CHOICE BASED CREDIT SYSTEM – REGULATION & CURRICULUM (2023-25)

(With effect from the Academic year 2023-2024)

M. Sc. Biotechnology

Semester - I

PROGRAM M. Sc., Biotechnology														
Course (Code	Cou	rse Name:							L	Т	Р		С
PABTC	101	Cell	and Mol	ecular E	Biology					4	0	0		4
Year an	d Semester	I Ye	ar (I Seme	ester)		1.1 * 1.2	<u> </u>	1 1	-		Contact h	ours per v	week	Σ.
Prerequ	isite course	Any	Under Gr	aduate I	Jegree v	vith Life	e Science	backgr	ound	D ^	() 	4Hrs)	•	
		Hu	manities	and Soc	ial Sciei	nces	Mar c	agemei ourses	nt	Profes Co	ssional ore	Profe Ele	essio ectiv	onal Ze
Course	category		Bas	sic Scien	ice		Engineering Science			Oj Elec	pen ctive	Mandatory		ory
		• To acquaint students with the concepts in Cell and Molecular Biology.												
Course	Objectives		• To appraise on cellular and genomic processes and regulation											
	• To understand the basics of molecular biology and gene expression.								<u> </u>	דידים				
	At the end of the course the student will be able to:										BIL			
1. Exhibit a knowledge base in cell structure, organelles a							enes an	u their f	unctions			К2		
	0	2.	Outline t	he proce	ess that c	control o	cell cycle	e, and ce	ll death	l 				K2
Course	Outcomes	3.	Understa	ind the p	process c	ot replic	ation, tra	nscriptio	on and	translati	on			K2
		4.	Appraise	the pos	t-synthe	sis mod	ification	s for trai	nscripti	on and t	ranslatior	1		K1
		5.	Compreh gene reg	nend the ulation	role of	genetic	code, cl	nromatir	n, opero	ons and	cis/trans	elements	in	K3
		6.	Relate th	e Cell c	ommuni	cations	and sign	aling pa	thways					K3
	POS/	PO 1	1 PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4		
	C03	3	2	1	2	3	1	1	1	2	1	1		
	CO2	3	2	2	2	2	1	1	2	2	2	1		
	CO3	3	1	2	1	3	1	2	1	2	1	1		
	CO4	2	1	1	2	2	1	2	1	3	2	1		
	CO5	2	1	2	1	3	1	3	1	3	2	1		
	CO6	3	2	3	2	3	2	2	2	3	1	2		
	Average	2.67	1.50	2	1.67	2.67	1.17	1.83	1	2.50		1.25		
	LEVELS	AHOI	N	I. SLIC	JHI (LU	vv)	(MEDI	UM),		5. SU (HIG	H)	AL		
Unit 1													12 1	Hrs
Cell orga	anelles and or	ganiza	tion: Chei	nical or	ganizatio	on of cel	lls; intern	al organ	ization	of the c	ell - cell r	nembrane	es: st	ructure
of cell n	nembranes an	d conc	cepts relat	ed to co	mpartme	entalizat	tion in eu	ıkaryoti	c cells;	intrace	llular orga	anelles: e	ndop	olasmic
reticulur	n and Golgi a	appara	tus, lysos	omes an	d peroxi	isomes,	ribosom	es, cellu	ılar cyt	oskeleto	on, mitoch	nondria, c	hlor	oplasts
and cell	energetics; nu	iclear	compartm	ent: nuc	ieus, nu	cieolus	and chro	mosome	es.				12 1	Irc
Cellular	Processes: C	ell cvo	le and its	regulati	on cell	divisio	n. mitosi	s meios	sis and	cytokin	esis: cell	differenti	ation	n: stem
cells, th	eir differenti	ation	into diffe	rent cel	l types	and or	ganizatio	n into	speciali	zed tiss	sues; cell	-ECM ai	nd c	ell-cell
interaction	ons; cell rece	ptors a	and trans-	membra	ne signa	ling; ce	ell motili	ty and r	nigratic	n; cell	death: dif	ferent mo	odes	of cell
death an	d their regula	tion.												
Unit 3		C		•	1				<u>. 1 1</u>		(7)	14 15	<u>12 I</u>	Hrs
Genome	Organization	: Gen	ome organ	ization	in proka Tropof	ryotes a	nd eukar	yotes, N	/10/ecul	ar struct	ture of DN	NA and R	NA,	Forms
Prokarvo	otes. Enzyme	s in re	n Recond	regulation:	on of re	plication	n. DNA	Replicat	ion – F	and Col	ijugation. tes and M	utations	- Mi	itation:
types, D	NA repair sys	stems -	- methylat	ion, mis	match re	pair, Pl	noto reac	tivation	repair,	SOS rej	pair, recor	nbination	repa	air.
	Documen	t Prena	red in "Bos	ard of Stu	idies" hel	d on		Docum	ent Ann	roved in	"Academi	c Council"	'held	lon
	I	Date:				- 011		Docum	Date:		, readenill		neit	- 011
						Contro	lled Con	v			Rev	00/01.03	3.201	19
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Unit 4

12 Hrs

12 Hrs

Transcription, Genetic Code and Translation: RNA polymerase, features of promoters and enhancers, transcription factors, Prokaryotic and eukaryotic transcription, post-transcriptional modification - RNA splicing and RNA editing, Inhibitors, Elucidation of genetic code - salient features, Process of translation in prokaryotes and eukaryotes, Post translational modifications, Inhibitors, Regulation of gene expression: In prokaryotes – lac and trp operons. Regulation in eukaryotes – cis and trans-elements, chromatin re-organization in gene regulation.

Unit 5

Current Trends in Cell and Molecular Biology: Stem cells and progress in stem cell therapy. Cell imaging techniques: Fluorescence microscopy and confocal microscopy, FACS.

References

- 1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2008). Molecular Biology of the Cell (5th Ed.). New York: Garland Science.
- 2. Cooper, G. M., & Hausman, R. E. (2013). The Cell: a Molecular Approach (6th Ed.). Washington: ASM; Sunderland.
- 3. Gupta, H.L and Jangir, H.L. (2010) Cell biology: Fundamentals and Applications, Agrobios, Jodhpur, India.
- 4. Hardin, J., Bertoni, G., Kleinsmith, L. J., & Becker, W. M. (2012). Becker's World of the Cell. Boston (8th Ed.). Benjamin Cummings.
- 5. Krebs, J. E., Lewin, B., Kilpatrick, S. T., & Goldstein, E. S. (2014). Lewin's Genes XI. Burlington, MA: Jones & Bartlett Learning.
- 6. Lodish, H. F. (2016). Molecular Cell Biology (8th Ed.). New York: W.H. Freeman.
- 7. Sambrook, J and Russes D. Molecular Cloning. 3 volumes. Cold Spring Harbor Laboratory Press
- 8. Watson, J. D. (2008). Molecular Biology of the Gene (5th ed.). Menlo Park, CA: Benjamin/Cummings.

Text Book, if any.

- 1. Ajoy, P. (2009) Textbook of Cell and Molecular Biology, Second edition, Books and Allied Publication, Mumbai.
- 2. Veerbala Rastogi. Fundamentals of Molecular Biology. ANE Books India.

PROGRAM	M. Se	M. Sc., Biotechnology										
Course Code	Cour	se Name:		L	Т	Р	С					
PABTC102	Micr	obiology and Virology		4	0	0	4					
Year and Semester	I Yea	r (I Semester)			Contact 1	hours per	week					
Prerequisite course	Any	der Graduate Degree with Life Science background (4Hrs)										
	Hur	Humanities and Social Sciences Management Professional										
		courses Core										
Course category					\checkmark							
course category		Basic Science	Engineering Science	0	pen	Ma	ndatory					
				Ele	ective							
		To highlight the functions a	ind characteristics of mic	roorgan	isms							
Course Objectives		• To study the cultivation and	l purification of viruses									
		To evaluate explicitly, the r	netabolic pathways, role	of micro	obes in pu	iblic heal	th; insight					
	4 1	into the physical and chemi	cal control of microorgar	nisms			DTI					
	At th	e end of the course the student	will be able to:				BTL					
	1	Recall the basic knowledge or	n the development of mic	robiolo	gу		K2					
	2	Recognize the fundamental co	oncepts pertaining to the s	structur	e and fun	ctions of	K2					
Course Outcomes		microbes										
course outcomes	3	Apply appropriate physical an	d chemical methods to co	ontrol tl	ne growth	of micro	bes K2					
	4	4 Compare and categorize the interactions of microorganisms with plants and animals K										
	5	5 Appraise the importance and classification of the viruses K3										
	6	Infer about the virology studie	es and analytical approach	hes			K2					

Document Prepared in "Board of Studies" held on	Document Approved in "Academic Council" held on
Date:	Date:
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	POS/ COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4	
	CO1	3	2	1	2	3	1	1	1	2	1	1	
	CO2	3	2	2	2	2	1	1	2	2	2	1	
	CO3	3	1	2	1	3	1	2	1	2	1	1	
	CO4	2	1	1	2	2	1	2	1	3	2	1	
	CO5	2	1	2	1	3	1	3	1	3	2	1	
	CO6	3	2	3	2	3	2	2	2	3	1	2	
	Average	2.67	1.50	2	1.67	2.67	1.17	1.83	1	2.50	2	1.25	
	CORREL LEVELS	ATION		1. SLIC	GHT (LO	W)	2. MOI (MEDI	DERATE UM),		3. SUB (HIGH)	STANTL)	AL	
Unit 1 Microbial D the evolutio	Diversity: In on of divers	ntroduct sity, clas	tion to m ssification	nicrobiol on of mi	ogy and croorgai	microbe nisms, ci	es, histor riteria fo	ry & sco or classif	pe of mi ication;	crobiolo classific	gy, Micı ation of	obial tax bacteria;	12 Hrs conomy as eukaryo
ilgae, fungi	, slime mo	Ids and	protozo	a; extren	nophiles	and unc	culturabl	e microl	bes.				
methods; c conjugation Unit 3 Control of microorgan plants; Path control of n Unit 4 Virology: H taxonomy;	Microorga Microorga isms, Bena iogenicity nicroorgan History ana viral strate	anisms: anisms: eficial r islands isms. d princi gies for	Steriliza nicrobes and the ples of attachm	on and ation, di s; Host– ir role i virolog nent and	recomt isinfectio Pathoge n bacter y, molec entry, d	on, and on, and n intera rial viru cular bio	antiseps ctions; 1 lence, an ology of strategic	sis: phy Microbe ntibiotic	sical an s infecti s, antivi al virus ral repli	d chemi ng huma ral and , viral c cation -	rmation, cal metl ans, vete antifung lassifica the Balt	hods for erinary a al drugs tion, no imore Cl	12 Hrs control nimals as biologic 12 Hrs menclatur assificati
System; Ba	sic immun	e respor	ise to vi	al infect	tion, gen	neral viru	is patho	genesis;	virus sti	ucture a	nd morp	hology.	assilicatio
Unit 5					. 0		Y	<u> </u>			1		12 Hrs
Virological bacterial, pl	Methods: ant and an	Cultiva imal vir	tion and uses, de	l purific terminat	ation of ion of yi	viruses ields; Pu	: Differe	ent <i>in v</i> n of viru	ivo, in v 1ses usir	<i>itro</i> and g variou	<i>in ovo</i> s technic	growth ques.	systems fo
References 1. Lita M. 2. Matthai & Sons 3. Tewari 4. Willey, York: M	Proctor. M i, W., Berg Advances J. M., She AcGraw-H	Marine V g, C. Y., g in Mic grwood, ill.	/irus Eco & Blach robial To L., Woo	ology, S <, J. G. (echnolog lverton,	pringer, 2005). <i>M</i> gy. APH C. J., Pi	pp 113- <i>Aicrobio</i> I, New D rescott, I	130. 199 <i>blogy, Pr</i> Delhi, pp L. M., &	98. <i>inciples</i> . 567. 20 Willey,	<i>and Exp</i> 000. J. M. (2	oloration 011). Pr	es. Bosto rescott 's	n, MA: J <i>Microbi</i>	lohn Wile <u>)</u> ology. Ne
Text Book.	if anv												

PROGRAM	M. Sc., Biotechnology					
Course Code	Course Name:		L	Т	Р	С
PABTC103	Biochemistry and Biophysics		4	0	0	4
Year and Semester	I Year (I Semester)			Contact l	nours per	week
Prerequisite course	Any Under Graduate Degree with L		((4Hrs)		
	Humanities and Social Sciences	Profe	ssional	Prof	fessional	
		C	ore	E	lective	
Course estadory				\checkmark		
Course category	Basic Science	Engineering Science	0	pen	Ma	ndatory
Course category	Basic Science	Engineering Science	Oj Ele	pen ctive	Ma	ndatory
Course category	Basic Science	Engineering Science	Oj Ele	pen ctive	Ma	ndatory
Document	Basic Science Prepared in "Board of Studies" held on	Engineering Science Document App	O Ele	pen ctive "Academ	Ma ic Council	ndatory " held on
Document Da	Basic Science Prepared in "Board of Studies" held on ate:	Engineering Science Document App Date:	O Ele	pen ctive "Academ	Ma ic Council	ndatory " held on
Document Da	Basic Science Prepared in "Board of Studies" held on ate: Contr	Engineering Science Document App Date: Olled Copy	O Ele	pen ctive "Academ Rev	Ma: ic Council	ndatory "held on 3.2019

