THIRUVALLUVARUNIVERSITY SERKKADU,VELLORE –632115



B.SC., MICROBIOLOGY

SYLLABUS

FROM THE ACADEMIC YEAR

2023-2024

SECOND SEMESTER

Sl.N	Course	Course	Cre	edit			Overall	Total contact	Marks	Marks	
0	Category		dis	tribu	tion		Credits	Hours/week			
									CIA	ESE	Total
			L	Т	Р	S					
1	Part –I	Language	L				3	6	25	75	100
		- Tamil									
2	Part –II	English	L				3	6	25	75	100
3	Part -III	CC-3	L				5	5	25	75	100
4	Part -III	CC-4			Р		5	5	25	75	100
5	Part -III	AL-2	L				3	4	25	75	100
6	Part –IV	SEC-2	L				2	2	25	75	100
7	Part –IV	SEC-3	L				2	2	25	75	100
							23	30			
		Total									

Subject	Subject Name	Category	L	Т	Р	S	Cre	Inst.	Marl	Aarks			
Code							dits	Hour	CI	Exte	r Total		
								S	Α	nal			
22MBU	MICROBIAL	Core	Y	-	-	1	5	5	25	75	100		
GC12	PHYSIOLOGY	Course III											
	AND												
	METABOLISM												
		C		1	- 4 •								
CO1	Study the basic princip	Cours	se U		cuv	es							
COI	Study the basic princip.	les of microbia.	i gro	Jwti	1.								
CO2	Understand the basic co	oncepts of aero	bic :	and	anae	erob	nic met	abolic n	athway	vs			
002					unu	0100		uoone p	aunva	y 5.			
CO3	Analyze the role of ind	ividual compor	nent	s in	ove	rall	cell fu	nction.					
		1											
CO4	Provide information on	sources of ene	rgy	and	its	utili	zation	by micr	oorgar	nisms.			
CO5	Study the different type	es of metabolic	stra	tegi	es.								
TT • /	Details) of	Course		
Unit		Details								J. 01			
Unit		Details							Ho	ours	Objectives		
Unit I	Physiology of microbia	al growth: Batc	-2h	COI	ntinu	uous	s - syn	chronou	Ho s 1	ours	Objectives CO1		
Unit	Physiology of microbia cultures; Growth Cu	al growth: Batc rve and mea	h – sure	con eme	ntinu nt 1	uous met	s - syn hod (chronou turbidity	Ho s 1	ours	Objectives CO1		
I	Physiology of microbia cultures; Growth Cu biomass, and cell count	al growth: Batc rve and mea t). Control of m	ch – sure	con eme	ntinu nt 1 l gro	uous met owth	s - syn hod (n.	chronou turbidity	Ho s 1 /,	2	Objectives CO1		
I	Physiology of microbia cultures; Growth Cu biomass, and cell count Nutrition requirement Chemolithotrophs (A)	al growth: Batc rve and mea t). Control of m ts - Photoau mmonia Nitri	ch – sure licro totro	con come: obia oph	ntinu nt 1 l gro s, 1 lfur	uous met owth Pho	s - syn hod (1. toorga	chronou turbidity notrophs	Ho s 1 7, 3, 1	burs 2 2 2 2	Objectives CO1 CO2		
I	Physiology of microbia cultures; Growth Cu biomass, and cell count Nutrition requirement Chemolithotrophs (An oxidizing Bacteria).	al growth: Batc rve and mea t). Control of m ts - Photoau mmonia, Nitri Chemoorganc	ch – sure icro totro ite,	con eme obia oph Su	ntinu nt 1 l gro s, 1 lfur, N	uous met owth Pho , F	s - syn hod (1. toorga Iydrog	chronou turbidity notrophs en, Iro	Ho s 1 7, s, 1 n rt	Durs 12 12	Objectives CO1 CO2		
I	Physiology of microbia cultures; Growth Cu biomass, and cell count Nutrition requirement Chemolithotrophs (An oxidizing Bacteria), mechanisms – Passiv	al growth: Bato rve and mea t). Control of m ts - Photoau mmonia, Nitri Chemoorgano re diffusion au	ch – sure icro totro ite, otrop nd	con obia oph Su ohs. Act	ntinu nt 1 l gro s, 1 lfur, N ive	uous met owth Pho , H Jutri tra	s - syn hod (1. toorga Iydrog ition nsport.	chronou turbidity notrophs en, Iro transpor Factor	Ho s 1 7, s, 1 n rt s	2 2 2	Objectives CO1 CO2		
I	Physiology of microbia cultures; Growth Cu biomass, and cell count Nutrition requirement Chemolithotrophs (Ar oxidizing Bacteria), mechanisms – Passiv affecting microbial gro	al growth: Batc rve and mea t). Control of m ts - Photoau mmonia, Nitri Chemoorganc re diffusion at wth.	ch – sure icro totro ite, otrop nd	con eme obia oph Su ohs. Act	ntinu nt 1 l gro s, 1 lfur, N ive	uous met owth Pho , H Jutri tra	s - syn hod (1. toorga Iydrog ition nsport.	chronou turbidity notrophs en, Iro transpor Factor	Ho s 1 7, 3, 1 n rt 's	2 2 2	Objectives CO1 CO2		
I	Physiology of microbia cultures; Growth Cu biomass, and cell count Nutrition requirement Chemolithotrophs (Ar oxidizing Bacteria), mechanisms – Passiv affecting microbial gro An overview of Metab	al growth: Bato rve and mea t). Control of m ts - Photoau mmonia, Nitri Chemoorgano re diffusion at wth.	ch – sure icro totro ite, otrop nd	con eme obia oph Su ohs. Act	ntinu nt 1 l gro s, 1 lfur, N ive erho	uous met owth Pho , F Nutri tra	s - syn hod (1. toorga tion nsport. athway	chronou turbidity notrophs en, Iro transpor Factor	Ho s 1 /, s, 1 n n ct s s 1	2 2 2 2 2 2 2 2 2	Objectives CO1 CO2 CO3		
