

Department of Electronics and Communication Engineering

Academic Year 2023-24

5rd and 6th Semester

Scheme and Syllabus

BATCH: 2021-25

CREDITS: 160



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NEW HORIZON COLLEGE OF ENGINEERING INSTITUTION

Vision

To emerge as an institute of eminence in the fields of engineering, technology and management in serving the industry and the nation by empowering students with a high degree of technical, managerial and practical competence.

Mission

- To strengthen the theoretical, practical and ethical dimensions of the learning process by fostering a culture of research and innovation among faculty members and students.
- To encourage long-term interaction between the academia and industry through their involvement in the design of curriculum and its hands-on implementation.
- To strengthen and mould students in professional, ethical, social and environmental dimensions by encouraging participation in co-curricular and extracurricular activities.

Quality Policy

To provide educational services of the highest quality both curricular and co-curricular to enable students integrate skills and serve the industry and society equally well at global level.

Values

- Academic Freedom
- Innovation
- ✤ Integrity

- Professionalism
- ✤ Inclusiveness
- Social Responsibility

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING VISION

To create high quality engineering professionals who can serve the society and earn global recognition.

MISSION

- To build strong foundation in Electronics and Communication Engineering aspects by exposing students to state of the art technology and research.
- To strengthen the curriculum through interaction with industry experts to equip the students with the required competency.
- To mould students to share technical knowledge and to practice professional and moral values.

PEO1	To produce graduates with understanding of fundamentals and applications of Electronics and Communication Engineering.
PEO2	To hone graduates with ability to apply, analyze, design and develop electronic systems.
PEO3	To enhance graduates with latest technologies to enable them to engineer products for real world problems in Electronics and Communication.
PEO4	To build leadership qualities, management skills, communication skills, moral values, team spirit and lifelong learning ability for the graduates.

Program Education objectives (PEOs)

PEO to Mission Statement Mapping

Mission Statements	PEO1	PEO2	PEO3	PEO4
To build strong foundation in Electronics and				
Communication Engineering aspects by exposing	3	3	3	2
students to state of the art technology and research.				
To strengthen the curriculum through interaction with				
industry experts to equip the students with the required	2	3	3	2
competency.				
To mould students to share technical knowledge and to	1	2	2	2
practice professional and moral values.	L	Z	Z	3

Correlation: 3- High, 2-Medium, 1-Low

Program Outcomes (PO) with Graduate Attributes

	Graduate Attributes	Program Outcomes (POs)
1	Engineering knowledge	PO1: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems in Electronics and Communication Engineering.
2	Problem analysis	PO2: Identify, formulate, review research literature, and analyze complex engineering problems in Electronics and Communication Engineering reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	Design/development of solutions	PO3: Design solutions for complex engineering problems and design system components or processes of Electronics and Communication Engineering that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	Conduct investigations of complex problems	PO4: Use research-based knowledge and research methods including design of experiments in Electronics and Communication Engineering, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5	Modern tool usage	P05: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities in Electronics and Communication Engineering with an understanding of the limitations.
6	The engineer and society	PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice in Electronics and Communication Engineering.
7	Environment and sustainability	P07: Understand the impact of the professional engineering solutions of Electronics and Communication Engineering in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	Ethics	PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9	Individual and team work	PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	Communication	P010: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	Project management and finance	PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	Life-long learning	PO12: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

DGG 4	To demonstrate the ability to design and develop complex systems in the areas of next
PS01	generation Communication Systems, IoT based Embedded Systems, Advanced Signal and Image Processing, latest Semiconductor technologies, RF and Power Systems.
PSO2	To demonstrate the ability to solve complex Electronics and Communication Engineering problems using latest hardware and software tools along with analytical
100-	skills to contribute to useful, frugal and eco-friendly solutions.

	P01	P02	P03	P04	P05	P06	P07	P08	P09	PO1 0	P01 1	P01 2	PSO1	PSO2
PEO1	3	3	2	2	2	1	1	1	1	1	1	1	1	1
PEO2	3	3	3	3	3	2	2	2	2	2	2	2	3	2
PEO3	3	3	3	3	3	3	3	2	2	2	2	2	3	3
PEO4	1	1	1	1	1	2	2	3	3	3	3	3	1	1

Mapping of PEOs to POs & PSOs

Correlation: 3- High, 2-Medium, 1-Low

B. E. in Electronics and Communication Engineering Scheme of Teaching and Examinations for 2021- 2025 BATCH (2021 Scheme) V Semester **NEW HORIZON COLLEGE OF ENGINEERING**

S. No.Course and Course CodeCourse TitleCourse TitleBos $\begin{tabular}{$
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $
$ \begin{array}{ c c c c c c } \hline \mbox{Vortunes triplet} & Vortunes triplet$
$ \begin{array}{ c c c c c } \hline \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $
$\begin{array}{ c c c c c c } \hline \mathbf{Narks} & \mathbf{Contact} & \mathbf{Varks} & \mathbf{Credits} & \mathbf{Hours} & \mathbf{CIE} & \mathbf{SEE} & \mathbf{Total} \\ \hline \mathbf{N} & \mathbf{S} & S$
$ \begin{array}{ c c c c c } \hline \text{Overall} & \text{Contact} & \text{Hours} & \text{CIE} & \text{SEE} & \text{Total} \\ \hline \text{Credits} & \text{Hours} & \text{CIE} & \text{SEE} & \text{Total} \\ \hline \ 3 & 3 & 50 & 50 & 100 \\ 1 & 2 & 50 & 50 & 100 \\ 1 & 2 & 50 & 50 & 100 \\ 1 & 2 & 50 & 50 & 100 \\ 3 & 3 & 3 & 50 & 50 & 100 \\ 1 & 2 & 50 & 50 & 100 \\ 1 & 2 & 50 & 50 & 100 \\ 1 & 2 & 50 & 50 & 100 \\ 1 & 2 & 50 & 50 & 100 \\ 1 & 2 & 50 & 50 & 100 \\ 1 & 2 & 50 & 50 & 100 \\ 1 & 2 & 50 & 50 & 100 \\ 1 & 2 & 50 & 50 & 100 \\ 1 & 2 & 50 & 50 & 100 \\ 1 & 2 & 50 & 50 & 100 \\ 1 & 1 & 2 & 50 & 50 & 100 \\ 1 & 2 & 50 & 50 & 100 \\ 1 & 1 & 2 & 50 & 50 & 100 \\ \end{array} $
$\begin{array}{ c c c c c } \hline & & & & & & & & & & & & & & & & & & $
Marks CIE SEE Total 50 50 100 50 50 100 50 50 100 50 50 100 50 50 100 50 50 100 50 50 100 50 50 100 50 50 100 50 50 100 50 50 100 50 50 100 50 50 100 50 50 100 50 50 100 50 50 100 50 50 100 50 50 100 50 50 100
Marks SEE Total 50 100 50 100 50 100 50 100 50 100 50 100 50 100 50 100 50 100 50 100 50 100 50 100 50 100 50 100 50 100 50 100
s Total 100 100 100 100 100 100 100 100 100

NCMC		
21Y0G84	21PES84	21NSS84
Yoga	Physical Education (PE) (Sports and Athletics)	National Service Scheme (NSS)
Yoga Teacher	Physical Education Director	NSS coordinator
SEE in the above courses shall be conducted during VIII semester examinations and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for the award of the degree. The events shall to be reflected in the calendar prepared for the NSS, PE and Yoga activities.	Yoga with the concerned coordinator of the course during the first week of V semester. The activities shall be carried out from (for 4 semesters) between V semester to VIII semester.	All students have to register for any one of the courses namely National Service Scheme, Physical Education (PE) (Sports and Athletics) and

PCC: Professior Enhancement C Continuous Inte	ial Core Course, PCCL : Professional Core Course laboratory, ourse, PEC : Professional Elective Course, PROJ : Mini Proje ernal Evaluation, SEE :Semester End Evaluation	UHV : Universal Human ± work L: Lecture, T: Tı	Value Course, NCMC: Non-Credit Mandatory Course, AEC: Ability ttorial, P: Practical S: SDA: Self Study for Skill Development, CIE:
	Professio	nal Elective Course-I	
21ECE541	Internet of Things	21ECE544	Programming with Data Structures using C
21ECE542	Electromagnetic Field Theory	21ECE545	Nanoelectronics
21ECE543	DSP Algorithms and Architecture		
	Ability En	hancement Course-V	
21ECL551	ALP with Microcontrollers	21ECL554	Electronics Applications using Scilab
21ECL552	Antenna simulation using Ansys	21ECL555	Optical Communication using Optsim
21ECL553	Network simulation using NS-2		
Professional Ele and Technology	ective Courses (PEC): A professional elective (PEC) course i curriculum. Multidisciplinary courses that are added supple	s intended to enhance th ment the latest trend aı	e depth and breadth of educational experience in the Engineering Id advanced technology in the selected stream of engineering.
Mini-project w	ork: Mini Project is a laboratory-oriented/hands on course	that will provide a platf	orm to students to enhance their practical knowledge and skills
by the developr	nent of small systems/applications etc. Based on the ability	/abilities of the studen	/s and recommendations of the mentor. A student can do mini
project as			
(i) A group	of 2 if mini project work is single discipline (applicable to a	ll IT allied branches)	
(ii) A group	of 2-4 if mini project work is single discipline (applicable t	o all Core Branches)	
(iii) A grouț	o of 2 - 4 students if the Mini Project work is a multidisciplir	ary (Applicable to all B	anches)
CIE procedure	for Mini-project:		
(i) Single disc	ipline: The CIE marks shall be awarded by a committee c	onsisting of the Head o	if the concerned Department and two faculty members of the
Department, or	ne of them being the Guide. The CIE marks awarded for t	he Mini-project work s	hall be based on the evaluation of the project report, project
presentation sk	ill, and question and answer session in the ratio of 50:25:25	. The marks awarded fc	r the project report shall be the same for all the batches mates.
(ii) Interdisciț	vlinary: Continuous Internal Evaluation shall be group-wise	at the college level with	the participation of all the guides of the project.
The CIE marks	awarded for the Mini-project, shall be based on the evaluat	ion of the project repor	t, project presentation skill, and question and answer session in
the percentage	ratio of 50:25:25. The marks awarded for the project report	shall be the same for al	I the batch mates
Credit Definiti	ion:	03-Credits courses are	to be designed for 40 hours in Teaching-Learning Session
1-hour Lecture	(L) per week=1Credit	02- Credits courses are	to be designed for 25 hours of Teaching-Learning Session
Z-hoursTutoria	ll('I') per week=1Credit	01-Credit courses are t	o be designed for 15 hours of Teaching-Learning Sessions
2-hours Practic	al / Drawing (P) per week=Lcredit dv for Skill Davelonment (SDA) ner week = 1 Credit		
1 1000	in to the the second first with the to the		

Scheme of Teaching and Examinations for 2021-2025 BATCH (2021 Scheme) **B. E. in Electronics and Communication Engineering NEW HORIZON COLLEGE OF ENGINEERING**

		Total	100	100	100	100	100	100	100	100	100	100	1000
	Marks	SEE	50	50	50	50	50	50	50	50	50	50	500
		CIE	50	50	50	50	50	50	50	50	50	50	500
	Contact	Hours	3	3	2	3	2	3	2	0	2	3	23
	Overall	Credits	3	3	1	3	1	3	1	3	1	3	22
	on	S	0	0	0	0	0	0	0	0	0	0	
	tributi	Ρ	0	0	1	0	1	0	1	3	1	0	
	dit Dis	Т	0	0	0	0	0	0	0	0	0	0	
r	Cre	L	3	3	0	3	0	3	0	0	0	3	
VI Semeste	Jod	cng	ECE	ECE	ECE	ECE	ECE	ECE	ECE	ECE	ECE	ECE	
			Operations Research and Management	Embedded System Design	Embedded System Design Lab	Communication Systems - II	Communication Systems - II Lab	Professional Elective Course - II	Social Connect and Responsibility	Innovation / Entrepreneurship / Societal Internship	Mini Project	Industrial Open Elective Course - I	Total
	ie and Course	Code	21ECE61	21ECE62	21ECL62	21ECE63	21ECL63	21ECE64X	21ECK65	21ECE66	21ECE67	21NHOP6XX	
	Cours		HSMC	PCC	PCCL	PCC	PCCL	PEC	UHV	INT	MP	OEC	
	s.	No.	1	2	3	4	5	9	7	8	6	10	

HSMC: Humanity and Social Science & Management Course, PCC: Professional Core Course, PCCL: Professional Core Course laboratory, NCMC: Non-Credit Mandatory Course, AEC: Ability Enhancement Course, PEC: Professional Elective Course, OEC: Open Elective Course, PROJ: Project work, L: Lecture, T: Tutorial, P: Practical S: SDA: Self Study for Skill Development, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation.

Industrial Open Elective Course (OEC): Credit for OEC is 03 (L: T: P: S) can be considered as (3: 0: 0: 0). The teaching and learning of these Courses will be based on hands-on. The Course Assessment will be based on CIE and SEE in practical mode. This Courses will be offered by Centre of Excellence to students of all the branches. Registration to Industrial open electives shall be documented and monitored on college level Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering.

თ

21XXX61(economics For IT alli For Core B	(HSMC)- This course must be pertaining to economics s and management topics and the course title should be ied Branches: Software Product Management 3ranches: Engineering Economics and Management / I	and management of th ar the word Manageme ndustrial Management	e concerned degree program. The course syllabus should have both nt. / Construction Management
	Pro	essional Elective Cou	rse-II
21ECE641	Fiber Optic Communication	21ECE644	Object Oriented Programming using C++
21ECE642	Biomedical Signal Processing	21ECE645	Bio-inspired Design and Innovation
21ECE643	Low Power VLSI Design		
Credit Def	finition:	03-Credits courses ar	e to be designed for 40 hours in Teaching-Learning Session
1-hour Lec	ture (L) per week=1Credit torial(T) ner week=1Credit	02- Credits courses an	e to be designed for 25 hours of Teaching-Learning Session to be designed for 15 hours of Teaching, earning Sessions
2-hours Pr	actical / Drawing (P) per week=1Credit	יד-טו רמון רטמו שיש מי י	הם הר מרכזנצוורת וסד דם ווסמוס סד דרמניווויום הרמי וווים הרכזיהויום
2-hous Seli	f Study for Skill Development (SDA) per week = 1		
Credit			

FIFTH SEMESTER

(SYLLABUS)

COMMUNICATION SYSTEMS - I														
Course Code	21E	ECE5	1						CIE I	Marks		50)	
L:T:P:S	3:0	:0:0							SEE	Marks		50)	
Hrs / Week	3								Tota	l Marks	6	10	00	
Credits	03								Exar	n Hours	5	03	8	
Course outcon	nes:													
At the end of t	he co	ourse	, the s	studen	t will b	e able	to:							
21ECE51.1	Con	npare	e the	Genera	tion ar	nd Dete	ection c	of Anal	og mod	lulation	techniqu	ies		
21ECE51.2	Eva	luate	the I	Power	consun	nption	and Ba	indwid	th utili	zation i	n Analog	modula	tion tech	iniques
21ECE51.3	Exa	mine	the s	tatisti	cal ave	rages a	issociat	ted wit	h rand	om proc	esses			
21ECE51.4	Арр	ly th	e fun	damen	tals of	digital	Comm	unicati	ion for	basebar	nd signal	process	sing and	coding
21ECE51.5	Cate	egori	ze dig	gital mo	odulati	ion tecl	hnique	s based	l on Bit	t Error F	Rate perf	ormanc	е	
21ECE51.6 Estimate the signal in presence of noise by appropriate receiver design Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:														
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes: P01 P02 P03 P04 P05 P06 P07 P08 P09 P010 P011 P012 PS01 PS02														
	PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PS01 PS02 3 - - 2 - - - - 2 3 3													
21ECE51.1	3	-	-	-	2	-	-	-	-	-	-	2	3	3
21ECE51.2	3	2	1	-	2	-	-	-	-	-	-	2	3	3
21ECE51.3	3	3 2 2 2 3										3		
21ECE51.4	3	3 2 2 3 3										3		
21ECE51.5	3												3	
21ECE51.6	3	2	1	-	2	1	1	-	-	-	-	2	3	3
MODULE-1	AN	ALO	G MO	DULA	TION						21ECE5 21ECE5	1.1, 51.2	8 I	lours
Introduction, A	mpli	tude	Mod	ulation	, Doub	ole side	e band	-suppr	essed	carrier	modulati	ion, Qua	drature	Carrier
Multiplexing, Si	ingle-	sidel	band	modul	, ation, V	VSB Mo	odulati	on, The	eme Ex	ample:	VSB Trar	nsmissio	on of Ana	log and
Digital Televisi	on, Fr	eque	ency 🛛	Fransla	tion, F	requer	ncy- Div	vision l	Multipl	exing.				-
Phase and Freq	uenc	y mo	dulat	ion: Ba	sic def	inition	s, Freq	uency	Modula	ation, Pł	ase-Loc	ked Loc	p.	
Self-study / Cas	se Stu	dy	Inv	estigat	e the a	applica	tions o	of AM a	and FM	l in toda	ıy's Com	munica	tion sce	nario
/ Applications														
Text Book			Tex	t Book	1: 3.1-	3.8, 4.1	L – 4.4				04505	= 4.0		
MODULE-2	RAI	NDO			LES AF	ND PR	<u>OCESS</u>	ES		1	21ECE	51.3	8	Hours
Introduction, P	robal	bility	, Ran	dom v	ariable	es, Stat	istical	averag	es, Rar	idom pi	ocesses,	Mean,	correlati	on, and
Lovariance fund	dong	S. itaz C	'aucci	an nro	cocc N	loico N	arrow	hand n	oico					
Solf-study /	Inv	ny, u	aussi ato th	all pro	ct of n	oise in	Comm	unicat	tion Sv	stomen	nd moth	ods to	tackle it	
Case Study /	1110	esug	ate ti	le elle		oise iii	Comm	lunica	lion Sy	stems a	nu meu	1005 10	lackie il.	
Applications														
Text Book	Tex	t Boc	ok 1∙⊓	51-5	658-	- 5 11								
Text Dook	SAN		NG P	ROCES	<u>S AND</u>	WAVE	FORM		NG					
MODULE-3	TEC	CHNI	QUES	5	011112						21ECE	51.4	8	Hours
Sampling Theo	orem,	Qua	dratı	ire san	npling	of ban	d pass	signal	ls, Reco	onstruc	tion of a	messag	ge proces	ss from
its samples, Pr	actica	al asj	pects	of san	npling	and sig	gnal re	covery	7, Pulse	e Ampli	tude Mo	dulatio	n, Time	
Division Multip	plexii	ng.												
Pulse code mo	dulat	ion,	Quan	tizatio	n nois	e and S	Signal-	to-noi	se ratio	o, Robu	st quant	ization,	Differen	tial
PCM, Delta mo	dulat	tion.			-									
Self-study /	Exp	lore	the u	ises of	analog	g-to-di	gital co	onvers	ion in (current	Digital S	systems	i.	
Lase Study /														
Applications	1													

Text Book Text Book 2: 4.1 – 4.3,4.5-4.7, 5.1,5.3-5.6												
MODU	LE-4	DIGITA	L MODU	LATION TECH	NIQUES		21ECE51.5	8 Hours				
Digital	Modulati	ion forn	nats, Col	nerent binary n	nodulation te	chnique	s- Coherent Binary PSK,	Coherent				
Binary	FSK,Cohe	erent qu	adrature	e modulation tee	chniques-Qua	idri pĥas	e-shift keying, Noncoher	ent binary				
modula	ation tech	iniques-	Differen	tial PSK.		-		-				
Self-stu	idy /	Explore	the app	lications of digi	al modulatio	n techni	ques in today's Commun	ication				
Case St	udy /	scenario).									
Applica	ations											
Text Bo	ook '	Text Boo	ok 2: 7.1	- 7.2, 7.3 (1), 7.4	(2)			1				
MODU	LE-5	DETEC	FION AN	DESTIMATIO	N		21ECE51.6	8 Hours				
Model	of Digita	al Com	municat	ion System, G	ram-Schmidt	Orthog	onalization procedure,	geometric				
interpi	retation o	f signals	s, respor	nse of bank of c	orrelators to	noisy in	put, Detection of known	signals in				
noise,	correlatio	n receiv	ver, mato	hed filter receiv	/er.							
Estima	tion: cond	cepts an	d criteri	a, Maximum Lil	elihood Estir	nation.						
Self-stu	ıdy /	Survey o	on the di	fferent detectio	n techniques	used in	existing Communication	Systems.				
Case S	tudy /											
Applica	ations											
Text Bo	ook '	Text Boo	ok 2: 3.1-	-3.5,3.7-3.8, 3.10	,3.11							
CIE As	sessment	Pattern	(50 Ma	rks – Theory)								
]	Marks Distribu	tion							
	DT Loval	<u> </u>	Test	Qualitative	MCO's							
R	CB1 Level	S	(s)	Assessment (s) MCQ'S							
			25	15	10							
L1	Remen	nber	5	-	5							
12	Unders	tand	5	-	5							
112	onderb	tanu			0							
L3	Appl	ly	10	10	-							
L3 L4	Appl Analy	ly vze	10 5	10 5	-							
L3 L4 L5	Appl Analy Evalua	ly vze ate	10 5 -	10 5 -	- - -							
L2 L3 L4 L5 L6	Appl Analy Evalua Creat	ly vze ate te	10 5 - -	10 5 - -								
L2 L3 L4 L5 L6 SEE As	Appl Analy Evalua Creat	ly vze ate te t Pattern	10 5 - - n (50 M a	10 5 - - rks - Theory)	-							
L2 L3 L4 L5 L6 SEE As	Appl Analy Evalua Creat	ly vze ate te batteri	10 5 - n (50 Ma Exam	10 5 - rks - Theory) Marks	-							
L2 L3 L4 L5 L6 SEE As	Appl Analy Evalua Creat sessment RBT Leve	ly ////////////////////////////////////	10 5 - - (50 Ma Exam Distr	10 5 - rks - Theory) Marks ibution	-							
L2 L3 L4 L5 L6 SEE As	Appl Analy Evalua Creat sessment RBT Leve	ly vze ate te t	10 5 - - (50 Ma Exam Distr (10 5 - rks - Theory) Marks ibution 50)	-							
L2 L3 L4 L5 L6 SEE As	Appl Analy Evalua Creat sessment RBT Leve	ly vze ate te t	10 5 - (50 Ma Exam Distr (10 5 - rks - Theory) Marks ibution 50) 10								
L2 L3 L4 L5 L6 SEE As	Appl Analy Evalua Creat sessment RBT Leve Reme Under	ly ////////////////////////////////////	10 5 - n (50 Ma Exam Distr (10 5 - rks - Theory) Marks ibution 50) 10 10	-							
L2 L3 L4 L5 L6 SEE As L1 L2 L3 L4	Appl Analy Evalua Creat sessment RBT Leve Reme Under Ap	ly ////////////////////////////////////	10 5 - (50 Ma Exam Distr (10 5 - rks - Theory) Marks ibution 50) 10 10 20 10								
L1 L2 L3 L4 L5 L6 SEE As L6 L1 L2 L3 L4 L4	Appl Analy Evalua Creat sessment RBT Leve RBT Leve Reme Under Ap	ly // // // // // // // // // // // // //	10 5 - (50 Ma Exam Distr (10 5 - rks - Theory) Marks ibution 50) 10 10 20 10	-							
L2 L3 L4 L5 L6 SEE As L6 L1 L2 L3 L4 L5 L6	Appl Analy Evalua Creat sessment RBT Leve RBT Leve Under Ap Ana Eval	ly vze	10 5 - (50 Ma Exam Distr (10 5 - rks - Theory) Marks ibution 50) 10 10 20 10 -	-							
L2 L3 L4 L5 L6 SEE As L6 L1 L2 L3 L4 L5 L6	Appl Analy Evalua Creat sessment RBT Leve Reme Under Ap Ana Eval Created Loop	ly vze ate te ate ate ate ate ate ate ate ate	10 5 - n (50 Ma Distr (10 5 - rks - Theory) Marks ibution 50) 10 10 20 10 - -	-							
L2 L3 L4 L5 L6 SEE As L6 L1 L2 L3 L4 L5 L6 Sugges Text B	Appl Analy Evalua Creat sessment RBT Leve Reme Under Ap Ana Eval Cre sted Lear	ly vze ate te ate te ate ate ate ate ate ate	10 5 - (50 Ma Exam Distr (10 5 - rks - Theory) Marks ibution 50) 10 10 20 10 - - - s:								

1) Communications Systems, 5th Edition, Simon Haykin, Michael Moher, Publisher: WILEY India Pvt. Ltd, 2019 ISBN: 978-81-265-2151-7

2) Digital Communications, Simon Haykin, Publisher: WILEY India Pvt. Ltd, 2006, ISBN-10: 8126508248, ISBN-13: 978-8126508242

Reference Books:

 An Introduction to Analog and Digital Communication, Simon Haykin, 2008, John Wiley India Pvt. Ltd.
 Modern digital and analog Communication systems, B. P. Lathi, 3rd edition, 2015, Oxford University Press.

3) Electronic communication systems, Kennedy and Davis, 5th edition, 2011, TMH.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=-PWg-0k2oks
- <u>https://www.youtube.com/watch?v=wMflxR3KsXg&list=PLt3Fk5B7L7NZJv3PAZkxW83Fp</u> <u>7ww6_JE</u>
- <u>https://www.youtube.com/watch?v=ZW1glqkIgcw&t=135s</u>
- <u>https://www.youtube.com/watch?v=692SRjrT2MY</u>

- Visit to any communication-based company/public sector enterprise.
- Simulation demonstration on modulation processes.
- Video demonstration of latest trends in communication sector.
- Contents related activities (Activity-based discussions)
 - For active participation of students, instruct the students to prepare presentations on current research topics in communication sector.
 - > Organizing Group wise discussions on applications or products.
 - ➢ Seminars.

COMMUNICATION SYSTEMS – I LAB																
Course Code	;	21ECL	.51						CIE	Marks		50				
L:T:P:S		0:0:1:	0						SEE	Marks		50				
Hrs / Week		2							Tota	al Marks		100)			
Credits		01							Exa	m Hours		03				
Course outco	omes	:	م ام ا			o oblo	t o.									
At the end o	of the	course	e, the s	studen			to:	C	1	1 1						
21ECL51.1		Demoi	istrat	e gene	ration	and de	etectior	of ana	log mo	dulation	techniq	ues				
21ECL51.2		Analyz	ze pul	se moc	lulatio	n syste	ems and	d their	perform	mance						
21ECL51.3		Exami	ne the	e differ	ent dig	gital mo	odulati	on sche	emes u	sed in th	e field of	f commu	nication			
21ECL51.4		Evalua transn	ite the nissio	e perfo n envii	rmanc onmei	e of mo nts	odulati	on and	demod	dulation	echniqu	ies in var	ious			
Mapping of	Cour	se Ou	tcom	es to l	Progra	am Ou	tcome	es and	Progr	am Spee	cific Out	tcomes:				
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PSO1	PSO2		
21ECL51.1	3	3	2	1	3	-	-	-	2	-	-	3	3	3		
21ECL51.2	3	3	2	1	3	-	-	-	2	-	-	3	3	3		
21ECL51.3	3	3	2	1	3	-	-	-	2	-	-	3	3	3		
21ECL51.4	3 3 2 1 3 2										3	3	3			
Exp. No. / Pgm. No. List of Experiments / Programs											Hour	s (COs			
			P	rereg	uisite	e Expe	erimei	nts / P	rogra	ms / De	emo					
	To lear htt	Learn rn the (ps://y	the ba comm outu.	usics of unicat be/Ul	using ion sys 91up_h	MATL stem to ijnY	AB sim oolbox	ulation in MAT	softwa LAB.	are and a	lso to	2		NA		
							PAR	T-A								
1	То	genera	ite An	nplitud	e Mod	ulation	techni	ique us	ing tra	nsistor.		2	21E 21F	CL51.1		
2	Ger	ieratio	n and	detect	tion of	ASK.						2	21E	CL51.3		
3	Ger	ieratio	n and	detect	tion of	PAM.						2	211	CL51.2		
4	Ger	eratio	n of P	WM.								2	21E 21E 21E	CL51.4		
5	Ger	eratio	n of F	SK usi	ng IC 5	55 Tin	ner					2	216	CL51.4 CL51.3		
6	Ger	eratio	n of P	SK	0							2	218	CL51.4 CL51.3		
	der			0111			DAD	T D				-	21E	CL51.4		
							PAR	І-В					210			
7	Fre	quenc	y Mod	lulatio	n and I	Demod	ulation	using	MATL	AB.		2	21E 21E	CL51.1		
8	Imp	olemer	itatio	n and a	nalysi	s of QP	SK mo	dulatio	n and o	demodul	ation.	2	21E 21F	CL51.3		
9	Ger	neratio	n and	detect	tion of	Pulse (Code M	odulat	ion usi	ng MATL	AB.	2	21E	21ECL51.4 21ECL51.2		

								21ECL51.4
	10	Realize Time I	Division Mult	iplexing an	d Demultiplex	ing of two band	2	21ECL51.4
	10	limited signals	5.		_	-	Z	
	11	Signal to Noise	e ratio calcula	ation using	MATLAB.		2	21ECL51.4
	12	Simulation of	OAM Generat	tion and De	tection Schem	.es.	2	21ECL51.4
			C.	F	PART-C			•
			Beve	ond Svllabu	s Virtual Lab (Content		
		(То	be done duri	ing Lab but	not to be inclu	ided for CIE or SEE)		
1.	Method t	o set and measu	ire the dept	1 of modula	tion and trap	ezoidal display.		
	https://w	eb.niit.edu/~gi	lhc/ECE489	/ece489-V.l	ntm	F - J		
2.	Study the	envelope of a w	videband sign	nal.				
	https://w	eb.niit.edu/~gi	lhc/ECE489	/ece489-VI.	htm			
3.	Explore T	wo path channe	el pass band	simulation.				
_	https://w	ww.etti.unibw.	de/labalive/	experiment	/two-path-ch	annel-baseband/		
4.	Examinat	ion of AM trans	mission - svn	chronous d	letector.	<u> </u>		
	https://w	ww.etti.unibw.	de/labalive/	experiment	/amtransmiss	ionsvnchronousdet	ector/	
5.	Encode a	nd decode mess	ages and obs	erve the im	pact of coding	g on error detection	and corre	ction.
	https://in	.mathworks.co	m/help/com	m/ug/erro	r-detection-an	d-correction.html		
6.	Computat	ion of BER for (OAM System	with AWGN	Using MATLA	AB.		
_	https://ii	n.mathworks.co	m/help/com	m/gs/use-	pulse-shaping	-on-16-gam-signal.h	ntml	
			, ,,	,,,,		· · ·		
CIE	Assessme	ent Pattern (50) Marks – La	b)				
		· · ·		,				
		-	Test (s)	Weekly A	Assessment			
	RBT	Levels	20	, j	30			
L1	Rem	ember	-		-			
L2	Und	erstand	_		5			
L3	App	v	10		10			
L4	Ana	vze	5		10			
L5	Fval	uate	5		5			
16	Cres	to	-		-			
CEE	Accoccm	ant Dattarn (El	Morke La	<u>ь</u>				
JEE	Assessiii	ent rattern (50	0 Mai KS - La	IJ				
			Evom	Iorke	7			
	RBT	Levels	EXdIII N Dictribut	rar (E0)				
11	Dom		Distribut	1011 (30)	_			
	Keme	ember	-		-			
	Unde	rstanu)	-			
	Apply	/	20		-			
	Analy	ze	1	<u>)</u>	4			
L5	Evalu	ate	10	J	4			
L6	Creat	e	-					
Sug	gested Lo	earning Resou	irces:					
-								

Reference Books:

- 1. Raveendranathan, K. C. Communication systems modelling and simulation: using MATLAB and Simulink. Universities Press, 2011. ISBN: 978-81-737-1722-2.
- 2. Hari, Bhat KN. Digital Communications With Lab Manual, 3/E. Pearson Education India, 2010. ISBN-10. 8131732371; ISBN-13. 978-8131732373.