Course Ob	To facilitate strong knowledge on metabolic pathways and their regulations To articulate the importance of bioenergetics To gain knowledge on the structures of biomolecules at different levels												
		At th	e end of	the cour	rse the s	tudent w	vill be ab	ole to:					BTL
		1	Acqui	re know	ledge on	the met	abolic p	athways					K2
		2	Summ	arize the	e biosynt	thesis an	d degrad	dation pa	athways	of biom	olecules		K2
Course Ou	itcomes	3	Explai	n the im	portance	e of bioe	nergetic	s and en	ergy ric	h compo	unds		K2
		4	Under	stand va	rious bio	ophysica	l metho	ds and th	eir appl	ications			K1
		5	Articu biotec	late the hology	significa	nce of th	he biom	olecules	and to a	pply the	se funda	mentals in	K3
		6	Explai	n the ap	plicatior	n of anal	ytical in	strumen	tation in	macrom	nolecular	r structure	K2
	POS/ COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4	
	C01	3	2	1	2	3	1	1	1	2	1	1	
	CO2	3	2	2	2	2	1	1	2	2	2	1	
	CO3	3	1	2	1	3	1	2	1	2	1	1	
	CO4	2	1	1	2	2	1	2	1	3	2	1	
	C05	2		2	1	3		3	1	3	2		
	Average	2 67	2 1.50	2	2 1.67	2 67	∠ 1.17	2 1.83		2 50	2	1 25	
	CORREL	ATION	1.50	1. SLIC	GHT (LO	W)	2. MOI	DERATE	1	3. SUB	STANTI.	AL	
	LEVELS						(MEDI	UM),		(HIGH))		
Chemical interleukin Unit 3 Scope and Application Thermodyn Unit 4 Measureme Indices, U	methods of methods of ns. Differen namic Poter ent of pH, I nit cell, C	Biophy Biophy nt type ntials an Radioac oncept	des and loids – A sics: The of proc d relatio	ermodyn esses of ons, Max	accharid igments amics: 7 Heat 7 well equ	Thermod ransfer;	staglandi skeletal o lynamic Therm	system, odynam ntal Equ	tion. Equilibr ic varial ation of	ium, The ble; entr	ermodyn opy, en	a related in 5 – Interfe 12 12 12 12 12 12 12 12 12 12	rons and 2 Hrs and their
ndices, Unit cell, Concept of different crystal structure, determination of crystal structure, X-ray crystallography, NMR/MRI.											n, Recipi ure, X-1	12 rocal Lattic ray crystall	2 Hrs e, Miller lography,
Unit 5	Unit 5 12 Hrs										n, Recipi ure, X-1	12 rocal Lattic ray crystall	2 Hrs 2 Hrs bography, 2 Hrs
Unit 5 Biomolecu	lar Structur	es: Und	erstandi	ng struct	ystal str	ing, Autucture,	toradiog determin at differe	raphy. Enation of	Bragg`s of crysta s-primat	Equation al struct	n, Recipi ure, X-i idary, tei	12 rocal Lattic ray crystall 12 rtiary and qu	2 Hrs e, Miller lography, 2 Hrs uaternary
Unit 5 Biomolecu – conforma Reference 1. Charle 2. Daniel 3. Dobso 4. Lehnir 5. Noltin 6. RMJ C 7. Serdyu Cambr 8. Serdyu Cambr 9. Voet, I	lar Structur ational analy s s, R., Canto , M. 2007. 1 n, C. M. (20 nger, A. L. (g, B. (2006) Cotterill, Bio ik, I. N., Za idge: Camb ik, I.N., Zac idge Unive D., & Voet,	es: Und ysis and or, I. and Basic B 2012). <i>Pr</i> 2012)) Metho pophysics ccai, N. pridge U ccai, N.H rsity Pro J. G. (2	erstandi forces. 1 d Schimi iophysic cotein For Principl ds in Mo s An Intra S An Intra R., & Z Universit R. and Za ess, Indi 2016). Bi	mel, P.R mel, P.R es for Bio olding an es of Bio odern Bi coductio Zaccai, C y Press. accai, J. (a iochemis	(2004) (2004) (2004) (2004) (2004) (2004) (2004) (2004) (2004) (2004) (2007) (2007) (2007) (2007) (2007) (2007)	ing, Aut ucture, proteins tructures Biophys Agrobio olding. N ry (6th e s, 2nd Ed Wiely ar). Methods dethods ed.). Ho	toradiog determin at differe s of nucle sical Che s, India. lature, 42 ed.). New dition, S ad Sons 2 in Molece bboken, I	raphy. E nation of ent level eic acids emistry, 26(6968 w York, pringer New Yo <i>olecular</i> cular Bio	Bragg`s S of crysta s-priman at diffen Part II,), 884-8 NY: Wo Publicat rk <i>Biophys</i> ophysics iley & S	Equation al structury, secon rent leve W.H.Fre 90. orth. ions, Ne sics: Structury Sons.	n, Recipi ure, X-i idary, ter ls, Detai eeman & w Jersey <i>ucture, I</i> ure, Dyn	12 rocal Lattic ray crystall 12 rtiary and q ls of lipid st 2 Co., New 7. Dynamics, 1 namics and 1	2 Hrs e, Miller lography, 2 Hrs uaternary tructures. York. Function,
Unit 5 Biomolecu – conforma Reference 1. Charle 2. Daniel 3. Dobso 4. Lehnir 5. Noltin 6. RMJ C 7. Serdyu Cambr 8. Serdyu Cambr 9. Voet, I	lar Structur ational analy s s, R., Canto , M. 2007. 1 n, C. M. (20 nger, A. L. (g, B. (2006) Cotterill, Bio ik, I. N., Za idge: Camb ik, I.N., Zac idge Unive D., & Voet, Document	es: Und ysis and or, I. and Basic B 2012). <i>Pi</i> 2012)) Metho pophysics ccai, N. pridge U ccai, N.F rsity Pre J. G. (2 Prepare	erstandi forces. 1 d Schimi iophysic cotein For Principl ds in Mo s An Intr R., & Z Universit R. and Za ess, Indi 2016). Bi d in "Boa	mel, P.R mel, P.R es for Bio olding an es of Bio odern Bi coductio Zaccai, C y Press. accai, J. (a iochemis	(2007) N (2007) N (2007) N (2007) N (2007) N (2007) N (2007) N	ing, Aut ucture, proteins tructures Biophys Agrobio olding. N ry (6th e s, 2nd E Wiely ar). Methods dethods ed.). Ho	toradiog determin at differe s of nucle sical Che s, India. lature, 42 ed.). New dition, S ad Sons 2 ods in Moleo boken, I	raphy. E nation of ent level eic acids emistry, 26(6968 w York, pringer New Yo <i>olecular</i> cular Bio NJ: J. W	Bragg`s S of crysta s-priman at diffen Part II,), 884-8 NY: Wc Publicat rk <i>Biophys</i> ics iley & S ent Appro	Equation al structury, secon rent leve W.H.Fre 90. orth. ions, Ne sics: Structury Cons.	n, Recipi ure, X-i idary, ter ls, Detai eeman & w Jersey <i>ucture, I</i> ure, Dyn	12 rocal Lattic ray crystall 12 rtiary and q ls of lipid st 2 Co., New 7. Dynamics, 1 namics and 1 e Council" he	2 Hrs e, Miller lography, 2 Hrs uaternary tructures. York. Function, Function,
Unit 5 Biomolecu – conforma Reference 1. Charle 2. Daniel 3. Dobso 4. Lehnir 5. Noltin 6. RMJ C 7. Serdyu Cambr 8. Serdyu Cambr 9. Voet, 1	lar Structur ational analy s s, R., Canto , M. 2007. 1 n, C. M. (20 nger, A. L. (g, B. (2006) Cotterill, Bio ik, I. N., Zac idge: Camb ik, I. N., Zac idge Unive D., & Voet, Document	es: Und ysis and or, I. and Basic B 003). <i>P1</i> (2012)) Metho ophysic: ccai, N. oridge U ccai, N.F rsity Pro J. G. (2 Prepare Date:	erstandi forces. 1 I Schimi iophysic <i>rotein Fo</i> <i>Principl</i> ds in Mo s An Intr S An Intr R., & Z Universit R. and Za ess, Indi 2016). <i>Bi</i> d in "Boa	rent cry ng struct Understa mel, P.R s for Bio olding an es of Bio odern Bio codern Bio	(2004) (2004) (2004) (2004) (2004) (2004) (2004) (2004) (2004) (2004) (2007) (2	ing, Aut ucture, proteins fructures Biophys Agrobio <i>Iding</i> . N <i>ry</i> (6th e s, 2nd E Wiely ar). <i>Metho</i> Methods ed.). Ho d on	toradiog determine at different s of nucle sical Che s, India. Jature, 42 ed.). New dition, S ad Sons 1 in Molece boken, 1	raphy. E nation of ent level eic acids emistry, 26(6968 v York, 7 pringer New Yo <i>plecular</i> cular Bio NJ: J. W	Bragg`s of crysta s-priman at differ Part II,), 884-8 NY: Wo Publicat rk Biophysics iley & S ent Appro Date:	Equation al struct ry, secon rent level W.H.Fre 90. orth. ions, Ne sics: Struct Sons.	n, Recip ure, X-1 adary, ter ls, Detai eeman & w Jersey <i>ucture, I</i> ure, Dyn	12 rocal Lattic ray crystall 12 rtiary and qi 1s of lipid st Co., New Q. Dynamics, I namics and I c Council" here	2 Hrs e, Miller lography, 2 Hrs uaternary tructures. York. Function, Function,

- Text Book, if any.
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 Stryer, L. (2015). Biochemistry. (8th ed.) New York: Freeman.

PROG	RAN	1	M. S	c., Biote	chnolog	у									
Course	e Code	e	Cour	se Name	e:		-				L	Т	P		C
PABT	<u>C104</u>		Deve	elopmen	tal Biol	ogy and	Immu	nology			4	0	0	-	4
Year a	and So	emester	I Yea	ar (I Sen	hester)	Degree	with T 1	fo Caire	a ha -1		C	ontact h	ours per v	week	
Prerec	quisite	e course	Any	Under G	and So	Degree	with Li	te Scienc	e backgi	ound	Duofogo	4) Honol	Hrs)		nal
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			-					courses							C
Cours	e cate	egory		Ba	sic Sciei	nce		Engineering Science			Ope	en	Mar	ndato	ory
								0	0		Elect	tive			•
				• Top	provide f	fundame	ntals an	d advanc	es of de	velopn	ental bio	logy.			
				• To i	mpart b	asic kno	wledge	in Immu	inology	encom	passing, 1	history,	developn	nent a	and its
Cours	e Obj	jectives		impact on human system.										untor	na tha
			• To help the students familiarize with the organs and cells immune response and molecular interactions involved in imm								of the fi	nmune s	ysten	us, the	
			immune response and molecular interactions involved in immune response.												
			At th	e end of	the cou	rse the s	tudent v	vill be ab	le to:						BTL
			1	Underst	tand the	basic co	ncepts	of develo	pment i	n plants	and anir	nals			K2
							· · ·		1 . 1			IZ A			
~	~		2	Describ	e model	organis	ms and	Iandmarl	k discov	eries in	research	related	to		K 2
Cours	e Out	tcomes	3	Able to	explain	the anti-	ten_ant	ibody int	eraction	and the	ir enacif	ficity and	1 sensitiv	ity	кn
			1	Learn 4	ha kay a	onconte	of imm	unologic	al mash	and the	in specifi	incity all	1 SCHSHIV	ity	K2 1/2
			4	Learn u	ne key c	oncepts		unologica	ai mecha	unisins					NI.
			5	5 Understand the types of cells involved in the nervous system										K3	
			6	Explain	various	immune	e techni	ques in d	isease d	etection	1				K2
	-														
		POS/	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4		
	-	C05	3	2	1	2	3	1	1	1	2	1	1		
	ŀ	CO2	3	2	2	2	2	1	1	2	2	2	1		
	-	CO3	3	1	2	1	3	1	2	1	2	1	1		
	F	CO4	2	1	1	2	2	1	2	1	3	2	1		
	F	CO5	2	1	2	1	3	1	3	1	3	2	1		
	-	CO6	3	2	3	2	3	2	2	2	3	1	2		
	F	Average	2.67	1.50	2	1.67	2.67	1.17	1.83	1	2.50	2	1.25		
	Ē	CORRELA	ATION	•	1. SLIC	GHT (LO	W)	2. MOI	DERATE		3. SUB	STANTI	AL		
		LEVELS						(MEDI	UM),		(HIGH)			
I														10 7	Inc
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develo	pmen	t in plants	s and a	animals:	Morpho	ogenesis	and or	ganogen	esis in	plants	and anim	als. Ge	neral sta	ges i	n Cell
Develo	opmer	nt Potency,	induct	tion, con	npetence	, determ	ination	and diffe	erentiati	on; ster	n cells; c	hromoso	omal inhe	ritan	ce and
extra-c	hrom	osomal inf	neritano	ce. Cell d	lifferent	iation, e	mbryon	ic develo	pment,	Growth	, Metamo	orphosis	and Reg	enera	tion.
Unit 2														12 H	Irs
Advan	ces in	Developm	nental I	Biology:	Develop	omental	Biology	of Mode	el Organ	isms; Z	ebrafish,	frog; Se	a urchin,	Dros	ophila
melano	ogaste	er; Arabid	opsis	thaliana	i; Dicty	ostelium	ı disco	ıdeum;	Sacchar	omyces	s cerevis	siae and	1 Bacilli	is si	ubtilis;
Progra	inmec	u celi deatr	i, aging	g and sen	iescence									12 1	Irc
Compo	onents	s of the im	mines	vstem [.] F	listory o	f Immur	nlogy	innate im	miine re	sponse	(PRRs 1	Neutroph	nils Deno	14 f	cells)
complement system, humoral and cellular immunity and its components (T and B cell signaling).															
Unit 4		<i>, , , ,</i>				in the second		1	(·		6			12 H	Irs
L		Document	Prepare	ed in "Boa	ard of Stu	dies" hel	d on		Docum	ent App	roved in "	Academi	c Council'	' held	on
		Л	ate:							Date					
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Cells and organs of the immune system: Overview of lymphoid system, cells of the immune system, primary and secondary lymphoid organs, tertiary lymphoid tissues. Unit 5

12 Hrs

Antigen and antibodies: Antigen concept, criteria of antigens, immunogen, antibodies (structure, specificity, diversity), antigen-antibody interactions. Immunological tolerance, immunosuppression, history and status of tumour immunology, autoimmune disorders and immunology of infectious disease.

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- 1. Basir Seemi Farhat (2012). Textbook of Immunology, 2nd edition, PHI Learning.
- Bruce Alberts et al., Molecular Biology of the Cell, 6th Edition 2014. 2.
- Judy Owen, Jenni Punt and Sharon Stanford, (2012), Kuby Immunology, 7th edition, W.H.Freeman and Company, 3. New York, USA.
- Kuby, J. Goldsby, R.A., Kindt, T.J. and Osborne, B.A. (2007). Immunology, 6th edition, W.H.Freeman and Company, 4. NewYork, USA.
- Peter J. Delves, Ivan Maurice Roitt, Seamus J.Martin and Deninis Burton (2016). Essential Immunology, 13th edition, 5. Wiley Blackwell Scientific Publications, London.
- 6. Scott F. Gilbert, Developmental Biology, 10th Edition 2013.

- Rao, C.V. (2006). An Introduction to Immunology, 2nd edition, Narosa Publishing House, Delhi, Chennai, Mumbai, 1. Kolkata.
- 2. Madhavee Latha P. (2012). Textbook of Immunology, 1st edition, S. Chand Publishers.

PROGRAM	M. Sc., Biotechnology										
Course Code	Course Name:		L	Т	Р	С					
PABTP101	Molecular Biology and Biochemis	stry Lab	0	0	4	2					
Year and Semester	I Year (I Semester)			Contact l	hours per	week					
Prerequisite course	Any Under Graduate Degree with L	ife Science background			(4Hrs)						
	Humanities and Social Sciences	Management	Profe	essional	Prof	fessional					
		courses	C	ore	E	lective					
Course cotegory				\checkmark							
Course category	Basic Science	Engineering Science	O Ele	pen ective	Ma	ndatory					
Course Objectives	 Develop comprehensive u Nucleic acids Provide technical skills at To facilitate the skills o biomolecules 	nderstanding in the salier pout electrophoresis and I f the students in Quali	nt featur PCR itative a	res involv and Quar	red in the	isolation of Analysis of					
	At the end of the course the student	will be able to:				BTL					
	1 Define the basic concepts invo microorganism sources	olved in the nucleic acid is	solation	from pla	nt, animal	and K2					
	2 Explain the principles of quan	Explain the principles of quantification of nucleic acids and molecular weight analysis									
Course Outcomes	3 Knowledge in the amplification of DNA using PCR										
	4 Estimate carbohydrates, protein etc.										
	5 Learn separation techniques f	Learn separation techniques for various phytochemicals									
	6 Estimate the biochemical com	Estimate the biochemical composition and enzymes kinetics									

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	POS/	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4
	COS	3	2	1	2	3	1	1	1	2	1	1
	C02	3	2	2	2	2	1	1	1	2	2	1
	CO3	3	1	2	1	2	1	1	2 1	2	1	1
	CO4	2	1	1	2	2	1	2	1	2	2	1
	C05	2	1	2	1	2	1	3	1	3	2	1
	CO6	3	2	3	2	3	2	2	2	3	1	2
A	verage	2.67	1 50	2	1 67	2.67	1 17	1.83	1	2.50	2	1.25
C	CORRELA EVELS	ATION	1.00	1. SLIC	GHT (LO	W)	2. MOI (MEDI	DERATE UM),	· ·	3. SUB (HIGH)	STANTI.	AL
6. Amp 6. Amp Biochemistry 1. Estin 2. Estin 3. Estin 4. Estin 5. TLC	lification nation of nation of nation of separation	total ca total ca reducir cholest protein	A using arbohydr ng sugar erol by by Low	Polyme rate by A s by Di I Zak's m vry's/ Br nicals	and ana rase Cha Anthrone Nitro Sa ethod radford's	e method licylic a	tion cid meth	od	vergints (y ger de	ounent	
References 1. Michael 2. Sawhney	R. Green	n, Josep Randhir	h Sambi Singh, I	rook, Me	olecular tory prac	Cloning ctical Bi	a Labor	atory M try. Naro	anual, 4 osa publ	th ed., C ishers, 2	hsl Press 006	s, New York.
PROGRAM		M. Sc.	, Biotec	hnology					г	T	T	n
Lourse Code		Course	= manne:							L	1	r
		Micro	hiology	and Im	munolo	ov Lah				0	0	4

1 AD 11 102	WIICI	obiology and minimunology La	10	0 0	4	2					
Year and Semester	I Yea	r (I Semester)		Contact l	nours per week						
Prerequisite course	Any	Under Graduate Degree with Li	fe Science background	((4Hrs)						
	Hur	nanities and Social Sciences	Management	Professional	Professional						
			courses	Core	Electiv	e					
Course estagory											
Course category		Basic Science	Engineering Science	Open	Mandato	ory					
				Elective							
	•	• To make the student understand the basic principles involved in the isolation of different									
		kinds of microorganisms									
Course Objectives	•	 To Identify the microorgani 	isms using various stainir	ig techniques and	l tests						
	•	 To impart the knowledge or 	n the application of immu	nology in diagno	ostic and therap	peutics					
						r					
	At the	e end of the course the student	will be able to:			BTL					
	1	Develop media for cultivation	of microorganisms			K2					
	2	Demonstrate microbial isola	ation and staining tech	niques for ider	ntification of	K2					
Course Outcomes		microorganism	C	1							
	3 Demonstrate the skill in collecting blood and separating serum.										
	4	Evaluate the generation of antibodies through different experimental methods.									
	5 Analyze the effect of adverse immune reactions.										
	6	6 Demonstration off blood groups detection K4									

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POS/	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4
C03	3	2	1	2	3	1	1	1	2	1	1
CO2	3	2	2	2	2	1	1	2	2	2	1
CO3	3	1	2	1	3	1	2	1	2	1	1
CO4	2	1	1	2	2	1	2	1	3	2	1
CO5	2	1	2	1	3	1	3	1	3	2	1
CO6	3	2	3	2	3	2	2	2	3	1	2
Average	2.67	1.50	2	1.67	2.67	1.17	1.83	1	2.50	2	1.25
CORREL LEVELS	CORRELATION LEVELS			GHT (LO	W)	2. MOI (MEDI	DERATE UM),		3. SUB (HIGH)	STANTL)	AL

Microbiology

- 1. Media preparation- Nutrient broth, Nutrient agar, slants, soft agar
- 2. culturing of microorganisms- in broth and in plates (pour plates, streak plates)
- 3. Staining Techniques (Simple, Gram staining and negative staining)
- 4. Exposing the Sabouraud's agar plate in different location -Fungal identification by LPCD mount
- 5. Antibiotic sensitivity assay Disc and Well diffusion method

Immunology

- 1. Blood Grouping
- 2. Drawing Blood and separation of Serum.
- 3. Study of Tonicity using RBC model
- 4. Maintenance of Fish & Dissection of Lymphoid organs
- 5. Preparation and Administration of Antigen.
- 6. Estimation of specific Antibodies using Haemagglutination.
- 7. Graft Rejection
- 8. Delayed type hypersensitivity in Fish

References

- 1. James G. Cappuccino, Microbiology: A Laboratory Manual, 5th Edition, Benjamin Science Publishing, 2009.
- 2. Senbagam Duraisamy, Practical Immunology A Laboratory Manual: LAP LAMBERT Academic Publishing; 1st edition, 2017.

