Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Third Year Engineering

(Biotechnology Engineering)

Faculty of Science and Technology



SYLLABUS

Semester – V & VI

W.E.F. 2020 – 21

			Taaahing	Sahama			Eva	aluation Sc	heme		
		Teaching Scheme		Theory		Practical					
Name of the Course	Group	Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE	Total	Credits
Molecular Biology	D	3	-	-	3	40	60	-	-	100	3
Reaction Engineering	D	3	-	-	3	40	60	-	-	100	3
Enzyme Engineering	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course –I	Е	3	-	-	3	40	60	-	-	100	3
Open Elective Course – I	F	3	-	-	3	40	60	-	-	100	3
LAB Molecular Biology	D	-	-	2	2	-		25	25(OR)	50	1
LAB Reaction Engineering	D	-	-	2	2	-		25	25(OR)	50	1
LAB- Pharmaceutical Biotechnology	D	-	-	2	2	-	-	25	25(OR)	50	1
Minor Project (Stage-I)	G	-	-	6	6	-	-	50	-	50	3
Constitution of India		-	-	-	-	-	-	-	-	-	0
		15	0	12	27	200	300	125	75	700	21

Syllabus Structure for Third Year Engineering (Semester – V) (Biotechnology Engineering) (w.e.f. 2020 – 21)

ISE: Internal Sessional Examination

ESE: End Semester Examination

ICA: Internal Continuous Assessment

	Professional Elective Course – I	Open Elective Course – I		
1	Food Biotechnology	1	Biofuel & Alcohol Technology	
2	System Biology	2	Bioorganic Chemistry	
3	Biothermodynamics	3	Biomedical Instrumentation	
4	Cell Biology	4	Energy Engineering	

			Taaahing	Sahama			Eva	aluation Sc	heme		
		Teaching Scheme		Theory		Practical					
Name of the Course	Group	Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE	Total	Credits
Genetic Engineering	D	3	-	-	3	40	60	-	-	100	3
Mass Transfer	D	3	-	-	3	40	60	-	-	100	3
Bioprocess Engineering	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – II	E	3	-	-	3	40	60	-	-	100	3
Open Elective Course – II	F	3	-	-	3	40	60	-	-	100	3
LAB Genetic Engineering	D	-	-	2	2	-	-	25	25(OR)	50	1
LAB Mass Transfer	D	-	-	2	2	-	-	25	25(OR)	50	1
LAB Bioprocess Engineering	D	-	-	2	2	-	-	25	-	25	1
Minor Project	G	-	-	6	6	-	-	50	25(OR)	75	3
Internship - II	Н	-	-	-	-	-	-	-	-	-	-
		15	-	12	27	200	300	125	75	700	21

Syllabus Structure for Third Year Engineering (Semester – VI) (Biotechnology Engineering) (w.e.f. 2020 – 21)

ISE: Internal Sessional Examination

ESE: End Semester Examination

ICA: Internal Continuous Assessment

	Professional Elective Course – II	Open Elective Course – II		
1	Plant Biotechnology	1	Environmental Biotechnology	
2	Protein Engineering	2	NanoBiotechnology	
3	Metabolic Engineering	3	Enterprise Resource Planning & SAP	
4	Stem Cell Technology	4	Bioprocess Instrumentation and Analysis	

*Internship - II is a mandatory and non-credit course. It shall be during summer vacation after semester - VI. The satisfactory completion of Internship should be submitted to university at the end of semester VIII.

Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Third Year Engineering

(Biotechnology Engineering)

Faculty of Science and Technology



'A' Grade NAAC Re-Accredited 3rd Cycle

SYLLABUS

Semester – V

W.E.F. 2020 – 21

				ar Biology			
~			COURSE	OUTLINE			
Course Title:		Molecul	ar Biology	Short Title:	Mol Bio	Course Code:	
Course d	description	n:			I		
This cou	rse is aim	ed at develo	pping the basic	knowledge and s	skills of mo	olecular	biology t
				xpected includes			
				urse are to under	stand the	oasic pri	nciples (
Molecula			plications in eng				
		Hours/week		Total hours Semester		er credi	
Lect	ture		Weeks				
03144201Prerequisite course(s):-11 th , 12 th Biology, SE Biotechnology courses				03			
			12 th Biology, Sl	E Biotechnology c	ourses		
	objectives						
				lls of molecular b			
				biology and their i		gical sys	stems.
		•	-	nolecular Biology.			
		the genetic					
			epts for protein	synthesis.			
	outcomes:		.11				
		-		tudent will be able			
			U U	oncepts and princip	-	in mit	ton and
	ral format.		amental concep	ts of molecular b	lology bou	i in write	len and
			d replication and	d its types			
			-	esign experiments	to address	a novel r	oroblem
	ne form of		develop and de	sign experiments			
		1 0	nowledge in a s	specialized field of	f molecular	biology.	
			0	CONTENT			
Name	of the Sub	oject: Molecu	ılar Biology	Semester:		V	
	a Sahama					•	
Teaching	g Scheme:	•		Examination so	heme	•	
	-		s/week			· ·	
Teaching Lectures	-	3 hour	s/week	Examination so End semester e		· ·	60
	-		s/week		xam (ESE)	· ·	60 marks
	-		s/week	End semester e	xam (ESE) E:	:	60 marks 03 hour 40
	5:	3 hour		End semester e Duration of ES Internal Session	xam (ESE) E: nal Exams	: (ISE):	60 marks 03 hour 40 marks
Lectures	Unit–I:	3 hour	No. of Lectu	End semester e Duration of ES	xam (ESE) E: nal Exams	:	60 marks 03 hour 40 marks
Lectures	Unit–I: ction to Go	3 hours	No. of Lectu	End semester e Duration of ES Internal Session res: 08 Hours	xam (ESE) E: nal Exams N	: (ISE): Iarks: 12	60 marks 03 hour 40 marks 2
Lectures Introduct	Unit–I: ction to Gettion: Nucle	3 hours	No. of Lectu rial NA Chemical C	End semester e Duration of ES Internal Session res: 08 Hours Composition, Char	xam (ESE) E: nal Exams N rgoffs Equ	: (ISE): Iarks: 12	60 marks 03 hour 40 marks 2 ase Rati
Lectures Introduct Molecula	Unit–I: ction to Generation: Nuclear Structure	3 hour enetic Mate eic acids, DI e of DNA, W	No. of Lectu rial NA Chemical C /atson and Cricl	End semester e Duration of ES Internal Session res: 08 Hours Composition, Char Composition Helical I	xam (ESE) E: nal Exams N rgoffs Equ	: (ISE): Iarks: 12	60 marks 03 hour 40 marks 2 ase Rati
Lectures Introduct Introduct Molecula (B-DNA,	Unit–I: ction to Gettion: Nuclear Structure , A-DNA,	3 hours enetic Mater eic acids, DI e of DNA, W C-DNA, D-I	No. of Lectu rial NA Chemical C /atson and Crich DNA, E-DNA, 2	End semester e Duration of ES Internal Session res: 08 Hours Composition, Char Composition, Char Composition Helical I Z-DNA)	xam (ESE) E: nal Exams N goffs Equ Model of D	: (ISE): Iarks: 12 imolar B NA, form	60 marks 03 hour 40 marks 2 ase Ratins of DN
Introduc Introduct Molecula (B-DNA, RNA: O	Unit–I: ction to Gettion: Nuclear Structure, A-DNA, cccurrence,	3 hours enetic Mater eic acids, Di e of DNA, W C-DNA, D-I types of R	No. of Lectu rial NA Chemical C /atson and Crick DNA, E-DNA, 7 NA: rRNA, tR	End semester e Duration of ES Internal Session res: 08 Hours Composition, Char Composition, Char Couble Helical I Z-DNA) NA, mRNA. Str	xam (ESE) E: nal Exams N goffs Equ Model of D	: (ISE): Iarks: 12 imolar B NA, form	60 marks 03 hour 40 marks 2 ase Rati as of DN
Introduc Introduct Molecula (B-DNA, RNA: O	Unit–I: ction to Gettion: Nuclear Structure, A-DNA, cccurrence,	3 hour enetic Mate eic acids, DI e of DNA, W C-DNA, D-I types of R – One Polyp	No. of Lectu rial NA Chemical C Vatson and Crick DNA, E-DNA, 7 NA: rRNA, tR eptide Hypothes	End semester e Duration of ES Internal Session res: 08 Hours Composition, Char Composition, Char Couble Helical I Z-DNA) NA, mRNA. Str	xam (ESE) E: nal Exams Model of D ucture of r	: (ISE): Iarks: 12 imolar B NA, form	60 marks 03 hour 40 marks 2 ase Rati as of DN s. Centr
Introduct Introduct Molecula (B-DNA, RNA: O Dogma, 0	Unit–I: ction to Gene tion: Nucle ar Structure , A-DNA, ccurrence, One Gene	3 hour enetic Mate eic acids, DI e of DNA, W C-DNA, D-I types of R – One Polyp	No. of Lectu rial NA Chemical C Vatson and Crick DNA, E-DNA, 7 NA: rRNA, tR eptide Hypothes	End semester e Duration of ES Internal Session res: 08 Hours Composition, Char Compo	xam (ESE) E: nal Exams Model of D ucture of r	: (ISE): Iarks: 12 imolar B NA, form	60 marks 03 hour 40 marks 2 ase Ratins of DN s. Centr
Lectures Introduct Introduct Molecula (B-DNA, RNA: O Dogma, (DNA Re	Unit–I: ction to Get tion: Nucle ar Structure , A-DNA, ccurrence, One Gene Unit–II: plication	3 hour enetic Mater eic acids, DI e of DNA, W C-DNA, D-I types of R – One Polyp	No. of Lectur rial NA Chemical C Jatson and Crick DNA, E-DNA, Z NA: rRNA, tR eptide Hypothes No. of Lectur	End semester e Duration of ES Internal Session res: 08 Hours Composition, Char Compo	xam (ESE) E: nal Exams Model of D ucture of r	: (ISE): Iarks: 12 imolar B NA, form ibosome' Iarks: 12	60 marks 03 hour 40 marks 2 ase Rati as of DN 's. Centr 2
Lectures Introduct Molecula (B-DNA, RNA: O Dogma, (DNA Re Replicati	Unit–I: ction to Genetion: Nuclear Structure , A-DNA, ccurrence, One Genetion Unit–II: plication on: Over	3 hour enetic Mate eic acids, DI e of DNA, W C-DNA, D-I types of R – One Polyp : view, Basic	No. of Lectur rial NA Chemical C Jatson and Crick DNA, E-DNA, Z NA: rRNA, tR eptide Hypothes No. of Lectur rules and re	End semester e Duration of ES Internal Session res: 08 Hours Composition, Char Composition, Char Couble Helical I C-DNA) NA, mRNA. Strussis. res: 08 Hours	xam (ESE) E: nal Exams goffs Equ Model of D ucture of r N Replication,	: (ISE): larks: 12 imolar B NA, form ibosome' larks: 12 Types	60 marks 03 hour 40 marks 2 ase Ratins of DN s. Centr 2 of DN

masharian of DNA mulication	Ensure and metains involves	d in DNA nonlighting Structure				
mechanism of DNA replication, Enzymes and proteins involved in DNA replication: Structure and functions of DNA polymerase I,II,III, primase, polynucleotide ligase, endonuclease,						
helicase, single stranded binding proteins, topoisomerase, Replication Models Theta replication						
		cation Models Theta replication				
model, Rolling circle Model, D-Loop Model.						
Unit–III:	No. of Lectures: 09 Hours	Marks: 12				
Transcription	ite of Lectures. 07 Hours					
-	of RNA: Transcription, Me	chanism of Transcription in				
	of prokaryotes (structure, typ					
	ar Mechanism of Transcription					
	Eukaryotes, RNA polymerase	•				
	Factors, Eukaryotic prom					
	troduction, processing of the pre					
transcript(eukaryotic), RNA spl						
Unit–IV:	No. of Lectures: 09 Hours	Marks: 12				
Genetic Code and Protein Syn	thesis					
Genetic code: Nature and chara	cteristics of Genetic Code, Reas	sons for degeneracy, Biological				
Significance of Degeneracy of C	Genetic Code					
Protein synthesis:- Mechanism	n of protein synthesis: Transci	ription Overview, Translation:				
	ttachment of activated amino aci					
	okaryotes and Eukaryotes, Tr					
	eins (Protein Folding and Bioche	mical Modifications)				
Unit–V:	No. of Lectures: 08 Hours	Marks: 12				
Regulation of gene expression						
	es, Mechanisms of gene regu					
L	Operon System, Tryptophan Op	peron System, Gene regulation				
and Translation level, Gene reg	•					
• •	ypes of damages, damaging	• •				
	oostreplicational recombination r	epair, SOS repair.				
Text Books:						
1. Veer Bala Rastogi, Fundamentals of Molecular Biology, Ane Books Pvt. Ltd						
	lecular Biology, Third Edition, F	Rastogi Publications				
Reference Books:		Rastogi Publications				
	Biology of cell	Rastogi Publications				

				Ingineering			
			COURSE	OUTLINE			
Course Title:		Reaction 1	Engineering	Short Title:	RE	Course Code:	
Course d	lescriptio	n:					
			led to provide a rocess industrie	strong foundation	in concep	pts and pr	inciples of
Chenneu		Hours/week		Total ho	irs	Semest	ter credits
Lect			Weeks	10000100		Semes	
2000	03 14 42 03				03		
Prereaui	site cours			SE Biotechnology	Courses.		
-	bjectives						
2. To 2 3. To 2 4. To 2 5. To 2 Course o After suc 1. Det 2. Ana 3. Apprendict	understan understan design var interpret t utcomes: cessful co ermine th alyze and oly the fur ctors.	d the kinetic s d the kinetic s rious types of he experimen ompletion of t e rate and ord interpret the h indamentals of	study of various study of various reactors used in tal data. his course the suler of reaction finkinetics of react	biochemical reac n process industrie tudent will be able com experimental	tions. es. e to: data.	n differer	nt types of
5. Use				erent types of hor	nogeneous	s and hete	erogeneous
5. Use read	the varions.	ous types of r	course of the co	erent types of hor	nogeneous		
5. Use read	the varions.	ject: Reaction	reactors for diffe	erent types of hor CONTENT Semester:		s and hete	
5. Use read	the varions.	ject: Reaction	COURSE COURSE	erent types of hor			
5. Use read	e the vario ctions. of the Subj g Scheme	ject: Reaction	COURSE COURSE	erent types of hor CONTENT Semester:	heme	V	
5. Use read Name o Teaching	e the vario ctions. of the Subj g Scheme	ject: Reaction	COURSE COURSE	erent types of hor CONTENT Semester: Examination sc	heme	V	7
5. Use read Name o Teaching	e the vario ctions. of the Subj g Scheme	ject: Reaction	COURSE COURSE	erent types of hor CONTENT Semester: Examination sc	heme kam (ESE	V	⁷ 60
5. Use read Name o Teaching	e the vario ctions. of the Subj g Scheme	ject: Reaction	COURSE COURSE	erent types of hor CONTENT Semester: Examination sc End semester ex	heme xam (ESF E:	V E):	60 marks
5. Use read Name o Teaching	e the vario ctions. of the Subj g Scheme	ject: Reaction : 3 hours	reactors for difference of the course of the	erent types of hor CONTENT Semester: Examination sc End semester ex Duration of ES	heme xam (ESE E: nal Exams	V E):	60 marks 03 hours 40 marks
5. Use read Name o Teaching Lectures Introduct reaction,	the variations. f the Subj g Scheme Unit–I: ion to ch order and d tempera	iect: Reaction iect: Reaction iemical reaction d molecularit ature depende	reactors for difference of the course of the	erent types of hor CONTENT Semester: Examination sc End semester ex Duration of ES Internal Session res: 09 Hours : Classification of ate constant, active n of theories, Read	heme xam (ESE E: nal Exams I f chemica vation ene	V E): s (ISE): Marks: 12 al reaction ergy, trans- nanism.	60 marks 03 hours 40 marks 2 ns, rate of sition state
5. Use read Name o Teaching Lectures Introduct reaction, theory an	the variations. f the Subj g Scheme Unit–I: ion to ch order and d tempera Unit–II	iemical reaction molecularity	COURSE (COURSE (Engineering No. of Lecture ion engineering y of reaction, r ency, comparison No. of Lecture	CONTENT Semester: Examination sc End semester ex Duration of ES Internal Session res: 09 Hours : Classification of ate constant, active n of theories, Read res: 08 Hours	heme xam (ESE E: nal Exams f chemica vation ene ction mech	V C): s (ISE): Marks: 12 al reaction ergy, trans nanism. Marks: 12	60 marks 03 hours 40 marks 2 ns, rate of sition state 2
5. Use read Name o Teaching Lectures Introduct reaction, theory an Collectio	the vario tions. f the Subj Scheme Scheme Unit–I: ion to ch order and d tempera Unit–II n and interview.	iect: Reaction iect: Reaction i 3 hours iemical reaction d molecularity ature depende ierpretation of	No. of Lecture of reaction, reaction	erent types of hor CONTENT Semester: Examination sc End semester examination of ESI Duration of ESI Internal Session res: 09 Hours : Classification of theories, Read res: 08 Hours integral and diffe	heme kam (ESE E: nal Exams I f chemica vation ene ction mech I rential me	V E): s (ISE): Marks: 12 al reaction ergy, trans- nanism. Marks: 12 ethod of a	60 marks 03 hours 40 marks 2 ns, rate of sition state 2 analysis of
5. Use read Name o Teaching Lectures	the vario tions. f the Subj Scheme Scheme Unit–I: ion to ch order and d tempera Unit–II n and interview.	iemical reaction iemical reaction implemented implemen	No. of Lecture ion engineering No. of Lecture ion engineering y of reaction, restriction, restriction ion of Lecture ion engineering y of reaction, restriction, restriction ion of Lecture ion batch	erent types of hor CONTENT Semester: Examination sc End semester examination of ESI Duration of ESI Internal Session res: 09 Hours : Classification of theories, Read res: 08 Hours integral and difference	heme kam (ESE E: nal Exams of chemica vation ene ction mech i rential ma volume ba	V E): s (ISE): Marks: 12 al reaction ergy, trans- nanism. Marks: 12 ethod of a	60 marks 03 hours 40 marks 2 ns, rate of sition state 2 analysis of r.
5. Use read Name of Teaching Lectures Introduct reaction, theory an Collectio data, Hall Ideal read time and	the vario tions. f the Subj g Scheme Scheme Unit–I: ion to ch order and d tempera Unit–II n and inter f life meth Unit–III ctors, mix l space	iect: Reaction iect: Reaction iemical reaction d molecularit ature depende ierpretation of nod , Constan ied flow reac time, compa	No. of Lecture ion engineering No. of Lecture ion engineering y of reaction, r incy, comparison No. of Lecture f kinetic data, , t volume batch No. of Lecture ion engineering	erent types of hor CONTENT Semester: Examination sc End semester examination of ESI Duration of ESI Internal Session res: 09 Hours : Classification of theories, Read res: 08 Hours integral and diffe	heme kam (ESE E: hal Exams I f chemica vation ene ction mech I rential me volume ba I e and spa	V E): s (ISE): Marks: 12 al reaction ergy, trans- nanism. Marks: 12 ethod of a tch reacto Marks: 12 ce velocit	60 marks 03 hours 40 marks 2 ns, rate of sition state 2 analysis of r. 2 ty, holding
5. Use read Name of Teaching Lectures Introduct reaction, theory an Collectio data, Hall Ideal read time and	the vario tions. f the Subj g Scheme Scheme Unit–I: ion to ch order and d tempera Unit–II n and int f life meth Unit–III ctors, mix	iect: Reaction iect: Reaction i 3 hours a shours i a molecularit a molecularit a molecularit a molecularit a ture depende i erpretation of nod , Constan i a compa ion.	No. of Lecture ion engineering No. of Lecture ion engineering y of reaction, r ion, comparison No. of Lecture f kinetic data, , t volume batch ion, plug flow further ion in mixe	content types of hor CONTENT Semester: Examination sc End semester examination of ESI Internal Session res: 09 Hours : Classification of theories, Read res: 08 Hours integral and difference or to the constant, active of t	heme xam (ESE E: nal Exams f chemica vation ene ction mech l rential me volume ba volume ba l e and spa	V E): s (ISE): Marks: 12 al reaction ergy, trans- nanism. Marks: 12 ethod of a tch reacto Marks: 12 ce velocit	60 marks 03 hours 40 marks 2 ns, rate of sition state 2 analysis of r. 2 ty, holding le reactor,

information, Models for non-ideal flow, Dispersion models, Concept of micro and macro							
mixing.							
Unit–V:	Unit–V: No. of Lectures: 09 Hours Marks: 12						
Introduction to Rate equations	for heterogeneous systems, Con	tacting patterns in Two –Phase					
system, Introduction to fluid pa	system, Introduction to fluid particle reaction non-catalytic reactions, un reacted core model for						
Spherical particle of unchanged	ing size, Rate of reaction for	shrinking spherical particles,					
Determination of rate controlli	ng step ,Various contacting path	terns in fluid solid reactors for					
fluid-particle non-catalytic reac	tions.						
Text Books:							
1. Octave Levenspiel, Cher	1. Octave Levenspiel, Chemical reaction engineering, John Wiley and sons.						
2. Scott Fogler, Elements of	of chemical reaction engineering,	Prentice Hall New, Jersy.					

