t	he thermal analysis of nano material	Cognitive	App	ly			
CO4	Demonstrate t	he study of the magnetic properties of	Cognitive	App	ly			
	nanomaterial							
CO5	Articulate the nanomaterial synthesis and measurement by Psychomotor							
	AFM							

List of Experiments

- 1. UV/VIS Spectroscopy and Spectrophotometry: Spectrophotometric Analysis of Potassium Permanganate Solutions.
- 2. Determination of Food Quality by UV Spectroscopic Methods.
- 3. Experimental studies on Thermal and Electrical properties of NiO2 thin film using SEM
- 4. Experimental setup for the measurement of the electrical resistivity and thermopower of thin films and bulk materials
- 5. Measuring Magnetization by Induction method
- 6. To determine the composition of a piece of tire tread using thermogravimetric analysis (TGA).
- 7. Analysis of the Thermal Properties of Ammonium Nitrate and Polystyrene by Differential Scanning Calorimetry (DSC)
- 8. Nanomechanical Measurements On Different Materials using Contact Mode AFM.

COURSE CO	DE	YNT207		L	Т	Р	C
COURSE NA	ME	Computational Nanotechnology Lab		0	0	1	1
PREREQUIS	ITES			L	Т	Р	H
C:P:A				0	0	2	2
COURSE OU	COURSE OUTCOMES			IN	LEVEL		
CO1	Demonst	rate concepts of Scientific Computing	Cognit	ive	Apply		
CO2	Interpret	the numerical methods of modelling methods	Cognit	ive	Apply		
CO3	Examine structure	the studies on the optical properties of nano s	Cognit	ive	Appl	у	
CO4	Choose nano sur	the protocol of developing the nanofilm and faces	Cognitive Evaluate				
CO5	Examine	the interaction studies of the nanomaterial	Psycho	motor	Evalu	ıate	

List of Experiments

1. Simulation and modelling of simple molecular structures.

2. Prediction of crystals structure and properties using nanomaterials modelling methods.

3. Simulation and modelling of various nanostructures.

4. Simulation and modelling of metals nanoparticles and their studies.

5. Development of simulation protocols for the study of nanofilms and nano surfaces.

6. Simulation and modelling study of nanomaterials and their optical property studies.

7. Simulation and modelling of nanomaterials and their electronic property studies.

8. Modelling of nanomaterials and their interaction studies with other molecules.

					L	Т	Р	С
Y	NT2)8			0	0	1	1
			MINIPROJECT					
С	Р	Α			L	T	Р	H
1.5	0.5	0.5			0	0	4	4
PRE	REO	 IISIT	F• - Nil					
	DCE		NOMES.					
	KSE	0010	COMES:			1 .		-
			Course Outcomes	Doma	nin		Leve	1
On t	he su	ccessfu	l completion of the course, students will be able to					
CO1 Identify		dentify	the engineering problem relevant to the domain	Cog		Analyze		
	ir	nterest.			Anaryze			
CO2	I	nterpr	et and infer literature survey for its worthiness.	Cog		Analyze		
						A	pply	
CO3	Α	nalyse	and identify an appropriate technique for solve the	Cog		An	alyze	<u>,</u>
	p	roblem				A	pply	
CO4	P	erforn	n experimentation	Phy		Com	p. Ov	ert
	/5	Simulat	ion/Programming/Fabrication, Collect and interpret	Cog		R	esp.,	
	d	ata.			Create, Apply			
CO5	R	ecord	and report the technical findings as a document.	Cog		Rem	embe	er,
						Understand		

COURS	E CODE	YNT104A		L	Т	Р	С		
COURS	E NAME	Societal Implications of Nanotechnology		3	0	0	3		
PRERE	QUISITES			L	Т	Р	Н		
C:P:A				3	0	0	3		
COURS	E OUTCOMES		DOMAIN	LEV	EL				
CO1	Define the c nanotechnology	concepts and economic impact on	Cognitive	Unde	erstandi	ng			
CO2	Discuss the utilit	utility of nanotechnology for social implications Cognitive Understanding							
CO3Outline the use of analogies for interdisciplinary research in the nanotechnologyCognitiveUnderstanding,									
CO4 Forecast the Ethical Issues in Nanoscience & Technology Cognitive Understanding, Analysis Analysis									
CO5	Demonstrate the Nanotechnology	public perception and participation in for social implications	Psychomoto r	Anal					
UNIT I	Economic	Impact of Nanotechnology					9		
Socio-Ec	Socio-Economic Impact of Nanoscale Science - Managing the Nanotechnology Revolution: Consider the								
Malcolm	a Baldrige Nationa	al Quality Criteria - The Emerging Nano	Economy: Key	Drive	ers, Cha	allenges	s, and		
Opportu	nities -Transcend	ling Moore's Law with Molecular Electron	ics and Nanote	chnolo	ogy -Se	emicono	luctor		
Scaling	as a Model for N	Nanotechnology Commercialization - Susta	ining the Impa	act of	Nanote	chnolo	gy on		
Producti	vity, Sustainability	y, and Equity							
UNIT II	Social Scen	narios					9		
Navigati	ng Nanotechnolog	gy Through Society - Nanotechnology, Su	urveillance, and	1 Socie	ety: Me	ethodol	ogical		
Issues a	nd Innovations	for Social Research - Nanotechnolog	gy: Societal	Impli	cations:	Indiv	vidual		
Perspect	ives -Nanotechno	logy and Social Trends - Five Nanotech So	cial Scenarios-	Techno	ological	Revol	ations		
and the I	Limits of Ethics in	n an Age of Commercialization – Vision, Inne	ovation, and Po	olicy					
UNIT I	II Convergi	ng Technology and Governance					9		
Nanotec	hnology's Implica	ations for the Quality of Life - Mana	agement of In	novati	on for	Conve	ergent		
Technolo	ogies -The "Integr	ration/Penetration Model:" - The Use of An	alogies for Inte	erdisci	plinary	Resear	ch in		
the Conv	vergence of Nano	-, Bio-, and Information Technology -	Converging 7	Fechn o	logies:	Innov	ation,		
Legal R	isks, and Society	Governance- Problems of Governance of I	Nanotechnolog	y -Ins	titution	al Impa	.cts of		
Governm	Government Science Initiatives – Nanotechnology for National Security								
UNIT I	V Ethics and	d Law					9		
Ethics a	and Law - Ethic	Ethics and Law - Ethical Issues in Nanoscience and Nanotechnology: Reflections and Suggestions -							

 Ethics and Nano: A Survey - Law in a New Frontier - An Exploration of Patent Matters Associated with

 Nanotechnology -The Ethics of Ethics – Negotiations over Quality of Life in the Nanotechnology Initiative.

 UNIT V
 Public Perception and Participation
 9

 Public Interaction Research - Communicating Nanotechnological Risks - A Proposal to Advance
 Understanding of Nanotechnology's Social Impacts - Nanotechnology in the Media: A Preliminary
 Analysis - Public Engagement with Nanoscale Science and Engineering - Nanotechnology: Moving Beyond

 Risk - Communication Streams and Nanotechnology: The (Re)Interpretation a New Technology – Nanotechnology:Societal Implications — Individual Perspectives.

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	0	45

TEXT

1.Mihail C.Roco and William Sims Bainbridge —Nanotechnology: Societal Implications II-Individual Perspectives, Springer (2007)

REFERENCES

- Geoffrey Hunt and Michael D. Mehta —Nanotechnology: Risk, Ethics and Lawl, Earthscan/James & James publication (2006).
- Jurgen Schulte —Nanotechnology: Global Strategies, Industry Trends and Applications^{II}, John Wiley & Sons Ltd (2005).
- 3. Mark. R. Weisner and Jean-Yves Bottero —Environmental Nanotechnology applications and impact of nanomaterial^I, The McGraw-Hill Companies (2007).

E REFERENCES

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www.mit.co.in

COURS	SE CODE	YNT104B		L	L T P C					
COURS	SE NAME	NANOCHEMISTRY		3	0	0	3			
PRERF	QUISITES			L	Т	Р	Н			
C:P:A				3	0	0	3			
COURS	SE OUTCOME	S	DOMAIN	LEV	EL	I				
CO1	Describe the cl	hemistry of nanoparticles	Cognitive		Unders	standin	g			
CO2	Discuss the app	plication of polymeric materials in	Cognitive		Understanding					
	catalysis		Cognitive		Understanding					
CO3	Outline the use	e of multiple recognition and dendrimers	Cognitive		Unders	standin	g			
CO4	Demonstrate th	ne concept of the nano catalysis in	Cognitive		Ar	nlv				
	commercial ap	plication	Cognitive			,pry				
CO5	Forecast the ap	pplication of nanoparticles in	Psychomotor		Evaluation					
	electrochemist	ry	1 Sychomotor							
UNIT I CHEMISTRY OF NANOPARTICLES 9										
Synthesis by Organic Molecule Templates – Molecular Self-Assembly – Spatially Constrained Synthesis										
– Biom	imetic Synthesi	s – Oxide Nanoparticles – Particle siz	ze – Particle sł	nape –	Partic	le dens	sity –			
Compos	ite structure -	- Pore structure – Surface modification	n of inorganic	Nanopa	articles	by or	ganic			
function	al groups									
UNIT I	I ADVAN	CED POLYMERIC MATERIALS					9			
Polymer	chain statis	stics – Static light scattering – Hyd	drodynamics	of pol	ymer	solutio	ons –			
Thermo	dynamics of pol	lymer solutions – Polymer blends – Solu	bility paramete	ers and	group	contrib	oution			
methods	s – High perform	nance thermoplastics - Polymer material	for photovoltai	c appli	cations	– Syn	thetic			
biomedi	cal polymers -	Optical fibers – Assembly of polyme	er – Nanopartic	ele con	mposite	e mate	rial –			
Fabricat	ion of polymer -	- Applications of polymers in catalysis.								
UNIT]	III SUPRAN	MOLECULAR CHEMISTRY					9			
Dendrin	ners and their ap	oplications – From molecular to supramole	ecular Chemistr	y, Mole	ecular l	Recogn	ition,			
Anionic	Coordination	Chemistry and Recognition of Anie	onic Substrates	s, Mu	ltiple	Recog	nition			
Applica	tions.									
UNIT 1	IV NANOC	ATALYSIS					9			
Types o	f catalysis – Ho	mogeneous, heterogeneous and biocatalys	is – Catalysis b	y nanoj	particle	es - Ph	ysical			
properti	es of free and	supported nanoparticles - Reactivity of	f supported me	etal nai	noparti	cles –	Gold			
nanoparticles - Preparative methods and properties - Reactions - Water gas shift - vinyl acetate synthesis -							esis –			
hydrogenation – CO oxidation – Heck reaction – Commercial application.										