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Date:	Date:
Controlled	Copy Rev 00/ 01.03.2019
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Course Cod	M	M. S	c., Biotec	hnology									
Lourse Coo	le	Cour	se Name:							L	Т	Р	С
PABTC201	1	Gen	etic Engi	neering	and Bio	oinform	atics			4	0	0	4
lear and S	Semester	I Yea	ar (II Sem	lester)			~ .			C	ontact h	ours per v	week
Prerequisit	te course	Any	Under Gr	aduate I	Degree v	vith Life	Science	backgro	ound	D 4	(4	Hrs)	
		Hu	manifies a	and Soc	ial Sciei	nces	Mar	nagemen	nt	Profess	sional	Prof	essional
							C	ourses			re	El	ective
Course cat	egory		_	ia Saian			Enginog	mina Sai	ionaa			Mor	datany
			Das	sic Scien	ce		Enginee	ering Sci	lence	Elect	tive	Man	luatory
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Course Ob	ijectives		 Acqu Deve for cl To le 	aint stud lop tech oning. arn and	lents wit nical ski understa	th the co lls abou and spec	oncepts in it different ific datal	n Geneti nt types bases and	c engine of restri d perfor	eering. ction en m effect	zymes, t	ypes of v base searc	ectors use
		At th	e end of t	he cours	se the stu	ident wi	ll be abl	e to:					BT
		1	Understa	and the u	se of res	striction	endonuc	cleases in	n gene c	loning.			K2
		2	Ablata	Jacorita	the diff	aront vo	otors (no	hamot	a) that a	an ha ua	ad in acc	a clonin	
		2	experime	ents		erent veo	lors (pro	JKaryotto	() that C	an de us	eu in ger	ie cioning	5 K 2
Course Ou	itcomes	3	Demons	trate the	various	strategi	es of clo	ning. scr	eening	and selea	ction me	thods.	K7
		4	Apply th	e knowl	edge of	Bioinfo	rmatics s	kill to se	olve the	hiologic	al proble	ems in	K
			Genomic	cs and Pi	roteomic	s.	i inacio e			oronogie	ui proon		
		5	Analyse	differen	t types c	of Biolog	gical data	abases ai	nd resou	irces.			Ka
		6	Apply va	arious so	ftware t	ools in t	oioinforn	natics					K
	POS/	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4	
	COS	2		1	2	2	1	1	1	2	1	1	
	C01	2	2	1	2	2	1	1	1	2	1	1	
	CO2	3	1	2	2	2	1	2	1	2	1	1	
	CO4	2	1	1	2	2	1	2	1	3	2	1	
	CO5	2	1	2	1	3	1	3	1	3	2	1	
	CO6	3	2	3	2	3	2	2	2	3	1	2	
	Average	2.67	1.50	2	1.67	2.67	1.17	1.83	1	2.50	2	1.25	
	CORREL	ATION	1	1. SLIC	GHT (LO	W)	2. MOI	DERATE	1	3. SUB	STANTI	AL	
	LEVELS						(MEDI	UM),		(HIGH)		
T •4 1													10.11
Unit I	in a Daina		of Care	Classia	Dente			Class	-: f : 4: -			Dad	12 Hrs
Exonucleas Plasmids as	s vectors V	PBR3	odifying e 22 - pUC	enzymes vectors	g. Kesu ; Linkei - M13-J	rs, Adar Lambda	pters and phage v	Homopy Hortors, (oolymer Cosmid	tailing. vectors,	Properti Phagem	ies of ide	eal vector tle vector
Jnit 2		c, D	, 171ull										12 Hrs
CR: Polyr	merase cha	in rea	ction – M	lethod-L	imitatio	ns and	applicati	ions- Ty	pes of l	Primers	– Unive	rsal, Nes	ted, Poisc
orimers- T	ypes – Q-	PCR,	RT-PCR-	Probe	Preparat	ion and	method	ls of La	belling,	Souther	n Hybri	dization	- Norther
	on; Western	n blott	ing, Auto	radiogra	phy; DN	IA finge	r printin	g.					
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ybridizatio Jnit 3 Recombina	nt DNA: C	c of T		uon), u <i>i</i>	T	enesis a	nd Bioet	thics		reening	of Recoi	nomani i	JNA- UEI
ybridizatio Jnit 3 Recombina Ind biologio	nt DNA: C cal method	s of Ti and rI	$\mathbf{N}\mathbf{A}$ $\mathbf{A}\mathbf{n}\mathbf{n}$	lications	- I ranco			incs.					
ybridizatic J nit 3 Recombina nd biologic Sequencing J nit 4	nt DNA: C cal method g, Libraries	s of Ti and rI	<u>DNA App</u>	lications	s-1 ransg								12 Hrs
aybridizatic J nit 3 Recombina and biologic Sequencing J nit 4 Bioinforma	nt DNA: C cal method <u>g, Libraries</u> ntics: Introd	s of Tr and rI	DNA App	lications	s: Scon	e and ar	plication	ns of hic	oinform	atics. old	bal bioi	nformatio	12 Hrs
ybridizatio J nit 3 Recombina nd biologi dequencing J nit 4 Bioinforma definition o	nt DNA: C cal method g, Libraries ttics: Introc of terms - or	s of Tr and rI luctior rtholog	کی کی کی ک	lications formatic gy, xenc	s: Scope	e and ap d analog	oplication gy; Simil	ns of bio arity and	oinforma l identit	atics, glo y- Introd	bal bioi luction to	nformatic o databas	12 Hrs cs scenario es- types o
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databases, information retrieval system (Entrez and SRS) and database collaboration, file formats, sequence, structure and pathway databases of nucleotides and proteins.

Unit 5

12 Hrs

Application of bioinformatics: Multiple Sequence Alignment, progressive method, iterative method; data searching tools for homologous sequences analysis - BLAST & FASTA; Sequence editors - BioEdit, BoxShade etc. Prediction tools- profile, motifs, domains, and feature identification - Phylogenetic prediction: Phylogenetic tree construction - distance based method and character-based methods; Gene prediction, protein structure & functions prediction, Phylogenetic analysis package – MEGA.

References

- 1. Attwood, T. and Parry, D. (2002) Introduction to Bioinformatics Pearson Publication, Asia
- 2. Claverie, J-M. and Notredame, C. (2003) Bioinformatics A Beginner's guide, 1st Edition –Wiley Publishing Inc, New York.
- 3. Dubitzky, W. (2007) Fundamentals of Data mining in Genomics and Proteomics, Springer Publication, New Jersey.
- 4. Gibas, C. and Jambeck, P. (2001) Developing Bioinformatics Computer Skills, Schroff. Publishers & Distributors Pvt. Ltd.
- 5. Gromiha, M.M. (2010) Protein Bioinformatics: From Sequence to Function, Academic Press, New Delhi.
- 6. Krane, D.L. (2006) Fundamental Concept of Bioinformatics, Pearson Publication, Asia.
- 7. Lacroix, Z. and Critchlow, T. (2009) Bioinformatics: Managing Scientific Data Mayan Kaufmann Publishers, San Francisco.
- 8. Mount, D. (2006) Bioinformatics, Sequence and Genome Analysis, CBS.
- 9. Ramsden, J.J. (2009) Bioinformatics: An introduction, Kluwer Academic Publishers
- 10. Sambrook, J and Russes D. Molecular Cloning. 3 volumes. Cold Spring Harbor Laboratory Press.
- 11. Simpson, R.J. (2003) Protein and Proteomics, Cold Spray Harbour Laboratory, New York.
- 12. Varma V.S Cell Biology Genetics: Molecular Biology, Evolution and Ecology
- 13. Winchester. A. M. Genetics (Third Edition). 1996.

- 1. Alberts Bruce. "Molecular biology of the cell". 4th edition, Garland Science publishers. 2002.
- 2. Roy, D. (2009) Bioinformatics, Narosa publishing house, India.

PROGRAM	M. Se	c., Biotechnology									
Course Code	Cour	se Name:		L	Т	Р	С				
PABTC202	Geno	ics and Proteomics 4 0 0									
Year and Semester	I Yea	(II Semester) Contact hours per week									
Prerequisite course	Any	Under Graduate Degree with Li	fe Science background		(•	4Hrs)					
	Hur	nanities and Social Sciences	Management	Profe	ssional	Prof	essional				
			courses	C	ore	Ele	ective				
Course category											
course category		Basic Science	Engineering Science	0	pen	Man	datory				
				Ele	ctive						
	•	• Provide advanced theoretical knowledge on the organization and function of genomes.									
Course Objectives		• Understand the principles of functional genomic analyses.									
course cogeentes	•	• Have knowledge on the adv	anced methods and appro	oaches i	n proteon	nics.					
	At th	e end of the course the student v	will be able to:				BTL				
	1	Define and describe structural	, functional, and compara	ative ge	nomics		K2				
	2	Learn detailed structure and o	rganization of genes and	other D	NA elem	ents in a	K2				
~ ~		genome	8								
Course Outcomes	3	Describe advanced techniques	and methods used for ge	enome a	nalysis, s	uch as	K2				
		DNA microarrays and NGS back	ased platforms.		•						
	4	Able to understand the import	ance and application of p	roteomi	cs in med	lical field	. K1				
	5	Well acquainted with proteom	e databases.				K3				
	6	Summarize the basics of Gene	omics and proteomics and	d its rece	ent advan	cement	K2				

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Date:	Date:

	POS/ COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4	
	CO1	3	2	1	2	3	1	1	1	2	1	1	
	CO2	3	2	2	2	2	1	1	2	2	2	1	
	CO3	3	1	2	1	3	1	2	1	2	1	1	
	CO4	2	1	1	2	2	1	2	1	3	2	1	
	CO5	2	1	2	1	3	1	3	1	3	2	1	
	CO6	3	2	3	2	3	2	2	2	3	1	2	
	Average	2.67	1.50	2	1.67	2.67	1.17	1.83	1	2.50	2	1.25	
CORRELATION LEVELS1. SLIGHT (LOW)2. MODERATE (MEDIUM),3. SUBSTANTIAL (HIGH)													
Unit 1													12 Hrs
Basics of	Genomics	and P	roteomi	cs: Brie	ef overv	iew of	prokary	otic an	d eukar	votic ge	nome o	rganizat	ion; extra-
chromosor	nal DNA: t	acterial	plasmic	ls, mitod	chondria	, and ch	loroplas	t.				e	,
Unit 2													12 Hrs
mapping, hybridizati Unit 3	physical m on, radiatic	apping, on hybri	linkage d maps,	analysi in situ h	aps; mai is, cytog iybridiza	genetic t	echnique mparativ	es, FISH	I techni mapping	que in g	gene maj	pping, so	matic cell
Comparati	ve Genom	nics: Id	lentificat	tion an	d class	ification	of or	ganisms	using	molecu	ılar ma	rkers- 1	6S rRNA
typing/seq	uencing, SI	NPs; use	e of gen	omes to	understa	and the o	evolution	n of euk	aryotes,	track en	nerging of	diseases	and design
new drugs	determinir	ng gene	location	in genor	me seque	ence. Ge	nome Se	equencir	ig Projec	ts: Hum	an Geno	me Proje	ct, genome
sequencing	g projects fo	or micro	bes, pla	nts and a	animals,	accessi	ng and re	etrieving	g genom	e project	informa	tion from	n the web.
Unit 4													12 Hrs
Proteomics: Aims strategies and challenges in proteomics: proteomics technologies: 2D-PAGE isoelectric focusing mass													
Proteomic	spectrometry, MALDI-TOF, yeast 2-hybrid system, proteomics detabases.									D-PAGI	E, isoele	ctric focu	ising, mass
Proteomic: spectrome	try, MALD	I-TOF,	and chai yeast 2-	hybrid s	n proteo: ystem, p	mics; pro roteome	oteomics databas	s techno es.	logies: 2	D-PAGI	E, isoele	ctric focu	ising, mass
Proteomic: spectrome Unit 5 Functional	Genomics	and Pro	yeast 2-1	hybrid s	n proteon ystem, p criptome	mics; pro roteome analysis	oteomics databas	s techno es. ntificatio	logies: 2	D-PAGI	E, isoeled	ctric focu	ising, mass 12 Hrs ene, Contig
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		5 Acquire the ability to approach novel problems in Science with AI/ML.									K3			
		6	6 Apply the knowledge on AI and ML in Molecular diagnosis K3									K3		
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trees, Kernel-Ridge Regression, Random-Forest, evaluating regression models performance, Logistic Regression, SVM, KNN (Confusion matrix, accuracy score), Decision trees classification, Random-Forest classification, classification model selection in python, evaluating classification models performance. Introduction to R in Healthcare: Basic analysis in R, R programming: understanding common data distribution and types of variables, formulate scientific hypothesis, correlation and dependence. Statistical analysis, Survival analysis, Logical and Logistic regression. Ways to choose predictors in regression model, Run and interpret Kaplan-Meier curves in R

Unit 5

Deep Learning: Introduction, Types of Deep Learning, ANN, Neural Networks, DNN, RNN, CNN architectures for medical data manipulations. Challenges in Pharmaceutical industries which AI can solve: Notations, Approaches of AI to be used in solving healthcare data and its applications. Case studies: Disease identification and diagnosis-Google DeepMind Health, Personalized Treatment/Behavioral Modification (Study any one case), COVID – 19 Coronavirus Prediction Outcomes, Forecasting, Analysis & Visualization.

12 Hrs

References

- 1 Arlindo, L. Oliveir Biotechnology, Big Data and Artificial Intelligence, Biotechnol. J. 2019, 14, 1800613. DOI: 10.1002/biot.201800613
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- 3 Anil Philip, Aliasgar Shahiwala, Mamoon Rashid, Md Faiyazuddin. (Editors) A Handbook of Artificial Intelligence in Drug Delivery, 1st Edition - March 27, 2023, Elsevier,

PROG	RAM	M. Sc., Biotechnology							
Course	Code	Course Name:		L	Т	P	С		
PABTO	C101	Genetic Engineering and Bioinform	natics Lab	0	0	4	2		
Year a	nd Semester	I Year (II Semester)			Contact I	hours per	week		
Prereq	uisite course	Any Under Graduate Degree with Li	fe Science background			(4Hrs)			
		Humanities and Social Sciences	Profe	essional	Prof	fessional			
			C	ore	E	lective			
Course	actora			\checkmark					
Course	e category	Basic Science	Engineering Science	0	pen	Mandatory			
				Ele	ective				
		• To impart knowledge on the b	basic laboratory techniqu	es emp	loyed in a	a genetic	engineering		
Course	e Objectives	Lab							
		To learn and understand specified	fic databases and perform	ı effecti	ve databa	ase search	es.		
Γ	Document	t Prepared in "Board of Studies" held on Document Approved in "Academic Council" held on							
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		At the	e end of	the cour	se the st	udent w	ill be ab	le to:	1101	connes			F	BT
		1	Gain e	xperienc	ce in the	develop	pment of	f moleci	ılar tool	s for vir	al vecto	r-based ge	ne	K
		2	Demor	y istrate va	arious to	ols invo	lved in s	penetic e	ngineer	ing				K
Course O	utcomes	- 3	Evpros	e nurify	and and	lyza rac	ombina	nt protei	n					<u>K'</u>
		3	Unders	tand the		ance of	biologic	al datab	n asas and	their uti	lization			K
			Cilders		signific		biologic	aruatab		ulcii ul	inzation.			K.
	5 Construct phylogenetic tree										Κ.			
6Apply various software tools in bioinformatics1								K.						
	POS/ COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4		
	CO1	3	2	1	2	3	1	1	1	2	1	1		
	CO2	3	2	2	2	2	1	1	2	2	2	1		
	CO3	3	1	2	1	3	1	2	1	2	1	1		
	C04	2	1	1	2	2	1	2	1	3	2	1		
	CO5	2	2	2	2	3	2	2	2	3	1	2		
	Average	2.67	1.50	2	1.67	2.67	1.17	1.83	1	2.50	2	1.25		
	CORREL	ATION		1. SLIC	GHT (LO	W)	2. MOI	DERATE	1	3. SUB	STANTI	AL		
	LEVELS						(MEDI	UM),		(HIGH))			
 RE dig Prepar Analys Wester *Demo Bioinform NCBI ExPAS EMBC Swiss- Gene I EMBL EMBL Trop R 	gestion of the ation of con sis of express rn blotting a o in Lab visi natics Database Sy Database DSS pairwise rg RNA Too Prot Databa Prediction EBI databa	e PCR I pipetent sed pro nalysis ts e Seque bls Smit se use	broduct & <i>E.coli</i> ar tein usin nce Alig th-Water	& clonin nd transf g SDS- nment man	g the dig formation PAGE.	gested Pon of the	CR prod cloned p	luct into olasmid a	<i>E.coli</i> E and selec	Expressic	n vector	[•] by ligatio nant clones	1* .*	
Reference	s D C L													