3. S.D. Dawande, Principles of reaction engineering, Central Techno publication, Nagpur.

Reference Books:

1. J.M. Smith, Chemical engineering kinetics, McGraw Hill

2. Lanny D. Schimdt, Chemical reaction engineering, Oxford University Press.

			Enzyme E	ngineering	g			
			COURSE					
Course Title:		Enzyme Ei			Short Title: EE		Course Code:	2
	escription:						00400	
	_		earning the b	asic funda	mentals	of Enzy	me Engi	neering to
			als of the cou			•	•	0
			duction, purifi					
areas.		× 1	× 1					
	H	lours/week	No. of	Т	otal hou	irs	Semest	er credits
Lectu	ure		Weeks					
		03	14		42			03
Prerequi	site course	(s):- 12 th Std	. Science and S	SE Biotech	nology	Courses.		
	bjectives:							
	0	nowledge of	enzyme & its	classificati	on & its	s role in m	etabolic p	athway of
	ng systems.	U	5				1	5
	•••	nted with er	nzyme kinetics	s and its a	applicat	ion in pro	oduction	of desired
	lucts.					1		
-		conduct exp	eriments to an	alyze and	interpre	et enzyme	kinetic d	ata for the
	-	-	or production o	•	-	•		
	••••		nalytical techn		-		enzymes	
-	-		cation of en	-			•	
				-		is muusu	usee	
		ог вторгоац	cts for the welf	lare of soci	ety.			
Course o		1 C.1	•	. 1 . 111	1 11			
			is course the st			to:		
	• •		sis of their wor	0				
		•	ics and activity	• •	-	rious assag	ys.	
			y using moder			on hattan a	tability of	ad activity
			ious immobiliz sses during use		inques i	of better s	tability a	
			n of various er		lifforon	t metaboli	o nothway	10
J. App	ny molecula						c pattiway	/5.
Name o	f the Subje	ct: Enzyme I		Semester			V	
	ð						v	
	Scheme:			Examina				
Lectures		3 hours/	week	End sem	ester ex	am (ESE):	60
				-		_		marks
				Duration				03 hours
				Internal	Session	al Exams	(ISE):	40 marks
	Unit–I:		No. of Lectur	res: 08 Ho	urs	N	Aarks: 12	2
Introduc	tion to Enz	vmes:						
		-	ernational unit	ts and type	es of en	zymes. Ge	eneral cha	aracters of
			ificity, catalys	• 1		•		

Classification, nomenclature, International units and types of enzymes, General characters of enzymes: characters such as specificity, catalysis and regulation and localization of enzymes in the cell, Structure of enzymes: Primary, secondary and tertiary structure of enzyme, Models of enzyme activity: Lock and key model, Induced fit, Substrate Strain model. Isoenzyme, with example and its application.

							
Unit–II:	No. of Lectures: 09 Hours	Marks: 12					
Enzyme Kinetics:							
Introduction to kinetics: activation energy, transition state theory and energy, consideration,							
Enzyme kinetics, rate equation, Rate of reaction, First order and second order reaction,							
Michaelis – menten equation (Steady state kinetics) and Haldane relationship, Significance of							
Km, Lineweaver – Burk or Double – reciprocal plot, Eadie- Hofstee plot, Hanes plot, Turnover							
number, Specificity constant, B	isubstrate reaction.						
Unit–III:	No. of Lectures: 09 Hours	Marks: 12					
Enzyme inhibition, its kinetic	s and Catalysis:						
Types of inhibition- Reversible	e and irreversible inhibition, K	Linetics of inhibition. Catalytic					
efficiency- proximity and orie	entation effects, distortion or st	rain, Different mechanisms of					
enzyme catalysis, acid base	and covalent catalysis and r	metal-ion catalysis, Molecular					
mechanism of action of chy	motrypsin, Lysozyme, Chemio	cal modification of enzymes,					
	action: Ping – Pong mechanism,						
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12					
Allosteric and regulatory enzy	yme, enzyme production and p	urification:					
Binding of ligands to Protein,	Co-operativity models- MWC and	nd KNF model, Regulations by					
allosteric enzymes, other mech	anisms of enzyme regulation-en	zyme induction and repression					
and covalent modification. Sou	rces of enzymes-animal plant an	d microbial sources, large scale					
production of enzymes- basic	methodology of production,	extraction and purification of					
enzymes, Enzyme production a	nd recombinant DNA technology	У.					
Unit–V:	No. of Lectures: 08 Hours	Marks: 12					
Enzyme immobilization:							
Methods of immobilization - id	onic bonding, adsorption, covale	nt bonding (based on R groups					
of amino acids), and microe	ncapsulation and gel entrapme	nt, Properties of immobilized					
enzymes, Applications of immo	bilized enzymes.						
Enzyme Applications: Applica	tions of enzymes in food, suga	ar, leather, detergent industries					
etc., Uses of enzymes in drug,	medicine, industries, Uses of enz	zymes to make amino acids and					
peptides, Legislative and safety	aspects.						
Text Books:							
1. Lehninger, Nelson and co	x. Principles of Biochemistry –N	Iacmillan publishers.					
2. Palmer, Enzymes, Oxford	University press.						
Reference Books:							
1. Voet and Voet, Biochen	nistry, Wiley publisher.						
2. Biotol series, Principles	of Cell energetics, Butterworth	h- Heinemann Ltd, Jordan Hill,					
Oxford.							
3. Murray moo-young, Co	mprehensive Biotechnology Perg	gemon Press(Vol 2)					
4. Nicholascprice and Tew	vis stereous, Fundamentals of Enz	zymology, Oxford University					
press.							
	et Kargi, Bioprocess Engineering	g, Basic concepts, Prentice Hall					
India Pvt. Ltd., New De	lhi.						

Professional Elective Course - I									
			Food Biot	technology	y				
			COURSE	OUTLIN					
Course Title:		Food Bio	technology		Short Title:	FB	Г Cour Cod		
Course	descriptio	on:				•	•		
This cou	rse is int	roduced to un	derstand the co	onstituents	s of foo	d. This	course de	als	with the
study of	microorg	anism present	in food and the	principles	to cont	rol then	n		
Lect	ture	Hours/week	No. of Weeks	T	'otal ho	urs	Seme	este	r credits
		03	14 42 03			13			
Prerequisite course(s):- Microbiology, Unit operations and Biochemistry.									
Course	objective	s:							
2. T sj 3. T 4. T	 To understand the different microorganisms present and their role in causing food spoilage. To give the knowledge to students how to preserve the food. To get acquainted with production of different food products. 								
-	outcomes						~		
			his course the s	tudent will	l be able	e to:			
2. E 3. U 4. A 5. U	Distinguis Use their k Apply thei	h different con mowledge to p r knowledge o	croorganism res stituents of the reserve the foo f unit operation Il and moderr	food and t d. in food in	their rol ndustry.	e in boo	ly.	eng	gineering
			COURSE	CONTEN	Π				
Name of	the Subje	ect: Food Biote	echnology	Semeste	r:			V	
Teachin	g Scheme	2:		Examina	ation sc	heme			
Lectures	-	3 hours	/week	End sem	nester e	xam (E	SE):		60 narks
				Duratio	n of ES	E:		(3 hours
				Internal	Session	nal Exa	ims (ISE):		10 narks
	Unit–I	[No. of Lectu	res: 08 Ho	ours		Marks:	12	
Introduct and thei	Food Biotechnology:No. of Lectures: 08 HoursMarks: 12Introduction to food biotechnology, Constituents of food, the sources of dietary carbohydrates and their functional property, the sources of protein and their functions, requirements of vitamins, fatty acids in food.Image: 12								
	Unit–I	I:	No. of Lectur	res: 09 Ho	ours		Marks:	12	
Types of micro or	ganism i	ganism in foc n foods, Facto	od, Microbial e ors influencing oorne parasites,	microbial	activit	y, Food	-		

	Unit–III:	No. of Lectures: 08 Hours	Marks: 12				
Ferme	entation Processes Food						
		microbial culture in food ind	dustry, Fermentation of dairy				
	-	everage, Single cell proteins,	•				
sauerkraut, Fermentation for production of vinegar and Idly.							
	Unit–IV:	No. of Lectures: 09 Hours	Marks: 12				
Food S	Spoilage and Preservati	on:					
Causes	s of food spoilage, Spoil	age of various foods and food j	products, Deterioration of food				
quality	v, Food preservation usin	g high temperature, Evaporation	, Drying, Low temperature and				
Irradia	tion.						
	Unit–V:	No. of Lectures: 08 Hours	Marks: 12				
Food S	Storage and Packing:						
Storag	e and packaging of var	ious food products like fruits a	and vegetables, milk and milk				
produc	cts, bakery products, conf	ectionary products & other food	products.				
Text E	Books:						
1.	B. Sivashankar, Food Pr	ocessing and Preservation, Prent	ice Hall ,India.				
-	<u> </u>	General Microbiology (vol 2), H	limalaya Publishing House.				
	ence Books:						
1.		Comprehensive Biotechnology (Vol: 3), Pergamon Press, An				
	imprint of Elsevier.						
		egy: Fundamentals and Application	on, Agrobios India.				
3.	Fraizer, Food Microbiol						
4.		ering of Food: Detection of	Genetic Modifications, Willy				
	Publication.						
5.		chemical analysis of food and foo	1 1				
	Nostrand Company Pric	eton New Jersey (3rd edition, 20	06).				

			P	rofessional Ele	ective Co	urse - I				
System Biology										
-				COURSE		IE				
Course Title:			System	Biology		Short Title:	SB	Cou Coc		
Course	descriptio	on:				1				
	_		basics of	system biology	. It also in	ntroduce	s vario	us softwar	e in	volved in
				course has also						
construct	constructions of biological pathways.									
Lect	ture	Hou	rs/week	No. of WeeksTotal hoursSemester cred					r credits	
			03	14		42			()3
Prerequ	isite cour	rse(s)	- Bioche	mistry, Molecu	lar biolog	gy, Gene	tics.			
Course	objective	s:								
2. T	pproach. `o cover tl	he bas	sics of m	of both theore athematical mo- work for steady	deling pa	rt of Sys	tems B	-	sten	ı biology
				Modeling Cond				ell Biolo	v	
				al Models of B						S.
-	outcomes				1010 810 11				<u></u>	
			etion of t	his course the st	tudent wi	ll be abl	e to:			
1. A		-		gy analysis app				of molec	ula	r biology
-		assess	the qual	ity of high-thro	ughput pr	otein-pr	otein in	teraction of	lata	
	•		-	al networks.	011	I				
			0	ational metho	ds for b	oiologica	l netw	orks base	ed	on high-
tl	nroughput	t data.	. –			-				-
5. E	Describe a	nd ap	ply basic	algorithms.						
				COURSE	CONTEN	T				
Nan	ne of the S	Subjec	et: Syster	n Biology	Semeste	er:			\mathbf{V}	
Teachin	g Scheme	e:			Examin	ation so	heme			
Lectures	5:		3 hours	/week	End ser	nester e	xam (E	CSE):		60 marks
					Duratio	on of ES	E:		(03 hours
					Interna	l Sessio	nal Exa	ams (ISE)		40 marks
	Unit–I	[:		No. of Lectur	res: 08 H	ours		Marks		
System 1	Biology:									
•		tem S	Structure	Identification,	System	Behavi	or Ana	lysis, Sys	em	Control,
System	Design, 1	Measu	urement	Technologies	and Expe	erimenta	l meth	ods, Syste	em	Structure
Identific	ation, The	e Syst	em Proje	ct, Impacts of S	System Bi	ology.		-		
	Unit–I	I:		No. of Lectur	res: 09 H	ours		Marks	12	
	0	0		a Mining From ing A Gene N		-			/-St	ate Gene
Expressi	on Data,	Perfo	rmance o	of The DBRF N	Aethod, A	Applicati	on To	Yeast Gen	e E	xpression
Data, The Analysis of Cancer Associated Gene Expression Matrices, Automated Reverse										

Engineering of Metabolic Pathways From observed data by Means of Genetic Programming.							
Unit–III:	No. of Lectures: 08 Hours	Marks: 12					
Software for Modeling And Simulation:							
The ERATO Systems Biology Workbench: An Integrated Environment For Multiscale And							
		Biology Markup Language, The					
		For Signal Transduction With					
Applications To MAP-Kinase	e Pathways, Mapk Pathway	With Scaffolds: Experimental					
Background, Parameter Estimat	tion.						
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12					
Cellular Simulation:							
Towards A Virtual Biological	Laboratory, Modular Modeling	g Concept, Computational Cell					
Biology, The Stochastic Appro	ach, Modeling Bacterial Chemo	otaxis, Computer Simulation Of					
The Cell: Human Erythrocyte Model And Its Application.							
Unit–V:	No. of Lectures: 09 Hours	Marks: 12					
System-Level Analysis:							
		duction Pathways: An Analysis					
-		eedback control In Bacterial					
		And Positive Feedback As A					
- -	m In Homeostasis And Signa	l Transduction, Regulation of					
MAPK Concentration.							
Text Books:							
	tions of Systems Biology edited;	-					
	on to Systems Biology: Design F						
Circuits, First edition; C	hapman and Hall/CRC Publicati	ons.					
Reference Books:							
1. Eberhard Voit, First Co	urse in Systems Biology; Garland	d Science.					
2. Edda KlippSystems, Bio	ology , Wolfram Liebermeister; I	First edition Wiley VCH					

]	Professional E	lective Co	urse - I				
	Biothermodynamics								
			COURSE	OUTLIN	Έ				
Course Title:		Biothermo	odynamics		Short Title:	BTH	Cours Code		
Course	Course description:								
			hermodynamics	s system bi	ology. '	This cours	se has also	been dealt	
with various mathematical model constructions.									
Lec	ture	Hours/week	No. of Weeks	T	Total hours		Semester credits		
		03	14		42			03	
Prerequ	isite cour	se(s):- 12 th ST	D						
	objectives								
			with the basics of	f first law c	of therm	odvnamic	s both theo	oretical and	
		pects of thermo				oaynanne		lotiour und	
			with the basics of	f second la	w of the	rmodynan	nics both t	heoretical	
		al aspects of the				2			
			ncepts of materi	al and ener	gy balar	ice of the	systems.		
4. T	'o understa	nd the thermod	ynamic properti	ies of fluids			•		
5. T	'o explain t	the concepts of	thermodynamic	solutions.					
Course	outcomes:								
After suc	cessful co	mpletion of th	is course the stu	udent will	be able	to:			
1. I	Describe fin	rst and second	law of thermod	lynamics.					
2. A	apply the c	concept of mate	erial and energy	y balance.					
3. I	Discuss the	thermodynam	ic properties of	fluids.					
4. I	D emonstrat	te the concept of	of thermodynam	nic propert	ies of fl	uids.			
5. I	Describe cl	nemical concep	ots of ideal and	non ideal s	olution	5.			
			COURSE	CONTEN	JT				
Name of	the Subje	ct: Biothermod	lynamics	Semester	••			V	
Teachin	g Scheme	•		Examina	tion scl	neme			
Lecture	5:	3 hours/	/week	End sem			E):	60 marks	
				Duration	of ESI	E:		03 hours	
				Internal	Session	al Exam	s (ISE):	42 marks	
	Unit–I	:	No. of Lectur	res: 09 Ho	urs		Marks:	12	
Basic Co	oncepts In	Engineering	Thermodynan	nics:					
First an	d Secon	d law of th	ermodynamics	; Calculat	tion of	Work,	energy a	nd property	
changes	in revers	sible processe	s, Thermodyn	amics of	flow	processe	s; Power	cycles and	
refrigera	tion cycles	s, Residual pro	perties						
	Unit–II	[:	No. of Lectur	res: 08 Ho	urs		Marks:	12	
Materia	Balance:								
Steady s	tate and e	equilibrium, ty	pes of materia	l balances	, stoich	iometry o	of growth	and product	
formatio	n, Electroi	n balance, The	oretical oxygen	demand					
	Unit–II	I:	No. of Lectur	res: 09 Ho	urs		Marks:	12	
Energy	Balances:								
		-	e and Extensi		-		••	-	
			erties-reactive			•			
of combustion, Heat of reaction in non-standard condition; Energy balance equation for cell									

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
Thermodynamic Properties of	f Fluids:	
	roperties using equations of state v processes based on actual prope	; Maxwell relationships and their rty changes
Unit–V:	No. of Lectures: 08 Hours	Marks: 12
Solution Thermodynamics:		
Partial molar properties; con	acents of chemical potential	and for a deal man deal
	neepis of chemical potential	and fugacity ideal non ideal
1 1	on; Excess properties of mixtures	
1 1	1 1	
solutions; Gibbs Duhem equation	1 1	e
solutions; Gibbs Duhem equation corm position models Text Books:	1 1	; Activity Coefficient -
solutions; Gibbs Duhem equation corm position models Text Books:	on; Excess properties of mixtures s and M. M. Abbott. Introduction	; Activity Coefficient -
solutions; Gibbs Duhem equation corm position models Text Books: 1. J M. Smith, H. C. Van Ness Thermodynamics McGraw	on; Excess properties of mixtures s and M. M. Abbott. Introduction	; Activity Coefficient - to Chemical Engineering
solutions; Gibbs Duhem equation corm position models Text Books: 1. J M. Smith, H. C. Van Ness Thermodynamics McGraw	on; Excess properties of mixtures s and M. M. Abbott. Introduction Hill.	; Activity Coefficient - to Chemical Engineering