CMOS VLSI DESIGN														
Course Code	211	ECE5	2						CIE	Marks		50		
L:T:P:S	3:0	:0:0							SEE	Marks		50		
Hrs / Week	3								Tota	al Marks		10	0	
Credits	03								Exai	n Hours		03		
Course outcom	nes:													
At the end of t	the co	ourse	e, the	studen	t will b	e able	to:							
21ECE52.1	Unc	derst	and tl	ne gen	eric mo	del an	d basic	conce	pts of I	MOSFET				
21ECE52.2	Ide	ntify	the p	rocess	sequer	nce for	the fat	oricatio	on of IC	s and the	e relevar	nt layout	design r	ules
21ECE52.3	Em	ploy	the d	elay m	odel to	the co	mbinat	tional N	40S cir	rcuits				
21ECE52.4	Diff	feren	tiate	the dif	ferent o	combin	ationa	l circui	t desig	ns that a	re curre	ntly in u	se	
21ECE52.5	Exa	mine	e the s	sequen	tial cire	cuits in	terms	of the	delay o	constrair	nts			
21ECE52.6 Evaluate the Combinational and Sequential Circuits in terms of timing Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:														
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes: PO PO2 PO4 PO5 PO6 PO2 PO4 PO4 PO5 PO6 PO7 PO6 PO4 PO4 <td< th=""></td<>														
	PO	PO2	2PO3	P04	P05	P06	P07	P08	P09	P010	P011	P012	PSO1	PSO2
	1												2	2
21ECE52.1	2	<u>2</u> <u>-</u> <u>-</u> <u>-</u> <u>-</u> <u>-</u> <u>3</u> <u>2</u> <u>3</u> <u>3</u> <u>-</u> <u>-</u> <u>-</u> <u>-</u> <u>-</u> <u>-</u> <u>3</u> <u>2</u>												
21ECE52.2 21FCF523	3	<u>3 3 2 3 2</u> <u>3 3 2 3 2</u>												
21ECE52.5	3	3	1	_		-						2	3	2
21ECE52.5	3	3	1	-	-	-	-	-	-	_	-	2	3	2
21ECE52.6	3	3	1	-	-	-	-	-	-	-	-	2	3	2
	-			1									-	
MODULE-1	MO	S TF	RANS	ISTOR	S						21ECE5	52.1	8 H	lours
MOS Transistor	rs: In	trodı	uction	, MOS	transis	tors, C	MOS Lo	ogic, De	esign p	ortionin	g.			
MOS Transisto	r The	eory:	Intro	oductio	n, Lon	g-Char	nel I-V	/ chara	acterist	tics, C-V	Charact	eristics	- Simple	MOS
Capacitance Mo	odels	, Non	-idea	l I-V ef	fects, D	C tran	sfer ch	aracter	istics.					
Case Study			Inv	estigat	e how t	o Fnha	ance th	e Powe	r Fffic	iency in	Mohile D	evices w	vith Adva	anced
case study			MO	S Tran	sistor T	echno	logv.	C I UWC		iency in			/1011/10/0	meeu
							8,-							
Text Book	_		Tex	t Book	-1: 1.3,	1.4, 1.	6, 2.1, 2	2.2, 2.3	(up to	2.3.1), 2	.4, 2.5			
MODULE-2	CM	<u>OS P</u>	ROC	ESSIN	<u>G TECI</u>	HNOL	JGY				21ECE	52.2	81	Hours
CMOS Processi	ng To	echn	ology	CMOS	Fabri	cation	and La	yout, I	Exercis	es for st	ick diag	ram and	layout,	Euler
path, Lambda d	lesigi	n ruie	e, CMC	JS Tec	nnologi	les, Lay	out De	esign R	ules, C	MUS Pro	cess Enr	anceme	nts.	
Applications	E	xplor	e the	Signifi	cance o	of CMO	S techr	nology	in vari	ous elect	ronic an	plication	15.	
Text Book	Te	ext B	ook 1	: 1.5. 3	.1. 3.2.	3.3.3.4	1	10108)			<u></u>	piioutioi		
MODULE-3	DE	LAY	& CO	MBIN	ATION		RCUIT	BASI	CS		21ECE9	52.3,	81	Hours
Dolari Introdu	ction	<u>.</u> Ти	ancia	nt Doo	nonce	ם אם		Indal	Effa	ctive De	ZIEUE	54.4	nd Diff	usion
Canacitance Fo	nuiva	lent	RC Ci	nt Kes renite	poilse, Tranci	nt Dent Re	snonse	Flmo	- Ene	uve Ke	it Denen	, uate à dence o	niu Dill f Canacit	ance
Linear Delav M	odel	- Log	ical E	ffort. P	arasiti	c Delay	. Delav	, in a L	ogic Ga	ite. Drive	ie Dehell		capacit	ance,
Combinational	Circu	iit Ba	sics:	Introd	action.	Circuit	; Famili	ies - Sta	atic CM	10S.				
					- 1									

Self-St	tudy	Optimization of combinational circuits to minimize delay.											
Text B	ook	Text Book 1:	4.1, 4.2, 4.3	6 (excluding 4.3.7), 4	4 (up to 4.	4.4), 9.	1, 9.2 (up to 9.2.1)						
MODU	JLE-4	COMBINAT DESIGN	IONAL & S	EQUENTIAL CIRCU	IT		21ECE52.4, 21ECE52.5	8 Hours					
Combi Circuit	national ts- Domin	Circuit Design to Logic, Silico	n: Circuit F n-On-Insula	amilies - Ratioed Ci ator Circuit Design.	rcuits, Cas	code V	oltage Switch Logic	, Dynamic					
Sequer	ntial Circ	uit Design: Int	roduction,	Sequencing Static Cir	cuits, Circ	uit Des	ign of Latches and F	lip-Flops -					
Conver	ntional C	MOS Latches,	Convention	al CMOS Flip-Flops, l	Pulsed Late	ches, Re	esettable Latches						
Self-St	tudy	Introduction	to System-	on-Chip (SoC) Desig	1.								
Text B	ook	Text Book 1: 9.2 (up to 9.2.4.1), 9.5, 10.1, 10.2, 10.3 (up to 10.3.4)											
MODU	JLE-5	TIMING ANALYSIS21ECE52.68 Hours											
Timing	g Analysi	sis: Delay in general, Slew Balancing & Transistor Equivalency, Design of 2-Inputs NAND & NOR											
Gates f	or Equal Rise and Fall Slew, MOS Capacitances, Design Techniques for Delay Reduction, Intrinsic Delay												
of Inve	erter and	its Sizing Effec	t on Propag	ation Delay, Inverte	Chain Des	ign, Tir	ning Terms - Analysi	s - Models					
- Goals	5, Static T	iming Analysi	s, Timing C	onstraints & Verifica	tion, Timi	ng Con	vergence, Timing dr	iven Logic					
	and Layout Synthesis.												
Case 3	tuuy	design.	the mporta		is and opti	IIIIZatit	on the context of C	19102 A F21					
Text B	ook	Text Book 2:	10.1 - 10.6	, 10.8 - 10.10, 10.12 -	10.15, 10.	19 - 10	.39						
CIE As	sessmer	it Pattern (50	Marks – T	'heory)			1						
				Marks Distribut	ion								
	RBT L	evels	Test (s)	Qualitative Assessment (s)	M	CQ's							
			25	15		10							
L1	Reme	mber	5	-		5							
L2	Unde	rstand	5	-		5	-						
L3	Apply	1	10	10		-	-						
L4	Analy	ze	5	5		-							
L5	Evalu	ate	-	-		-							
L6	Creat	e	-	-		-							
SEE As	ssessme	nt Pattern (50) Marks – 7	Theory)									
	RBT Le	evels	Exam Distribu	Marks ition (50)									
L1	Remen	nber	1	10									
L2	Under	stand	1	10									
L3	Apply			20									
L4	Analyz	e	1	10									
L5	Evalua	te											
	Create												
Sugge	Suggested Learning Resources:												
Text E	Books:	D · A O·											

1) "CMOS VLSI Design – A Circuits and Systems Perspective", Neil H. E. Weste, David Money Harris, 4th Edition, Pearson Education, 2015.

2) VLSI Design, Debaprasad Das, 2nd edition, 2016, Oxford University Press.

Reference Books:

1) CMOS Digital Integrated Circuits, Analysis and Design, Sung-Mo Kang & Yusuf Leblebici, 3rd Edition, 2007, TMH.

2) Digital Integrated Circuits – A design Perspective, Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, 2nd Edition, 2009, Prentice-Hall.

3) Basic VLSI Design, Douglas A. Pucknell and Kamran Eshraghian, 3rd Edition, 2011, PHI.

4) Static Timing Analysis for Nanometer Designs - A Practical Approach, J. Bhasker, Rakesh Chadha, Springer, 2009.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc21 ee09/preview
- https://nptel.ac.in/courses/117101105
- <u>https://resources.pcb.cadence.com/blog/2020-cmos-vlsi-design-and-circuit-simulation-tasks</u>
- <u>http://pages.hmc.edu/harris/cmosvlsi/4e/index.html</u>
- https://www.tutorialspoint.com/vlsi design/index.htm

- Visit to any VLSI Industry.
- Demonstration of Layout/STA/Fabrication Process.
- Demonstration of working of Silicon Fab.
- Demonstration of purification Silicon from MGS to EGS.
- Video demonstration of latest trends in Semiconductor and VLSI Industry.
- Contents related activities (Activity-based discussions)
 - > For active participation of students, instruct the students to prepare Flowcharts and Handouts.
 - > Organizing Group wise discussions on issues.
 - Seminars.

	CMOS VLSI DESIGN Lab													
Course Code		21ECI	L 52						CIE	Marks		50		
L:T:P:S	(0:0:1:	0						SEE	Marks		50		
Hrs / Week		2							Tota	l Marks		10	0	
Credits	(01							Exar	n Hours		03		
At the end o	omes f the	: course	, the s	studen	t will b	e able	to:							
21ECL52.1]	Demor	istrat	e the w	vorking	g of ana	alog an	d digita	al CMO	S circuits	throug	h simula	tion	
21ECL52.2	1	Use th	e sche	ematics	s of CM	OS ciro	cuits to	constr	uct and	d verify t	heir layo	outs		
21ECL52.3	1	Apply	Switc	h level	descri	ption t	o digit	al CMO	S circu	iits Mode	eling			
21ECL52.4]	Emplo	y the	Gate le	vel des	scriptio	on of di	igital Cl	MOS ci	rcuits for	· simulat	tion and	synthesi	is
Mapping of	Cour	se Ou	tcom	es to l	Progra	am Ou	tcome	s and	Progra	am Spec	ific Out	tcomes:		
	P01 P02 P03 P04 P05 P06 P07 P08 P09 P010 P011											P012	PSO1	PSO2
21ECL52.1	3	3	2	1	3	-	-	-	2	-	-	3	3	2
21ECL52.2	3	-	-	-	3	-	-	-	2	-	-	3	3	2
21ECL52.3	3	-	-	-	3	-	-	-	2	-	-	3	3	2
21ECL52.4	3	3 3 2 1 3 2											3	2
Exp. No. / Pgm. No.	List of Experiments / Programs											Hour	s	COs
Prerequisite Experiments / Programs / Demo														
	Intr to V	oducti Verilog	on to and S	CMOS System	VLSI E Desigi	esign : n using	and ana Verilo	alog VL g.	SI Des	ign. Intro	duction	2		NA
							PAR'	Т-А				1	1	
1	Dra veri	w the ify usir	schen 1g Tra	natic of ansient	f CMOS and D	Inver C Anal	ter for yses.	the give	en speo	cification	s, and	2	21E 21E	CL52.1 CL52.2
2	Dra and gate	w the verify e, ii) 2-	schen using input	natic of g Trans : CMOS	f the fo sient ai NOR g	llowin nd DC A ate.	g circu Analyse	its for t es: i) 2-	he give input (en specif CMOS NA	ications, ND	2	21E 21E	CL52.1 CL52.2
3	Dra and	w the verify	schen using	natic of g Trans	f transi sient ai	mission nd DC /	n gate f Analyse	for the ges.	given s	pecificat	ions,	2	21E 21E	CL52.1 CL52.2
4	Dra spe i) Ce	w the cificati ommo	schen lons, a n Sou	natic of and ver rce am	f the fo rify the plifier,	llowin same , ii) Coi	g ampl using T mmon 1	ifiers fo Transie Drain a	or the g nt, DC a mplifie	given and AC A er.	nalyses:	2	21E 21E	CL52.1 CL52.2
5	Dra usir veri	w the ng DRC ify the	layou 2, ERC Desig	t of the and L ^v m.	e CMOS VS. Ext	Invert ract R(ter and C and b	perfor ack-an	m phy: notate	sical veri the same	fication e and	2	21E 21E	CL52.1 CL52.2
6	Dra veri sam CM	w the ification of and OS NO	layou on usi verify R gate	t of the ng DRC 7 the D e.	e follow C, ERC a esign: i	ving cin and LV i) 2-inp	rcuits a S. Extra out CM	and peri act RC a OS NAN	form p and bac ID gate	hysical ck-annot e ii) 2-inp	ate the out	2	21E 21E	CL52.1 CL52.2
7	For	the fe	llovit	na cinc	uite	nito the	PAR'	I-B	Iorilaa	Codo or	ducate	1	215	
	usir gate	ng Test	Bend	ch: i) Cl	MOS in	verter	, ii) 2-ii	nput CN	AOS NA	AND and	NOR	2	21E 21E	CL52.1 CL52.3

8	For the following circuits, write the switch level Verilog Code and verify using Test Bench: i) 2-input EXOR gate using CMOS logic, ii) 2-input EXOR gate using PTL.	2	21ECL52.1 21ECL52.3
9	Synthesize the following circuits using the gate level Verilog Code, with the given Constraints: i) CMOS inverter, ii) 2-input CMOS NAND and NOR gates.	2	21ECL52.1 21ECL52.4
10	For the following circuits, write the Verilog Code, verify using Test Bench, and then synthesize with the given Constraints: i) 4-bit Parallel adder ii) D Flip-flop.	2	21ECL52.1 21ECL52.4
11	For the following circuits, write the Verilog Code, verify using Test Bench, and then synthesize with the given Constraints: i) T Flip-flop, ii) 4-bit Synchronous counter.	2	21ECL52.1 21ECL52.4
12	Write the Verilog Code for Sequence detector using Mealy and Moore, verify using Test Bench, and then synthesize with the given Constraints.	2	21ECL52.1 21ECL52.4

PART-C

Beyond Syllabus Virtual Lab Content

(To be done during Lab but not to be included for CIE or SEE)

- 1. MOSFET To plot the (i) output characteristics & (ii) transfer characteristics of an nchannel and p-channel MOSFET http://vlsi-iitg.vlabs.ac.in/MOSFET theory.html
- 2. Ring Oscillator To design and plot the output characteristics of a 3-inverter ring oscillator.
 - http://vlsi-iitg.vlabs.ac.in/RingOscillator theory.html
- 3. 4X1 multiplexer To design and plot the characteristics of 4x1 digital multiplexer using pass transistor logic.
 - http://vlsi-iitg.vlabs.ac.in/Multiplexer theory.html
- 4. Latches To design and plot the characteristics of a positive and negative latch based on multiplexers.

http://vlsi-iitg.vlabs.ac.in/Latches theory.html

CIE Assessment Pattern (50 Marks - Lab)

	DDT Lovale	Test (s)	Weekly Assessment
	KD1 Levels	20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks - Lab)								
	DBT Lovols	Exam Marks						
	KDI Levels	Distribution (50)						
L1	Remember	-						
L2	Understand	05						
L3	Apply	20						
L4	Analyze	15						
L5	Evaluate	10						
L6	Create	-						

Suggested Learning Resources:

Reference Books:

1) "CMOS VLSI Design – A Circuits and Systems Perspective", Neil H. E. Weste, David Money Harris, 4th Edition, Pearson Education, 2015

2) VLSI Design, Deba prasad Das, 2nd edition, 2016, Oxford University Press.

3) Digital System design Using Verilog, Charles H. Roth Jr., Lizy Kurian John, Byeong Kil Lee, 1st Edition, 2015, CL Engineering.

4) Digital Design: An Embedded Systems approach Using VERILOG, Peter J. Ashenden, 2014, Elesvier.

LINEAR ICS AND APPLICATIONS														
Course Code		21ECE	53						CIE N	Marks		50		
L:T:P:S		3:0:0:0)						SEE	Marks		50		
Hrs / Week		3							Tota	l Marks		10	0	
Credits	(03							Exan	n Hours		03		
Course outco	omes													
At the end o	f the	course	, the s	student	t will b	e able 1	to:							
21ECE53.1	1	Apply	the ba	asic cor	ncepts	of the o	circuits	for the	e desig	n of vari	ous conf	iguratio	n of OPA	MP
21ECE53.2	(Compa	re th	e DC ar	id AC c	haract	eristics	s of ope	eration	al amplif	fiers			
21ECE53.3]	Build li	inear	and no	n-linea	ar anal	og circ	uits usi	ng ope	rational	amplifie	ers		
21ECE53.4		Analyz	e swi	tching	circuit	s, signa	al proce	essing	and sig	nal conv	erting ci	rcuits us	sing	
21ECE53.5]	Examii	ne filt	er circi	uits usi	ng ope	ration	al amp	ifiers					
21ECE53.6 Analyze the behavior of timer IC and other linear IC's														
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:														
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PSO1	PSO2
21ECE53.1	3	-	-	-	-	-	-	-	-	-	-	2	3	2
21ECE53.2	3.2 3 3 2 3 2													
21ECE53.3	3													
21ECE53.4	3	3	2	-	2	-	-	-	-	-	-	2	3	2
21ECE53.5	3	3	2	-	2	-	-	-	-	-	-	2	3	2
21ECE53.6	3	3	2	-	2	-	-	-	-	-	-	2	3	2
MODULE		ODED							41.0		245055	0.4		
MODULE-1		OPERA	AIIU	NAL A	MPLI	TER F	UNDA	MENI	ALS		21ECE5 21ECE5	3.1, 3.2	8 1	lours
Basic Op-Am	p circ	uit, Op	o-Amj	p parai	neters	– Inpı	it and	output	voltag	ge, CMRF	R and PS	RR, offs	et voltag	ges and
currents, Inpu	ut and	l outpi	ıt imp	oedanc	es, Slev	v rate,	Freque	ency lir	nitatio	ns.				
Op-Amps as	DC .	Amplif	fiers-	Direct	coup	led –	Voltag	e Foll	owers,	Non-in	verting	Amplifie	ers, Inve	rting
amplifiers, Su	ımmiı	ng amp	olifier	s, Diffe	rence a	amplifi	er.							
Case Study			Exp	lore ho	ow to	Create	a func	tion ge	enerato	or using	Op-Amp	os to ger	nerate di	fferent
			way	veform	s, such	as sine	e, squai	re, tria	ngle, ar	nd sawto	oth wav	es.		
Text Book			Tex	t Book	1: 1.1,	2.3 - 2.	.6,3.2 -	3.7, 4.2	l, 4.3, 4	.5				
MODULE-2	(OP-AN	AP AS	SACA	MPLIF	IERS					21ECE	53.2	8 I	lours
Capacitor cou	upled	Volta	ge Fo	ollower	, Capa	citor c	oupled	Non-i	nvertir	ng Ampl	ifiers, aı	nd Capa	citor cou	ıpled
Inverting amp	plifier	'S.												
High input in	npeda	nce -	Capa	citor co	oupled	Voltag	ge Follo	ower, s	etting	the upp	er cut-of	ff freque	ncy, Use	e of a
single polarit	y pow	ver sup	ply											
Self-Study		Investi circuit	gate s.	how to	calcul	late vo	ltage g	ain an	d analy	ze freq	uency re	sponse	in AC an	nplifier
Text Book	,	Гext В	ook 1	1:4.2.4	.6.4.8	. 5.1. 5	.2. 5.4	5.6.5	9 (2 nd	Edition)			
MODULE-3	(OP-AN	/IP Al	PPLICA	ATION	S					21ECE5	3.3,	81	lours
Voltage sources current sources Integrator and differentiator Log and antilog amplifiers Analog														
Multinlieran	d Div	ider I	nstru	menta	tion ar	nnlifie	r. Prec	ision r	ectifie	rs. Limit	ing Circi	uits. San	inclos, Al	hold
circuits, Zero	cros	sing d	etect	ors, In	verting	z Schm	itt trig	ger ci	cuits.	_,	-0 5.1 0	, oun	runu	

Applic	ations	cions Develop a bio-signal amplifier circuit using an instrumentation amplifier for biomedical applications.									
Text B	ook	Text Book 1: 7.1, 7.2, 8.6 (Basic Differentiating circuit),8.7 (Basic Integrating circuit, 3.6, 7.6, 3.8, 9.1,9.2, 9.3, 9.6, 8.2(Zero Crossing Detector), 8.3 Text Book 2: 4.9 (Analog Multiplier)									
MODU	JLE-4	FILTERS A	AND IC RE	GULATORS	<u>,</u>			21ECE53.5, 21ECE53.6	8 Hours		
RC low-pass and high pass circuit, Active Filters – First and second order Low pass & High pass filters, Band pass and Band Elimination filters, Voltage regulators using IC 78XX and 79XX, 723 general purpose regulators, Switching regulator.									ass filters, ll purpose		
ApplicationsExplore real-world applications of filters, including audio processing, commun signal conditioning.						rocessing, communi	cations, and				
Text B	ext Book Text Book 1: 12.1,12.2,12.3,12.5,12.6 Text Book 2: 6.3,6.4,6.5										
MODU	JLE-5	OTHER IC	APPLICA	FIONS				21ECE53.6	8 Hours		
555 Ti	imer and i	ts different	circuit ann	lications as A	stable & M	onosta	ble m	ultivibrator. PHASE	E LOCKED		
LOOP	-operating	principles.	Phase det	ector / comp	arator. LM	566 VC	0. DA	C and ADC convert	ers - DAC		
using	R2R ADC	using SAR a	nd counter	tvne			0,21		2110		
Annlic	ations	Use PLL IC	s to build a	frequency syr	thesizer for	genera	ating	stable and precise fr	equencies in		
mpphe	ations	DE applications									
Tout D	oolr	Kr applications. Toxt Pool 2, 01, 02, 02, 04, 01, 02, 02, 04, 102, 1022, 1024									
Text B	ext Book 1ext Book 2: 8.1, 8.2, 8.3, 8.4,9.1, 9.2, 9.3, 9.4,10.2, 10.3.2, 10.3.4										
CIE As	CIE Assessment Pattern (50 Marks – Theory)										
	Marks Distribution										
	RBT Lev	vels	Test (s)	Qualita	ative	мсо)'s				
	NDT LC	015	1050 (5)	Assessment (s)			25				
			25	15		1()				
L1	Remem	ıber	5	-		5					
L2	Unders	tand	5	-		5					
L3	Apply		10	10)	-					
L4	Analyz	9	5	5		-					
L5	Evaluat	e e	-	-		-					
16	Create		_								
	- Ci cate			-							
SEE AS	ssessment	Pattern (5	<u> Marks – </u>	neory)							
	RBT Lev	els	Exam Distribi	Marks							
L1	Rememl	per		10							
L2	Underst	and		10							
12	Annly	Apply 20									
	LS Apply 20										
	IS Evaluate										
	Evaluate	;		-							
				-							
Sugge	sted Lear	ning Resou	irces:								
Text	Books:	11.0	1					c 1			
1) Ope	erational A	mplifiers a	nd Linear I	C's, David A. l	Bell, 3rd edit	tion, 20	11,0	xtord University Pr	ess.		
·	-	1 0 .	n n - '	11			-				

International.

3) Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 4th edition, 2015, Pearson. **Reference Books:**

1) Op amps - Design, Applications and Troubleshooting, Terrell, 3rd edition, 2006, Elsevier.

2) Operational Amplifiers, George Clayton and Steve Winder, 5th edition, 2008, Elsevier.

3) Operational Amplifiers and Linear Integrated Circuits, Robert. F. Coughlin & Fred F. Driscoll, 2006, PHI/Pearson.

4) Design with Operational Amplifiers and Analog Integrated Circuits, Sergio Franco, 3rd edition, 2005, TMH. **Web links and Video Lectures (e-Resources):**

- <u>https://onlinecourses.nptel.ac.in/noc21_ee31/preview</u>
- <u>https://youtu.be/UWPxa6N7VvA</u>
- <u>https://www.khanacademy.org/science/electrical-engineering/ee-amplifiers/ee-opamp/v/ee-opamp-intro</u>
- <u>https://www.youtube.com/playlist?list=PL285BE2DDBCB6839F</u>
- https://archive.nptel.ac.in/courses/108/106/108106184/

- Video demonstration of latest trends in Linear ICs and its applications.
- Contents related activities (Activity-based discussions)
 - > For active participation of students, instruct the students to prepare Flowcharts and Handouts.
 - > Organizing Group wise discussions on issues .
 - ➢ Seminars.

INTERNET OF THINGS														
Course Code	21F	ECE5	41						CIE I	Marks		50		
L:T:P:S	3:0	:0:0							SEE	Marks		50		
Hrs / Week	3								Tota	l Marks		10	0	
Credits	03								Exar	n Hours	;	03		
Course outcon	nes:		<u>م</u> ام	the states		o oblo	t a.							
		ourse .1	, the s				$\frac{10}{C}$							
21ECE541.1	Des	cribe	. 101 a	archite	ctures	and its		enges		. 1		. 1		
21ECE541.2	Cha	characterize the smart objects and communication protocols for IoT network												
21ECE541.3	Inte	erpre	t desi	gn prii	nciples	and cl	oud co	mputir	ng for Io	oT netwo	ork			
21ECE541.4	App	oly so	ftwar	e desi	gn cono	cepts a	nd pro	gram N	AQTT c	lients an	d servei	-		
21ECE541.5	Idei	ntify	the se	ecurity	attack	s and s	solution	ns in Io	T netw	vork				
21ECE541.6	Inve	estiga	ate th	e IoT a	pplicat	tions fo	or resol	lving re	eal-wor	rld probl	ems and	l life-lon	g learnin	g
Mapping of Co	ourse	e Out	tcom	es to l	Progra	ım Ou	tcome	s and	Progra	am Spe	cific Ou	tcomes:		
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PSO1	PSO2
21ECE541.1	2	-	-	-	-	-	-	-	-	-	-	2	3	2
21ECE541.2	3	-	-	-	-	-	-	-	-	-	-	2	3	2
21ECE541.3	3	3 2 3 2									2			
21ECE541.4	3	3	2	1	-	-	-	-	-	-	-	2	3	2
21ECE541.5	3	3	2	-	-	-	-	-	-	-	-	2	3	2
21ECE541.6	<u>21ECE541.6 3 3 2 1 2 2 1 - 2 - 2 3 2</u>													
MODULE-1 IOT OVERVIEW AND ARCHITECTURE 21FCF541.1 8 Hours														
Overview of Ir	itern	et of	Thin	gs: Ge	nesis o	f IoT -I	oT and	_ Digiti:	zation.	IoT Imp	act. IoT (Challeng	es.	
IoT Network	Arch	itect	ure:	Driver	s Behi	nd Ne	w Netv	work A	Archited	ctures, C	Comparii	ng IoT A	rchitect	ures, A
Simplified IoT	Archi	tectu	re, Tł	ne Core	e IoT Fi	unctior	nal Stac	k, IoT	Data M	anagem	ent and (Compute	Stack.	
Calf Charles		1	ul:			I - TT :	4l	J						
Self-Study	Exp	lore	the si	gnifica	nce of	lolin	the mo	dern w	vorld.					
Text Book	Tex	t Boc	ok 1: 1	1,2										
MODULE-2	SM	ART	OBJE	ECTS A	ND CO	OMMU	NICAT	TION			21FCF5	41 2	81	Hours
	PR	OTO	COLS	IN IO	T					_	ZILCLU			10415
Smart Objects	s- The	e "Th	ings"	in IoT,	Senso	rs, Acti	uators,	and Sr	nart Ob	ojects, Se	nsor Ne	tworks.		
Design Princi	ples	for V	veb			- Web	COMM	unicat	ion pro	Dtocols 1	or conn	ected de	evices, N	lessage
communication	i prot	00015	s (COP	AP-SM3	5, COAP	'-мQ, №	/IQT1, /	(MPP)	101 101	/MZM 0	evice.			
Self-Study	Exn	lore	vario	us IoT	device	s sens	ors an	d actua	ators us	sed to co	llect and	transmi	t data	
Text Book	Тех	t Boc	$\frac{vario}{k}$	2 Text	Book 2	$2 \cdot 323$	3	u actue	11015 43		neet and	i ti ansim	t uata.	
MODULE-3	IOI	DES	SIGN	AND (COMPL	JTING					21ECE 5	41.3	81	Hours
Design Princ	iples	for	ΙοΤ	- Intro	oductio	on, Int	ernet	connec	tivity,	Internet	t- based	commu	inication	, IPv4,
IPv6,6LoWPAN	f prot	ocol,	IP Ad	ldressi	ng in tl	he IoT.			57					, ,
Data Collection, Storage and Computing using a Cloud Platform- Introduction, Cloud computing														
paradigm for data collection, storage and computing, Cloud service models, IoT Cloud- based data collection,														
storage and cor	nputi	ng se	ervice	s using	g Nimb	its.								
Caco Study	C+	d.,	rolos	a	nuniaa	tion to	chrole	gios s	ich as I		notooth	Tighas	LoDoW	N and
case study	Cell	ular VI	leg /	s comi 4G LTF	E = 5G f	or IoT	connec	gies st tivity	ich as v	vvi-ri, Bl	uelooth	, zigbee,	LUKAWA	un, and

Text B	ook	Text Book	2: 4.1,4.2,4	.3.1, 4.3.2, 4.4, 6.1	,6.2,6.3,6.4.2						
MOD	ULE-	4 PROTOTY	PE AND S	OFTWARE FOR	ΙΟΤ	21ECE5 4	1.4	8 Hours			
Destad		- APPLICAT	IONS				·				
Protot	ro D	g and Designing Emi	ig Softwai	re for lot Appli vice Arduine Plat	form using IDF	uction, Prototyp Poading data from	ing Embe	aded device			
Device	ire, ri Is Ga	toways Internet	and Web	Cloud services so	oftware develop	ment Programn	ning MOTT	Clients and			
MOTT	servi	r		ciouu sei viees se		incht, i i ogranni	ing mg i	cheffes and			
Applic	catio	n Analyze the	e impact of	f loT in the autor	notive industry,	including conne	ected car t	echnologies,			
		autonomou	s vehicles,	and predictive m	aintenance.						
Text B	ook	Text Book 2	2: 9.1, 9.2.1	.,9.2.2,9.3							
MODU	JLE-9	5 SECURITY	AND SMA	ART APPLICATIO	ON	21ECE54 21ECE54	-1.5 -1.6	8 Hours			
Introd	lucti	on to IoT priva	icy and se	ecurity - Vulnera	bilities, security	requirements a	nd threat a	analysis, IoT			
Securit	ty To	mography and la	yered atta	cker model, Ident	ity management	, and establishm	ent, access	control and			
secure	mes	sage communica	tion.								
Conne	ected	Cities and Sn	nart Tran	sportation- IoT	applications for	r smart homes.	cities. env	ironment-			
monito	oring	and agriculture		- F		,	,				
Case S	tudy	Investigate	how IoT is	used in agricultu	re for soil monit	oring, crop mana	agement, a	nd precision			
		agriculture	agriculture.								
Text B	ext Book Text Book 2: 10.1, 10.2, 10.4, 12.3.1, 12.5										
CIE As	CIE Assessment Pattern (50 Marks – Theory)										
				M	arke Distributio	n					
		RBT Levels		Test (s)	Qualitative A	ssessment (s)					
				25							
11		Domomhor		25 E	25						
		Understand		5 F		- F					
13		Annly		10	1	<u> </u>					
		Analyze		5	1	0					
L5		Fvaluate		-	د	-					
L6		Create		-		-					
SEE As	sess	ment Pattern (50 Marks -	- Theory)							
			Exa	m Marks							
	RB	T Levels	Distri	bution (50)							
L1	Re	member		10							
L2	Un	derstand		10							
L3	Ap	ply		20							
L4	An	alyze		10							
L5	Eva	aluate		-							
L6	Cre	eate		-							
Sugge	sted	Learning Reso	urces:								
Text E	300k	s:	, . .				<i></i>	1 . 1			
1) Dav	na H	anes, Gonzalo S	aigueiro, F	atrick Grossetet	e, Robert Barto	n, Jerome Henr	y, lol Fur	aamentals:			
2017	Networking Technologies, Protocols, and Use Cases for the Internet of Things , First Edition, Cisco Press,										
2017.											

2) Raj Kamal, "Internet of Things: Architecture and Design Principles", First Edition, McGraw Hill Education, 2017.

Reference Books:

1) Adrian Mcewen, HakinCassimally, "Designing the Internet of Things", First Edition, Wiley, 2014.

2) Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Aves and, Stamatis Karnouskos, David Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press, 2014.

3) Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner, Enabling things to talk Designing IoT solutions with the IoT Architecture Reference Model, 2013, Springer Open, USA.

Web links and Video Lectures (e-Resources):

- <u>https://onlinecourses.nptel.ac.in/noc23_cs83/preview</u>
- <u>https://www.youtube.com/watch?v=irq6608NdvA</u>
- <u>https://www.youtube.com/watch?v=36zducUX16w</u>

- Video demonstration of latest trends and applications of IoT.
- Contents related activities (Activity-based discussions)
 - > Seminars on architecture designs for IoT applications and programming sensors.