PROGRAM	M. Sc., Biotechnology					
Course Code	Course Name:		L	Т	Р	С
PABTP202	Genomics, Proteomics, AI and ML l	Lab	0	0	4	2
Year and Semester	I Year (II Semester)			Contact l	nours per	week
Prerequisite course	Any Under Graduate Degree with Life	Science background			(4Hrs)	
	Humanities and Social Sciences	Management	Profe	ssional	Pro	fessional
Course category		courses	C	ore	E	lective
				\checkmark		

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		Basic Science	Engineering Science	Open Elective	Mandato	ory				
Course Objectives		 Able to know database searc To explore how ever-growing disease To identify innovative researce 	hing, alignments and patt g gene and protein data-se rch directions in Artificial	ern matching ets can provide ke	ey insights into l Machine Lear	human ming				
	At the end of the course the student will be able to:									
	1	1 Perform computational analysis and wet-lab investigations								
	2	Familiar with conditions for de	esigning primers for PCR			K2				
Course Outcomes	3	Demonstrate Proteomic analys	is			K2				
	4	Understand Pharma data analy	sis based on computer sci	ence		K1				
	5 Learn the importance and application of Artificial Intelligence and Data Science									
	6	Apply the knowledge on AI an	d ML in Molecular diagn	osis		K3				

POS/	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4
COS											
CO1	3	2	1	2	3	1	1	1	2	1	1
CO2	3	2	2	2	2	1	1	2	2	2	1
CO3	3	1	2	1	3	1	2	1	2	1	1
CO4	2	1	1	2	2	1	2	1	3	2	1
CO5	2	1	2	1	3	1	3	1	3	2	1
CO6	3	2	3	2	3	2	2	2	3	1	2
Average	2.67	1.50	2	1.67	2.67	1.17	1.83	1	2.50	2	1.25
CORREL	ATION		1. SLIC	GHT (LO	W)	2. MOI	DERATE		3. SUBSTANTIAL		
LEVELS						(MEDI	UM),		(HIGH))	

Genomics, Proteomics

- 1. ORF finding using bioinformatics tools
- 2. Searching similar sequences using BLASTp, BLASTt and BLASTn
- 3. Multiple sequence alignment and finding conserved sequences.
- 4. Designing primers for PCR
- 5. Protein Structure: Data, Visualization, Alignment, Pocket detection, Homology Modeling
- 6. Molecular Docking: Protein-Protein and Protein Small molecule/drug

AI and ML

- 1. Data Manipulation using Numpy and Pandas,
- 2. Data Visualization in different Graphs and basic python based on arrays, list, data management, functions.
- 3. Clustering: K-means clustering, Hierarchical clustering
- 4. R programming for Pharma data analysis, Data classification using Python
- 5. IRIS Flower Classification using KNN

References

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Semester – III

PROG	RAM	AM M. Sc., Biotechnology												
Course	Code	Cour	se Name	:						L	Т	Р	C	
PABT	C301	Dru	g Design	and Dis	scovery					4	0	0	4	
Year a	ind Semester	II Ye	ear (III Se	emester)	_					(Contact h	nours per	week	
Prereg	uisite course	Any	Under G	raduate	Degree v	with Lif	e Scienc	e backgı	round		((4Hrs)		
		Hu	manities	and So	cial Scie	nces	Ma	nageme courses	nt	Profes Co	sional ore	Prof E	lessional lective	
Course	e category		Ba	sic Scie	nce		Engine	ering So	cience	Op Elec	en etive	Ma	ndatory	
		•	To explo	ore the p	rocess of	f drug de	evelopm	ent, fron	n target i	dentifica	ation to fi	inal drug	registratio	on.
		•	To prov	ide the	knowled	ge in di	rug deve	lopment	as a pr	ocess in	volving	target sel	ection, le	ad
Course	e Obiectives		discover	y using	g comp	uter-bas	ed metl	nods an	d com	binatoria	l chemi	stry/high	-throughr	put
			screenin	g.										
		•	To deve	lop skill	s in spec	ialized	areas rela	ated to b	ioavaila	bility, cl	inical tria	als, and tl	ne essentia	als
		A + +1	of paten	t law	.1 .	1 /		1 /					D	TI
		At th	e end of	the cour	se the st	udent w	fill be ab	le to:					BI	
		1	Descri	be and ju	istify the	e impor	tance of	rational	drug de	sign met	hods ove	er irration	al K	.2
			approa	ches.	•	1		1 . 1	1.					
		2	Classif	y the co	mputatio	onal me	thods use	ed in dru	ig disco	very			K	.2
Course	e Outcomes	3	3 Be able to discuss the challenges of using various computer-assisted drug design methods										K	2
		4	Gained	l a basic	knowled	dge of a	pplying	computa	tional n	nethods i	n drug d	esign and	I K	.1
		5	Demor	nstrate th	eir abili	ty to we	ork in tea	ms and	commu	nicate sc	ientific i	nformatio	on K	3
		5	effectiv	velv	ion uom	<i>cy co w</i>		ins and	commu	incute se		morman		
		6	Constr	uct. revi	ew and e	evaluate	preclini	cal and	clinical	pharmac	eutical s	tudies.	K	4
		-		,			I ···			I			I	
	POS/ COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4		
	CO1	3	2	1	2	3	1	1	1	2	1	1		
	CO2	3	2	2	2	2	1	1	2	2	2	1		
	CO3	3	1	2	1	3	1	2	1	2	1	1		
	CO4	2	1	1	2	2	1	2	1	3	2	1		
	CO5	2	1	2	1	3	1	3	1	3	2	1		
	CO6	3	2	3	2	3	2	2	2	3	1	2		
	Average	2.67	1.50	2	1.67	2.67	1.17	1.83	1	2.50	2	1.25		
	CORRE	LATION	•	1. SLIC	GHT (LO	W)	2. MOI	DERATE	ļ	3. SUE	STANTI	AL		
	LEVEL	5					(MEDI	UM),		(HIGH)		I	
Unit 1													12 Hrs	
Introdu	iction to drug	design a	nd discov	verv: St	ages of I	Drug dis	scoverv a	and deve	lopmen	t. Drug I	Discover	v approa	$\frac{1}{\text{ches}} - \text{Dr}$	ug
discove	ery by Rationa	l Drug de	esign, Ra	ndom Se	creening	, Serenc	lipity, Cl	inical ot	oservatio	ons, etc.	with exa	mples. Fu	undament	als
of Con	nputational dru	g design	: Introdu	ction to	molecul	ar mech	nanics an	d quantu	im mec	hanics, E	Energy M	linimizati	ion metho	ods
and Co	onformational .	Analysis	. Applica	tions of	Comput	ational	methods	in drug	discove	ery.				
Unit 2													12 Hrs	
Target	Identification	and Vali	dation: T	arget id	entificati	ion metl	10ds, Cri	teria of t	target va	alidation	, Study o	f targets	using RCS	SB
protein	i data bank, C	oncept o	of Homo	logy me	deling f	for cons	struction	of a m	odel foi	target j	protein.	Lead ger	eration a	nd
databas	ses: 1D, 2D, a	nd 3D ch	emical st	ructures	and sof	tware to	o draw it	– Chem	draw, M	IarvinSk	etch, AC	D/ Chem	Sketch et	tc.,
Conver	rting 2D to 3D	chemic	al structu	ires – O	pen Bab	el, Sma	ll molec	ule struc	ture dat	tabases –	ZINC,	Drug bar	ik, Cocon	ut,
ChEM	BL, Pubchem	etc. Stru	cture-bas	ed drug	design (SBDD)	: Concep	t of SBI	DD, Me	thods of	SBDD –	Docking	, Fragmer	nt-
based of	arug design, D	e-novo d	lrug desig	gn, etc.,	Ligand i	receptor	interact	ion, Bine	ding ene	ergy scor	es (Dock	(score)	10.11	
Unit 3													12 Hrs	
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Molecular Docking: Concept and application of molecular docking, Steps in molecular docking – Protein preparation, Ligand preparation, Active site identification, Grid generation, Selection of parameters for docking, interpretation of docking results. Software used for molecular docking studies. Molecular Dynamic Simulation: Introduction to molecular dynamics. Importance of molecular modeling in drug design. Software used for molecular dynamics studies.

Unit 4

12 Hrs

Quantitative Structure Activity Relationship (QSAR): SAR versus QSAR, History, and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, lipophilic effects, logP, and logD, the effect of ionization on logP, calculation of logP and logD, Steric effects- the Taft equation Hammet's substituent constant and Tafts steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA. Software used for 3D QSAR Studies. Pharmacophore Mapping: Pharmacophore concept, Introduction to Pharmacophore mapping, Steps in Pharmacophore mapping studies, Applications of Pharmacophore modeling studies. Software used for Pharmacophore mapping.

Unit 5

12 Hrs

Virtual screening (VS): Concept of virtual screening. Virtual screening Vs High throughput screening. Different methods of virtual screening e.g., Docking-based VS, 3D QSAR, Pharmacophore-based VS. Drug like Properties (DLP): Concept of Drug like Properties, Importance of DLP in drug discovery projects, Prediction of Absorption, Distribution, Metabolism, Elimination and Toxicity (ADMET) of the molecule, Lead Optimization, Software for prediction of DLP. Cheminformatics, Bioinformatics, and Artificial Intelligence: Introduction to Cheminformatics, Bioinformatics, and Artificial Intelligence and their applications in drug discovery and development.

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- 1. Stroud R.M. and Moore J.F., 2008, Computational and structural approaches to drug discovery, Vol. 8, RSC Press.
- 2. Martin Y.C., 2010, Quantitative Drug Design: A Critical Introduction, 2nd Ed., CRC Press.
- 3. Smith J.H. and Williams H., 2006, Principles of Drug Design and Action, 4th Ed., CRC Press.
- 4. Abraham D.J., 2003, Burger's Medicinal Chemistry and Drug Discovery, 6th Ed., Vol. 1, John Wiley & Sons: New York.
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- 6. Patrick G.L., 2013, An Introduction to Medicinal Chemistry, 5th Ed., Oxford University Press.
- 7. Beale J.M. and Block J.H., 2011, Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, 12th Ed., Lippincott Williams & Wilkins.
- 8. Kerns, E.H.; Di, L., 2008, Drug-Like Properties: Concepts, Structure Design, and Methods: from ADME to Toxicity Optimization, 1st Ed., Academic Press, Oxford.
- 9. Leach A. R., 2001, Molecular Modelling Principles and Applications, 2nd Ed., Prentice- Hall.
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- 12. Schlick T., 2010, Molecular Modeling and Simulation -An Interdisciplinary Guide, 2nd Ed., Springer.
- 13. Artificial Intelligence in Drug Discovery. United Kingdom: Royal Society of Chemistry, 2020.

Text Book, if any

 Strømgaard K., Krogsgaard-Larsen P. & Madsen U, 2016, Textbook of Drug Design and Discovery, 5th Ed., CRC Press.

PROGRAM	M. Sc., Biotechnology										
Course Code	Course Name:		L	Т	Р	С					
PABTC302	Biosafety, Bioethics, and IPR		4	0	0	4					
Year and Semester	II Year (III Semester)		Contact hours per week								
Prerequisite course	Any Under Graduate Degree with Life Science background (4Hrs)										
	Humanities and Social Sciences Management Professional Profession										
		courses	Core Elective								
Course category											
	Basic Science	Engineering Science	0	pen	Ma	ndatory					
			Ele	ctive							
	To understand Biosafety regu	ulations and IPR									
Course Objectives	• To introduce the biosafety re	gulations and ethical con	cepts in	biotechn	ology						
Course Objectives	• To emphasize on IPR issues	and need for knowledge	in paten	ts in biot	echnolog	У					
	-	-	-								
Course Outcomes	At the end of the course the student w	ill be able to:				BTL					

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		1 I	nterpret	the basi	cs of bio	safety a	nd bioetl	nics and	its impa	ict on all	the biol	ogical		K2
		2 T	Recogniz	and the o	quality c	of humar	afety new	actions a	nd anid	lingin	racassal			KJ
		2 f								ennes m	research			K2
		3 (Compreh	end the	benefits	of GM	technolo	$\frac{gy}{r}$ and r	elated is	sues		1.	1	K2
		4 H	Recogniz n busine	ss	portance	e of prot	ection of	t new kn	owledge	e and inr	novation	s and its	role	KI
		5 I	Learn the	e patent j	processe	s in Indi	a							K3
		6 5	Summari	ze awar	eness on	the Bio	safety, B	lioethics	, Intelle	ctual pro	perty rig	ghts.		K2
		1		T	T	T	1		n	1	T	1	1	
	POS/	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4		
	C03	3	2	1	2	3	1	1	1	2	1	1		
	CO2	3	2	2	2	2	1	1	2	2	2	1		
	CO3	3	1	2	1	3	1	2	1	2	1	1		
	CO4	2	1	1	2	2	1	2	1	3	2	1		
	CO5	2	1	2	1	3	1	3	1	3	2	1		
	CO6	3	2	3	2	3	2	2	2	3	1	2		
	Average	2.67	1.50	2	1.67	2.67	1.17	1.83	1	2.50	2	1.25		
	CORREL LEVELS	ATION		1. SLIC	GHT (LO	W)	2. MOI (MEDI	DERATE UM),		3. SUB (HIGH)	STANTI.)	AL		
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to biosafe Bt Cotton - contain Unit 2 Bioethics GMOs, h and bioet Unit 3 Introduct Rights, A Knowled	to biosafety, Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture- Bt Cotton, Bt Brinjal etc; Environmental release of GMOs; Cross border movement of germplasm; Risk management issues - containment. Unit 2 12 Hrs Bioethics: Definition; General considerations of bioethics, bioethics and medical research, ethical issues in Biotechnology, GMOs, human genetics research, gene therapy; human cloning, eugenics, artificial intelligence, organ transplantation, religion and bioethics Unit 3 12 Hrs Introduction to Intellectual Property: General Introduction to intellectual property rights and its different forms, Farmers Rights, Animal and Plant breeders' rights; Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of New GMOs													
Unit 4 IPR in th Studies; J of Biotec Unit 5	ne era of Glob Introduction to chnology invest	oalizatic o Histor ntion, B	on: prote y of GA' Budapest	ction of TT, WT treaty.	IP, IP a O, WIPO	a facto D, and T	or in R& RIPS; Re	cD; IPs ecent De	of releva	ance to l ent in Pa	Biotechn tent Syst	ology ar	12 H nd few Patent	Case ability
IPR and	India: Patent I	Process	in India:	Basic r	equirem	ents, pat	entable s	subject r	natter, n	ovelty a	nd the Pu	ublic Do	main;	Patent
infringen	nents and rev	ocation	; Patent	Litigati	on. Imp	lications	of intel	lectual	property	rights	on the c	ommerci	ializat	ion of
biotechno	ology product	s.												
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4. Flei 5. Gar Pub	 Fleming, D.A., Hunt, D.L. Biological safety Principles and practices (3rd Ed). ASM Press, Washington, 2000. Ganguli, P. (2001). Intellectual Property Rights: Unleashing the Knowledge Economy. New Delhi: Tata McGraw-Hill Pub. 													
 Rehm H.J. and G. Reed, Biotechnology - A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions, 2008 Traveli See C. eta Letallaet al Departe Level. Letik View Level Level. 2011 														
9. The 10. Wa	man Sen Gupt omas, J.A., Fu tal J. Intellect	ch, R.L ual Proj	. Biotech perty rigi	nology hts in the	and Safe	ety Asse	ssment (eloping	3rd Ed).	Acader s. Oxfor	nic Press d Univer	s, 2002 rsity Pres	ss. 2001.		
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11. WIPO Intellectual Property Handbook

 Text Book, if any.