I	Physiology of microbia cultures; Growth Cu biomass, and cell count Nutrition requirement Chemolithotrophs (Ar oxidizing Bacteria), mechanisms – Passiv affecting microbial gro An overview of Metab Doudoroff Pathway,	al growth: Bato rve and mea t). Control of m ts - Photoau mmonia, Nitri Chemoorgano re diffusion at wth. polism - Embde Pentose Phosp	h – sure iicro totro ite, otrop nd en N	con eme obia oph Su ohs. Act Ieye e P	ntinu nt 1 gro s, 1 lfur, N ive erho athy	uous met owth Pho , H Iutri tra	s - syn hod (1. toorga Iydrog ition nsport. athway , Tric	chronou turbidity notrophs en, Iro transpor Factor r, Entner arboxyli	Ho s 1 7, 3, 1 n rt s s - 1 c	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Objectives CO1 CO2 CO3		
I	Physiology of microbia cultures; Growth Cu biomass, and cell count Nutrition requirement Chemolithotrophs (Ar oxidizing Bacteria), mechanisms – Passiv affecting microbial gro An overview of Metab Doudoroff Pathway, Acid Cycle. Elect	al growth: Bato rve and mea t). Control of m ts - Photoau mmonia, Nitri Chemoorgano re diffusion at wth. polism - Embde Pentose Phosp ron Transpor	ch – sure iicro totro ite, otrop nd en N bhato rt	con eme obia oph Su ohs. Act Ieye e P Ch	ntinu nt 1 groo s, 1 lfur, N ive erho athy ain	uous met owth Pho , H Iutri tra f Pa way a	s - syn hod (1. toorga Iydrog ation nsport. athway , Tric nd (chronou turbidity notrophs en, Iro transpor Factor 7, Entner arboxyli Oxidativ	Ho s 1 7, 3, 1 n rt '- 1 c e	2 2 2 2 2 2 2 2	Objectives CO1 CO2 CO3		
I	Physiology of microbia cultures; Growth Cu biomass, and cell count Nutrition requirement Chemolithotrophs (An oxidizing Bacteria), mechanisms – Passiv affecting microbial gro An overview of Metab Doudoroff Pathway, Acid Cycle. Elect Phosphorylation. Ar	al growth: Bato rve and mea t). Control of m ts - Photoau mmonia, Nitri Chemoorgano ve diffusion at wth. polism - Embde Pentose Phosp ron Transpo FP synthesis	ch – sure icro totro ite, otrop nd en N bhato rt	con eme: blia oph Su ohs. Act Ieye e P Ch Fe	ntinu nt 1 gro s, 1 lfur, N ive erho athy ain	net pwth Pho , H Jutri tra f Pa way a ntat	s - syn hod (toorga toorga ition nsport. athway , Tric nd (ion-Ho	chronou turbidity notrophs en, Iro transpor Factor , Entner arboxyli Dxidativ	Ho s 1 /, s, 1 /, s, 1 n rt s 1 c c c	2 2 2 2 2 2 2 2	Objectives CO1 CO2 CO3		
I	Physiology of microbia cultures; Growth Cu biomass, and cell count Nutrition requirement Chemolithotrophs (Ar oxidizing Bacteria), mechanisms – Passiv affecting microbial gro An overview of Metab Doudoroff Pathway, Acid Cycle. Elect Phosphorylation. Ar Fermentation, Heterola	al growth: Bato rve and mea t). Control of m ts - Photoau mmonia, Nitri Chemoorgano re diffusion at wth. polism - Embde Pentose Phosp ron Transpor FP synthesis ctic Fermentati	ch – sure icro totro totro nd en M bhato rt s. on,.	con eme obia oph Su ohs. Act fleye Ch Fe	ntinu nt 1 l gro s, 1 lfur, N ive erho vathv ain rme:	net owth Pho , H Jutri tra f Pa way a ntat	s - syn hod (1. toorga lydrog ition nsport. athway , Tric. nd (ion-Ho	chronou turbidity notrophs en, Iro transpor Factor , Entner arboxyli Dxidativ omolacti	Ho s 1 7, 5, 1 n rt s s - 1 c e c	Joint Jurs 12 12 12	Objectives CO1 CO2 CO3		
III	Physiology of microbia cultures; Growth Cu biomass, and cell count Nutrition requirement Chemolithotrophs (Ar oxidizing Bacteria), mechanisms – Passiv affecting microbial gro An overview of Metab Doudoroff Pathway, Acid Cycle. Elect Phosphorylation. Ar Fermentation, Heterola Photosynthesis – A	al growth: Bato rve and mea t). Control of m ts - Photoau mmonia, Nitri Chemoorgano re diffusion at wth. polism - Embde Pentose Phosp ron Transpo TP synthesis ctic Fermentati	ch – sure icro totro ite, otrop nd en N bhato rt s. on,	con eme: obia oph Su ohs. Act Ieye Ch Fe	ntinu nt 1 groo s, 1 lfur, N ive erho vathy ain rme	uous met pwth Pho Jutri tra: f Pa way a ntat	s - syn hod (n. toorga Iydrog ation nsport. athway , Tric nd (ion-Ho last	chronou turbidity notrophs en, Iro transpor Factor r, Entner arboxyli Dxidativ omolacti	Ho s 1 7, 3, 1 n rt s c c c c . 1	Joint Jurs 12 12 12 12 12 12 12 12 12 12	Objectives CO1 CO2 CO3		
I I II III IV	Physiology of microbia cultures; Growth Cu biomass, and cell count Nutrition requirement Chemolithotrophs (Ar oxidizing Bacteria), mechanisms – Passiv affecting microbial gro An overview of Metab Doudoroff Pathway, Acid Cycle. Elect Phosphorylation. Ar Fermentation, Heterola Photosynthesis – A Photosynthetic Pigmer	al growth: Bato rve and mea t). Control of m ts - Photoau mmonia, Nitri Chemoorgano re diffusion au wth. polism - Embde Pentose Phosp ron Transpor TP synthesis ctic Fermentati an Overview nts, Light Rea	ch – sure icro totro totro nd en N bhato rt s. on, o actio	con eme obial oph Su ohs. Act Ieyo e P Ch Fe f on-(ntinu nt i gro s, i lfur, N ive erho erho ain rme chlo Cycl	uous met Pho , H Jutri tra f Pa way a ntat	s - syn hod (1. toorga Iydrog ition nsport. athway , Tric nd (ion-Ho last and n	chronou turbidity notrophs en, Iro transpor Factor , Entner arboxyli Dxidativ omolacti structure on-cycli	Ho s 1 /, s, 1 n rt s c e c c l c	Joint Jurs 12 12 12 12 12 12	Objectives CO1 CO2 CO3		