UNIT V ELECTI	ROCHEMISTRY OF NANON	IATERIALS	9
Electrochemistry of Sen	niconductor Nanostructures, Na	anostructured Metal Oxide Films. E	lectrochemistry
with Nanoparticles - F	reparation of Nanostructures	s, Electrochemistry with Metallic N	Vanoparticles –
Monolayer protected	nanoclusters, Nanoelectrode	Ensembles, Single Electron Ex	vents, Probing
Nanoparticles using Ele	ctrochemistry Coupled with Sp	ectroscopy – Nanosensors –Biosens	ors – Chemical
Sensors –Electrocatalysi	s.		
LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	0	45
TEXT	1		
1. Hosokawa.M., N	logi.K., Naito.M. Y., "Nanopar	ticle Technology Handbook" Vol. I, I	Elsevier, 2007
2. Pignataro.B., "T	omorrow's Chemistry Today, C	Concepts in Nanoscience, Organic Ma	aterials and
Environmental	Chemistry", Wiley-Vch Verlag	GmbH, 2008.	
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2. Rao. C. N. R., Mu ["] ll	er.A., Cheetham.A. K., "The Cl	hemistry of Nanomaterials: Synthesis	5,
3. Properties and Appli	cations", Wiley-Vch Verlag G	mbH, 2004	
4. Ozin.G.A., Arsenaul	t.A.C., "Nanochemistry: A Che	mical Approach to Nanomaterials". I	RSC
Publishing 2005	,	rr,	
5 Br'echignac C Ho	ıdv P Lahmani M "Nanoma	terials and Nanochemistry" Springer	r-
Verlag 2007	augur, Dummunn, min, munomu		L
E REFERENCES			
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COUR	SE CODE	YNT104C		L	Т	Р	С	
COUR	SE NAME	NANOMEDICINE		3	0	0	3	
PRER	EQUISITES			L	Т	Р	Н	
C:P:A				3	0	0	3	
COUR	SE OUTCOME	5	DOM	AIN	LEV	VEL		
CO1	Summarize the o	concept of nanomedicine	Cog	nitive	Un	derstan	ding	
CO2	Outline the cha	llenges, performance and implementation of	Cos	nitive	Un	derstan	ding	
	drug delivery sy	stem					ung	
CO3	Discuss the ther	apeutic application of the nanoparticulate	Cos	derstan	ding			
	system		002	ang				
CO4	Interpret the con	cept of lipid based nanocarriers and its	Cos	Apply	1			
	advancement to	wards medical application	002	,iiiti ve		1 1991)		
CO5	Demonstrate the	drug targeting tool of nanocarriers in human	Psych	omotor	E	Evaluati	tion	
	system		1 8 9 0 1					
UNIT	I PROSPEC	CT OF NANO-MEDICINE					9	
History	of the idea – T	he Biological and Mechanical Traditions - N	ano-meo	licine -	- Taxo	nomy –	- Bio-	
Pharma	aceuticals – Impl	antable Materials – Implantable Devices – S	Surgical	Aids –	Diagno	ostic To	ools –	
Genetic	e Testing – Imag	ging – Nanoparticles Probe – Case Analysi	s – 1)	Resipro	cytes –	Mech	anical	
Artifici	al Red Cells – 2)	Using DNA as a construction medium						
UNIT	II NANOCA	RRIERS FOR DRUG DELIVERY					9	
Fundan	nentals and ration	ale of sustained / controlled/ targeted drug deliv	very – Fa	actors in	fluenci	ng the o	lesign	
and per	rformance of sust	ained release / controlled / targeted release pro	ducts –	Needs a	nd Rec	luireme	nts of	
nanoca	rriers – Nanopar	ticle Flow: Implications for Drug Delivery -	- Polym	eric Na	nopartio	cles as	Drug	
Carrier	s and Controlled	Release Implant Devices.						
UNIT	III NANOP.	ARTICULATE SYSTEMS FOR DRUG DEI	LIVERY	ζ			9	
Polyme	er used for the fo	rmulation of controlled drug delivery systems	– Class	ification	and ap	plication	ons of	
polyme	ers – Polymeric	Micelles as Drug Carriers – Dendrimers as	Nanopa	articulate	e Drug	Carrie	ers –	
Nanoca	psules preparatio	n, Characterization and Therapeutic Application	ns					
UNIT	IV LIPID B	ASED NANOCARRIERS					9	
Liposo	mes for Genetic	Vaccines and cancer therapy – Recent Advance	es in M	icroemu	lsions a	is Drug		
Deliver	ry Vehicles – Lipo	oproteins as Pharmaceutical Carriers – Solid Lip	pid Nano	oparticle	s as Dr	ug Carr	iers	
– Lipidic core nanocapsules								
UNIT	V NANO CA	NANO CARRIERS AS DRUG TARGETING TOOLS 9						

45	0	0	
FEVTDOOV		0	45
LEATBOOK			
1. Parag D., and Ashish.,	"Nano Medicines", Pent	agon Press, 2006.	
2 Vladimir P T "Nano	narticulates as Drug Carrie	ers" Imperial College Press 20	06
	purifications as Brag Curri	, imperiar concege riess, 20	
REFERENCES			
1.Reza.A., Kentus. L., "Sn	nart Nanoparticles in Nano	omedicine ", Voume8, Kentus E	Books, 2005

Course	e		YNT104D		3	0	0	3
Code:	COURSE		Nanotechnology In Energy Conserva	tion and Storage				
NAME	E							
PRER	EQUISITI	ES			L	Т	Р	Н
C:P:A					3	0	0	3
COUR	SE OUTC	COMES		DOMAIN	LE	VEL		
CO1	Summariz	ze the e	nergy conservation process.	Cognitive		Unde	erstand	ing
CO2	Outline implemen	the ntation o	challenges, development, and ofrenewable energy	development, and Cognitive Understanding				
CO3	Illustrate	the mic	ro-fuel cell systems and its application	Cognitive		Unde	erstand	ing
CO4	Interpret	the condechanication	cept of microfluidic system and its nano- al systems	Cognitive				
CO5	Articulate	e the hy	drogen storage methods	Psychomotor	Evaluation			
UNIT	I Introduction 9							
Nanote	chnology 1	for sust	ainable energy- Energy conversion pro	cess, indirect and o	lirect	energ	gy con	version-
Materia	als for light	t emittir	ng diodes-batteries-advanced turbines-ca	talytic reactors-capa	citors	-fuel	cells	
UNIT	II R	enewał	le Energy Technology					9
Energy	challenge	es, deve	lopment and implementation of renew	vable energy techno	ologie	s - n	anotec	hnology
enabled	d renewabl	e energ	gy technologies -Energy transport, c	onversion and stor	rage-	Nano	o, mic	ro, and
poly c	rystalline a	and amo	orphous Si for solar cells, Nano-micro Si	-composite structure	e, vari	ous te	echniqu	ues of Si
deposit	tion.							
UNIT	III M	licro Fı	iel Cell Technology					9
Micro-	fuel cell te	echnolog	gies, integration and performance for	micro -fuel cell	syste	ms -1	thin fi	lm and
microf	abrication r	methods	s – design methodologies – micro-fuel ce	ll power source				
UNIT	IV M	licroflu	idic Systems					9
Nano-e	electromech	hanical	systems and novel microfluidic device	ces - nano engines	s - di	riving	mecha	nisms -
power	generation	- micr	ochannel battery - micro heat engine (I	MHE) fabrication -	thern	nocap	ollary	torces -
Thermo	ocapillary p	pumping	g (TCP) – piezoelectric membrane					
UNIT	V H	ydroge	n Storage Methods	1	•.	1 1		9
Hydrog	gen storage	e metho	ds - metal hydrides - size effects - h	ydrogen storage cap	acity	-hyd	rogen	reaction
kinetic	s -carbon-f	Tree cyc	e- gravimetric and volumetric storage (capacities - hydridi	ng/de	nydri	aing ki	netics -
mgn en				DDACTICAL			тот	
L	LECIUKE	4	IUIUKIAL	FRACTICAL			101	AL

45	0	0	45
TEXTBooks			
M.A. Kettani, Direct end	ergy conversion, Addision	Wesley Reading, (1970).	
Linden, Hand book of B	atteries and fuel cells, Mc	Graw Hill, (1984).	
Hoogers, Fuel cell techn	ology handbook. CRC Pres	ss, (2003).	
Vielstich, Handbook of	fuel cells: Fuel cell technol	ogy and applications, Wiley, CRC Press,	(2003)
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2. Martin A Green, Solar	cells: Operating principles	, technology and system applications,	
Prentice Hall Inc, Engle	ewood Cliffs, NJ, USA, (19	81).	
3. H J Moller, Semicond	uctor for solar cells, Artech	House Inc, MA, USA, (1993).	
4. Ben G Streetman, Soli	is state electronic device, Pr	rentice Hall of India Pvt Ltd., New Delhi	(1995)
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www.mit.co.in			

COUDCE		X 13 10	10.45					-	-			
COURSE	CODE	YNT	104E				L	T	P	C		
COURSE		Nano	fluid Dy	namics			3	1	0	4		
PREREQU	JISITES	Appli	ied Physi	ics and l	Partial Differential	Equation	L	T	P	Н		
C:P:A			2	2:1:1								
COURSE	OUTCOMES					DOMAIN	LEV	/EL				
CO1	Define the role	e of nan	o fluids			Cognitive	Rem	nemb	er			
CO2	Discuss the fea	atures a	rising ou	t of nan	ofluids	Cognitive	Und	ersta	ndin	g		
CO3	Highlight the f	fluid dy	mamics			Cognitive	Und	Understanding				
CO4	Examine the n	anomat	terials of	electro l	nydrodynamics	Cognitive	Ana	lysis				
CO5	Revise the app	olicatior	ns of mic	ro fluidi	cs devices	Psychomotor	Understanding, Evaluation			g,		
	SYLLABUS					1		H	OU	RS		
UNIT I	Introduction	to Mic	ro fluids						9			
Continuum Governing equation; boundary conditions; Cute and Poiseuille flow; thin film equations; flow in nanotubes												
UNIT II	Transport Pl	nenome	ena						9			
Ficks law; application	hydrodynamic to confined flui	equation d at nar	ons; Nav noscale	vier-stok	es equation; Boltzn	nann transport eo	quatio	n; K	ubo	formulae;		
UNIT III	Surface Tens	ion					9					
Static & dynamic contact angle; surface energies; 179unnell capillary and electro capillary flows.												
UNIT IV	Electro hydro	odynan	nics						9			
Poisson-Bo	ltzmann double	layers;	electro o	smosis;	electrophoresis in lie	quids.	1					
UNIT V	Micro fluidic	s Devic	es		_	_			9			
Microarray, multilayer s	chips as well oft lithography	l comp	oonent; p	oumps, 1	mixers, valves, lith	ography, etching	g; pho	oto p	olyn	nerization;		
			LECT	TURE	TUTORIAL	PRACTICA	L		T(DTAL		
			4	5	15	0				60		
ТЕХТ					II			1				
 Nanoflu Edition Nanoma Microm Microm REFEREN "Physic Fundam Colloid 	aidics by Joshua 2009. aterials and Surf achines as tools CES al Chemistry of mentals of Micro	B. Ede face En s for Na Surfac fabrica	el and An gineering notechno es," Arth tion; the	drew J. g by Jam blogy by uur W. A Scientifi	Demello, RSC Nano al Takadoum, Wiley H. Fujita, Springer I dmson& Alice P. Ga ic Miniaturization,M	Publishers, 2010 Publications, 200 ast, Wiley, 1997. Tare J. Madou, CR) edition 3 edition 3 edition RC Pre	y Pul	002.	ers,		
4. Statistic	al Dispersion," cal Mechanics,"	W.B. R Donald	lussel, D. d Allan &	A. Savil c McQua	arrie, Harper & Row,	1, Cambridge Uni , 1976.	iversit	y Pre	:88.			
5. BIO NAI	INCES	IS DY P	eter J. He	esketh, S	springer Publications	s, 2008 Edition.						
E KEFERI	LINCES											
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www.mit.co	<u>0.111</u>											