 1.
 Sree Krishna. V., Bioethics and Biosafety in Biotechnology. New Age International (P) Limited. 2007.

PROG	GRAM	M. Sc	c., Biote	chnolog	у									
Course	e Code	Cours	se Name	:						L	Т	Р		С
PABT	C303	Ecoto	oxicolog	y and N	anobiot	echnolo	ogy			4	0	0		4
Year a	and Semester	II Yea	ar (III Se	emester)						(Contact l	nours per	week	
Preree	quisite course	Any U	Under G	raduate	Degree	with Lif	e Scienc	e backgı	ound		((4Hrs)		
		Hun	nanities	and So	cial Scie	nces	Ma	nageme	nt	Profes	ssional	Prof	ession	nal
							(courses			ore	El	ecuve	2
Cours	e category		Ra	sic Scie	nce		Engine	ering Sc	rience	 Or	/	Mar	ndato	rv
			Du	Sie Dele	nee		Lingine		actice	Elec	ctive		luuto	19
		•	o Tou	nderstar	nd toxico	ology an	d effects	of conta	aminant	s in ecos	systems			
		•	o To ii	ntroduce	the con	cepts an	ıd fundar	nentals of	of nanot	echnolo	gу			
Cours	e Objectives	•	o To u	nderstar	nd the sy	nthesis	and char	acteriza	tion of a	nanomat	erials an	d their ap	plicat	tion in
			bion	nedical f	ïelds									
		At the	end of	the cou	se the st	udent w	vill be ab	le to:						BTI
		1	Descri	he source	es and fat	es of che	micals in	the envir	ronment				-+	K2
		1	Desen	Se soure			incuis III		onnent					K2
		2	Able t	o present	and expl	ain mech	nanisms fo	or adverse	e effects	of chemi	cals			K2
Cours	e Outcomes	3	Under	stand the	basic pri	nciples c	of nanotec	hnology						K2
		4	Under	stand and	d apply th	e knowle	edge of na	nomateri	ials and 1	nanobiom	aterials to	o enable he	alth	K1
			sector	advance	ments.									
		5	Analy	se the im	pact of na	notechn	ology in v	various se	ectors					K3
		6	Apply	nanotox	icology ir	n biorem	ediation a	nd biome	edical sci	ences				K3
	POS/	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4		
	COS	2	2	1	2	2	1	1	1	2	1	1		
	C01	3	2	1	2	2	1	1	1	2	2	1		
	CO2	3	1	2	1	2	1	1	2 1	2	1	1		
	CO4	2	1	2 1	2	2	1	2	1	2	2	1		
	C05	2	1	2	1	3	1	3	1	3	2	1		
	C06	3	2	3	2	3	2	2	2	3	1	2		
	Average	2.67	1.50	2	1.67	2.67	1.17	1.83	1	2.50	2	1.25		
	CORREL	ATION	1.00	1. SLI	GHT (LO	W)	2. MOI	DERATE		3. SUE		AL		
	LEVELS				, -	,	(MEDI	UM),		(HIGH	()			
Unit 1													1 2 민	Irc
Introd	uction to ecotor	icology	· Defini	tion and	Scope	of eco_t	oxicolog	v = Rrai	nches in	Ecotor	icology	- Environ	ment«	u ə al Fate
and Sc	ources of Polluta	nts – Me	easurem	ent of L	D50 and	LC50 v	alues. Pr	actical r	problem	s in asse	ssing tox	cicity - Ro	ute of	f entrv
and it	s influence in	toxicity	-Factors	s that i	nfluence	toxici	ty- Cher	mical, t	oiologica	al, nutri	tional a	nd physic	cal fa	actors.
Ecotox	kicology, Bioma	rkers an	d Biomo	onitoring										
Unit 2													12 H	lrs
Eco-T	oxicological Te	sting &	Applica	tions: P	rinciples	of Biol	logical T	ests for	Toxicit	y –Type	s of Tox	cicity Test	ing: /	Acute,
Chron	ic, Prolonged to	DX1CIty,	1 eratoge	enicity,	Carcinog	genicity	, Mutage	enicity -	Conce _j	DE OF DIG	bassay, t	nreshold	limit	value,
Metab	olism and Even	retion) -	. ADME	E II (Te	sponse R	etics an	d Metab	olism)	and Cl	asses of	E I (AUS Enviror	mental C	'isuit) 'hemi	icals -
Bioche	emical Effects a	nd Mech	nanism o	of Toxic	ity of Po	llutants.		5115111),	unu Ch	UI				.cuis -
				- 3	.,									
	Documen	nt Prepare	ed in "Bo	ard of St	udies" he	ld on		Docum	nent App	roved in	"Academ	ic Council'	' held	on
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Unit 3

12 Hrs

Applications of ecotoxicology: Regulatory frame for ecotoxicology; role of ecotoxicology in environmental protectionnational and international standards in ecotoxicology; safety limits - predictive ecotoxicology; QSAR and mathematical models - risk assessment; human vs. ecological risks.

Unit 4

12 Hrs

Introduction to Nanobiotechnology: Introduction to Nanobiotechnology; Concepts, historical perspective; Different formats of nanomaterials and applications with example for specific cases; Cellular Nanostructures; Nanopores; Biomolecular motors; Bio-inspired Nanostructures, Synthesis and characterization of different nanomaterials - Methods for the measurement of nanomaterials; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging.

Unit 5

12 Hrs

Medical applications: Nanomaterials in Diagnostics, therapeutics, drug delivery, Nano Surgery and Tissue Engineering. Drug Delivery Applications, Bioavailability, Sustained and targeted release. Benefits of Nano drug delivery system. Use of Microneedles and nanoparticles for targeted and highly controlled drug delivery. Nano robots in drug delivery and cleaning system. Design of nanoparticles for oral delivery of peptide drugs. Nanotoxicity assessment: *In-vitro* laboratory tests on the interaction of nanoparticles with cells - Health and environmental impacts of nanotechnology.

References

- 1. Gary M. Rand, Editor. *Fundamentals of aquatic toxicology: effects, environmental fate, and risk assessment*. 2nd ed. Boca Raton: CRC Press, 1995.
- 2. Glenn W. Suter. Ed. Ecological risk assessment. 2nd ed. Boca Raton: CRC Press/Taylor & Francis, 2007. 643 p
- Grassian, V.H, "Nanoscience and Nanotechnology Environmental and health impacts", John Wiley & Sons, 2008
- 4. HOFFMAN, D.J. and B.A. RATTNER. Handbook of Ecotoxicology. Boca Raton, FL, USA: CRC Press, 1994.
- 5. Hunt, G and Mehta, M. 2007. Nanotechnology: Risk, Ethics and Law, Earthscan, London
- John H Duffs.; Howard G J Worth. (Editors). 2015. Fundamental Toxicology. 2nd Edition Publisher: Royal Society of Chemistry; UK, 516 pages
- 7. Laura Robinson & Ian Thorn, 2005. Toxicology and Ecotoxicology in chemical safety Assessment. Black well Publishing Ltd. CRC Press.
- 8. Neelina H. Malsch (2005), Biomedical Nanotechnology, CRC Press
- 9. Newman, Michael C. and Michael A. Unger. *Fundamentals of ecotoxicology*. 2nd ed. Boca Raton, Fla.: Lewis Publishers, 2003.
- 10. Nolting, B. (2006) Methods in Modern Biophysics, 2nd Edition, Springer Publications, New Jersey.
- 11. Nordberg. G. Effects and Dose-response Relationships of Toxic metals, Elsevier Scientific Publishing Co., New York
- 12. Ram. M, Andreescu. S.E, and Hanming. D, Nanotechnology for Environmental Decontamination, 2011, McGraw Hill.
- 13. Sellers. K, Mackay. C, Bergeson. L.L, Clough S.R, Nanotechnology and Environment, CRC Press, 2009
- 14. Simeonova P.P, Opopol N, and Luster M.I, Nanotechnology: Toxicological Issues and Environmental Safety", Springer 2006.
- 15. Yuliang Zhao and Harising Nalwa (2007). Nanotoxicology, American Scientific Publishers
- 16. Vencatesan R.; Randolph V. L.; (2006). "Bionanotechnology: Proteins to Nanodevices, Springer

- 1. Parthasarathy, B.K. 2007. Challenges and Opportunities in Nanotechnology, Isha Books, New Delhi
- 2. Peter Calow. Handbook of ecotoxicology. Oxford: Blackwell scientific publications, 1994.

PROGRAM	M. Sc., Biotechnology									
Course Code	Course Name:		L	Т	Р	С				
PABTP301	Drug Design and Discovery Lab 0 0 4									
Year and Semester	I Year (I Semester) Contact hours per week									
Prerequisite course	Any Under Graduate Degree with Life Science background (4Hrs)									
	Humanities and Social Sciences	Management	Profe	essional	Professional					
		courses	C	ore	Ε	lective				
Course estadowy										
Course category	Basic Science	Engineering Science	Open		Mandatory					
			Ele	ective		-				

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		•	o To u	nderstan	nd phase	s in drug	g develo	pment ai	nd disco	very pro	cess		
Course Ob	jectives	•	Toe	xplore C	Compute	r-aided d	lrug des	igning					
		•	o Tog	et know	ledge on	n molecu	lar struc	ture pre	diction f	or drug	developr	nent	
		At the	At the end of the course the student will be able to:										BT
		1	Familia	Familiarize with drug development pathway									
C	Course Outcomes			2 Able to understand secondary structure prediction and validation									
Course Ou	icomes	3	Demor	Demonstrate biologically active compounds in a drug candidate									
		4	Organi	Organize the computational methods used in drug discovery									
		5	Understand various gene finding programs									K	
		6	Constr	uct, revi	ew and e	evaluate	preclini	cal and o	clinical p	oharmac	eutical st	udies.	K
	Dogu	D 0.1		D 0.0		DO F	D O (D O -	PGG4		PGOA	PGOA	
	POS/ COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PS01	PSO2	PSO3	PSO4	
	CO1	3	2	1	2	3	1	1	1	2	1	1	
	CO2	3	2	2	2	2	1	1	2	2	2	1	
CO3 3 1 2 1							1	2	1	2	1	1	
	CO4	2	1	1	2	2	1	2	1	3	2	1	
	CO5	2	1	2	1	3	1	3	1	3	2	1	
	CO6	3	2	3	2	3	2	2	2	3	1	2	

Drug Design and Discovery lab

LEVELS

Average 2.67

CORRELATION

1. Gene finding programs – GeneMark, GeneScan

1.50

2

1.67

1. SLIGHT (LOW)

2. Biology Workbench – retrieval of sequences, alignment of sequences, phylogenetic tree building – rooted and unrooted trees – alignment presentation method – secondary structure prediction of proteins.

2.67

1.17

1.83

2. MODERATE

(MEDIUM),

1

2.50

(HIGH)

2

3. SUBSTANTIAL

1.25

- 3. Computer-aided drug design and analysis demonstration of the modules of Schrödinger Drug Design Suite.
- 4. Secondary structure prediction and validation
- 5. Molecular mechanics
- 6. Structure Based Drug Design
- 7. Ligand Based Drug Design
- 8. Molecular Dynamics
- 9. Binding Site Identification

References

1. Spriet, Alain et al. Methodology of clinical drug trials. Basel: Karger, (2004)

PROGRAM	M. Sc., Biotechnology									
Course Code	Course Name:		L	Т	Р	С				
PABTP302	Ecotoxicology and Nanobiotechnol	logy Lab	0	0	4	2				
Year and Semester	I Year (I Semester)		Contact hours per week							
Prerequisite course	Any Under Graduate Degree with Life Science background (4Hrs)									
	Humanities and Social Sciences	Humanities and Social Sciences Management				fessional				
		courses	C	ore	Ε	lective				
Course estagory										
Course category	Basic Science	Engineering Science	0	pen	Ma	ndatory				
		_	Ele	ctive		-				

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	 To know about the impacts of contaminants including pesticides on individ- ecosystems 	uals and
Course Objectives	 To understand the changes in the state or dynamics of an organism due to toxicity To summarize the importance and synthesis of Nanoparticles 	
	• To summarize the importance and synthesis of Nanoparticles	DTI
	At the end of the course the student will be able to:	BIL
	1 Understand the exposure and effects of environmental contamination	K2
Course Outcourse	2 Determine metals / organics / pesticides etc. using various techniques	K2
Course Outcomes	3 Understand fundamental concepts of nanotechnology and nanomaterials	K2
	4 Have knowledge on the fabrication and characterization of nanomaterials	K1
	5 Familiarize with the principle of TEM/SEM	K3
	6 Apply nanotoxicology in bioremediation and biomedical sciences	K3

Ecotoxicology:

- 1. Conduct Acute Toxicity testing using Plankton, and bivalve / fish and calculate the endpoints such as LC50/EC50, NOAEC, Safe Limit under toxicant exposure.
- Conduct Chronic Toxicity testing using Plankton, and calculate the endpoints such as NOEC/LOEC. Safe Limit 2. under toxicant exposure.
- 3. Determination of Cytotoxicity of fish under acute exposure.
- 4. Quantification of metals / organics in water, sediments and biological samples using AAS/GCMS
- 5. Determination of metals / organics / pesticides etc., using GCMS/ ICP-AES/AAS working principles and protocols

Nanotechnology:

- 1. Biological Synthesis of Nanoparticles (Seaweeds / Microbes)
- 2. Chemical Synthesis of Nanoparticle
- Testing anti-bacterial property of Synthesized Nanoparticles. 3.
- 4. Determination of shape and size of Nanoparticles using TEM/SEM working principles and protocols.

References

- Glenn W. Suter. Ed. Ecological risk assessment. 2nd ed. Boca Raton: CRC Press/Taylor & Francis, 2007. 643 p 1.
- Grassian, V.H, "Nanoscience and Nanotechnology Environmental and health impacts", John Wiley & Sons, 2008 2.
- Hunt, G and Mehta, M. 2007. Nanotechnology: Risk, Ethics and Law, Earthscan, London 3.
- 4 John H Duffs.; Howard G J Worth. (Editors). 2015. Fundamental Toxicology. 2nd Edition Publisher: Royal Society of Chemistry; UK, 516 pages
- 5. Laura Robinson & Ian Thorn, 2005. Toxicology and Ecotoxicology in chemical safety Assessment. Black well Publishing Ltd. CRC Press.
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- Newman, Michael C. and Michael A. Unger. Fundamentals of ecotoxicology. 2nd ed. Boca Raton, Fla.: Lewis 7. Publishers, 2003.
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- Nordberg, G. Effects and Dose-response Relationships of Toxic metals, Elsevier Scientific Publishing Co., New York 9
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- 11. Ram. M, Andreescu. S.E, and Hanming. D, Nanotechnology for Environmental Decontamination, 2011, McGraw Hill.
- 12. Sellers. K, Mackay. C, Bergeson. L.L, Clough S.R, Nanotechnology and Environment, CRC Press, 2009
- 13. Simeonova P.P, Opopol N, and Luster M.I, Nanotechnology: Toxicological Issues and Environmental Safety", Springer 2006.
- 14. Yuliang Zhao and Harising Nalwa (2007). Nanotoxicology, American Scientific Publishers
- 15. Vencatesan R.; Randolph V. L.; (2006). "Bionanotechnology: Proteins to Nanodevices, Springer

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- 2. HOFFMAN, D.J. and B.A. RATTNER. Handbook of Ecotoxicology. Boca Raton, FL, USA: CRC Press, 1994.
- 3. Peter Calow. Handbook of ecotoxicology. Oxford: Blackwell scientific publications, 1994.

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PROGRA	M de	M. Sc	., Bioteci	nnology						T	Т	Р		C
PABTE10	1e 1	Mari	ne Resou	rces an	d Biopro	ospectir	ng			3	0	0		3
Year and S	Semester	I Year	(I Seme	ster)	F -		8			-	Contact l	nours per	week	
Prerequisi	te course	Any U	Jnder Gra	aduate D	Degree w	ith Life	Science	backgro	ound		((3Hrs)		
		Hun	nanities	and Soc	ial Scier	nces	Ma	nageme	nt	Profe	ssional	Prof	essio	nal
							(courses		C	ore	El	ectiv	e
Course Ca	tegory									-				
	0.		Bas	sic Scien	ice		Engine	ering Sc	eience	U Flo	pen	Mandatory		ory
										Lit				
		• T	o acquire	e knowle	edge abo	ut vario	us marir	ne bio-re	sources	: impor	tance of s	ustainable	e utili	izatio
		a	nd manag	gement o	of the ma	arine bio	o-resourc	es.		, 1				
Course Of	viectives	• T	o under	stand t	he mari	ine nat	ural pro	oducts i	in disea	ase tre	atments,	drug de	velop	oment
	yccuves	e	nvironme	ental and	l industr	ial appli	ications;	agricult	ure, aqu	acultur	e and fish	neries sect	ors, a	anima
		h	usbandry	;			1.							
		• I	o know t	he IPR (concept 1	for mari	ne-biote	chnologi	Ical lice	nsing.				DTI
		At the	Underst	and the	e the stu			e to.		and from	n mianal	ana ta		
		1	inverteb	and the	umquene d verteb	ess of Va rates	u ious m	ai iile D10	-iesour	Les Iroi	n meroal	gae, io		к2
		2	Acquire	knowle	dge aboi	ut threat	s, protec	tion, cor	nservatio	on and	managem	ent of		K2
~ ~			marine i	resource	s for var	ious app	olication	s.						
Course Ou	itcomes	3	Acquire	knowle	dge isola	ation, ex	traction,	, purifica	ation, str	ructure	elucidatio	on techniq	ues	K2
			of marin	ne bioact	tive com	pounds	from mi	crobes to	o verteb	rates fo	r various	applicatio	ons.	
		4	Relate the	he tradit	ional kn	owledge	e on Mar	ine Biop	prospect	ing and	recogniz	e the curr	ent	K1
		5	Underst	ment.	ragulato	ry offoir	e in mar	ino nhar	macolor	w for i	ductrial	nnlication	20	K3
		5	Anni			iy anan	5 III IIIai			3y 101 11			15	KJ KO
		6	Apply ti	ne know	ledge fo	r marine	e pnarma	cologica	al resear	cn and	marketing	g strategy		K 2
	POS/	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4		
	COS	101	102	105	104	105	100	107	1501	1502	1505	1504		
	CO1	3	2	1	2	3	1	1	1	2	1	1		
	CO2	3	2	2	2	2	1	1	2	2	2	1		
	CO3	3	1	2	1	3	1	2	1	2	1	1		
	C04	2	1	1	2	2	1	2	1	3	2	1		
	C05	2	1	2	1	3	1	3	1	3	2	1		
	Average	267	1 50	3	2 1.67	3	2 1 1 7		2 1	2 50	2	1 25		
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Unit 1			D: 1		1 1.		r. 1	9	1 0			T	9 H	rs
Coastal and	1 Marine Re	Esologi	s: Distrit	ution ar	id divers	ity of M	licrobes,	Seawee	ds, Seag	grasses,	Mangrov	es, Invert	ebrat	es and
Unit 2		Lologi		incance									9 H	rs
Manageme	nt and Sust	ainable	Use of I	Marine 1	Bioresou	rces: In	stitution	al respo	nsibilitie	es – Ec	osystem -	- Based N	lanas	gemen
Approache	s - marine r	esource	e manage	ment me	easures -	- village	-based	marine r	esource	manag	ement me	asures.	Ĺ	,
Unit 3													9 Hi	rs
Traditional	and Curre	nt Appl	lications	of Mari	ne Reso	urces: T	radition	al use of	f marine	e bio ar	nd other r	esources:	med	icines
food, neut	Pionros	etc; M	for bor	oprospe	cting-che	oice of	organisi	ms, ecos	System Enviro	selectio	n, screer	ning crite	ria; I	Marin
diagnostic	agriculture	and fis	heries a	nd agrici	ultural a	s. muu pplicatio	$\sin a_1$, where $\sin a_2$ is $\sin a_1$ is $\sin a_2$ is $\sin a_1$ is $\sin a_2$.	ture pros	enviro	mienta	II, FIIAIII	laceutical,	COS	metic
Unit 4	ugileulture	und mo	ileries, u	ila agric	unturur u	pheun	<u> 10</u>	ture prot	species.				9 H	rs
Extraction	and Chara	cteriza	tion of 1	Bio-Pro	lucts: S	eparatio	n, purif	ication	and stru	ıctural	character	rization o	f bio	oactiv
compounds	s. Molecula	r Docki	ng Analy	sis. Bio	logical,	Toxicol	ogical ar	nd Clinic	al Evalu	uation:	Types of	Screening	, Scr	eenin
Models and	l Activity, A	Antican	cer Scree	ening, To	esting M	ethods:	Toxicity	v Evaluat	tion, Us	e of An	imals in H	Experimer	nts, C	linica
	Documer	nt Prepar	red in "Bo	ard of St	udies" he	ld on		Docum	nent App	roved in	"Academ	ic Council'	' held	on
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Trials Unit 5