V	Bacterial reproduction - Binary fission, Budding, Reproduction	12	CO5	
	through conidia, cyst formation, endospore formation. Fungi asexual			
	and sexual reproduction, Microalgae reproduction.			
	Total	60		
~	Course Outcomes			
Course	On completion of this course, students will;			
Outcom	es	D	0.6 D0.0	
COI	Describe microorganisms based on nutrition.	P	06, PO9	
CO2	Know the concept of microbial growth and identify the factors	PO6	, PO7, PO9	
	affecting bacterial growth.			
CO3	Explain the methods of nutrient uptake.	P	O6, PO9	
CO4	Describe anaerobic and aerobic energy production.	PO6, PO9		
CO5	Elaborate on the process of bacterial photosynthesis and reproduction.	P	O6, PO9	
	Text Books			
1	Schlegal, H.G. (1993). General Microbiology.,7 th Edition, F University of Cambridge.	Press syn	dicate of the	
2	RajapandianK.(2010). Microbial Physiology, Chennai: PBS Book	Enterpris	es India.	
3	MeenaKumari. S. Microbial Physiology, Chennai 1 st Edition MJP	Publisher	rs 2006.	
4	Dubey R.C. and Maheswari, S. (2003). A textbook of Microb Chand & Co.	oiology, 1	New Delhi: S.	
5	S. Ram Reddy, S.M. Reddy (2008). Microbial Physiology. Anmol	Publicati	ons Pvt Ltd.	
	References Books			
1	Robert K. Poole (2004). Advances in Microbial Physiology, El New York, Volume 49.	sevier Ad	cademic Press,	
2	Kim B.H., Gadd G.M. (2008). Bacterial Physiology and M University Press, Cambridge.	/letabolisi	n. Cambridge	