ELECTROMAGNETIC FIELD THEORY														
Course Code	1	21ECE	E 542						CIE	Marks		50		
L:T:P:S		3:0:0:	0						SEE	Marks		50		
Hrs / Week	3	3							Tota	al Marks	6	10	0	
Credits	(03							Exa	m Hours	5	03		
Course outco	omes	:												
At the end o	f the o	course	e, the s	tudent	will be	able to):							
21ECE542.1	I	Utilize	e laws a	and the	orems	to solv	e elect	rostati	c field v	/ariables	5			
21ECE542.2	I C	Apply the static characteristics of electric and magnetic fields to various charge and current distribution												
21ECE542.3	21ECE542.3 Analyze the boundary characteristics of electric fields on various medium													
21ECE542.4	Ι	llustr	ate the	conce	pt of ca	pacitai	nce and	d induc	tance u	ising ele	ctric and	l magnet	tic fields	
21ECE542.5	(Catego	orize tł	ne Maxv	well's E	Equatio	ns for	static a	nd tim	e varyin	g electro	magnet	ic fields	
21ECE542.6	I	Analyz	ze the o	charact	eristics	s of ele	ctroma	ignetic	waves	over var	ious me	dium		
Mapping of	Cour	se Ou	tcom	es to P	rogra	m Out	comes	and P	rogra	m Speci	fic Out	comes:		
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PSO1	PSO2
21ECE542.1	3	-	-	-	-	-	-	-	-	-	-	-	3	2
21ECE542.2	3	-	-	-	-	-	-	-	-	-	-	-	3	2
21ECE542.3	3	3	2	1	-	-	-	-	-	-	-	-	3	2
21ECE542.4	3	3	2	-	-	2	2	-	-	-	-	3	3	2
21ECE542.5	3	3	2	-	-	2	2	-	-	-	-	3	3	2
21ECE542.6	3	3 2 1 - 2 2 3 3 2												
MODULE-1		COUL INTEN LAW	OMB'S	S LAW, , FLUX DIVERC	ELEC DENS ENCE	TRIC F	TELD AUSS'S			21ECE 21ECE	542.1 542.2		8	Hours
to infinite line	sis, Va e chai s) and	rious rge, E d dive	Coord lectric rgence	flux de theore	ystems ensity a em.	nd Gau	riment uss law	al law o , Conc	ept of 1	omb, Ele Diverger	ice, Max	well 's F	ity, Field	d due ation
Case Study		Expre ordina	ssion f	for gra stems.	dient, d	diverge	ence ai	nd curl	in rec	tangulaı	r, cylind	rical and	d spheri	cal co-
Text Book]	Гext-1	: Chap	ter 1, 2	.1, 2.2,	2.3, 2.4	4, 3.1, 3	3.2, 3.5,	3.6, 3.	7				
MODULE-2	I	РОТЕ	NTIAI	LAND	CURRI	ENT				21E 21E	CE542.3 CE542.4	ļ	8	Hours
Definition of	poter	ntial a	nd pot	ential o	differe	nce, po	tential	gradie	ent, Cui	rent and	d curren	nt densit	y, Conce	ept of
Continuity eq	uatio	n, Con	iducto	r prope	rties a	nd bou	ndary	conditi	ons.					
Poisson's and	a Lap	place's	s Equa	tions	Detere	. (a an a	ITanla	aa (a E c		a Even	مامع مليا		an afta	mlana
Concept of ca	pacita	ance, i	Deriva	uon or sitor Co	POISSO		i Lapia	ce s Et	quation	s, Exam	pies of ti	ie soluti	on of La	place
S equation: F		Parall	e capat		J-axial	vith true	niu spi	atrica	uith di	oloctric	intorfo	no no no l	al ta th	
Case study	case study Parallel plate capacitor with two dielectrics with dielectric interface parallel to the													
Text Book Text-1: 4.3 4.6 5.1 5.2 5.4 6.3 7.1 7.3														
MODULE-3 STEADY MAGNETIC FIELD 21ECE542.1 21ECE542.2 8 Hours														
Biot-Savart Law and its application: Magnetic Field due to straight current carrying conductor, Ampere 's circuital law and its application: Magnetic Field due to co-axial cable, Concept of Curl, Stokes' theorem, Scalar and Vector Magnetic Potentials.Biot-Savart Law Magnetic Materials and Inductance : Magnetic circuits, Inductance and mutual inductance														

Case Study	y Nature of magnetic	: materials, magne	etization and	d permeability.							
Text Book	Text-1: 8.1, 8.2 , 8.3,	ext-1: 8.1, 8.2 , 8.3, 8.4 , 8.6 , 9.8 , 9.10									
MODULE	-4 TIME-VARYING FI	ELDS AND		21ECE542.5	8 Hours						
MODULE	MAXWELL'S EQUA	TIONS			0 11001 3						
Faraday's	law, displacement current	, Maxwell 's equat	tions in poir	nt form and integral f	orm.						
Applicatio	ons Retarded Potential	S.									
Text Book	Text-1: 10.1, 10.2, 1	0.3, 10.4									
MODULE	-5 UNIFORM PLANE	WAVE		21ECE542.6	8 Hours						
Wave pro	pagation in free space, die	lectrics and good	conductors	. Poynting's theorem	and wave power,						
Skin Effec	ct, Reflection of uniform pla	ne waves at norm	nal incidence	e and Standing wave	ratio.						
Applicatio	ons VSWR Measureme	nt for various EM	structures.								
Text Book	Text-1: 12.1, 12.2, 1	2.3, 12.4, 13.1, 13.2	2								
CIE Asses	sment Pattern (50 Marks ·	- Theory)			_						
		M	arks Distrib	oution							
			Qualitati	va Accaccmant (c)							
	RBI Levels	Test (s)	Quantati	(NPTEL)							
		25		25							
L1	Remember	5									
L2	Understand	5		5							
L3	Apply	10		10							
L4	Analyze	5 10									
L5	Evaluate	-									
L6	Create	-		-							
SEE Asses	ssment Pattern (50 Marks	– Theory)									
	RRT Lovols	Exam Marks Di	istribution								
	KDT LEVEIS	(50)									
L1	Remember	10		_							
L2	Understand	10		_							
L3	Apply	20		_							
L4	Analyze	10		_							
L5	Evaluate			_							
LO											
Suggeste	d Learning Resources:										
1) W H H	avt and IA Buck "Engineer	ing Flectromagne	tics" 7th Fd	lition Tata McGraw H	111 2009 ISBN-978-						
0-07-061	223-5	ing freed offiagite			1111, 2009, 13DIX 970						
Referen	ce Books:										
1) John K	rauss and Daniel, A Fleisch	"Electromagnetic	cs with appl	ications", McGraw- H	(ill,2017						
2.) N. Narayana Rao, "Fundamentals of Electromagnetics for Engineering", Pearson, 2008.											
Web links and Video Lectures (e-Resources):											
https://onlinecourses.nptel.ac.in/noc21_ee83/preview#:~:text=The%20course%20cover											
<u>S</u> C	%20static%20and,nume	rical%20method	<u>ls%20are%</u>	620also%20discuss	sed.						
• <u>h</u>	<u>ttps://byjus.com/jee/ele</u>	ctromagnetic-sp	ectrum-an	d-electromagnetic-	<u>waves/</u>						
•			_								
• <u>h</u>	<u>ttps://www.youtube.com</u>	<u>1/watch?v=508Z</u>	<u>smsllno</u>								
• <u>h</u>	ttps://www.youtube.com	1/watch?v=508Z	<u>smsllno</u>								
• <u>h</u> Activity-l	ttps://www.youtube.com Based Learning (Suggeste	n/watch?v=508Z	ismsllno lass)/ Prac	tical Based learning	;						

- Demonstration of working of EM wavesVideo classes for the EM wave propagations

DSP ALGORITHMS AND ARCHITECTURE														
Course Code	21EC	E543	3					C	IE Mar	ks		50		
L:T:P:S	3:0:0	:0						S	EE Mai	rks		50		
Hrs / Week	3							Т	'otal M	arks		100		
Credits	03							Ε	Exam Hours 03					
Course outcon	nes:													
At the end of	the cou	rse, t	he stud	dent wi	ll be al	ole to:								
21ECE543.1	Unde DSP F	rstan Proce	d the f ssor	undam	ental c	oncept	s of fix	ed- an	d floati	ng-poi	nt archit	ecture o	fdiffere	ent
21ECE543.2	Analy	ze th	e arch	itecture	e of dig	ital sig	nal pro	ocessoi	:s					
21ECE543.3	Deve	lop th	ie prog	rammi	ng kno	wledge	e using	the in	structio	on set o	of DSP pr	ocessor		
21ECE543.4	Analy	ze th	ie signa	, al proce	essing	algorith	ıms in	DSP			1			
21ECE543.5	Apply	the	signal	archite	cture i	n embe	dded a	applica	tions					
21ECE543.6	Utiliz	e the catio	advan ns	tages o	f mode	ern digi	tal sigi	nal pro	cessor	s for re	al world	signal p	rocessi	ng
Mapping of Co	ourse	Outc	omes	to Pro	gram	Outco	mes a	nd Pro	ogram	Specif	fic Outc	omes:		
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PSO1	PSO2
21ECE543.1	2	-	-	-	-	-	-	-	-	-	-	3	3	3
21ECE543.2	3	3	2	-	-	-	-	-	-	-	-	3	3	3
21ECE543.3	3	3	-	-	2	-	-	-	2	-	-	3	3	3
21ECE543.4	3	3	2	-	2	-	-	-	-	-	-	3	3	3
21ECE543.5	3	3	-	-	2	-	-	-	2	-	-	3	3	3
21ECE543.6	3	3	2		2	-	-	-	2	-	-	3	3	3
	_		1			I						-		-
MODULE-1	INTR	RODU	JCTIO	N OF D	SP PR	OCESS	OR			21 21	LECE543 1ECE54	3.1, 3.2	8 H	ours
DSPs are differ	ent fro	m oth	ner Mic	roproc	essors	, Circul	ar Buf	fering,	Archite	ecture	of the Di	gital sigi	nal Pro	cessor,
Fixed versus F	loating	poin	nt, C ve	ersus A	ssemb	ly, Req	uireme	ents of	DSP P	rocess	or, Evol	ution of	Digital	signal
processor in m	arket.													
Self-study	Impo	rtanc	e of D	SP in S	martpl	hone.								
Text Book	Text	Book	1:28.1	L-28.7										
MODULE-2	PRO	GRA	MMAB	LE DS	P PRO	CESSO	R			2	1ECE54 1ECE5 4	-3.2, 13 3	8 H	lours
Architecture F	inite w	ord l	ength	Data A	ddress	sing Mo	ndes of	TMS3	2054X	X Inst	ruction s	set and F	Program	nming
Pipeline Operat	tion of	DSP F	Process	sor. Int	roduct	ion to T	rms32	0C671	3 DSP I	Process	sor and (C6713 D	SK.	
Self-study	Explo	ore di	fferent	DSP a	chitec	tures s	uch as	fixed-r	oint v	s floatii	ng point	and thei	r impa	ct on
	signa	lpro	cessing	tasks.				F			-0		P	
Text Book	Text	Book	2: 5.3,	, 5.4,5.5,	5.7,5.1	0 ; Tex	t Book	3: 10.1	L,10.3					
MODULE-3	IMPI	EME	ENTAT	ION O	F DSP	ALGO	RITH	AS	,	21	ECE54 3	.4	8 H	lours
FIR Filters, IIR	Filters,	FFT.	Algorit	hm for	DFT C	omput	ation, (Overflo	w and	Scaling	g, Bit-Rev	versed Ir	ndex	
Generation & In	mplem	entati	ion on	the TM	S3200	67XX, 1	Introdu	uction	to adar	otive fil	ters.			
Applications Design of an adaptive filter in digital signal processor for active noise control.														
Text Book Text Book 2 :7.3.7.4.7.5.7.6.8.2.8.3.8.4.8.5.8.6														
MODILLE 4	EMBEDDED SIGNAL PROCESSING AND 21ECEE 42 E 9 Hours													
MODULE-4	** CONCEPTS 21ECE543.5 8 Hours													
Introduction to micro signal architecture, Overview of Blackfin Processor, Data arithmetic unit, address arithmetic unit control unit. Bus Architecture and memory														
Case Study	Case Study Investigate how to design a Real Time Granhic Equalizer using Blackfin Processor													
-acc crucy	ase Study Investigate how to design a Real Time Graphic Equalizer using Blackfin Processor.													

MODULE-5	APPLICATIONS OF DSP PROCESSORS	21ECE543.6	8 Hours						
CODEC Interface Circuit. DSP Based Bio-telemetry Receiver, audio equalization and filtering. speech									
recognition sys	tem, An Image Processing System, DTMF Detection usin	ig modified Goertzel algorith	m.						
Case Study	Research and analyze real-world applications of DSP processors, such as noise cancellation								
-	headphones, medical imaging devices, or radar system	ns to represent their findings	and						
	discuss the DSP principles involved.								
Text Book	Text Book 3: 8.8,8.9,9.1,9.2,9.4								
	Reference Book 3: Chapter 1								

CIE Assessment Pattern (50 Marks – Theory)

		М	arks Distribution
	RBT Levels	Test (s)	Qualitative Assessment (s) (NPTEL)
		25	25
L1	Remember	5	-
L2	Understand	5	5
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Theory)

	RBT Levels	Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	
L6	Create	

Suggested Learning Resources:

Text Books:

1) Steven W. Smith, 2002, The Scientist and Engineer's Guide to Digital Signal Processing, California Technical Publishing.

2) Avatar Singh and S. Srinivasan, 2004, "Digital Signal Processing", Thomson Learning, 2004

3) Andhe Pallavi & K. Uma Rao, 2012, "Digital Signal Processors-Architecture, Programming and Applications", Sanguine Technical Publishers.

4) Woon Seng Gan, Sen M. Kuo, Hoboken,2007, "Embedded Signal processing with the micro signal architecture", New Jersey Publisher.

Reference Books:

1) B Venkataramani and M Bhaskar,2010, "Digital Signal Processors", TMH, 2nd edition.

2) Sen M. Kuo and Woon-Seng Gan. 2004, "Digital Signal Processors: Architectures, Implementations, and Applications",

3) Chiouguey J Chen, 1996, "Application report on: "Modified Goertzel algorithm in DTMF Detection using TMS320C80.

4)R. Chassaing, 2004 , 'Digital Signal Processing and Applications with the C6713 and C6416 DSK', John Wiley and Sons, Inc., New York.

Web links and Video Lectures (e-Resources):

- <u>https://www.dspguide.com/ch12.htm</u>
- https://www.ti.com/lit/ug/spru307a/spru307a.pdf?ts=1691420154210&ref url=https% 253A%252F%252Fwww.google.com%252F
- <u>https://www.ti.com/lit/ug/spru733a/spru733a.pdf?ts=1691469745326&ref_url=https%</u> 253A%252F%252Fwww.google.com%252F
- <u>https://www.slideshare.net/pantechsolutions/blackfin-core-architectureslides</u>
- <u>https://onlinelibrary.wiley.com/doi/10.1002/acs.959</u>
- <u>https://www.nxp.com/docs/en/application-note/AN2110.pdf</u>

- Demonstration of DSP program with actual hardware or software simulation tools to implement and test signal processing algorithm.
- Video demonstration of Digital Signal Processor market Overview.
- Contents related activities (Activity-based discussions)
 - For active participation of students, debate the advantage and limitation of different DSP Techniques.
 - Assign pre-recorded video lectures or readings for students to review before class, freeing up class time for interactive discussions, problem-solving, and hands-on activities.
 - ➢ Seminars

			PR	OGRA	MMI	NG W	ITH D	DATA	STRU	CTURE	E <mark>S USI</mark> N	IG C			
Course Code	21E	ECE5	44						CIE I	Marks		50			
L:T:P:S	3:0	:0:0							SEE	Marks		50			
Hrs / Week	3								Tota	l Marks		10	100		
Credits	03								Exar	Exam Hours 03					
Course outcom	nes: A	At the	e end o	of the co	ourse, f	the stu	dent w	ill be a	ble to:						
21ECE544.1	Unc	lerst	and th	e conce	ept of n	nemory	y alloca	tion te	chniqu	es, Point	ers, Arra	iys and s	tructure	, union	
21ECE544.2	Арр	oly ap	propr	iate alg	gorithn	n for pr	oblem	solving	g using	arrays, s	stacks, q	ueues			
21ECE544.3	Idei	ntify	the va	rious li	nked li	sts, an	d their	operat	ions						
21ECE544.4	Exp	lore	advan	ced dat	a struc	tures a	and imp	olemen	t corre	sponding	g algorit	hms for o	operatio	ns like	
	trav	/ersa	l and r	nanipu	lation		1		,	1					
21ECE544.5	Util	ize tl	ne con	cepts o	f searc	hing ar	id sorti	ing to s	olve re	al time p	oroblems				
21ECE544.6	Des	ign a	pprop	riate da	ata strı	ictures	s for so	lving co	omputi	ng probl	ems				
Mapping of Co	urse	Out	comes	to Pro	gram	Outco	nes an	d Prog	gram S	pecific C)utcome	es:			
	PO	PO	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PSO1	PSO2	
	1	2													
21ECE544.1	2	-	-	-	2	-	-	-	-	-	-	-	2	2	
21ECE544.2	3	2	-	-	2	-	-	-	-	-	-	2	2	2	
21ECE544.3	3	2	-	-	2	-	-	-	-	-	-	2	2	2	
21ECE544.4	3	2 2					-	-	-	-	2	2	2		
21ECE544.5	3	2	2	1	2	-	-	-	-	-	-	2	2	2	
21ECE544.6	3	2	2	1	2	-	-	1	2	-	-	2	2	2	
MODULE-1	INT	ROD	UCTI	ON							21ECE5	44.1	8 H	lours	
Basics: Arrays	l Struc	ture	s unio	ns Poir	nters F	vnami	c Mem	orv All	ocation	Algorit	hm Spec	ification	The Abs	stract	
Data type. ADT	of Na	atura	l Num	bers.	10010, 2	y nann		01 y 1111	ocation	, 1190110	inn opee		1110 1100	, ci ucc	
Introduction to	Data	stru	cture:	primiti	ive and	non-p	rimitiv	e data	types, 🛛	Types of	Data Str	uctures.			
Applications			Stu	dy the 1	real tin	ne usag	ge of Ar	rays, S	tructur	es and U	nions.				
Text Book			Tex	t Book	1: 1.2.	2.1, 2.2	2, 2.3								
MODULE-2	STA	ACKS	AND	QUEUE	S						21ECE5	44.2	81	Hours	
Stack ADT, rep	resen	tatio	n of st	acks an	d oper	ations	perfor	med or	Stacks	, Applica	ation of S	Stacks: in	nfix to po	ostfix	
conversion-pos	stfix e	valu	ation.		- - -		r			,					
Queues ADT, re Queues - job sc	epres hedul	enta ling	tion of	Queue	es and	operati	ions pe	erforme	ed on q	ueues, C	ircular o	queues, A	Applicati	on of	
Self-study	Exercises on Infix, Postfix and prefix conversions, Study the real time use of Stacks and Queues														
Text Book	Tex	t Boo	ok 1: 3	.1,3.2, 3	3.4										
MODULE-3	LIN	KED	LISTS	;							21ECE5	44.3	81	lours	

Linked Lists: Singly Linked Lists, Operations on Singly Linked Lists, other operations on lists: Delete a Node from the front end, insert a node at the rear end, delete a Node from the rear end, Search for an item in a list **Doubly Linked Lists:** Insert a node at the front end, insert a node at the rear end, delete a node from front end, Delete a node from rear end.

Theoretical Introduction to circular Singly and circular doubly Linked lists.

Self-study	Exercises on Linked lists operations like Insert a Node at	a specified Position, rotatin	ng a list,
	counting frequency of nodes.		
Text Book	Text Book 2: Ch 9.2, 9.3.1-9.3.3, 9.3.8, 9.8.1-9.8.4. Text B	ook 1: Ch 4.5.2	
MODULE-4	TREES	21ECE544.4 21ECE544.6	8 Hours

Introduction of trees and its Terminology, Tree as an ADT, Binary Search Tree (BST), properties of Binary search Trees, construction of binary search tree, operations performed on Binary search Tree, Binary Tree Traversal: In order traversal, preorder traversal, post order traversal.

Case Study	Study on AVL Trees.		
Text Book	Text Book 1: Chapter 5.1, 5.2, 5.3, 5.7.1-5.7.2		
MODULE-5	SEARCHING AND SORTING	21ECE544A.5 21ECE544A.6	8 Hours

Searching: Linear search (Sequential search), Binary search.

Sorting: Bubble sort, Quick sort, Insertion sort, Selection sort, Merge sort, Heap Sort.ApplicationsPractice Sorting and searching Algorithms for solving real time applications.

Applications	Practice solving and searching Algorithms for solving real time ap	p

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		М	Marks Distribution	
		Test (s)	Qualitative Assessment (s) (NPTEL)	
		25	25	
L1	Remember	5	-	
L2	Understand	5	5	
L3	Apply	10	10	
L4	Analyze	5	10	
L5	Evaluate	-	-	
L6	Create	-	-	

SEE Assessment Pattern (50 Marks - Theory)

RBT Levels		Exam Marks	
		Distribution (50)	
L1	Remember	10	
L2	Understand	10	
L3	Apply	20	
L4	Analyze	10	
L5	Evaluate	-	
L6	Create	-	
Suggested Learning Resources:

Text Books:

- 1. Horowitz, Sahni, Anderson-Freed, "Fundamentals of Data Structures in C,2nd Edition, 2011, Universities Press.
- 2. Padmareddy, Systematic Approach to Data structures using C, Sri Nandi Publications, 2012

Reference Books:

- 1. Yedidyah Langsam, Moshe Augenstein, Aaron M. Tenenbaum, "Data Structures using C & C++", Second Edition, Pearson, Tenth Impression 2020.
- 2. Richard F. Gilberg and Behrouz A. Forouzan, "Data Structures A Pseudo code approach with C", Second Edition, CENGAGE LEARNING, Sixth Indian Reprint2016.
- 3. E. Balagurusamy, Data Structures using C, 2017, McGraw Hill Education.

Web links and Video Lectures (e-Resources):

- <u>https://onlinecourses.nptel.ac.in/noc23_cs95/preview</u>
- <u>https://log2base2.com/courses/data-structures-in-c/</u>
- <u>https://www.geeksforgeeks.org/data-structures/</u>

- Conduct on spot problem solving based on Data Structures and C.
- Develop simple algorithms and programs to build projects and applications.

	NANOELECTRONICS													
Course Code	21EC	E545						CI	E Mar	'ks		50		
L:T:P:S	3:0:0	:0						SE	EE Mai	rks		50		
Hrs / Week	3							Т	otal M	arks		100		
Credits	03							Ex	kam H	ours		03		
Course outcom	nes:													
At the end of t	the cou	rse, th	e stu	dent w	ill be al	ble to:								
21ECE545.1	Discu	ss the	funda	amenta	ıl princ	iples,	synthet	ic meth	od of f	fabricatio	on of n	anomate	rials	
21ECE545.2	Comp Nano	oare th techno	e con ology	cepts o	of chara	acteriz	zation to	echniqu	ies use	d in Nan	oscien	ce and		
21ECE545.3	Recognize the basic principles of Quantum physics and various semiconductor nanostructures													
21ECE545.4	Explo	re var	ious 1	nanosti	ructure	es of c	arbon a	nd the 1	nature	of the ca	rbon b	ond itse	lf	
21ECE545.5	Illust	rate th	e fun	ctionin	g and p	orope	rties of	the nan	o sens	ors				
21ECE545.6	Inves	tigate	the aj	pplicat	ions of	semi	conduct	or nanc	ostruct	ures and	their	significai	nce	
Mapping of Co	ourse	Outco	mes	to Pro	gram	Outc	omes a	nd Pro	gram	Specifie	c Outc	omes:		
	P01	P02	P03	P04	P05	PO	P07	P08	P09	P010	P01	P012	PSO1	PSO
						6					1			2
21ECE545.1	2	-	-	-	-	-	-	-	-	-	-	2	3	2
21ECE545.2	3	-	-	-	-	-	-	-	-	-	-	2	3	2
21ECE545.3	3	3	-	-	-	-	-	-	-	-	-	2	3	2
21ECE545.4	3	3	-	-	-	-	-	-	-	-	-	2	3	2
21ECE545.5	3	3	3	-	-	-	2	-	-	-	-	2	3	2
21ECE545.6	3	3	3	•	-	-	2	-	-	-	-	2	3	2
MODULE-1	INTR		TIO	N TO N	IANOE	LECT	RONIC	S:		21 E	CE54 5	.1	8 Ho	urs
Classification o	f Nano	structi	ires,	Nanoso	cale are	chitec	ture, El	ectronio	c prop	erties of	atoms	and soli	ds: Isola	ted
atom, Bonding	betwe	en ato	ms, G	iant m	olecula	ar soli	ids, Fre	e electr	on mo	dels and	energ	y bands,	crystall	ine
solids, Periodio	city of	crystal	latti	ces, El	ectroni	ic con	duction	, effect	s of na	anometer	r lengt	h scale,	Fabricat	ion
methods: Top	down p	process	ses, B	ottom	up pro	cesse	s metho	ods for	templa	ating the	grow	th of nan	omateri	als,
ordering of nar	io syste	ems.	-											
Text Book	•		Tex	t Book	1: 1.1,	1.2, 1	.3, 1.4							
MODULE-2	CHA	RACTI	ERIZA	ATION	OF NA	ANOM	IATER	IALS		21E	CE54 5	5.2	8 Ho	urs
Characterizatio	on tools	ofNar	iomat	terials:	Micros	сору	techniq	ues, sca	inning	electron	micro	scopy, Tr	ansmiss	ion
electron micro	scopy,	Field	ion	micros	copy,	Scanr	ning tur	nelling	micr	oscopy,	atomic	c force r	nicrosco	ру,
Diffraction tech	inique:	Diffra	iction	techn	ique, S	urface	e diffrac	tion teo	chniqu	e, Spectr	oscop	y technic	lue: Pho	ton
spectroscopy, I	Radio fi	requen	cy sp	ectros	copy, E	lectro	n spect	roscopy	/.					
Case study	Diffe	rent M	1. 2 1	$\frac{copic}{2}$	na spe	$\frac{\text{ctrose}}{242}$		chniqu	es					
Text BOOK			1: Z.Z	2, 2.3.4	, 2.3.5,	2.4, 2	.5.1, 2.5	.2, 2.0,2	/	21E	CEEA		0 Uo	
Characteristic	longth			Copic			antum	macha	nical c	21E		D.D		
and dots Dons	ity of s	S III II	and d	limons	ionalit	is, Qu w Sor	antum nicondi	inechal	atoros	tructure	e, Qua	intum tr	ells, wii	es,
Quantum Nan	and dots, Density of states and dimensionality, Semiconductor neterostructures, Quantum transport													
Multiple Quantum well. The concept of superlattice.														
Text Book	Text	Rook 2	· 1 2	$\frac{13 \text{ to}}{13 \text{ to}}$	1852	53	5455	1						
MODULE-4	CAR	SOUR Z	ANO	TURF	<u>, J.2</u>	, J.J,	J. 1, J.J.	±		21F	CE54	5.4	8 Ho	urs
Carbon mole	cules	Carbo	n Clu	sters	- Carhoi	n Nan	otubes	Fahrie	ration	Structu	re Ele	ectrical V	Vibratio	nal
and Mechan	nical n	roper	ties.	Applic	cations	of	carbon	nanot	ubes:	Field I	Emissi	on and	shieldi	ng,
Computers, F	<u>Fuel c</u> el	lls, Ch	emica	al sens	ors, Ca	talysi	is, Mecł	<u>anica</u> l	Reinfo	orcemen	t			<i>,</i>

Seminar	Applications of nanotubes.		
Text Book	Text Book 3: 5.1,5.2,5.3,5.4,5.5		
MODULE-5	NANOSENSORS AND APPLICATIONS	21ECE545.5,	8 Hours
		21ECE545.6	
-			- 1.0

Introduction to Nano sensors, Order from Chaos, Characterization, Perception, Nano sensors Based On Quantum Size Effects, Electrochemical Sensors, Sensors Based On Physical Properties, Nano biosensors, Smart dust Sensor for the future.

Injection lasers, quantum cascade lasers, single-photon sources, biological tagging, optical memories, coulomb blockade devices, photonic structures

Case Study Various Nano sensors that are currently applied in the healthcare sector

Text Book Text Book 4: 12.1 to 12.11 Text Book 1: 3.8

CIE Assessment Pattern (50 Marks - Theory)

		М	arks Distribution
	RBT Levels	Test (s)	Qualitative Assessment (s) NPTEL
		25	25
L1	Remember	5	-
L2	Understand	5	5
L3	Apply	10	10
L4	Analyze	5	10
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Theory)

	RBT Levels	Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	

Suggested Learning Resources:

Text Books:

1) Edited by Robert Kelsall, Ian Hamley and Mark Geoghegan, "Nanoscale Science and Technology", John Wiley, 2007.

2) J.M. Martinez-Duart, R.J. Martin Palma, F. Agulle Rueda Nanotechnology for Microelectronics and optoelectronics, Elsevier, 2006

3) Charles P Poole, Jr, Frank J Owens, "Introduction to Nanotechnology", John Wiley, Copyright 2006, Reprint 2011

4) T Pradeep, "Nano: The Essentials-Understanding Nanoscience and Nanotechnology", TMH,2007 **Reference Books:**

1) Edited by William A Goddard III, Donald W Brenner, Sergey E. Lyshevski and Gerald J Iafrate, "Hand Book of Nanoscience Engineering and Technology", CRC press, 2003

Web links and Video Lectures (e-Resources):

- <u>https://onlinecourses.nptel.ac.in/noc23_mm37/preview</u>
- <u>https://www.coursera.org/learn/nanotechnology</u>
- <u>https://www.youtube.com/watch?v=2voX3fjMGjA&t=129s</u>
- https://www.youtube.com/watch?v=5Uh6b3CDRaA&t=10s

- Video demonstration of nanotubes
- Group Discussion on latest trends in nano sensors
- Contents related activities (Activity-based discussions)
 - > For active participation of students, instruct the students to prepare pictures and Handouts
 - > Organizing Group wise discussions on significance of nanostructures Seminars

ALP WITH MICROCONTROLLERS														
Course Code	21	ECL5	51						CIE Ma	arks		50		
L:T:P:S	0:0):1:0							SEE M	arks		50		
Hrs / Week	2								Total	Marks		100)	
Credits	01								Exam	Hours		03		
Course outcom	nes:													
At the end of	the co	ourse	, the s	tudent	: will be	e able t	:0:							
21ECL551.1	Wı	rite 8	051 a	ssemb	ly level	progra	ams to	perfo	rm arit	hmetic	and log	ical ope	rations,	code
	COI	nvers	ion p	rogran	15									
21ECL551.2	Ap	ply the basic knowledge of addressing modes and instructions to write assembly guage program in 8051 Microcontroller												
	lan	nguage program in 8051 Microcontroller												
21ECL551.3	An	alyze	the c	oae in	assemi	oly leve	el for a	ррпса	ition of	80511	imers,	Interrup	ots and s	berial
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21ECL551.2 21ECL551.3	3	3	3	- 2	3	-	-	-	2	-	-	2	3	3
21ECL551.5	3	3	3	2	3	_	_	_	2	_	_	2	3	3
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Prerequisite Experiments / Programs / Demo														
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	Kno	wled	σe in	moder	n tools	and er	ια μις ισασεί	in self-	learnii	acing ε ng to ca	rry out	2		NA
	real	worl	d pro	iects	11 10015	unu er	iguge i	in sen	icui iii	15 to cu	iry out			
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	div	ision,	squa	re, Cub	oe – (16	bits A	rithm	etic op	eration	ns – bit		2	21E	CL551.1
	add	lressa	able)											
3	Boo	olean	& Lo	gical In	structi	ons (B	it man	ipulati	ions).			2	21E	CL551.1
	0	1				011 40	<u> </u>		1.0.	1 40			21E	CL551.2
4	C00		ivers	ion: BC	D – AS	UII; AS	CII – D	ecima	I; Decii	mal - AS	scii;	2	21E	CL551.2
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8	Asse	embly	v Leve	el Prog	rammi	ng to il	lustrat	te the i	interfa	cing of s	stepper		21EC	L551.4
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	mic	rocor	ntrolle	er 8051	L							_		
9	Asse	embly	y Leve	el Prog	rammi	ng to il	lustrat	te the i	interfa	cing of s	simple	2	21EC	L551.4
	swit	tches	with	the mi	crocon	troller	8051				-	2		
10	Asse	embly	y Leve	el Prog	rammi	ng to il	lustrat	te the i	interfa	cing of	LCD	2	21EC	L551.4
	mod	lules	with	the mi	crocont	troller	8051					2		

-	11.	Assembly Level Programming to illustrate the interfacing of LED 2 21ECL551.4											
-	12	Write a Accor	mbly Lovel D	agram to t	non afon lotton	"A" corially at							
-	12.	write a Asser	indiy Level Pl	by Level Program to transfer letter A serially at 2 21ECL551.4									
		4800 baud , d	continuously										
			_	P/	ART-C								
	Beyond Syllabus Virtual Lab Content												
	(To be done during Lab but not to be included for CIE or SEE)												
1.Repr	Representation of Integers and their Arithmetic												
<u>https:/</u>	ttps://cse11-iiith.vlabs.ac.in/exp/integers-arithmetic/												
2. Float	. Floating Point Numbers Representation												
https:/	<mark>//cse11-i</mark> i	<u>iith.vlabs.ac.in</u>	<u>/exp/floating</u>	<u>g-point-nui</u>	<u>nbers/</u>								
3.Inter	Rups://cserr-mun.viabs.ac.in/exp/noating-point-numbers/ B.Interfacing of ADC and data transfer by software polling, study of aliasing												
http://	vlabs.iitl	<u>xgp.ernet.in/rt</u>	es/exp4/ind	<u>ex.html</u>									
4.MCU-	-DAC inte	erfacing and ge	eneration of r	amp wave									
http://	vlabs.iitl	<u>kgp.ernet.in/rt</u>	es/exp3/ind	<u>ex.html</u>									
5.Inter	facing 4x	4 switch matr	ix with the m	icrocontro	ller								
http://	/vlabs.ii	tkgp.ernet.in	/rtes/exp12	2/index.ht	ml								
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	CIE Assessment Pattern (50 Marks – Lab)												
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L4	Analy	ze	5		10								
L5	Evalu	ate	5		5								
L6	Creat	e	-		-								
SEE As	ssessme	nt Pattern (50) Marks – La	b)									
	DDTL		Exam M	larks									
	KB1 L	evels	Distribut	ion (50)									
L1	Remer	nber	-										
L2	Under	stand	05										
L3	Apply	-	20		1								
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and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006 / Pearson, 2006.
2) "The 8051 Microcontroller Architecture, Programming & Applications", 2e nneth J. Ayala ;, Penram International, 1996 /Thomson Learning 2005.