9 Hrs

Challenges and Opportunities in Marine Pharmacology: Biopharmaceutics classification system. Regulatory affairs in clinical trials IND, NDA, ANDA- Parts and contents, Safety monitory boards, FDA in various countries including India. Synthetic equivalents of marine natural products, approval and marketing of marine natural products, improvement of academic and industry collaborations, sustainable resources for marine pharmaceuticals, environmental challenges of resources for marine pharmaceuticals, newer opportunities in Marine Pharmacology.

Reference Books

- 1. Vanessa Sunkel, 2010. Marine Bioprospecting and Natural Product Research
- 2. Se-Kwon Kim, 2013. Bioprospecting of Marine Microbial Symbionts: Exploitation of Underexplored Marine Microorganisms
- 3. Anne Osbourn, Rebecca J. Goss and Guy T. Carter, 2014. Marine Bioprospecting
- 4. Shyam, S Salim and Sathiadhas, R and Sathianandan, T V and Geetha, R and Aswathy, N and Vipinkumar, V P (2010) *Marine fisheries resources: exploitation, management and regulations in India.* Seafood Export Journal, 40(2).25-34.
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- Heinz Lüllmann, Klaus Mohr, Lutz Hein and Detlef Bieger. Jürgen Wirth, Darmstadt. Color Atlas of Pharmacology 3rd edition. Thieme Stuttgart, New York 2005.
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- 9. Charles B. Spainhour, 2005. NATURAL PRODUCTS, *Drug Discovery Handbook*, by Shayne Cox Gad, John Wiley & Sons, Inc. pp: 72

Text Book, if any

- 1. Thompson, J.E., Sarojini, R and Nagabhushanam, R. 1991. Bioactive compounds form marine organisms. Oxford & IBH Publishing Co. Pvt., Ltd. New Delhi.
- 2. Attaway, D.H. and Zaborsky, O.R. 1993. Marine Biotechnology: Pharmaceutical and bioactive natural products. Plenum Press, New York.
- 3. Bhakuni, D.S., and Rawat, D.S. 2005. Bioactive Marine Natural Products, Co-published by Springer, New York 10013, USA with Anamaya Publishers, New Delhi, India.

PROGRAM	M. Sc., Biotechnology										
Course Code	Course Name:	irse Name:									
PABTE102	Fish Biotechnology		3	0	0	3					
Year and Semester	I Year (I Semester)			week							
Prerequisite course	Any Under Graduate Degree with Lif	y Under Graduate Degree with Life Science background									
	Humanities and Social Sciences	Profe	ssional	Pro	fessional						
		courses	C	ore	E	lective					
Course Category						\checkmark					
course category	Basic Science	Engineering Science	0	pen	Ma	ndatory					
			Ele	ctive							
	• To obtain knowledge on breeding	g of fish.									
Course Objectives	• To study the genetic markers for	fish disease resistance an	d DNA	vaccines.							
	To understand the concepts of get	enetic engineering and mo	lecular	modeling	in marin	e fishes.					
	At the end of the course the student w	vill be able to:				BTL					
	1 Explain about fish breeding, Hy	bridization of fishes and	conserv	ation of g	ermplasn	n. K2					
	2 Explain the application on mole	cular and immunogenetic	s.			K2					
Course Outcomes	3 Apply techniques in fish feed p	roduction industries.				K2					
	4 Understand Genetic Engineerin	g Techniques in aquacult	ıre indu	stry		K1					
	5 Infer the Molecular Modelling	Fechniques & Trans gene	sis in fis	shes		K3					
	6 Apply the molecular tools for a	dvanced research in fish b	oiotechn	ology		K2					

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	COS	2	2	1	2	2	1	1	1	2	1	1	
	C01	3	2	1	2	3	1	1	1	2	1	1	
	CO2	3	1	2	1	2	1	2	2 1	2	2 1	1	
	C04	2	1	1	2	2	1	2	1	3	2	1	
	C05	2	1	2	1	3	1	3	1	3	2	1	
	CO6	3	2	3	2	3	2	2	2	3	1	2	
	Average	2.67	1.50	2	1.67	2.67	1.17	1.83	1	2.50	2	1.25	
	CORREL LEVELS	ATION		1. SLIC	HT (LO	W)	2. MOI (MEDI	DERATE UM)		3. SUB (HIGH)	STANTI.	AL	
Unit 1													0 Hrs
Hybridizatic transgenic fi tripoidy, cry	on of fishes ish product opreservat	- select ion. Ch	ive bree romosoi conserv	ding, cro ne mani ation of	pulation germpla	ling, dev a, its role asm.	elopmer e in aqua	nt of dise	ease resis	stance an enesis, g	gue stru d high q ynogene	uality of esis, sex	new strains, reversal and
Unit 2													9 Hrs
Molecular a genetic para monoclonal Unit 3	nd Immuno ameters. C Antibodies	Sell hyt	s: Bioch	on: Son	Markers: natic ce	: Allozy: 11 fusio:	me poly n, hybri	doma t	m and it	s applica gy, Proc	tion in e luction	and Ap	g population plication of 9 Hrs
Fish Feed D	evelopmer	nt and F	eeding 7	Fechniq	les: Fee	d Techn	ology: N	Aicro en	capsulat	ed feeds	, micro	coated f	eeds, micro-
particulate f	eeds and bi	io-encap	osulated	feeds, n	nycotoxi	ns, and	their effe	ects on f	eeds.				
Unit 4													9 Hrs
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Unit 5													9 Hrs
Molecular N	Iodeling To	echniqu	es: Tran	sgenesis	: Metho	ds of ger	ne transfe	er in fish	es, singl	e gene tr	aits, scre	ening fo	r transgenic,
site of integr	ration, appl	lications	s, regula	tions of	GMOs,	IPR, Ev	aluation	of GFP	transger	11C.			
 Alberts 8153-32 John R. Lanfrosi Pasteur Text Books 	Bruce <i>et a</i> l 218-1. W.Mesters hney, R. Cu et al., Prac if any	, 2002. s Ed. Ar ulture of tical Iso	"Molec nimal cel f animal zyme G	ular bio Il culture cells (3 enetics.	logy of t e –Practi rd editio Ellis Ho	he cell'' ical appr n), Wile rewood	² . 4 th edir toach, O y-Liss. Ltd, Eng	tion, Grl xford. gland: 2	and Scie 15p 198	ence pub 8.	lishers:	1249 p. 1	SBN:0-
1. Reddy. 7164-02	P.V.G.K; A 29-x. 2005.	Ayappar	n <i>et al</i> ., '	'Text bo	ok of fis	sh Genet	ics and	Biotechi	nology''	. 218p IG	CAR put	olication	s. ISBN: 81-

PROGRAM	M. Sc., Biotechnology					
Course Code	Course Name:		L	Т	Р	С
PABTE201	Bioprocess & Fermentation technol	ogy	3	0	0	3
Year and Semester	I Year (II Semester)			Contact l	hours per	week
Prerequisite course	Any Under Graduate Degree with Life			(3Hrs)		
	Humanities and Social Sciences	Management	Profe	ssional	Prof	essional
		C	ore	E	ective	
Course Cotogowy						\checkmark
Course Category	Basic Science	Engineering Science	0	pen	Ma	ndatory
Course Category	Basic Science	Engineering Science	O Ele	pen ctive	Ma	ndatory
Course Category	Basic Science	Engineering Science	O Ele	pen ctive	Ma	ndatory
Documer	Basic Science	Engineering Science Document App	O Ele	pen ctive "Academ	Ma ic Council	ndatory " held on
Documer	Basic Science The part of Studies" held on Date:	Engineering Science Document App Date:	O Ele	pen ctive "Academ	Ma ic Council	ndatory
Documer	Basic Science The Prepared in "Board of Studies" held on Date: Contr	Engineering Science Document App Date: Tolled Copy	O Ele	pen ctive "Academ Rev	Ma: ic Council 	ndatory "held on 3.2019

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		in • To	ferment	ation pro	ocess.	and pro	duct for	mation	and eval	uate the	kinetics	s and me	chanism	n of
Course Obj	jectives	m	icrobial	growth.	Slowin	and pro	duct 101	mation		iudie ine	Killetie	s and m	, chamsin	1 01
		• To	o impact	knowle	dge abo	ut biolog	gical and	1 bioche	mical te	chnolog	y, with a	a focus o	n biologi	ical
		pr At the	oducts, t	he desig	gn and op	peration	of indus	strial pra	ctices.					TI
		At the	Evaluate	factors	that cou	ntribute	in onbar	coment	of call (and prod	uct form	ation du	ring k	1L 7
		1	fermenta	ation pro	cess.	litiloute		lecilient		ind prod			ing i	12
		2	Analyse cultures	kinetics	s of cell	and proc	luct forn	nation in	batch, o	continuo	us and fe	ed-batch	H	ζ2
Course Out	tcomes	3	Examine	e the app	olication	of biolo	gical an	d engine	ering pr	inciples	to probl	ems	ŀ	K2
		4 Understand and explain the development of bioprocess engineering in educational											ŀ	X 1
		5	world ar	nd indus	try to su	pport a l	bio-base	d econor nation ir	my.	ontinuo	us and fe	-d-hatch	I	K 3
		5	cultures	KIIICUC		and proc			i baten, t	continuo	us and r	u-baten	1	XJ
		6	Examine	e the app	olication	of biolo	gical an	d engine	ering pr	inciples	to probl	ems	ŀ	Χ2
			involvin	g micro	bial, ma	mmaliar	i, and bi	ological	biochen	nical sys	tems.			
	POS/ COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4		
	CO1	3	2	1	2	3	1	1	1	2	1	1		
	CO2	3	2	2	2	2	1	1	2	2	2	1		
	CO3	3	1	2	1	3	1	2	1	2	1	1		
	C04	2	1	1	2	2	1	2	1	3	2	1		
	CO6	3	2	3	2	3	2	2	2	3	1	2		
	Average	2.67	1 50	2	1.67	2.67	1 1 7	1.83	1	2.50	2	1.25		
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Text & Reference Books

- 1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
- 2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition, Panima Publishing Co. New Delhi.
- Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
 Jackson AT., Bioprocess Engineering in Biotechnology, Prentice Hall, Engelwood Cliffs, 1991.

PROGR	AM	M. S	c., Biotecl	hnology											
Course C	ode	Cour	se Name:							L	T	P		С	
PARTE2	20de 202	Rese	arch Met	hods, S	tatistics	& Scier	ntific								
TADIEZ	102	Com	municati	on Skill	s					3	0	0		3	
Year and	d Semester	I Yea	ar (II Sem	ester)			<u>a</u> .			(Contact h	nours per	week		
Prerequi	isite course	Any	Under Gra	aduate E	Degree w	ith Life	Science	backgro	ound	D 6	((3Hrs)			
		Hu	manifies	and Soc	al Sciei	nces	Ma	nageme courses	nt	Profes	ssional ore	Proi El	essioi ective	nal e	
C C	7-4												\		
Course	Lategory		Bas	sic Scier	ice		Engine	ering So	cience	Op Elec	pen ctive	Ma	Mandatory		
Course C	Objective	 To introduce the students to the field of research To understand the statistical methods for biological applications To make familiarise with research articles and research writing 													
		At th	e end of t	he cours	e the stu	dent wil	ll be able	e to:		iiiig				BTL	
		1	Underst	and the	hasic pri	nciples	of Biost	atistics						K2	
			Cincerst			nerpies	51 1030							112	
Correct	Jutoorea	2	Learn al	bout the	importa	nce and	role of a	researc	her					K2	
Course	Jutcome	3	Evaluate	e, preser	nt and pu	ıblish sc	ientific a	articles						K2	
		4	Know to	o apply s	statistics	in resea	irch							K1	
		5	Write re	esearch p	proposal	s and sci	ientific v	vriting u	sing the	proper	ways			K3	
		6	Apply f	or samp	le analys	sis, data	processi	ng and p	oreparing	g a resea	arch artic	le		K3	
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	POS/	PO 1	1 PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4			
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	COl	3	2	1	2	3	1	1	1	2	1	1			
	C02	3	2	2	2	2	1	1	2	2	2	1			
	CO3	3	1	2	1	3	1	2	1	2	1	1			
	C04	2	1	1	2	2	1	2	1	3	2	1			
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	LEVELS						(MEDI	UM)		(HIGH	I)				
Unit 1													9 Hr	·s	
Introduct	ion and scop	e: Scie	nce. Scien	tific Fie	ld and B	iologica	l researc	h. Role	of a rese	archer i	n differe	nt stages	of a p	roject.	
Routes to	o research fu	nding	(academic	c and co	ommerci	al). Res	earch, D	efinition	n, Impor	rtance o	f researc	h, Chara	cterist	tics of	
research,	Types and s	steps ir	n research	, Identif	ication,	Selectio	on and fo	ormulati	on of re	search	problem,	Research	h ques	stions,	
Research	design – For	mulati	on of Hyp	othesis,	Review	of Liter	ature.						0 -		
Unit 2		1 ~							6		•		9 Hr	S	
Types of	research arti	cies: 1	ype of A	rticles (1 Writing	eview, l	Ve une	tc). Scie	ntific pa	per torn	nat (Abs	stract, In	troduction	n, Ma	terials	
scientific	research in t	he aca	demic pre	winnig ss (iourr	(eunical	vs une	etc) Ch	evaluatii	ug, pres	onriate i	iournal (S	isining th Sources I	nform	nation	
Instructio	ons to author	s. peer	review s	vstem. i	ournal e	valuatic	n). Case	e studies	s of area	s of cu	rrent rese	earch. Fo	rmula	ting a	
research	plan and its r	resenta	ation.	,, j			.,, eus								
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Unit 3

9 Hrs

9 Hrs

Sampling methods: Sampling theory, types of sampling, Steps in sampling, Advantages and limitations of sampling. Collection of Data: Primary Data, Meaning, Data Collection methods, Secondary data, Meaning - Relevance's, Limitations and cautions. Statistics in Research.

Unit 4

Sampling methods: Probability Sampling and Non-Probability Sampling methods, Measure of central tendency and measure of dispersion, Random variables and Probability Distribution, Simple problems involving Binomial, Poisson and Normal variables. Formulation of Hypothesis (One-tailed & Two-tailed), Type I and Type II errors, power of a test, Significance of a test, P-value testing, Hypothesis Testing (students T-test, Z-test, Chi-square test), Regression and correlation analysis, Analysis of variance (ANOVA).

Unit 5

9 Hrs

Scientific Communication skills: Technical writing skills - types of reports; layout of a formal report; scientific writing skills - importance of communicating science; problems while writing a scientific document; plagiarism, software for plagiarism; scientific publication writing: elements of a scientific paper including abstract, introduction, materials & methods, results, discussion, references; drafting titles and framing abstracts; publishing scientific papers - peer review process and problems, recent developments such as open access and non-blind review; plagiarism; characteristics of effective technical communication; scientific presentations; ethical issues; scientific misconduct.