COURS	E COD	DE	YNT104F		L	Т	Р	C	
COURS	E NAN	1E	Cell And Molecular Biology		3	1	0	4	
PRERE	QUISI	ГES			L	Т	Р	Η	
C:P:A			2:1:1		3	1	0	4	
COURS	E OUT	COMES		DOMAIN	LEVEL				
CO1	Descri	ibe the con	cept of cell and its functional organization	Cognitive	Remember				
CO2	Discus and its	ss the deta s molecular	il outline about the cell transport system	Cognitive	Unde	ersta	ndin	g	
CO3	3 Illustrate the facts of immunology and its mechanism in the cellular organization Cognitive						Understanding		
CO4	Demor Eukar	nstrate th yotes	e gene regulation in prokaryotes and	Cognitive	Analysis				
CO5	Invest	igate cell t	ranscription and translational process	Psychomotor	Apply				
	SYLL	ABUS			HOURS				
UNIT I		Cell	Cell						
Types of	feukar	yotic and j	prokaryotic cells - Plasma membrane, Chro	omosome organiza	ation -	-Intr	acell	ular	
organelle	es and the	heir functio	on – Cell division – Mitosis and Meiosis – Ce	ell cycle and cell c	ycle g	genes			
UNIT II		Cell Fund	tion		9				
Cell Fun	ctionM	olecular or	ganization of cell – Endocytosis and exocyt	osis – Passive and	activ	ve tra	nspo	ort –	
Sodium	and po	tassium pu	imps – Ca2+ATPase pumps – ATP depen	dent proton pump	os – C	Co tr	ansp	ort-	
Symport	and and	tiport							
UNIT I	Π	Immunol	ogy			9			
Cellular	Immun	nology, and	tigen, antibody, major 180unnelling180ibil	ity complexes (M	IHC),	auto	imm	nune	
processe	s, tran	splantation	immunity, Tumor immunology, immu	nological toleran	ce ar	nd 1	80u	nnel	
suppress	ion								
UNIT I	V	Structure	Of Nucleic Acids And DNA Replication			9			
Conform	ation o	f DNA and	I RNA; replication in prokaryotes, D-loop at	nd rolling circle n	node o	of rep	licat	tion,	
replicatio	on of 1	inear vira	DNA. Organisation of eukaryotic chron	nosome – cot va	lue, r	eplic	atior	ı of	
telomere	s in euk	aryotes							
UNIT V	7	Transcrip	otion And Translation		9				
In proka	ryotes	and eukar	yotes, feature of promoters and enhancers,	transcription fac	tors, 1	nucle	ar R	NA	
	LECTURE	TUTORIAL	PRACTICAL	TOTAL					
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-	45	15	0	60					
TEXT		I	<u> </u>						
1. Essentials of Molecular Biology	. George M. Ma	alacinski. Fourth ec	lition 2015, Jones an	d Berlett					
Learning.									
2. Cell Biology – Gerald Karp Sev	enth Edition, W	'iley.							
3. Molecular Cell Biology – Lodis	h [et al], Sixth e	dition 2007, W.H.	Freeman Company.						
REFERENCES									
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Edition, Pearson Education Pv	t. Ltd., (2004).								
2. Bruce A., Dennis B., Alexander J.,	Julian L., Marti	n R., Keith R. and	l Peter W., Molecula	ar Biology o					
the Cell", Third Edition, Garland S	cience (2002).								
3. Freifelder D. and Malacinski G.M., '	'Essentials of M	lolecular Biology"	, Third Edition, Jone	es and Barle					
Publishers Inc., (1998).									
4. Lodish H., Berk A., Matsudaira P., I	Kaiser C A., Kri	eger M., Scott M I	P., Zipursky S L. and	Darnell J.,					
"Molecular Cell Biology", Fifth Editi	on, W.H. Freem	nan (2004).							
5. Karp G., "Cell and Molecular Biol	ogy – Concepts	s and Experiments	", Third Edition, Jo	ohn Wiley &					
Son's Inc. (2003).									
E REFERENCES									
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COURSE CODE	YNT105A		L	Т	P	С	
COURSE NAME	Nanoscale Magnetic Materials and Device	es	3	0	0	3	
PREREQUISITES			L	Т	P	Η	
C:P:A			3	0	0	3	
COURSE OUTCOMES		DOMAIN]	LEVE	L		
CO1 Define the role of f	erromagnetic materials	Cognitive		Ren	nemb	er	
CO2 Discuss the feature	s arising out of nano magnetism	Cognitive		Under	rstand	ding	
CO3 Highlight the fabric	CO3 Highlight the fabrication and imaging techniques Cognitive Understanding						
CO4 Demonstrate the m	agnetic data storage and recording	Cognitive		An	alysi	S	
CO5 Revise the applicat	ions of magnetic structures in biomedical	Psychomoto	or	A	pply	0	
UNIT Introduction	1 Autificant and the sector into the Devening of					9	
Magnetic fundamentals	-Antiferromagnetic materials – Domains a	nd the magi	ietiza	ation	proce	ss –	
coercivity of the particles	E – Super paramagnetism in the particles	- Exchange a		lorizod	- mo	atron	
182unnelling – Interlaye	r exchange coupling Spin relevation in n	ayers – spri	i po Ilic la	avers	and n	oulti_	
lavers - Non-equilibrium	spin dynamics in laterally defined magnetic st	nagnetie meta		ayers a	ina n	lulu-	
UNIT II Nanomagne	tism	luctures				9	
Two-spin channel model	- Two terminal spin electronics – Three	terminal spir	ı ele	ctronic		Spin	
182unnelling - Study of	ferromagnetic and antiferromagnet inter	faces – Pho	toem	ission	Ele	ctron	
Microscopy - X-ray Abs	orption Spectroscopy - X-ray Magnetic Lir	near Dichrois	m (X	KMLD) - 2	K-ray	
Magnetic Circular Dichro	ism (XMCD) -Temperature dependence of X	K-ray Magnetic	c Dic	hroisn	i.	5	
UNIT III Fabrication	and Imaging					9	
Molecular nanomagnets	– Mesoscopic magnetism - Particulat	e nanomagn	ets	– Ge	eome	trical	
nanomagnets -Fabricatio	on techniques scaling – Characterization usi	ng various te	echni	ques -	- Ima	aging	
magnetic microspectrosco	py –Optical Imaging – Lorentz Microsco	opy – Elect	ron	Holog	raph	y of	
Magnetic Nanostructures	-Magnetic Force Microscopy						
UNIT IV Magnetic D	ata Storage and Recording					9	
Magnetic data storage -	- Disk formatting – Partitioning – Hard	disk features	—	Hard	disk	data	
transfer modes –Program	med I/O – Direct memory access – Ultra D	MA - Data a	ddres	sing –	Star	ndard	
CHS addressing – Exter	nded CHS addressing – Logical Block Add	iressing – N	lagne	etic re		ng -	
Optio recording Magnetic rec	cording - Magnetic digital recording - Per	pendicular re	cordi	ng -	Mag	neto-	
UNIT V Magnetic St	ructures and Applications					0	
Magnetic sonsors and (Signt Magnetoregistance Onticelly transp	orant motorio	10	Soft	forri	tos	
Nanocomposite magnets	- Magnetic refrigerant – High TC sup	erconductor -	- E	Son Jerro/h	oflui	ds -	
Biomedical applications of	f magnetic nanonarticles – Diagnostic applica	ations – There	neuti	ic annl	icatio	nns —	
Physiological aspects – To	xic effects		ipeui	ie uppi	icuti	5115	
	TUTORIAL	PRACTICA	L	ТС)TAI	[,	
45	45 0 0 45						
TEXT							
1. Hans P.O., and Hopster H., —Magnetic Microscopy of Nanostructures Springer (2004)							
REFERENCES							
1. Bland J.A.C., and B. H	Ieinrich.B., —Ultra thin Magnetic Structures I	II – Fundamer	ntals (of			
Nanomagnetism. Springer (2004).							
2. Nicola A.S., —Magne	etic Materials: Fundamentals and Device Appli	cations, Cam	bridg	ge Univ	versit	y	
Press (2003).	r r	,	2	-		-	

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COUR	SE CO	DDE	YNT105B			L	Т	Р	С
COUR	SE NA	ME	METALLOPOLYMER NANOCOMP	OSITES		3	0	0	3
PRER	EQUIS	SITES				L	Т	Р	Н
C:P:A						3	0	0	3
COUR	SE OU	JTCOMES		DOMAIN	LE	VE	L		
CO1	Defin	e the charac	teristics of nanoparticle	Cognitive		R	Reme	mber	
CO2	Discu	ss the featur	es arising out of polymeric nanoparticles	Cognitive		Un	derst	andin	g
CO3	Highl	ight the fabr	ication method of metallo-polymer	Cognitive		Un	derst	andin	g
CO4	Demo	onstrate the v	various synthetic methods of metallo-	Cognitive			Anal	ysis	
CO 5	polyn Dowio	er nanocom	posites	Davahamatar			1	1	
	Revis			Psychomotor			Ар	ny	0
		Nanoparti	cles In Materials Chemistry And In The	Natural Science					9
Classifi	ication	of nanopa	ticles by size – Structural organizati	on of nanopart	icles	-	- D	imens	ional
phenon	nena 1n	the chemist	ry and physics of nanoparticles – nano	particles and r	nater	als	on	their	base
charact	eristic	features of	f nanoparticles nucleation – Kinetic feat	ures of new pha	ase fo	orm	ation	1 – I	Phase
formati	on in c	chemical rea	ctions – Self organization of metal conta	aining nanoparti	cles	(Fra	actal	struct	ures)
– Bri	ef acco	ount of maj	or production methods of metal contain	ing nanoparticl	es –	Μ	etal	cluste	rs as
nanopa	rticles	with fixed d	imensions.						
UNIT	Π	Principles	and Mechanisms of Nanoparticle Stabili	ization by Poly	mers				9
Stabilit	y of	nanopartic	es in solutions – Stabilizing capabi	ility characteri	stics	0	f po	olyme	rs –
Charac	teristic	s of polym	er absorption on metal surfaces specifics	of polymer surf	actan	nts a	as sta	bilize	ers –
Mecha	nism o	f nanopartic	eles stabilization by polymers – Stabilization	ation of nanop	articl	es	by e	electro	olytes
– Surf	face p	roofing as	a method of stabilizing nanoparticles l	by polymers on	the	pro	blem	of m	natrix
confine	ement								
UNIT	III	Synthetic	Methods for Metallo-Polymer						9
Nanoco	omposi	te preparati	on – Physical methods of incorpora	ting nanoparti	icles	int	o po	lymer	·s –
Mecha	nochen	nical disper	sion of precursors jointly with p	olymers – M	Micro	oend	capsu	lation	of
nanopa	rticles	into polym	ers – Physical deposition of metal nanopa	articles on polyr	ners -	– F	Forma	ation of	of 2D
nanostr	nanostructures on polymers – Formation of metal nanoparticles in polymer matrix voids (pores) –								
Physica	al modi	fication and	filling of polymers with metal reduction o	f polymer – B	ound	l m	etal	comp	lexes
– Nano	ocomp	osites forma	ation by metal containing precursor the	rmolysis –Nano	ocom	pos	ite fo	ormati	on in
Physica – Nano	al modi	fication and	filling of polymers with metal reduction on the second sec	f polymer – B rmolysis –Nano	ound	l m pos	etal ite fo	comp ormati	lexes on in

monomer – Polymer matrices in thermolysis – Nanocomposites on the base of polymer – Immobilized metalloclusters

UNIT IVPhysico-Chemical Methods for Metallo-Polymer Nanocomposite Production9Cryochemical methods of atomic metal deposition on polymers – Metal evaporation methods on polymerslocalized at row temperature – Synthesis of nanocomposites in a plasma-chemical process – Radiolysis in
polymer solutions – Photolysis of metal-polymer systems as means of obtaining nanocomposites –
Electrochemical methods of nanocomposite formation – General characteristics of sol-gel reactions – A
combination of polymerization reactions and in situ sol-gel synthesis of nanocomposites – Sol-gel
synthesis in the presence of polymers – Morphology and fractal model of Hybrid nanocomposites –
Nanocomposites incorporating multi-metallic ceramics – Intercalation process – Polymerization into
the basal space – Macromolecules introduction into the layered host lattices –Intercalation
nanocomposites of polymer/metal chalcogenide type – Langmuir-Blodgett metallopolymers films as
self organized hybrid nanocomposites.

UNIT V Nanobiocomposites

Basic notion of metal containing protein systems – Metal nanoparticles in Immunochemistry, Cytochemistry and Medicine – Biosorption, selective heterocoagulation and bacterial concentration of metal nanoparticles – Sol-gel process as a way of template – Synthesized nanobioceramics – Biomineralization and bioinorganic nanocomposites – Control of physic-mechanical properties of nanocomposites – Peculiarity of nanocomposites synthesized by solgel methods – Polyolefin based nanocomposites – Polymer matrix structurization in nanocomposites – Physical and mechanical properties of metallopolymer nanocomposites – Nanocomposites in adhesion compounds and Tribopolymers – New trends in Material science connected with metallopolymeric nanocomposites

9

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	0	45

TEXT

1.C. F. Candau and R. H. Ottewill, —An introduction to polymer colloids, Springer Berlin Heidelberg, New York, (2005)

REFERENCES

1.A. D. Pomogailo and V. S. Savostyanov, -Synthesis and polymerization of metal containing monomers CRC press, (1994).

E REFERENCES

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COURSE NAME Properties Of Nanophase Materials 3 0 0 3 PREREQUISITES Introduction to Nanotechnology, Material Science L T P H C:P:A 2:1:1 3 0 0 3 COURSE OUTCOMES DOMAIN LEVEL Value 1000000000000000000000000000000000000	COURS	E CODE	YNT105C		L	Τ	Р	С
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C:P:A 2:1:1 3 0 0 3 COURSE OUTCOMES DOMAIN LEVEL CO1 State the structure of nano materials Cognitive Understanding CO2 Discuss the electric properties of nano-materials Cognitive Analysis CO3 Describe optical properties of nano-materials Cognitive Analysis CO4 Demonstrate the magnetic properties of nano-materials in nanotechnology Psychomotor Understanding. CN5 Investigate the updating about Biomaterials Psychomotor Understanding. VNIT I Structural Properties of Nano Materials Psychomotor P Crystal structures of nano particles; lattice vibrations; size-dependent of properties; chemical & mechanical properties; charlical properties; nano-structures of nano-materials. Mechanical properties: hardness, compressive & tensile structure multilayers; metal nano cluster composite; crystals of metal nano particles; nano-structural stability; powder consolidation; properties of nano phase materials; structure: micro-structural stability; powder consolidation; properties of nano materials at low temperatures; thermal contact & isolation 9 UNIT II Electronic Properties of Nano-materials 9 Energy bands & gaps in semiconductors; Fermi surfaces; localized particle, donors, acceptors, deep traps, excitons, mobility; size-dependent effect	PRERE	QUISITES	Introduction to Nanotechnology, Mat	erial Science	L	Т	Р	Н
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TEXT

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COUR	SE COD	E	YNT105D		L	Т	Р	С
COUR	SE NAM	1E	Nanotoxicology		3	0	0	3
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Enviro	Environmental Health							
UNIT	UNIT IVToxicology of Nanoparticles in Environmental Pollution9					9		
Air Po	llution; Ii	ntroductio	n to Air Pollution Particles; Adverse Effe	ects of PM in E	pidemi	ologic	al Stu	dies;
Role of	f Nanopa	rtides in N	Mediating the Adverse Pulmonary Effects	of PM; Effects	of Na	noparti	des o	n the
Cardio	vascular	System;	Nanopartide Translocation and Dir	rect Vascular	Effec	ts; E	Endotl	nelial
Dysfun	iction and	d Endoge	nous Fibrinolysis; Coagulation and Throm	bosis; Cardiac A	utonoi	nie Dy	/sfunc	ction;

Effects of Nanopartides on the Liver and Gastrointestinal Tract; Effects of NP on the Nervous System.