	ANTENNA SIMULATION USING ANSYS													
Course Code	2	1ECI	.552						CIE	Marks		50		
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Credits	0	1							Exa	m Hours	5	03		
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				- Stude			:			- 6 1:66		6		
21ECL552.1	A	naiyz	ze the	funda	menta	I princ	iples a	na con	cepts o	of differe	ent types o	of antenna		
21ECL552.2	D	emoi	nstrat	e prof	iciency	in usi	ng AN	SYS HF	SS for	antenna	modeling	g and simi	ilation	
21ECL552.3	Ν	easure the radiation pattern of wired, aperture, planar and array antennas												
21ECL552.4	0	Optimize antenna designs to achieve desired specifications												
Mapping of C	our	se Oı	utcor	nes to	Prog	ram O	utcon	nes an	d Pro	gram Sj	pecific O	utcomes		
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21ECL552.3	3	3	2	2	2	-	-	-	1	_	-	2	3	3
21ECL552.4	3	3	2	2	2	-	-	-	1	-	-	2	3	3
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				Prere	quisi	te Exp	oerim	ents /	Prog	rams /	Demo			
Electromagnetics Fundamentals: A solid understanding of														
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	101	tom	prem	munig	uic ui	lucityi	<u>PA</u>	RT-A	01 ant		iulation.			
1	Int	trodu	ction	of HFS	SS Ans	vs simi	ulation	tool fo	or ante	enna des	ign	2	21E(CL552.1
2	De	sign	a Mor	nopole	(Quar	, ter wa	ve) ant	tenna f	or 88 I	MHZ-108	3MHz	2	2150	יז ררס ז
	ар	plicat	tion u	sing A	nsys.							Z	ZIEU	L227'1
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1	fre	equen	icy an	d opti	mize it	s perfo	orman	ce by a	djustir	ig paran	ieters	2	21E0	L552.2
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6	De	d ont	a circ	ular m	ICrosti rform:	nce by	cn ante z adius	enna 10 ting na	r a spe	ecific fre	quency	2	21F('I 552 2
	m	ateria	l. nat	ch dim	ensior	ince by	aujus	ung pa	amet	ers like i	substrate	2	2110	11332.2
	PART-B													
7	De	Design of probe feed microstrip patch antenna and optimize its												
	pe	rformance. 2 21ECL552.3												
8	He	elical Antenna Simulation: Simulate a helical antenna and analyze 2 21ECL552.3												
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9	or an	tenn:	anu A a capa	antenn able of	a Desi§ coveri	ng a w	ide fre	a sinu anenci	iate a	e Ontim	nu ize the	2	21EC 21FC	L552.3
	an	tenna	a's im	pedan	ce mat	ching a	and ra	diation	patter	rns.	20 010	4	2 11(.2002.1

	10	Antenna Arr techniques t	ay Pattern Sy o achieve spe	attern synthesis S	2	21ECL552.3 21ECL552.4							
	11	Design and a software for	nalysis of a 2 3.5 GHz.	x2 antenna array usinį	g Ansys simulation	2	21ECL552.3 21ECL552.4						
 	12	Design and a software.	nalysis of 5G	array antenna using A	nsys simulation	2	21ECL552.3 21ECL552.4						
				PART.C									
		(To	bo dono duri	ing Lab but not to bo in	cluded for CIF or SFI	7)							
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 3) S. Chandran, Adaptive antenna arrays, trends and applications, Springer, 2009.
 4) NPTEL online course. https://www.youtube.com/watch?v=wx tIvaajAI&list=PL3UZlxOnyu9CRoBFsG5x-VqYeC69FmMZT&ab_channel=Antennas

	NETWORK SIMULATION USING NS-2														
Course Code	21EC	L553	3						CIE M	larks		50			
L:T:P:S	0:0:1	:0							SEE N	larks		50			
Hrs / Week	2								Total	Marks		100			
Credits	01								Exam	Hours		03			
At the end of t	n es: the cou	ırse, t	he st	udent	will be	able to	:								
21ECL553.1	Use t	he ne	twor	k simu	lator fo	or learı	ning an	d pract	tice of	network	algorith	ms			
21ECL553.2	Illust	llustrate the operations of network protocols and algorithms u										ogramm	ing		
21ECL553.3	Simu	Simulate the network with different configurations to measure the										rmance p	paramet	ers	
21ECL553.4	Imple	plement the data link and routing protocols using C programming													
Mapping of Co	ourse	se Outcomes to Program Outcomes and Program Specific Outcomes:													
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PSO1	PSO2	
21ECL553.1	3	3	3	2	2	-	-	-	1	-	-	2	3	3	
21ECL553.2	3	3	3	2	2	-	-	-	1	-	-	2	3	3	
21ECL553.3	3	3	3	2	2	-	-	-	1	-	-	2	3	3	
21ECL553.4	3	3	3	2	2	-	-	-	1	-	-	2	3	3	
Evn No /															
Pgm. No.				List	of Ex	perim	ents /	Prog	rams			Hour	C	0S	
- 8			Dr	orogu	icito	Evnor	imont	c / Dr	ogran		m o	3			
			<u> </u>	erequ	1.00	схрег	intent	. 5 / F T	ugran		110				
		► EX	xperii emo (ments	on ain ket for	erent n mats	letwor	k topol	ogies.			2	N	A	
	,			on pac	Net Ior	mats.	PART	-A							
1	Imple	emen	tapo	oint-to-	point	networ	k with	four no	odes ai	nd duple	x links				
	betw	een t	hem.	Analyz	the r	networ	k perfo	rmanc	e by se	tting the	queue	2	21ECI	553.1	
	size a	and va	aryin	g the b	andwi	dth.	-		-	-	-				
2	Imple	emen	t a fo	ur-nod	le poin	t-to-po	int net	work v	vith lin	ks n0-n2	2, n1-				
	n2 ar	nd n2	-n3. /	Apply '	ГСР ад	ent bet	ween i	10-n3 a	nd UD	P betwee	en n1-	2	24 5 61	FF0 1	
	n3. A	pply	relev	ant ap	olicatio	ons ove	r TCP a	and UD	P agen	ts chang	ing the	Z	ZIECI	-553.1	
	parai	meter	and	detern	nining	the nu	mber o	f packe	ets sen	t by TCP	/UDP.				
3	Imple	emen	t Eth	ernet I	AN us	ing n (6	6-10) n	odes. C	Compai	e the		2	21FCI	5531	
	throu	ıghpı	it by (changi	ng the	error r	ate and	d data r	ate.				21101		
4	Imple	emen	t Eth	ernet I	AN usi	ing n n	odes ai	nd assig	gn mul	tiple traf	fic to				
	the n	odes	and o	obtain	conges	tion w	indow	for diff	erent s	ources/		2	21ECI	553.3	
	desti	natio	ns.												
5	Imple	emen	t ESS	with t	ransmi	ission r	10des i	n Wire	less LA	N and ol	otain	2	21FCI	5533	
	the p	the performance parameters.											2120	1000.0	
6	Imple	Implementation of Link state routing algorithm.221ECL553.3													
							PART	-B							
7	Write	e a pr	ograi	n for a	HLDC	frame	to perf	orm th	e follo	wing.					
	i) Bit	t stuff	fing									2	21501	5522	
	ii) Cł	narac	ter st	uffing.								۷	ZIEU	.553.2	

9 For the given data, use the CRC-CCITT polynomial to obtain the CRC code. Verify the program for the cases a. Without error b. With error 10 Implementation of Stop and Wait Protocol and Sliding Window Protocol 2 21ECL553.4 11 Write a program for congestion control using a leaky bucket algorithm. 2 21ECL553.4 12 Implement Dijkstra's algorithm to compute the shortest routing path. 2 21ECL553.4 PART-C Beyond Syllabus Virtual Lab Content (To be done during Lab but not to be included for CLE or SEE) 1. Basics of Network Simulation. http://vlabs.iitkgp.ernet.in/ant/3/ http://vlabs.iitkgp.ernet.in/ant/3/ A concept of network. http://vlabs.iitkgp.ernet.in/ant/3/ http://vlabs.iitkgp.ernet.in/ant/3/ Ylabs.iitkgp.ernet.in/ant/3/ Ylabs.iitkgp.ernet.in/ant/3/ Ylabs.iitkgp.ernet.in/ant/3/ http://vlabs.iitkgp.ernet.in/ant/3/ Ylabs.iitkgp.ernet.in/ant/3/ Ylabs.iitkgp.ernet.in/ant/3/ Ylabs.iitkgp.ernet.in/ant/3/		8	Write a prog for transmis	ram for a dis sion.	tance vecto	r algorithm to	find a suitable path	2	21ECL553.2
10 Implementation of Stop and Wait Protocol and Sliding Window Protocol 2 21ECL553.4 11 Write a program for congestion control using a leaky bucket algorithm. 2 21ECL553.4 12 Implement Dijkstra's algorithm to compute the shortest routing path. 2 21ECL553.4 PART-C Beyond Syllabus Virtual Lab Content (To be done during Lab but not to be included for CIE or SEE) 1. Basics of Network Simulation. 1 http://vlabs.itkgp.ernet.in/ant/1/ 2 21ECL553.4 2. Simulating a Local Area Network. http://vlabs.itkgp.ernet.in/ant/2/ 3 7 3. Concept of network performance evaluation, and different http://vlabs.itkgp.ernet.in/ant/7/ related metrics http://vlabs.itkgp.ernet.in/ant/7/ 5. Implement OSPF protocol using 5 routers scenario. http://www.nittrkol.acin/vlab-cse-nl-expl.php#top 7 CIE Assessment Pattern (50 Marks - Lab) SEE Assessment Pattern (50 Marks - Lab) RBT Levels Exam Marks Li1 Remember - - Li2 Understand - 5 Li2 Numeric (s) Marks - Lab) RBT Levels Exam Marks		9	For the given the CRC code a. Without e b. With erro	n data, use th e. Verify the p error er	to obtain	2	21ECL553.2		
11 Write a program for congestion control using a leaky bucket algorithm. 2 21ECL553.4 12 Implement Dijkstra's algorithm to compute the shortest routing path. 2 21ECL553.4 PART-C Beyond Syllabus Virtual Lab Content (To be done during Lab but not to be included for CIE or SEE) 1. Basics of Network Simulation. http://vlabs.iitkgp.ernet.in/ant/1/ 2 21ECL553.4 2. Simulating a Local Area Network. http://vlabs.iitkgp.ernet.in/ant/3/theory/ 3. Concept of network performance evaluation, and different related metrics http://vlabs.iitkgp.ernet.in/ant/3/theory/ 3. Soncept of network betwork. http://vlabs.iitkgp.ernet.in/ant/7/ 5. Implement OSPF protocol using 5 routers scenario. http://vlabs.iitkgp.ernet.in/ant/7/ 5. Implement (50 Marks - Lab) Test (s) Weekly Assessment 12 Understand - 5 13 Apply 10 10 14 Analyze 5 5 15 Evaluate 5 5 14 Analyze 15 15 14 Analyze 15 15 15 Evaluate 10 10 14 Analyze 15 15		10	Implementa Protocol	tion of Stop a	nd Wait Pro	otocol and Slic	ling Window	2	21ECL553.4
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2. Simulating a Local Area Network. http://vlabs.iitkgp.ernet.in/ant/2/ 3. Concept of network performance evaluation, and different related metrics http://vlabs.iitkgp.ernet.in/ant/3/theory/ 4. Simulating a Mobile Adhoc Network. http://vlabs.iitkgp.ernet.in/ant/7/ 5. Implement OSPF protocol using 5 routers scenario. http://www.nittrkol.ac.in/vlab-cse-nl-exp-1.php#top CIE Assessment Pattern (50 Marks - Lab) RBT Levels Test (s) 20 30 L1 Remember - - L2 Understand - 5 L3 Apply 10 10 L4 Analyze 5 5 L6 Create - - L2 Understand 05 13 L6 Create - - L2 Understand 05 05 L6 Create - - L4 Analyze 15 Evaluate L3	2	<u>http://</u>	/vlabs.iitkgp.e	<u>rnet.in/ant/</u>	<u>1/</u>				
3. Concept of network performance evaluation, and different related metrics http://vlabs.iitkgp.ernet.in/ant/3/theory/ 4. Simulating a Mobile Adhoc Network. http://vlabs.iitkgp.ernet.in/ant/7/ 5. Implement OSPF protocol using 5 routers scenario. http://www.nitttrkol.ac.in/vlab-cse-n1-exp-1.php#top CIE Assessment Pattern (50 Marks - Lab) RBT Levels Test (s) Weekly Assessment L1 Remember - - L2 Understand - 5 L3 Apply 10 10 L5 Evaluate 5 5 L6 Create - - 11 Remember - - L3 Apply 10 10 L4 Analyze 5 5 L6 Create - - 12 Understand 05 13 13 Apply 20 14 13 Apply 20 14 14 Analyze	Ζ.	Simula	ting a Local A	rea Network.					
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http://www.nittrkol.ac.in/vlab-cse-nl-exp-1.php#top CIE Assessment Pattern (50 Marks - Lab) RBT Levels Test (s) Weekly Assessment 20 30 L1 Remember - L2 Understand - L3 Apply 10 L4 Analyze 5 L3 Apply 10 L4 Analyze 5 L6 Create - SEE Assessment Pattern (50 Marks - Lab) Exam Marks RBT Levels Exam Marks Distribution (50) 11 L1 Remember - - SEE Assessment Pattern (50 Marks - Lab) RBT Levels Exam Marks Distribution (50) L1 Remember - - L2 Understand 05 L3 Apply 20 L4 Analyze 15 L5 Evaluate 10 L6 Create -	5.	Implei	nent OSPF pro	otocol using 5	5 routers sc	enario.			
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KBT LevelsDistribution (50)L1Remember-L2Understand05L3Apply20L4Analyze15L5Evaluate10L6Create-				Exam M	Jarks]			
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L3Apply20L4Analyze15L5Evaluate10L6Create-	L2	Under	stand	05	5				
L4Analyze15L5Evaluate10L6Create-	L3	Apply		20)				
L5Evaluate10L6Create-	L4	Analyz	æ	15	5				
L6 Create -	L5	Evalua	te	10)	4			
	L6	Create		-					

Suggested Learning Resources:

Text Books:

1) Computer Networking. Textbooks B.A. Forouzan, Data Communications, and Networking, 4th Edition, McGraw Hill, 2007 Peterson and Davie, Computer Networks

2) Andrew S. Tanenbaum, Computer Networks, Third Edition, Prentice Hall of India Private Limited, New Delhi.

Reference Books:

1) Data Communication & Computer Networks (First Edition) by Tanmaya Kumar Das and Dili Kumar Mahapatra.

2) Stallings W., Data and Computer Communications, Pearson Education, 7th Edition, 2003.

	ELECTRONICS APPLICATIONS USING SCILAB													
Course Code		21ECLS	554						CIE	Marks		50		
L:T:P:S	(0:0:1:	0						SEE	Marks		50		
Hrs / Week		2							Tota	ıl Marks		10	0	
Credits	(01							Exa	n Hours		03		
Course outco	omes													
At the end o	of the o	course	e, the s	studen	t will b	e able	to:							
21ECL554.1	1	Apply	powe	erful ni	umeric	al com	nputati	on cap	abilitie	es, makir	ng it sui	table for	analyzi	ng and
	(design	ing el	ectron	ic circu	iits	· ·,	1	. 1 .1	· .	1 1 .	1		1 .
21ECL554.2		Simula	ite the	e vario	us elec	tronic	circuit	s and s	tudy tr	ie circuit	benavio	or, and o	ptimize	designs
21ECL554.3		Analvz	tous a	model	of con	ıplex e	lectror	ic circi	iits an	dassess	their pei	rformand	e	
21ECL554.4		Explore complex electronics signal scenarios for real time applications												
Manning of	Cour		tcom	os to l	Drogra	m Ou	tcome	s and	Progr	am Sno	rific Ou	tcomos		
Mapping of	P01	P02	P03	P04	PO5	P06	PO7	P08	P09	PO10	P011	P012	P\$01	PS02
21ECL554.1	3	3	2	2	2		-		107	-	-	2	3	3
21ECL554.2	3	3	2	2	2	-	-	-	1	-	-	2	3	3
21ECL554.3	3	3	2	2	2	-	-	-	1	-	-	2	3	3
21ECL554.4	3	3	2	2	2	-	-	-	1	-	-	2	3	3
Exp. No. /					- C T			(D						C
Pgm. No.				LIST	OI EX	perim	ients /	Prog	rams			Hour	S	LOS
	Prerequisite Experiments / Programs / Demo													
	Bas elec Scil Circ mod Mat mat equ	tronic ab Pro cuit Si dels us themat ations	ctron s prin oficie mula sing si tical tical o , and	ics Kn iciples, ncy: Fa tion K mulati Conce perations signal	owled circuit amiliar nowle on too pts: El ons, su proces	ge : Fun ts, and tity wit dge : Cr ls can b ectroni ch as s sing.	ndamen compo h Scila reate a pe high ics app olving	ntal un onents b is ess nd anal ly adva licatior equatio	dersta ential. yze ele intageo is ofter ons, dif	nding of ectronic bus. n involve ferential	circuit	2		NA
							PAR'	Г-А				•		
1	Det con	ermino figurat	e the l tion fo	base, e or the g	mitter, given a	collect lpha va	tor cur alue.	rent of	Comm	on Base		2	21E	CL554.1
2	Det and	ermine base t	e opei to emi	rating _l itter vo	point o oltage.	f Fixed	Bias c	ircuit, g	given t	ransistor	gain	2	21E	CL554.1
3	Det	ermin	e out	put vol	tage of	f circui	t given	Vbe fo	r trans	istors Q	l, Q2.	2	21E	CL554.1
4	Det	ermine	e valu	e of dr	ain cur	rent Ic	l and g	ate sou	rce vo	ltage Vgs	for self-	2	21F	CI 554.1
	bias	s circui	it.									2	215	CL334.1
5	Des	Design Zener Shunt voltage regulator for the given specifications221ECL554.2												
6	Determine the value of Rs to achieve self-bias condition of N channel 2 21ECL554.2													
	JLE	PART-R												
7	Find	d the c Frea o	apaci of osc	tance v illatior	value ir 1.	n Wien	-bridge	oscilla	itor giv	ven value	of R	2	21E0	L554.2
8	Find	d Freq acitan	of RC ces ar	phase e equa	shift o l.	scillato	or if the	e 3 resi	stance	s are equ	al and 3	2	21E0	L554.2

1	9 Determine input, output impedance voltage and current gain given h- parameters of transistor 2 21ECL554.									
1	10 Design Schmit	tt Trigger cire	cuit using 2	silicon NPN ti	ransistors with	2	21ECL554.3			
1	given configui	ration 243	** *** ****	antial Coguan						
1	virtue a progra	am to genera			ce.	2	21ECL554.4			
	$X(n) = (a)^n$	for $(i)0 \leq$	$a \leq 1$ $(u) -$	$1 \le a \le 0$ (<i>ui</i>)	$a \le -1$ (<i>iv</i>) $a > 1$					
1	12 Write a prog	gram to gen	erate the	signal $S(n)$:	$= 2 * n * (0.8^{n})$					
	corrupted by	the noise $d(n$)resulting	the signal $X(n)$).	2	21ECL554.4			
	X(n) = s(n)	+ d(n).								
		Bevond	Syllabus	Virtual Lab	Content					
	(To be do	one during	Lah hut n	ot to be incl	uded for CIE or Si	EE)				
1. To s	study I-V Characterist	ics of Diode				,				
https:	//ee-iitb.vlabs.ac.in	/exp1/inde	x.html							
2. To s	study the operation of	frectifiers								
https:	//ee-iitb.vlabs.ac.in	/exp2/inde	<u>x.html</u>							
3. To s	study the output char	acteristics of	BJT							
https:	//ee-iitb.vlabs.ac.in	/exp4/inde	<u>x.html</u>							
4. To s	study the voltage com	parator								
https:	//ae-iitr.vlabs.ac.in	<u>/exp/volta</u>	e-compar	<u>ator/</u>						
5. To s	tudy log and antilog a	mplifier.								
https:	//ae-iitr.vlabs.ac.in	<u>/exp/log-ar</u>	itilog-amp	<u>lifier/</u>						
CIE As	sessment Pattern (50	0 Marks – La	b)		7					
	RBT Levels	Test (s)	Weekly	Assessment	-					
		20		30	-					
L1	Remember	-		-	-					
L2	Understand	-		5	-					
L3	Apply	10		10	-					
L4	Analyze	5		10	-					
L5	Evaluate	5		5	-					
L6	Create	-		-	J					
SEE As	ssessment Pattern (5	0 Marks – La	ıb)	-						
	RBT Levels	Exam I	Marks							
		Distribut	ion (50)	_						
L1	Remember	-	_	_						
L2	Understand	0	5	_						
L3	L3 Apply 20									
L4	Analyze	1	<u> </u>	_						
L5	Evaluate	10	J	_						
LO	create	-								
Sugge	sted Learning Reso	Irces								
Refer	ence Books:									
1. Anil	1. Anil Kumar Verma, "Scilab A Beginner'S Approach by Anil Kumar Verma, Cengage India". Books from									
1	, erma, oema		PPI Su	~ <i>j</i> - mm nu		,				

same Publisher, ISBN:9789386858931. Cengage India. 2. Sandeep Nagar, "Introduction to Scilab: For Engineers and Scientists Paperback", Apress; ISBN: 1484231910

	OPTICAL COMMUNICATION USING OPTSIM													
Course Code		21ECL	555						CIE	Marks		50		
L:T:P:S	(0:0:1:0)						SEE	Marks		50		
Hrs / Week		2							Tota	al Marks		100)	
Credits	(01							Exa	n Hours		03		
Course outco	omes													
At the end o	of the o	course	, the s	studen	t will b	e able	to:							
21ECL555.1		Demor commເ	istrat unicat	e analo tion.	og and	digital	link, p	ropaga	tion lo	ss, nume	rical ape	erture for	optical	fiber
21ECL555.2]	Recogr	ıize tl	he chai	acteri	stics of	Optica	ıl devic	es					
21ECL555.3]	Design	the r	eceive	r and a	mplifi	ers beh	avior f	or opti	cal comr	nunicati	on		
21ECL555.4	4	Analyz signals	e the	optica	l syste	m perf	orman	ce using	g Eye d	liagram,	Q-factor	& BER o	f optical	
Mapping of	Cour	se Ou	tcom	es to l	Progra	am Ou	tcome	es and	Progr	am Spe	cific Ou	tcomes:		
	PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 3 3 2 2 3 - - 1 -											P012	PSO1	PSO2
21ECL555.1	3	3 3 2 2 3 - - 1 - 3 3 2 2 3 - - 1 -										2	3	3
21ECL555.2	3	3 3 2 2 3 - - 1 - 3 3 2 3 3 - - 1 -										2	3	3
21ECL555.3	3	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$											3	3
21ECL555.4	3	3	2	3	3	-	2	3	3					
Exp. No. / Pgm. No.		List of Experiments / Programs Hours Cos												
			P	rereq	uisite	e Expe	rimer	ıts / P	rogra	ms / De	emo			
		• M	lodula	ation a	nd den	nodula	tion of	ASK, P	SK and	FSK.				
		• W	/orki1	ng of Ll	ED & L	ASER.						2		NT 4
		• T	ypes	of opti	cal fibr	es & th	ieir los	ses.				2		NA
							PAR	T-A						
1	To o soft	design ware.	a bas	ic opti	cal fibe	er comi	munica	tion sy	stem u	sing Opt	Sim	2	21E	CL555.1
2	Mea	surem	nent o	of nume	erical a	pertur	e and b	pending	g loss c	of optical	fiber.	2	21E	CL555.1
3	Mea loss	asuren /conn	nent o ector	of fiber loss by	charac 7 OTDF	cteristi R.	cs, fibe	r dama	ige and	splice		2	21E	CL555.1
4	Tog	genera	te an	intens	ity mo	dulated	d signa	l at the	transn	nitter an	d	2		
	den	nodula	te it a	t the r	eceiver	r using	direct	detecti	ion sch	eme in C	ptSim		21E	CL555.1
	soft	ware.			. (11								245	01 555 0
5	Ske	tch Vol	ltage	vs. cur	rent(V	-1) cha	racteri	stics of	LED.	liodo		2	ZIE	LL555.Z
0	эке		itage	vs. cui	rent(v	-ij cha	ractern	SUCS OF	laser (noue.		2	21E	CL555.2
							PAR	T-B				1	1	
7	Tog	genera	te a P	SK mo	dulate	d signa	al at the	e transr	nitter a	and dete	ct it at	2		
	the soft	receiv ware	er usi	ing hor	nodyn	e and h	ieterod	lyne de	modul	ators in (OptSim		21E	CL555.2
8	То в	genera	te an	intens	ity mo	dulated	d signa	l at the	transn	nitter an	d	2		
	den soft	nodula ware.	te it a	t the r	eceive	r using	direct	detecti	ion sch	eme in C	ptSim		21E	CL555.2
9	Sim	ulatio	1 and	analys	is of A	PD-HE	BT Rec	eiver.				2	21E	CL555.3

	0 Simulation a	nd analysis of	SLA (SOA)	Amplifier ar	nd Raman	2								
	Amplifier.	ia analy 515 01		-	21ECL555.3									
1	1 Simulation a	nd analysis of	WDM syste	ems.		2	21ECL555.4							
1	2 To modulate	a continuous	wave laser	using external	PRBS generator	2								
	and analyze	he BER, Q-fac	tor and eye	diagram obta	ined at the output.		21ECL555.4							
			PA	RT-C										
		Beyond	Syllabus	Virtual Lab	Content									
	(To be d	one during	Lab but n	ot to be incl	uded for CIE or SH	EE)								
1. Stud	y Of LED and Detecto	r Characterist	ics											
https:/	/vlab.amrita.edu/ind	ex.php?sub=5	9&brch=26	69∼=1371	<u>&cnt=3512</u>									
2.Num	erical Aperture of Op	tical Fiber												
https:/	https://vlab.amrita.edu/?sub=1&brch=189∼=343&cnt=2 3 Fiber Ontic Analog and Digital link													
3.Fiber	3.Fiber Optic Analog and Digital link https://ulah.amrita.edu/index.php?sub=59%brch=269%sim=1217%ent=2790													
https:	https://vlab.amrita.edu/index.php?sub=59&brch=269∼=1317&cnt=2780													
4. Fibe	4. Fiber Optic Bi-directional Communication													
https:	<u>//vlab.amrita.edu/</u> i	<u>ndex.php?su</u>	<u>b=59&brc</u>	<u>:h=269∼=</u>	<u>=1372&cnt=3055</u>									
5.Wave	elength Division Mult	iplexing												
https:	//vlab.amrita.edu/i	<u>ndex.php?su</u>	<u>b=59&brc</u>	<u>:h=269∼=</u>	<u>=1373&cnt=3289</u>									
CIE As	sessment Pattern (S	0 Marks - La	b)		-									
	RRT Lovals	Test (s)	Weekly	Assessment										
		20		30										
L1	Remember	-		-										
12	Understand	-		5										
14	L2 Understand - 5													
L2 L3	Apply	10		L3 Apply 10 10										
L2 L3 L4	Apply Analyze	10 5		10 10										
L2 L3 L4 L5	Apply Analyze Evaluate	10 5 5		10 10 5										
L2 L3 L4 L5 L6	Apply Analyze Evaluate Create	10 5 5 -		10 10 5 -										
L2 L3 L4 L5 L6 SEE As	Apply Analyze Evaluate Create ssessment Pattern (S	10 5 5 - 50 Marks – La	b)	10 10 5 -										
L2 L3 L4 L5 L6 SEE As	Apply Analyze Evaluate Create Sessment Pattern (S	10 5 - 50 Marks - La Exam M	b) Marks	10 10 5 -										
L2 L3 L4 L5 L6 SEE As	Apply Analyze Evaluate Create sessment Pattern (S RBT Levels	10 5 5 - 50 Marks - La Exam M Distribut	b) Marks ion (50)	10 10 5 -										
L2 L3 L4 L5 L6 SEE As	Apply Analyze Evaluate Create ssessment Pattern (S RBT Levels Remember	10 5 5 60 Marks – La Exam M Distribut	b) Marks ion (50)	10 10 5 										
L2 L3 L4 L5 L6 SEE As L1 L2	Apply Analyze Evaluate Create ssessment Pattern (S RBT Levels Remember Understand	10 5 5 60 Marks – La Exam M Distribut - 05	b) Marks ion (50)	10 10 5 -										
L2 L3 L4 L5 L6 SEE As L1 L2 L3	Apply Analyze Evaluate Create sessment Pattern (S RBT Levels Remember Understand Apply	10 5 5 60 Marks – La Exam M Distribut 05 20	b) Marks ion (50)	10 10 5 -										
L2 L3 L4 L5 L6 SEE As L1 L2 L3 L4	Apply Analyze Evaluate Create Sessment Pattern (S RBT Levels Remember Understand Apply Analyze	10 5 5 5 60 Marks - La Exam M Distribut - 05 20 15	b) Marks ion (50)											
L2 L3 L4 L5 L6 SEE As L1 L2 L3 L4 L5	Apply Analyze Evaluate Create ssessment Pattern (Free construction of the second of the	10 5 5 5 60 Marks - La Exam M Distribut - 05 20 15	b) Marks ion (50)	10 10 5 										
L2 L3 L4 L5 L6 SEE As L1 L2 L3 L4 L5 L6	Apply Analyze Evaluate Create ssessment Pattern (SRBT Levels Remember Understand Apply Analyze Evaluate Create	10 5 5 5 60 Marks - La Exam M Distribut 05 20 15 10	b) Marks ion (50)											
L2 L3 L4 L5 L6 SEE As L1 L2 L3 L4 L5 L6	Apply Analyze Evaluate Create sessment Pattern (SRBT Levels Remember Understand Apply Analyze Evaluate Create	10 5 5 5 60 Marks - La Exam M Distribut - 05 20 15 10	b) Marks ion (50)											
L2 L3 L4 L5 L6 SEE As L1 L2 L3 L4 L5 L6 Sugge	Apply Analyze Evaluate Create ssessment Pattern (SRBT Levels Remember Understand Apply Analyze Evaluate Create	10 5 5 5 60 Marks - La Exam M Distribut - 05 20 15 10 10 -	b) Marks ion (50)											
L1 L3 L4 L5 L6 SEE As L1 L2 L3 L4 L5 L6 Sugge Refered	Apply Analyze Evaluate Create ssessment Pattern (Free Pattern (Free Pattern) RBT Levels Remember Understand Apply Analyze Evaluate Create sted Learning Resource ence Books: triagl Eihen Community	10 5 5 5 60 Marks - La Exam M Distribut - 05 20 15 10 - 10 -	b) Marks ion (50)		ducation Copy d F	dition 7th	Improgrie							

2010.
 2) "Optical Fiber Communication", Gerd Keiser, 4th Ed., MGH,2008.
 3) Fiber Optic Communication - Joseph C Palais: 4th Edition, Pearson Education,2004

	MINI PROJECT														
Cours	e Cod	e	21EC	E56						CIE I	Marks		50		
L:T:P:	S	(0:0:1:	0						SEE	Marks		50		
Hrs /	Week	(0							Tota	l Marks		10	0	
Credit	S		01							Exar	n Hours		03		
Cours	e outo	comes	:		. .	.11.1									
At the	end of	t the co	ourse,	the st	udent	will be	able to):							
21ECE	56.1		Identif approa	fy tech ach	nnical a	spects	of the	choser	n proje	ct with	a compr	ehensiv	e and sys	stematic	
21ECE	56.2		Reviev	v the l	literatu	ire and	develo	op solu	tions f	or proł	olem stat	ement			
21ECE	56.3	'	Worka	as an	individ	ualor	in a tea	ım in d	evelop	ment c	of technic	cal proje	cts		
21ECE	56.4		Experi	ment	with s	tate-of	-the-ar	t meth	ods an	d analy	ze the av	vailable s	solutions	5	
21ECE	56.5		Impler	nentt	the pro	posed	solutio	n utiliz	zing th	e syste	matic ap	proach			
21ECE	56.6		Extend	l or us	se the i	dea in	mini pi	roject f	for maj	or proj	ect				
Mapp	ing of	f Cour	se Ou	e Outcomes to Program Outcomes and Program Specific Outcomes:											
		P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PS01	PSO2
21ECE	56.1	3	3	-	-	-	-	-	-	3	•	•	•	3	3
21ECE	56.2	3	3	3	-	-	-	-	-	3	3	3	3	3	3
21ECE	56.3	3	3	3	-	-	-	-	-	•	3	3	3	3	3
21ECE	56.4	3	3	3	3	2	-	-	2	3	3	3	3	3	3
21ECE	56.5	2	3	3	3	2	- 2	-	2	3	3	3	3	3	<u> </u>
ZIECE	50.0	5	3	3	3	2	2	1	<u>_</u>	3	3	3	3	3	3
CIE As	sessn	nent P	atterr	ı (50	Marks)									
	RB	T Leve	els		E Dist	xam M ributi	arks on (50)							
L1	l	Remer	nber			-									
L2	I	Jnder	stand			-									
L3	I	Apply				20									
L4	I	Analyz	ze			10									
L5	l	Evalua	ite			10									
L6	(Create	;			10									
SEE As	ssessr	nent F	Patter	n (50	Marks	5)									
	RBT Levels Distribution (50)														
L1	Ren	nembe	er			-	()								
L2	Und	derstand -													
L3	Арр	ly				20									
L4	Ana	lyze				10									
L5	Eva	luate				10									
L6	Crea	ate				10									

	RESEARCH METHODOLOGY AND IPR														
Course Code	21	ECK5	7						CIE M	arks		50			
L:T:P:S	1:0	:0:0							SEE M	larks		50			
Hrs / Week	02								Total	Marks		10	0		
Credits	01								Exam	Hours		02			
Course outco	mes:	At the	end o	f the co	ourse, t	he stuc	dent w	ill be a	ble to:	-					
21ECK57.1	Ch	aract	erize t	he sign	ificanc	e and s	uitabil	ity of 1	researc	h in eng	ineerin	g applic	ations		
21ECK57.2	De	mons	strate t	he var	ious pr	ocessir	ng tech	nique	s of rese	earch					
21ECK57.3	Ev	aluate	e the r	esearc	h in the	develo	opmen	t of en	gineeri	ng mate	rials, pi	ocess a	nd tools		
21ECK57.4	An	nalyze	criter	ia to fi	t own ii	ntellect	tual wo	ork in j	particul	ar form	of IPR				
21ECK57.5	Ар	ply st	tatutor	y prov	isions t	o prot	ect par	ticula	r form o	of resear	rch				
21ECK57.6 Develop the art of scholarly writing and evaluate its quality Manning of Course Outcomes to Program Outcomes and Program Specific Outcomes:															
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:															
P01 P02 P03 P04 P05 P06 P07 P08 P09 P010 P011 P012 PS01 PS02 21ECK57.1 3 3 3 - - - 3 3 2 3 3 2															
21ECK57.1	3 3 3 - - - - 3 3 2 3 3 2 3 3 3 1 2 - - 3 3 2 3 3 2 3 3 3 1 2 - - 3 3 2 3 3 2														
21ECK57.2	3	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$													
21ECK57.3	3	3 3 1 2 - - 2 3 3 2 3 3 2													
21ECK57.4	3	3	-	-	-	-	-	2	3	3	2	3	3	2	
21ECK57.5	3	-	-	-	-	-	-	2	3	3	2	3	3	2	
21ECK57.6	3	3	3	1	2	-	-	1	3	3	2	3	3	2	
MODULE-1	RES	SEAR	CH FO	RMUL	ATION	AND I	DESIGN	N		2	1ECK5 1ECK5	7.1, 57.2	3 H	lours	
Definition and	objec	ctive c	of rese	arch, ty	pes of	resear	ch, ste	ps in r	esearch	n proces	s, resea	rch desi	gn, conc	ept and	
types of resea	rch d	esign	, defin	ing an	d form	ulating	the r	esearc	h probl	ems, in	nportan	ce of lit	erature i	review-	
primary and s	econd	ary so	ources	, revie	ws, moi	nograp	hs, pat	ent, re	esearch	databas	se, web	sources	, identify	ing gap	
areas from the	litera	ature :	and re	search	data ba	ase, sui	rveying	g syntl	<u>iesis, In</u>	terpret	ation.	.1			
Self-study / Ca	ise Sti	ıdy	Explo	ore how	v to alig	gn rese	earch q	uestio	ns and	objectiv	res with	the app	ropriate		
/ Applications	5		Toyt	rcn pr Rook 1	$\frac{\text{oblem}}{1}$	28.6									
Text DOOK			Text	DOOK	: CII. 1,	200					21FCK	572	31	Jours	
MODULE-2	SAI	MPLI	NG &	DATA	INTER	PRET	ATIO	N			21ECK	57.3	51	10015	
Mathematical	tools	for ar	nalysis	, statis	tical an	alysis (of data	, regre	ession a	nalysis,	correla	tion, co	ncept of	best fit	
and exact fit, e	xact fi	it, the	ory, ex	ample	s from	linear	regres	sion w	ith one	and mo	re unkr	iowns.	• 1	1.	
Self-study /	E	xplore	e diffei	ent da	ta colle	ction t	ecnniq	ues as	sociate	a with e	eacn me	thodolo	gy, inclue	ling	
Applications	St	ii vey:	s, mei	views,	observ	ations	, and u	ocume	ent anai	ysis.					
Text Book	Т	ext Bo	ook 1:	Ch. 4&	7										
	DA	TENIT		TC AN						2	21ECK	57.3,	31	Hours	
MUDULE-3		I EIN I	кібЦ	1 3 AN	U IPK			1.			21ECK	57.4		~	
Patents and its	s basic	cs, pro	ocess o	t tiling	patent	at nati	ional a	nd inte	ernatio	nal leve	l, Introd	luction a	ind signi	icance	
Administration	prope	erty fi atent	giiiS, C systan	omme: 1 in Inc	i cializa lia lice	uun, ro nsing a	yaity,	copyri nsfer (igiit, tra of techn	ue reiat	eu aspe	ties OF IF	ΥК,		
Auministratio	n or pa	atent	systell	1 111 1110	iia, iicel	iisiiig a	inu tra	113161 (n tetiili	ology, C	ase siu				

Self-study /	Examine how startups develop and implement intellectual property strategies to protect their innovations, considering patents, trademarks, copyrights, and trade secrets.												
Applications	millovacions,	constacting	5 patentis, trademarks, e	opyrigii	ts, and	trade secrets.							
Text Book	Text Book 2:	Ch. 1 & 2/	IPR India website.										
MODULE-4	RESEARCH	AND PUBLI	CATIONETHICS			21ECK57.4, 21ECK57.5	3 Hours						
Research and	Integrity, Scien	ntific mis c	onduct: Falsification, Fa	abricatio	on and	Plagiarism (FFP),	Conflict of						
research, Pre	latory publish	ers and Jo	urnals, Open access p	ublicatio	on, cita	ation and acknow	ledgement,						
reproducibilit	y and accounta	bility, softw	are tools for similarity o	check.									
Self-study /	Explore the e	ethical issue	es surrounding data fabi	rication	and im	age manipulation i	n research						
Case Study /	publications												
Applications		Cl 140.1	-										
Text Book	Text Book 1:	Ch. 14 & 15)				2.11.01170						
MODULE-5	REPORT WI	RITING				21ECK57.6	3 HOURS						
Structure and	components of	omponents of research report, types of report, layout of research report, mechanism of writing											
a research rep	ort, referencing in academic writing, Abstracting, Bibliography.												
Self-study /	Report Writing in a Emerging technology.												
Case Study /													
Applications													
Text Book	Text Book 1:	Ch. 14											
CIE Assessme	nt Pattern (50) Marks - T	'heorv) –										
			Marks Distribution										
RBT	Levels	Test (s)	Qualitative Assessment (s)	МС	Q's								
		25	15	1	0								
L1 Rem	ember	5	-		-								
L2 Und	erstand	5	-		-								
L3 App	У	5	5	Į,	5								
L4 Anal	yze	5	5	ŗ	5								
L5 Eval	uate	5	5		-								
L6 Crea	te	-	-		-								
SEE Assessme	ent Pattern (5	0 Marks - T	Theory)										
RBT I	.evels	Exam	Marks										
L1 Reme	mher	DISUIDU											
L2 Unde	rstand		10										
L3 Apply	, ,	-	10										
L4 Analy	ze	-	10										
L5 Evalu	ate	-	10										
L6 Creat	e												
Suggested Le	arning Resou	irces:											
Text Books													
1) Kothari, 13: 978-	C.R., "Researcl 8122436235	n Methodol	ogy: Methods and Tech	iniques	". New	Age International	, 2018, ISBN-						
2) Ramakr	ishna Chintakı	unta, A Text	book of Intellectual Pr	operty	rights,	Blue Hill Publicati	on, ASIN:						

Reference Books:

1) Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K, An introduction toResearch Methodology, RBSA

Publishers. 2015, ISBN-13:978-8176111652

- 2) Ranjith Kumar, Research methodology, Saga publications,4th edition, 2014, ISBN-13- 978-9351501336Anderson, T. W., "An Introduction to Multivariate Statistical Analysis", Wiley Eastern Pvt., Ltd., New Delhi, 2011, ISBN-13: 978-8126524488
- 3) Montgomary, Douglas C. & Runger, George C. (2016) 6/e, Applied Statistics & probability for Engineers (Wiley India) ISBN-13: 978-1118539712
- 4) Montgomary, Douglas C. (2012) 8th edition, Design and Analysis of Experiments (Wiley India) ISBN: 978-1-118-14692-7
- 5) Sinha, S.C. and Dhiman, A.K., 2012. Research Methodology, EssEss Publications. 2 volumes. ISBN : 81-7000-324-5, 81-7000-334-2

Web links and Video Lectures (e-Resources):

- <u>https://onlinecourses.nptel.ac.in/noc22_ge08/preview</u>
- <u>https://www.youtube.com/watch?v=zY6Xf87GAyg</u>
- <u>https://guides.library.stanford.edu/qualitative research</u>
- https://onlinecourses.nptel.ac.in/noc21 hs08/preview

<u>https://mitxonline.mit.edu/courses/course-v1:MITxT+21A.819.2x/</u>

- > Demonstration of LaTeX writing.
- > Demonstration of design patent templates.
- > Contents related activities (Activity-based discussions).
- > Organizing Group wise discussions on ethics of research.