Reference Books

- 1. Angellka Hofmann (2014). Scientific Writing and Communication. Oxford University Press
- 2. Daniel. W.W., Biostatistics: A foundation for analysis in the Health Sciences, Publisher: John
- 3. Gopen, G. D., & Smith, J. A. The Science of Scientific Writing. American Scientist, 78 (Nov-Dec 1990), 550-558.
- 4. Kothari, C.R. 2019. Research Methodology Methods and Techniques New Age International Publishers
- 5. Mohan, K., & Singh, N. P. (2010). Speaking English Effectively. Delhi: Macmillan India.
- 6. Washington, D.C.: On Being a Scientist: a Guide to Responsible Conduct in Research. (2009). National Academies Press.
- 7. Valiela, I. (2001). Doing Science: Design, Analysis, and Communication of Scientific Research. Oxford: Oxford University Press.

- 1. Ronald Forthofer, Eun Lee, Mike Hernandez, 2006. Biostatistics: A Guide to Design, Analysis and Discovery, 2nd Edition, Publisher: Elsevier.
- 2. Zar., J.H., Biostatistical Analysis, 5th Edition, Prentice Hall
- 3. Santosh Gupta, 2022. Research Methodology Methods and Statistical Techniques, Deep & Deep Publications

PROGRAM	M. 5	Sc., Biotechnology							
Course Code	Cou	irse Name:		L	Т	Р	С		
PABTE203	Ma	rine Environmental Biotechnol	ogy	3	0	0	3		
Year and Semester	ΙYe	ear (II Semester)		Contact hours per week					
Prerequisite course	Any	Under Graduate Degree with Li	fe Science background			(3Hrs)			
	Hu	imanities and Social Sciences	Management	Profe	ssional	Pro	fessional		
			courses	C	ore	E	lective		
Course Category							\checkmark		
Course Category		Basic Science	Engineering Science	0	pen	Ma	ndatory		
				Ele	ctive				
	•	To understand the different a	spects of the marine e	nvironn	nent (phy	vsical, ch	emical and		
Course Objectives		biological).							
	•	To understand their interaction v	with the marine organism	s.					
	At t	he end of the course the student y	will be able to:				BTL		
	1	Outline the major and minor po	ollutants involved in for r	narine e	nvironme	ent and its	s K2		
		bioremediation. Acquire know	ledge about threats, prote	ction, co	onservati	on and			
Course Outcomes		management of marine resourc	es for various applicatior	ıs.					
Course Outcomes	2	List out the reason for marine of	lisaster and to operate the	e disaste	r manage	ment.	K2		
	3	Understand the impact of globa	al warming and current st	atus of	global wa	rming.	K2		
	4	Extend the information about b	biological process affectir	ig to the	marine e	environm	ent. K1		
			· · · · ·						
	5	Explain the conservation of ma	rine resources and manage	gement.			K3		
Docume	ent Prepa	ared in "Board of Studies" held on	Document App	proved in	"Academ	ic Council	" held on		
	Date: _		Date						
		Contr	olled Copy		Rev	/ 00/ 01.0	3.2019		

		6	Summar	ize abou	it the po	llution a	nd impa	ct of glo	bal war	ming and	d conserv	ve the	K2
			marine e	ecosyste	ms.								
	POS/	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4	
	CO3	3	2	1	2	3	1	1	1	2	1	1	
	CO2	3	2	2	2	2	1	1	2	2	2	1	
	CO3	3	1	2	1	3	1	2	1	2	1	1	
	CO4	2	1	1	2	2	1	2	1	3	2	1	
	CO5	2	1	2	1	3	1	3	1	3	2	1	
	CO6	3	2	3	2	3	2	2	2	3	1	2	
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Unit 2													9 Hrs
habitats. Nature cyclones, etc; of marine disa Unit 3	ral and n Disaster asters, en	nanmade Manage vironme	e Marine ement- p ental imp	e disaster rinciples pact and	rs: Tsun s, systen risk asse	ami, vol ns and oj essment	cano eru peration	iption, la ; Role of	andslide f Media	s, earthq in Disas	uakes, s ter Mana	hipwrech igement,	Forecasting
Impact of Glo Detecting Cha tools; Sea leve protocol, Ocea	bal warm anges in t el rise an an acidifi	ning and the Ocea nd sea s cation	climate ans: Mo surface t	change lecular b emperat	on Mari iology a ure, Cu	ne envir and gene rrent sta	onment: etics tech tus and	Global iniques, research	processe New vie on Glo	es impac leo tech bal war	ting the l nologies ming-Ca	Marine e , New hy arbon tra	nvironment; /droacoustic ding, Kyoto
Unit 4													9 Hrs
Biological Pro	ocesses a	ffecting	g Marine	e enviro	nment: 1	Marine f	fouling-l	Microfo	ulers an	d Macro	ofoulers,	Biofilm	formations,
basic principle and control; M	es of anti Iarine To	fouling, oxicolog	Marine y	corrosio	n, Eutro	phicatio	n, Marir	ne borers	s, – Biol	ogy, stra	tegy, into	eractions	, prevention
Unit 5			~										9 Hrs
Marine Resou reserves - Mar Text & Refer	rces Mai	nagemei s - herita oks	nt: Cons age sites	ervation Role of	and ma	al and In	nt of manternatio	arine res mal ager	ources: ncies, Int	in situ a tegrated	nd ex sit	u. Marir zone Ma	ne biosphere nagement
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PROGRAM	M. Sc., Biotechnology						
Course Code	Course Name:		L	Т	Р	С	
PABTE204	Algae Biotechnology		3	0	0	3	
Year and Semester	I Year (II Semester)		Contact hours per week				
Prerequisite course	Any Under Graduate Degree with Lif	e Science background			(3Hrs)		
	Humanities and Social Sciences	Management	Profe	essional	Prof	fessional	
		courses	C	ore	Elective		
Course Cotogony							
	ategory Basic Science Engineering Science						
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	Basic Science	Engineering Science	O Ele	pen ective	Ma	ndatory	
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		5 I	nvestigate different products from algal sources through technological interventions										K3
		6 A	5 Apply the knowledge on genetic tools to explore the marine bioactive compounds										
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	CO4	2	1	1	2	2	1	2	1	3	2	1	
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Unit 2	8					8.		8,				9	Hrs
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- 2. Fogg G.E. Stewart, W.D.P., Fay P., and Wals by A.E. 1973. The blue green algae. Academic Press. London
- 3. Richmond A. (Ed). Hand Book of Microalgal culture, Blackwell Publishing House, 2003

PROGRAM	Л	M. Sc	A. Sc., Biotechnology											
Course Cod	e	Cours	se Name:							L	Т	P		C
PABTE301		Mole	ecular Te	chnique	e and Di	agnosti	cs			3	0	0		3
Year and S	emester	II Ye	ar (III Sei	mester)						(Contact l	nours per	week	
Prerequisit	e course	Any	Under Gr	aduate E	Degree w	ith Life	Science	backgro	ound		((3Hrs)		
		Hui	manities	and Soc	ial Scie	nces	Ma	nageme	nt	Profes	sional	Prof	essio	nal
							C	ourses		Co	re	E	ective	e
Course Cat	tegory		D	· · · ·			T		•	0		М		
			Bas	sic Scier	ice		Engine	ering So	cience	Up Floo	en tivo	Ma	ndato	ry
										Litt	uve			
		• 1	To know t	he nurif	ication a	nd quar	tification	n of diff	erent nu	cleic aci	ds and n	roteins		
Course Ob	iectives	• 1	To provid	e knowl	edge on	various	molecul	ar techni	iques us	ed in the	field of	diagnosti	ics	
course on	jeeuves	• 7	To unders	tand the	theoreti	cal aspe	cts of va	rious sea	quencin	o technia	mes	anagnost		
		At the	e end of f	he cours	e the stu	dent wi	ll be able	e to:	- ucheni	5	1405			BTL
		1	Perform	molecu	lar techr	niques in	ncluding	nucleic	acid ext	raction	conventi	onal and		K2
		1	real-tim	e polvm	erase ch	ain reac	tion	nucleic	acia est	iaction,	convent	unu unu		112
		2	Underst	and the	concept	of nucle	eic acid s	equenci	ng					K2
Course Ou	tcomes	3	Recom	iza and t	roublack	not pro	hlame in	routine	molecul	ar diam	ostic tec	hniquas		K)
		4	Able to	perform	senarati	on of h	iomolecu	les	molecu	iai ulagli		miques		K1
		5	Polete wet leb and dry leb works										K2	
		3	Relate v	vet-lab a	na ary-i	ab work	LS							К3
		6	Perform	n molecu	lar techr	niques a	nd advar	ice the r	esearch	activitie	s in bion	nolecules		K2
	Dogu	D O 1			D O (D O F	D O (D O -	DOOL	200		D CO (
	POS/	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4		
	CO3 CO1	3	2	1	2	3	1	1	1	2	1	1		
	CO2	3	2	2	2	2	1	1	2	2	2	1		
	CO3	3	1	2	1	3	1	2	1	2	1	1		
	CO4	2	1	1	2	2	1	2	1	3	2	1		
	CO5	2	1	2	1	3	1	3	1	3	2	1		
	CO6	3	2	3	2	3	2	2	2	3	1	2		
	Average	2.67	1.50	2	1.67	2.67	1.17	1.83	1	2.50	2	1.25		
	CORREL	ATION	1	1. SLIC	GHT (LO	W)	2. MOI	DERATE		3. SUB	STANTI	AL		
	LEVELS						(MEDI	UM)		(HIGH)			
T T 1 / 1													0.77	
Unit 1				· · · ·	. 1 1	1 0		<u> </u>	1		(DNA	9 Hr	S 1
DNA Tech	niques:	isolation	on of gei	nomic a	nd plas	mia Di	NA, pur	meation	and q	uantifica	tion of	DNA, A	Agaros	se gel
blotting and	Oligonua	leotide	argestion	i, Ligati	011, MO	umcati	m, wietr	iyiation	anarysi	s, iviuta	genesis,	Labeling	5, 30	umern
Unit 2	ongonue	conues	3.										<u>9</u> н,	•6
RNA Techn	iques. Isol	ation n	urificatio	n. quant	ification	differe	ent RNA	. cDNA	synthsi	s. Northe	ern blott	ng, Reve	rse bl	otting
Dot and Slot	t Blot. In V	<i>itro</i> Tr	anscriptio	n. mRN	A Stabi	lity Ass	av. RAC	E. Reve	rse Tran	scription	n (RT). F	NA Elec	troph	oresis.
Small RNAs	s, microRN	IA, sm	all nuclea	r RNA.	RNA In	terferen	ce (RNA	i), RNA	Splicin	g, RNas	e Protect	tion Assa	у.	,
Unit 3		,					``			<u>,</u>			9 Hr	S
Protein Tec	chniques a	nd Bio	omolecule	es separ	ation: B	asic co	ncepts in	1 Protei	ns, Bas	ic conce	pts in I	Recombir	nant p	rotein
	Documer	nt Prepa	red in "Bo	ard of St	udies" he	ld on		Docum	nent App	roved in '	'Academ	ic Council	" held	on
		Date:							Date:					
L						Contro	olled Cor)V			Rev	00/01.0	3.201	9
							31	2						

expression studies, Expression vectors, Expression host strains, Different induction methods, Purification of recombinant proteins, Protein sequencing, Peptide sequencing, Western blotting, enzyme assays. Principles of biomolecules separation, Distillation, crystallization, solvent extraction, chromatography techniques, electrophoresis, filtration techniques, reverse osmosis.

Unit 4

9 Hrs

9 Hrs

Molecular medicine Techniques: DNA/RNA/protein-based diagnostics, fluorescence in situ hybridisation (FISH). DNA techniques within diagnostics and forensic medicine are dealt with together with techniques for functional genome analysis, array technology for gene expression, comparative genomics, tissue expression and current methods for analysis of epigenetic regulatory mechanisms such as chromatin immunoprecipitation (ChIP).

Unit 5

Molecular Phylogeny and its applications: Principles of molecular taxonomy, Principles and methods of DNA sequencing, sequence alignment techniques, construction and analysis of phylogenetic tree, PCR techniques, genetic fingerprinting, Pyrosequencing, DNA barcodings. IT enabled tools in molecular phylogeny. Integration of wet-lab and dry-lab works.

Reference Books

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- 2. Biji T. Kurien (Editor), Western Blotting: Methods and Protocols: 1312 (Methods in Molecular Biology) by R. Hal Scofield (Editor)
- 3. Campbell, A.M. & Heyer, L.J. 2002 Discovering Genomics, Proteomics and Bioinformatics. Benjamin/Cummings.
- 4. Joseph Sambrook and David W. Russell. Molecular Cloning-A Laboratory Manual Vol1. 2001.
- 5. McPherson. M. J. & Moller S. G., PCR The Basics (Garland Science, 2nd Edition). (2006). Taylor & Francis
- 6. Primrose. S.B., Twyman R.M. (2014) Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell Science Limited.
- 7. Sean R.Gallagher, SDS-Polyacrylamide Gel Electrophoresis (SDS-PAGE); Current protocols essential laboratory techniques.
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- 9. Barsanti, Laura and Paolo Gualtieri, 2005 Algae-Anatomy, Biochemistry and Biotechnology. Taylor & Francis, London, New York.
- 10. Xinkun Wang. Next Generation Sequencing Data Analysis, CRC Press.
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- 2. Fogg G.E. Stewart, W.D.P., Fay P., and Wals by A.E. 1973. The blue green algae. Academic Press. London
- 3. Richmond A. (Ed). Hand Book of Microalgal culture, Blackwell Publishing House, 2003

PROGRAM	M. Sc., Biotechnology						
Course Code	Course Name:		L	Т	Р	С	
PABTE302	Stem Cell and Cancer Biology		3	0	0	3	
Year and Semester	II Year (III Semester)		Contact hours per week				
Prerequisite course	Any Under Graduate Degree with Lif	e Science background		((3Hrs)		
	Humanities and Social Sciences	Management	Profe	essional	Prof	essional	
		courses	C	ore	El	ective	
Course Cotogomy						\checkmark	
Course Category	Basic Science	Engineering Science	0	pen	Mandatory		
			Ele	ective			
Course Objectives	 To understand the unique propert To provide fundamental concepts To get knowledge on different for 	ties of stem cells s of Cancer Biology rms of cancer therapy					
Docume	nt Prepared in "Board of Studies" held on	Document App	proved in	"Academ	ic Council	" held on	
	Date:	Date:	Date:				
	Controlled Copy				v 00/ 01.0	3.2019	
		32					