UNIT VDosimetry, Epidemiology and Toxicology of Nanoparticles9Epidemiological Evidence for Health Effect Associations with Ambient Particulate Matter; Toxicological9Evidence for Ambient Particulate Matter Induced Adverse Health Effects; Inhaled Nanoparticle9Dosimetry; Toxicological Plausibility of Health Effects Caused by Nanoparticles; Integrated Concept of9Risk Assessment of Nanoparticles9

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	0	45

TEXT

1. Challa S. S. R. Kumar, —Nanomaterials - Toxicity, Health and Environmental Issues^{II}, Wiley-VCH publisher (2006).

2. Nancy A. Monteiro-Riviere, C.Lang Tran, —Nanotoxicology: Characterization, Dosing and Health Effects|, Informa healthcare (2007)

REFERENCES

- D. Drobne, —Nanotoxicology for safe and Sustainable Nanotechnology^{II}, Dominant publisher (2007).
- 2. M. Zafar Nyamadzi, —A Reference handbook of nanotoxicologyl, Dominant publisher (2008).

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COUR	RSE CO	DDE	YNT105E		L	Т	P	С
COUR	RSE NA	ME	3D PRINTING		3	0	0	3
PRER	EQUIS	SITES			L	Т	Р	Н
C:P:A					3	0	0	3
COUR	RSE OU	JTCOMES	S	DOMAIN	LEVE	L		
CO1	Defin	e the struct	ture of 3D Printing Technology	Cognitive		Remei	nber	
CO2	Discu	iss the prop	perties of photopolymerization	Cognitive	U	nderst	anding	z
	proce	sses						-
CO3	Highl	ight the ex	trusion based system	Cognitive	U	nderst	anding	5
CO4	Identi	fy the Desi	ign for 3D Printing	Cognitive		Anal	ysis	
CO5	Reco	gnise the ap	oplication of 3D printing in biomedical	Psychomotor		App	oly	
	field							
UNIT	1	Introduc	tion and Basic principles					9
3D Pri	inting, (Generic 3L	D Printing Process, Benefits of 3D Prin	ting, Distinction I	Betweer	1 3D P	rıntın	g and
CNC I	Machin	ing, Other	Related Technologies Development	of 3D Printing T	echnolo	ogy: In	itrodu	ction,
Compt	iters, C	Computer-A	Aided Design Technology, Other Asso	ciated Technolog	ies, Th	e Use	of La	ayers,
Classif	ication	of 3D Pi	rinting Processes, Metal Systems, Hy	brid Systems, Mi	lestone	s in 3	D Pr	inting
Develo	opment,	3D Printin	ig around the World.	•				•
UNIT	<u>II</u>	3D print	ing process chain & photopolymerizat	tion processes				9
Eight	Steps 1	n Additive	e Manufacture, Variations from One	3D Printing Mac	chine to) Anot	ther,	Metal
System	ns, Mai	ntenance of	f Equipment, Materials Handling Issues,	Design for 3D PR	antin	G. Intr	oduct	ion to
Photop	olymei	ization Pro	cesses: Photopolymerization Materials,	Reaction Rates, V	ector S	can SI	L, SL	Resin
Curing	g Proc	ess, SL	Scan Patterns, Vector Scan Mic	ro stereolithogra	phy,	Mask	Proje	ection
Photop	olymei	ization Tec	chnologies and Processes, Two-Photon S	SL				•
UNIT	III	Powder I	bed fusion processes & extrusion-base	d systems				9
Powde	r Bed	Fusion Pro	cesses: Introduction, SLS Process Des	cription, Powder	Handlin	ig, Apj	proach	ies to
Metal	and Ce	eric Part C	reation, Variants of Powder Bed Fusio	on Processes, Proc	ess Par	:3D Pr	inting	eters,
Applied Energy Correlations and Scan Patterns, Typical Materials and Applications, Materials –								
Capabilities and Limitations. Extrusion-Based Systems: Introduction, Basic Principles, Plotting and Path								
Contro	Control, Materials, Limitations of FDM, Bioextrusion, Other Systems							
UNIT	IV	Design, g	guidelines for process selection & softw	vare issues				9
Design	n tor 3I) Printing	– Design for Manufacturing and Assen	nbly, Core DFM f	or 3D	Printin	g Cor	icepts
and O	bjectiv	and Objectives, 3D Printing Unique Capabilities, Exploring Design Freedoms, Design Tools for 3D						

Printing. Guidelines for Process Selection – Selection Methods for a Part, Challenges of Selection, Preliminary Selection, Production Planning and Control. Software Issues for 3D Printing – Preparation of CAD Models – the STL File, Problems with STL Files, STL File Manipulation, Beyond the STL File, Additional Software to Assist 3D Printing

UNIT V Medical applications & future directions for 3d printing

9

Medical Applications for 3D Printing – Use of 3D Printing to Support Medical Applications, Software Support for Medical Applications, Limitations of 3D Printing for Medical Applications, Further Development of Medical 3D Printing Applications. Use of Multiple Materials in 3D Printing – Discrete Multiple Material Processes, Porous Multiple Material Processes, Blended Multiple Material Processes, Embedded Component 3D Printing, Commercial Applications Using Multiple Materials, Future Directions, Business Opportunities and Future Directions

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	0	45
TEXT			

 Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010

REFERENCES

1. Chua Chee Kai, Leong Kah Fai, "Rapid Prototyping: Principles & Applications", World Scientific, 2003.

2. Ali K. Kamrani, Emand Abouel Nasr, "Rapid Prototyping: Theory & Practice", Springer, 2006.

3. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001.

E REFERENCES

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COUR	SE CODE	YNT105F		L	Т	Р	С
COUR	SE NAME	Green Manufacturing Technology		3	0	0	3
PRER	EQUISITES			L	Т	Р	Н
C:P:A				3	0	0	3
COUR	SE OUTCOMES	5	DOMAIN	LEV	/EL		
CO1	Summarize the methods	he fundamentals of the green manufacturing Cognitive Remember				r	
CO2	Outline the inter compliance	national green manufacturing standards and	Cognitive	U	nders	tandi	ng
CO3	Illustrate the ma	terial and solid waste management	Cognitive	Understanding			
CO4	Generalize the se	cope of industrial ecology and its life cycle	Cognitive		Ana	lysis	
CO5	Compare the var material	ious production of green -based plastic	Psychomotor		Ар	ply	
UNIT	I Green Ma	anufacturing Trends	<u> </u>				9
Green	Manufacturing:	Fundamentals and Applications - basic	definitions and	issu	es su	irrou	nding
green	manufacturing a	t the process, machine and system -	government mo	otivati	ons	for	green
manufa	cturing - tradition	onal manufacturing to green manufacturin	ng -economic	issue	s- su	irrou	nding
green	manufacturing -	the areas of automotive, semiconductor an	d medical areas	s as	well	as in	n the
supply	chain and packa	nging areas Green Manufacturing.					
UNIT	II Sustainat	ble Green Manufacturing					9
Introdu	iction – sustair	nable green manufacturing -green manu	facturing susta	inabi	lity	proce	esses,
require	ments, and risk -	The sustainable lean and green audit proces	s. International	green	man	ufact	uring
standar	ds and compliant	ce. Green rapid prototyping and rapid manuf	acturing. Green	flexi	ble a	utom	ation.
Green	collaboration pro	cesses . Alternative energy resources. Glob	bally green m	anufa	cturin	ig si	upply
chains	and logistic netw	works. Sustainable green manufacturing syste	em design.				
UNIT	III Waste Ma	anagement					9
Sustain	ability and globa	l conditions - Material and solid waste m	anagement - E	nergy	man	agen	nent -
chemic	al waste manage	ment and green chemistry - Climate chang	ge and air emiss	sions	mana	geme	ent -
Supply water and waste water management – Environmental business management							
UNIT	UNIT IV Industrial Ecology 9						
Introdu	ction-Material fl	lows in chemical manufacturing-Industrial	parks-Assessin	g op	portu	nitie	s for
waste	exchanges and	by product synergies-Life cycle concept	s-Product shew	ardsł	nip a	nd	green
engine	ering-Regulatory,	social and business environment for g	reen manufactu	ring	· Me	etrics	and

analytical too	ols Green	supply chainsPresent state	of green manufacturing.			
UNIT V	Green Pla	astics Manufacturing		9		
Introduction to commercial plastics and elastomers -Natural Rubber (NR), modified NR and blends -						
Polyesters fro	m microbia	al and plant biofactories (poly	lactic acid and poly hyroxyalkar	noates) -Plastics from		
vegetable oil	s -Cellulos	e and starch based materia	ls -Natural fillers, fibers, rein	forcements and clay		
nanocomposi	tes -Biodeg	gradability, life cycle assessme	ent and economics of using natur	al materials.		
LECTU	JRE	TUTORIAL	PRACTICAL	TOTAL		
45		0	0	45		
TEXT				I		
1. T. David	Allen and I	David R. Shonnard, Green eng	gineering, Prentice Hall NJ, (200	2).		
2. David Do	ornfeld, Gre	een manufacturing fundamenta	al and applications, Prentice hall	(2002).		
3. G. Samm	y Shinga, G	Green electronics design and r	nanufacturing, Prince publication	ns, (2008).		
4. James cl	ark, Green	chemistry, Blackwell publishi	ng (2008)			
REFERENC	ES					
1. Paulo Da	vim, Sustai	nable Manufacturing, Wiley	publications (2010).			
2. Frank Kr	eith, Georg	e Tchobanoglous, Solid waste	e management, McGraw Hill (20	02).		
3. E. S. Stev	vens, Green	plastics, Princeton university	press (2002).			
4. U. Rober	t Ayres, A	Handbook of Industrial Ecolo	gy, Edward elgar publishing (20	02).		
E REFERENCES						
www.nptel.ac	.in					
www.mit.co.i	n					

COURSE CODE YNT204A				L	Т	Р	C
COURS	E NAME	Polymer Engineering		3	0	0	3
PRERE	QUISITES			L	Т	Р	Н
C:P:A				3	0	0	3
COURS	E OUTCOMES		DOMAIN	LE	VEL	4	
Co1	Infer The Funda Science	amental, Introduction Of Polymer	Cognitive		Und	erstan	d
Co2	Understand The U	tility of Bio And Inorganic Polymers	Cognitive		Und	erstan	d
Co3	Different Types S Polymers	Synthesis, Process Of Preparation Of	Cognitive	Apply			
Co4	Co4 Forecast The Types Of Mechanism Involved In Cognitive Polymerization Cognitive					alyze	;
Co5	Co5 Explain The Different Types Of Characterization Of Polymers Psychomotor Understance					erstan	d
UNIT I FUNDAMENTAL OF POLYMER							9
Basics -	polymer classifica	tions based on- occurrence, types, proc	ess, structure and	d end	uses	. Pol	ymer
microstr	ucture-chemical and	l geometrical structure - ladder, star and	telechelic polym	ers –i	nterp	enetr	ating
networks	s –tacticity –Polym	ers- crystalline-amorphous nature- crys	stallizationcryst	alliza	bility	-effe	ct on
propertie	es.						
UNIT II	BIO AND IN	NORGANIC POLYMERS					9
Bridgem	an method – Kyro	polous method - Czochralski method	- Verneuil met	hod –	- Zor	ne me	lting
method.	Growth from flux	x – Slow cooling method – Temp	erature difference	ce m	ethoo	1 –	High
pressure	method - Solvent	evaporation method – Top seeded solut	tion growth				
UNIT I	II CHAIN POI	LYMERIZATION					9
Kinetics	and mechanism of	free radical, cationic, anionic and coord	ination polymeriz	zation	-Zie	gler l	Natta
catalysts	-monometallic mec	hanism- stereo regular polymerization -	- chain transfer r	eactio	on an	d con	stant
- living	polymers – Alfin ca	talysts - iniferters - new polymerization	n concepts and te	chniqu	ues li	ke R	AFT,
click pol	ymerization, green	polymerization concepts					
UNIT I	V STEP GROV	WTH POLYMERIZATIONS AND CO	OPOLYMERIZ	ATIC	DN		9
Polycone	densation polymeriz	zation - copolymerization- kinetics - o	copolymer equat	ion –	comp	ositic	on of
copolymers by NMR - monomer reactivity ratios and their significance -polymerization reactions-							ions-
mathema	atical, electrochemic	cal, GTP and ring opening.					
UNIT V	MOLECUL	AR WEIGHT, SOLUBILITY OF PO	LYMERS				9

Number, weight and viscosity average molecular weights – polydispersity - molecular weight distribution – determination of molecular weight by GPC and viscometry – polymer dissolution - thermodynamics of polymer dissolution - solubility parameter.