Professional Elective Course - I								
			Biology					
		COURSE	OUTLIN					
Course	Cell B	iology		Short	СВ	Course		
Title:				Title:		Code:		
Course description:								
This course is introduced for learning the basic fundamentals of Life sciences to undergraduate students. The prospectus includes a prior knowledge of Biotechnology. The goals of the course								
	re to understand the basic principles of Biotechnology and its applications in different areas.							
	Hours/week	No. of	Total hours Semester credit					
Lecture	Hours, week	Weeks	_ ^		uis	Semes	ici ci cuito	
Lecture	03	14		42			03	
Prerequisite cou			gv. Rotan				05	
Course objective			<u>5</u> , <u>5</u> , <u>5</u> ,	. j .				
	will understand	the structures a	and nurnos	ses of h	sic compor	ents of		
	ic and eukaryoti		1 1		1		I	
organelles	•	e cons, espeen	any macro	moreeu		unos, uno	•	
-	will understand	how these cell	ular compo	onents a	re used to g	generate a	and utilize	
energy in			1		C C			
	will apply their l	knowledge of a	cell biolog	y to sele	ected examp	oles of ch	nanges or	
	cell function. Th	-	-	•	-	-	-	
changes, o	or alterations of	cell function b	rought abo	out by n	nutation.	-	-	
	will learn the ba	sic principles o	of inheritar	nce at th	e molecula	r, cellula	r and	
Organism	levels.							
	will understand	-			1			
("Modern	genetics") and	organism-leve	l patterns o	of hered	ity ("classic	cal" gene	etics).	
Course outcome								
After successful of	<u>.</u>							
1. Apply all genetics.	knowledge ab	out basic biol	ogy to all	proble	ms in mole	ecular bi	ology and	
U	nd the knowledg	ge about living	g organism	ns which	n is main su	ubject of	molecular	
	nd genetics.	2	0			J		
	the current conc	epts in Cell Bi	ology, Ste	m Cell I	Biology and	d Develo	pment.	
4. Illustrate	the basic cellul	ar processes i	ncluding l	heredity	, transcript	ion/trans	lation (the	
central de	ogma), cellular	replication an	nd their r	ole in o	developmer	nt, physi	ology and	
higher lev	el biological or	ganization.						
5. Demonstr	ate the structu	re/function of	f the bas	sic com	ponents of	f prokar	yotic and	
eukaryoti	c cells including	macromolecu	les and org	ganelles	•			
		COURSE						
	e Subject: Cell	Biology	Semeste			V	,	
Teaching Schem	le:		Examina	ation sc	heme			
Lectures:	3 hours/	week	End sem	nester e	xam (ESE)	:	60	
			Duratio	n of FC	F۰		marks 03 hours	
			Internal	Sessiol	nal Exams	(15E):	40 marks	
							marks	

Unit–I:	No. of Lectures: 08 Hours	Marks: 12					
Cell Biology and Cell Theory:							
Structural organization of life, Concepts of modern cell, history of cell, Cell theory, Structure							
of cell:- Cell shape, size and cell number, Types of cells:- Prokaryotic cells and Eukaryotic							
cells, Chemistry of cells.							
Unit–II:	No. of Lectures: 08 Hours	Marks: 12					
Study of Intracellular Compo							
0	nctions of: Mitochondria, Plastic	1 1 1					
	nplex, Endoplasmic Reticulum, I	Endosomes, Lysosomes,					
Peroxisomes.							
Unit–III:	No. of Lectures: 08 Hours	Marks: 12					
Cell Division:							
	netic and biochemical approache						
•	check points, meiotic cell divisio	-					
· · · · · · · · · · · · · · · · · · ·	central cell cycle control systems						
Unit–IV:	No. of Lectures: 09 Hours	Marks: 12					
Basic Concepts in Genetics:							
	s law of segregation, Assump						
	Law of Independent Assortment						
1 0 0	cross of dihybrid & trihybrid, p	•					
	nodified concept, fine structure of						
Unit–V:	No. of Lectures: 09 Hours	Marks: 12					
Elements of Genetics:	1 1 .	1 1 1 1 1					
	chromosome number, size, mor	•••					
	Structural chromosomal aberra	-					
	of chromosomal aberrations, van						
	teristics of mutations, classification	· •					
Text Books:	- Introduction, gene frequency, g	genotype frequency, gene pool.					
	Kalvani Dublications						
1. B.D. Singh "Genetics"	egcularBiology"Rastogi Publicat	ions					
-	blecular Biology" New Age Inter						
Reference Books:	blology New Age litter	national Publications.					
1. C.B. Pawar" Cell Biolog	w" Himalaya Publications						
		lighting					
2. C.B. Pawar" Cell and Molecular Biology" Himalaya Publications.							

			р	Open Electiv iofuel and Alco					
			В		OUTLINE				
Course Title:	Bi	Biofuel and Alcohol Technology Short Title: BAT Course Code:							
Course description:									
	-		o develo	p the basic kno	wledge and	d opera	ations of	Biofuel a	and alcoho
technolog BE Biote biofuels j	gy to unde echnology productior	ergrac cour n & f	luate stu rses. The ermentat	dents. The back e goals of the ions for produc in engineering t	ground exp course are tion of orga	bected i to un	includes derstand	a prior kn the basic	owledge c principle
processes			rs/week			tal hou	IFC	Somos	ter credit
Lect		1100	15/ WEEK	Weeks	10		115	Semes	ter creun
Lett			03	14		42			03
Prereau	site cours	se(s).		cess engineering	g Fermentat		hnology	Biochemi	
	bjectives		Diopic	eess engineering	5, 1 011101110		linology	, Dioenenni	suy.
	U		asic kno	wledge and ski	lls in alcoho	ol prod	uction		
	-			wledge and ski		-			
	1			ots of Renewabl		1		resources	
				pes of fermenta					
				g processes for			1.		
	outcomes:		•		1				
After suc	cessful co	mple	tion of th	nis course the st	tudent will b	be able	to:		
1. U	nderstand	Biof	fuel and b	piomass produc	tion.				
				tical issues ass	ociated wit	h impl	lementin	g large sc	ale biofue
	nd biomas		U 1			_			
		echnic	cal, eco	nomic and en	vironmenta	l com	parisons	of vario	ous energ
•	/stems.	4		- (1 1 - - - - -					
				ethods of ferme			5.		
5. Il	iustrate th	e alco	Shot recy	cling & bioche COURSE					
Name of	the Subje	ot. Bi	ofuel an	d Alcohol	CUNTENT				
	the Subje		chnology		Sem	ester:		Ţ	V
Teaching	g Scheme			y	Examinat	ion sel	heme		
Lectures		•	3 hours	wook	End seme			F)•	60
Letures	•		5 11001 5	WCCK	Linu seine			12)•	marks
					Duration	of ESI	J:		03 hour
					Internal S			ns (ISF).	40
					muman	0055101			marks
	Unit–I:			No. of Lectur	es: 08 Hou	rs		Marks: 1	
Renewab	tion to Fulle & No	uel T	ewable		es, Useful	featur		piofuels, I	Jndesirabl
	Unit–II			No. of Lectur			<i>, </i>	Marks: 1	
Bioenerg	y from b		ss:			I			
				power: therma	al gasificati	on of	biomass.	anaerobio	digestion

Unit–III:	No. of Lectures: 08 Hours	Marks: 12						
Alcohol Technology:								
Introduction to Alcohol Techno	ology, Raw Material of Alcohol	Industry, Storage & handling of						
Raw material in detail, Study of different yeast strains used in alcohol industries, Study of yeast								
production as single protein cell.								
Unit–IV:	Unit–IV: No. of Lectures: 09 Hours Marks: 12							
Alcoholic Fermentations:								
Study of different alcoholic	fermentation techniques, Ba	tch fermentation, Continuous						
fermentation, Modem technique	es of Continuous fermentation, E	Bio still fermentation, Encillium						
process Wet milling of grain	for alcohol production, Grain d	ry milling cooking for alcohol						
production, Use of cellulosic f	eed stocks for alcohol production	on, Scaling in distilleries, Fusel						
oil separation.								
Unit–V:	No. of Lectures: 09 Hours	Marks: 12						
Biochemistry & Recycling of	Alcohol:							
Study of different recycling pro-	ocess, Biochemistry of alcohol p	production, The management of						
fermentation in the production	of alcohol, Alcohol distillation-	The fundamental, Parameters &						
affecting alcoholic fermentation	ons, By product of alcoholic f	Fermentation, Distillery quality						
control, Alcoholometry.								
Text Books:								
1. B.D. Singh, Kalyani Pul	blications.							
2. Charles E Dryden; Rao,	M. Gopala,; Sittig, Marshall. ,O	ut lines of Chemical						
Technology.								
Reference Books:								
1. Olaf A Hougen, Kwei	nneth M. Watson, and Roland	A Ragatz, Chemical Process						
Principles – Part I, Mat	erial and Energy Balances by C	BS Publishers and Distributors						
(1995).								

2. T. P. Lyons ,Text books of alcohol tech.

			Open Electi						
Bioorganic Chemistry COURSE OUTLINE									
			COURSE	OUTLIN					
Course Title:		Bioorganic	Chemistry		Short Title:	BC	Cours Code	-	
Course of	lescriptio	on:							
This cou	rse is aim	ed to develop	the basic know	ledge dete	rminatio	n of mole	ecular con	npounds.	
The goal	s of the c	ourse are to un	derstand the ba	sics of alig	phatic co	ompounds	s, alkanes	alkynes	
etc.									
		Hours/week	No. of	Total hours Semester credit				ter credits	
Lect	ure		Weeks						
		03	14		42			03	
-	isite cour								
-	objective								
	-		edge and skills	in Bioorga	anic con	pounds.			
		e types of com							
			ture of aromati	-					
			ative and quant		•	alcohols.			
			al production of	f organic s	solvents.				
	outcomes								
			nis course the s						
			molecular for						
	•	-	oduction of alc	ohol and c	carbonyl	compoun	ds.		
		structure of aro			4.0				
			process of organ			wa analw	is of also	hola	
J. Dell		the techniques	used for qualita			ive analys		11018.	
Name of	the Subje	ect: Bioorganic		Semeste			V	7	
Teachin	g Scheme	2:		Examina	ation sc	heme			
Lectures	5:	3 ho	ours/week	End sen	nester ex	am (ESI	E):	60	
						,	,	marks	
				Duratio	n of ESI	E:		03 hours	
				Internal	Session	al Exam	s (ISE):	40	
								marks	
	Unit–I		No. of Lectur	res: 08 Ho	ours		Marks: 1	2	
		nd Stereo Isor							
			lar weight, en						
			al isomerism-						
notation, stereo isomerism of aliphatic hydrocarbons (cyclohexane and its derivatives only).									
	Unit–I		No. of Lectur	res: 09 Ho	ours		Marks: 1	2	
-	c Compo					1 0		• • • • •	
			reaction, Kolbe						
		-	nergy of activat						
		•	nation reaction				-		
			onikov's and A		anikon	s rule), 1	soprene r	uie, rubber	
vulcanization, compounding of rubber, elastemers.									

Unit–III:	No. of Lectures: 08 Hours	Marks: 12				
Alkynes:	•					
Industrial method of preparation	on of acetylene, acidity of alkyr	nes, dines-1,2 and 1,4 addition,				
diels-Alder reaction. Cyclo alka	anes: preparation and properties	of simple cycloalkanes, Bayer's				
strain theory						
Unit–IV:	No. of Lectures: 09 Hours	Marks: 12				
Aromatic compounds:						
Benzene: structure of	benezene, aromatic charac	ter, electrophilic aromatic				
substitution(mechanism of nitra	ation, sulphonation, halogenation	s, Friedel crafts alkylation and				
acylation). Orientation of disubstituted benzens- activating and deactivating groups.						
Arenes: preparation of arenas, clemenson and WolfKishner reductions, Arylhalides:						
	sand Meyer and Gattermann re					
substitution.						
Unit–V:	No. of Lectures: 08 Hours	Marks: 12				
Alcohols and carbonyl compo	ounds:					
Alcohols- industrial method of	f preparation of ethyl alcohol, d	ifferentiation tests for primary,				
secondary and tertiary alcohol	s, Grignard synthesis of alcohol	s, Ethers: preparation of ethers				
and epoxides- Williamson synt	hesis					
Text Books:						
1. R.T Morrison and R.N	Boyd, Text book of organic chem	nistry.				
2. I.L Finar, Longman gro	up publishers, A text book of org	anic chemistry vol.1.				
Reference Books:	<u> </u>	•				
1. L.G.Wade, jr., Pearson,	A text book of organic chemistry	•				
2. Francis A. Carey, Tata, A text book of organic chemistry. Mc Graw-Hill Publication.						

				Open Elective	e Course - I				
]	Biomedical Inst		n			
				COURSE O	UTLINE				
Course Title:		Biome	edical In	strumentation	ation Short BMI Title:				
Course of	descriptio	on:			·				
	-	asic kn	owledge	of the principle	of operation	and design	of biome	dical	
instrume	nts.								
Lect	ure		s/week	No. of Weeks	Total hours Semester credit				
	03 14 42 03								
			Concept	of Biotechnolog	gy.				
	objective								
				stems and the tee				alth c	are.
2. To	apply in a	an ethic	cally resp	oonsible manner	for the good	l of societ	у.		
3. To	demons	trate 1	the use	of variety	of software	used i	n variou	ıs bi	omedical
	trumentat			5					
			octions of	Cardiac Pacem	akers and De	fibrillator	S		
				and modern eng			~•		
	outcomes		ics, skill	and modern eng	sincering too	15.			
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	-		3 hours/	week	End semes	ster exam	(ESE):		60 narks
	-		3 hours/	week	End semes		(ESE):	r	
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dialysis Machine, Portable kidney machine, Mechanics of respiration Artificial ventilation,						
ventilators Types, ventilator terms, classification of ventilators Modern ventilators, HF						
ventilators, Nebulisers and Aspirators.						
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12				
Cardiac Pacemakers and Defi	ibrillators:					
Need for pacemakers, external	pacemakers, and Implantable pac	cemakers, recent developments,				
pacing system analyzer, need	for defibrillators, DC defibrillat	tors, Implantable defibrillators,				
and Defibrillators analyzers, me	easurement of blood PCO2.	_				
Unit–V:	No. of Lectures: 08 Hours	Marks: 12				
Nervous System:						
Nervous system ,Classification	of Nervous system, Anatomy of	Nervous system, Organization				
of Brain Neuronal communic	ation, Neuronal receptors, Son	natic and Autonomic nervous				
system Spinal reflexes ., Neuron	nal firing measurements, EEG m	easurement.				
Text Books:						
1. Cromwell - Biomed	ical Instrumentation, Pearson / Pl	HI.				
2. Khandpur - Handbo	ok of Biomedical Instrumentation	1				
Reference Books:	▲ ▲					
1. Vander, Sherman, Human Physiology. The Mechanism of Body Function, TMH						
Ed.1981						
2. Carr & Brown Introd	duction To Biomedical Equipmen	nt Technology				

Course Title: Energy Engineering Short Title: EE Course Code: Course description: Energy engineering aims to give students real-world technical expertise in strategic renewable energy disciplines, as well as an in depth understanding of the issues associated with renewable energies and their development, including the short and medium-term technical, technological, geopolitical and environmental challenges. Hours/week No. of Weeks Total hours Semester credits Engineering Chemistry, physics and Mathematics. O3 14 42 03 Prerequisite course(s):- Engineering Chemistry, physics and Mathematics. Energy Sources and forms of energy. 2 1 To impart introduction to energy engineering. Energy resources and forms of energy. 2 7 to study about Conventional Energy Sources like Coal and types of coal and byproduct, Petroleum, Natural gas and Refinery Products. 3 10 Hydrogen, Methanol, Nuclear energy, wind energy, geothermal, tidal energy, Bio energy. 4 5 To give the knowledge of Energy conversion processes and devices, Power plants with conventional energy sources. 1 Analyze and interpret the data. 1 Understand the conventional and nonconventional source of energy. 4 5 Analyze and about the power plants. 5 2 Analyze and interpret the data. 1<
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3. Understand the conventional and nonconventional source of energy. 4. Explain the National energy strategy and energy plans, energy power management. 5. Describe the energy audit, various energy conversion processes, devices and about the power plants. COURSE CONTENT Name of the Subject: Energy Engineering Semester: V Teaching Scheme: Lectures: 3 hours/week End semester exam (ESE): 60 marks Marks Duration of ESE: 03 hours
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5. Describe the energy audit, various energy conversion processes, devices and about the power plants. COURSE CONTENT Name of the Subject: Energy Engineering Semester: V Teaching Scheme: Examination scheme 60 marks Lectures: 3 hours/week End semester exam (ESE): 60 marks Duration of ESE: 03 hours
power plants. COURSE CONTENT Name of the Subject: Energy Engineering Semester: V Teaching Scheme: Examination scheme Lectures: 3 hours/week End semester exam (ESE): 60 marks Duration of ESE: 03 hours
COURSE CONTENT Name of the Subject: Energy Engineering Semester: V Teaching Scheme: Examination scheme 60 Lectures: 3 hours/week End semester exam (ESE): 60 Duration of ESE: 03 hours
Name of the Subject: Energy Engineering Semester: V Teaching Scheme: Examination scheme 60 marks Lectures: 3 hours/week End semester exam (ESE): 60 marks Duration of ESE: 03 hours
Teaching Scheme: Examination scheme Lectures: 3 hours/week End semester exam (ESE): 60 marks Duration of ESE: 03 hours
Lectures: 3 hours/week End semester exam (ESE): 60 marks Duration of ESE: 03 hours
Duration of ESE: 03 hours
Duration of ESE: 03 hours
Internal Sessional Exams (ISE): 40
marks
Unit-I: No. of Lectures: 08 Hours Marks: 12
Energy engineering and energy technology: Law of conservation of Energy, Generalized equation of Energy conservation, Energy resources and forms of energy, Energy demand, Changing energy consumption trends, National energy strategies of India, Crucial Issue in India's energy planning. Energy payer management and Energy planning in India
in India's energy planning. Energy power management and Energy planning in India. Energy Audit- Types of Energy Audits Conservation and recycling.

Unit–II:	No. of Lostungs 00 Hours	Marks: 12
	No. of Lectures: 09 Hours	Marks: 12
Conventional Energy Sources	fication of Indian coal. Im	portant Proportion of coal
	, Removal of sulphur, Storage	
	efaction. Petroleum, Natural	-
	and Natural gas and Naph	
	tural gas. Transportation of crud	0 0
Unit–III:	finery. Liquefaction of Natural gamma background financial gamma background filter fil	Marks: 12
	No. of Lectures: 08 Hours	Marks: 12
Chemical Energy Sources:		: f : f : f1 1
	and operation of aFuel cell. Cl	• 1
<u> </u>	nd disadvantages of fuel cells	
	cations of Hydrogen, Production	
	gement, Hydrogen technology de	
Unit–IV:	No. of Lectures: 09 Hours	Marks: 12
Nuclear Energy:		
	compared with coal, Fuels for N	
	ortation. Energy from Nuclear	
-	or. Pressurized heavy and Li	ight Water reactor. Uranium
Enrichment Process. Nuclear V	Vaste Management.	
Solar Energy:		
-	pplication of solar heater solar en	
	f Solar energy. Wind energy: B	
	Considerations. Classification	
	, Power in wind stream, I	
	or, Definition of wind speed for	
Unit–V:	No. of Lectures: 08 Hours	Marks: 12
Bio energy:		
	iomass conversion processes, c	
	of biomass, Biochemical conve	
	y conversion technologies and	
plants with conventional energy	v sources, Coal fired steam the	rmal power plants, Combined
cycle power plants, Integrate	d coal gasification combined cy	ycle power plants, Plant factors
and reserves.		
Text Books:		
1. S. Rao and Dr. B.B. Par	ulekar, "Energy Technology" No	on Conventional, Renewable
and Conventional, Khar	na Publishers, New Delhi.	
2. G.D. Rai "Non conventi	onal Energy Sources", Khanna P	Publishers,New Delhi.
Reference Books:		
1. S.B. Pandya, "Conven	tional Energy Technology" Fu	elsand Chemical Energy Tata
-	Company Ltd, New Delhi	
	Energy", Principals of therma	l collection and Storage. Tata
	Company Ltd, New Delhi	
	ve fuels" Jaico Publishing House	; First edition, 2010
	nology, Khanna Book Publishin	
	Engineering & Management, PHI	-
	<u> </u>	

		I	ab Molecu	ular Biolo	gv			
			B COURS					
Course Title:		Lab Molecular			Short Title:	Lab Mol Bio	Course Code:	;
Course of	descriptio	n:						
	-	course emphasis	is on the	understan	ding of	basics of	Molecula	r Biology
	es. The lea	arner can use this						
Laboratory		Hours/week	No. of w	veeks	Tota	l hours	Semest	er credits
		02		4		28	01	
End Sen	nester Exa	am (ESE) Patter	n:		I	Practical (DR)	
		se(s):- 11th, 12th		E Biotechi		,		
	objectives		0,7		05			
		he fundamental k	nowledge of	of molecul	lar biolo	gy at the r	esearch l	evel to the
	tudents.					8,		
2. T	o develop	their ability to a	apply the s	pecific pro	ocedure	s to analyz	e the exp	perimental
	esults.	j		r · · r		J		
3. T	o get fam	niliar with the mo	olecular Bi	ology lab	technic	ues which	they can	n apply in
	esearch.			05		L	5	11 5
4. T	o develop	lab protocols to p	perform ger	ne expressi	ion at in	vitro level		
	-	separated nuclei	-	-				
Course of	outcomes:		*	ľ		ť		
After su	ccessful co	ompletion of lab (Course, stu	dent will b	be able to	0:		
1. Is	solate the	genetic material e	.g. DNA &	RNA from	m differ	ent cells.		
		nolecular weight b					electroph	oresis
3. E	xtract of c	chromosomal DN	A from onio	on cells			_	
4. D	Determine	the melting temp	erature (Tn	n) and bas	se comp	osition of l	DNA fro	m thermal
d	enaturation	n characteristics.						
5. Q	Quantify N	ucleic acids.						
		LA	B COURS	E CONT	ENT			
	Lab Mo	olecular Biology		Semeste	r:		V	
Teachin	g Scheme	•		Examina	ation sc	heme		
Practica	l:	2 hours/we	ek	End sem	nester ex	xam (ESE)	:	25
								marks
				Internal	Contin	uous Asses	ssment	25
				(ICA):				marks
		nts (Note: Minim			nts fror	n the follow	wing)	
1. Is	solation of	genomic DNA fr	om bacteri	a.				
2. Is	solation of	RNA from yeast						
3. Is	solation of	total plasmid DN	IA from ba	cteria.				
		of molecular wei	ght by usin	ıg DNA m	arker w	ith agarose	gel	
	lectrophor							
		ction from blood.						
		f chromosomal D						
		ion of melting ten	nperature ('	I'm) and b	ase com	position of	DNA fro	om
tł	nermal der	naturation.						
		• =	-					
8. Is		genomic DNA fr genomic DNA fr	-	naterial.				