3	Daniel R. Caldwell. (1995). Microbial Physiology & Metabolism Wm.C. Brown									
5	Communications, Inc. USA.									
	Moat, A.G and J.W Foaster (1995). Microbial Physiology, 3 rd edition. Wiley – LISS, A									
4	4 John Wiley & Sons. Inc. Publications.									
5	BhanuShrivastava. (2011). Microbial Physiology and Metabolism: Study of Microbial									
5	Physiology and Metabolism. Lambert academic Publication.									
	Web Resources									
1	https://sites.google.com/site/microbial physiologyoddsem/teaching-contents									
1										
2	https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition									
3	https://onlinecourses.swayam2.ac.in/cec20_bt14/preview									
5										
4	http://web.iitd.ac.in/~amittal/2007_Addy_Enzymes_Chapter.pdf									
+										
5	https://wwwfrontiersin.org.microbial-physiology-and-metabolism									

	Methods of Evaluation						
	Continuous Internal Assessment Test						
Internal	Assignments	25 Marks					
Evaluation	Seminars						
	Attendance and Class Participation						
External	End Semester Examination	75 Marks					
Evaluation		75 Warks					
	Total	100 Marks					
	Methods of Assessment						
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definition	18					
Understand/							
Comprehend	MCQ, True/False, Short essays, Concept explanations, Sh	ort summary or overview					
(K2)							
Application	Suggest idea/concept with examples, Suggest formulae,	Solve problems, Observe,					
(K3)	Explain						
Analyze (K4)	Problem-solving questions, Finish a procedure in many st	teps, Differentiate between					
Analyze (IS4)	various ideas, Map knowledge						
Evaluate	Longer essay/ Evaluation essay, Critique or justify with pr	ros and cons					