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	0	45

TEXT

1.F.W. Billmeyer, Text Book of Polymer Science, 3rd edition, John Wiley and sons, New York, 2002.

REFERENCES

1. Gorge Odeon – Principles of Polymerization, 4th edition, McGraw Hill Book Company, New York 2004.

2. M.S.Bhatnagar, "A Text Book of Polymers (Chemistry and Technology of Polymers), Vol I, II & III, 1stEdn., S.Chand and Company, New Delhi, 2007

3. PremamoyGhosh," Polymer Science and Technology, 2ndedition, McGraw-Hill Publishing

4. R.J. Young, Introduction to Polymers, Chapman and Hall Ltd., London, 1992

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COURS		L	Т	Р	С				
COURS	E NAME	Advanced Crystal Growth Te	echniques	3	0	0	3		
PRERE	QUISITES			L	Т	Р	Н		
C:P:A				3	0	0	3		
COURS	E OUTCOM	ES	DOMAIN	L	EVEI	4			
CO1	Outline the c	oncept of crystal growth nucleatio	on Cognitive	e	Re	membe	er		
CO2	Discuss the d	fferent growth methods	Cognitive	e	Unde	erstand	ing		
CO3	Demonstrate	he different characterization tech	iniques Cognitive	e	Unde	erstand	ing		
CO4	Investigate th	e growth process in the solution	Cognitive	¢	A	nalysis			
CO5 Interpret the different epitaxial method of surfaces and						Apply			
films						тррту			
UNIT I Crystal Growth Theory 9									
Introduc	tion – Nuclea	tion – Gibbs – Thomson equa	ation for melt and solu	tion –	kineti	c theo	ory of		
nucleatio	on –Limitatio	n of classical nucleation - Rate	e of nucleation – Diffe	rent sh	apes o	f nucle	eus –		
spherica	, cap shaped a	nd cylindrical.							
UNIT II Growth from Melt 9							9		
Bridgem	an method – k	yropolous method – Czochralski	method – Verneuil metho	od – Zoi	ne mel	ting m	ethod.		
Growth	from flux -	Slow cooling method – Te	emperature difference m	ethod	– Hi	gh pr	essure		
method	 Solvent eva 	poration method – Top seeded sol	lution growth						
UNIT I	II Grow	h from Vapor Phase					9		
Physical	vapor deposit	on – Chemical vapor transport –	- Open and Closed system	m – T	hermo	dynam	nics of		
chemica	vapor deposit	on process – Physical and Therm	no-chemical factors affecti	ng gro	wth pro	ocess.			
UNIT I	V Grow	h from Solutions					9		
Solvent	and solutions	– Solubility – Preparation of	f a solution – Saturation	on and	supers	saturati	on –		
Measure	ment of super	saturation – Expression for sup	ersaturation - Low tem	peratu	re gro	wth so	lution		
growth -	- Slow cooli	ng method – Manson jar metho	od – Evaporation method	l – Tei	nperat	ure gr	adient		
method	- Electro crys	allization. Growth from gels	- Experimental method	ls – (Chemi	cal re	action		
method	- Reduction	method - Complex decompositi	on method – Solubility re	duction	n meth	od – G	rowth		
by hydrothermal method.									
UNIT V	EPIT	XY					9		
Vapor	phase epitaxy	- Liquid phase epitaxy - M	lolecular beam epitaxy –	Aton	nic lay	er epit	axy –		
Electro	Electro-epitaxy – Metalorganic vapor phase epitaxy – Chemical beam epitaxy.								
I	ECTURE	TUTORIAL	PRACTICAL			TO	ΓAL		
•									

45	0	0 0 45							
TEXT									
1. Sangwal. K., —Eleme	1. Sangwal. K., —Elementary Crystal Growth [∥] 1 st Ed., Saan Publisher, UK, (1994).								
2. Faktor. M. M. and Garet. I., —Growth of crystal from vapor 1^{st} Ed., Chapmann and Hall, (1988).									
3. Santhana Ragavan. P. and Ramasamy. P., -Crystal growth and process, 1st Ed., KRU Publications,									
(2000).									
REFERENCES									
1. Ramasamy. P., IST.	E Summer School Lecture No	otes, —Crystal Growth Centrel, Anna							
University, Chenna	i, (1991).								
2. Brice, J. C., -Cryst	al growth process∥, 1 st Ed., Jo	hn Wiley Publications, New York, (19	86).						
3. Chernov. A. A., —M	lodern Crystallography: III –	Crystal Growthl, 1 st Ed., Springer seri	es in Solid						
State, New York, (1984)								
E REFERENCES									
www.nptel.ac.in									
www.mit.co.in									

COUR	SE CODI	E	YNT204C		L	Т	Р	С
COUR	RSE NAM	E	Carbon Nanotube Electronics and De	vices	3	0	0	3
PRER	EQUISIT	ES			L	Т	Р	Η
C:P:A					3	0	0	3
COUR	SE OUT	COMES		DOMAIN	LEV	EL		
CO1	Outline t	he concep	ot of carbon nanotubes	Cognitive		Reme	ember	
CO2	Discuss t	the differe	ent synthesis of SWNT devices	Cognitive		Unders	tanding	5
CO3	Demonst	rate the d	ifferent carbon nanotube field effect	Cognitive		Unders	tanding	g
transistors								2
CO4	Investiga	te the AC	C responses and device simulation of	Cognitive		Ana	lysis	
	SWNT o	of FETs						
CO5	Interpret	the differ	rent carbon nanotube device modelling	Psychomotor		Ap	ply	
UNIT	I	Basics of	Carbon Nanotubes					9
Carbon materials - Allotropes of carbon - Structure of carbon nanotubes - Types of CNTs - Electronic								
propert	ties of CN	Ts – Ba	nd structure of Graphene – Band structu	are of SWNT fr	om gra	aphene	– Ele	ctron
transpo	ort properti	ies of SW	NTs – Scattering in SWNTs – Carrier mo	obility in SWNT	ſs.			
UNIT	II	Synthesis	s and Integration of SWNT Devices					9
Introdu	iction –	CVD syn	nthesis – Method – Direct incorporat	tion with device	ce fab	ricatior	n proce	ss –
SWNT	synthesis	on meta	l electrodes – Lowering the synthesis	temperature –	Cont	rolling	the S	WNT
growth	– Locati	on, Orien	tation, Chirality - Narrowing diameter	r distributions	– Ch	irality	distrib	ution
analysi	s for dif	ferent C	VD processes – Selective removal of t	he metallic nan	otubes	s in FE	T devi	ces –
Integra	tion							
UNIT	ш	Carbon I	Nanotube Field-Effect Transistors					9
Schottl	ky barrier	heights	of metal S/D contacts - High k-g	ate dielectric	integr	ation	– Qua	ntum
capacit	ance – C	Chemical	doping - Hysteresis and device pass	sivation – Ne	ar ide	al, Me	tal-con	taced
MOSE	ETs – SW	VNT MOS	SFETs – SWNT band-to-band tunnelling	FETs				
UNIT	IV	AC Resp	onse and Device Simulation OfSwntFe	ts				9
Assess	ing the A	AC respo	nse of Top gated SWNT FETs - P	ower measure	ment	using	a spec	ctrum
analyze	er –Homo	dyne dete	ection using SWNT FETs – RF charact	erization using	a two	tone n	neasure	ment
– AC	gain fron	n a SWN	T FET common source amplifier – Devi	ce simulation of	of SWI	NT FE	Ts - S	WNT
FET si	mulation u	using NEC	GF-Device characteristics at the Ballis	stic limit – Ro	ole of	Phono	n scatt	ering
– High	– High frequency performance limits –							
Optoel	ectronic pl	henomena	1.					

UNIT V	Carbon Nan	otube Device Modeling and	Circuit Simulation		9			
Schottky barrier	SWNT-FET	198unnellin – Compact n	nodel for circuit simulation -	- Model of	f the			
intrinsic SWNT	channel regio	n – Full SWNT-FET mode	el - Applications of the SWN	T-FET con	npact			
model – Perfo	rmance 198un	nellin for carbon nanotube i	nterconnects – Circuit models	s for SWN	Гs —			
Circuit models for SWNT bundles – Circuit models for MWNTs – Carbon nanotube interconnects –								
Applications.								
LECTU	JRE	TUTORIAL	PRACTICAL	TOT	AL			
45	45 0 0 45							
TEXT		L						
1. Ali Javey a	nd Jing Kong,	-Carbon Nanotube Electron	nics Springer Science media, (20)09).				

2. Michael J. O'Connell, —Carbon nanotubes: Properties and Applications^{II}, CRC/Taylor & Francis, (2006).

REFERENCES

1. Francois Leonard, —The Physics of Carbon Nanotube Devicesl, William Andrew Inc., (2009).

2. R. Saito and M. S. Drbselmus, —Physical properties of Carbon Nanotubes Imperial College Press, (1998).

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- 1. www.nptel.ac.in
- 2. www.mit.co.in

COURSE CODE YNT204D						Р	С	
COUR	SE NAME	Nanoscale Integrated Computing		3	0	0	3	
PRER	EQUISITES			L	Т	Р	Н	
C:P:A				3	0	0	3	
COUR	SE OUTCOMES	5	DOMAIN	LE	VEL			
CO1	Summarize the based quantum of	organization and function of nano	Cognitive		Rem	embe	r	
CO2	Discuss the arch	itecture of nanocomputing system	Cognitive	U	nders	tandi	ng	
CO3 Describe the concepts of nano scale Spin-Wave Architectures Cognitive							ng	
CO4 Correlate the integration of biomolecules for nanocomputing Cognitive						lysis		
CO5	Psychomotor		Aŗ	ply				
UNIT	UNIT IExperiment with the advancements of nanocomputing in image processing9							
Micro computing era - Transistor as a switch, difficulties with transistors at the nanometer								
scale -	- Nanoscale devi	ces – Molecular devices – Nanotubes –	- Quantum dots –	Wav	e cor	nputi	ng –	
Quantu	m computing.							
UNIT	II Quantum	Computing					9	
Reversi	ible computation	s – Quantum computing models –	- Complexity bo	ound	s for	quar	tum	
comput	ting – Quantum	compression – Quantum error correct	ing codes – Qua	ntun	n cryp	otogra	aphy	
– Con	nputing with qua	antum dot cellular automata – Quant	um dot cellular	aut	omat	a cel	1 –	
Ground	I state computing	g – Clocking – QCA addition – QCA	A multiplication –	QCA	A me	mory	- 4-	
bit proc	cessor							
UNIT	III Spin-Way	ve Architectures					9	
Spin v	wave crossbar -	- Spin wave reconfigurable mesh -	- Spin wave fu	ılly	intero	conne	cted	
cluster	– Multi-scale I	Hierarchical architecture – Spin wa	we based logic	dev	ices	– L	ogic	
function	nality – Paralle	l computing with spin waves - Par	rallel algorithm de	esign	tech	nique	s –	
Parallel	l routing and broa	dcasting – On-Spin wave crossbar –	OnSpin wave rec	onfig	gurab	le me	sh –	
On-Spi	n wave fully inter	connected cluster						
UNIT	IV Molecula	r Computing					9	
Switchi	ing and memory	in molecular bundles – molecular	r bundle switche	s –	Ci	rcuit	and	
archited	ctures in molecula	ar computing – Molecular grafting f	or silicon comp	uting	- 1	Molec	ular	
grafting	g on intrinsic sil	icon nanowires – Self assembly of CN	VTs					

UNIT V Computational Tasks In Medical Nanorobotics								
Medical Nan	orobot desi	gns – Microbivores	s - Clottocytes - Chromallocytes - Comm	on functions				
requiring onboard computation - Nanorobot control protocols: Operation protocols -								
Biocompatibi	ility protoc	ols – Theater protoc	cols -Nanoscale image processing: Labelin	g problem –				
Convex Hull	problem –	Nearest neighbor pro	oblem					
LECTURE		TUTORIAL	PRACTICAL	TOTAL				
45	5	0	0					
TEXT								
1.Nielsen M.	A. and Isaa	ic L. Chuang, —Qua	ntum computation and quantum information	ıI,				
Cambridge	e University	, Press, (2000).						
2.Jain A. K.,	—Fundame	entals of Digital Imag	ge Processingl, Prentice-Hall, (1988)					
REFERENC	CES							
1. Schroder I	D. K., —Ser	niconductor Materia	l and Device CharacterizationI, New York, ((2006).				
2. Zhou C. and New Haven, —Atomic and Molecular wires, Yale University Press, (1999).								
E REFEREN	NCES							
1. <u>www.npte</u>	l.ac.in							