Text Books:

- 1. David Plummer, Introduction to Practical Biochemistry, Third Edition.
- 2. S. Sadasivam, A. Manickam, Biochemical Methods, Second Edition, New Age International Ltd, Publishers.

Guide lines for ICA:

Students must submit ICA in the form of journal. Each practical should be well documented. Faculty in charge will assess the practical continuously and grade or mark each practical on completion date declared for each practical.

Guidelines for ESE:

ESE will be based on the oral examination of laboratory experiments submitted by the students in the form of journal.

	1	Lab Reaction Eng	neering			
	Ι	LAB COURSE OU	TLINE			
Course	Lab Reaction H		Short I	ab RE	Course	
Title:		Singinio on ing	Title:		Code:	
Course descript		• , 11, •	1 6	1.4	· ·	
		intended to provie sed in bioprocess i		undation	n in conc	cepts an
Lecture	Hours/week	No. of weeks	Total hou	rs	Semeste	er credit
Laboratory	02	14	28	1.5	01	1 crean
	Exam (ESE) Patte		-	ral (OR		
		Science and SE Bio			-)	
Course objectiv			6,			
1. To impa	rt the fundamen	tal knowledge of	Chemical rea	action e	ngineerin	g to th
students.						
		apply the specific p	rocedures in in	dustries	•	
	ze the experiment					
		lsorption processes				
Course outcome		a obtained during p	erformance of t	ne expe	riment	
		Course, student w	ill be able to:			
		idy of various che		homical	reaction	e usad i
process in		idy of various che		nenneai	reaction	s uscu i
2. To design		_				
	i various types of	Reactors.				
	• -		es, skills, and	modern	engineer	ing too
3. Demonstr	• -	use the techniqu	es, skills, and	modern	engineer	ing too
3. Demonstr necessary	rate an ability to for engineering p	use the techniqu			-	ing too
 Demonstration necessary Demonstration Understation 	rate an ability to for engineering prate the understand rate the environment	use the techniqu practice.	l and ethical re	sponsibi	ilities.	-
 Demonstration Demonstration Demonstration 	rate an ability to 7 for engineering p rate the understand nd the environme gies	use the techniqu practice. ding of professiona ental issues and t	l and ethical re provide solu	sponsibi	ilities.	-
 Demonstration necessary Demonstration Understation technology 	rate an ability to for engineering p rate the understand nd the environme gies	b use the technique practice. ding of professiona ental issues and the AB COURSE CO	l and ethical re provide solu NTENT	sponsibi	ilities. r green a	-
 Demonstration necessary Demonstration Understation Lab Reaction En 	rate an ability to 7 for engineering p rate the understand nd the environme gies L gineering	b use the technique practice. ding of professiona ental issues and the AB COURSE CONSE CONSE Sem	l and ethical re provide solu NTENT ester:	sponsibi tions fo	ilities.	-
 Demonstration necessary Demonstration Understation Understation Lab Reaction En Teaching Schen 	rate an ability to 7 for engineering p rate the understand nd the environme gies L gineering ne:	o use the technique practice. ding of professiona ental issues and to AB COURSE CO Sem Exam	l and ethical re provide solu NTENT ester: nination schen	sponsibi tions fo	ilities. r green a	and clea
 Demonstration necessary Demonstration Understation 	rate an ability to 7 for engineering p rate the understand nd the environme gies L gineering	o use the technique practice. ding of professiona ental issues and to AB COURSE CO Sem Exam	l and ethical re provide solu NTENT ester:	sponsibi tions fo	ilities. r green a V	25
 Demonstration necessary Demonstration Understation Understation Lab Reaction En Teaching Schen 	rate an ability to 7 for engineering p rate the understand nd the environme gies L gineering ne:	b use the technique practice. ding of professiona ental issues and to AB COURSE CO Sem Exan veek End	l and ethical re provide solu NTENT ester: nination schen semester exan	sponsibi tions fo ne n (ESE):	ilities. r green a V	and clea
 Demonstration necessary Demonstration Understation Understation Lab Reaction En Teaching Schen 	rate an ability to 7 for engineering p rate the understand nd the environme gies L gineering ne:	use the technique practice. ding of professional ental issues and technique and technis and technique and technique and technique and	l and ethical re provide solu NTENT ester: nination schen semester exan	sponsibi tions fo ne n (ESE):	V	and clea 25 marks 25
 Demonstration necessary Demonstration Understation Understation Lab Reaction En Teaching Schen Practical: 	rate an ability to 7 for engineering p rate the understand nd the environme gies L gineering ne: 2 hours/w	b use the technique practice. ding of professional ental issues and the AB COURSE CO Sem Example veek End Inter (ICA	l and ethical re provide solu <u>NTENT</u> ester: nination schen semester exan mal Continuou .):	sponsibi tions fo ne n (ESE): ns Asses	ilities. r green a V : 2 sment 2	and clea
 Demonstration necessary Demonstration Understation Understation Lab Reaction En Teaching Schen Practical: 	rate an ability to 7 for engineering p rate the understand nd the environme gies L gineering ne: 2 hours/w	use the technique practice. ding of professional ental issues and technique and technis and technique and technique and technique and	l and ethical re provide solu <u>NTENT</u> ester: nination schen semester exan mal Continuou .):	sponsibi tions fo ne n (ESE): ns Asses	ilities. r green a V : 2 sment 2	and clean 25 marks 25
 Demonstration necessary Demonstration Understation Understation Lab Reaction En Teaching Schen Practical: 	rate an ability to y for engineering p rate the understand nd the environme gies L gineering ne: 2 hours/w ents (Note: Minir	b use the technique practice. ding of professional ental issues and the AB COURSE CO Sem Example veek End Inter (ICA	l and ethical re provide solu NTENT ester: nination schen semester exan mal Continuou .): nents from the	sponsibi tions fo ne n (ESE): ns Asses followir	ilities. r green a V : 2 issment 2 ng)	25 marks 25 marks
 Demonstration necessary Demonstration Understation Understation Lab Reaction En Teaching Schen Practical: 1. To determany	rate an ability to y for engineering p rate the understand nd the environme gies L gineering ne: 2 hours/w ents (Note: Minir	o use the technique practice. ding of professiona ental issues and te AB COURSE CC Sem Exan veek End Inter (ICA num Eight Experiment	l and ethical re provide solu NTENT ester: nination schen semester exan mal Continuou .): nents from the	sponsibi tions fo ne n (ESE): ns Asses followir	ilities. r green a V : 2 issment 2 ng)	25 marks 25 marks
 Demonstration necessary Demonstration necessary Demonstration Understation Understation Lab Reaction En Teaching Schen Practical: List of Experim To determ SEMIBA To determ 	rate an ability to 7 for engineering p rate the understand and the environme gies L gineering ne: 2 hours/w ents (Note: Minir nine the reaction r TCH / PFR) nine the effect of the float of	o use the technique practice. ding of professiona ental issues and te AB COURSE CC Sem Exan veek End Inter (ICA num Eight Experiment	l and ethical re provide solu NTENT ester: nination schen semester exan rnal Continuou .): nents from the r given reaction	sponsibi tions fo ne n (ESE): ns Asses followir	ilities. r green a V : 2 sment 2 ng) R / BATC	25 marks 25 marks
 Demonstration necessary Demonstration 1 Understation 1 Understation 1 To determing 1 To determing 1 To determing 1 To determing 1 	rate an ability to / for engineering p rate the understand nd the environme gies L gineering ne: 2 hours/w ents (Note: Minir nine the reaction r TCH / PFR) nine the effect of t TCH / PFR)	o use the technique practice. ding of professiona ental issues and to AB COURSE CO Sem Exan veek End Inter (ICA num Eight Experin rate constant {k} for temperature on rea	l and ethical re provide solut NTENT ester: nination schen semester exan mal Continuou .): nents from the r given reaction ction rate consta	sponsibi tions fo ne n (ESE): 1s Asses followir n.(CSTI ant(Ca	ilities. r green a V : 2 sment 2 n sment 2 n r g) R / BATC STR / BA	25 marks 25 marks 25 marks
 Demonstration necessary Demonstration necessary Demonstration Understation Understation Lab Reaction En Teaching Schen Practical: List of Experim To determing To determing SEMIBA To determing 	rate an ability to 7 for engineering p rate the understand and the environme gies L gineering ne: 2 hours/w ents (Note: Minin nine the reaction r TCH / PFR) nine the effect of r TCH / PFR) nine the activation	o use the technique practice. ding of professiona ental issues and te AB COURSE CC Sem Exan veek End Inte (ICA num Eight Experiment rate constant {k} for	l and ethical re provide solut NTENT ester: nination schen semester exan mal Continuou .): nents from the r given reaction ction rate consta	sponsibi tions fo ne n (ESE): 1s Asses followir n.(CSTI ant(Ca	ilities. r green a V : 2 sment 2 n sment 2 n r g) R / BATC STR / BA	25 marks 25 marks 25 marks
 Demonstration necessary Demonstration necessary Demonstration of the second second	rate an ability to 7 for engineering p rate the understand and the environme gies L gineering ne: 2 hours/w ents (Note: Minir nine the reaction r TCH / PFR) nine the effect of r TCH / PFR) nine the activatior TCH / PFR)	o use the technique practice. ding of professional ental issues and the course of the cours	l and ethical re provide solu <u>NTENT</u> ester: nination schen semester exan mal Continuou .): nents from the r given reaction ction rate consta	sponsibi tions fo ne n (ESE): ns Asses followin n.(CSTI ant(CSTI	ilities. r green a V : 2 ssment 2 ng) R / BATC STR / BA	25 marks 25 marks 25 marks 24 7 TCH / 7 CH /
 Demonstration necessary Demonstration necessary Demonstration Understation Understation Understation Lab Reaction En Teaching Schen Practical: List of Experim To determing To determing SEMIBA To determing SEMIBA To determing SEMIBA To determing SEMIBA To determing 	rate an ability to / for engineering p rate the understand nd the environme gies L gineering ne: 2 hours/w ents (Note: Minin nine the reaction r TCH / PFR) nine the effect of r TCH / PFR) nine the activation TCH / PFR) C [t], E [t] and F [b use the technique practice. ding of professional ental issues and the AB COURSE CO Sem Exan veek End Inte (ICA num Eight Experiment rate constant {k} for temperature on real in energy {E} for the [t] curve and to calcond [t] curve and [t] curve [t] curve [t] curve [t] curve [t] curve [t] curve [t] curve [t]	l and ethical re provide solu NTENT ester: nination schen semester exan mal Continuou .): nents from the r given reaction etion rate consta e given reaction sulate the mean	sponsibi tions fo ne n (ESE): ns Asses followin n.(CSTI ant(CSTI	ilities. r green a V : 2 ssment 2 ng) R / BATC STR / BA	25 marks 25 marks 25 marks 24 7 TCH / 7 CH /
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 Demonstration necessary Demonstration necessary Demonstration Understation Understation Understation Lab Reaction En Teaching Schen Practical: List of Experim To determ SEMIBA 	rate an ability to 7 for engineering prate the understand and the environment $rate the understand rate the understand rate the understand rate the understand rate the environment rate the environment rate the environment rate the environment 2 hours/w ents (Note: Minim nine the reaction r TCH / PFR) nine the effect of r TCH / PFR) nine the activation TCH / PFR) C [t], E [t] and F [\{\sigma 2\} and skewneC [t], E [t] and F [$	o use the technique practice. ding of professional ental issues and technique and technique and technique and technique and technique and technique and to calculate the set of the set of the set of technique and to calculate and technique and to calculate and the calculate	l and ethical re provide solu <u>NTENT</u> ester: nination schen semester exan mal Continuou): nents from the r given reaction ction rate consta e given reaction culate the mean ow reactor. culate the mean	sponsibi tions fo ne n (ESE): ns Asses followin n.(CSTI ant(CSTI ant(CSTI ant(CSTI resideno	ilities. r green a V : 2 sment 2 ng) R / BATC STR / BA TR /BATC ce time {t	25 marks 25 m 25 marks 25 m 25 m 25 m 25 m 25 m 25 m 25 m 25
 Demonstration necessary Demonstration necessary Demonstration Understation Understation Understation Lab Reaction En Teaching Schen Practical: List of Experim To determ SEMIBA 	rate an ability to 7 for engineering prate the understand and the environmediates gineering ne: 2 hours/w ents (Note: Minin nine the reaction r TCH / PFR) nine the effect of r TCH / PFR) nine the activation TCH / PFR) C [t], E [t] and F [$\{\sigma_2\}$ and skewnes	o use the technique practice. ding of professional ental issues and technique and technique and technique and technique and technique and technique and to calless { S3} for plug for the practice and to calless and technique and technique and technique and to calless and technique and te	l and ethical re provide solut NTENT ester: nination schen semester exan rnal Continuou .): nents from the r given reaction ction rate consta e given reaction culate the mean ow reactor. culate the mean eactor.	sponsibi tions fo ne n (ESE): 1s Asses followir n.(CSTI ant(CSTI ant(CSTI residend residend	ilities. r green a V : 2 sment 2 r sment 4 r sment 4 r s	and clea 25 marks 25 marks 27 CH / CH / CH / m} m}

variance $\{\sigma 2\}$ and skewness $\{S3\}$ for packed Bed reactor.

- 7. To study the cascade CSTR.
- 8. To study the kinetic in tubular flow reactor [coiled tube] for the given reaction.

Text Books:

- 1. H. Scott Fogler, Elements of chemical reaction engineering, Prentice Hall New, Jersy.
- 2. 2. Octave Levenspiel, Chemical reaction engineering, John Wiley and sons.

Guide lines for ICA:

Students must submit ICA in the form of journal. Each practical should be well documented. Faculty in charge will assess the practical continuously and grade or mark each practical on completion date declared for each practical.

Guidelines for ESE:

ESE will be based on the oral examination of laboratory experiments submitted by the students in the form of journal.

		Lab Pha	irmaceut	ical Biote	chnolog	у									
	LAB COURSE OUTLINE														
	1	LAI	B COURS	SE OUTI	LINE	1	T								
Course Title:	Lab Ph	armaceutical B	iotechnolo	ogy	Short Title:	Lab PBT	Cours Code								
Course	description:														
		ourse emphas													
		ses. The learne			wledge a	nd apply in	allied	oranches of							
-		Biotechnology					I								
Lecture		urs/week	No. of w	veeks	Total l	nours	Semes	ter credits							
Laborat	ory	02	1	4		28		01							
End Sen	nester Exam	(ESE) Pattern:				Oral (OR	k)								
		: Microbiology	, Bioproce	ess Engine	ering.										
	objectives:														
	-	undamental kno	-	-		-									
	-	ir ability to app	oly the ana	alytical te	chnique	s for interpr	reting ex	xperimental							
	esults.														
		e antimicrobial	assay of a	antibiotic	, introdu	ction to zor	ne of inf	nibition and							
-	alculation.	1.1	1	11 1 1	• •	• • • • • •	/								
		bilization of er					n/agar.								
		on of thermal d	ieath time	and theri	nai deati	i point.									
	outcomes:	lation of lab Ca	urao atua	ont will h	a abla ta										
		letion of lab Co obes by air mic					nt moth	ode							
		coliform count of			-	1 0	int metn	ous.							
		rility as per IP.	or water o	y 1011 10 tt	ennique	•									
	•	ctions of select	ive media	: McConl	kev Aga	r. Cetrimide	Agar. Y	Vogel							
	ohnson, Salt n					,		-8							
		mmunology an	d biochen	nical test.											
	•		B COURS		TENT										
Lal	o Pharmaceuti	cal Biotechnolo	ogy	Semeste	er:			V							
Teachin	g Scheme:			Examin		heme									
Practica	<u>.</u> l:	2 hours/weel	k	End ser	nester e	xam (ESE)	:	25							
			-				•	marks							
				Interna	l Contin	uous Asses	sment	25							
				(ICA):				marks							
List of F	Experiments (Note: Minimun	n Eight E	xperimen	ts from	the followin	ng)								
1. A	ir microbiolo	gy by solid and	liquid im	pingemer	nt metho	ds.	<u> </u>								
2. C	Coliform count	of water by M	PN techni	que.											
		y as per IP (Inje	ection wat	er/ nonab	sorbent	cotton/solub	ole powe	der/ear							
	rops).														
		test on excipie	-		-	-									
	tudies on sele nannitol agar.	ctive media: M	cConkey .	Agar, Cet	rimide A	agar, Vogel	Johnson	n, Salt							
	0	itivity test by d	isc metho	d.											
		• •					 Antibiotic sensitivity test by disc method. Widal test tube agglutination method. 								

8. Biochemical tests (Catalase, Oxidase, Urease, Nitratase, Protease, Amylase and

IMVIC).

- 9. Antimicrobial assay of antibiotic, introduction to zone of inhibition and calculation.
- 10. Immobilization of enzymes/cells by calcium alginate/gelatin/agar.
- 11. Isolation of DNA.
- 12. Selection and isolation of bacteria by replica plating.
- 13. Determination of thermal death time and thermal death point.
- 14. Effect of Ultra-Violet exposure on growth of E coli.
- 15. Demonstration of electrophoresis either by PAGE or Agarose gel electrophoresis.

Text Books:

- 1. Kanai L. Mukherjee, Medical Laboratory Technology: A Procedure Manual for Routine Diagnostic Tests Tata McGraw Hill Publishing Company Ltd., New Delhi.
- 2. Desmond S. T. Nicholl, An Introduction to GENETIC ENGINEERING, 2nd Edition, Cambridge University Press.
- 3. Wulf Crueger & Anneliese Crueger, Panima, Biotechnology: A Textbook of Industrial Microbiology, 2nd Edition, Publishing Corporation, New Delhi/Bangalore.

Guide lines for ICA:

Students must submit ICA in the form of journal. Each practical should be well documented. Faculty in charge will assess the practical continuously and grade or mark each practical on completion date declared for each practical.