(K5)	
Croata (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or
Cleate (K0)	Presentations

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1						М			М		
CO2						М	L		М		
CO3						М			М		
CO4						М			М		
CO5						М			М		

Subject	Subject Name	Catego	L	Т	P	S	Cre	Inst.		Marks	
Code		ry					dits	Hours	CIA	Exter	Total
										nal	
22MBU		CCIV-	-	-	Y	-	5	5	25	75	100
GCF2	MICROBIAL	CORE									
	PHYSIOLOGY	PRAC									
	AND Metadol ISM										
	WIETADOLISM	11									
		(Cours	l se Ol) Diecti	ves					
CO1	Understand the prir	nciples of r	notili	ty tes	st.						
	1	1		5							
CO2	Understand the bas	ic concepts	s of st	ainir	ng me	ethods	5.				
CO3	Learn the bacterial	count usin	g diff	erent	t met	hods	and ana	aerobic cu	lture.		
GOA					6		•				
CO4	Study the morpholo	ogical dem	onstra	ation	of m	1croo	rganisr	ns and ide	intificatio	on.	
CO5	Study the biochemi	cal identif	icatio	n of	the h	acteri	9				
005	Study the biochemi		icutio	11 01		ucterr	u.				
UNIT		I	Detail	S					No.of	Сот	irse
									Hours	Obje	ctives
Ι	Motility demonstra	tion: hang	ging o	drop,	wet	mou	nt prep	paration,	12		
	semi-solid agar.	Staining	tech	nique	es:	Smea	r prep	paration,		CO	D1
	Capsular, and Acid	-fast staini	ng								
II	Direct counts – I	Direct cell		nt (l	Petro	ff-Ha	usser o	counting	12	CO	52
TIT	chamber), Turbidoi	netry. Via	ble cc	ount -	- pou	r plate	e, sprea	id plate.	10		22
111	sensitivity testing:	methods Disc diffus	– Ca vion te	andle	jar	metri	iod. A	nubiotic	12		55
IV	Morphological va	riations	in a	lgae	fm	noi :	and n	rotozoa	12	C	74
1,	Micrometry.	induitions	iii u	igue,	141	-81	und p	1010200.	12		51
V	Methods of	bacterial	ide	ntific	ation	l-	morph	ological,	12	CO	05
	physiological, and	biochemic	al me	thods	s - IN	IViC	test, H	2S, TSI,			
	Oxidase, catalase,	urease tes	st, an	d Ca	arboh	ydrat	e ferm	entation			
	test.Maintenance o	f pure cult	ture, j	paraf	fin n	netho	d, stab	culture,			
	maintenance of mo	ld culture.									
	Total								60		
			Cours	se Oi	utcor	nes					