INNOVATION AND DESIGN THINKING															
Course Code	21	LECK5	8						CIE I	Marks		50			
L:T:P:S	1:	0:0:0							SEE	Marks		50			
Hrs / Week	01	L							Tota	ıl Marks		10	0		
Credits	01	L							Exar	n Hours	;	01			
Course outco	mes:	: At the	e end	of the	course	, the st	udent	will be	able to	:					
21ECK58.1	Ar	ticulat	te a co	omprel	hensive	e unde	rstandi	ng of tl	he con	cept of D	esign Th	inking			
21ECK58.2	Ap	oply De	esign	Thinki	ng met	hodol	ogies to	o solve	comple	ex and a	nbiguou	s proble	ms effect	ively	
21ECK58.3	Ut	ilize d	esign	thinki	ng tool	s for ci	reative	solutio	ons						
21ECK58.4	Im	npleme	ent de	sign th	ninking	in IT t	hat sho	owcase	the ab	oility to d	rive mea	aningful	innovatio	on	
21ECK58.5	De	evelop	strate	egic in	novatio	on for I	Busines	ss Mod	el Desi	gn					
21ECK58.6	Cr	eate th	ne Mir	nimum	ı Viable	e Produ	uct to s	olve so	cietal r	needs us	ing Desi	gn Think	ing		
Mapping of C	our	se Out	tcom	es to l	Progra	ım Ou	tcome	s and	Progra	am Spe	cific Ou	tcomes:			
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PSO1	PSO2	
21ECK58.1	3	-	- - - - - 3 3 - 3 3 2 3 2 - - - - 3 3 - 3 3 2												
21ECK58.2	3	3	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$												
21ECK58.3	3	3	3 2 - - - - - 5 5 - 5 5 2 3 2 - 2 - - - 3 3 - 3 3 2												
21ECK58.4	3	3	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$												
21ECK58.5	3	3	3 2 2 2 - - 3 3 - 3 3 2 3 2 2 - - - - 3 3 - 3 3 2												
21ECK58.6	3	3	2	2	2	1	1	1	3	3	1	3	3	2	
MODULE-1	U	NDERS	STAN	DING I	DESIGN	N THIN	IKING				21ECK5 21ECK5	58.1 58.2	3 H	ours	
Definition, Ori	gin a	and fe	ature	s of D	esign T	hinkir	ıg, Des	ign thi	nker iı	n organi	zation, I	Principle	s and sta	ages of	
Design thinking	ng. I	Design	Shai	red m	odel ii	n tean	n-based	d desig	gn, Th	eory an	d practi	ce in D	esign th	inking.	
Collaborative of	lesig	gn thin	king.	Live ex	kample	s of M	VP or P	rototy	ping.						
Self-study /	St	udy th	e imp	ortanc	e of etl	nics in	design	and ho	ow to c	reate pro	oducts tł	nat are so	ocially		
Case Study /	re	sponsi	ible.												
Applications															
MODULE-2	T	OOLS I	FOR D	DESIGN	I THIN	KING					21ECK	58.3	3 H	lours	
Visualization, J	ourr	ney ma	pping	g, Valu	e Chain	I Analy	sis, Th	e mind	map, F	Rapid Co	ncept de	velopme	nt, Assuı	nption	
testing, Protot	ype,	Co cre	ation,	, Learn	ing lau	nches	and Sto	orytelli	ng.						
Self-study /	S	Study t	the po	pular	design	thinki	ng tool	s and s	oftwar	e like Mi	ro, Figm	a, and A	dobe XD		
Case Study /															
Applications															
MODULE-3	D	ESIGN	THIN	KING	IN IT						21ECK	58.4	3 H	lours	
Business proce	ess n	iodelli	ng (B	PM). A	gile in	Virtua	l collab	oratio	n envir	onment.	Scenari	o based l	Prototyp	ing.	
Case studies of	n De	sign th	inkin	g											
Self-study /	Ar	alyze	how a	a tech s	startup	applie	ed desig	gn thin	king to	create u	iser-frie	ndly and	highly-r	ated	
Case Study /	m	obile a	pplica	ations,	drivin	g user	engage	ement a	and rev	enue gro	owth.				
Applications	_														
MODULE-4	D	ESIGN	THIN	IKING	FUR S	FRATI	GIC IN	INUVA	TION		21ECK	<u>58.5</u>	3 H	iours	
Strategic mana	agen	ient ai	nd Ini	novatio	on mar	ageme	ent, Ty	pes of	Innova	tions, Fe	eatures a	ind Scop	e of stra	tegic	
innovations, D Innovation.	esig	n thin	king a	and str	ategic	innova	ation, F	ractice	es of in	itegratin	g Desigr	i thinkin	g in Stra	tegic	
Self-study /	St	udv th	e late	st tron	ds and	devel	nment	ts in th	e field i	of innov	ation and	d design	thinking		
Case Study /	50	uuy ill		51 11 11	as and	acven	phiem		c neiu	01 11110 00	actori and	a ucoigii	unning		
Applications															

MODU	JLE-5 DESIGN TH	INKING WORK S	бнор		21	ECK58.6	3 Hours						
Focus,	Focus, Need and stages of Design thinking workshop. Empathize, Design, Ideate, Prototype and Test.												
Case St	tudy Remote heal providers.	Ith monitoring so	olutions to provide r	eal-tim	e data for	patients and hea	lthcare						
CIE As	sessment Pattern (50) Marks – Theor	ry) –										
			Marks Distributio	n									
	RBT Levels	Test (s)(15)	Assignment (10)	Se Acti	minar/ vity (25)								
	ſ	15	10		25	_							
L1	Remember	5	-		-	_							
L2	Understand	5	-		5	4							
L3	Apply	5	5		5	_							
L4	Analyze	-	5		10	_							
L5	Evaluate	-	-		5	_							
L6	Create	-	-		-								
SEE As	ssessment Pattern (5	<u>0 Marks – Theo</u>	ry)										
	RBT Levels	Exam Mar Distribution	ks (50)										
L1	Remember	10											
L2	Understand	25											
L3	Apply	15											
L4	Analyze												
L5	Evaluate												
L6	Create												
Sugge	sted Learning Resou	irces:											
1.	Christian Mueller-Ro	oterberg, Handbo	ook of Design Thinki	ng - Tip	os & Tools	for how to design	n thinking.						
2.	John.R.Karsnitz, Ste (International editio	phen O'Brien a n) Second Editio	nd John P. Hutchin n, 2013.	son, "I	Engineerin	g Design",Cenga	ge learning						
3.	Roger Martin, "Th Advantage",Harvard	e Design of Business Press,	Business: Why De 2009.	esign	Thinking	is the Next (Competitive						
4.	Hasso Plattner, Chri Apply", Springer, 20	stoph Meinel an 11	d Larry Leifer (eds)), "Desi	ign Thinkiı	ng: Understand -	- Improve -						
5.	Yousef Haik and Ta	mer M.Shahin, '	'Engineering Design	Proce	ess", Cenga	geLearning, Sec	ondEdition,						
6.	Book - Solving Probl Publishing) Hardcov	ems with Design er – 20 Sep 2013	Thinking - Ten Stor by Jeanne Liedtka (A	ies of V Author]	Vhat Work), Andrew F	s (Columbia Bus King (Author), Ke	inessSchool vin Bennett						
(Author). Web links and Video Lectures (e-Resources): • https://www.ibm.com/design/thinking/ • https://www.ideou.com/pages/design-thinking • https://www.youtube.com/watch?v=3RemkU4BH8U													
Activi 1. 2. 3.	 <u>https://www.ideou.com/pages/design-thinking</u> <u>https://www.youtube.com/watch?v=3RemkU4BH8U</u> <u>ctivity-Based Learning (Suggested Activities in Class)/ Practical Based learning</u> Problem Definition Through Observation. Provide materials to create paper prototypes of a user interface or physical product. Organizing the brainstorming sessions where students generate creative ideas to solve a specific problem. 												

SIXTH SEMESTER

(SYLLABUS)

	OPERATIONS RESEARCH AND MANAGEMENT													
Course Code	21E0	CE61							CIE	Marks		50		
L:T:P:S	3:0:0	0:0							SEE	Marks		50		
Hrs / Week	3								Tota	ıl Marks	;	10	0	
Credits	03								Exai	n Hours	;	03		
At the end o	o mes: f the c	ourse,	the st	udent	will be	able to):							
21ECE61.1	Appl	y basic	c prin	ciples o	of proje	ect mar	nageme	ent for	real tin	ne probl	ems			
21ECE61.2	Pron roles	note er s with 1	trepi respe	reneurs ct to gr	ship as owth o	an ind f econ	ividual omic de	or as a evelopi	i group ment	by crea	ting awa	reness o	n its nee	ds and
21ECE61.3	Deve	elop so	lutior	is for b	arriers	in sma	all scale	e indus	tries					
21ECE61.4	Calcu	ulate tł	ne int	erest ra	ates, ca	sh flov	vs and	costing	g mater	ials, pro	duction a	and over	heads	
21ECE61.5	Anal	yse the	e sequ	ience o	f jobs o	on vari	ous ma	chines						
21ECE61.6	Apply the game theory concepts to determine the optimal solutionf Course Outcomes to Program Outcomes and Program Specific Outcomes:													
Mapping of	Course Outcomes to Program Outcomes and Program Specific Outcomes:P01P02P03P04P05P06P07P08P09P010P011P012PS01PS02													
04505(4.4	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PS01	PSO2
21ECE61.1	3	-	-	-	-	-	-	-	-	-	2	2	2	2
21ECE61.2	3	-	-	-	-	1	1	1	-	-	2	2	2	2
21ECE01.3	3	- 2	2	-	-	1	1	1	-		2	2	2	2
21ECE61.5	3	2	2	-	-	-	-	-	-	-	2	2	2	2
21ECE61.6	3	2	2	-	1	-	-	-	-	-	2	2	2	2
MODULE 1	BAS	ICS OF	PRO	JECT M	IANAG	EMEN	Т				21ECE6	1.1	8 H	lours
Introduction, phases of pro project leader	Defini oject lii r.	ition of fe cycl	f proj e mai	ect, ch 1ageme	aracter ent, imj	ristics of pact of	of proj f delays	ects, ty s in pro	pes of oject co	projects ompletio	, need fo ns, roles	or projects and res	t manag ponsibil	ement, ities of
Self-study / C Applications	ase Sti	udy /	Cre	ate pro	oject m	nanage	ement j	olan by	v takin;	g any re	al time p	project a	s examp	ole.
Text Book			Tex	t Book	3: 1.1,	1.1, 1.8	8, 1.9, 1	.10, 1.	18, 1.1	6.				
MODULE 2	ENT	REPRE	ENEU	R AND	SSI						21ECE	51.2 51 3	8 H	lours
Meaning of F	I Entren	reneur	Fun	ctions	of an	Entrer	reneu	r Tvne	es of E	ntreprei	reur Sta	iges in e	entrenre	neurial
process; Role Entrepreneur SSI Impact of Government	e of en ship - f Liber for SSI	trepre its Bar alizati . Mean	neurs riers, on, P ing. N	in Eco rivatiza lature o	onomic ation, (: Devel Globali	opmen zation	on SSI	eprene Effect	eurship i of WTC	n India;)/GATT Help.	women Supporti	entrepro	eneurs, icies of
Self-study /	L	ist ou	t soi	ne of	the S	mall-S	cale I	ndustr	ies w	hich are	e mainly	y focus	ed on v	vomen
Case Study / Applications	e	mpow	erme	nt.								, ,		
Text Book	Т	ext Bo	ok 4:	2.2, 2.3	s, 2.4 to	2.15								
MODULE 3	INTE	EREST,	, CAS	H FLOV	N, EST	IMATI	ON AN	D COS	TING		21ECE	51.4	8 H	lours
Law of demar Compound in	nd and terest,	supply Cash -	y, Lav · flow	v of ret diagra	urns, Iı ms, Pe	nterest rsonal	and In loans a	iterest ind EM	factors I Paym	: Interes ent, Exe	t rate, Si rcises an	mple int d Discus	erest, sion.	
Administrativ	of cost ve Ove	s such r-Head	as Di s, Fir	rect Ma st cost,	Margi	Losts, I nal cos	t, Sellir	Labor (ng price	.osts, F e, Estin	ixed Ove	er-Heads r simple	, Factory compon	v cost, ents.	

Text Bo	ok Text Book 5: 2	2.1 to 2.10											
MODU	LE 4 SEQUENCING	ì				21ECE61.5	5 8 Hours						
Basic as	sumptions, sequencir	ng 'n' jobs o	n single machi	ine using pi	riority ru	ıles, sequencing us	sing Johnson's rule-						
'n' jobs	on 2 machines, 'n' job	s on 3 macł	nines, 'n' jobs c	on 'm' mach	ines. Seo	quencing 2 jobs on	'm' machines using						
graphic	al method.												
Case Sti	ady Case study on	i sequencin	ng by taking an	ny real tim	e examp	oles.							
Text Bo	ok Text Book 2 : (Chapter 11											
MODU	LE 5 GAME THEOR	(Y				21ECE61.6	6 8 Hours						
Formula	ation of games, Two p	person-Zero	o sum game, ga	ames with	and with	out saddle point,	Graphical solution						
(2x n, m	1 x 2 game), dominanc	e property.	1 4 1 *	1.0		1							
Case Sti	ady Case study on	i game theo	bry by taking a	any real th	ne exan	iples.							
Text Bo	ok Text Book 2: C	hapter 14											
CIE Ass	<u>CIE Assessment Pattern (50 Marks – Theory) –</u> Marks Distribution												
Marks Distribution													
RBT LevelsTest (s)Qualitative Assessment (s)MCQ's													
	25 15 10												
L1	23 13 10 L1 Remember 5 - 5												
L2	L1Remember5-5L2Understand10-5												
L3	L2 Onderstand 10 - 5 L3 Apply 5 5 -												
L4	L3 Apply 5 5 - L4 Analyze 5 5 -												
L5	Evaluate	-	5		-								
L6	Create	-	-		-								
SEE Ass	sessment Pattern (5	<u>0 Marks - 1</u>	Theory)										
	RBT Levels	Exam	Marks										
11	Domomhor	Distribu	ition (50)										
	Kemember		20										
13	Annly	-	10										
	Apply		10										
LT	Fvaluate		-										
L5 L6	Create												
Sugges	ted Learning Resou	irces:											
Text I	Books:												
1.	Operations Research	: An Introd	uction, H A Tal	na, Pearson	; 10th ec	lition (17 January2	2017), ISBN-13: 978-						
2.	Operation Research	n, S D Sł	narma, Kedar	Nath Ran	nNath p	oublication, 2014	edition, ISBN-13:						
3.	Contemporary Proje	ect Manager	ment, Timothy	y J Klopper	nborg, C	engage Learning,	2 nd Edition, ISBN:						
4.	97881315187 Project Management	t a System	approach to I	Planning So	chedulin	g & Controlling. F	larold Kerzner. CBS						
	Publishers and Distr	ibutors.2nd	Ed., ISBN: 978	881239086	570	,							
5.	Engineering Econom	y, Riggs J.L.	, 4 TH ed. , Mc	Graw Hill, 2	2002								
6.	Engineering Econon	ny, Thuesen	i H.G. PHI , 200)2									
Web liı	nks and Video Lectu	ures (e-Re	sources):										
•	https://onlinecou	rses.nptel.	.ac.in/noc22	ge24/pre	eview								
•	https://projectma	nagement	.berkeley.ed	u/project	-manag	emenet-course/	<u></u>						
•	https://www.you	<u>itube.com</u>	n/watch?v=o	<u>cwxXY9Q</u>	<u>e8ss</u>								
•	https://www.yout	ube.com/v	watch?v=V20	<u>GvQXvjhL</u>	1								

<u>https://nsf-gov-resources.nsf.gov/2023-03/Bio-inspired%20Design%20Workshop%20Report 2232327 October%202022 Final.508.pdf</u>

- Demonstration of project management by taking any real time examples.
- Demonstration of implementation of game theory in industries.
- Demonstration of application of sequencing in the industries.
- Motivational videos from a women entrepreneur.
- Contents related activities (Activity-based discussions)
 - > For active participation of students, instruct the students to prepare Flowcharts and Handouts.
 - > Organizing Group wise discussions on issues.
 - Seminars.

EMBEDDED SYSTEM DESIGN														
Course Code	21E	ECE62						CI	E Marl	ks		50		
L:T:P:S	3:0	:0:0						SE	E Mar	ks		50		
Hrs / Week	3							Тс	otal Ma	arks		10)	
Credits	03							Ex	am Ho	ours		03		
Course outco	mes: A	At the o	end of t	he coui	se, the	studer	nt will b	oe able	to:					
21ECE62.1	App	ly the	feature	es of pro	ocessoi	rs, Men	ory, I/	0 and	commı	unicatio	on inter	faces i	n develo	ping
21ECE62.2	Use	softw	are dev	n elopme	ent tool	s to de	sign en	ıbedde	ed syste	ems				
21ECE62.3	Con	npare	the pro	gramm	er's mo	del of	Cortex	M proc	cessors	to give	e frugal	solutio	ons for re	eal
	wor	<u>ld pro</u>	blems	-	114			-		, .				
21ECE62.4	Des	ign co	mputat	ional m	odels f	or hard	lware a	and sof	tware	design				
21ECE62.5	Apply the concept of RTOS in embedded system applications Engage in self-learning in analyzing and carry out embedded projects													
21ECE62.6 Engage in self-learning in analyzing and carry out embedded projects														
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:														
	Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:P01P02P03P04P05P06P07P08P09P010P011P012PS01PS02													
21ECE62.1	3	PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PS01 PS02 3 - - - - - - 3 3 2 3 3 3 3 - - - - 3 3 2												
21ECE62.2	3	3 - - - - - - - 3 3 2 3 3 - 3 - - - - - 3 3 2 3 3 - 3 - - - - - 3 3 2 3 3 - - - - - - 3 3 2 3 3 - - - - - - 3 3 2 3 3 - - - - - - 3 3 2												
21ECE62.3	3	3 3 - 3 - - - - 3 3 2 3 3 2 3 2 2 - - - 3 3 2 3 3 2 3 2 2 - - - 3 3 2												
21ECE62.4	3	3	3	-	3	-	-	-	-	-	-	3	3	2
21ECE62.5	3	-	-	-	-	-	-	-	-	-	-	3	3	2
21ECE62.6	3	3	3	2	3	2	2	-	2	1	-	3	3	2
MODULE-1	INT	RODI	UCTION	ν το	EMBE	DDED	SYSTI	EMS		21	ECE62	2.1	8 H	lours
What is an	Embeo	dded	System	ı?, Emb	edded	Syste	ms Vs	Gene	eral Co	omputii	ng Sys	tems,	Classific	ation
of Embedded	Syster	n, Maj	jor App	licatio	n areas	s of En	nbedde	d Syst	em, Pu	irpose	Embed	ded	System,	The
Innovative Bo	onding	of lif	estyle	with E	mbedd	ed Tec	hnolog	ies. Co	re of th	ie Emb	edded	System	, Sensor	s and
Actuators, Me	mory,	Comm	unicati	on Inte	rface, E	Embedd	led Firi	nware	•					
Self-study / Ca	ase Stu	dy	Discuss	s the ro	le of en	nbedde	d oper	ating s	ystems	s in sma	artphor	nes and	smart T	Vs.
/ Application	S													
Text Book			Text Bo	ook 1: 1	.1, 1.2,	1.3, 1.4	r, 1.5, 1	.6, 1.7,	2.1, 2.2	2, 2.3.1,	2.3.2, 2	2.4, 2.4.	1, 2.4.2,	2.5
MODULE-2	IN'I PRO	RODU	JCTION SORS	N ТО А	RM CC	ORTEX	М			21	LECE62	2.2	81	lours
What are AR	M Cort	ex M I	Process	ors?, Fe	eatures	of Cor	tex M3	and M	4, Adva	antages	and A	pplicati	ons of C	ortex
M Processors.				C.	P			6	5	,		0		. 1
Introduction applications.	to Ei softwa	mbedo are flo	ied So	oftware roconti	Deve oller iu	lopmei iterfac	nt: So es.	oftware	e Deve	lopmei	nt flo	ow, Co	mpiling	the
Self-study /	Di	scuss	how en	bedde	d syste	ms in g	aming	consol	es mar	nage tas	sks like	rendei	ing grar	hics.
Case Study /	pr	ocessi	ng user	input.	and pr	oviding	z netwo	ork con	nectiv	itv for o	online g	gaming		,
Applications	Г		0	1 ,	F		,			- J	(5- 0		
Text Book	Τe	ext Boo	ok 1: 1.	1, 1.2, 3	3.2, 1.3,	2.3, 2.	4, 2.5,	2.8						
MODULE-3	AR	M- 32	BIT M	ICROC	ONTR	OLLER	FAMI	LY		21	ECE62	2.3,	81	lours
Cortov MA Do	sice A	rchite	cture e	FADM	ortor	MAD	ock di	aram	of AD	M Com	LEUEOA	0nor	tion m	odos
and states, R	egister et Sum	rs, Spe imary.	ecial Re	gisters	s, Data	type, l	Memor	y Syst	em, Ex	ceptio	ns and	interr	upts ,De	ebug,

Self-stu	udy /	Create a net	work of wir	eless sensors that monito	or environme	ental parameters lil	ke						
Case St	tudy /	temperature	, numidity,	and air quality.									
Applica Terret D	ations	Track Datala (41014		16 676								
Text Bo		Text BOOK -2	: 4.1, 3.1.4,	4.2, 4.4, 4.5, 4.7, 5.6.1-5.6	.15, 5.7.5	2150562 5	0 Hours						
MODU	LC-4		E SUF I WA Model Ind	C CO-DESIGN AND		21ECE02.5	onours						
Funda	mental I	ssues in Har	dware So	ftware Co-Design, Com	putational	Models in Embed	ded Design,						
Introd	uction to	o Unified Mod	lelling Lang	guage, Hardware Softwa	re Trade-of	fs.							
Self-stu	udy /	Create a sm	art traffic n	nanagement system and	try to inclu	de the hardware-s	software co-						
Case St	tudy /	design princ	ciples and p	orogram modelling.									
Applic	ations												
Text Bo	ook	Text Book 1	: 7.1, 7.2, 7.	3, 7.4									
MODU	ILE-5	3-5 REAL TIME OPERATING SYSTEM (RTOS) BASED 21ECE62.6 8 Hours EMBEDDED SYSTEM DESIGN											
	EMBEDDED SYSTEM DESIGN												
Operating system basics, Types of operating systems, Tasks, Process and threads, Multiprocessing and Multitasking, Task Scheduling. The embedded product development lifecycle.													
Self-sti	udv /	Build a hom	e automati	on system that controls	lights, temp	erature, and secu	rity using an						
Case S	Study /	RTOS.		j	8, ·· ·	· · · · · · · · · · · · · · · · · · ·	-y						
Annlia	ationa												
Applic		T : D 14											
Text Bo	ook	Text Book 1:	15.1-15.4										
CIE As	sessmer	t Pattern (50) Marks – T	'heory)		-							
				Marks Distribution		_							
		_		Oualitative									
	RBT L	evels	Test (s)		MCO's								
	RBT L	evels	Test (s)	Assessment (s)	MCQ's	_							
		evels	Test (s)	Assessment (s) 15	MCQ's	-							
L1	RBT L	mber	Test (s) 25 5	Assessment (s) 15	MCQ's 10 5	_							
L1 L2	RBT L	mber rstand	Test (s) 25 5 5	Assessment (s) 15 - -	MCQ's 10 5 5	-							
L1 L2 L3	RBT L	evels mber rstand	Test (s) 25 5 10	Assessment (s) 15 - - 5 -	MCQ's 10 5 5 -	-							
L1 L2 L3 L4	RBT L Reme Unde Apply Analy	mber rstand ze	Test (s) 25 5 10 5	Assessment (s) 15 - - 5 5 5	MCQ's 10 5 - - -	-							
L1 L2 L3 L4 L5	RBT L Reme Unde Apply Analy Evalu	mber rstand ze ate	Test (s) 25 5 10 5 -	Assessment (s) 15 - - 5 5 5 5 5	MCQ's 10 5 - - - -								
L1 L2 L3 L4 L5 L6	RBT L Reme Unde Apply Analy Evalu Creat	mber rstand ze ate e	Test (s) 25 5 10 5 - - -	Assessment (s) 15 - - 5 5 5 5 - -	MCQ's 10 5 - - - - - - -								
L1 L2 L3 L4 L5 L6 SEE As	RBT L Reme Unde Apply Analy Evalu Creat	evels mber rstand ze ate e nt Pattern (50	Test (s) 25 5 10 5 - - 0 Marks - 1	Assessment (s) 15 - - 5 5 5 - Theory)	MCQ's 10 5 - - - - -								
L1 L2 L3 L4 L5 L6 SEE As	RBT L Reme Unde Apply Analy Evalu Creat sessmer RBT Lo	evels mber rstand ze ate e e nt Pattern (50 evels	Test (s) 25 5 10 5 - - 0 Marks - 1 Exam Distribu	Assessment (s) 15 - - 5 5 5 - Theory) Marks ttion (50)	MCQ's 10 5 - - - - -								
L1 L2 L3 L4 L5 L6 SEE As	RBT L Reme Unde Apply Analy Evalu Creat ssessmer RBT Lo Remer	evels mber rstand ze ate e nt Pattern (5) evels nber	Test (s) 25 5 10 5 - - 0 Marks - 1 Exam Distribut	Assessment (s) 15 - - 5 5 5 - Theory) Marks ition (50) 10	MCQ's 10 5 - - - - -								
L1 L2 L3 L4 L5 L6 SEE As L1 L2	RBT L Reme Unde Apply Analy Evalu Creat RBT L RBT L Remer Under	evels mber rstand ze ate e e nt Pattern (50 evels nber stand	Test (s) 25 5 10 5 - 0 Marks - 1 Exam Distribut	Assessment (s) 15 - - 5 5 5 - Theory) Marks ttion (50) 10 10	MCQ's 10 5 - - - - -								
L1 L2 L3 L4 L5 L6 SEE As L1 L2 L3	RBT L Reme Unde Apply Analy Evalu Creat Sessmer RBT L Remer Under Apply	evels mber rstand ze ate e nt Pattern (50 evels nber stand	Test (s) 25 5 10 5 - 0 Marks - 1 Exam Distribu 1 2	Assessment (s) 15 - - 5 5 5 - Theory) Marks tion (50) 10 10 20	MCQ's 10 5 - - - - -								
L1 L2 L3 L4 L5 L6 SEE As L1 L2 L3 L4	RBT L Reme Unde Apply Analy Evalu Creat sessmer RBT Lo Remer Under Apply Analyz	evels mber rstand ze ate e nt Pattern (5) evels nber stand	Test (s) 25 5 10 5 - 0 Marks - 1 Exam Distribut	Assessment (s) 15 - - 5 5 5 - Theory) Marks tion (50) 10 10 20 10	MCQ's 10 5 - - - - -								
L1 L2 L3 L4 L5 L6 SEE As L1 L2 L3 L4 L5	RBT L Reme Unde Apply Evalu Creat RBT L RBT L RBT L RBT L RBT L RBT L RBT L RBT L R RBT L R R R R R R R R R R R R R R R R R R R	evels mber rstand ze ate e nt Pattern (5) evels nber stand se te	Test (s) 25 5 10 5 - 0 Marks - 1 Exam Distribut 1 2 1 2 1	Assessment (s) 15 - - 5 5 5 - Theory) Marks tion (50) 10 10 20 10 -	MCQ's 10 5 - - - - -								
L1 L2 L3 L4 L5 L6 SEE As SEE As L1 L2 L3 L4 L5 L6	RBT L Reme Unde Apply Analy Evalu Creat RBT L RBT L Remer Under Apply Analyz Evalua Create	evels mber rstand ze ate e e t Pattern (50 evels nber stand e te	Test (s) 25 5 10 5 - 0 Marks - 1 Exam Distribut 1 2 1 2 1	Assessment (s) 15 - - 5 5 5 - Theory) Marks ttion (50) 10 20 10 - - -	MCQ's 10 5 - - - - -								
L1 L2 L3 L4 L5 L6 SEE As L1 L2 L3 L4 L5 L6 Sugges	RBT L Reme Unde Apply Analy Evalu Creat RBT L RBT L Remer Under Apply Analyz Evalua Create sted Lea	evels mber rstand rstand re ate e ate e ate e ate ate ate ate ate	Test (s) 25 5 10 5 - 0 Marks - 7 Exam Distribu 1 2 1 2 1 2 1 1 2 1	Assessment (s) 15 - - 5 5 - - - - - - - - - - - - -	MCQ's 10 5 - - - - -								
L1 L2 L3 L4 L5 L6 SEE As L1 L2 L3 L4 L5 L6 Sugges Text	RBT L Reme Unde Apply Analy Evalu Creat Sessmer RBT L Remer Under Apply Analyz Evalua Create sted Lea Books:	evels mber rstand re ate e nt Pattern (5) evels nber stand te te te te	Test (s) 25 5 10 5 - 0 Marks - 1 Exam Distribu 1 2 1 2 1	Assessment (s) 15 - - 5 5 - Theory) Marks tion (50) 10 10 - - - -	MCQ's 10 5 - - - - -								
L1 L2 L3 L4 L5 L6 SEE As SEE As L1 L2 L3 L4 L5 L6 Sugges Text 1)	RBT L Reme Unde Apply Analy Evalu Creat RBT La REME RBT La Remer Under Apply Analyz Evalua Create sted Lea Books: Introd	evels mber rstand re ate e nt Pattern (5) evels nber stand re te te urning Resou	Test (s) 25 5 10 5 - 0 Marks - 1 Exam Distribut 1 2 1 <td>Assessment (s) 15 - - - - - - - - - - - - -</td> <td>MCQ's 10 5 - - - - - - - - - - - - -</td> <td>IcGRAW HILL.</td> <td></td>	Assessment (s) 15 - - - - - - - - - - - - -	MCQ's 10 5 - - - - - - - - - - - - -	IcGRAW HILL.							
L1 L2 L3 L4 L5 L6 SEE As SEE As L6 L1 L2 L3 L4 L5 L4 L5 L6 Sugges Text 1) 2)	RBT L Reme Under Apply Analy Evalu Creat RBT La Remer Under Apply Analyz Evalua Create sted Lea Books: Introd	evels mber rstand re ate e nt Pattern (5) evels nber stand re te	Test (s) 25 5 10 5 - 0 Marks - T Exam Distribut 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 3 3 4 5 5 5	Assessment (s) 15 - - - - - - - - - - - - -	MCQ's 10 5 - - - - - - - - - - - - -	IcGRAW HILL. rs Joseph Yiu, 3rd 1	Edition,						
L1 L2 L3 L4 L5 L6 SEE As SEE As L1 L2 L3 L4 L5 L6 Sugges Text 1) 2)	RBT L Reme Unde: Apply Analy Evalu Creat RBT L RBT L Remer Under: Apply Analyz Evalua Create sted Lea Books: Introd The De 2014, 1	evels mber rstand re ate e ate e nt Pattern (50 evels nber stand re te te urning Resou uction to Eml efinitive Guide Elsevier.	Test (s) 25 5 10 5 - 0 Marks - 7 Exam Distribut 1 2 2 3 3 4 5 <td>Assessment (s)</td> <td>MCQ's 10 5 - - - - - - - - - - - - -</td> <td>IcGRAW HILL. 's Joseph Yiu, 3rd</td> <td>Edition,</td>	Assessment (s)	MCQ's 10 5 - - - - - - - - - - - - -	IcGRAW HILL. 's Joseph Yiu, 3rd	Edition,						
L1 L2 L3 L4 L5 L6 SEE As L6 SEE As L1 L2 L3 L4 L5 L6 Sugges Text 1) 2) Reference	RBT L Reme Unde Apply Analy Evalu Creat RBT L Remer Under Apply Analyz Evalua Create sted Lea Books: Introd The De 2014, J ence Boo	evels mber rstand re ate e ate e ate e ate e ate ate ate at	Test (s) 25 5 10 5 - 0 Marks - 1 Exam Distribu 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 2 3 4 5	Assessment (s) 15 - 5 5 5 5 -	MCQ's 10 5 - - - - - - - - - - - - -	IcGRAW HILL. rs Joseph Yiu, 3rd I	Edition,						

1) Embedded Systems – A contemporary Design Tool, James K Peckol, 2014, John Wiley.

- 2) Cortex M4 Technical Reference Manual, ARM.
- 3) M4 Programming manual, ST microelectronics.