Guidelines for ESE:

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		Ν	linor Project (Stage	e – I)			
			AB COURSE OUT				1
Course Title:		Minor Project (S	stage – I)	Short Title:	MPROJ- S-I	Course Code:	
Course d	escription	:		•			
minor pro emphasis	oject offers	the opportunity to a sarily on facilitation	on of study towards apply and extend mang student learning	terial lear	ned through	out the pro	gram. Th
Laborat	<u> </u>	Hours/week	No. of weeks	Total l	nours	Semeste	er credit
	v	6	14		84		3
End Sem	ester Exa	m (ESE) Pattern:					
	site course						
Course o	bjectives:						
		the basic concepts	& broad principles	s of proje	cts.		
1. To u	nderstand	-	& broad principles	1 0			lation
1. To u 2. To u	nderstand nderstand	the value of achiev	ving perfection in p	roject im	plementatio	-	
 To u To u To u To a 	nderstand nderstand pply the th	the value of achiev neoretical concepts	ving perfection in p to solve problems	roject im	plementatio	-	
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At third year the students shall carry out a minor project in a group of maximum up to 5 students. The project work spans both the semesters. By the end of Semester – V the students shall complete the partial work, and by the end of Semester - VI the students shall complete remaining part of the project. Assessment for the project shall also include presentation by the students. Each teacher can guide maximum 04 groups of minor projects.

The students should take project work, as specified in the curriculum, based on the knowledge acquired by the students during the degree course till Semester - IV. The project may be either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department. The work may also be Study/Survey/Design.

Minor Project (Stage – I) may involve literature survey, problem identification, design methodology, collection of data etc. The project work shall involve sufficient work so that students get acquainted with different aspects of design and analysis. Approximately more than 50% work should be completed by the end of Semester – V. Each student group should submit partial project report in the form of thermal bound at the end of Semester –V.

Each student group is required to maintain separate log book for documenting various activities of the project.

Suggestive outline for the partial project report is as follows.

Abstract
Chapter 1. Introduction
Chapter 2. Project Planning and Literature Survey
Chapter 3. Methodology
Chapter 4. Implementation and Analysis
Chapter 5. Testing
Chapter 6. Result and Discussion
Chapter 7. Conclusion & Future Work
Bibliography
Index
Appendix

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Minor Project (stage – I) in Semester – V shall be as per the guidelines given in Table – A.

	Table – A Assessment by Guide Assessment by Guide Assessment by Departmental Committee								
Sr. No.	Name of the Student	Attendance / Participation	Problem Identification / Project Objectives	Literature Survey	Methodology / Design	Report	Depth of Understanding	Presentation	Total
	Marks	5	5	5	5	5	10	15	50

Constitution of India

Basic features and fundamental principles:

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content

- 1. Meaning of the constitution law and constitutionalism
- 2. Historical perspective of the Constitution of India
- 3. Salient features and characteristics of the Constitution of India
- 4. Scheme of the fundamental rights
- 5. The scheme of the Fundamental Duties and its legal status
- 6. The Directive Principles of State Policy Its importance and implementation

7. Federal structure and distribution of legislative and financial powers between the Union and the States

8. Parliamentary Form of Government in India – The constitution powers and status of the President of India

- 9. Amendment of the Constitutional Powers and Procedure
- 10. The historical perspectives of the constitutional amendments in India
- 11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
- 12. Local Self Government Constitutional Scheme in India
- 13. Scheme of the Fundamental Right to Equality
- 14. Scheme of the Fundamental Right to certain Freedom under Article 19
- 15. Scope of the Right to Life and Personal Liberty under Article 21

Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Third Year Engineering

(Biotechnology Engineering)

Faculty of Science and Technology



'A' Grade NAAC Re-Accredited 3rd Cycle

SYLLABUS

Semester – VI

W.E.F. 2020 – 21

				ngineering					
Course Title:		Genetic Er	COURSE ngineering	5	Short Fitle:	GE	Course Code:		
Course descri	otion:				i itic.		couc.		
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Molecular research procedure	es:								
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Knockout Technology, SAGE.									
Unit–V:	No. of Lectures: 08 Hours	Marks: 12							
Significance of rDNA technology	ogy and Human Welfare:								
Gene therapy, Restriction fr	agment length polymorphism	(RFLPs), Random amplified							
polymorphic DNA (RAPD), SN	NPs, AFLP, microarray, DNA fin	gerprinting.							
Text Books:									
1. Benjamin Lewin, Benja	min Cummings; Genes VIII, Uni	ted States edition.							
2. R.C.Dubey, Textbook o	f Biotechnology, S. Chand & Co	. P Ltd, New Delhi.							
Reference Books:									
1. B.D.Singh, Textbook of	Biotechnology, Kalyani Publica	tion.							
2. U.Satyanarayana, Texth	book of Biotechnology, Books a	nd Allied Pvt.Ltd.							
3. Genes and Genomes $-S$	inger M and Berg P.								

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distillation, Azeotropic, extracti	ve and steam distillation.	
Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Extraction & Leaching:		
Introduction to extraction proce	ess, Liquid equilibria, Material	balances for stage wise contact
methods, Stage contact and con	tinuous contact type extractors.	Leaching: General principles of
	of moving-bed leaching equ	
Hildebrandt extractor.		
Unit–IV:	No. of Lectures: 09 Hours	Marks: 12
Adsorption and ion exchange	operation:	
Introduction to adsorption ope	eration, Type of adsorption op	eration, Nature of adsorbents,
Adsorption equilibria, Adsorpt	ion of liquids, Material balance	s for stage wise for operation,
Continues contact process for	adsorption, Principle of ion ex	change operation, Rate of ion
exchange operation, Application	n of ion exchange operation.	
Unit–V:	No. of Lectures: 08 Hours	Marks: 12
Crystallization and Drying:		
	Effect of impurities in crystalliz	
	crystals, Different type of cryst	
1 0	Mechanism of moisture move	ement during drying, Drying
equipments, Different methods	of drying.	
Text Books:		
1. R. E. Treybal, Mass tra	nsfer operation ,McGraw Hill Pu	blication
2. Coulson and Richardson	Chemical Engineering (Vol. I a	nd II), Pergamon Press
Reference Books:		
1. Christie J. Geankoplis,	Transport Processes and Unit Op	erations, Prentice Hal inc
2. P. Chattopadhayay , U	Unit operation in Chemical En	ngg. (Vol. I and II), Khanna
Publications Delhi.		
3. B.K. Dutta, Principles o	f Mass Transfer and Separation I	Processes, PHI Publication .

			Bioprocess	Engineer	ring			
			COURSE	OUTLIN	NE			
Course Title:		Bioprocess I	Engineering		Short Title:	BPE	Course Code:	
Course d	escriptio	on:						
		ed at introduci	ng the fundam	nentals of	bioproce	ess engine	ering. The	basics of
		ng have also be						
		f bioreactors.	1					5
			No. of Week	S	Total	hours	Semeste	er credits
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•		d conduct expe		fferent bi	oreactors	and to ar	nalyze and	interpre
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3. De	esign var	rious bioproces	e equinment to					
co			s equipment ic	meet de	sired nee	ds of manl	kind within	n realistic
	nstrain I	ike social, ethic			sired nee	ds of manl	kind within	n realistic
4. Ge		-	cal, health and	safety.				
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achievement and	mainten	ance of	aseptic	conditions,	valves a	nd steam to	aps, ty	pes of v	valves and
pressure control	valves.	Scale	up of	fermenters,	design	condition	for so	cale up,	scale-up
methods.									

methods.		
Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Types of Bioreactors:		
Batch bioreactors, Continuou	as bioreactors, Semi continuo	bus bioreactors, Stirred tank
bioreactors, Airlift bioreactor s	ystems, Trickle bed bioreactor, A	Airlift external loop bioreactors,
waldhof-type fermenter, Tow	er fermenter, Cylindro- conica	l vessel, Deep jet fermenter,
Cyclone column, Rotating disc	fermenter, Reactor dynamics: Dy	ynamic models and stability
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
Solid state & Submerged Ferr	mentation, Process monitoring	& Control:
Introductions, types of solid st	ate fermenter, Submerged Ferm	entation, Brief introduction to
pipe joints, Physical and chemi	cal sensors for medium and gases	s, Online/ Offline sensors.
Unit–V:	No. of Lectures: 09 Hours	Marks: 12
Bioreactor Design Considerat	ions:	
8	codes, maximum working pre	ssure, design pressure, design
•	or of safety, and selection of fa	• •
thickness, corrosion ratio, P	oisson ratio, criteria of failur	e. Materials of construction:
	ls, corrosion, protective coating,	
prevention.		
Text Books:		
1. Bailey JE and Ollis DF,	Biochemical Engineering Funda	mentals (1986) (2/e), McGraw-
Hill International Editio		
2. Blanch HW and Clark I	OS, Biochemical Engineering (19	97) Marcel Dekker Inc., USA.
	F, Bioprocess Engineering: Ba	
Education Pvt. Ltd., Sin		
Reference Books:		
	A and Hall SJ, Principles of Fe	ermentation Technology (1995)
2^{nd} Edition, Butterworth	,	
• •	rehensive Biotechnology Vol. 2	2 (1985) Pergamon Press Ltd.,
UK.		
4. Doran PM, Bioprocess I	Engineering Principles (1995) Ac	cademic Press Ltd, USA.

			Pr	ofessional Ele	ctive Cou	ırse - II			
				Plant Biot					
				COURSE	OUTLIN	E			
Course Title:		Р	Plant Biote	echnology		Short Title:	PBT	Course Code:	
Course (descriptio	on:							
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				ls of the cours					
-			-	tions in the fiel				rr-	F
				No. of Week			l hours	Semes	ter credit
Lect	ture		03	14			42		03
Prereau	isite com	·ce(c)·		D, Genetic engi	neering ar			hnology	
			- 12 511	D, Ochetie eligi	incerning an			intology.	
	objective:		hosio lu	ovuladas and	alrilla of	mlant ti		ning lile	avalante
		-		nowledge and	SKIIIS OI	plant u	ssue cultur	fing, fike	e explains
	allus, antl		•	abaniam of	molting	of come	tion lly m	dified	nlanta fo
				chanism of	0	0	encarry mo	Jamea	plants to
		-		n the field of B	lotechnol	ogy.			
	-		-	totipotency.	tuon of ou to	a han i arra	~		
				anism of gene			s.		
	•		ypes of pl	ant tissue cult	life technic	ques.			
	outcomes		<u></u>	• (1	<u>, 1 , 1</u>	11 11			
				is course the s					
				issues related				1 •	1. 6.
				hniques in pl	ant tissue	e culturi	ng for ma	king the	e modifie
	arieties of	-			anta				
				best resistant pl	lants.				
4. P		1-							
						ing com	mercial val	lue by ap	plying th
p	rotocols o	of fern	nentation	technology.	h are hav			lue by ap	oplying the
p	rotocols o	of fern	nentation	technology. ant biotechnol	h are hav ogy in hig	ther stud		lue by ap	oplying the
p 5. E	rotocols o Explore th	of fern e optio	nentation ons for pl	technology. ant biotechnol COURSE	h are hav ogy in hig CONTEN	gher stud			
5. E	rotocols o Explore th the Subje	of fern e optio ect: Pl	nentation ons for pl	technology. ant biotechnol	h are hav ogy in hig CONTEN Semeste	gher stud NT er:	y.	lue by ap	
5. E Name of Teachin	rotocols of explore th the Subje g Scheme	of fern e optio ect: Pl	nentation ons for pl ant Biote	technology. ant biotechnol COURSE chnology	h are hav ogy in hig CONTEN Semeste Examin	gher stud NT er: ation sc	y.	V	I
5. E Name of Teachin	rotocols of explore th the Subje g Scheme	of fern e optio ect: Pl	nentation ons for pl	technology. ant biotechnol COURSE chnology	h are hav ogy in hig CONTEN Semeste Examin	gher stud NT er: ation sc	y.	V	
5. E Name of Teachin	rotocols of explore th the Subje g Scheme	of fern e optio ect: Pl	nentation ons for pl ant Biote	technology. ant biotechnol COURSE chnology	h are hav ogy in hig CONTEN Semeste Examin End sen	wher stud VT er: ation sc nester ex	y. heme kam (ESE)	V	I 60 marks
5. E	rotocols of explore th the Subje g Scheme	of fern e optio ect: Pl	nentation ons for pl ant Biote	technology. ant biotechnol COURSE chnology	h are hav ogy in hig CONTEN Semeste Examin	wher stud VT er: ation sc nester ex	y. heme kam (ESE)	V	I 60 marks
5. E Name of Teachin	rotocols of explore th the Subje g Scheme	of fern e optio ect: Pl	nentation ons for pl ant Biote	technology. ant biotechnol COURSE chnology	h are hav ogy in hig CONTEN Semeste Examin End sen Duratio	gher stud VT er: ation sc nester es n of ES	y. heme kam (ESE)	V	I 60 marks
5. E Name of Teachin	rotocols of explore th the Subje g Scheme	of fern e optio ect: Pl	nentation ons for pl ant Biote	technology. ant biotechnol COURSE chnology	h are hav ogy in hig CONTEN Semeste Examin End sen Duratio	gher stud VT er: ation sc nester es n of ES	y. heme xam (ESE) E:	V	I 60 marks 03 hours
5. E Name of Teachin	rotocols of explore th the Subje g Scheme	of ferm e optio ect: Pl	nentation ons for pl ant Biote	technology. ant biotechnol COURSE chnology	h are hav ogy in hig CONTEN Semeste Examin End sen Duratio Interna	ther stud T er: ation sc nester es n of ESI I Sessior	y. heme kam (ESE) E: nal Exams	V	I 60 marks 03 hours 40 marks
5. E Name of Teaching Lectures	rotocols o explore th the Subje g Scheme	of ferm e optio ect: Pl e:	nentation ons for pl ant Bioted 3 hours /	technology. ant biotechnol COURSE chnology /week	h are hav ogy in hig CONTEN Semeste Examin End sen Duratio Interna	ther stud T er: ation sc nester es n of ESI I Sessior	y. heme kam (ESE) E: nal Exams	V : (ISE):	I 60 marks 03 hours 40 marks
p 5. E Name of Teaching Lectures Plant Tig	the Subject sciences of Scheme sciences Unit–l ssue Eng	of ferm e optio ect: Pl e: : : : ineeri	nentation ons for pl ant Biotec 3 hours/ ing-I:	technology. ant biotechnol COURSE chnology /week	h are have ogy in hig CONTEN Semeste Examin End sen Duratio Internal res: 09 Ho	ther stud VT er: ation sc nester ex n of ESI I Sessior ours	y. heme kam (ESE) E: nal Exams N	V : (ISE): farks: 1	I 60 marks 03 hours 40 marks 2
5. E Name of Teaching Lectures Plant Tis Introduct	the Subject sciences of the Subject g Scheme sciences Sciences Unit–J ssue Eng tion to t	of ferm e optio ect: Pl e: issue	ant Bioted 3 hours/	technology. ant biotechnol COURSE chnology /week	h are have ogy in hig CONTEN Semeste Examin End sen Duratio Internal res: 09 He	ther stud VT er: ation sc nester es n of ESI I Sessior ours	y. heme kam (ESE) E: hal Exams N o and ma	V : (ISE): /arks: 1 cro_nutr	I 60 marks 03 hours 40 marks 2 ients) an
5. E Name of Teaching Lectures Plant Tis Introduct preparati	the Subject science of	of ferm e optio ect: Pl e: ineeri issue a sele	ant Bioted 3 hours/ ing-I: engineer ction, Cel	technology. ant biotechnol COURSE chnology /week /week	h are have ogy in hig CONTEN Semeste Examin End sen Duratio Internal res: 09 Ho omponent cy, Practi	ther stud T ation sc nester ex n of ES I Session ours	y. heme xam (ESE) E: nal Exams N o and ma ication of c	V :: (ISE): <u>farks: 1</u> cro_nutr cellular to	I 60 marks 03 hours 40 marks 2 ients) an otipotency
5. E Name of Teaching Lectures Plant Tis Introduct preparati Criteria f	Unit–I ssue Eng tion to t on, Medi for selecti	ect: Pl ect: Pl ect: Pl e: ineeri issue a sele on of	ant Bioted ant Bioted 3 hours/ ing-I: engineer ction, Cel explants,	technology. ant biotechnol COURSE chnology /week /week ing, Media c llular totipoten Classification	h are have ogy in hig CONTEN Semeste Examin End sen Duratio Internal res: 09 Ho omponent cy, Practi	ther stud VT er: ation sc nester es n of ESI I Session ours ts (micr cal appliculture,	y. heme kam (ESE) E: hal Exams N o and ma ication of c callus cult	V (ISE): (ISE): (Iarks: 1) cro nutr cellular to ure, cell	I 60 marks 03 hours 40 marks 2 ients) ano otipotency suspensio
5. E Name of Teaching Lectures Plant Tis Introduct preparati Criteria f	Unit–I ssue Eng tion to t on, Medi for selecti	ect: Pl ect: Pl ect: Pl e: ineeri issue a sele on of	ant Bioted ant Bioted 3 hours/ ing-I: engineer ction, Cel explants,	technology. ant biotechnol COURSE chnology /week /week ing, Media c llular totipoten	h are have ogy in hig CONTEN Semeste Examin End sen Duratio Internal res: 09 Ho omponent cy, Practi	ther stud VT er: ation sc nester es n of ESI I Session ours ts (micr cal appliculture,	y. heme kam (ESE) E: hal Exams N o and ma ication of c callus cult	V (ISE): (ISE): (Iarks: 1) cro nutr cellular to ure, cell	I 60 marks 03 hours 40 marks 2 ients) and otipotency suspension
5. E Name of Teaching Lectures Plant Tis Introduct preparati Criteria f culture, A	Unit–I ssue Eng tion to t on, Medi for selecti	e optioner of fermine optioner of fermine optioner of fermine optioner of the sector o	ant Bioted ant Bioted 3 hours/ ing-I: engineer ction, Cel explants,	technology. ant biotechnol COURSE chnology /week /week ing, Media c llular totipoten Classification	h are have ogy in hig CONTEN Semeste Examin End sen Duratio Internal res: 09 Ho omponent cy, Practi of tissue uspensior	ts (micr culture, n culture	y. heme kam (ESE) E: hal Exams o and ma ication of c callus cultu , single cel	V (ISE): (ISE): (Iarks: 1) cro nutr cellular to ure, cell	I 60 marks 03 hours 40 marks 2 ients) anotipotency suspensio , Merister

Bioprocess consideration in using plant cell cultures, Bioreactors for suspension cultures,

Biorea	ctors for organized tissu	e, Production of secondary met	abolites Anther culture Ovary
	e	last culture, Synthetic seeds and	•
Culture	Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Plant	transformation Technol		
		transfer; Agrobacterium based	vectors, viral vectors and their
		er methods; chemical methods,	
particl	e bombardment.		
	Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
Plant	Tissue culture, Genetic	Engineering for Productivity a	nd Performance-I:
Somat	ic embryogenesis, organ	ogenesis; Protoplast isolation cu	lture and fusion, Production of
haploi	ds, Somaclonal variation	ons, Germplasm conservation	(Cryopreservation), Herbicide
resista	nce, Insect resistance pla	nts, Disease resistance plants, vir	rus resistance plants.
	Unit–V:	No. of Lectures: 09 Hours	Marks: 12
Molec	ular farming & Indus	trial products, Genetic Engin	neering for Productivity and
Perfor	mance-II and Metaboli	c Engineering:	
Abioti	c stress tolerance; Droug	ght, temperature, salt, Metabolic	e engineering for plant primary
metab	olites and secondary met	abolites, Application of Plant bi	iotechnology for the production
of qua	ality oil, Industrial enz	ymes, Therapeutic Proteins, A	Antigens (edible vaccine) and
plantib	oodies.		
Text H	Books:		
1.	B.D.Singh, Biotechnol	ogy: Expanding Horizons, Ka	lyani Publishers, New Delhi,
	Second Revised Edition	, 2008.	
2.	J.Hammond,P.McGarve	ey and V.Yusibov (Eds.), Plant	Biotechnology New Products
	and Applications, Sprin		
3.		logy: Fundamentals and Appli	cations, Agrobios (India), 4th
	Edition, 2005.		
	ence Books:		
		s, Plant Cell Culture : A Practica	1
2.		ssue Culture: Techniques and E	Experiments. 2nded., Academic
	Press,2000.		
3.	Bhojwani, S.S.and Rajd	an, Plant Tissue Culture: Theory	and Practice,2004.