2. <u>www.mit.co.in</u>

COURSE	CODE	YNT204E		L	Т	Р	С		
COURSE	NAME	Thin Film Science and Technology		3	0	0	3		
PREREQ	UISITES			L	Т	Р	Н		
C:P:A				3	0	0	3		
COURSE	OUTCOM	ES	DOMAIN	LEVEL					
C01	Outline the	thin film deposition techniques	Cognitive		Rem	ember			
CO2	Demonstrat	e the different characterization techniques	Cognitive	1	Unders	standin	g		
CO3	Investigate	the adsorption and diffusion in thin films	Cognitive	1	Unders	standin	g		
CO4	Analyze the	e stress in the thin Films	Cognitive		Ana	lysis			
CO5	Compare th	e different modification of surfaces and	Psychomotor		Δr	nly			
	films		1 sychomotor		ΔĻ	pry			
UNIT I	Thin Fil	m Deposition Techniques	L				9		
Introductio	on – Kineti	c theory of gases - Physical vapour d	eposition tech	niques	– P	hysics	and		
Chemistry	of Evaporat	ion - Thermal evaporation - Pulsed laser d	eposition – Mo	olecula	ar bear	n epita	xy –		
Sputtering	deposition	-DC, RF, Magnetron, Ion beam and reactiv	e sputtering -	Cher	nical	metho	ds –		
Thermal C	CVD – Plas	ma enhanced CVD - Spray Pyrolysis -	Sol Gel met	hod -	- Spii	n and	Dip		
coating -	Electro plat	ing and Electroless plating –Deposition m	echanisms.						
UNIT II	Charact	erization Techniques					9		
Surface a	analysis tecl	hniques – Auger Electron spectroscopy	– Photoeleo	ctron	Spect	roscop	y –		
Secondary	Ion Mass S	Spectroscopy – X-ray Energy Dispersive	Analysis – Ru	therfo	rd Ba	ckscatt	ering		
spectrosco	py - Imagin	g Analysis Techniques – Scanning Electron	Microscopy –	Tran	smissi	on Ele	ctron		
Microscop	y – Optica	l analysis Techniques –Ellipsometry – Four	rier Transform	Infrare	ed Spe	ctrosco	opy –		
Photolumi	nescence Spe	ectroscopy							
UNIT III	Adsorpt	ion And Diffusion In Thin Films					9		
Physisorpt	ion – Chem	isorption - Work function changes induce	ed by adsorbat	es –	Two o	dimens	ional		
phase trans	sititions in a	dsorbate layers – Adsorption kinetics – D	esorption techr	iques	. Fund	amenta	uls of		
diffusion -	-Grain Boun	dary Diffusion – Thin Film Diffusion Coupl	es - Inter Diff	usion	-Elect	romigr	ation		
in thin films – Diffusion during film growth									
UNIT IV	Stress in	Thin Films					9		
Origin of '	Thin film st	ress - Classifications of stress - Stress i	n epitaxial film	ns –	Grow	th Stre	ss in		
polycrystalline films - Correlation between film stress and grain structure - Mechanisms of stress									
evolution	– film stres	s and substrate curvature - Stoney formula	– Methods of c	urvatu	re mea	asurem	ent –		
Scanning 1	aser method								

UNIT V	Modifica	tion of	f Surfa	aces And Filn	ıs							9
Introduction	– Laser	and	their	Interactions	with	Surfaces	-	Laser	modific	ation	effects	and
applications	– Laser so	ources	and 1	Laser scannir	ng met	hods - The	erm	al ana	lysis of	Laser	anneali	ng -
Laser surface	e alloying	- Ion	impla	ntation effects	in so	lids – Ener	rgy	loss ar	d structu	ral m	odificatio	on –
compositional modification - Ion beam modification phenomena and applications												
IECT	UDF		TT	TODIAI		D	D A	CTIC	Т		тот	A T

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	0	45
TEVT			

TEXT

- 1. Amy E. Wendt, Thin Films High density Plasmas, Volume 27, Springer Publishers. (2006).
- 2. Rointan F. Bunshah, Hand Book of Deposition technologies for Thin Films and coatings by Science, Technology and Applications ,Second Edition , Noves Publications, (1993).
- 3. Milton Ohring, Materials Science of Thin films Published by Academic Press Limited(1991)

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1. L.B. Freund and S.Suresh, Thin Film Materials, (2003). L.B. Freund and S.Suresh, Thin Film Materials, (2002)

Materials, (2003).

- 2. Hans Luth, Solid surfaces, Interfaces and Thin Films' 4th edition, Springer Publishers (2010).
- 3. Harald Ibach, Physics of Surfaces and Interfaces, Springer Publishers (2006).AM

E REFERENCES

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COU	RSE CODE	YNT204F		L		Т	Р	С		
COUI	RSE NAME	Micro and Nano Emulsions		3		0	0	3		
PREF	REQUISITES			L		Т	Р	Н		
C:P:A				3		0	0	3		
COU	RSE OUTCOMES		DOM	AIN	LE	VEL	4			
CO1	Summarize the de emulsifying agent	fine and identify emulsions and s	Cog	gnitive	Remember					
CO2	Discuss the mecha stabilization	anism of emulsions and the process of	Cog	gnitive	U	Jnder	stand	standing		
CO3 Describe the formulation and characterization of emulsions C					U	Jnder	stand	ing		
CO4Correlate the characterization techniques of nano emulsionCognitiveAnalysi						alysis				
CO5Investigate the stability of the nano emulsionPsychomotorApply										
UNIT I Introduction							9			
Definition of nano- and micro- emulsions - Reason for their long term kinetic stability - Practica										
applic	ation in personal	care products and cosmetics, healthcar	e pro	ducts, ph	arma	aceut	icals	and		
agroch	nemicals – Scher	matic representation of oil/water and water/	oil emu	ulsions –	Co	ompa	rison	with		
micell	es and macroemul	sions – Methods of emulsification: Pipe	flow,	static mi	ixers	s an	d ge	neral		
stirrer	s, high-speed mix	ers, colloid mills and high pressure homog	genizers	s – continu	ous	and l	oatch	-wise		
prepar	rations – turbulent f	low.								
UNIT	II Mechanis	m of Emulsification						9		
Role of	of interfacial energ	y – Explanation of the high energy required	l for fo	rmation of	f nai	noem	ulsio	ns –		
The L	aplace pressure co	ncept - Role of surfactants: Reduction in	interf	acial tensi	on	and	the e	effect		
on 20	3unnelli size – G	ibbs adsorption equation – Interfacial dilatio	nal mo	dulus and o	drop	let de	eform	ation		
– Inte	erfacial tension gra	dients and the Marangoni effect - Solubiliz	ation th	neories: C	once	ept o	f a dı	ıplex		
film a	nd bending of the	interface to form o/w or w/o emulsions - P	hase di	agrams of	tern	nary s	syster	ns of		
water,	surfactant and co	surfactant – Concept of normal and inver	se mi	celles –	Qua	arterr	nary p	phase		
diagra	ms of oil/water sur	factant and cosurfactant – Solubilization of o	il by no	onionic sur	facta	ant				
UNIT	III Formulati	on of Emulsion						9		
High	pressure homogeni	zation and efficiency of preparation - The	Phase	Inversion	Ten	npera	ture	(PIT)		
princip	ple –Variation of in	nterfacial tension with temperature – Phase d	liagram	s as a func	tion	of te	mper	ature		
- Formulation of microemulsions - Selection of microemulsions: Hydrophilic Lipophilic Balance (HLB)								HLB)		
conce	pt – Phase Inversio	on Temperature (PIT) concept – Cohesive Ene	ergy Ra	tio (CER)	conc	cept				
UNIT	IV Character	ization of Emulsions						9		

Scattering techniques: Time average light scattering – Neutron scattering – Quasi-elastic light scattering (Photon Correlation Spectroscopy(PCS)) – Conductivity and NMR techniques: Conductivity of water/oil microemulsions, percolating and non-percolating emulsions, bicontinuous emulsions – Viscosity of emulsions – NMR technique for measurement of self diffusion of all components in emulsions and explanation of the various structures

UNIT V Stability of Emulsion

9

Steric stabilization: Unfavourable mixing of the stabilizing chains – Entropic repulsion – Total energy – Distance curves for sterically stabilized emulsions – Variation of the energy curve with the ratio of adsorbed layer thickness to droplet radius – Thermodynamic stabilization: Reason for combining surfactant and cosurfactant to produce an ultra low interfacial tension – Formation of a model w/o emulsion using 4 steps – Relationship of droplet size to interfacial tension

LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	0	45
TEXT			

1. Seid Mahdi Jafari, —Encapsulation of nano-emulsions by spray dryingl, Lambert Academic Publishing, (2009).

2. Hans Lautenshlager — Emulsionsl, Kosmetik International, (2002)

REFERENCES

1. Roque Hidalgo-Alvarez, -Structure and Functional properties of Colloidsl, CRC Press, (2009).

2. Richard J. Fann, -Chemistry and Technology of Surfactants, Wiley-Blackwell, (2006).

E REFERENCES

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COURSE CODE YNT205B						Т	Р	С
COURSE NAME Graphene Nanotechnology					2	0	1	3
PRERE	QUISI	TES	Introduction to Nanotechnology		L	Т	Р	Н
			Materials Science					
C:P:A		1.5:1.2:0).3					
COURS	E OU	FCOME	3	DOM	AIN		LE	VEL
CO1	Outlin	ne the bas	ics and fundamentals of graphene	Cognitive	;	U	nderst	and
	Psychomotor Remember							
CO2 Identify the various types of graphene and their properties Cognitive Understand							and,	
				Psychomo	otor	G	uided	
						Re	espons	se
CO3	Demo	onstrate t	ne process of synthesis of graphene and	Cognitive	;	U	nderst	and,
	their o	characteri	zation	Psychomo	otor	G	uided	Set
CO4	Generalize the applications of graphene in energy sector Cognitive Under						nderstand,	
	Psychomotor Mechanism							
CO5	Demo	onstrate th	e measurement of electrical parameters	Cognitive Understa		and,		
				Psychomo	otor	Μ	echan	ism
UNIT I		Introdu	ction of Graphene				6+	6
Graphen	e: Intro	oduction	of graphene, Graphite, Definition and struc	ture of gra	phene,	Туре	s of g	raphene:
stacking	AA, B	B, AB di	spersion relation, Single layer, Bi-layer, few	layer				
UNIT II		Propert	ies of graphene				6+	6
Properties of graphene; Optical: thickness dependency, optical conductivity, electric filed tunable								
transpare	ency, p	lasmons	and polaritons, carrier multiplication. Elect	trical: Bolt	zmann (equati	on, a	mbipolar
conduction, density of states and doping (electrostatic and chemical), quantum hall effect, Klein								
205unnelling, diamagnetism, magnetoresistance and spin current, thermal conductivity. Mechanical,								
Surface phenomenon.								
UNIT III Synthesis of Graphene 6+6							6	
Preparation of graphene: Epitaxial growth of graphene on Silicon carbide, Chemical deposition (CVD)								
growth of graphene films, Chemically derived graphene, Synthesis of graphene oxide: Hummer's method,								
Modified Hummer's method, Reduction of graphene oxide: Chemical methods, Physical methods,								
Electrochemical exfoliation, Nanotube slicing, from solid state carbon sources.								
UNIT IV	V	Charact	cerization of Graphene				6+	6
Characte	rizatio	n of gr	aphene: Transmission electron microsco	py (TEM)), Scan	ning	2051	unnelling

microscopy (STM), Raman Spectroscopy, Electrical measurements: electric field effect, temperature							
dependent resistivity measurement.							
UNIT VApplication of Graphene6+6							
Applications of	of graph	ene: Graphene	in the energy application	Li-ion batteries,	Supercapacitors,		
Photovoltaic, R	Radio-freq	uency transistor,	Photodetector, Modulator, M	Iode locked lasers, O	Other applications		
of graphene: A	nti-corroi	son coating, Anti	- bacterial coating, catalyst, S	Sensors, Transparen	t Conductors		
LECTURE TUTORIAL PRACTICAL TOTAL							
HOUR	S	30	0	30	60		
HOURS List of Experim	S ments	30	0	30	60		
HOURS List of Experi 10 to 12 Experi	S ments iments wi	30 ll be provided rel	0 levant to the five course outco	30 ome based on the factor	60 culty will be		
HOURS List of Experim 10 to 12 Experim taught and also	S ments iments wi feasibilit	30 Il be provided rel y.	0 levant to the five course outco	30 ome based on the fac	60 culty will be		
HOURS List of Experim 10 to 12 Experiment taught and also TEXT BOOK	S ments iments wi feasibilit	30 Il be provided rel y.	0 levant to the five course outco	30 ome based on the fac	60 culty will be		
HOURS List of Experi 10 to 12 Experi taught and also TEXT BOOK 1. Graphe	S ments iments wi feasibilit ene: Fund	30 Il be provided rel y. amentals, Device	0 levant to the five course outco s, and Applications-by Serhii	30 ome based on the fac Shafraniuk	60 culty will be		