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/106/105/106105193/
- <u>https://embeddedcomputing.com/technology/software-and-os/introduction-to-realtime-operating-systems-rtos</u>
- <u>https://www.youtube.com/watch?v=dOiJuXYFMkE&list=PLqmN55CTOnLeArO1_td4vHkAY35h6GlH</u>
 <u>M</u>
- <u>https://www.arm.com/resources/education/education-kits/efficient-embedded-systems</u>

- Visit to any ARM Company.
- Demonstration of STM ARM cortex M4.
- Complete the course available at https://www.arm.com/resources/education/online-courses.
- Contents related activities (Activity-based discussions).
 - For active participation of students, instruct the students to prepare Flowcharts and Handouts
 - > Organizing Group wise discussions on issues.
 - Seminars.

	EMBEDDED SYSTEM DESIGN LAB													
Course Code	21	1ECL	62						CIE I	Marks		50		
L:T:P:S	0:	0:1:0)						SEE	Marks		50		
Hrs / Week	2								Tota	l Marks		10	0	
Credits	01	1							Exar	n Hours		03		
At the end o	f the co	ourse	, the s	studen	t will b	e able	to:							
21ECL62.1	Сс	onduc	ct exp	erime	nts to ı	inders	tand da	ata trar	sfer, p	rocess a	nd mem	ory acces	s instru	ctions
21ECL62.2	Сс	onduc	ct exp	erime	nts usi	ng bit f	ïeld an	d proc	ess con	trol inst	ructions			
21ECL62.3	De	evelo	p cod	le for s	aturati	on and	l floatir	ıg-poin	t opera	ations				
21ECL62.4	Us	se En	nbeda	led C c	ode to	demon	istrate	periph	eral in	terfacing	with AF	RM devel	opment	kit
Mapping of	Course	e Out	tcom	es to l	Progra	ım Ou	tcome	s and	Progr	am Spec	cific Out	tcomes:		
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PSO1	PSO2
21ECL62.1	3	3	1	2	3	-	-	-	2	-	-	1	3	3
21ECL62.2	3	3	1	2	-	1	3	3						
21ECL62.3	3	3 3 1 2 3 - - 2 - 3 3 1 2 3 - - 2 -											3	3
21ECL62.4	3	3	1	Z	-	1	3	3						
Exp. No. / Pgm. No.		List of Experiments / Programs Hours COs												
			Р	rereg	uisite	Expe	rimen	nts / P	rogra	ms / De	emo			
	•	Re St	evisit cudy o	to 808 of ARM	86 and - Corte	8051 p x M4 p	orogran	nming or dev	basic p elopme	rogramr ent boarc	ning l	2		NA
							PAR	Г-А						
1	Asser data y	nbly withi	Level n the	Progr	am (AI ssor.	LP) inv	olving	instruc	tions f	or transf	erring	2	211	ECL62.1
2	ALP t and a	o der	nons	trate m	nemory S.	v acces	s instru	uction f	or vari	ous data	sizes	2	21	ECL62.1
3	ALP i	nvolv	/ing l	ogic op	eratio	ns.						2	21	ECL62.1
4	ALP i	nvolv	ving d	lata co	nversio	on opei	rations					2	21E	ECL62.1
5	ALP in	nvolv	ing s	hift an	d rotat	e oper	ations.					2	211	ECL62.1
6	ALP t	o illu	strat	e bit fie	eld pro	cessing	g instru	iction.				2	21	ECL62.2
							PAR	Г-В						
7	ALP t	<u>0 illu</u>	strat	e progi	am flo	w insti	ruction					2	211	CL62.2
8		<u>.0 111u</u>	strat	e satur	ation o	perati	on.					2	211	SCL62.3
9	ALP I	nvoiv	$\frac{1 \text{ Ing I}}{2 \text{ I ED}}$	loating	point	operat	1011.		mala a d			2	211	SCL62.3
10	progr a b	ramm . W . N	g LED ling Vith d Vitho	elay ut dela	y	I M 32F	401XX	using r	mbeut	ied C		2	211	ECL62.4
11	Embe using	eddec ; ARM	l C pr I Cort	ogram tex dev	to den elopm	nonstra ent boa	ate seri ard.	ial com	munica	ation (UA	ART)	2	211	ECL62.4
12	Desig	n of s	stepp	er mot	or driv	er bas	ed on S	STM32.				2	211	ECL62.4
							PART-	-C						

	Beyond Syllabus Virtual Lab Content												
	(To be done during Lab but not to be included for CIE or SEE)												
1.	1. Fixed Point Arithmetic Operations and Logical Operators												
	https://portal.coepvlab.ac.in/vlab/auth/home?dept=1&lab=1												
2.	Temperature control using ATmega16												
	https://portal.coepvlab.ac.in/vlab/auth/home?dept=2&lab=9												
3.	Interfacing 4x4 switch matrix with the microcontroller												
	http://vlabs.iitkgp.ac.in/rtes/exp12/index.html												
4.	4. Floating Point Arithmetic Operations												
	https://portal.coe	pvlab.ac.in	<mark>vlab/auth/</mark>	/home?dep	<u>t=1&lab=1</u>								
5.	Serial Communica	tion betwee	en micro co	ontroller and	d PC								
	http://vlabs.iitkg	o.ac.in/rtes/	exp15/in/	<u>dex.html</u>									
6.	Pulse Width Modu	lation (PW	M) Genera	tion Using Fl	PGA								
	https://portal.coepylab.ac.in/ylab/auth/home?dent=1&lab=1												
CIE Assessment Pattern (50 Marks - Lab)													
	DDT Levele	Test (s)	Weekly A	ssessment									
	RB1 Levels	20		30									
L1	Remember	-		-									
L2	Understand	-		5									
L3	Apply	10		10									
L4	Analyze	5		10									
L5	Evaluate	5		5									
L6	Create	-		-									
SEE AG	ssessment Pattern (5	0 Marks – La	b)		·								
	ssessment i attern (s	Fyan N	larks]									
	RBT Levels	Distribut	ion (50)										
L1	Remember	-		1									
L2	Understand	0!	5										
L3	Annly	20)										
L4	Analyze	1!	5	1									
L5	Evaluate	10)										
L6	Create	-	-	1									
				1									
Sugge	Suggested Learning Resources:												

Reference Books (Arm Developer documents)

- 1. The Definitive Guide to ARM Cortex –M3 and Cortex-M4 Processors Joseph Yiu, 3rd Edition, 2014, Elsevier.
- 2. Arm Developer documents
 - (a) <u>https://developer.arm.com/documentation/dui0068/b/ARM-Instruction-Reference</u>
 - (b) <u>https://developer.arm.com/documentation/ddi0403/d/Application-Level-</u>
 - Architecture/Application-Level-Programmers--Model/The-optional-Floating-pointextension/Floating-point-data-types-and-arithmetic?lang=en

COMMUNICATION SYSTEMS - II															
Course	21 E	ECE63						CIE I	CIE Marks 50						
Code															
L:T:P:S	3:0:0:0									SEE Marks			50		
Hrs / Week	3								Tota	l Marl	ks	100			
Credits	03 Exam Hours 03														
Course outco	Course outcomes:														
At the end of	f the	course	e, the s	studen	t will b	e able	to:								
21ECE63.1	Solv	Solve the transmission line problems using analytical and graphical approach													
21ECE63.2	Ana	Analyze the behavior and characteristics of microwave active components													
21ECE63.3	App mic	Apply the knowledge of low frequency network to express Scattering parameter for microwave multiport junctions													
21ECE63.4	Inte	erpret	the re	lations	ships b	etweer	n anten	na par	ameter	S					
21ECE63.5	Ana	lyze tł	ie pov	wer rad	diated	by diffe	erent a	ntenna	s and t	heir ra	diation o	characte	ristics		
21ECE63.6	Use	Use the modern mathematical techniques to the solutions of antenna problems and wave													
	propagation mechanism at different frequencies														
Mapping of	Cour	se Ou	tcom	es to l	Progra	ım Ou	tcome	s and	Progra	am Sp	ecific O	utcome	s:	1	
	P01	P02	P03	P04	P05	P06	P07	P08	P09	PO	P011	P012	PSO1	PSO2	
21ECE63 1	3	3	2	_	2	_	_	-	-	- 10	-	3	3	3	
21ECE63.2	3	3	-	-	-	-	-	-	-	-	-	3	3	3	
21ECE63.3	3	-	-	-	2	-	-	-	-	-	-	3	3	3	
21ECE63.4	3	3	-	-	2	-	-	-	-	-	-	3	3	3	
21ECE63.5	3	3	-	-	2	-	-	-	-	-	-	3	3	3	
21ECE63.6	3	3	2	1	2	1	1	-	1	-	-	3	3	3	
MODULE 1			MI	CROW TRAN	AVE S	OURC	ES AN	D			21ECE6 21ECE6	3.1, 3.2	8 H	lours	
MICROWAV	E SO	URCE	S: Int	roduct	ion to	Micro	wave S	ystem	and M	icrow	ave freq	uencies	Genera	tion of	
Microwaves-	Refle	ex Kly	stron	, TWT,	Magn	etron.	_							_	
TRANSMISS	ION	LINES	Equ	livaler	nt Circ	uit of	a Tra	nsmiss	ion Li	ne, Tr	ansmiss	ion Line	equatio	ons and	
solutions, An	alysi	s of l	Prima	iry an	d Seco	ondary	^v Cons	tants.	Reflec	tion a	nd Trar	ismissic	on Coeff	icients,	
Standing Way	ves a	nd SW	/R, Sn	nith Ch	iart, Si	ngle St	tub ma	tching	•						
Self-study / C	ase S	tudv	Rad	liation	Hazar	ds. An	plicatio	ons of	Microv	vave S	vstem				
/ Application	IS					-,P	1				J				
Text Book			Tex	t Book	1: 9.1,	9.2, 9.	3, 9.5								
			Tex	t Book	2 – 0.	1, 0.2,	0.3, 3.1	1, 3.2, 3	3.3, 3.4	, 3.5, 3	8.6				
MODULE 2	M	ICROV	NAVI	E NETV C(WORK OMPO	THEC	DRY AN S	ND PAS	SSIVE		21EC	E63.3	8	B Hours	
MICROWAV	E NE	TWO	RK 1	HEOR	Y: Int	roduc	tion, S	matr	ix rep	resent	ation of	f multip	ort net	works,	
Properties of	S pa	ramet	ers, S	- para	meters	s of a T	'wo-po	ort netv	vork w	vith mi	ismatche	ed load.			
DACOURS CO			TC	.		147		m	N .	-	0.	1.	1 ·	1.	
Directional C	Ouplo	JNEN ers-Be	TS: A the F	Attenu Iole Co	ators, upler.	Wave	guide	Tees,	Magi	c Tee	s, Circu	lators	and Isc	olators,	
	· · F · ·				F										
Self-study	Ana	lyze t	he S p	oarame	eter of	a micr	owave	passi	ve devi	ices					
Text Book	Tex	t Book	2:6.	1, 6.2, 6	6.3, 6.4	.2,6.4.1	4, 6.4.	15, 6.4.	16						

MODU	JLE 3	ANTENNA FUNDAMENTALS 21ECE63.4 8 Hours												
Introd	Introduction, Radiation patterns, Radiation Power Density and intensity, Beam-width, Directivity,													
Antenna Efficiency, Gain, Beam Efficiency, Bandwidth, Polarization, Input Impedance, Antenna Radiation														
Efficie	ency, V	ector Effectiv	ve Length	and Equiv	alent Area	s, Max	imum	Effective Area,	Antenna					
tempe	erature,	Friis Equation	n. Antenna f	ield zones.										
Case St	tudy	Simulation of Antenna Parameters												
Text B	ook	Dok Text Book 3: 2.1 - 2.7, 2.9-2.11, 2.13												
MODI		POINT SOUR	CES AND A	RRAYS AND	ELECTRIC		2	21ECE63.4,	0.11.					
MODU	ULE 4	DIPOLES					2	21ECE63.5	8 Hours					
POINT	POINT SOURCES AND ARRAYS: Point Sources, Power Patterns, Power Theorem, Radiation Intensity, Arrays													
of two isotropic point sources, Linear Arrays of n Isotropic Point Sources of equal Amplitude and Spacing.														
ELECT	FRIC D	POLES: Introd	luction. Sho	rt Electric Dir	ole. Fields o	of a Shor	t Dipol	le. Radiation Resis	tance of a					
Short I	Electric	Dipole, Thin Li	near Anteni	na (Field Anal	vses)		· ·	-,						
onore breeze bipole, rinn binear Antenna (rielu Antaiyses)														
Self-st	udy	Design of an A	Antenna											
	-													
Text B	Text Book Text Book 3: 5.1- 5.6, 5.9, 5.13, 6.1 - 6.5													
MODI		RADIOWAVI	F PROPAGA	ATION			2	1ECE63.5,	9 Hours					
MODU	ULE J			mon			2	21ECE63.6	onours					
Introd	Introduction, Classification of Electromagnetic Waves, Ground wave propagation, free space propagation,													
ground reflection, surface wave, diffraction. Tropospheric scatter, Ionosphere propagation, electrical														
proper	properties of the ionosphere, effects of earth's magnetic field.													
Self-st	Self-study Guided wave concepts													
Text B	ook	Text Book 3: 2	22.1, 22.3, 2	5.4, 25.10										
CIE Assessment Pattern (50 Marks – Theory)														
	Marks Distribution													
	DDE		T	Qualit	ative	1400	,							
	KRI	Levels	lest (s)	Assessm	ent (s)	MCQ'S								
			25	15		10								
L1	Rem	lember	5	-		5								
L2	Und	erstand	5	-		5								
L3	App	ly	10	5		-								
L4	Ana	lyze	5	5		-								
L5	Eval	uate	-	5		-								
L6	Crea	ite	-	-		-								
			1											
SEE As	ssessm	ent Pattern (5	0 Marks – 1	Theory)										
	RRT	Levels	Exam	Marks										
	KB1 Levels Distribution (50)													
			nember 10											
L1	Reme	ember	1	10										
L1 L2	Reme Unde	ember rstand	1	10 10										
L1 L2 L3	Reme Unde Apply	ember rstand y		10 10 20										
L1 L2 L3 L4	Reme Unde Apply Analy	ember rstand y yze		10 10 20 10										
L1 L2 L3 L4 L5	Reme Unde Apply Analy Evalu	ember rstand y yze nate		10 10 20 10 -										
L1 L2 L3 L4 L5 L6	Reme Unde Apply Analy Evalu	ember rstand y yze ate ce		10 10 20 10 - -										
L1 L2 L3 L4 L5 L6 Sugge	Reme Unde Apply Analy Evalu Creat	ember rstand y yze aate ce earning Resou	irces:	10 10 20 10 -										
L1 L2 L3 L4 L5 L6 Sugge Text F	Reme Unde Apply Analy Evalu Creat ested Lo Books:	ember rstand y yze aate ce earning Resou	irces:	10 10 20 10 -										
L1 L2 L3 L4 L5 L6 Sugge Text E 1.	Reme Unde Apply Analy Evalu Creat ested Lo Books: Micro	ember rstand y yze nate ce earning Resou wave Engineer	urces:	10 10 20 10 - - ut Das, Oxford	l Higher Edu	ucation, 2	2nd Ed	n, 2015.						

- **3.** Antennas and Wave Propagation-John D. Krauss, Ronald J Marhefka, Ahmad S Khan, 4th Edition, McGraw Hill Education, 2013.
- **4.** Antennas and Wave Propagation Harish and Sachidananda: Oxford University Press, 2007.

Reference Books:

- 1. Microwave Engineering David M Pozar, John Wiley India Pvt. Ltd., 3rd Edn,2008.
- 2. Microwave Devices and circuits- Liao, Pearson Education.,2005
- 3. Antennas and Wave Propagation Harish and Sachidananda: Oxford University Press, 2007

Web links and Video Lectures (e-Resources):

- <u>https://youtu.be/2SxSBMum4gc</u>
- <u>https://youtu.be/0NgWS9HvSDk</u>
- <u>https://youtu.be/ldBBrD6259A</u>
- <u>https://youtu.be/wx_tIvaajAI</u>
- <u>https://youtu.be/JPwk9Cjjo_I</u>
- <u>https://youtu.be/s4yTE2h OYM</u>
- <u>https://youtu.be/bUsS5KUMLvw</u>

- Visit to any manufacturing/Assembling unit of Transmission Line or Antenna printed boards.
- Video demonstration of latest trends in Microwave System/ Antenna Design.
- Contents related activities (Activity-based discussions).
 - Group Discussion.
 - Case- Study.

COMMUNICATION SYSTEMS - II LAB															
Course Code		21ECL	63					CIE I	Marks		50				
L:T:P:S	(0:0:1:0								Marks		50			
Hrs / Week 2 Total Marks							100								
Credits 01 Exam Hours									03						
Course outcomes: At the end of the course, the student will be able to:															
21ECL63.1 Calculate different microwave parameters for microwave circuits									cuits						
21ECL63.2	Demonstrate the working of various microwave components														
21ECL63.3	1	Model	an op	tical co	ommur	nicatio	n syste	m and	analyz	e its char	acteristio	CS			
21ECL63.4	1	Analyz	e the	design	of ant	enna p	arame	ters an	d radia	tion patt	ern of dif	fferent a	ntenna	types	
Mapping of	Cour	se Ou	tcom	es to I	Progra	ım Ou	tcome	es and	Progra	am Spec	ific Out	comes:			
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PSO1	PSO2	
21ECL63.1	3	3	-	-	-	-	-	-	2	-	-	3	3	2	
21ECL63.2	3	3	2	-	2	-	-	-	2	-	-	3	3	2	
21ECL63.3	3	3	2	1	-	-	-	-	2	-	-	3	3	2	
21ECL63.4	3	3	2	1	2	-	-	-	2	-	-	3	3	2	
Exp. No. / Pgm. No.	List of Experiments / Programs											Hours	; (COs	
Prerequisite Experiments / Programs / Demo															
	 The ANSYS Electronics Desktop Environment: <u>https://www.youtube.com/watch?v=oOH6hVP6vcA&list=PL0l</u> <u>ZXwHtV6Ol3KjVHLh0ZF3q1Ey491LF7</u> Introduction to HFSS for antenna/microwave device design: 2 NA <u>https://www.youtube.com/watch?v=2ADK971gKKU&list=PL4l</u> <u>HevQbRIInAhw2BJIhiHDi2lkGaS9Xs</u> 											NA			
							PAR	T-A							
1	Mea atte	suren nuatio	nent o on in r	f frequ nicrow	ency, g vave te	guide v st benc	vaveler ch.	ngth, po	ower, V	SWR and	l	2	21ECL63.1		
2	To c fact	conduc or for	ct an e the M	experin agic Te	nent to ee.	find o	ut the i	insertio	on loss	and coup	oling	2	21E 21E	21ECL63.1 21ECL63.2	
3	Dete dire	ermina ectiona	ation (of Couj oler.	oling a	nd isol	ation c	haracte	eristics	of micro	strip	2	21E	CL63.2	
4	Dete (a) com (b)	ermina Resona Iputati Power	ation ance c on of divis	of charact dielect ion and	eristic tric con d isolat	s of mi istant tion of	crostri of the s micros	p ring i substra strip po	resonat te. wer di	tor and vider.		2	21ECL63.2		
5	Mea of a	isuren n optio	nent o cal fib	f propa er.	agatior	1 loss, l	bendin	g loss a	nd nur	nerical aj	perture	2	21E	CL63.3	
6	Mea ante	isuren ennas	nent o	f direc	tivity a	ınd gai	n of mi	crostri	p dipol	le and Ya	gi	2	21E	CL63.4	
	-						PAR'	T-B							
7	Tog	genera	te Ele	ctroma	agnetic	: Wave	using	MATLA	B soft	ware.		2	21E	CL63.3	

			21ECL63.4
8	To plot radiation pattern of dipole antenna using MATLAB software.	2	21ECL63.4
9	To plot radiation pattern of uniform linear Array using MATLAB software.	2	21ECL63.4
10	To design and simulate rectangular microstrip patch antenna with coaxial probe feeding technique for the frequency f=3.5GHz using ANSYS HFSS software.	2	21ECL63.4
11	To design and simulate rectangular microstrip patch antenna for the frequency 3GHz using strip line feed using ANSYS HFSS software.	2	21ECL63.4
12	To design and simulate U-shaped Slot Rectangular Microstrip Patch Antenna with strip line feed working at operational frequency 5 GHz using ANSYS HFSS software.	2	21ECL63.4

PART-C

Beyond Syllabus Virtual Lab Content

(To be done during Lab but not to be included for CIE or SEE)

- 1. Measurement of VSWR on a line: <u>http://eem-iitd.vlabs.ac.in/exp1.html</u>
- 2. Determination of unknown impedance: <u>http://eem-iitd.vlabs.ac.in/exp2.html</u>
- 3. Microwave Coupler: <u>http://eem-iitd.vlabs.ac.in/exp5.html</u>
- 4. Radiation Pattern of Horn Antenna: http://eem-iitd.vlabs.ac.in/exp7.html
- 5. Antenna Gain measurement: <u>http://eem-iitd.vlabs.ac.in/exp8.html</u>

CIE Assessment Pattern (50 Marks – Lab)

		· · · · · · · · · · · · · · · · · · ·								
	DDT Lovele	Test (s)	Weekly Assessment							
	KD1 Levels	20	30							
L1	Remember	-	-							
L2	Understand	-	5							
L3	Apply	10	10							
L4	Analyze	5	10							
L5	Evaluate	5	5							
L6	Create	-	-							

SEE Assessment Pattern (50 Marks - Lab)

	RBT Levels	Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	20
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1) Constantine A. Balanis, "Antenna Theory: Analysis and Design" 4th Edition, Publisher: Wiley, 2016, ISBN: 978-1-118-64206-1

2) David M. Pozar, "Microwave Engineering" 4th Edition, Publisher: Wiley, 2021, ISBN: 978-1-119-77062-6

FIBER OPTIC COMMUNICATION															
Course	21ECE641									CIE Marks 50					
Code												50			
L:T:P:S	3:0:	:0:0						SEE	Marks		50				
Hrs / Week	3								Tota	I Marks		100	100		
Course outco	EXAMPOUTS US														
	A	Apply the fundamental concents of ontical fiber communication in modern digital													
21666041.1	App	Apply the infidamental concepts of optical fiber communication in modern digital communication systems													
21ECE641.2	Ider	Identify suitable optical fiber structures for specific applications													
21ECE641 3	Inve	Investigate the effects of channel impairments in optical fiber communication systems													
21ECE641.4	Evaluate the performance of optical receivers														
				r 101 1112					1.	1.					
21ECE641.5	Util	ize the	theo	ry of o	ptical n	nultipl	exers fo	or netv	vorking	g applica	itions				
21ECE641.6	Dep	oloy va	rious	concep	ots for	creatio	on of op	otical a	mplifie	rs					
Mapping of	Cour	se Ou	tcom	es to l	rogra	m Ou	tcome	s and	Progra	am Spe	cific O	utcom	es:	DCOO	
21ECE641.1	2	POZ	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	2	PS02	
21ECE041.1 21ECE641.2	3	- 2	- 2	-	-	-	-	-	-	-	-	-	3	3	
21ECE641 3	3	3	3	- 3	- 2	-	-	-	-	-	-	-	3	3	
21ECE641.4	3	3	3	3	2	_	-	-	-	_	-	-	3	3	
21ECE641.5	3	3	-	-	-	-	-	-	-	-	-	-	3	3	
21ECE641.6	3	3	3	3	-	-	-	-	-	-	-	-	3	3	
MODULE 1	OV	ERVIE	W OI	F OPT	ICAL F	IBER	COMM	UNIC	ATION	21	ECE64	1.1	8	Hours	
Historical de	velop	ment,	The	Genera	al Syst	em, ac	lvantag	ges, dis	sadvant	tages, ai	nd app	licatior	ns of c	ptical fiber	
communicatio	on, Ra	ay theo	ory, si	ngle m	ode fib	er, cut	off way	ve leng	th, moo	le filed c	liamete	er.			
Self-study			Imp	oact of	the fib	er opt	ics rev	olutio	n on co	mmuni	cation	and co	nnecti	vity across	
			vari	ious in	dustri	es.			4 0 0 0			0 = 0			
Text Book			Tex	t Book	1:1.1,	1.2, 1	3, 2.1, 2	2, 2.3.	.1,2.3.2	,2.3.3,2.4	4, 2.5.1,	2.5.2			
	OP	ГІСАІ		SOLU	RCFS	Δ	NDTR	ANSM	ISSION	I	21FCF	641 2			
MODULE 2	CH	ARAC	FERI	STICS	OF OP	TICAL	FIBE	RS	21ECE64				8 Hours		
Optical source	es: LI	ED, po	wer a	nd effi	ciency,	, LED s	structu	res, LE	D char	acteristi	cs, LAS	ER bas	ic con	cepts, The	
Semiconducto	or In	jectior	n LAS	SER A	ttenua	tion, a	absorpt	ion, s	catterii	ng losse	es, ben	ding l	oss, d	ispersion,	
Chromatic dis	persi	ion, Int	ter me	odel di	spersic	on.	anamia	nion a	haraat	oriation	ofonti	aal fiba	20		
Self-study	mv	estigat	le opt	lical sc	urces	anu u	ansmis	SIOILC	naracu	ensucs	oi opti	carnbe	ers.		
Text Book	Tex	t Book	1:7.2	2,7.3.1	7.3.2,7	.3.3,7.3	3.4, 7.4	6.2,6.4	.3.1, 3.	2 3.3, 3.4	1, 3.				
	3.8,	3.9, 3.	10	· ·		,									
	_										21ECE	641.4		0 V	
MODULE 3	OP'	FICAL	REC	EIVER							21ECE	641.6		8 Hours	
Physical Drin	ciple	s of D	hoto	diodo		and A	ים חק	noto d	etector	noise	Ontica	1 Reco	iver O	neration	
receiver sens	itivit	y, qua	ntum	i limit,	eye di	agram	s, cohe	erent d	etectio	noise.	optica			peration,	
Case Study	Inv	estigat	te the	princ	iples o	fopera	ations	of pho	to dioc	les, PIN	,APD a	nd exp	lore tł	ie	
-	app	licatic	ons of	optica	al recei	ivers.		-				•			
Text Book	Text Book2:	6.1.1,6.1.2	2, 6.2, 7.1, 7.2.2, 7.	2.3,7.3, 7.4											
--	------------------------------	-----------------	--	--	-----------------------	--------------	-------------	--	--						
MODULE	4 OPTICAL AM	PLIFIER	S		21ECE64 21ECE64	1.4, 1.6	8 Hours								
Basic Appl	ications and type	s of Optic	cal amplifiers, typ	oes of Optical an	nplifiers, semico	onductor o	optical								
amplifiers,	, EDFA, Amplifier	Noise, Op	otical SNR.												
Self-study	Scrutinize the	e Differen	t types of optical	amplifiers and	their applicatio	ons.									
Text Book															
MODULE !	5 WDM CONCE	EPTS ANI	OOPTICAL NETV	WORKS	21ECE64	1.5	8 Hours								
Overview	of WDM- operation	on princi	ples, WDM stand	ards, Mach-Zeh	ender interfero	meter mu	ıltiplexer,								
Isolators a	nd circulators, Op	otical netv	work concepts, ne	etwork topologi	es, SONET/SDH	l, Optical A	dd/Drop								
Multiplexit	ng.	o on orati	ing principles of	WDM CONET /C	DIL Optical Ad	d /Drop M	ultiplouing								
		$\frac{1}{0}$	$\frac{1}{1} \frac{1}{2} \frac{1}{10} \frac{1}{2} \frac{1}{10} \frac{1}{2} \frac{1}{10} \frac{1}{2} \frac{1}{10} \frac{1}{2} \frac{1}{10} \frac{1}{2} \frac{1}{10} \frac{1}{10}$	$\frac{1}{2} \frac{1}{1} \frac{1}{2} \frac{1}$		алор мі	unplexing								
Text Book	Text Book2:1	U.1.1, 10.	1.2,10.2.5,10.3,1	3.1,13.2,13.3,13	.5										
CIE Assess	ment Pattern (50) Marks -	· i neory j			1									
			Ma	irks Distributio	n										
	RBT Levels		Test (s)	Qualitative A (NP	ssessment (s) TEL)										
			25	2	5										
L1	Remember		5		-										
L2	Understand		5		5										
L3	Apply		10	1	.0										
	Analyze		5	1	.0										
L5 L6	Create				-										
SEE Assess	sment Pattern (5)	0 Marks -	- Theory)												
		Exa	m Marks												
KE	31 Levels	Distri	bution (50)												
L1 Re	member		10												
L2 Un	derstand		10												
L3 Ap	ply alway		20												
L4 An	aluato		10												
LS LV	eate		-												
Suggested	Learning Resou	irces:													
Text Book	s:														
1)"Optical	Fiber Communic	ations", Jo	ohn M. Senior, Pe	arson Educatio	n, Second edit	ion,7th Im	pression,								
2010.	F :h C	- L' " C -													
2) [°] Optical Poforonce	Fiber Communic	ation", Ge	era Keiser, 4th Ea	I., MGH,2008.											
1) Fiber O	, poors. ptic Communicati	on - Iose	ph C Palais: 4th E	dition. Pearson	Education.										
	pero communicati	J050			_auturion.										
Web links	and Video Lect	ures (e-R	lesources):												
• <u>ht</u>	<u>tps://www.yout</u>	ube.com	/watch?v=ougK	<u>(UUM3hJA</u>											
• <u>ht</u>	tps://www.yout	ube.com	/watch?v=2zZZ	<u>c6RXVjo</u>											
<u>https://www.youtube.com/watch?v=XtXbPabLmU4</u>															
• <u>ht</u>	tps://www.yout	ube.com	/watch?v=5dlY	NIWKZTC											
• <u>nt</u>	<u>ups://www.yout</u>	<u>.upe.com</u>	<u>/ watch?v=8LAa</u>												
			72												

• <u>https://www.youtube.com/watch?v=4W7hieXDAmc</u>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Video demonstration of latest trends in Optical Fiber Communication
- Contents related activities (Activity-based discussions)
- For active participation of students, conduct problem solving sessions
- Organizing Group wise discussions on issues
 - > Seminars

BIOMEDICAL SIGNAL PROCESSING														
Course Code			21EC	E642					CIE I	Marks		50	50	
L:T:P:S			3:0:0	:0					SEE	Marks		50		
Hours / Wee	k		3						Tota	l Marks	5	10	0	
Credits			03						Exar	n Hours	5	03		
Course outco	mes:	At the	e end	of the	course	, the st	udent v	will be	able to	:				
21ECE642.1	De	scribe	e the o	origin,	prope	rties ar	nd suit	able m	odels o	ofbiome	edical sig	nals suc	h as ECO	Gand
	EE	G												
21ECE642.2	Ap me	ply sig	gnal p men	orocess ts	sing me	ethods	to exti	ract rel	evant	informa	tion from	n biome	dical sig	nal
21ECE642.3	De	velon	the r	elevan	t math	ematio	cal and	compi	itation	alskills	relevan	t in com	pression	of
	bio	omedi	cal si	gnals		01110101		comp			1010101	• • • • • • • • • • • • • • • •	000101	
21ECE642.4	Analyze the ECG Signal behavior using signal processing methods													
21ECE642.5	Analyze the rhythms and detection process in neurological signal processing													
21ECE642.6	42.6 Examine the quality of biomedical images acquired from Computed Tomographic Imaging													
Monning of	and Ultrasound Imaging modalities Course Outcomes to Program Outcomes and Program Specific Outcomes:													
mapping of		ourse Outcomes to Program Outcomes and Program Specific Outcomes:												002
215056421	2	P02	PU3	P04	P05	P00	P07	PUo	P09	P010	PUII	P012	2	2
21ECE042.1	2	-	-	-	-	-	-	-	-	-	-	-	2	2
21ECE042.2	3	3	-	-	-	-	-	-	-	-	-	-	2	2
21ECE042.3	3	3	Z	-	-	-	-	-	-	-	-	-	<u>э</u>	2
21ECE042.4	3	3	-	-	-	-	-	-	-	-	-	-	3	2
21ECE642.5	3	3	-	-	-	-	-	-	-	-	-	-	3	2
21ECE642.6	3	3	2	2	1	2	-	-	-	-	-	-	3	2
MODULE-1	L	IN	roe	OUCTI	ON TO	BIOM	EDICA	AL SIG	NALS		21ECE 21ECE	542.1, 642.2	81	Hours
The nature	of B	iomec	lical	Signal	s, Exa	mples	of Bi	omedi	cal Sig	gnals, C	bjective	es and	difficult	ies in
Biomedical a	nalys	is, Sir	nple	signal	convei	sion s	ystem	s, Conv	version	n require	ements f	or biom	edical si	gnals,
Signal conver	rsion	circuit	s, Ba	sics of	signal	averag	ging, si	gnal av	veragir	ng asa d	igital filt	er, a typ	ical ave	rager,
software for	signa	l aver	aging	g, limita	ations	of sign	al ave	raging.	D I					
Self-Study			Filt	ering a	nd Fre	quency	Analy	$\frac{1}{2}$ SIS Of 2	D Imag	ges				
Text Book			Tex	T BOOK		,Z.1-Z.	3,3.2-3	.4; 9.1·	-9.5.	1	1ECEC	12.2	01	Lours
MODULE-2				E CAN	CELLA SSSION	I TECH	AND I INIOU	JATA FS		2	TECE04	FZ.Z, 17 3	01	iours
Adantive Noi	se Ca	ncelli	ng· P	rincina	al nois	e canc	eller m	nodel (50- Hz	adantiv	e cancel	ling usir	ig a sine	wave
model, other	appli	catior	ng. i 1sof a	daptiv	e filter	ing.		iouci, (0 112	uuuptiv	e cuncer	iiiig ubii	ig a bille	mare
Data Compre	essio	n Tec	hniqu	ies: Ti	urning	point	algor :	ithm,	AZTEC	algorit :	hm, Far	n algorit	hm, Hu	ffman
coding, data i	reduc	tional	lgorit	hms, u	sage o	fFour	ier tra	nsform	, Corre	elation,	Convolu	tion, Po	wer spe	ctrum
estimation fo	r ana	lysis	of EC	G signa	al time	and fr	equen	cy don	nains.					
Self-Study			Filter	ring an	d Frequ	lency A	Analysi	s: ECG						
Text Book			Text	Book n	io 1: 8.	1-8.3,1	0.1-10).4,11.1	1-11.4					
MODULE-3			ELE	CTRO	CARDI	OGRA	PHY			21	ECE642	.4	81	Hours
Basic Electro	cardi	ograp	hy, E	CG dat	aacqui	sition,	ECG le	ead sys	tem, E	CG sign	al chara	cteristic	s (paran	neters
and their est	and their estimation), Analog filters, ECG amplifier, and QRS detector, Power spectrum of the ECG, Band-													
pass filtering	pass filtering techniques, Differentiation techniques, Template matching techniques, A QRS detection													
algorithm, R	eal-ti noni+	ine E	ւս թ	rocess	ing alg	orithn	1, ECG	inter	pretat	ion, SI	segmer	ic analy	zer, Po	rtable
ar nytiinid fi	nomi	01.												