			Pr	ofessional Ele	ctive Cou	rse - II			
				Protein Er	ngineering				
				COURSE	OUTLIN	E			
Course Title:		Protei	n Er	gineering		Short Title:	PE	Course Code:	
Course	descriptio	on:						·	·
This cou living sy		ned to dev	velop	the knowledg	ge of basi	cs prote	eins, its ro	ole and fu	unctions i
Lect	ture	Hours/w	eek	No. of Weeks	Т	otal ho	urs	Semes	ter credit
		03		14		42			03
Prerequ	isite cour	se(s):- 12	th ST	D, Cell Biolog	gy, Bioche	mistry			
Course	objectives	5:							
1. T	To develop	the basic	knov	vledge and ski	lls of prote	ein struc	ture deter	mination.	
2. T	To unders	tand the	conc	ept of protein	engineer	ing and	l applicat	ions of j	proteins i
E	Biotechnol	ogy resear	ch.						
3. T	To explain	the analyt	ical	techniques for	protein str	ucture d	leterminat	ion.	
4. T	To develop	the variou	is te	chniques for pr	otein extra	action a	nd purifica	ation.	
5. T	To underst	and the so	ftwa	re used in prote	ein modeli	ng and o	drug desig	jn.	
Course	outcomes	:							
After suc	ccessful co	ompletion	of th	is course the st	tudent will	l be able	to:		
1. I	Determine	the variou	s str	uctures of prote	eins.				
				ents for protein		determ	ination.		
		•		help of compu					
				iques of protei					
				cations of prote			Biotechno	ology.	
	A			COURSE				0,	
Name of	the Subie	ct: Protein	Eng		Semeste			V	I
	g Scheme		2		Examina		heme		
Lecture	0			week				").	60
Lecture	5:	5 110	ours/	week	End sem	lester ez	xam (ESE	<i>.</i>):	ou marks
					Duration	n of ES	E:		03 hours
					Internal	Session	al Exams	s (ISE):	40 marks
	Unit–I	:		No. of Lectur	res: 09 Ho	ours]	Marks: 1	
	ction to P			1100 01 20000			-		-
Introdu			nrot	ein, post trans	lation mod	lificatio	n primary	seconda	rv tertiar
	f101 b105				inclose moe	*III Callo		,	
Introduc			prote	ins conformat	ional anal	vsis and	forces th	at determ	ine protei
Introduc and quat	ernary str	ucture of p		ins, conformat					
Introduc and quat structure	ernary str , energy	ucture of p status of	a pr	otein, effect					
Introduc and quat structure	ernary str , energy	ucture of p status of	a pr						
Introduc and quat structure example	ernary str e, energy , structure Unit–I	ucture of p status of and funct	a pr	otein, effect	of amino	acids of	on structu		oteins wit
Introduc and quat structure example	ernary str e, energy , structure	ucture of p status of and funct	a pr	otein , effect relationship.	of amino	acids of	on structu	re of pro	oteins wit
Introduc and quat structure example Structur	ernary str , energy , structure Unit–II re Detern	ucture of p status of and funct [: hination:	a pr ional	otein , effect relationship.	of amino	acids o	on structu	re of pro Marks: 1	oteins wit
Introduc and quat structure example Structur Methods	ernary str e, energy , structure Unit–II re Detern s of prote	ucture of r status of and funct in ination: in isolation	a pr ional	otein , effect relationship. No. of Lectur	of amino res: 08 Ho quantifica	acids o	on structu	re of pro Marks: 1 ethods to	oteins wit 2 determin
Introduc and quat structure example Structur Methods	ernary str e, energy , structure Unit–II re Detern s of prote	ucture of p status of and funct in isolation X-ray cryst	a pr ional	otein , effect relationship. No. of Lectur urification and	of amino res: 08 Ho quantifica spectrosco	acids of ours ation, pl py; ami	n structu	re of pro Marks: 1 ethods to	2 determin methods.
Introduc and quat structure example Structur Methods protein s	unit–II of protest tructure:	ucture of p status of and funct in ination : in isolation X-ray cryst I:	a pr ional	otein , effect relationship. No. of Lectur urification and graphy, NMR s	of amino res: 08 Ho quantifica spectrosco	acids of ours ation, pl py; ami	n structu	re of pro Marks: 1 ethods to quencing	2 determin methods.
Introduc and quat structure example Structur Methods protein s Protein	ernary str e, energy , structure Unit–II re Detern s of protes tructure: 2 Unit–II	ucture of p status of and funct in isolation X-ray cryst I: ing:	a pr ional	otein , effect relationship. No. of Lectur urification and graphy, NMR s	of amino res: 08 Ho quantifica spectrosco res: 08 Ho	acids of the second sec	n structu nysical m no acid se	re of pro Marks: 1 ethods to quencing Marks: 1	2 determin methods.

modifications to 3D structure of	of proteins, design and synthesis	s of peptides, PCR, PCR insite						
directed mutagenesis.								
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12						
Application of Protein Engine	ering:							
1 1 0	ed enzymes, Tryesyl tRNA synth							
Subtilisin, Pepsin class of enzymes, Lysozyme, charging tRNA, Peptide vaccines, Engineered								
	on, Chemical modifications: p	bhosphorylation, glycosylation,						
methylation, formylation, Appl		1						
Unit–V:	No. of Lectures: 09 Hours	Marks: 12						
Protein Modeling and Drug D	8							
	tabase, alignment methods to d	±						
•	molecular modeling, structural s							
1	tions: docking, calculation of							
	tion to software used in protein r	nodeling and drug design.						
Text Books:								
	ovel Therapeutic Proteins.: Wile							
	Aicrocharacterisation of proteins.	•						
	ected Molecular Evolution of Pro	teins Wiley Publications						
Reference Books:								
	nology and Biochemistry., 2nd ec	•						
	ics in Practice Wiley Publicatio							
	n. W. and Jones. R.L. 2000Biod	•						
4. Biology of Plants Ame	erican Society of Plant Physiolog	ists, Maryland, USA.						
5. Messer- Schmidt, .Hand	book of Metaloproteins Wiley	Publications.						

		Pr	ofessional Ele	ective Cours	se - II			
				Engineering				
				OUTLINE				
Course Title:		Metabolic I	Engineering		Short Fitle:	ME	Cours Code	
Course o	descriptio	n:					ł	
			the knowledge	e of basics	of met	abolic er	gineering	, metabolic
regulatio	ns, and an	alysis of pathy	ways.					
		Hours/week	No. of	To	Total hours Seme		Semes	ter credits
Lect	ture		Weeks					
		03	14		42			03
Prerequ	isite cours	se(s):- Cell Bi	iology, Bioche	mistry				
Course of	objectives	:						
1. T	o develop	the basic know	ledge and skill	s of metaboli	ic react	tion of liv	ing system	ns in
	esearch pro							
		1	utational Metho		bolic I	Pathways	•	
	1	1	of metabolic flu					
			models for cel		ons.			
			amic cellular p	process.				
	outcomes:							
		<u>+</u>	is course the s		be able	to:		
1. ł	Explain me	etabolic pathw	ays of living s	ystems.				
2. I	Demonstra	te knowledge	of regulations	in metabolic	c regul	ations in	living sys	tems
3. A	Analyze co	mputational n	nethods in met	abolic pathv	vays.			
4. H	Explain the	e concept of m	etabolic flux a	nd its applic	ations			
	-	-	of thermodyna					
J. 1	Jenionsua	te the concept	Ţ		-			
Name of	the Subie	ct: Metabolic l		CONTENT Semester:			v	'I
	g Scheme:		Engineering	Examinat		homo	•	•
	0							(0)
Lectures	S:	5 110	urs/week	End seme	ster ex	am (ES	E):	60 manka
				Duration	of FSI	7.		marks 03 hours
				Internal S		ial Exam		40 marks
	Unit–I:		No. of Lectu	res: 08 Hou	Irs		Marks: 1	2
		letabolic Engi	0					
	-		neering, overv					ion
		1 . 1	rimary and sec		abolite	s, medica	al and	
Agriculti	_		dary metabolit				N. 1 4	2
	Unit–II		No. of Lectur	res: 09 Hou	Irs		Marks: 1	4
	ic Regulati		a lavral T 1	and Mr.	.d		dinata	
	-	-	e level, Jacob					
	-	-	lactose opercorregulation of g	•		peron, 1	eeuback	regulation
Cumulati	ve recubat	r iegulatioli,	legulation of g	ene express	1011.			

Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Computational Methods for P	Pathways:	
Introduction, Analysis of pa	thways: metabolic pathways,	genetic pathways, signaling
pathways, pathway resources,	metabolic control analysis, sin	nulation of cellular activities,
biological markup languages.		
Unit–IV:	No. of Lectures: 09 Hours	Marks: 12
Metabolic Flux:		
	algorithms, metabolic flux	analysis and its application,
1 0 0	e flow of carbon and nitrogen fl	
	es by isotope labeling, stereoche	
concepts of regulatory analogs.		
Unit–V:	No. of Lectures: 08 Hours	Marks: 12
Different models for cellular 1	reactions, genetic regulation of	metabolic fluxes, examples of
metabolic pathway manipulatic	ons and engineering, analysis of	metabolic control and structure
metabolic networks, thermodyn	amics of cellular processes.	
Text Books:		
1. James Bower and Itamie	d Bodour, Computational modeli	ng of Genetic and Biochemical
Networks,		
Networks, 2. Valino, Metabolic Flux	Analysis.	
2. Valino, Metabolic Flux	Analysis. formatics: A Modern Approach, I	PHI.
2. Valino, Metabolic Flux	•	PHI.
 Valino, Metabolic Flux Vittal.R.Srinivas, Bioint Reference Books:	•	
 Valino, Metabolic Flux Vittal.R.Srinivas, Bioint Reference Books: S.C.Rastogi, N.Mendira 	formatics: A Modern Approach, I	lethods and Applications, PHI.

Nuts and Bolts, PHI, New Delhi.

		D	rofessional Ele	etive Cour	•60 - II				
		1	Stem Cell						
			COURSE						
Course Title:		Stem Cell		1	Short	SC	Cours		
	lescriptior	Stem Cell Technology Title: SCT Code:							
	_		the knowledge	of basics o	of stem	cell bio	ology plurir	otency and	
			bryonic and car						
			ethical, regula						
			se are to unders						
	-		hniques of stem		-	1		1	
		Hours/week	_		otal ho	urs	Semes	ster credits	
Lect	ure		Weeks						
		03	14		42			03	
Prerequi	isite cours	e(s):- Cell E	iology, Immuno	logy.			1		
-	bjectives:								
	U		wledge and skills	s of stem ce	ll scien	ce in re	search proje	cts.	
	-		pts of embryoni				FJ-		
		the different							
			nanism of cell si	ignaling.					
			nenomenon of S		n tissue	e engine	eering.		
	outcomes:	1				<u> </u>	0		
After suc	cessful con	mpletion of t	his course the st	tudent will	be able	e to:			
			m cell in lab						
		•	regeneration of	cells.					
		m cell therap	0						
			ssues related to	stem cell te	echnolo	ogy.			
			eutic application						
		•	**						
			COURSE	CONTENT	Γ				
Name o	f the Subje	ect: Stem Cel	l Technology	Semester	:		I	ľ	
Teaching	g Scheme:			Examina	tion so	heme			
Lectures			ours/week	End seme			SE).	60	
Lectures	•			Linu sein	ester e			marks	
				Duration	of ES	E:		03 hours	
							ams (ISE):	40	
				Internar s	56222101	liai L'Ac	uiis (ISE).	marks	
	Unit–I:		No. of Lectur	res: 08 Hoj	urs		Marks: 1		
Stem cel					41.5		17101 NJ. J		
		le organizat	ion, Stem cells	s Sources	Unio	me pro	nerties of	stem cells	
			cells, adult stem						
			tional characteri			und un		con adult	
	Unit–II:		No. of Lectur		ure		Marks: 1	2	
Embryo	nic stem c			1.5.07 1100	u1.5		171al N5. 1		
•			ntal potential, In	vitro fertil	ization	-cultur	ing of embry	VOS	
		-	ion and growing				•	705	
Studiocyd			Year Engineeri	-					

characterization of human ES c	ells-Cloning and controlled differ	rentiation of human embryonic
stem cells, Applications of Emb	ryonic stem cells – Gene knock	in – Gene knock out.
Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Adult stem cells:		
	entification of adult stem cells,	
	ells, liver stem cells, skeletal m	uscle stem cells, bone marrow
derived stem cells, Induced plui	1	
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
Cancer stem cell signaling:		
	Breast Cancer Stem Cells: Ident	ification - Signalingpathways:
Notch signaling – Wnt signaling		
Unit–V:	No. of Lectures: 09 Hours	Marks: 12
Stem cells in tissue engineerin	-	
	ell and biomaterial interactions	-
	tissue engineering, Cartilage tiss	6 6
	ue engineering, Therapeutic app	
-	eration. Stem cell based gene the	erapy and benefits to human.
Text Books:		
	Lee "Stem Cells: From Bench	to Bedside" World Scientific
Publishing Company. 20		
2. C S Potten "Stem Cells"	-	
	m cell biology" Cold Spring Har	bor Laboratory Press.
Reference Books:		
	s of Stem Cell Biology" Elevier,	
2. Peter Quesenberry "Ster	n cell biology and Gene Therapy	" Wiley, Liss, 1988.

				Open Electiv	e Course	- II				
				Environmental						
				COURSE	OUTLIN	Е				
Course Title:		Envir	onmental	Biotechnology	7	Short Title:	EB		'ourse Code:	
Course	descriptio	on:								
			to deve	lop the basic	knowled	ge of E	Environ	mental	Engin	eering to
undergra	aduate stu	dents	. The go	als of the cou	irse are t	o under	stand t	the bas	ic prin	nciples of
Environ	mental En	ginee	ring and t	their application	ns in the f	field of l	Biotech	nology.		
		Hou	rs/week	No. of	Г	otal ho	urs	S	emest	er credits
Lec	ture			Weeks						
			03	14		42				03
Prerequ	isite cour	se(s):	- Microbi	iology and Biop	rocess eng	gineering	g.			
Course	objective	s:								
1. 7	To develop	o the l	basic know	wledge and ski	lls of Env	ironmer	ntal Bio	technol	ogy.	
				n of Bioremedi						
3. 7	To describ	e the	concepts	of xenobiotics.						
4. 7	To demon	strate	the detai	l mechanism o	f Bioleacl	hing &	underst	anding	their 1	ole in the
f	ield of Bi	otechi	nology.							
5. 7	To underst	and th	he mecha	nism of Hazard	lous Wast	e Manag	gement	& Biolo	ogical	Control.
	outcomes									
After su	ccessful c	omple	etion of th	is course the st	udent wil	l be able	e to:			
	•		-	lem and write	clear, ste	p-by-ste	ep instr	ructions	for c	onducting
	xperimen			1						
				ent application						e different
				bioremediation		0			с.	
	•			organisms in b	-					
				detect and ide		0				
5. E	Exhibit ap	proac	hes to ana	erobic digestic			olve re	lated pr	oblem	S.
				COURSE	CONTEN	T				
	the Subje	ect: E	nvironme	ntal	Se	mester:			VI	
Biotechr										
Teachin	g Scheme	:			Examin	ation so	cheme			
Lecture	s:		3 ho	ours/week	End sen	nester e	xam (E	CSE):		60
										marks
					Duratio	n of ES	E:			03 hours
					Interna	l Sessio	nal Exa	ams (IS	E):	40
										marks
	Unit–I	:		No. of Lectur	res: 08 Ho	ours		Mar	ks: 12	
Environ			ion & En	vironmental S			s:			
				ntroduction, so	•	-		tions):	Types	of waste.
				ironment Prote			-		• •	
	genesis-N		-		and ferr				proce	
condition	0		U ,	C					1	
	Unit–I	I:		No. of Lectur	res: 09 H	ours		Mar	ks: 12	
Microbi			: Diversi	ity on earth:						
		•		problem, Findi	ng New d	liversitv	, biodiv	versity o	of bact	eria:
· · · · · · · · · · · · · · · · · · ·	1	,	2	<u>۰</u>	<u> </u>	2				

		· · · · · · · · · · · · · · · · · · ·
	ation strategies, Fungal biodivers	
	environmental DNA, accessing u	
	ening environmental libraries, bar	
Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Bioremediation:		
	priorities of Bioremediation,	•
occurring microbial activities	, Bioaugmentation, in situ, ex	situ, intrinsic & engineered
bioremediation, Solid phase	bioremediation -land farming	g, prepared beds, soil piles,
Phytoremediation, Composting	g, Bioventing & Biosparging; I	Liquid phase bioremediation -
suspended bioreactors, fixed bi	ofilm reactors.	
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
Hazardous Waste Manageme	nt& Biological Control:	
Introduction - Xenobiotic con	npounds, recalcitrance, hazardo	us wastes - biodegradation of
Xenobiotics, Biological detox	ification, Biological control of f	foliar pathogens and pests with
bacterial biocontrol agents: bio	control agents, ecology of the pl	lant pathogen or pest, source of
antagonist, Empirical approach	es to select biocontrol agents	
	es to select blocontiol agents	
Unit–V:	No. of Lectures: 09 Hours	Marks: 12
	No. of Lectures: 09 Hours	Marks: 12
Unit–V: Treatment of Industrial Wast	No. of Lectures: 09 Hours	
Unit–V: Treatment of Industrial Wast Waste water characteristics; bio	No. of Lectures: 09 Hours	models, unit operations, design,
Unit–V: Treatment of Industrial Wast Waste water characteristics; bio principle and modelling of activ	No. of Lectures: 09 Hours tes: blogical waste treatment; kinetic	models, unit operations, design, ilters, fluidized reactor, up flow
Unit–V: Treatment of Industrial Wast Waste water characteristics; bio principle and modelling of activ anaerobic sludge blanket rea	No. of Lectures: 09 Hours tes: blogical waste treatment; kinetic r vated sludge process. Trickling f	models, unit operations, design, ilters, fluidized reactor, up flow bed reactor, hybrid reactors,
Unit–V: Treatment of Industrial Wast Waste water characteristics; bio principle and modelling of acti- anaerobic sludge blanket rea sequential batch reactors; Bio	No. of Lectures: 09 Hours tes: blogical waste treatment; kinetic vated sludge process. Trickling finctor, contact process, packed	models, unit operations, design, ilters, fluidized reactor, up flow bed reactor, hybrid reactors, d organic waste material into
Unit–V: Treatment of Industrial Wast Waste water characteristics; bio principle and modelling of acti- anaerobic sludge blanket rea sequential batch reactors; Bio	No. of Lectures: 09 Hours tes: blogical waste treatment; kinetic r vated sludge process. Trickling fr actor, contact process, packed bconversions of agricultural and	models, unit operations, design, ilters, fluidized reactor, up flow bed reactor, hybrid reactors, d organic waste material into
Unit–V: Treatment of Industrial Wast Waste water characteristics; bio principle and modelling of activ anaerobic sludge blanket rea sequential batch reactors; Bio gainfully utilizable products- ce Text Books:	No. of Lectures: 09 Hours tes: blogical waste treatment; kinetic revated sludge process. Trickling finator, contact process, packed beconversions of agricultural and ellular hydrogen, food and feed st	models, unit operations, design, ilters, fluidized reactor, up flow bed reactor, hybrid reactors, d organic waste material into tocks.
Unit–V: Treatment of Industrial Wast Waste water characteristics; bid principle and modelling of acti- anaerobic sludge blanket rea sequential batch reactors; Bid gainfully utilizable products- ce Text Books: 1. Metcalf Eddy – Waste w	No. of Lectures: 09 Hours tes: blogical waste treatment; kinetic reveated sludge process. Trickling fractor, contact process, packed beconversions of agricultural and ellular hydrogen, food and feed st	models, unit operations, design, ilters, fluidized reactor, up flow bed reactor, hybrid reactors, d organic waste material into tocks.
Unit–V: Treatment of Industrial Wast Waste water characteristics; bid principle and modelling of acti- anaerobic sludge blanket rea sequential batch reactors; Bid gainfully utilizable products- ce Text Books: 1. Metcalf Eddy – Waste w	No. of Lectures: 09 Hours tes: blogical waste treatment; kinetic revated sludge process. Trickling finator, contact process, packed beconversions of agricultural and ellular hydrogen, food and feed st	models, unit operations, design, ilters, fluidized reactor, up flow bed reactor, hybrid reactors, d organic waste material into tocks.
Unit–V: Treatment of Industrial Wast Waste water characteristics; bio principle and modelling of activanaerobic sludge blanket rea sequential batch reactors; Bio gainfully utilizable products- ce Text Books: 1. Metcalf Eddy – Waste w 2. R.S. Ramalho, - Introdu Reference Books:	No. of Lectures: 09 Hours tes: blogical waste treatment; kinetic reveated sludge process. Trickling finator, contact process, packed beconversions of agricultural and ellular hydrogen, food and feed st water Engineering – 3rd Ed., THM tection to Waste Water treatment.	models, unit operations, design, ilters, fluidized reactor, up flow bed reactor, hybrid reactors, d organic waste material into tocks.
Unit–V: Treatment of Industrial Wast Waste water characteristics; bio principle and modelling of activanaerobic sludge blanket rea sequential batch reactors; Bio gainfully utilizable products- ce Text Books: 1. Metcalf Eddy – Waste w 2. R.S. Ramalho, - Introdu Reference Books: 1. S.K.Agarwal, Environm	No. of Lectures: 09 Hours tes: blogical waste treatment; kinetic reveated sludge process. Trickling finator, contact process, packed beconversions of agricultural and ellular hydrogen, food and feed st water Engineering – 3rd Ed., THM tection to Waste Water treatment.	models, unit operations, design, ilters, fluidized reactor, up flow bed reactor, hybrid reactors, d organic waste material into tocks. M publications.