Course	On completion of this course, students will;						
Outcomes							
CO1	Describe hanging drop, wet mount preparation, semi-solid agar, Craigie's tube method.	PO6, PO7, PO8, PO9, PO11					
CO2	Demonstrate Smear preparation, permanent specimen preparation, Capsular, and Acid-fast staining.	PO6, PO7, PO8, PO9, PO11					
CO3	Explain antibiotic sensitivity testing: Disc diffusion test- quality control with standard strains.PO6, PO7, PO8, PO9, PO11						
CO4	Describe demonstration of the size of yeast, fungal filaments and protozoa.	PO6, PO7, PO8, PO9, PO11					
CO5	Elaborate on the bacterial identification- morphological, physiological, and biochemical methods.	PO6, PO7, PO8, PO9, PO11					
	Text Books						
1	James G Cappucino and N. Sherman MB (1996). A lab manual E York .	Benjamin Cummins, New					
2	Kannan. N (1996).Laboratory manual in General Microbiology. Pa	alani Publications.					
3	Sundararaj T (2005). Microbiology Lab Manual (1 st edition) public	cations.					
4	Gunasekaran. P (2007). Laboratory manual in Microbiology. publisher.	New age international					
5	Elsa Cooper (2018). Microbial Physiology: A Practical Appropublisher.	oach. Callisto Reference					
	References Books						
1	DavidWhite., James Drummond., Clay Fuqua (2012) Physiolo Prokaryotes. 4th Ed. Oxford University Press, New York.	gy and Biochemistry of					
2	Robert K. Poole (2004). Advances in Microbial Physiology, E New York, Volume 49.	lsevier Academic Press,					
3	Kim B.H., Gadd G.M. (2008). Bacterial Physiology and University Press, Cambridge.	Metabolism. Cambridge					
4	Dawes, I.W and Sutherland L.W (1992). Microbial Physiolog Blackwell Scientific Publications.	gy (2 nd edition), Oxford					

	Moat, A.G and J.W Foaster, (1995). Microbial Physiology, 3 rd edition. Wiley – LISS, A
5	John Wiley & Sons. Inc. Publications.
	Web Resources
1	https://sites.google.com/site/microbial physiologyoddsem/teaching-contents
1	
2	https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition
3	https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
4	https://www.studocu.com/microbial-physiology-practicals
5	https://www.agr.hokudai.ac.jp/microbial-physiology

	Methods of Evaluation							
	Continuous Internal Assessment Test							
Internal	Assignments	10 Morks						
Evaluation	Seminars	40 Walks						
	Attendance and Class Participation							
External Evaluation	End Semester Examination	60 Marks						
	Total	100 Marks						
	Methods of Assessment							
Recall (K1)	call (K1) Simple definitions, MCQ, Recall steps, Concept definitions							
Understand Comprehen (K2)	MCQ, True/False, Short essays, Concept explanations, Sho	ort summary or overview						
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Explain	Solve problems, Observe,						
Analyze (K4	Problem-solving questions, Finish a procedure in many st various ideas, Map knowledge	eps, Differentiate between						
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pro-	os and cons						
Create (K6)	Check knowledge in specific or offbeat situations, Presentations.	Discussion, Debating or						

	-	-									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1						М	L	М	L		М
CO2						М	М	L	М		L
CO3						L	М	М	L		М
CO4						L	М	М	М		М
CO5						М	М	М	М		М

Mapping with Programme Outcomes:

Subject	Subject Name	NameCategoryLTPSCreInst.			Marks						
Code							dits	Hour	CI	Exte	er Total
								S	Α	nal	
22MBUGDE	BIO	Elective	Y	-	-	-	3	4	25	75	100
2	INSTRUMENTA	Generic									
	TION	/Disciplin									
		e Specific									
		Elective II									
Course Objectives											
CO1	Understand the ana sciences.	lytical instru	mer	nts a	and	stu	dy the	basic pr	incipl	es in	the field of
CO2	To gain knowledge a	about princip	les o	of sp	oecti	rosc	ору				
CO3	Understand the analytical techniques of Chromatography and electrophoresis										
CO4	To understand the principle of different types of scans used in medical diagnosis										
CO5	To gain information about the principles of radioactivity and its measurements										
Unit	Details									.of ours	Course Objectives
Ι	Basicinstruments:pH meter, Buffer of biological importance, Centrifuge- Preparative, Analytical and Ultra, Laminar Air Flow, Autoclave, Hot Air Oven and Incubator. Biochemical calculations-preparations of Molarity, molality and normality solutions							CO1			
II	Spectroscopic Techniques:Spectroscopic Techniques: 12 CO2 Colorimeter, Ultraviolet and visible, Infra red and Mass Spectroscopy. 12 CO2										
III	Chromatographic and Electrophoresis Techniques: Chromatographic Techniques: Paper, Thin Layer, Column, HPLC and GC. Electrophoresis Techniques: Starch Gel, AGE, PAGE.										CO3
IV	Imaging techniques: ECG, EEG, EMG, M	Principle, Ins IRI, CT and	strur PET	nen Sca	tatic ın ra	on ai adio	nd appl isotope	ication o s.	f 1	2	CO4
V	Fluorescence and rad Flame photometer, S	;] ;	2	CO5							