Self-St	udv		Medical Imag	e Segmentation					
Text B	look		Text Book no	2:7.1-7.4					
I ONC D	0011		Text Book no	1: 12.1-12.6.13.	1-13.3				
MO	DUL	E-4	EE	G SIGNAL	21ECE642.5	5 8 Hours			
Neuro	ologic	al signal pro	cessing: The l	orain and its pote	entials, The electrophysiologica	l origin of brain			
waves	s. The	EEG signal	and itscharact	eristics (EEG rhy	thms, waves, and transients), (Correlation.			
Analys	sis of	EEG channe	els: Detection o	of EEG rhythms."	Templatematching for EEG, spi	ke and wave			
detect	tion.				· · · · · · · · · · · · · · · · · · ·				
Self-St	udv		Medical Imag	e Analysis.					
Text B	look		Text Book no	2: 4.1-4.4					
MC	DUI	Æ-5	BIOMEDICAL	IMAGE PROCES	SING 21ECE642.6	5 8 Hours			
Biome	edical	Image Pro	cessing using	g CT: Introduction	on, CT Instrumentation, Imag	e Formation, Image			
Qualit	v in (CT.	0						
Biome	- edical	Image Pro	cessing using	Ultrasound: In	troduction. Instrumentation. I	Pulse-Echo Imaging.			
Trans	duce	r Motion Illt	rasound Imag	ying Modes Stee	ring and Focusing 3-D Illtraso	und Imaging Image			
Qualit	uuce.		i asouna imag	ing modes, see	ing and i ocusing, 5 D offiaso	unu imaging, image			
Case S	y. tudv		Mini-project (n Bio-Medical Im	aging systems				
Toyt D	Pool		Tort Poole no	2.6161111	11.0				
Text D	OOK		Text BOOK IIO	5: 0.1-0.4, 11.1	11.0				
CIE AS	ssess	ment Patter	n (50 Marks –	Theory)		1			
				Ma	rks Distribution				
		RBT Leve	ls	T = -1 (-)	Qualitative Assessment (s)				
			-	Test (s)	(NPTEL)				
				25	25				
L1		Remember	•	5	-				
L2		Understan	d	5	5				
L3		Apply		10	10				
L4		Analyze		5	10				
L5		Evaluate		-	-				
L6		Create		-	-				
CEE A									
	CCACC	ment Patter							
SEE AS	ssess	ment Patter	Exa	m Marks					
SEE AS	ssess RB	<u>ment Patter</u> T Levels	Exa Distril	m Marks					
	ssess RB Re	ment Patter T Levels member	Exa Distril	m Marks bution (50) 10					
L1 L2	SSESS RB Re Un	ment Patter T Levels member derstand	Exa Distril	m Marks bution (50) 10 10					
L1 L2 L3	RB RB Rei Un Ap	ment Patter T Levels member derstand ply	Exa Distril	m Marks bution (50) 10 10 20					
L1 L2 L3 L4	RB Re Un Ap An	ment Patter T Levels member derstand ply alyze	Exa	m Marks bution (50) 10 10 20 10					
L1 L2 L3 L4 L5	RB Re Un Ap An Eva	ment Patter T Levels member derstand ply alyze aluate	Exa	m Marks bution (50) 10 10 20 10 -					
L1 L2 L3 L4 L5 L6	RB Re Un Ap An Eva Cre	ment Patter T Levels member derstand ply alyze aluate eate	Exa Distril	m Marks bution (50) 10 10 20 10 - -					
L1 L2 L3 L4 L5 L6 Sugge	RB Re Un Ap An Eva Cre ested	ment Patter T Levels member derstand ply alyze alyze aluate eate Learning F	Exa Distril	m Marks bution (50) 10 10 20 10 -					
L1 L2 L3 L4 L5 L6 Sugge Text	RB Re Un Ap An Eva Cre sted	ment Patter T Levels member derstand ply alyze aluate cate Learning R ks:	Exa Distril	m Marks bution (50) 10 10 20 10 - -					
L1 L2 L3 L4 L5 L6 Sugge Text	RB Rei Un Ap An Eva Eva Sted Boo 1.	ment Patter T Levels member derstand ply alyze aluate eate Learning R ks: W. J. Tompk	Eesources:	m Marks bution (50) 10 10 20 10 - - -	l Processing," PHI Learning Pr	ivate Limited,New			

- 2. D. C. Reddy, "Biomedical Signal Processing: Principles and techniques," Tata McGraw-Hill, New Delhi, India, 2015.
- 3. J. L. Prince, and J. M. Links, "Medical Imaging Signals and Systems," PearsonEducation, Inc., New Delhi, India, 2015.

Reference Books:

- 1. R. Rangayyan, "Biomedical Signal Analysis," Wiley India Private Limited, New Delhi, India, 2015.
- 2. Bruce, "Biomedical Signal Processing & Signal Modeling," John Wiley and Sons, Singapore, 2001.
- 3. Sörnmo, "Bioelectrical Signal Processing in Cardiac & Neurological Applications," Reed Elsevier Private Limited, New York, U.S.A., 2009.
- 4. Semmlow, "Biosignal and Biomedical Image Processing," Marcel Dekker, London,U.K., 2004
- 5. Enderle, "Introduction to Biomedical Engineering," 2nd Edition, Reed Elsevier Private Limited, New York, U.S.A., 2005.

Web links and Video Lectures (e-Resources):

- Biomedical signal processing NPTEL course.
- Biomedical signal processing NPTEL lecture videos <u>https://www.youtube.com/watch?v=ezfPl8kUdbg&list=PLVDPthxoc3lNzu07X-Cb0WPZNMboPXKtb</u>
- Biomedical Signal processing lecture videos by Dr.Geetika Dua <u>https://www.youtube.com/watch?v=R7WaykzESlg&list=PLeefXVKiX48rcnK0TentV2rXrQ</u> <u>olhuqpy</u>

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Game based learning Kahoot Quizzes.
- Contents related activities (Activity-based discussions).
- For active participation of students, instruct the students to prepare Flowcharts and Handouts.
- Organizing Group wise discussions on issues.
- Seminars & Flip-classes.

	LOW POWER VLSI DESIGN													
Course	21F	ECE64	3						CIE Ma	arks		50		
Code														
L:T:P:S	3:0	:0:0							SEE M	arks		50		
Hrs / Week	3								Total	Marks		100		
Credits	03								Exam	Hours		03		
Course outco	omes	: At the	e end of	the co	urse, t	he stuc	lent wi	ll be al	ole to:					
21ECE643.1	Exa	mine t	he sour	ces of	power	dissipa	ation ir	n CMOS	S circui	ts				
21ECE643.2	Inve	estigat	e the In	npact o	f devic	e and t	cechno	logy sc	aling o	n Low Po	ower Ele	ctronics		
21ECE643.3	Insp	pect di	fferent	low po	wer ci	rcuit &	Modul	e tech	niques	to desig	n digital	circuits		
21ECE643.4	Distinguish various architectural techniques for minimizing power in microprocessor & SRAM													
21ECE643.5	5 Analyze various energy recovery techniques in low power VLSI Design													
21ECE643.6 Compare research articles on low power design methodologies in VLSI Design														
Mapping of	of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	P01	P02	PO3	P04	PO5	P06	P07	P08	P09	P010	P011	P012	PS01	PSO 2
21ECE643.1	3	3	-	-	2	-	-	-	-	-	-	1	3	2
21ECE643.2	3	3	2	-	2	-	-	-	-	-	-	1	3	2
21ECE643.3	3	3	2	-	2	-	-	-	-	-	-	1	3	2
21ECE643.4	3	3	2	-	2	-	-	-	-	-	-	1	3	2
21ECE643.5	3	3	2	-	2	-	-	-	-	-	-	1	3	2
21ECE643.6	3	3	2	-	2	-	-	-	-	-	-	1	3	2
MODULE-1	INT	RODI	UCTIO	N TO L	OW P	OWER	VLSU	DESIG	N	2	1ECE64 3	3.1	8 Ho	urs
Need for Lov	v Pov	ver VI	SI Chi	os. Cha	rging	and Di	scharg	ing Ca	pacita	nces. Sh	ort circu	it currei	nt in CM	105
Circuits (Inve	rter),	CMOS	Leaka	ge Curr	ent.			0	F · · · ·	, -				
Sources of Di	ssipa	tion in	n Digita	I Integr	ated C	ircuits	, Degre	es of F	reedor	n, Emerg	ging Low	Power A	Approac	hes
– An Overview	<i>N</i> .			_			_							
Self-study	Des	sign Co	onstraii	nts in I	C tech	nology	, Inves	stigate	the ba	ttery ca	pacity tr	ends, Di	fferent	
	typ	es of L	eakage	e curre	nt in C	MOS C	ircuits	5.						
Text Book	Tex	t Book	: 1: 1.1,	1.2, 1.3	8.1, 1.4	Text E	Book 2:	1.2, 1.	3, 1.5				-1	
MODULE-2	DEV	VICE A	ND TE		LOGY S	IMPA	CT ON	LOW		2	1ECE6 4	3.2	8 Ho	ours
Introduction,	Dyna	amic D	issipati	ion in (CMOS,	Effects	of and	d on Si	peed, C	onstrair	its on Re	duction.	Transis	tor
Sizing and Op	timal	Gate (Oxide T	hickne	ss, Imp	act of '	Techno	ology S	caling,	Technol	ogy and	Device Ir	novatio	n.
Applications		Simul	ation P	ower A	nalysi	s, SPICI	E Circu	it Sim	ulation	1 TEXT 1	:2			
Text Book	,	Text B	ook 2: 2	2.1to 2.	7									
MODULE-3	LO	W POV	NER CI	RCUIT	AND	MODU	JLE TE	CHNI	QUES	2	1ECE64	3.3	8 Ho	ours
Introduction	, Pow	ver Co	nsump	tion in	Circui	ts, Flip	flops a	and La	tches, I	Logic, H	igh capa	citance l	Nodes.	
Low Power A	rithr	netic (Compo	nents, .	Adder.									
Self-study	Lov	v Pow	er Aritl	nmetic	Comp	onents	s, Mult	ipliers	, Divisi	on				
Text Book	Tex	t Book	2:3.1-3	3.5, 7.3						[
MODULE-4	AR	CHITE	CTUR	E AND	SYSTI	EM				2	1ECE64	3.4	8 Ho	ours
Power and P	erfor	manc	e mana	igemer	nt, Swi	tching	activi	ty red	uction,	Paralle	l archite	ecture w	ith volta	age
reduction,					a	D 4 1 7 -		A N		1.0		(ap + 1 -		
Low Power S	кам	Archi	tecture	e, MOS	Static	KAM M	lemor	y Cell,	Banke	d Organ	ization c	ot SRAMs	s, Reduc	ıng
Voltage Swin	g on	Bit lin	es.											

Self-stu	udy /	Reducing Pov	Reducing Power in Write Driver Circuits, Reducing Power in Sense Amplifier Circuits.										
Text Bo	ook	Text Book 1:7.	.1.1,7.2,7.	3 Text Book 3: 6	.1-6.5		•						
MODU	JLE-5	LOW ENER	GY CO	MPUTING USI	NG ENERGY	21ECE64	3.5,	8 Hours					
		RECOVERY T	ECHNIQ	UES		21ECE64	3.6						
Energy	v Diss	ipation in Tran	sistor cha	annel using an F	C Model, Energ	y Recovery Cir	cuit Desig	n. Design					
with P	artial	ly reversible Log	gic, Suppl	y Clock Generati	on.	<i>y</i> neeevery en	0410 20018	, 2001811					
Self-stu	udy	Energy recove	ery SRAM	l Core, Energy D	issipation in Me	mory Core							
Text Bo	ook	Text Book 3: 7	.1, 7.2, 7.3	3, 7.3.1, 7.3.2,7.3.3	3, 7.4								
CIE As	IE Assessment Pattern (50 Marks – Theory)												
				Ma	arks Distributio	n							
		DDT Lovale			Qualitative A	ssessment (s)							
		NDT Levels		Test (s)	(NP)	TEL)							
				25	2	25							
L1	J	Remember		5		-							
L2	1	Understand		5		5							
L3	1	Apply		10	1	.0							
L4	1	Analyze		5	1	.0							
L5]	Evaluate		-		-							
L6	(Create		-		-							
SEE As	sessn	nent Pattern (50	0 Marks -	- Theory)									
	RRT	Levels	Exa	m Marks									
		Levels	Distril	bution (50)									
L1	Rem	iember		10									
L2	Und	erstand		10									
	Арр	ly		20									
	Ana	lyze		10									
	Eval	luale		-									
	ctod I	acting Resou	ircosi	-									
Text	Book	S:											
1.	 Practical Low Power Digital Low Power VLSI Design, Gary Yeap, 4th edition, 2014, Springer International Edition. 												
2. Low Power Design Methodologies, Jan M. Rabaey, Massoud Pedram, 2 nd edition 2014, Springer													
2	3 Low Power CMOS VLSI Circuit Design Kaushik Roy Sharat C Prasad 2015 Wiley India Pyt Ltd												
J. Refere	3. Low Power CMOS VLSI Circuit Design, Kaushik Roy, Sharat C. Prasad, 2015, Wiley India Pvt.Ltd.												

- - 1. CMOS VLSI Design: A Circuit and System perspective, Neil H.E. Weste, David Harris, 4th Edition 2015, Pearson.

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/106/105/106105034/ •
- https://archive.nptel.ac.in/courses/106/105/106105161/ •

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- SPICE Simulation of VLSI Circuits to estimate the Power. •
- Video demonstration of the latest trends in VLSI Technology.
- Contents related activities (Activity-based discussions) •
 - For active participation of students, instruct the students to prepare Flowcharts and Handouts. ≻
 - ≻ Organizing Group wise discussions on issues and Seminars.

OBJECT ORIENTED PROGRAMMING USING C++														
Course Code		21E	ECE64	14 14					CIE Ma	arks		50		
L:T:P:S		3:0	:0:0						SEE M	arks		50		
Hrs / Week		3							Total	Marks		10	0	
Credits		03							Exam	Hours		03		
Course outcon	nes:													
At the end of t	he cou	rse, t	he stı	udent v	vill be	able to	:							
21ECE644.1		Arti	culat	e the fi	undam	ental c	oncept	s of ob	ject-or	iented p	rogram	iming w	ith C++	
21ECE644.2		Ana pro	lyse t gram	the wo	rking o	of differ	ent op	erator	s in C+-	+ for the	develo	pment o	of C++	
21ECE644.3		App	oly the	e conce	epts of	classes	and o	bjects	to solve	e real wo	orld pro	blems		
21ECE644.4		Con	Compare the implementation of different Inheritances and overloading concepts											
21ECE644.5		Analyze the exception handling mechanism to handle Real-time problems												
21ECE644.6	21ECE644.6 Develop applications for real time problems using object-oriented programming techniques													
Mapping of Co	techniques Manning of Course Outcomes to Program Outcomes and Program Specific Outcomes:													
	P01	PO2	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PSO1	PSO2
21ECE644.1	3	-	-	-	-	-	-	-	-	-	-	-	2	-
21ECE644.2	3	3	1	-	3	-	-	-	-	-	-	3	2	2
21ECE644.3	3	-	-	-	3	-	-	-	-	-	-	3	2	2
21ECE644.4	3	3	1	-	3	-	-	-	-	-	-	-	2	2
21ECE644.5	3	3	1	-	3	-	-	-	-	-	-	-	2	2
21ECE644.6	3	3	1	-	3	-	-	-	-	-	-	3	2	2
											40004			-
MODULE-1	1		ROD		JN TO	00P	1	1	P 4		TECE6	44.1	8 6	lours
Introduction, P	roceau	aral A	Appro	of the	bject-u	Jriente	a appi	roach,	Featur	es of of)Ject-or vs and	Strings	Drogram User de	ming, fined
types	, , , ,	stiut	luie	of the	стт, D	αια ιγμ	165, 601		uutui	es, Alla	ys anu	su ings,	User ue	inieu
Self-study			Exp	lore ho	w 00I	o is use	d in re	al-wor	ld softv	vare dev	velopm	ent proje	ects.	
TEXT BOOK			TEX	T 800	K 1 · Cł	anter	12				1	1 ,		
MODULE-2		OB	ECT	S AND	CONS	TRUC'	TORS			2	1ECE6	44.2	81	Hours
Class, Data me	mbers	and	Mem	ber fui	nctions	, Creat	ing Ob	jects o	of Class	, Access	Specif	fier, Sco	oe Resol	ution
Operator, Frien	d Fund	ctions	and	Friend	Classe	es, Stati	ic Mem	bers, (Compar	ison of o	class w	ith struc	ture, Pui	rpose
of Constructors	and D	estru	ctors	, Types	s of Co	nstruct	ors, Co	nstruc	tor Ove	erloadin	g, Invol	king Con	structor	s and
Destructors.														
Self-study			Stuc	dy how	encap	sulatio	n help	s in dat	ta hidir	ig and pi	rotectii	ng data v	vithin ob	jects.
Text Book			Tex	t Book	1: Cha	pter 3,	6				1 - 0 - 0			
MODULE-3	1.5	OP	ERAT	<u>'OR OV</u>	ERLO.	ADING	, ,			2	1ECE6	44.3		Hours
Introduction a	nd Fur	Idam	entals	s of ov	erload	ing, ov	erloadi	ng of I	binary	and una	ry ope	rators, o	verloadi	ng of
prenx and post	lix ope		<u>s, Dyi</u> walan		memor	y mana tainan	agemer		to alt a		linked	lict) with	onorati	
Lase-study Develop a custom container class (e.g., a stack, q							iack, ql ns (φ σ	nuch n	iniked	ustj witi mene da	i operato)1		
Text Book	Text Book 1: Chanter 10							מנוסווס נכובה, דעסוו, דסף, כווקעכעכ, עכקעכעבן.						
MODULE-4		EXC			ANDLI	NG			21ECE644.4 8 H			Hours		
									21ECE044.4 21ECE644.6				-our o	

Introduction, handling an attempt to divide by zero, re-throwing an exception, stack unwinding, when to use exception handling, Uncaught exception, bad exception Classes, and Built-In Exceptions. Exception Vs Error Handling, Assertion in C++.

Self-study	Analyze real-world examples of examples.	eptional situations and how it handled	l in software
Text Book	Text Book 1: Chapter 17		
MODULE-5	INHERITANCE	21ECE644.5	8 Hours
		21ECE644 6	

Defining derived classes, protected access specifier in Base class, public, private & protected inheritance,
constructors and destructors in derived classes, Types of Inheritances, Virtual base class.ApplicationsImplement inheritance to create a hierarchy of geometric shapes.

Text Book Text Book 1: Chapter 11

CIE Assessment Pattern (50 Marks - Theory)

		M	Marks Distribution						
	RBT Levels	Test (s)	Qualitative Assessment (s) (NPTEL)						
		25	25						
L1	Remember	5	-						
L2	Understand	5	5						
L3	Apply	10	10						
L4	Analyze	5	10						
L5	Evaluate	-	-						
L6	Create	-	-						

SEE Assessment Pattern (50 Marks - Theory)

	, ,	
	RBT Levels	Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

- 1. C++-How to program, Paul Deital and Harvey Deital, 9th Edition, 2014, Pearson.
- 2. The Complete Reference C++, Herbert Schildt, 4th Edition, 2003, Tata McGraw Hill.

Reference Books:

- 1. C++ Primer, Stanley B. Lippman, JoseeLajoie, Barbara E. Moo, 5th Edition, 2012, Addison Wesley.
- 2. The C++ programming language, Bjarne Stroustrup, 4 th Edition, 2013, Pearson.

Web links and Video Lectures (e-Resources):

- <u>C++ Programming Language GeeksforGeeks</u>
- <u>https://onlinecourses.nptel.ac.in/noc19 cs38/</u>

Activity-Based Learning (Suggested Activities in Cl ass)/ Practical Based learning

- Conduct on spot problem solving based on C++
- Develop simple GUI interfaces for a computer program to interact with users

BIO INSPIRED DESIGN AND INNOVATION														
Course Code	21	ECE64S	5						CIE M	arks		50		
L:T:P:S	3:0	:0:0							SEE M	arks		50		
Hrs / Week	3								Total	Marks		100		
Credits	03								Exam	Hours		03		
Course outco	mes:	ourco t	ho ct	udontu	will bo	abla ta								
		Surse, t			viii be			4 - 41		J		L		
21ECE645.1	Ver	rify the		imetics	s princ	iples in	relation	on to ti	ne need	as at that	t momen	t		
21ECE645.2	Eva	iluate t	he bio	o-mate	rial pro	opertie	s for h	ealth c	are app	olication	S			
21ECE645.3	Inv	estigat	e nov	el bioe	nginee	ring in	itiative	es by ev	valuati	ng desig	n and de	velopme	nt princi	ples
21ECE645.4	For	mulate	e bio-l	based s	olutio	ns for s	ocially	vital is	ssues v	vith criti	cal thoug	ght		
21ECE645.5	Cor	Comprehend the bio computing optimization through research and experiential learning												
21ECE645.6	Review the fundamental biological ideas through pertinent industrial applications and case studies													
Mapping of	Cours	e Outc	ome	s to Pr	ogran	n Outc	omes	and P	rograi	m Speci	fic Outc	omes:		
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PSO1	PSO2
21ECE645.1	3	3	3	3	2	-	-	-	1	1	-	2	2	1
21ECE645.2	3	3	3	3	2	-	-	-	1	1	-	2	2	1
21ECE645.3	3	3	3	3	2	-	-	-	1	1	-	2	2	1
21ECE645.4	3	3	3	3	2	-	-	-	1	1	-	2	2	1
21ECE645.5	3	3	3	3	2	-	-	-	1	1	-	2	2	1
21ECE645.6	3	3	3	3	2	-	-	-	1	1	-	Z	Z	1
MODULE-1	BIC	D-INSP	IREC	DESI	GN AN	D ENG	INEEI	RING		21	ECE645	5.1	8 Ho	urs
Bio-Inspired I	Engine	ering a	nd de	esign, H	listory	Evolut	tion, Ba	asics of	Biomi	metics a	nd other	Disciplin	nes, Raw	'ling's
Classification	s, Nee	d for B	io-Ins	pired	Design	s. Bio i	inspire	d Addi	itive m	anufactı	iring tec	hniques,	(self-he	aling,
self-assembly).													
Self-study / C	ase Sti	ıdv /	Inve	estigat	e the (Challen	ges of	Bio in	spired	design,	Compar	e with tr	adition	al
Applications		57	area	as of so	cience	and en	igineer	ring.	1	0,	1			
Text Book			Tex	t Book	1: 1.2,	1.3, 1.4	ł, 1.13,	1.15, 1	.16					
MODULE-2	BIC	D MAT	ERIA	LS AN	D BIO	HEAL	THCA	RE DE	SIGN	2	1ECE64	5.2	8 Ho	ours
Biomaterials,	Desig	n of Fo	orms-	(Hexa	igonal	unit c	ells, In	trinsic	disor	der, anis	otropy),	Design	of mate	rials-
(Hierarchy, fr	acture	e tough	mate	erials, s	tructu	ral col	ours, A	ctuatir	ng Mat	erials, B	io-Comp	atible Ma	iterials)	. Bio-
Mechanics, Aj	oplicat	tions of	Bion	nateria	ls and	Bio sys	stems i	in Heal	th care	e design	(Human	Prosthe	tics, Par	asitic
Wasp-Inspire	a Nee	ale, Uc	topus	S-Inspi Marir	rea su	Aorona	or 1188 Nutical	sue Gr	arting,	Реасосн	c-inspire	a Bioser	isors, G	еско-
Solf-study /	Ical GI	uej Kol	oto R	, Marin io-Con	notih		iutical.	nolum	ors for	human	implant	s and he	alth car	<u>م</u>
Case Study /		nnlicat	ions	10-0011	ipatio	ie alloy	/s anu	polym	15 101	numan	mpian	s and ne	aitii tai	e
Applications	u j	ppneae	10115.											
Text Book	Т	ext Boo	ok 1: 2	2.2, 2.3	, 2.4 to	2.15								
MODULE-3	BIC) SUST	'AIN/	ABLE I	DEVEL	OPME	NT			2	1ECE64	5.3,	8 Ho	ours
	21ECE645.4													
Innovations i	n Ene	rgy (Te	ermit	e mou	nd ins	pired s	hoppii	ng mal	ls), Inr	novation	ıs in Res	ource-A	r	
(purification,	filtra	tion), D)ew v	vater c	ollecti	on sys	tems, v	water j	purific	ation, de	esalinati	on, Mana	agemen	t of
spaces, desig	spaces, designs for megastructures.													

Self-study /	Explore the Bio	inspired environmen	tal constructions	s and development.	
Case Study /					
Text Book	Text Book 2.31	333537310			
MODULE-4	BIO COMPUTI	NG AND OPTIMISATI	ON	21ECE645.5	8 Hours
No Free Lunch	Theorem, Bat Alg	gorithm, Flower Pollin	ation Algorithm,	Genetic Algorithm-	Crossover and
Mutation Oper	ations. Bio-Inspi	ired Optimisation, An	it Colony Optimi	sation (ACO), Swam	n Intelligence-
Particle Swam	Optimisation (PS	SO).			
Self-study /	Scrutinize the D	Different types of Optin	mization techniq	ues, genetic researc	h.
Case Study /					
Applications			1 0 4 0 4 4 0 0 4		
Text Book	Text Book 1: 6.1	., 6.3, 6.5, 6.7, Text Boo	ok 2: 10.1, 10.3, 1	0.5, 10.7	0.11.5.55
MODULE-5	APPLICATION	S OF BIO-INSPIRED I	NNOVATIONS	21ECE645.6	8 Hours
Bioinspired in	novations in – Aut	tomotive, Automation,	, Materials and M	anufacturing, Senso	rs, Controllers,
Communicatio	ns, Healthcare, A	Agriculture, food pro	duction, and Sp	orts, Environment	infrastructure.
eco-restoration	i soluciolis (Cora is (Eco-friendly i	nesticide)	, Cal Doll Flee Sol	utions (Lotus lear in	spireu paints),
Self-study /	Survey on Bio in	nspired Innovations. c	design, applicatio	ons and case studies	of the same.
Case Study /			accient, approaction		
Applications					
Text Book	Text Book 2: 12.	.1 to 12.10			
CIE Assessmen	t Pattern (50 Ma	arke – Theory)			
311 113303311101	it i attern (50 Ma	arks – rheoryj			
		Marks – Theoryj	arks Distributio	n	
R	BT Levels	Marks - Theory	arks Distributio Qualitative As	n ssessment (s)	
R	BT Levels	Marks – Theory) Ma Test (s)	arks Distributio Qualitative As (NP	n ssessment (s) FEL)	
R	BT Levels	Marks - Theory Marks - Theory Test (s) 25	arks Distributio Qualitative As (NP) 2	n ssessment (s) FEL) 5	
R L1 Rei	BT Levels	Marks - Theory) Marks - Theory) Test (s) 25 5	arks Distributio Qualitative As (NP) 2	n ssessment (s) FEL) 5	
L1 Ren L2 Un	BT Levels member derstand	Main Test (s) 25 5 5 10	arks Distributio Qualitative As (NP) 2	n ssessment (s) FEL) 5	
L1 Rei L2 Un L3 Ap	BT Levels member derstand ply	Marks - Theory Marks - Theory Test (s) 25 5 5 5 10	arks Distributio Qualitative As (NP) 2	n ssessment (s) FEL) 5 5 0	
L1 Ren L2 Un L3 Ap L4 An	BT Levels member derstand ply alyze	Marks - Theory Marks - Theory Test (s) 25 5 5 5 10 5	arks Distributio Qualitative As (NP) 2 2 5 5 5 1 1 1	n ssessment (s) FEL) 5 5 0 0	
L1RefL2UnL3ApL4AnL5EvaL6Creation	BT Levels member derstand ply alyze aluate	Marks - Theory Marks - Theory Test (s) 25 5 5 5 10 5 -	arks Distributio Qualitative As (NP) 2	n ssessment (s) (FEL) 5 5 0 0 0	
L1 Rei L2 Un L3 Ap L4 An L5 Eva L6 Cre	BT Levels member derstand ply alyze aluate eate	Marks - Theory Marks - Theory Test (s) 25 5 5 10 5 - 10 5 - -	arks Distributio Qualitative As (NP) 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	n ssessment (s) FEL) 5 6 0 0 0	
L1 Ren L2 Un L3 Ap L4 An L5 Eva L6 Cre	BT Levels member derstand ply alyze aluate eate	Marks - Theory) Marks - Theory) Test (s) 25 5 5 10 5 - - -	arks Distributio Qualitative As (NP) 2 2 1 1 1 1	n ssessment (s) FEL) 5 6 0 0 0	
L1RefL2UnL3ApL4AnL5EvaL6Cre	BT Levels member derstand ply alyze aluate eate nt Pattern (50 M	Marks - Theory) Marks - Theory) Marks - Theory)	arks Distributio Qualitative As (NP7 2 2 5 5 1 1 1 1 1	n ssessment (s) (FEL) 5 	
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L1RefL2UnL3ApL4AnL5EvaL6CreSEE AssessmenRBT L6L1Rement	BT Levels member derstand ply alyze aluate eate nt Pattern (50 M evels nber	Arks - Theory) Mail Test (s) 25 5 10 5 -	arks Distributio Qualitative As (NP) 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	n ssessment (s) (FEL) 5 	
L1 Ref L2 Un L3 Ap L4 An L5 Eva L6 Cref SEE Assessmen RBT Le L1 Remen L2 Unders	BT Levels member derstand ply alyze aluate eate nt Pattern (50 Magnetic stand nber stand	Arks - Theory Ma Test (s) 25 5 5 10 5 - - arks - Theory) - Exam Marks - 10 10 10 - 0 - 10 10 10 10 10 10 10 10	arks Distributio Qualitative As (NP) 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	n ssessment (s) (FEL) 5 0 0 0	
L1 Rei L2 Un L3 Ap L4 An L5 Eva L6 Crei SEE Assessmen RBT Le L1 Rement L2 Undersidersidersider L3 Apply L4 Amedia	BT Levels member derstand ply alyze aluate eate nt Pattern (50 M evels finber stand	Arks - Theory Ma Test (s) 25 5 5 10 5 - - arks - Theory) - Exam Marks - Distribution (50) 10 10 10 10 10 10 10 10 10	arks Distributio Qualitative As (NP) 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	n ssessment (s) FEL) 5 0 0 0	
L1 Rei L2 Un L3 Ap L4 An L5 Eva L6 Crei SEE Assessmen RBT L6 L1 Rement L2 Understand L3 Apply L4 Analyz L5 Eva	BT Levels member derstand ply alyze aluate eate nt Pattern (50 Ma evels nber stand	Arks - Theory) Max Test (s) 25 5 10 5 10 5 - arks - Theory) Exam Marks Distribution (50) 10 10 10 10 10 10 10 10 10 10	arks Distributio Qualitative As (NP) 2	n	
L1 Ref L2 Un L3 Ap L4 An L5 Eva L6 Cref SEE Assessmen RBT L6 L1 Rement L2 Understand L3 Apply L4 Analyz L5 Evaluat L6 Create	BT Levels member derstand ply alyze aluate eate nt Pattern (50 Ma evels nber stand	Arks - Theory) Mail Test (s) 25 5 10 5 10 5 10 5 10 5 10 10 10 10 10 10 10 10 10 10 10 10	arks Distributio Qualitative As (NP) 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	n ssessment (s) (FEL) 5 	

Text Books:

1)Helena Hashemi Farzaneh, Udo Lindemann, "A Practical Guide to Bio-inspired Design", Springer Vieweg, 1st edition 2019, ISBN-10 : 366257683X, ISBN-13 : 978-3662576830

2)Torben A. Lenau, Akhlesh Lakhtakia," Biologically Inspired Design: A Primer (Synthesis Lectures on Engineering, Science, and Technology)", Publisher: Morgan & Claypool Publishers, 2021, ISBN-10: 1636390471, ISBN-13: 978-1636390475

Reference Books:

1)French M, "Invention and evolution: Design in nature and engineering", Publisher: Cambridge University Press, 2020

2)Pan L., Pang S., Song T. and Gong F. eds, "Bio-Inspired Computing: Theories and Applications", 15th International Conference, BIC-TA 2020, Qingdao, China, October 23-25, 2020, Revised Selected Papers (Vol. 1363). Springer Nature, 2021

3)Wann D, "Bio Logic: Designing with nature to protect the environment", Wiley Publisher, 1994

Web links and Video Lectures (e-Resources):

- <u>https://onlinecourses.nptel.ac.in/noc22_ge24/preview</u>
- <u>https://biodesign.berkeley.edu/bioinspired-design-course/</u>
- <u>https://www.youtube.com/watch?v=cwxXY9Qe8ss</u>
- <u>https://www.youtube.com/watch?v=V2GvQXvjhLA</u>
- <u>https://nsf-gov-resources.nsf.gov/2023-03/Bio-inspired%20Design</u>
- %20Workshop%20Report 2232327 October%202022 Final.508.pdf

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

Contents related activities (Activity-based discussions)

- For active participation of students, instruct the students to prepare Flowcharts and Handouts.
- > Organizing Group wise discussions on issues.
- ➤ Seminars.

				SC	OCIAL (CONNE	CT & 1	RESPO	NSIBII	ITY				
Course Code	21	ECK6	5						CIE M	arks		50		
L:T:P:S	0:0	:1:0							SEE M	larks		50		
Hrs / Week	02								Total	Marks		10	0	
Credits	01								Exam	Hours		02		
Course outcon At the end of	mes: the co	ourse	, the st	udent	will be	able to	:							
21ECK65.1	Re	alize	social	respon	sibility	throug	gh soci	etal ac	tivities					
21ECK65.2	Re	Review the history and culture of city through community interaction												
21ECK65.3	De	Develop responsible connection for societal benefits												
21ECK65.4	Cu	Cultivate the best practices for diverse scenarios												
21ECK65.5	Bu	Build planning and organizational skills												
21ECK65.6 Develop deep drive into societal challenges being addressed by NGO(s), social enterprises & the Government														
Mapping of C	ours	e Out	tcome	s to P	rogran	n Outc	omes	and F	rogra	m Spec	ific Ou	tcomes		
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PSO1	PSO2
21ECK65.1	-	-	-	-	-	3	2	2	3	2	-	1	-	-
21ECK65.2	-	-	-	-	-	3	2	2	3	2	-	1	-	-
21ECK65.3	-	-	-	-	-	3	2	2	3	2	-	1	-	-
21ECK65.4	-	-	-	-	-	3	2	2	3	2	-	1	-	-
21ECK65.5	-	-	-	-	-	3	2	2	3	2	-	1	-	-
21ECK65.6	-	-	-	-	-	3	2	2	3	2	-	1	-	-
MODULE-1	PL A	ANTA	TION	AND A	DOPTI	ON OF	ATR	EE		2	1ЕСК6 1ЕСК6	5.1, 55.2	3	Hours
Plantation of a documentary o literature.	a tree or a pl	that totob	will b log de	e ador scribin	oted for g the pl	four ant's o	years rigin, i	by a g ts usag	roup of ge in da	f B.E st ily life, a	udents. and its a	They w ppearar	ill also e ice in foll	execute a klore and
MODULE-2	HE	RITA	GE W	ALK A	ND CR	AFTS	CORN	ER			21ECK 21ECK 21ECK	65.1, 65.2, 65.3	3	Hours
Heritage tour, knowing the ci	know ty and	ving t d its c	he his raftsm	tory an ian, ph	id cultu otoblog	re of t and d	he city: ocume	y, conr ntary	ecting on evol	to peop ution ar	ole arou nd pract	nd throu tice of va	ugh theii rious cra	r history, aft forms.
MODULE-3	OR	GANI	C FAR	MING	AND W	ASTE	MANA	GEME	NT		21ECK 21ECK	65.4, 65.5	3	Hours
Usefulness of c campus.	organi	ic farr	ning, v	vet wa	ste mar	ageme	ent in r	neighb	oring vi	illages, a	and imp	olementa	ition in t	he
MODULE-4	WA	WATER CONSERVATION21ECK65.4, 21ECK65.5, 21ECK65.6											Hours	
Knowing the p photo blog pre	Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photo blog presenting the current practices.													

cturing Company.		
	21ECK65.3, 21ECK65.4	3 Hours
ous materials of th	e region used in cooking.	
er-friendly platform he city's diverse foo	n for food walk enthusiasts, b od culture.	oth residents
ased)		
ks and average o	of all the five modules wi	ll be the final
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Marks		
15	_	
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20		
50		
ased)		
Marks		
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50		
arning		
the stories with ot	hers:	
	turing Company.	21ECK65.3, 21ECK65.4 ous materials of the region used in cooking. er-friendly platform for food walk enthusiasts, be he city's diverse food culture. ased) ks and average of all the five modules will 15 20 50 xased) Marks 20 50 xased) ased) starting the stories with others:

Share the experience of Social Connect.
Exhibit the talent like playing instruments, singing, one-act play, art-painting, and fine art.