Melendrez Armada (Author), Aravind Vijayaraghavan

COURSE CODEYNT205CLTP						Р	С
COURS	E NAME	Carbon Nanotube		2	0	1	3
PRERE	QUISITES	Introduction to Nanotechnology		L	Т	Р	Н
		Materials Science, Nano Applications					
C:P:A		1.5:1.2:0.3					
COURS	E OUTCOM	ĒS	Ι	DOMAI	N	LEV	'EL
CO1Explain Basic concept of Carbon NanotubeCognitiveUnderstand							and
Psychomotor Remember							ber
CO2 Understand the properties Of Carbon Nanotubes C						Understa	and,
			Psycl	homotor		Guided	
						Respons	se
CO3	Describe the	application Of Carbon Nanotubes	Cogn	nitive		Understa	and,
			Psycl	homotor		Guided	Set
CO4	Illustrate the	Illustrate the properties of metal nanoparticles Co				Understa	and,
		Psychomotor Mechanism					
CO5	Demonstrate	the synthesis Process of Metal Nanoparticles	Cogn	nitive		Understa	and,
			Psycl	homotor		Mechani	ism
UNIT I	INTRO	DUCTION OF CNT					6+6
Basic Co	oncept of Car	bon Nanotube, the structure of Carbon Nar	notubes	s, Symr	netry of	Single-	walled-
Carbon 1	Nanotube, Syn	metry of Double walled- Carbon Nanotube, S	Symme	etry Ope	ration, S	Symmetry	y-based
Quantum	Numbers.						
UNIT II	PROP	ERTIES OF CARBON NANOTUBES					6+6
Mechani	cal Properties	, Thermal Stability, Heat transport in Carb	on Na	notubes	, Electro	onic Pro	perties,
Optical Properties, 12 14% Suggested Specification table with Marks (Theory): Elastic Properties,							
Vibrational Properties, Intrinsic Properties of individual Carbon Nano Tube.							
UNIT IIIAPPLICATION OF CARBON NANOTUBES6+6							6+6
Carbon Nanotubes in Electronics, Carbon Nanotubes in Energy Applications, Carbon Nanotubes For							
Mechanical Applications, Carbon Nanotube Sensors, Carbon Nanotubes in Field Emission and Lighting							
Applications, Carbon Nanotubes for Biological Applications							
UNIT IVMETAL NANOPARTICLES6+6							6+6
Introduction, Size-Dependent Properties of Metal nanoparticles, Band gap measurement, Magic Metal							
nanoparticle, Noble Metal Nanoparticles, Geometric configuration.							
UNIT V	UNIT VSYNTHESIS PROCESS OF METAL NANOPARTICLES6+						

Wet Chemical Synthesis Routes, Phase Transfer Method, Stabilization Mechanisms, Electrochemical									
Method									
	LECTURE	TUTORIAL	PRACTICAL	TOTAL					
HOURS 30 0 30 60									
List of Experiment	s								
10 to 12 Experiment	ts will be provided rele	evant to the five course ou	atcome based on the face	ulty will be					
taught and also feas	bility.								
TEXT BOOK									
1. Carbon Nan	1. Carbon Nanotubes: Basic Concepts and Physical Properties, Stephanie Reich, Christian Thomsen,								
Janina Mau	Janina Maultzsch								
2. Understand	2. Understanding Carbon Nanotubes: From Basics to Applications -English, Paperback, Annick								
Loiseau, Pa	Loiseau, Pascale Launois-bernede, Jean-paulSalvetat, Pierre Petit, Stephan Roche)								
3. Carbon Nar	. Carbon Nanotubes and Their Applications (English, Hardcover, Qing Zhang)								

COURSE NAME Quantum Dot 2 0 1 3 PREREQUISITES L T P H C:P:A 1.5:1.2:0.3 2 0 2 4 COURSE OUTCOMES DOMAIN LEVEL Course outcomes Domain Level 4 COURSE OUTCOMES DOMAIN LEVEL Course outcomes Psychomotor Remember CO2 Explain and understand Quantum Mechanical Cognitive Understand, Psychomotor Guided Response CO3 Determine and Describe Semiconductor and Device Cognitive Understand, Guided Set CO4 Describe and Illustrate the Quantum computing Cognitive Understand, Mechanism CO5 Classify and Describe the Quantum DOT cellular Cognitive Understand, Mechanism UNIT I Introduction Recent past, the present scenario of Computing and its challenges, Future, Overview basic Nano electronics. 6+6 UNIT II Quantum Mechanical Tunnel Devices 6+6 Overview of current research in nano-scale electronics and devices <	COURSE CODEYNT205ELTP							С
PREREQUISITES L T P H C:P:A 1.5:1.2:0.3 2 0 2 4 COURSE OUTCOMES DOMAIN LEVEL 4 COI Explain Basic Concept of Quantum dots Cognitive Understand Remember CO2 Explain and understand Quantum Mechanical Cognitive Understand, Guided Response CO3 Determine and Describe Semiconductor and Device Cognitive Understand, Guided CO4 Describe and Illustrate the Quantum computing Cognitive Understand, Set CO5 Classify and Describe the Quantum DOT cellular Cognitive Understand, Mechanism UNIT I Introduction 6+6 6+6 1 6+6 Introduction: Recent past, the present scenario of Computing and its challenges, Future, Overview basic Nano electronics. 6+6 VITI II Quantum Mechanical Tunnel Devices 6+6 Photonic Device and Materials, CMOS Device, Limit of CMOS technology-Scaling Theory. Quant Dots & Quantum wires. 6+6 UNIT IV Quantum computing 6+6 Introduction to nano-electronic and nano-computers,Quantum DOT cellular Automata (QCA	COURS	E NAME	Quantum Dot		2	0	1	3
C:P:A 1.5:1.2:0.3 2 0 2 4 COURSE OUTCOMES DOMAIN LEVEL CO1 Explain Basic Concept of Quantum dots Cognitive Psychomotor Understand Remember CO2 Explain and understand Quantum Mechanical Tunnel Devices Cognitive Psychomotor Understand, Guided Response CO3 Determine and Describe Semiconductor and Device Cognitive Psychomotor Understand, Guided CO4 Describe and Illustrate the Quantum computing Automata Cognitive Psychomotor Understand, Mechanism CO5 Classify and Describe the Quantum DOT cellular Automata Cognitive Psychomotor Understand, Mechanism UNIT I Introduction 6+6 Introduction: Recent past, the present scenario of Computing and its challenges, Future, Overview basic Nano electronics. 6+6 UNIT II Quantum Mechanical Tunnel Devices 6+6 Overview of current research in nano-scale electronics and devices 6+6 UNIT IIV Quantum computing 6+6 Photonic Device and Materials, CMOS Device, Limit of CMOS technology-Scaling Theory. Quant Dots & Quantum wires. 6+6 UNIT IV Quantum computing: Basics and examples: introduction, axioms, quantum states and notation, unitaries, Mea	PRERE	QUISITES			L	Т	Р	Н
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CO1 Explain Basic Concept of Quantum dots Cognitive Understand Psychomotor Remember CO2 Explain and understand Quantum Mechanical Cognitive Understand, Tunnel Devices Psychomotor Guided Response CO3 Determine and Describe Semiconductor and Device Cognitive Understand, Psychomotor Guided Set Set CO4 Describe and Illustrate the Quantum computing Cognitive Understand, Psychomotor Mechanism Set Understand, CO5 Classify and Describe the Quantum DOT cellular Cognitive Understand, Automata Psychomotor Mechanism 6+6 Introduction: Recent past, the present scenario of Computing and its challenges, Future, Overview basic Nano electronics. 6+6 UNIT II Quantum Mechanical Tunnel Devices 6+6 Overview of current research in nano-scale electronics and devices 6+6 Photonic Device and Materials, CMOS Device, Limit of CMOS technology-Scaling Theory. Quant Dots & Quantum wires. 6+6 UNIT IV Quantum computing 6+6 Quantum computing: Basics and examples: introduction, axioms, quantum states	COURS	E OUTCOM	ES	Γ	DOMAIN]	LEV	EL
Psychomotor Remember CO2 Explain and understand Quantum Mechanical Tunnel Devices Cognitive Understand, Guided Response CO3 Determine and Describe Semiconductor and Device Cognitive Understand, Psychomotor Guided Set Set CO4 Describe and Illustrate the Quantum computing Cognitive Understand, Psychomotor CO5 Classify and Describe the Quantum DOT cellular Automata Cognitive Understand, Psychomotor UNIT I Introduction 6+6 Introduction: Recent past, the present scenario of Computing and its challenges, Future, Overview basic Nano electronics. 6+6 UNIT II Quantum Mechanical Tunnel Devices 6+6 Verview of current research in nano-scale electronics and devices 6+6 UNIT III Semiconductor and Device 6+6 Photonic Device and Materials, CMOS Device, Limit of CMOS technology-Scaling Theory. Quantum Dots & Quantum wires. 6+6 Quantum computing: Basics and examples: introduction, axioms, quantum states and notation, unitaries, Measurement, Quantum circuits: classical reversible circuits, quantum circuits.universality. 6+6 INIT V Quantum DOT cellular Automata (QCA) 6+6 Introduction to nano-electronic and nano-computers,Quantum DOT cel	CO1	Explain Basi	c Concept of Quantum do	ots Cog	gnitive	Unders	stand	
CO2 Explain and understand Quantum Mechanical Tunnel Devices Cognitive Psychomotor Understand, Guided Response CO3 Determine and Describe Semiconductor and Device Cognitive Psychomotor Understand, Guided CO4 Describe and Illustrate the Quantum computing Cognitive Psychomotor Understand, Psychomotor CO5 Classify and Describe the Quantum DOT cellular Automata Cognitive Psychomotor Understand, Psychomotor UNIT I Introduction 6+6 Introduction: Recent past, the present scenario of Computing and its challenges, Future, Overview basic Nano electronics. 6+6 UNIT II Quantum Mechanical Tunnel Devices 6+6 Photonic Device and Materials, CMOS Device, Limit of CMOS technology-Scaling Theory. Quant Dots & Quantum wires. 6+6 UNIT IV Quantum computing 6+6 Quantum computing: Basics and examples: introduction, axioms, quantum states and notation, unitaries, Measurement, Quantum circuits: classical reversible circuits, quantum circuits, universality. 6+6 UNIT V Quantum DOT cellular Automata (QCA) 6+6				Psy	chomotor	Remer	nber	
Tunnel DevicesPsychomotorGuided ResponseCO3Determine and Describe Semiconductor and DeviceCognitiveUnderstand, PsychomotorGuidedCO4Describe and Illustrate the Quantum computingCognitiveUnderstand, PsychomotorSetCO5Classify and Describe the Quantum DOT cellular AutomataCognitiveUnderstand, PsychomotorMechanismUNIT IIntroductionCognitiveUnderstand, Psychomotor6+6Introduction:Recent past, the present scenario of Computing and its challenges, Future, Overview basic Nano electronics.6+6Overview of current research in nano-scale electronics and devices6+6Photonic Device and Materials, CMOS Device, Limit of CMOS technology-Scaling Theory. Quant Dots & Quantum wires.6+6Quantum computing: Basics and examples: introduction, axioms, quantum states and notation, unitaries, Measurement, Quantum circuits: classical reversible circuits, quantum circuits, universality.6+6INIT IVQuantum DOT cellular Automata (QCA)6+6Introduction to nano-electronic and nano-computers,Quantum DOT cellular Automata (QCA), molect circuits, Nano-computer Architecture.Defect analysis and Reliability: purpose of defect analysis in n	CO2	Explain and	understand Quantum M	echanical Cog	gnitive	Unders	stand	,
CO3 Determine and Describe Semiconductor and Device Cognitive Psychomotor Understand, Guided Set CO4 Describe and Illustrate the Quantum computing Cognitive Psychomotor Understand, Mechanism CO5 Classify and Describe the Quantum DOT cellular Automata Cognitive Psychomotor Understand, Mechanism UNIT I Introduction 6+6 Introduction: Recent past, the present scenario of Computing and its challenges, Future, Overview basic Nano electronics. 6+6 UNIT II Quantum Mechanical Tunnel Devices 6+6 Overview of current research in nano-scale electronics and devices 6+6 UNIT III Semiconductor and Device 6+6 Photonic Device and Materials, CMOS Device, Limit of CMOS technology-Scaling Theory. Quant Dots & Quantum wires. 6+6 UNIT IV Quantum computing: 6+6 Quantum computing: Basics and examples: introduction, axioms, quantum states and notation, unitaries, Measurement, Quantum circuits: classical reversible circuits, quantum circuits, universality. 6+6 INIT V Quantum DOT cellular Automata (QCA) 6+6 Introduction to nano-electronic and nano-computers, Quantum DOT cellular Automata (QCA), molect circuits, Nano-computer Architecture.Defect analysis and Reliability: purpose of defect analysis in n		Tunnel Devic	ces	Psy	chomotor	Guideo	l Res	ponse
CO4 Describe and Illustrate the Quantum computing Cognitive Understand, Psychomotor Mechanism CO5 Classify and Describe the Quantum DOT cellular Cognitive Understand, Automata Psychomotor Mechanism UNIT I Introduction 6+6 Introduction: Recent past, the present scenario of Computing and its challenges, Future, Overview basic Nano electronics. 6+6 UNIT II Quantum Mechanical Tunnel Devices 6+6 Overview of current research in nano-scale electronics and devices 6+6 Photonic Device and Materials, CMOS Device, Limit of CMOS technology-Scaling Theory. Quantum bots & Quantum wires. 6+6 Quantum computing: Basics and examples: introduction, axioms, quantum states and notation, unitaries, Measurement, Quantum circuits: classical reversible circuits, quantum circuits, universality. 6+6 UNIT V Quantum DOT cellular Automata (QCA) 6+6 Introduction to nano-electronic and nano-computers, Quantum DOT cellular Automata (QCA) 6+6	CO3 Determine and Describe Semiconductor and Device Cognitive Unde						stand	,
CO4 Describe and Illustrate the Quantum computing Cognitive Understand, Psychomotor Mechanism CO5 Classify and Describe the Quantum DOT cellular Cognitive Understand, Automata Psychomotor Mechanism UNIT I Introduction 6+6 Introduction: Recent past, the present scenario of Computing and its challenges, Future, Overview basic Nano electronics. 6+6 UNIT II Quantum Mechanical Tunnel Devices 6+6 Overview of current research in nano-scale electronics and devices 6+6 Photonic Device and Materials, CMOS Device, Limit of CMOS technology-Scaling Theory. Quantum Dots & Quantum wires. 6+6 Quantum computing: 6+6 Introduction to nano-electronic and nano-computers,Quantum DOT cellular Automa				Psy	chomotor	Guideo	1	
CO4Describe and Illustrate the Quantum computingCognitive PsychomotorUnderstand, MechanismCO5Classify and Describe the Quantum DOT cellular AutomataCognitive PsychomotorUnderstand, MechanismUNIT IIntroductionf+6Introduction:Recent past, the present scenario of Computing and its challenges, Future, Overview basic Nano electronics.f+6UNIT IIQuantum Mechanical Tunnel Devicesf+6Overview of current research in nano-scale electronics and devicesf+6UNIT IIISemiconductor and Devicef+6Photonic Device and Materials, CMOS Device, Limit of CMOS technology-Scaling Theory. Quant Dots & Quantum wires.f+6UNIT IVQuantum computingf+6Quantum computing:Basics and examples: introduction, axioms, quantum states and notation, unitaries, Measurement, Quantum circuits: classical reversible circuits, quantum circuits, universality.f+6UNIT VQuantum DOT cellular Automata (QCA)f+6Introduction to nano-electronic and nano-computers, Quantum DOT cellular Automata (QCA), molecricicuits, Nano-computer Architecture.Defect analysis and Reliability: purpose of defect analysis in n						Set		
CO5 Classify and Describe the Quantum DOT cellular Cognitive Understand, Automata Psychomotor Mechanism UNIT I Introduction Fecent past, the present scenario of Computing and its challenges, Future, Overview basic Nano electronics. 6+6 UNIT II Quantum Mechanical Tunnel Devices 6+6 Overview of current research in nano-scale electronics and devices 6+6 Photonic Device and Materials, CMOS Device, Limit of CMOS technology-Scaling Theory. Quantum Dots & Quantum wires. 6+6 Quantum computing: Basics and examples: introduction, axioms, quantum states and notation, unitaries, Measurement, Quantum circuits: classical reversible circuits, quantum circuits, universality. 6+6 INIT V Quantum DOT cellular Automata (QCA) 6+6 Introduction to nano-electronic and nano-computers, Quantum DOT cellular Automata (QCA), molecticicuits, Nano-computer Architecture.Defect analysis and Reliability: purpose of defect analysis in n 6+6	CO4	Describe and	Illustrate the Quantum c	omputing Cog	gnitive	Unders	stand	,
CO5Classify and Describe the Quantum DOT cellular AutomataCognitive PsychomotorUnderstand, MechanismUNIT IIntroduction6+6Introduction: Recent past, the present scenario of Computing and its challenges, Future, Overview basic Nano electronics.6+6UNIT IIQuantum Mechanical Tunnel Devices6+6Overview of current research in nano-scale electronics and devices6+6UNIT IIISemiconductor and Device6+6Photonic Device and Materials, CMOS Device, Limit of CMOS technology-Scaling Theory. Quant Dots & Quantum wires.6+6UNIT IVQuantum computing6+6Quantum computing: Basics and examples: introduction, axioms, quantum states and notation, unitaries, Measurement, Quantum circuits: classical reversible circuits, quantum circuits, universality.6+6UNIT VQuantum DOT cellular Automata (QCA)6+6Introduction to nano-electronic and nano-computers, Quantum DOT cellular Automata (QCA), molectic circuits, Nano-computer Architecture.Defect analysis and Reliability: purpose of defect analysis in n				Psy	chomotor	Mecha	nism	
AutomataPsychomotorMechanismUNIT IIntroductionIntroduction:6+6Introduction:Recent past, the present scenario of Computing and its challenges, Future, Overview basic Nano electronics.6+6UNIT IIQuantum Mechanical Tunnel Devices6+6Overview of current research in nano-scale electronics and devices6+6UNIT IIISemiconductor and Device6+6Photonic Device and Materials, CMOS Device, Limit of CMOS technology-Scaling Theory. Quant Dots & Quantum wires.6+6UNIT IVQuantum computing6+6Quantum computing:Basics and examples: introduction, axioms, quantum states and notation, unitaries, Measurement, Quantum circuits: classical reversible circuits, quantum circuits, universality.6+6UNIT VQuantum DOT cellular Automata (QCA)6+6Introduction to nano-electronic and nano-computers, Quantum DOT cellular Automata (QCA), molecu circuits, Nano-computer Architecture.Defect analysis and Reliability: purpose of defect analysis in n	CO5 Classify and Describe the Quantum DOT cellular Cognitive Understand						derstand,	
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circuits, Nano-computer Architecture.Defect analysis and Reliability: purpose of defect analysis in n	Introduction to nano-electronic and nano-computers, Quantum DOT cellular Automata (QCA), molecular							
computing and Challenges.Reliability measurement in nano scale computing. Different soft comput								
tool for reliability analysis like Bayesian Network, Neural Network								
LECTURE TUTORIAL PRACTICAL TOTA		OTAL						