			Open Electiv						
			NanoBiot	0	•				
	I		COURSE	OUTLIN	1	T	1		
Course Title:		NanoBi	otechnology		Short Title:	NBT	Cours Code		
Course	description	o n:	th applications resulting from the combination of biotechnology and						
	_		cations resulting	from th	e comb	ination of	biotechr	ology and	
nanotech	nnology ir	n the fields of	medicine and er	nvironmer	nt. The g	oal of this o	course is	to provide	
an insigl	nt into the	fundamenta	s of nanotechnol	ogy in bio	ological	and biomed	lical rese	arch.	
		Hours/wee	k No. of]	Fotal ho	urs	Semes	ter credits	
Lec	ture		Weeks						
		03	14		42			03	
Prerequ	isite cour	rse(s):- Mici	obiology, Biocher	mistry, Mo	olecular	biology			
Course	objective	s:							
1. 7	To underst	tand the esse	ntial features of 1	nanotechn	ology a	nd biology	that are	converging	
			of NanoBiotechno						
2. 7	To recogni	ize the struct	ural and function	al princip	les of Na	anoBiotech	nology.		
3. 7	To employ	v bionanomat	erials for analysi	s and sens	sing tech	iniques.			
4. 7	To appreh	end and expl	ain the biomedica	al applicat	tions of	nanotechno	logy.		
5. 7	To prepare	nanoparticle	5.						
	outcomes								
After su	ccessful c	ompletion of	this course the s	tudent wil	ll be able	e to:			
		-	students to und		ow Nan	omaterials	can be	used for a	
d	liversity o	f analytical a	nd medicinal rati	ionales.					
2. 8	Students w	vill be able to	synthesize and c	characteriz	ze the N	anomaterial	ls.		
		-	of drug delivery	by using	Nanoma	terials.			
		•	anomaterial.						
5. A	Apply kno	wledge in m	edical and agricu			treatment.			
			COURSE						
Name	of the Su	bject: NanoI	Biotechnology	Semeste	er:		V	Ι	
Teachin	g Scheme	e:		Examin	nation so	cheme			
Lecture	s:	3 hou	rs/week	End ser	nester e	xam (ESE)):	60	
						· · · · ·		marks	
		I		Duratio	on of ES	E:		03 hours	
				Interna	l Sessio	nal Exams	(ISE):	40	
				Internu				marks	
	Unit–l	[:	No. of Lectur	res: 08 H	ours	N	Iarks: 1		
Introduc			ogy, Nanobiote				concept		
			opores, Biomole				-		
		•	l applications, Bo			-		j	
	Unit–I	I:	No. of Lectur	res: 09 H	ours	Ν	Iarks: 1	2	
Methods	s of prepa	aration of na	noparticles, prop			terials; nar	oparticle	e synthesis	
			cterization techn				-	-	
-			py; Photon corre						
			nts in BioMEMS	-			-		
	Unit–Il	-	No. of Lectur		ours	Ν	Iarks: 1	2	
Concept			icrofluidic devid						

of microfluidic component, Fluidic structure, Nanostructures for drug delivery (Nanovesicles;
Nanospheres; Nanocapsules, Magnetic nanoparticles; Liposomes; Dendrimers), concepts,
targeting, routes of delivery and advantages.
Unit–IV: No. of Lectures: 09 Hours Marks: 12
Fluorescent nanomaterials for Biosensors and Biolabelling, Quantum dots, imaging and
biosensors; Nanodevices for sensor development, Antimicrobial activity and wound healing,
Artificial implants, Tissue engineering, Identification of pathogenic organisms by magnetic
nanoparticle-based techniques.
Unit–V: No. of Lectures: 08 Hours Marks: 12
Effect of nanomaterials on human health, environment and safety, Recent progress and
challenges in the risk assessment of Nanomaterials, Assessment of the toxic effects of
nanoparticles based on in-vitro laboratory tests.
Text Books:
1. Niemeyer C. M., Nanobiotechnology: Concepts, Applications and Perspectives, Wiley
– VCH, 2006.
2. David S Goodsell, Bionanotechnology, John Wiley & Sons, 2004.
Reference Books:
1. Debasis Bagchi, Manashi Bagchi, Hiroyoshi Moriyama, Fereidoon Shahidi, Bio-
Nanotechnology: A Revolution in Food, Biomedical and Health Sciences.
2. Buddy D. Ratner, Allan S. Hoffman , Frederick J. Schoen , Jack E. Lemons.
Biomaterials Science: An Introduction to Materials in Medicine 3rd Edition.

				Open Electiv	e Course	e - II			
			Ente	rprise Resour			AP		
				COURSE					
Course	Enter	nrisa Dag	ource	Planning and	SAD	Short	ERP &	c Cours	e
Title:	Linter	prise Kes	source	r failing and	SAF	Title:	SAP	Code	
Course d									
				lucing foundation					
				today's busi					
				large corporat					
				the need to	have a	large 1	number o	of separate	individual
computer	-based ap	-							
Lect	uro	Hours/v	veek	No. of Weeks	ľ	fotal ho	urs	Semes	ter credits
Lett		03		14		42			03
Preregui	site cour		ndustr	ial Manageme	nt	42			0.5
Course o			luusti	iai ivianageme	It				
	J		of En	terprise Resour	oo Dlanni	ing and	SAD		
				RP Risk, Benef					
				ctional Modul				105.	
	o explain a					piement	ation.		
				re of the SAP v	oh opplie	notion co	ruor		
Course o			lectui	e of the SAF v	eo applic				
			of th	is course the s	udont wil	ll bo oble	a to:		
	nderstand						5 10.		
				lated technolog	ios				
				modules of E					
	emonstrat				ΝΓ .				
				te of the SAP v	veh annlio	ration se	rver		
5. 0.	liueistallu		lieciui	COURSE (<u> </u>		1 VCI.		
Name of	the Subie	ct.		COURSE					
	e Resour		ino an	dSAP	Se	mester:		V	Τ
Teaching			ing an	u SAI	Examin	ation se	homo		
	,								(0
Lectures	•	5 1	IOULS/	week	Ena sen	nester e	xam (ES	E):	60 marks
					Duratio	f TC	D .		
							-	(707)	03 hours
					Interna	I Session	nal Exan	ns (ISE):	40
									marks
	Unit–I:			No. of Lectur	res: 08 H	ours		Marks: 1	2
ERP Int				- · · ·	D 1	-		D 1	D
· ·	L			Introduction					
-		-		formation, R	ole of	enterpris	sing ER	P system	i, Business
	ling, Inte	0							
				luction, Comm		•		History of	ERP, The
Adva	-		adma	p for the succe		-	nentation		•
	Unit–II		<u> </u>	No. of Lectur ed Technolog			nd Bene	Marks: 1	2 ERP: The
	v Konof	ite ond	120lot				nd Bene	tite of	

-			enefits of ERP, Risks of ERP,
	actor of ERP implementation		
			ta warehousing, Data Mining,
OL	AP, PLM, SCM, CRM, GIS,		
		o. of Lectures: 08 Hours	Marks: 12
	unctional Modules and Imp		
			ules of ERP software, Supply
cha	in and customer relationship	application	
b) ER	P Implementation Life C	ycle: Introduction, Object	tive of ERP Implementation,
Dif	ferent phases of ERP Implem	nentations	
	Unit–IV: N	o. of Lectures: 09 Hours	Marks: 12
ERP (Consultants, Vendor & Emp	lovees. eBusiness and Futu	re Direction:
		•	use implementation Pros and
	-	•	esistance, Reason for employee
	istance, Dealing with employ		
	• • •		siness-supply chain integration,
			he eBusiness supply chain,
	P/eBusiness integration, ERP	· •	the endustriess suppry chain,
			ew market new channel and
	ter implementation methodolo		ew market new channel and
145		ogies	
 	Unit–V: N	o. of Lectures: 09 Hours	Marks: 12
SAPI	ntroduction and Architectu		
			Business, SAP for industries,
· ·	P R/3 Releases and Fundar		
	ation Overview, SAP Servic	-	
			SAP Web Application Server,
	sic Architectural Concept		
	ent/Server SAP web AS Syste		cess Types, Bunding the
		em	
Text B		Diaman a Plana in a P	lition Tota Magness IIII
	Alexis Leon, "Enterprise Re	-	· · · · · · · · · · · · · · · · · · ·
2.	Jose A. Hernandez, Jim Keo	oh Eranklin Eoster Mertinez	z, "SAP R/3 Handbook", Third
		gii, i iaikiiii i östei wiertiitez	
	Edition, Tata McGraw Hill		
Refere	Edition, Tata McGraw Hill		
	,		nplementation Framework,
	nce Books:		nplementation Framework,
1.	ence Books: V.K. Garg, N .K. Venkita Kı PHI.	rishnan, "ERP Ware: ERP In	-
1.	nce Books: V.K. Garg, N .K. Venkita Kı PHI. Annetta Clewwto and Da	rishnan, "ERP Ware: ERP In	nplementation Framework, Planning ERP Application",
1. 2.	nce Books: V.K. Garg, N.K. Venkita Ki PHI. Annetta Clewwto and Da McGRaw-Hill, 1997.	rishnan, "ERP Ware: ERP In ane Franklin, "Guide to	Planning ERP Application",
1. 2.	nce Books: V.K. Garg, N .K. Venkita Kı PHI. Annetta Clewwto and Da	rishnan, "ERP Ware: ERP In ane Franklin, "Guide to	Planning ERP Application",

			Open Electiv					
		Biopro	cess Instrume			lysis		
Course	Bioproc	ess Instrumenta	COURSE tion and Anal		E Short	BIA	Cours	e
Title:	Diopioe			y 515	Title:	DIT	Code:	
Course	descripti	on:						
This cou	rse descr	ibes basic princ	iples of instru	mentation	and inst	rumental a	nalysis. '	This course
will mal	ke the st	udents knowled	lgeable in va	rious type	es of m	easuring i	instrumer	nts used in
process i	ndustries	•						
		Hours/week	No. of	Г	Total ho	urs	Semes	ter credit
Lect	ture		Weeks					
		03	14		42			03
		$rse(s):-12^{th} Std$. Science and	SE Biotec	hnology	Courses		
	objective							
		om the student v	-	-		nt techniq	ues.	
2. T	'o impart	the knowledge	of various typ	es of contr	roller.			
		he student fami				-	•	
4. T	o unders	tand basic princ	iples behind tl	ne working	g of diffe	erent analy	tical inst	ruments.
5. T	o apply t	he various appl	ications of inst	truments in	n industi	ries.		
Course	outcome	5:						
A ftor su	oossful a	completion of th	is course the s	tudont wil	l ba abla	to		
Allel suc	cessiui c	ompletion of th	is course the s	tudent wi	i de able	: 10.		
1. C	et famili	iar with various	s standards ar	nd calibrat	tion met	hods used	l in Instr	umentation
a	nd Instru	mental Analysis	5.					
2. C	et knov	vledge of basi	c principles	behind t	he wor	king of	different	analytica
iı	nstrumen	ts and its applic	ation in indust	ries.				
3. U	Jse suitab	le measuremen	t technique for	process in	ndustries	5.		
		ystem for moni					ss indust	ries and to
	naintain s		C			1		
5. 0	let insigh	ts of flame phot	ometry and m	icroscopy				
	0	1	COURSE	10				
Name of	the Subje	ect:	000102				T .	
•	•	mentation and A	Analysis	Se	mester:		V	Ί
Teachin	g Schem	e:		Examin	ation sc	heme		
Lectures	5:	3 hours/	week	End sen	nester ex	xam (ESE	:):	60 mark
				Duratio	n of ES	E:		03 hours
				Interna	Sessior	al Exams	s (ISE):	40 mark
	Unit–	[:	No. of Lectu				Marks: 1	2
Qualitie		surement:					~	
-		measurement, t	he elements o	f instrume	ents, Tei	nperature	measuri	ng devices
Introduc	tion, Con	istant volume g	as thermomet	er, Bimeta	allic The	rmometer	, Industri	al pressure
		ter, Industrial	-					-
Introduct	tion, Indi	cating pressure	gage, Bellows	pressure	element,	Mclead v	acuum ga	age.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12
	sed loop and open loop contro	l system, Proportional Control
-	controller, Feed forward and fe	-
Cascade Control, Controller Tu	ning.	
Unit–III:	No. of Lectures: 08 Hours	Marks: 12
pH measurement:		
Introduction, Method of pH	H Indicator, Potentiometric	Method, Application of pH
Measurement. Infrared Spectro	oscopy: Introduction, Instrumen	tation, Application of Infrared
spectroscopy. Xray diffraction:	Introduction, Application of X-	ray diffraction.
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
Refractrometry:		
	er, Applications of refractometer	
UV Spectrophotometer: Introdu	ction, Instrumentation, Applicat	ions of UV Spectrophotometer.
Colorimetery: Introduction, The	eorv.	
,,,,,, _		
Unit–V:	No. of Lectures: 09 Hours	Marks: 12
Unit–V: Flame photometry:	No. of Lectures: 09 Hours	
Unit–V: Flame photometry: Introduction, Instrumentation, A	No. of Lectures: 09 Hours	у.
Unit–V: Flame photometry: Introduction, Instrumentation, A Scanning Electron Microscope	No. of Lectures: 09 Hours Applications of Flame photometr e: Introduction, Instrumentatio	y. and Applications of Scanning
Unit–V: Flame photometry: Introduction, Instrumentation, A Scanning Electron Microscope Electron Microscope, Transm	No. of Lectures: 09 Hours Applications of Flame photometre: Introduction, Instrumentationission Electron Microscope:	y. and Applications of Scanning
Unit–V: Flame photometry: Introduction, Instrumentation, A Scanning Electron Microscope	No. of Lectures: 09 Hours Applications of Flame photometre: Introduction, Instrumentationission Electron Microscope:	y. and Applications of Scanning
Unit–V: Flame photometry: Introduction, Instrumentation, A Scanning Electron Microscope Electron Microscope, Transm Application of Transmission Electron	No. of Lectures: 09 Hours Applications of Flame photometre: Introduction, Instrumentationission Electron Microscope:	y. and Applications of Scanning
Unit–V: Flame photometry: Introduction, Instrumentation, A Scanning Electron Microscope Electron Microscope, Transm Application of Transmission Electron Text Books:	No. of Lectures: 09 Hours Applications of Flame photometre: Introduction, Instrumentationission Electron Microscope: ectron Microscope.	y. and Applications of Scanning Introduction, Instrumentation,
Unit–V: Flame photometry: Introduction, Instrumentation, A Scanning Electron Microscope Electron Microscope, Transm Application of Transmission Ele Text Books: 1. D.P.Eckman, Industrial	No. of Lectures: 09 Hours Applications of Flame photometre: Introduction, Instrumentation hission Electron Microscope: ectron Microscope.	y. and Applications of Scanning Introduction, Instrumentation, Ltd., New Delhi.
Unit–V: Flame photometry: Introduction, Instrumentation, A Scanning Electron Microscope Electron Microscope, Transm Application of Transmission Ele Text Books: 1. D.P.Eckman, Industrial 2. Gurdeep Chatwal and	No. of Lectures: 09 Hours Applications of Flame photometre: Introduction, Instrumentationission Electron Microscope: ectron Microscope.	y. and Applications of Scanning Introduction, Instrumentation, Ltd., New Delhi.
Unit–V: Flame photometry: Introduction, Instrumentation, A Scanning Electron Microscope Electron Microscope, Transm Application of Transmission Electron Text Books: 1. D.P.Eckman, Industrial 2. Gurdeep Chatwal and Himalaya publication H	No. of Lectures: 09 Hours Applications of Flame photometre: Introduction, Instrumentationission Electron Microscope: ectron Microscope.	y. and Applications of Scanning Introduction, Instrumentation, Ltd., New Delhi.
Unit–V: Flame photometry: Introduction, Instrumentation, A Scanning Electron Microscope Electron Microscope, Transm Application of Transmission Ele Text Books: 1. D.P.Eckman, Industrial 2. Gurdeep Chatwal and Himalaya publication H Reference Books:	No. of Lectures: 09 Hours Applications of Flame photometre: Introduction, Instrumentation hission Electron Microscope: ectron Microscope. Instrumentation, Willey Eastern Sham Anand, Instrumental mouse, Mumbai.	y. and Applications of Scanning Introduction, Instrumentation, Ltd., New Delhi. nethods of Chemical analysis,
Unit–V: Flame photometry: Introduction, Instrumentation, A Scanning Electron Microscope Electron Microscope, Transm Application of Transmission Ele Text Books: 1. D.P.Eckman, Industrial 2. Gurdeep Chatwal and Himalaya publication H Reference Books:	No. of Lectures: 09 Hours Applications of Flame photometre: Applications of Flame photometre: Introduction, Instrumentation hission Electron Microscope: ectron Microscope. Instrumentation, Willey Eastern Sham Anand, Instrumental mouse, Mumbai. haudhary, Instrumentation Measu	y. and Applications of Scanning Introduction, Instrumentation, Ltd., New Delhi. nethods of Chemical analysis,