Pedagogy:

- The students will be divided into groups. Each group will be handled by faculty mentor.
- Faculty mentor will design the activities (particularly Jamming sessions, open mic and poetry)
- The course is mainly activity-based that will offer a set of activities for the student that enables them to connect with fellow human beings, nature, society, and the world at large.
- The course will engage students for interactive sessions, open mic, reading group, storytelling sessions, and semester-long activities conducted by faculty mentors.
- Studentsshouldpresenttheprogressoftheactivitiesasperthescheduleintheprescribedpracticalsessioninthefi eld.

• There should be positive progress in the vertical order for the benefit of society in general through activities.

Plan of Action:

- Each student should do activities according to the scheme and syllabus.
- At the end of semester student performance has to be evaluated by the faculty mentor for the assigned activity progress and its completion.
- At last consolidated report of all activities from 1stto 5th, compiled report should be submitted as per the instructions and scheme.
- Practice Session Description:
 - Lecture session in field to start activities
 - Students Presentation on Ideas
 - Commencement of activity and its progress
 - Execution of Activity
 - Case study-based Assessment, Individual performance
 - Sector/ Teamwise study and its consolidation
 - Videobasedseminarfor10minutes by each student at the end of semester with Report.

Module Name	Group Size	Location Magnitude		Activity	Reporting
Plantation and adoption of a tree	03-05	Farmers Land or Roadside or Community area or institution's campus, anyone location to be selected.	Students must monitor till end of B Tech degree	Site selection Select suitable species in consultation with horticulture, forest or agriculture department. Interact with NGO/Industry and community to plant Tag the plant for continuous monitoring	Report shall behand written with paintings, sketches, poster, video

-					ч — т
Heritage walk and crafts corner	03-05	Preferably Within the city where institution is located or home town of the student group	One or two: One can be a structure or a heritage building the other can be heritage custom or practice	Survey in the form of questioner by connecting to the people and asking. No standard questioner to be given by faculty and has to be evolved involving students. Questions during survey can be asked in local language but report language is English.	and/or photograph with Geotag.
Waste managemen t	03-05 More than one group Can be assigned one task based on magnitud e of task.	Preferably in the near by villages and within the campus.	One	Report on importance and benefits of Waste management. Report on segregation, collection, transportation and disposal. Suggestion for composting. Visit near by village/location to sensitize farmers and public about waste management and also document	
Water Conservatio n	03-05	Rain water harvesting demonstration available in the campus or surroundings	One	Visit lakes/pond/river/drywell to involve on rejuvenation activity. Or Assessment of Water budget in the campus / village Report on traditional water conservation practices(to minimize wastage)	
Food Walk	03-05	Within the city where institution is located Food culture of student's resident region	One	Survey local food centers and identify the specialty Identify and study the food ingredients Report on the regional foods Report on Medicinals values of the local food grains, and plants.	

INNOVATION / ENTREPRENEURSHIP / SOCIETAL INTERNSHIP																
Course	e Code	1	21ECE	66						CIE	Marks		50	50		
L:T:P:S	5	(0:0:3:	0						SEE	Marks		50			
Hrs / V	Neek		3							Tota	al Marks	5	10	0		
Credit	S	(03							Exa	m Hours	5	03			
Course	e outco	mes:														
At the	e end of	the c	ourse,	the s	tudent	t will b	e able	to:								
21ECE	66.1		Apply	the p	roblen	1-solvi	ng skil	ls to p	rovide	creativ	ve soluti	ons tow	ards sus	tainable		
21666	66.2		Dromo	to in		on and	avatai	nahla	davala	mont	in diffor	ontnort	a of coa	otre		
21ECE 21ECE	66.2		Dovol	on pr	actical	incigh	sustai	offoctiv	uevelo	oluing	appropr	viato tod	hnology	in innor	ation and	
2 IECE	Entrepreneurship						ation and									
21ECE	66.4	(Create	a coi	nceptu	al fran	neworł	k towa	rds glo	bal iss	ues					
Маррі	i <mark>ng of C</mark>	Cours	e Out	com	es to I	Progra	ım Ou	tcome	es and	Prog	ram Spe	cific O	utcome	S:		
		P01	P02	PO3	P04	P05	P06	P07	P08	P09	P010	P011	P012	PS01	PSO2	
21ECE	266.1	3	-		-	2	2	2	2	3	2	1	3	3	3	
21ECE	266.2	3	3	1	-	2	2	2	2	3	2	1	3	3	3	
21ECE	266.3	3	3	1	-	2	2	2	2	3	2	1	3	3	3	
21ECE	266.4	3	3	1	-	2	2	2	2	3	2	1	3	3	3	
CIE As	sessme	ent Pa	ttern	(50	Marks	- Lab])									
						Ex	am Ma	arks								
	l	RBT I	Levels			Di	Distribution									
							(50)									
L1	Re	emen	nber				-									
L2	U	nders	stand				-									
L3	Aj	pply					20									
L4	A	nalyz	е				10									
L5	Ev	valua	te				10									
L6	Cr	eate					10									
SEE As	sessme	ent Pa	attern	(50	Marks	- Lab)									
		1	_		Ex	am Ma	arks									
	KRII	Levels	S	Distribution (50))								
L1	Reme	mbe	r		-											
L2	Unde	rstan	d		-											
L3	Apply	7			20											
L4	Analy	ze			10											
L5	Evalu	ate			10											
L6	Creat	e			10											

						MI	NI PR	OJEC	Т					
Course Co	le	21EC	E67						CIE	Marks		50		
L:T:P:S		0:0:1:	0						SEE	Marks		50		
Hrs / Wee	K	0							Tota	l Marks		10	0	
Credits		01							Exai	n Hours		03		
Course out	comes	5: 	+h+		uill ha	مامام								
At the end of	or the c	ourse,	the st	udent	will be	able to								
21ECE67.1		Identif approa	fy tecl ach	nnical a	spects	s of the	choser	1 proje	ct with	a compr	ehensiv	e and sys	stematic	
21ECE67.2		Reviev	v the	literatı	ire and	l develo	op solu	tions fo	or proł	olem stat	ement			
21ECE67.3		Work	as an	individ	ual or	in a tea	ım in d	evelop	ment o	of technic	cal proje	cts		
21ECE67.4		Select	appro	opriate	tools/	techno	logies	/ conce	epts to	solve the	e problei	n		
21ECE67.5		Write	a repo	report and communicate effectively through oral presentation in a team										
21ECE67.6		Extend	l or u	se the i	dea in	mini pi	roject f	for maj	or proj	ect				
Mapping of	of Cour	urse Outcomes to Program Outcomes and Program Specific Outcomes:												
	PO 1	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012	PSO1	PSO2
21ECE67.1	3	3	-	-	-	-	-	-	3	-	-	-	3	3
21ECE67.2	3	3	3	3	2	-	-	-	3	3	3	3	3	3
21ECE67.3	3	3	3	-	-	-	-	- ว	-	3	3	3	3	3
21ECE67.4	2	2	3	-	-	-	-	3	3	3	3	3	3	3
21ECE07.3	3	3	3	- 3	-	- 3	-	3	3	3	3	3	3	3
	0	5	0	0		0	-	0	5	5	0	0	0	0
CIE Assess	ment I	Patterr	ı (50	Marks)									
R	BT Lev	els		E Dist	xam M tributi	larks on (50)							
L1	Reme	mber			-									
L2	Under	stand			-									
L3	Apply				20									
L4	Analy	ze			10									
L5	Evalua	ate			10									
L6	Create	e			10									
SEE Assess	ment	Patter	n (50	Marks	5)									
RBT Levels Exam Marks Distribution (50)														
L1 Re	L1 Remember -													
L2 Un	dersta	nd			-									
L3 Ap	ply alwaa				20									
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	aiyze aluate				10									
L6 Cr	eate				10									

			NATI	ONAL S	ERVIC	E SCH	EME (NSS)					
Course Code	21NSS	84					CIE M	arks			50		
L:T:P:S	0:0:0:0)					SEE M	arks			50		
Hrs / Week	2						Total	Marks			100)	
Credits	00						Exam	Hours			2		
Course outc	omes:												
At the end of	the cours	se, the s	student w	ill be abl	e to:								
21NSS84.1	Unders	stand tl	ne importa	ance of h	is / her ı	respon	sibilities	towar	ds soci	ety			
21NSS84.2	Analyz for the	e the ei same.	nvironme	ntal and	societal	problei	ns/issue	es and v	will be	able to	o des	sign solu	itions
21NSS84.3	Evalua develo	te the e pment.	existing sy	rstem and	d to prop	ose pr	actical so	olution	s for th	ne same	e for	sustain	able
21NSS84.4	4 Implement government or self-driven projects effectively in the field.												
Mapping of C	f Course Outcomes to Program Outcomes:												
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P01	0	P011	P012
21NSS84.1	-	-	-	-	-	3	1	1	3	2		2	1
21NSS84.2	-	-	-	-	-	3	1	1	3	2		2	1
21NSS84.3	-	-	-	-	-	3	1	1	3	2		2	1
21NSS84.4	-	-	-	-	-	3	1	1	3	2		2	1
Semester					CONTE	NT						НО	URS
bemester					PART	Δ							010
	ONENSS NGO's/O	–CAMI General	P@Coll Social Ca	lege/Uni [,] mps	versity/S	State	or C	entral	Govt	t Lev	/el		
					<u>PART</u>	<u>B</u>							
	1. Org Con	anic f nectivi	farming, ity for ma	Indian rketing	Agricul	ture	(Past, 1	Presen	t and	l Futi	ıre)		
	2. Was	ste mar	nagement	-Public,	Private	and Go	vtorgan	izatior	1,5R's.			То	tal 32
	3. Sett	ing of	f the inf	formatio	n impa	rting	club fo	r wor	nen le	eading	to	I I I	Irs/
	con	tributi	on in soci	al and ec	conomic	issues		-	-			Sen	nester
5 th to 8 th	4. Wat Imp	er co lemen	onservatio tation.	on tecł	nniques-	-Role	of dif	fferent	stak	ceholde	ers-	2 Hrs	/week
	5. Prej	paring	an actio	nable b	usiness	propo	sal for	enhan	cing t	he vill	age		
	income and approach for implementation.												
	6. Help	6. Helping local schools to achieve good results and enhance their enrolment											
	in Hi	in Higher/technical/vocational education.											
	7. Deve	loping	Sustaina	ble Wate	er mana	igemen	t syster	n for	rural a	areas a	and		
	impl	ementa	ation appr	oaches.									

	8. Contribution to any national level initiative of Government of eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bhar	of India. For. rath, Make in	
	India, Mudra scheme, Skill development programs etc.		
	9. Spreading public awareness under rural outreach (minimum5programs).	programs.	
	10. Organize National integration and social harmony events/w	vorkshops /	
	Seminars. (Minimum02programs).		
	11. Govt. school Rejuvenation and helping them to ac infrastructure.	hieve good	
	smont Pottorn (EQ Marks - Practical)		
	ADT A. Compulsorily students have to attend one comp		
1. PAI	ART A: Compulsoring students have to attend one camp.		
2. PA	ART B: Students have to take up anyone activity on the above said topic	cs and have to prepa	are
content	nt for awareness and technical contents for implementation of the	projects and have	to
present	nt strategies for implementation of the same.		

3. CIE will be evaluated based on their presentation, approach and implementation strategies.

CIE Components	Marks
Presentation1-Selection of topic-	10
(phase1)	
Experiential Learning	10
Presentation 2 (phase2)	
Case Study-based Teaching-Learning	10
Sector-wise study & consolidation	10
Video based seminar (4-5 minutes per	10
student)	
Total	50

SEE Assessment Pattern (50 Marks - Practical)

- Implementation strategies of the project with report duly signed by the Dept's Coordinator, HoD and Principal.
- At last it should be evaluated by the NSS Coordinator.
- Finally consolidated report should be sent to the University.

Suggested Learning Resources:

Reference Books:

1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.

Pre-requisites to take this Course:

- 1. Students should have a service-oriented mindset and social concern.
- 2. Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works.
- 3. Students should be ready to sacrifice some of the time and wishes to achieve service-oriented targets on time.

	PH	YSICA	L EDUC	CATION	(PE) (SPOR	TS AN	D AT	HLET	ICS)			
Course Cod	e 21PES	84					CIE Ma	arks			50		
L:T:P:S	0:0:0:0)					SEE M	arks			50		
Hrs / Week	2						Total	<u>Marks</u>			100		
Credits	00						Exam	Hours			02		
At the end	comes: of the cours	se, the st	udent wi	ll be able	e to:								
21PES84.1	Demon	strate th	e startin	ig and fir	nishing p	osition	s of diffe	erent ti	ack an	d jump	p eve	ents.	
21PES84.2	Demon landing	strate th g position	ie holdin n in vario	g and re ous jump	leasing s bing ever	tances its of A	in vario thletics.	us thro	wing e	vents,	and	takeoff	and
21PES84.3	Demon	strate th	ie specifi	c skills a	nd techr	niques	of the se	lected	game/	event.			
21PES84.4	Demon	strate ar	nd descri	ibe the r	ules and	regulat	tions of s	specific	: game:	s.			
Mapping of	f Course O	utcome	s to Pro	gram O	utcome	s:							
04000000	P01	P02	P03	P04	P05	P06	P07	P08	P09	P01	10	P011	P012
21PES84.1	-	-	-	-	-	-	-	1	2	-		-	1
21PES84.2	-	-	-	-	-	-	-	1	2	-		-	1
21PES84.3	-	-	-	-	-	-	-	1	2	-		-	1
2192584.4	-	-	-	-	-	-	-	I	Z	-		-	1
Semester	nester CONTENT								ΗΟΙ	JRS			
5th	tips. Practical Athletic: 1. Tracl • St • A • Fi Sl 2. Jump Style 3. Thro Deliv	l Compo s: k -Sprint carting T f Starting ccelerati inishing nrug. s- Long /Hitch K ws- Sho very Stan	ments of ments: S echnique g Block. on with technique Jump: Cick)and ot Put: J cice and R	proper r ue: Run Approac Landing Holding	rength, E ing start unning t Throug ch Run, the Sho (Perry C	and Cr and Cr echniq h, Forv Take-o t, Plac)'Brien	ouch sta ouch sta ues. vard Lu off, Flig rement, Techniq	ibility, art(its v nging a ht in Initial jue)	and Ag variatic and Sh the ai Stance	gility ons)use noulder r (Har e, Glid	e ng le,	Total 3 Seme	2 Hrs/ ester
	Kabaddi: A. Fu 1. Skills in side kick, 2. Skills of position, 3. Addition escaping 4. Game p B. Ru	Delivery Stance and Recovery (Perry O'Brien Technique) Kabaddi OR Kho-Kho Tabaddi: A. Fundamental skills 1. Skills in Raiding: Touching with hands, Use of leg-toe touch, squat leg thrust, side kick, mule kick, arrow fly kick, crossing of baulk line. Crossing of Bonus line. 2. Skills of holding the raider: Various formations, catching from particular position, different catches, catching formation and techniques. 3. Additional skills in raiding: Escaping from various holds, techniques of escaping from chain formation, offense and defense. 4. Game practice with application of Rules and Regulations. B. Rules and their interpretations and duties of the officials.								/week			

	Kho-Kho:	
	A Fundamental skills	
	1. Skills in Chasing: Sit on the box (Parallel &Bullet toe method),Getup from the	
	box(Proximal & Distal foot method),Give Kho(Simple,Early, Late&	
	Judgment),Pole Turn, Pole Dive, Tapping, Hammering, Rectification of foul.	
	2. Skills in running: Chain Play, Ring play and Chain & Ring mixed play.	
	3. Game practice with application of Rules and Regulations.	
	B. Rules and their interpretations and duties of the officials.	
	Athletics:	
	1. Track -110 Mtrs and 400Mtrs:	
	• Hurdling Technique: Lead leg Technique, Trail leg Technique, Side	
	Hurdling, Over the Hurdles	
	• Crouch start (its variations)use of Starting Block.	
	• Approach to First Hurdles, In Between Hurdles, Last Hurdles to	
	Finishing.	
	2. Jumps- High jump: Approach Run, Take-off, Bar Clearance (Straddle) and	
	Landing.	
	3. Throws- Discus Throw: Holding the Discus, Initial Stance Primary Swing,	
	Turn, Release and Recovery (Rotation in the circle).	
	Volleyball OR Throw Ball	
	Volleyball:	
	A. Fundamental skills	
	1. Service: Under arm service, Side arm service, Tennis service, Floating service.	
	2. Pass: Under arm pass, Over-head pass.	
	3. Spiking and Blocking.	
	4. Game practice with application of Rules and Regulations	
6th	B. Rules and their interpretation and duties of officials.	
	Throw Ball:	
	A. Fundamental skills:	
	Over hand service, Side arm service, two hand catching, one hand over head	
	return, side arm return.	
	B. Rules and their interpretations and duties of officials	
	Football OR Hockey	
	Football:	
	A. Fundamental Skills	
	1. KICKING: KICKING the ball with Inside of the foot, KICKING the ball with Full Insten of the foot. Kicking the	
	ball with Outer Instep of the foot and Lofted Kick.	
	2. Trapping: Trapping- the Rolling ball, and the Bouncing ball with sole of the	
	foot.	
	3. Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with	
	Inner and Outer Instep of the foot.	
	4. Heading: In standing, running and jumping condition.	
	5. Throw-in: Standing throw-in and Running throw-in.	
	6. Feinting: With the lower limb and upper part of the body.	

	7. Tackling: Simple Tackling, Slide Tackling.	
	8. Goal Keeping: Collection of Ball, Ball clearance-kicking, throwing and	
	deflecting.	
	9. Game practice with application of Rules and Regulations.	
	C. Rules and their interpretation and duties of officials.	
	Hockey: A Fundamental Skills	
	1. Passing: Short pass, Longpass, pushpass, hit	
	2. Trapping.	
	3. Dribbling and Dozing	
	4. Penalty stroke practice.	
	5. Penalty corner practice.	
	6. Tackling: Simple Tackling, Slide Tackling.	
	7. Goal Keeping, Ball clearance- kicking, and deflecting.	
	8. Game practice with application of Rules and Regulations.	
	Athletics	
	1. Track -Relay Race:	
	• Starting, Baton Holding/Carrying, Baton Exchange in between zone,	
	and Finishing	
	 Crouch start (its variations) use of Starting Block. 	
	• Approach to First Hurdles, In Between Hurdles, Last Hurdles to	
	Finishing. 2 Jumps- Triple Jump: Approach Run Take-off Flight in the Hon Step Jump	
	and Landing	
	3. Throws- Javelin Throw: Grip, Carry, and Recovery (3/5 Impulse stride).	
	Cricket OR Baseball	
	Cricket:	
	A. Fundamental skills	
	1. Batting- Forward Defense Stroke, Backward Defense Stroke, OffDrive, On	
	Drive, Straight Drive, Cover Drive, Square Cut.	
7th	2. Bowling-Out-swing, In-swing Off Break, Leg Break and Googly.	
	3. Fielding: Catching - The High Catch, The Skim Catch, The Close Catch and	
	throwing at the stumps from different angles. Long Barrier and Throw, Short	
	Throw, Long Throw, Throwing on the Turn.	
	B. Rules and their interpretation and duties of officials.	
	Basehall	
	A. Fundamental skills:	
	1. Player Stances – walking, extending walking, L stance, cat stance Grip –	
	standard grip, choke grip	
	2. Batting – swing and bunt.	
	3. FIGHING 4. Baseball: slider fast nitch curve hall dron hall rise hall change up knuckle	
	ball, screw ball	
	B. Rules and their interpretations and duties of officials	
	Basketball OR Net Ball	

	Basketball:
	A. Fundamental Skills
	1. Passing: Two hand Chest Pass, Two hands Bounce Pass, One hand
	Baseball Pass, Side arm Pass, Overhead Pass, Hook Pass.
	2. Receiving: Two hand receiving, One hand receiving, Receiving in
	stationary position, Receiving while Jumping and Receiving while
	Running.
	3. Dribbling: How to start dribble, drop dribble, High Dribble, Low Dribble,
	Reverse Dribble, Rolling Dribble.
	4. Shooting: Lay-up shot and its variations, One hand set shot, Two hands
	jump snot, Hook snot, Free Inrow.
	5. Rebounding: Defensive rebound and Offensive rebound.
	6. Individual Defence: Guarding the player with the ball and without the ball,
	Pivoting.
	7. Game practice with application of Rules and Regulations.
	Netball:
	A. Fundamental Skills
	1. Catching: one handed, two handed, with feet grounded and in flight.
	2. Throwing (Different passes and their uses): One hand passes (shoulder,
	high shoulder, underarm, bounce, lob), two hand passes (Push, overhead
	and bounce).
	3. Footwork: Landing on one foot, landing on two feet, Pivot, Running pass.
	4. Shooting: One hand, forward step shot, and backward step shot.
	5. Techniques of free dodge and sprint, sudden sprint, sprint and stop,
	sprinting with change at speed.
	6. Defending: Marking the player, marking the ball, blocking, inside the circle,
	outside the circle. Defending the circle edge against the passing.
	7. Intercepting: Pass and shot.
	8. Game practice with application of Rules and Regulations.
	B. Rules and their interpretation and duties of officials.
	Athletics:
	A. Track -Combined Events:
	a. Heptathlon all the 7 events
	b. Decathlon: All 10 Events
	B. Jumps- Pole Vault: Approach Run, Planting the Pole, Take-off, Bar Clearance and
	Landing.
	C. Throws- Hammer Throw: Holding the Hammer, Initial Stance Primary Swing,
	Turn, Release and Recovery (Rotation in the circle).
	Shuttle Badminton UK Table Tennis
	A Fundamental skills
Qth	D Basic Knowledge: Various parts of the Backet and Grip
otii	F Service: Short service Long service Long-high service
	E. Service. Short service, hong service, hong high service.
	Net shot Smash
	G Game practice with application of Rules and Regulations
	B Rules and their interpretation and duties of officials
	D. Rates and then interpretation and duties of officials.
	Table Tennis:
	A. Fundamental skills:
	1. Basic Knowledge: Various parts of the Racket and Grip(Shake Hand &
	PenHold Grip).
	2. Stance: Alternate & Parallel.

	Total	50					
		E A					
	Handball/ Badminton	05					
	Shuttle Badminton / Table Tennis	05	_				
	Netball/Basketball	05	_				
	Football/Hockey	05	_				
	Volleyball / Throw ball	05	_				
	Kabaddi OR Kho-Kho	05	_				
	Athletics	20	_				
	SEE SEE	Marks	_				
			7				
E Assessr	nent Pattern (50 Marks - Practical)						
	Total	50					
	8 th Semester	15	-				
	/ ^{un} Semester	15	-				
	6 th Semester	10	-				
	5 th Semester	10	_				
	CIE	Marks	-				
activitie	s learnt in the semester.	Merler	7				
CIE to b	e evaluated every semester end based on practi	cal demonstration o	f Sports and Athletics				
E Assessn	ient Pattern (50 Marks – Practical) –						
	2. reacts and then interpretation and duties of 0		I				
	4. Game practice with application of Rules and Regulations. B Rules and their interpretation and duties of officials						
	Dropshot, Netshot, Smash.	d Pogulations					
	3. Shots: Overhead shot, Defensive clearshot, Attacking clearshot,						
	2. Service: Short service, Long service, Long-	high service.					
	1. Basic Knowledge: Various parts of the Rac	ket and Grip.					
	Ball badminton:						
	Pall hadminton.						
	B. Rules and their interpretations and duties of officials						
	6. Game practice with application of Rules and Regulations.						
	wings and center. 5 Blocking Goal Keening and Defensive skills						
	4. Attack and counter attack, simple counter attack, counter attack from two						
	3. Dribbling: High and low.						
	2. Goal Throws: Jumpshot, Centershot, Diveshot, Reverseshot.						
	1. Catching, Throwing and Ball control,						
	A. Fundamental Skills						
	Handball OR Ball Badn	ninton					
		011101010					
	B Rules and their interpretations and duties of	officials					
	5. Receive: Push and Chop with both Backhand & Forehand.						
	5. Receive: Push and Chop with both Backhan	d & Forehand.					

Reference Books:

Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
 Bandopadhyay,K. Sarir Siksha Parichay, Classic Publishers, Kolkata.

- 3. Petipus, etal. Athlete's Guide to Career Planning, Human Kinetics.
- 4. Dharma, P.N. Fundamentals of Track and Field, Khel Sahitya Kendra, NewDelhi.
- 5. Jain, R. Play and Learn Cricket, Khel Sahitya Kendra, New Delhi.
- 6. Vivek Thani, Coaching Cricket ,Khel Sahitya Kendra, NewDelhi.
- 7. Saha,A.K.Sarir SiksherRitiniti,RanaPublishingHouse,Kalyani.
- 8. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata
- 9. Naveen Jain, Play and Learn Basketball, Khel Sahitya Kendra, NewDelhi.

10. Dubey,H.C. Basketball, Discovery Publishing House, NewDelhi.

- 11. RachanaJain, Teach Yourself Basketball, Sports Publication.
- 12. JackNagle,Power Pattern Offences for Winning basketball,ParkerPublishingCo.,NewYork.
- 13. RenuJain, Play and Learn Basketball, Khel Sahitya Kendra, NewDelhi.
- 14. SallyKus, Coaching Volleyball Successfully, HumanKinetics.
- 15. Saha, A. K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
- 16. Bandopadhyay, K.Sarir Siksha Parichay, Classic Publishers, Kolkata

YOGA													
Course Cod	e 21Y00	21Y0G84					CIE Marks 50				0		
L:T:P:S	0:0:0:0	0:0:0:0				SEE Marks 50				50			
Hrs / Week	2	2				Total Marks 10				00			
Credits	00	00 Exam Hours					(02					
Course out	Course outcomes:												
At the end	At the end of the course, the student will be able to:												
21Y0G84.1	Use Yo	Use Yogasana practices in an effective manner											
21Y0G84.2	Becom	Become familiar with an authentic foundation of Yogic practices											
21YOG84.3	Practic Kriyas	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat Kriyas											
21Y0G84.4	Use the	e teachin	gs of Pa	tanjali in	daily life	e.							
Mapping o	f Course O	utcome	s to Pro	gram O	utcome	s:							
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P01	0 PC)11	P012
21Y0G84.1	-	-	-	-	-	3	-	-	2	-		-	1
21Y0G84.2	-	-	-	-	-	3	-	-	2	-		-	1
21Y0G84.3	-	-	-	-	-	3	-	-	2	-		-	1
21Y0G84.4	-	-	-	-	-	3	-	-	2	-		-	1
Semester		CONTENT								ноі	JRS		
	Introdu	ction of	Yoga:	Aim and	Objecti	ves of	yoga, P	rayer:	Yoga,it	ts origi	n		
	history ,	history and development. Yoga, its meaning, definitions, Different schools of							of				
	yoga, imj	yoga, importance of prayer											
	Brief int	Brief introduction of yogic practices for common man: Yogic practices for								r			
	common	common man to promote positive health											
	Rules and regulations: Rules to be followed during yogic practices by								у				
	practitioner Missensentione of voge, Voge its missensentione. Difference between vogie							0					
	and non-	misconceptions of yoga: Yoga its misconceptions, Difference between yogic								L			
	Survana	Survanamaskara											
	1 Surv	1 Survanamaskar nraver and its meaning Need importance and benefits of											
5th	Survanamaskar prayer and its meaning, weed, importance and benefits of												
	2. Surv	2. Survanamaskar 12 count.2rounds											
	Kapalabhati:												
	Meaning	Neaning, importance and benefits of Kapalabhati - 40strokes/min3rounds								То	tal 2	2 Hrs /	
	Different	Different types of Asanas:								10	lar 5 Seme	ester	
	1. Sitti	1. Sitting: Padmasana, Vajrasana, Sukhasana											
	2. Stan	2. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana							2	Hrs	/week		
	3. Pror	3. Prone line: Bhujangasana, Shalabhasana								_	,		
	4. Supineline: Utthitadvipadasana, Ardhahalasana, Halasana												
	Patanjali's Ashtanga Yoga: Yama, Niyama												
	Pranayan	na: Surya	anuloma	-V10ma	i, Chandi	ranulor	na-Vilon	na					
	Suryanan	askara:	: Suryan	amaskar Zanalahh	12 coun	t,4rour	10S min 2mai	mda					
	Kapalabhati: Kevision of Kapalabhati -60strokes/min3rounds												
6th		ng Pasch	imottor). Jacana A	rdha Hel	htracar	a Vabra	icana /	Jakarn	2			
Jui	I. Sitti Dhai	1. Sitting. Fastinniottanasana, Aruna Ushti asana, Vaki asana, Aakafila Dhanurasana											
	2. Standing: Parshva Chakrasana, Urdhva Hastothanasana, Hastanadasana												
	3. Prone line: Dhanurasana												

	4. Supine line: Karna Peedasana, Sarvangasana, Chakraasana						
	Patanjali's Ashtanga Yoga: Asana, Pranayama						
	Pranayama: Chandra Bhedana, Nadishodhana, Surya Bhedana						
	Suryanamaskara: Suryanamaskar 12 count,8rounds						
	Kapalabhati: Revision of Kapalabhati - 80strokes/min3rounds						
	Different types of Asanas:						
	1. Sitting: Yogamudra in Padmasana, Vibhakta Paschimottanasana,						
	Yogamudra in Vajrasana						
7th	2. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana						
	3. Prone line: Padangushtha Dhanurasana, Poorna Bhujangasana /						
	Rajakapotasana						
	4. Supine line: Navasana/Noukasana, Pavanamuktasana, Sarvangasana						
	Patanjali's Ashtanga Yoga: Pratyahara, Dharana						
	Pranayama: Ujjayi, Sheetali, Sheektari						
	Suryanamaskara: Suryanamaskar 12 count,12rounds						
	Kapalabhati: Revision of Kapalabhati - 100strokes/min3rounds						
	Different types of Asanas:						
	1. Sitting: Bakasana, Hanumanasana, Ekapada Rajakapotasana						
	2. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana						
8th	3. Prone line: Mayurasana						
	4. Supine line: Setubandhasana, Shavasanaa (Relaxation posture)						
	5. Balancing: Sheershasana						
	Patanjali's AshtangaYoga: Dhyana (Meditation), Samadhi						
	Pranayama: Bhastrika, Bhramari, Ujjai						
	Shat Kriyas: Jalaneti and sutraneti, Sheetkarma Kapalabhati						
F A							

Assessment Pattern (50 Marks – Practical)

CIE to be evaluated every semester end based on practical demonstration of Yogasana learnt in the semester.

CIE	Marks
5 th Semester	10
6 th Semester	10
7 th Semester	15
8 th Semester	15
Total	50

SEE Assessment Pattern (50 Marks - Practical)

SEE	Marks
Suryanamaskara	10
Kapalabhati	10
Asanas	10
Patanjali's Ashtanga Yoga	10
Pranayama / Shat Kriyas	10
То	tal 50

Suggested Learning Resources:

Reference Books:

- 2. Swami Kuvulyananda: Asma (Kavalyadhama, Lonavala)
- 3. Tiwari, O P: Asana Why and How
- 4. Ajitkumar: Yoga Pravesha (Kannada)
- 5. Swami Satyananda Saraswati: Asana Pranayama, Mudra, Bandha (Bihar School of yoga, Munger)

- Swami Satyananda Saraswati: Surya Namaskar (Bihar School of yoga, Munger) 6.
- 7. Nagendra H R: The art and science of Pranayama
- 8. Tiruka: Shatkriyegalu (Kannada)
 9. Iyengar B K S: Yoga Pradipika (Kannada)
- 10. Iyengar B K S: Light on Yoga (English)

APPENDIX A

List of Assessment Patterns

1	Assignments
2	Group Discussions
3	Case Studies/ Caselets
4	Practical Orientation on Design thinking
5	Participatory & Industry-integrated Learning
6	Practical activities / Problem solving exercises
7	Class Presentations
8	Analysis of Industry / Technical / Business Reports
9	Reports on Industrial Visit
10	Industrial / Social / Rural Projects
11	Participation in external seminars / workshops
12	Any other academic activity
13	Online / Offline Quizzes

APPENDIX B

Outcome Based Education

Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead classes, opportunities, and assessments should all help students achieve the specified outcomes.

There are three educational Outcomes as defined by the National Board of Accreditation:

Program Educational Objectives: The Educational objectives of an engineering degree program are the statements that describe the expected achievements of graduate in their career and also in particular what the graduates are expected to perform and achieve during the first few years after graduation. [nbaindia.org]

Program Outcomes: What the student would demonstrate upon graduation. Graduate attributes are separately listed in Appendix C

Course Outcome: The specific outcome/s of each course/subject that is a part of the program curriculum. Each subject/course is expected to have a set of Course Outcomes

Mapping of Outcomes

COURSE OUTCOME PROGGRAM OUTCOME PROGRAM EDUCATIONAL OBJECTIVES DEPARTMENTAL MISSION DEPARTMENTAL VISION

APPENDIX C

The Graduate Attributes of NBA

Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Conduct investigations of complex problems: The problems that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions that require consideration of appropriate constraints/requirements not explicitly given in the problem statement (like: cost, power requirement, durability, product life, etc.) which need to be defined (modeled) within appropriate mathematical framework that often require use of modern computational concepts and tools.

Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

APPENDIX D BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies.



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