	Autoradiography.								
	Total	60							
Course Outcomes									
Course On completion of this course, students will;									
Outcomes									
CO1	Gain knowledge about the basics of instrumentation.	PO1,PO	4,PO11						
CO2	Exemplify the structure of atoms and molecules by using the	PO4,PO	10,PO11						
	principles of spectroscopy. D04 D07 D011								
C03	Evaluate by separating and purifying the components.	P04,P0	97,POI1						
C04	Understand the need and applications of imaging techniques.	PO/,PO	8,POT						
CO5	Categorize the working principle and applications of	PO10,P	011						
	fluorescence and radiation.								
	Text Books								
1	Iavaraman I (2011) Laboratory Manual in Biochemistry 2 nd F	dition W	Viley Eastern						
	I td New Delhi								
2.	2. Ponmurugan, P and Gangathara PB (2012). Biotechniques 1 st Edition, MJP publishers								
3	3 Veerakumari, L (2009).Bioinstrumentation- 5 th EditionMJP publishers.								
4	4 Upadhyay, Upadhyay and Nath (2002). Biophysical chemistry – Principles and								
	techniques 3 rd Edition. Himalaya publishing home.								
5	Chatwal G and Anand (1989). Instrumental Methods of Chemical	Analysis	. S.Himalaya						
	Publishing House, Mumbai.								
	References Books								
1	1 Rodney.F.Boyer (2000). Modern Experimental Biochemistry, 3 rd Edition. Pearson								
	Publication.								
2	2 SkoogA.,WestM (2014). Principles of Instrumental Analysis – 14 th Edition								
	W.B.SaundersCo., Philadephia.								
3	N.Gurumani. (2006). Research Methodology for biological science	es- 1 st Ed	ition – MJP						
	Publishers .								
4	Wilson K, and Walker J (2010). Principles and Techniques	of Bioch	nemistry and						
	Molecular Biology.7 th Edition. Cambridge University Press.								
5	Webster, J.G. (2004). Bioinstrumentation- 4 th Edition - John	Wiley &	Sons (Asia)						
	Pvt.Ltd,Singapore.								
	Web Resources								
1	http://www.biologydiscussion.com/biochemistry/centrifugation/cent	rifugeintr	oduction-						
	types- uses-and-other-details-with-diagram/12489	C							

2	https://www.watelectrical.com/biosensors-types-its-working-andapplications/
3	http://www.wikiscales.com/articles/electronic-analytical-balance/ Page 24 of 75
4	https://study.com/academy/lesson/what-is-chromatography-definition-typesuses.html
5	http://www.rsc.org/learn-chemistry/collections/spectroscopy/introduction

Methods of Evaluation									
	Continuous Internal Assessment Test								
Internal	Assignments	25 Mortes							
Evaluation	Seminars	25 IVIAI KS							
	Attendance and Class Participation								
External Evaluation	End Semester Examination	75 Marks							
	Total	100 Marks							
	Methods of Assessment								
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions								
Understand/	MCO True/False Short assays Concept explanations Short summary or								
Comprehend	overview								
(K2)									
Application	Suggest idea/concept with examples, Suggest formulae, S	olve problems, Observe,							
(K3)	Explain								
Analyza (KA)	Problem-solving questions, Finish a procedure in ma	any steps, Differentiate							
Allalyze (IX4)	between various ideas, Map knowledge								
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pr	ros and cons							
Create (K6)	Check knowledge in specific or offbeat situations, D	Discussion, Debating or							
	Presentations								

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L			Μ							S
CO2				L						Μ	S
CO3				L			М				S

CO4				S	S		S
CO5						М	S