Lab Genetic En ourse emphasis ner can use this Iours/week 02 n (ESE) Patter (s):- 11th, 12th e fundamental 1 nd heir ability to a with the Gen nd Developmen DNA by using ne knowledge target DNA, RN npletion of lab (on digestion enz enzyme to join of nid for various a	Inte: Eng is on the understanding of basics of knowledge and apply in allied bran No. of weeks Total hours 14 28 : Practic Biology, SE Biotechnology courses nowledge of Genetic Engineering oply the specific procedures to ana etic Engineering lab techniques via the field of Biotechnology. various vectors of Southern, Northern and wes A and proteins. Course, student will be able to: me for various applications of DNA ifferent DNA to form new product	g Code: of Genetic Engineering aches of Biotechnology S Semester credits 01 al (OR) at the research level to lyze the experimental which they can apply tern blotting for the
ourse emphasis ner can use this Iours/week 02 n (ESE) Patter (s):- 11th, 12th e fundamental 1 and heir ability to a with the Gen DNA by using ne knowledge target DNA, RN npletion of lab (on digestion enz enzyme to join of nid for various a	IneeringTitle:Engis on the understanding of basics of knowledge and apply in allied brandNo. of weeksTotal hours14281428is on the specific procedures to analanowledge of Genetic Engineeringpoply the specific procedures to analetic Engineering lab techniques of in the field of Biotechnology. various vectorsof Southern, Northern and west A and proteins.course, student will be able to: me for various applications of DNA ifferent DNA to form new product pplications	g Code: of Genetic Engineering aches of Biotechnology S Semester credits 01 al (OR) at the research level to lyze the experimental which they can apply tern blotting for the
ourse emphasis ner can use this Iours/week 02 n (ESE) Patter (s):- 11th, 12th e fundamental 1 and heir ability to a with the Gen DNA by using ne knowledge target DNA, RN npletion of lab (an digestion enz enzyme to join of nid for various a	No. of weeks Total hour 14 28 14 28 Biology, SE Biotechnology courses nowledge of Genetic Engineering oply the specific procedures to ana etic Engineering lab techniques various vectors of Southern, Northern and wes A and proteins. Course, student will be able to: me for various applications of DNA ifferent DNA to form new product oplications	s Semester credits 01 al (OR) at the research level to lyze the experimental which they can apply tern blotting for the
ner can use this Jours/week 02 n (ESE) Patter: (s):- 11th, 12th e fundamental land heir ability to a with the Gen nd Developmen DNA by using ne knowledge target DNA, RN npletion of lab (on digestion enz enzyme to join of nid for various a	No. of weeks Total hour 14 28 14 28 Biology, SE Biotechnology courses nowledge of Genetic Engineering oply the specific procedures to ana etic Engineering lab techniques various vectors of Southern, Northern and wes A and proteins. Course, student will be able to: me for various applications of DNA ifferent DNA to form new product oplications	s Semester credits 01 al (OR) at the research level to lyze the experimental which they can apply tern blotting for the
02 n (ESE) Patter (s):- 11th, 12th e fundamental l and heir ability to a with the Gen DNA by using ne knowledge target DNA, RN npletion of lab (on digestion enz enzyme to join of nid for various a	14 28 Biology, SE Biotechnology courses Practic Biology, SE Biotechnology courses Image: Second	01 al (OR) at the research level to lyze the experimental which they can apply tern blotting for the a study
n (ESE) Patter (s):- 11th, 12th e fundamental l and heir ability to a with the Gen DNA by using ne knowledge target DNA, RN npletion of lab (on digestion enz enzyme to join of nid for various a	Practic Biology, SE Biotechnology courses nowledge of Genetic Engineering oply the specific procedures to ana etic Engineering lab techniques with the field of Biotechnology. various vectors of Southern, Northern and wes A and proteins. Course, student will be able to: me for various applications of DNA ifferent DNA to form new product pplications	at the research level to lyze the experimental which they can apply tern blotting for the
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omic DNA	•	
	B COURSE CONTENT	
ering	Semester:	VI
	Examination scheme	
2 hours/we	k End semester exam (E	SE): 25 marks
·	Internal Continuous A (ICA):	ssessment 25 marks
on of genomic I ial DNA. on. ng (by RFLP) ing restriction e	NA of bacteria	<u>llowing)</u>
	on of genomic D ial DNA. on. ng (by RFLP) ing restriction er f E.coli with plas	(Note: Minimum Eight Experiments from the fo on of genomic DNA of bacteria ial DNA. on.

2. S. Sadasivam, A. Manickam, Biochemical Methods. Second Edition, New Age International Ltd, Publishers.

Guide lines for ICA:

Students must submit ICA in the form of journal. Each practical should be well documented. Faculty in charge will assess the practical continuously and grade or mark each practical on completion date declared for each practical.

Guidelines for ESE:

ESE will be based on the oral examination of laboratory experiments submitted by the students in the form of journal.

]	Lab Mass Transfe	r				
	LAT	3 COURSE OUTL	INE				
Course Title:	Lab Mass Trar		Short Title: Lab MT		Course Code:		
Course descri	ption:		11000		00000		
	the course is intende	ed to provide a	strong	foundation	in con	cepts and	
-	mass transfer operation	-	-			1	
Lecture	Hours/week	No. of weeks	eeks Total hours S			er credit	
Laboratory	14		28	01			
•	02 Exam (ESE) Pattern:			Oral (OR			
	ourse(s): 12 th Std. Scie		nnology (-)		
			01				
Course object	ivos						
ý		T	(1	·	4 - 4		
	force concepts of Mass					1 .	
	ustom of unit operation	is like absorption,	humidifi	cation, cry	stallizatio	on, dryin	
operati							
	alyze & interpret data		perform	ance of the	he exper	iment fo	
underst	anding the Mass Transf	fer lecture course.					
4. To in	prove technical skil	ls & ability by	y formu	lating a	solution	throug	
	nentation.			-			
	nonstrate the understand	ling of professional	and ethi	cal respons	sibilities.		
Course outco		0 1		1			
	ul completion of lab Co	urse student will h	e able to				
	ize types of diffusion a						
0	• 1				loulating	the Mee	
	strate an ability to sol	ve the mass transi	ler probl	ems by ca	iculating	the Mas	
	er Coefficient.			c ,	C	<i>.</i> •	
-	actical considerations f	or designing and o	peration	of mass tr	anster of	berations	
equipm							
4. Identify	y, formulate, design an	d provide the solu	ition to	various che	emical er	ngineerin	
probler	ns.						
5. Unders	tand the environmenta	I issues and to pr	rovide so	olutions fo	r green	and clear	
technol	ogies						
	LAB	COURSE CONT	ENT				
Ι	ab Mass Transfer	Semeste	Semester:			VI	
Teaching Sch	eme:	Examin	ation scl	neme			
Practical:	2 hours/week	End sen	End semester exam (ESE):			25 marl	
		Interna	Internal Continuous Assessment				
		(ICA):	. contin	4046 11666		25 mark	
List of Experi	ments (Note: Minimun		ts from t	he followir	1g)		
	ermine mass transfer co					chemical	
reaction					* williout	chenneal	
		Daulaich's a+	for	ala diat:11 4	ion		
-	Distillation: To verify		i ioi sim	pie distinat	.1011		

- 3. To study Bubble Cap Distillation.
- 4. Liquid Liquid Extraction: To study and determine the efficiency of cross Current liquid- liquid extraction.

- 5. To construct ternary diagram for acetic acid -water -benzene
- 6. To plot Tie line diagram for acetic acid –water –benzene
- 7. To determine the percentage leaching of NaOH from a mixture of NaOH and CaCo3.
- 8. Adsorption: To study adsorption of acet ic acid on activated charcoal
- 9. To calculate percentage yield of crystals obtained with and without seeding in saturated solution of solute.
- 10. To Study Batch /Tray drying.

Text Books:

- 1. R. E. Treybal, Mass transfer operation, McGraw Hill Publication
- 2. Coulson and Richardson Chemical Engineering (Vol. I and II), Pergamon Press

Guide lines for ICA:

Students must submit ICA in the form of journal. Each practical should be well documented. Faculty in charge will assess the practical continuously and grade or mark each practical on completion date declared for each practical.

Guidelines for ESE:

ESE will be based on the oral examination of laboratory experiments submitted by the students in the form of journal.

		Lah	Rionroces	s Engine	ering					
Lab Bioprocess Engineering LAB COURSE OUTLINE										
Course Title:	e Lab Bioprocess Engineering				Short Title:	Lab BPE	Course Code:	è		
Course de	escription:									
	A	irse, emphasiz	e has giver	n on the	understa	unding of b	asics of	bioreactor		
		zation procedu								
procedure of various products.										
*		ours/week	No. of w	veeks Total ho		al hours	Semest	ter credits		
		02	1	4	28			01		
End Seme	ster Exam	(ESE) Patterr	n:		1		1			
Prerequis	ite course(s	s):- 11th, 12th	Biology, SE	E Biotech	nology c	courses				
	jectives: T		01							
1. Impar	t the basic k	knowledge of b	oioprocess e	ngineerir	ıg.					
		sterilization te				d of bioprod	cess engi	neering.		
•		and other aspe			ures.					
4. Learn the growth kinetics of microorganisms										
		rious fermentat	tion process	ses for bio	omolecu	les ferment	ation			
Course ou										
		pletion of lab C			be able to	D:				
		asic design of t								
		edge to study k		-				1 • .1		
		ledge of sense	ors and va	rious ste		n technique	es involv	ved in the		
proce		Componiet on pr								
		ermentation prization of vario		uete						
5. 1010			B COURS		FNT					
Lab Biopr	ocess Engin		DCOORD	Semeste			V	ſ		
Teaching	-			Examin		homo	• -	•		
Practical:	Scheme.	2 hours/wee								
Practical:		2 nours/wee	ek			xam (ESE)				
					I Contin	uous Asses	ssment	25 marks		
List of Es		Notos Minima		(ICA):		. the feller	(r			
	-	(Note: Minimu the fermenter.	-	xperime	ents from	ii the ionov	ving)			
	ed Sterilizat									
 Fermenter Sterilization. Growth kinetics of microorganisms using shake flask method. 										
 Determination of specific thermal death rate constant (Ka). 										
 Determination of specific mermal death rate constant (Ka). Determination of Volumetric oxygen transfer coefficient (KLa), effect of aeration 										
and agitation speed.										
7. Preparation of Immobilized enzymes and cells and evaluation of kinetic parameters.										
	-	of Product for	•				•			
	•	rate and produce		ation on b	oiomass	yield for ba	ker's yea	ist		
	duction.	-					-			
10. Stu	idies on sett	ling characteris	stics of vari	ous micr	obial cul	tures.				
 Studies on settling characteristics of various microbial cultures. Study of Physical and chemical sensors for medium and gases. 										
12 Fei	mentative p	production of S	auerkraut.							

Text Books:

- 3. David Plummer, Introduction to Practical Biochemistry, Third Edition.
- 4. S. Sadasivam, A. Manickam, Biochemical Methods, Second Edition. New Age International Ltd, Publishers.

Guide lines for ICA:

Students must submit ICA in the form of journal. Each practical should be well documented. Faculty in charge will assess the practical continuously and grade or mark each practical on completion date declared for each practical.

			ТА	B COURS		INE				
Course			LA Minor Proje		SE OUII	Short	MPRO).I (Course	
Title:						Title:			Code:	
Course	description	:								•
minor p emphasi	roject offers	the op sarily	e culmination portunity to ap on facilitating	oply and ex	xtend mat	erial lear	ned thro	ughout	t the pro	gram. Th
^		No. of w	weeks Total hours			Semester credit				
			6	14	14 84			3		
End Ser	nester Exai	n (ESE	C) Pattern:		Oral (OR		(OR)	0		
Prerequ	iisite course	e(s):								
Course	objectives:									
	v	and the	basic conce	nts & hroz	ad princi	ples of p	rojects			
			busic conce	L	a princip	. 1	5			
∠.		tand f	ha valua a	f achievi	na norfa	action in	n nroig	ot im	nlaman	tation &
			the value of	f achievi	ng perfe	ection in	n proje	ect im	plemen	tation &
	completion	l .			0 1		1 5		1	
3.	completion To apply	the	theoretical		0 1		1 5		1	
3.	completion To apply multidiscip	the tinary	theoretical approach.	concepts	to sol		1 5		1	
3. 4.	completion To apply multidiscip To demons	the the linary trate p	theoretical approach. rofessionalisi	concepts n with eth	to sol	lve pro	blems	with	teamw	ork an
3. 4.	completion To apply multidiscip To demons	the the linary trate p	theoretical approach.	concepts n with eth	to sol	lve pro	blems	with	teamw	ork an
3. 4. 5.	completion To apply multidiscip To demons	the the linary trate p	theoretical approach. rofessionalisi	concepts n with eth	to sol	lve pro	blems	with	teamw	ork an
3. 4. 5.	completion To apply multidiscip To demons Present eff	the the linary trate p	theoretical approach. rofessionalisi	concepts n with eth	to sol	lve pro	blems	with	teamw	ork an
3. 4. 5. Course	completion To apply multidiscip To demons Present eff context. outcomes:	the linary trate p ective	theoretical approach. rofessionalisi communicati	concepts n with eth on skills a	to sol	lve prol	blems	with	teamw	ork an
3. 4. 5. Course	completion To apply multidiscip To demons Present eff context. outcomes:	the linary trate p ective	theoretical approach. rofessionalisi	concepts n with eth on skills a	to sol	lve prol	blems	with	teamw	ork an
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3. 4. 5. Course Upon su 1. 2. 3.	completion To apply multidiscip To demons Present eff context. outcomes: ccessful con Demonstra Undertake Design eng	the trate pre- ective <u>npletion</u> te a sou problem	theoretical approach. rofessionalisi communicati n of lab Course und technical m identificati ng solutions t	concepts m with eth on skills a e, student v knowledg on, formu o complex	to sol nics; and relate <u>vill be ab</u> ge of the ilation an	lve prol e engined le to: ir selecte ad solutio	blems ering iss d projection.	with sues to	broade	ork and
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3. 4. 5. Upon su 1. 2. 3. 4. 5. Minor I	completion To apply multidiscip To demons Present eff context. <u>outcomes:</u> ccessful con Demonstra Undertake Design eng Conduct ar Demonstra	the trate pre- ective <u>npletion</u> te a sou problem	theoretical approach. rofessionalisi communicati <u>n of lab Course</u> und technical m identificati ng solutions t eering projec knowledge, sl	concepts n with eth on skills a e, student v knowledg on, formu o complex t kills and a	to sol nics; and relate will be abl ge of the ilation an c problem ttitudes of E CONT Semeste	lve prol e engined le to: ir selecte nd solutions utilizit of a profe ENT	blems ering iss d projec on. ng a sys	with sues to ct topic stems a	teamw broade c. approact	ork and
3. 4. 5. Upon su 1. 2. 3. 4. 5. Minor I	completion To apply multidiscip To demons Present eff context. outcomes: ccessful cor Demonstra Undertake Design eng Conduct ar Demonstra Project ag Scheme:	the linary trate pre- ective mpletion te a sou problem ineerin engin te the k	theoretical approach. rofessionalisi communicati <u>n of lab Course</u> und technical m identificati ng solutions t eering projec knowledge, sl	concepts n with eth on skills a e, student v knowledg on, formu o complex t kills and a	to sol nics; and relate will be ab- ge of the ilation and problem ttitudes of E CONT Semesto Examin	lve prob e engined le to: ir selecte ad solution s utilizion of a profe ENT er:	blems ering iss d projection ng a sys essional	with sues to ct topic stems a engin	teamw broade c. approact	ork and

In continuation with Minor Project (Stage – I) at Semester – V, by the end of Semester – VI, the student should complete implementation of ideas as formulated in Minor Project (Stage – I). It may involve coding, experimentation, data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, and sustainability. It may also include testing, results and report writing. Each student group should submit complete project report at the end of Semester-VI in the form of Hard bound. Assessment for the project shall also include presentation by the students.

Each student group is required to maintain separate log book for documenting various activities

of the project.

Suggestive outline for the complete project report is as follows.

Abstract

Chapter 1. Introduction

Chapter 2. Project Planning and Literature Survey

Chapter 3. Methodology

Chapter 4. Implementation

Chapter 5. Analysis

Chapter 6. Results and Discussion

Chapter 7. Conclusion & Future Scope

Bibliography

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Appendix

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Minor Project in Semester – VI shall be as per the guidelines given in Table – B.

Table – B

			Assessment by Gu	ide		Assessment by Departmental Committee			
Sr. No.	Name of the Student	of the Participation		Report	Depth of Understanding	Presentation	Demonstration	Total	
Marks		5	5	5	5	10	10	10	50

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation / demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

Internship:

Internship is a mandatory and non-credit course. It is mandatory for all admitted students to undergo Internship during the degree course. The course shall be of THREE weeks duration during summer vacation after Semester - VI. Following are the intended objectives of internship training:

- Will expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
- Exposure to the current technological developments relevant to the subject area of training.
- Experience gained from the 'Industrial Internship' will be used in classroom discussions.
- Create conditions conducive to quest for knowledge and its applicability on the job.

Students shall choose to undergo Internship / Innovation / Entrepreneurship related activities for Internship. Students shall choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO's/ Government organizations / Micro / Small / Medium enterprises / academic institutions / research institutions. In case student want to pursue their family business and don't want to undergo internship, a declaration by a parent may be submitted directly to the Department Head / TPO.

During the last year of FOUR year Bachelor of Engineering course the student should take project work, as specified in the curriculum, based on the knowledge acquired by the student during the degree course and during Internship. The project work provides an opportunity to build a system based on area where the student likes to acquire specialized skills. The work may also be on specified task or project assigned to the student during Internship.

The internship activities and list of sub-activities for Internship are as under.

- Innovation / Entrepreneurship:
 - Participation in innovation related Competitions for eg. Hackathons Robocon, Baha, IIT TechFest, Chemcon, Dipex etc
 - Development of new product/ Business Plan/ registration of start-up
 - Participation in Entrepreneurship Program of THREE weeks duration
 - Online certification courses by SWAYAM, NPTEL, QEEE etc.
 - Working for consultancy/ research project within the institutes
 - Training on Software (As per the need of respective branch);
 - Field Survey / Case Study
 - Work experience at family business
- Internship:
 - Internship with Industry/Govt. / NGO/ PSU/ Any Micro/ Small/ Medium enterprise/ academic institutions / research institutions
 - \circ Online Internship.
- Rural Internship
 - Any Long Term Goals may be carried out by students in teams:
 - Prepare and implement plan to create local job opportunities.

- Prepare and implement plan to improve education quality in village.
- Prepare an actionable DPR for doubling the village Income.
- Developing Sustainable Water Management system.
- Prepare and Improve a plan to improve health parameters of villagers.
- Developing and implementing of Low Cost Sanitation facilities.
- Prepare and implement plan to promote Local Tourism through Innovative Approaches.
- Implement/Develop Technology solutions which will improve quality of life.
- Prepare and implement solution for energy conservation.
- Prepare and implement plan to Skill village youth and provide employment.
- Develop localized techniques for Reduction in construction Cost.
- Prepare and implement plan of sustainable growth of village.
- Setting of Information imparting club for women leading to contribution in social and economic issues.
- Developing and managing efficient garbage disposable system.
- Contribution to any national level initiative of Government of India. For eg. Digital India/ Skill India/ Swachh Bharat Internship etc.

Faculty Mentor/Supervisors have to play active roles during the internship and minimum 20 students are to be supervised by each faculty mentor or as per the departmental strength. Mentor shall be responsible for selection of Internship activities by the student under his/her supervision and shall avoid repetition of activities by the student. The college / Institute shall facilitate internship for the students.

Every student is required to prepare a file for Internship containing documentary proofs (daily training diary, comprehensive report and completion certificate) of the activities done by him/her. The students should record in the daily training diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily training diary should include Date, Time of Arrival, Time of Departure, Main points of the day. The daily training diary should be signed after every day by the supervisor/ in charge of the section where the student has been working.

After completion of Internship, the student should prepare a comprehensive report to indicate what he / she has observed and learnt in the training period. The report should include Internship Objectives (in measurable terms), Internship Activities, and Internship Outcome.

The completion certificate should be signed by the supervisor / in charge of the section where the student has been working with performance remark as Satisfactory / Good / Excellent.

The evaluation of Internship shall be in Semester – VII. The evaluation shall be done by expert committee constituted by the concerned department including Department Head/ TPO/ faculty mentor or guide. It should be evaluated on the basis of the following criteria:

- Regularity in maintenance of the diary.
- Adequacy & quality of information recorded.
- Originality.

- Adequacy and purposeful write-up.
- Practical applications, relationships with basic theory and concepts taught in the course.
- Skill / knowledge acquired

Hence the satisfactory completion of Internship shall be submitted to the university at the end of Semester - VIII of FOUR year Bachelor of Engineering course. Only after successfully completion of Internship, Internship should be printed in the final year mark sheet as COMPLETED.