		At the	end of th	he cours	e the stu	dent wil	l be able	e to:					BTL			
			amiliari	ze with	basics of	f stem ce	ells						K2			
G	0.1	2 I	dentify t	he cell c	ulture p	rotocols							K2			
Course	Outcomes	3 U	Jndersta	nd the th	erapeut	ic applic	ations of	f stem c	ells.				K2			
		4 E	Explains	about th	e carcin	ogenesis	and var	ious car	ncer ther	apies.			K1			
		5 8	ummari	ze the ba	asics of	stem cel	& canc	er biolo	gy & its	recent a	dvancen	nent	K3			
		6 F	Familiari	ze with	the annli	ication o	f stems	and can	er studi				K2			
		0 1	amman		ine uppn	cation o	1 Stellis		cer stuar	65						
	POS/	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4				
	COS															
	COl	3	2	1	2	3	1	1	1	2	1	1				
	CO2	3	2	2	2	2	1	1	2	2	2					
	CO3	3	1	2	1	3	1	2	1	2	1	1 1				
	C04	2	1	1	2	2	1	2	1	3	2	1				
	C06	3	2	3	2	3	2	2	2	3	1	2				
	Average	2.67	1.50	2	1.67	2.67	1.17	1.83	1	2.50	2	1.25				
	CORREL	ATION		1. SLIC	GHT (LO	W)	2. MOI	DERATE]	3. SUB	STANTI	AL				
							(MLDI	0111)		(mon	,		ļ.			
Unit 1			9 Hrs													
Introdu	troduction to Stem cells: Introduction to stem cells and basis of stemness; Embryonic stem cells, embryonal carcinoma															
cells, ei	cells, embryonic germ cells, adult stem cells, hematopoietic stem cells, mesenchymal stem cells, cancer stem cells, induced															
Unit 2. 9 Hrs																
Stem Cell isolation and Culture: Cell culture basics and protocols: Stem Cell Niches: Hematopoietic Stem Cells.																
Mesenc	hymal Stem C	ells, Feta	al Stem C	Cells, Iso	lation, c	haracter	ization a	nd mair	itenance	of embr	yonic ste	em cell is	olated from:			
Mouse	and Human. Se	erum and	d feeder	free cult	ure of h	uman en	nbryonic	stem ce	ells, evo	lution of	xeno-fr	ee culture	e systems.			
Unit 3	<u> </u>			~ .									9 Hrs			
Therape	eutic application	on of Ste	em cells:	Gene th	herapy –	genetic	ally eng	ineered	stem cel	ls - sten	n cells a	nd Anim	al cloning –			
disorde	r – limb ampu	tation –	heart di	sease - s	spinal co	ancer – ord iniuri	ies – dia	utic app betes –	burns. H	s – raik Regenera	nison ui itive The	eranv – I	ntroduction:			
Applica	tions of Reger	nerative 1	Medicin	e.	r				,-	8		FJ	,			
Unit 4													9 Hrs			
Fundan	nentals of cano	cer biolo	ogy: Reg	gulation	of cell	cycle, m	utations	that ca	use cha	nges in	signal n	nolecules	, effects on			
receptor	r, signal switcl	hes, tum	our supp	pressor g	enes, m	odulatio	n of cell	cycle i	n cancer	, differe	nt forms	of cance	ers, diet and			
cancer.	Cancer screen	ing and o	early det	ection, I	Jetection	n using t	biochem	ical assa	ays, Tun	or mark	ers, mol	ecular to	ols for early			
Unit 5			Jucinio	ogy.									9 Hrs			
Carcino	genesis and C	Cancer T	herapy:	Theory	of carci	nogenes	is, Cher	nical ca	rcinoge	nesis, m	etabolisi	n of care	cinogenesis,			
principl	es of physical	carcino	genesis,	x-ray ra	diation-	mechani	isms of	radiatio	n carcin	ogenesis	. Differe	ent forms	of therapy,			
chemot	herapy, radiati	on thera	py, detec	ction of	cancers,	predicti	on of ag	gressive	eness of	cancer, a	advances	s in cance	er detection.			
Use of s	signal targets t	owards t	herapy c	of cancer	; Gene t	herapy.										
1 Kri	и се доокs sten Renwick I	Monroe	Ronald	B Mille	er Ieron	ne S. Tol	ois Fund	lamenta	ls of Th	e Stem C	'ell Deb	ate: The 9	Scientific			
Rel	igious, Ethical	, And Po	olitical Is	ssues, 20)08.		510, 1 UIN						serentine,			
2. Lar	iza R. and I. K	limanska	aya, Esse	ential of	Stem Co	ells Metl	nods. Ac	ademic	Press. 2	009						
3. Lar	iza, R., J. Gear	hart et a	l (Eds), l	Essentia	l of Sten	n Cell B	iology. I	Elsevier	Academ	ic press.	2008.					
4. Tar	ier Demirer, Pi	rogress i	n Stem (Cell Tran	splantat	tion, Sci	ence, Te	chnolog	$_{2007}$ and M	ledicine	open acc	ess publi	ısher. 2015.			
J. We Text R4	moerg, Kobert	A. The	ыоюду	or Cane	er. new	1 OFK: C	Jarrand S	science,	2007.							
1. An	thony Atala, Ja	ames A.	Thomsso	on. 2007	. Princir	oles of R	egenera	tive Me	dicine. A	cademic	Press;	l edition				
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Put	onshers. 2005.															
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PROGRAM	M. S	c., Biotechnology							
Course Code	Cou	se Name:		L	Т	Р	С		
PABTE303	Enz	me Technology and Applicati	ions	3	0	0	3		
Year and Semester	II Ye	ear (III Semester)			week				
Prerequisite course	Any	Under Graduate Degree with Li	fe Science background						
	Hu	manities and Social Sciences	Management	Profe	essional	Prof	essional		
	courses Core E				ective				
Course Category							\checkmark		
course caregory		Basic Science	Engineering Science	0	pen	Mandatory			
				Ele	ective				
	•	To understand the mechanism o	f biocatalyst						
Course Objectives	•	To learn the kinetics of enzymat	tic reaction						
	•	To learn about applications of en	nzymes						
	At th	e end of the course the student	will be able to:				B	TL	
	1	Understand the properties of en	nzymes				K	ζ2	
	2		- £				Ľ	70	
Course Outcomes	Z	Understand molecular aspects	or enzymes				r	12	
Course Outcomes	3	Apply enzymes in stereospecif	ic reactions				K	ζ2	
	4	Evaluate application of enzyme	es				K	ζ1	
	5	Analyze commercial production	n of enzyme				K	ζ3	
	6	6 Analyses the applications of enzymes with reference to marine organisms K							

POS/	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO1	PSO2	PSO3	PSO4
COS											
CO1	3	2	1	2	3	1	1	1	2	1	1
CO2	3	2	2	2	2	1	1	2	2	2	1
CO3	3	1	2	1	3	1	2	1	2	1	1
CO4	2	1	1	2	2	1	2	1	3	2	1
CO5	2	1	2	1	3	1	3	1	3	2	1
CO6	3	2	3	2	3	2	2	2	3	1	2
Average	2.67	1.50	2	1.67	2.67	1.17	1.83	1	2.50	2	1.25
CORRELA LEVELS	ATION		1. SLIC	1. SLIGHT (LOW)			DERATE UM)		3. SUB (HIGH)	STANTL	AL.

Unit 1

9 Hrs Introduction: Enzyme classification and nomenclature, General properties of enzymes like effect of pH, temp, ions etc.

Unit 2

Extraction, assay and purification of enzymes. Steady state kinetics. Michaelis-Menden, Line weaver-Burke, Eadie-hofstee and Hanes-Woolf equations and Km value.

Unit 3

Enzyme inhibitors, Pre-steady state kinetics. Fast kinetics to elucidate the intermediates and rate limiting steps (Flow and Relaxation methods). Enzyme specificity. Evidences for enzyme substrate complex. Nucleophilic and electrophilic attack. Role of metal ions in enzyme catalysis.

Unit 4

Mechanism of enzyme action e.g., Lysozyme, chymotrypsin, DNA polymerases, RNase, Zymogens and enzyme activation. Allosteric interactions and product inhibition; complex kinetics and analyses, Membrane bound enzymes - Extraction, assay lipid protein interaction and effect of fluidity on enzyme activity.

Unit 5

Coenzyme; Clinical and Industrial applications of enzymes. Immobilization of enzymes and their application. Ribozymes and their applications. Enzyme engineering.

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9 Hrs

9 Hrs

9 Hrs

9 Hrs

Reference Books

- 1. Chaplin M.F. and C. Bucke, Enzyme Technology, Cambridge University Press.
- 2. Copeland, R.A. Enzymes: A Practical Introduction to Structure, Mechanism and Data Analysis, John Wiley and Sons Inc.
- 3. James. E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill
- 4. Mathews, C.K., VanHolde, K.E. and Ahem, K.G. (2000) Biochemistry, 3rd Edition, Benjamin Cummings Publishing Co., Inc., U.K.
- 5. Segel, I.H. Enzyme Kinetics: Behaviour and Analysis of Rapid Equilibrium and Steady State Enzyme Systems, Wiley-Inter-science
- 6. Trevor Palmer, Enzymes Biochemistry, Biotechnology, Clinical Chemistry
- 7. Uhlig, H. Industrial Enzymes & their applications John Wiley and Sons Inc
- 8. Voet, D. and Voet, J.G. (2010) Biochemistry, 4th Edition, John Wiley and Sons, New York.
- 9. Wiseman, Enzyme Biotechnology, Ellis Horwood Pub.

Text Books if any

- 1. Palmer T. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, First East West Press Edition, 2004
- 2. Berg, J., Tymoezko, J.L. and Stryer, L. (2008) Biochemistry, 6th Edition, W.H. Freeman Publishing Company, New York.
- Nelson, D.L and Cox, M.M. (2008) Lehninger's Principles of Biochemistry, 5th Edition W.H. Freeman Publishers, New York.

PROGRAM	M. Sc., Biotechnology										
Course Code	Course Name:		L	Т	Р	С					
PABTE304	Biodegradation and Bioremediation	on Technology	3	0	0	3					
Year and Semester	II Year (III Semester)			Contact l	nours per	week					
Prerequisite course	Any Under Graduate Degree with Li	fe Science background		((3Hrs)						
	Humanities and Social Sciences	Management courses	Profe C	ssional ore	Prof E	fessional lective					
						<u></u>					
Course Category	Basic Science	Engineering Science	O Ele	pen ctive	Ma	ndatory					
Course Objectives	 To acquire the knowledge of end To develop skills in bioreactors solution to create green and clea To enable the degradation possible 	 To acquire the knowledge of environmental problems and develop technologies To develop skills in bioreactors and biotreatment methods of industrial wastewater and to find solution to create green and clean environment To enable the degradation possibilities using biological methods. 									
	At the end of the course the student	will be able to:				BIL					
	1 Infer the biotechnological solu pollution, mineral, renewable	ations to address environ energy and water recycli	mental i ng	ssues incl	luding	K2					
	2 Appraise the opportunities for processes and projects.	incorporating environme	ental qu	ality into	products,	K2					
Course Outcomes	3 Develop technologies for bior professional responsibility tov	emediation and biodegra vards protecting the envir	dation a ronment	nd demoi	istrate the	e K2					
	4 Apply scientific solutions for products	the development of envir	onment	al sustain	able	K1					
	5 Infer the bioremediation of heavy metal pollution and oil degrading microbes K3										
	6 Appraise the opportunities for incorporating environmental quality into products, processes and projects. K2										

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	POS/ COS	POI	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSOI	PS02	PS03	PS04	
	CO1	3	2	1	2	3	1	1	1	2	1	1	
	CO2	3	2	2	2	2	1	1	2	2	2	1	
	CO3	3	1	2	1	3	1	2	1	2	1	1	
	C04	2	1	1	1	2	1	2	1	3	2	1	
	CO6	2	2	2	2	3	2	2	2	3	2	2	
	Average	2.67	1 50	2	1 67	2.67	117	1.83	1	2.50	2	1 25	
	CORREL LEVELS	ATION	1.50	1. SLIC	GHT (LO	W)	2. MOI (MEDI	DERATE UM)	1	3. SUB	STANTI.	AL	
Unit 1										•			0 Una
Introduction	1 to Biorem	ediation	n: Clean	un tech	nologies	to treat	contam	inated so	oil and y	vater svs	tems –	Solid W:	9 mrs
and Treatm	ent Metho	ds - Action Ac	dvantage accelera	es and o ted bior	lisadvan emediati	tages of	f biolog	ical and - future	non-bio prospec	ological	bioreme bioremedia	diations	- Types of
Unit 2	,					,			<u>FF</u>				9 Hrs
Bioremediation and Degradation: Microbes and Plants in Biodegradation and Biotransformation. Microbial metabolism and factors influencing microbial activity. In situ and Ex situ bioremediation - Mineralization vs. Partial Degradation – Factors influencing biodegradation process; Methods in biodegradability determination - Bioremediation of VOCs, diesel fuel, polychlorinated biphenyls, dyestuffs, aromatic and polyaromatic hydrocarbons. Xenobiotics; Persistence and biomagnification of xenobiotic molecules: Microbial interactions with xenobiotics; Bioremediation of plastic waste.													
Unit 3				, 1.11					, 210				9 Hrs
Aerobic Bi	oremediatio	on: Bio	remedia	tion of	Surface	Soils:	Fate and	1 transp	ort of c	ontamin	ants in	the Vac	lose zone –
Biodegradation in soil ecosystems – Types of soil treatment systems – Bioreactors. Subsurface Aerobic Bioremediation: In situ Bioremediation, Bioventing, treatment of Harbour Sediments and Lagoon treatment. Bioremediation in fresh water and													
marine syst	ems. Anoxi	c/Anaei	robic Bi	oremedi	ation - A	Anoxic/A	Anaerobi	c Proces	sses – Fe	ermentat	ion		0 Hrs
Unit 4 9 Hrs													
pollutants	Microbial	notal ro	als and C) Microl	Sources	s of near	$a_{\rm p} = \Delta c_{\rm c}$	s - Mici	obiai illi	oncentra	s of fille	robes wi	
Oil Spills - (Oil field mi	crobiolo	ogy - Im	proved c	il recove	erv - Bic	oremedia	tion in n	narine ar	nd estuar	ine syste	ems: facto	ors affecting
bioremediat	tion: need f	or intro	ducing n	nicrobia	l culture	s.	nemeura		ilarine ai	iu estuai	ine syste		ors arrecting
Unit 5	,		0										9 Hrs
Developme	nt of Bio j	products	s and Te	echnolog	gies: Bio	oleachin	g - Bio	pesticid	e - Bio	fertilize	r - Bioc	legradab	le plastics -
integrated b	oio-digester	for biog	gas and e	electricit	y genera	ation - b	iosensor	for envi	ironmen	tal moni	toring - o	quorum s	sensing.
Reference	Books												
 Andrea Prasad, Bernd I Chakra 	, L.; (2001) Ram, Aran B., 2001. Bi varthy, A.N	. "Natur da, Elis odegrac 1., 1928	ral Atten abet, 20 lation ar . Biodeg	uation c 18 (Eds. nd Persis gradation	of Enviro), Appro stence. S	onmenta oaches ir pringer, toxificat	l Contan n Biorem Univers ion of E	ninants" rediatior ity of V nvironm	. Battello n – (2018 irginia. ental po	e Press, 1 3), Sprin 1lutants,	Universi ger CRC Pr	ty of Mio ess	chigan,
5. David S	5., 2010. Bi	oremed	iation Pr	otocols.	Human	a Press.			1	,			
6. Eve, R Process	iser-Robert ses". CRC F	s.; (201 Press, Le	l0). "Re ewis Put	emediati olishers	on of P	etroleur	n Conta	minated	Soils:	Biologic	al, Phy	sical, an	d Chemical
7. Ghulan	n, R. C.; (20	010). "B	iologica	l Degrae	dation ar	nd Biore	mediatio	on of To	xic Chei	nicals, T	ïmber P	ress	
8. Jogdano	d S.N. Envi	ronmen	tal Biote	echnolog	gy 1995.	1 st editi	on. Him	alaya Pu	ıblishing	House.	Bombay	· .	
9. John. T	. C.; (1995)). "Biore	emediati	on Engi	neering:	Design	and App	lication	". McGr	aw-Hill			
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 Metcalf Raffi, F Plenum 	f and Eddy, F.; Yehuda Publ.	Wastev F.; Sha	vater En ul R.; (1	gineerin 999). "1	g – Trea Novel A	tment, I pproach	Disposal es for B	and Reu ioremed	ise. Tata liation o	McGrav f Organi	w Hill, N ic Pollut	lew Dell ion". Kl	ni uwer Acad.,
13. Ronald press, U	, M. A.; (20 University o	005). "E f Michi	Bioremeo gan, ISE	diation: 3N: 155	Applied 5812392	Microb , 978155	ial Solut 5581239	ions for 3.	Real-W	orld En	vironme	ntal Clea	anup". ASM
14. Shahna 15. Trivedi	waz, M.; Sa , P.C.; (201	angale, 1 0). "Bio	м. к.; A oremedia	ation of	3., 2019. Wastes a	nd Envi	nediatio	n Techn al Laws	ology to	or Plastic	waste"		
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- 18. William Chang (Editor), 2017. Biodegradation and Bioremediation. Syrawood Publishing House,

- 1. Alan Scragg, Environmental Biotechnology. 2005. 2nd edition. Pearson Education Limited, England.
- 2. Edurado, D 2008. Microbial Biodegradation: Genomics and Molecular Biology, Spain
- 3. Katherine, H. B.; Diane, S. H., (1994). "Bioremediation". McGraw-Hill,
- 4. Martin A.; (1999). "Biodegradation and Bioremediation". 2nd Edition, Acad. Press,

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Model Question:



END SEMESTER EXAMINATIONS – Month xxxx

Programme & Batch: M. Sc. Biotechnology Course Name: Biosafety, Bioethics and IPR Duration: 3 hours

Semester: III Course Code: PABTC302 Maximum Marks: 100 marks

2

CO5

Instructions:

- Before attempting any question paper, be sure that you got the correct question paper. 1.
- 2. The missing data, if any, may be assumed suitably.
- 3. Use the sketches wherever necessary.

What is InPaSS?

10

Question No	Question	Mark	BTL	со
	Part A (10×2 = 20 Marks) Answer all Question	IS		
1	What is the role of GEAC?	2	K1	CO1
2	What is LMO and GMO?	2	K1	CO1
3	List out the risk groups involved in biohazards	2	K1	CO2
4	What are the ethics in biotechnology?	2	K1	CO2
5	What is a copyright?	2	K1	CO3
6	What is a plant patent?	2	K1	CO3
7	What is GATT principle?	2	K1	CO4
8	What is GATT GATS and TRIPS?	2	K1	CO4
9	Name two basic criteria that determines the patentability of invention in India	2	K1	CO5
10	What is InPaSS?	2	K1	COS

Part B (1×10 = 10 Marks) Compulsory Question

11	Explain about non patentable inventions in India	10	K3	CO6	
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Part C (5×14 = 70 Marks) Answer All Questions

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		1	-	
12 (a)	Explain in detail about the biosafety guidelines followed in India	14	K2	CO1
	(OR)			
12 (b)	Categorize the assessing the biosafety risks based on pathogens and safety precautions	14	K4	CO1
13 (a)	Summarize about artificial intelligence (AI) also explain the types and benefits and risks of AI	14	K2	CO
	(OR)			
13 (b)	Explain the ethical guidelines should be followed for GMO studies in detail	14	K2	CO
14 (a)	Explain the role of NCBI & GenBank citations for researchers credibility	14	K2	CO
	(OR)			
14 (b)	Explain the intellectual property rights with its various forms	14	K2	CO
15 (a)	Summarize the recent development in patent system and patentability of biotechnology?	14	K2	CO
	(OR)			
15 (b)	Explain the link between TRIPS WTO and WIPO in detail?	14	K2	CO
16 (a)	Simplify the process of patent search and patent databases	14	K2	CO
	(OR)			
16 (b)	Illustrate about the patent process in India	14	K2	CO

Knowledge Level as per Bloom Taxonomy K1- Remember; K2- Understand; K3- Apply; K4- Analyse; K5- Evaluate; K6- Create

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