HOURS	HOURS 30 0 30 60										
List of Experiments											
10 to 12 Experiments will b	e provided relevant	to the five course outco	ome based on the fact	ılty will be							
taught and also feasibility.											
TEXT BOOK											
1. Quantum Dots – Theory a	and Applicationsby	Vasilios N. Stavrou, Cl	BS Publishers & Dist	ributors Pvt.							
Ltd											
2. Quantum Dots: Optics, E	2. Quantum Dots: Optics, Electron Transport and Future Applications 1st Edition by										
Alexander Tartakovskii.											
3. Quantum Dots – A Variet	y of New Application	ons Edited by Ameenal	n Al-Ahmadi Publish	ed by InTech							
REFERENCES											
1. "Quantum -dot Dev	ices and Quantum-d	ot Cellular automata"	by Wolfgang Prodog,	Elsevier							
Science.											
2. "Electronic Transpo	ort in Quantum dot C	Cellular Automata", Le	o P. Kouwenhoven								
3. "Quantum-dot Cellular Automata, Theory, Experimentation and Prospects" M. Macucci											
4. "Probabilistic Mode	4. "Probabilistic Modeling of Quantum-dot Cellular Automata", Saket Rivastava, PhD dissertation										
5. "Quantum Computa	tion: Theory and Im	plementation", Edwar	d Stuart Boyden								

COURSE CODEYNT205FLTP								C	
COURS	SE NAME	Lithography techniques		2	0		1	3	
PRERE	QUISITES			L	Т	l	Р	Н	
C:P:A		1.5:1.2:0.3		2	0		2	4	
COURSE OUTCOMES DOMAIN LEVEL									
C01	CO1 Explain Basic Concept Of Micro fabrication Cognitive Understand								
			Psy	ychomoto	or	Ren	nember		
CO2	CO2Explain And Understand Photolithography AndCognitiveUnderstand,							,	
	Patterning Of T	hin Films	Psy	ychomoto	or	Gui	ded Res	ponse	
CO3	Determine And	Describe Direct Writing Methods –	Co	gnitive		Und	erstand	,	
	Maskless Optica	al Lithography	Psy	ychomoto	or	Gui	ded Set	;	
CO4	Describe And II	lustrate The Electron Beam Lithography	Co	gnitive		Und	erstand	,	
	(Ebl), X-Ray Ar	nd Ion Beam Lithography	Psy	ychomoto	or	Mec	hanism		
CO5	CO5Classify And Describe The Nanoimprint LithographyCognitiveUnderstand						erstand	,	
	And Soft Lithog	graphy	Psy	Psychomotor M		Mec	hanism		
UNIT	UNIT I Introduction And Micro fabrication 6+6								
Micro fa	abrication process	s flow diagram – Chip cleaning, coating of	pho	to resists,	patterr	ning, e	etching,		
inspecti	on – Process integ	gration – Etching techniques- Reactive Ion	etch	ing- RIE	reactiv	e ion	etching	;-	
Magnet	ically enhanced R	IEIBE Ion beam etching.							
UNIT I	I Photolithe	ography And Patterning Of Thin Films					6-	+6	
Lithogra	aphy -Optical lith	ography – different modes – Optical proje	ectio	n lithogra	aphy –	Multi	stage so	canners	
– resolu	- resolution and limits of photolithography - Resolution enhancement techniques - Photo mask- Binary								
mask- l	Phase shift mask	a – Attenuated phase shift masks – alte	ernat	ing phas	e shift	mas	ks – O	ff axis	
illumination- Optical proximity correction - Sub resolution assist feature enhancement-Optical immersion									
lithography									
UNIT IIIDirect Writing Methods – Maskless Optical Lithography6+6							+6		
Mask less optical projection lithography – types, Advantages and Limitations – required components –									
Zone plate array lithography – Extreme ultraviolet lithography – Light sources – Optics and materials issues									
UNIT IVElectron Beam Lithography (Ebl), X-Ray And Ion Beam Lithography6+6									
Scanning electron-beam lithography- Electron sources and electron optics system mask less EBL- parallel									
direct-write e-beam systems-electron beam projection lithography - Scattering with angular limitation									
projectio	projection e-beam lithography (SCALPEL) – Projection reduction exposure with variable axis immersion								
lenses. 2	XRPP – Ion beam	lithography-Focusing ion beam lithograph	ny –	Ion proje	ction li	thogr	aphy.		

UNIT V Nanoimprint Lithography And Soft Lithography							
Nanoimprint lithography (NIL)- NIL - hot embossing - UV-NIL- Soft LithographyMoulding/Replica							
moulding: PE	OMS stan	nps – Printing w	ith soft stamps- Edge lithogr	aphy – DipPen Lithog	graphy-set up and		
working princ	ciple – Se	lf-assembly – Ll	B films – Rapid prototyping.				
LECTURE TUTORIAL PRACTICAL TOTAL							
HOUR	S	30	0	30	60		
TEXT BOO	K						
1."Lithograph	nic and M	icromachining 7	Techniques for Optical Compo	onent Fabrication: II: 2	2 (Proceedings of		
SPIE)" by Err	nst-Bernh	ard Kley and Ha	nns Peter Herzig				
2."Nanoscale	CMOS V	LSI Circuits: D	esign for Manufacturability" l	by Sandip Kundu and A	Aswin Sreedhar		
3."Organic N	lanomater	rials: Synthesis,	Characterization, and Devic	e Applications" by T	omas Torres and		
Giovanni Bottari							
4. "Fabrication Techniques for Micro-Optical Device Arrays" by Ryan D Conk							
5."Aligned Carbon Nanotubes: Physics, Concepts, Fabrication and Devices (NanoScience and							
Technology)" by Yucheng Lan and Zhifeng Ren							
6."Nanomaterials: A Guide to Fabrication and Applications (Devices, Circuits, and Systems)" by							
Sivashankar Krishnamoorthy							