# FRANCIS XAVIER ENGINEERING COLLEGE AUTONOMOUS INSTITUTION ACCREDITED BY NBA

ISO 9001:2015 Certified | DST-FIST Supported Institution Recognized under Section 2(f) & 12(B) of the UGC Act, 1956 Vannarpettai, Tirunelveli - 627003, Tamil Nadu

# Department of Electronics and Communication Engineering

# **M.E – Communication Systems**

R 2019 , Curriculum and Syllabi 2021, Amendment 2022-PG

**CHOICE BASED CREDIT SYSTEM AND OBE** 

## Vision of the Department

To develop Electronics and Communication Engineers by permeating with proficient morals, to be recognized as an adroit engineer worldwide and to strive endlessly for excellence to meet the confronts of our modern society by equipping them with changing technologies, professionalism, creativity research, employability, analytical, practical skills and to excel as a successful entrepreneur.

## **Mission of the Department**

- To provide excellence through effective and qualitative teachinglearning process that equips the students with adequate knowledge and to transform the students' lives by nurturing the human values to serve as a precious resource for Electronics and Communication Engineering and nation.
- To enhance the problem solving and lifelong learning skills that will enable by edifying the students to pursue higher studies and career in research.
- To create students with effective communication skills, the abilities to lead ethical values in order to fulfill the social needs

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#### **PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

**PEO1: Core Competence:** To demonstrate core competence in mathematics, basic sciences and engineering concepts, that apply to communication systems engineering knowledge and/or also to pursue advanced study or research.

**PEO2: Design and Analysis:** To demonstrate good skills to comprehend communication engineering trade-offs, forecast, analyse, design, and synthesize data and technical concepts to create novel solutions for real life problems.

#### PEO3: Develop multi skills & Professionalism:

To have a successful career by meeting the demand driven needs of communication systems industries/ profession, with multi-disciplinary projects, adhering to ethical standards with social responsibility

#### PROGRAMME SPECIFIC OUTCOMES (PSOs)

**PSO1**:The ability to apply basic mathematics and sciences to analyse, design and implement application specific systems for complex engineering problems, pertaining to analog and digital domains in communication systems engineering and its allied fields.

**PSO2**: The ability to adapt to latest industrial sophistications, tools and technology in communication systems engineering and its allied fields.

**PSO3**:Excellent compliance to function in multi-disciplinary environment, exhibiting good interpersonal and leadership skills with an understanding of societal and ecological issues, adhering to ethical engineering practice.

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#### **PROGRAMME OUTCOMES (POS)**

Engineering Graduates will be able to:

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

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

**3. 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.

**4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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

**6. 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.

**7. 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.

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

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

**10. 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.

**11. 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.

**12. 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.

PO	PEO1	PEO2	PEO3	PSO1	PSO2	PSO3
1		Н		Н		
2		Н		М		
3		L	Н			Н
4	Н	L			Н	
5			М	Н		
6			L			М
7			L		Н	
8	L				Н	
9	L			М		М
10	М			М		М
11	М				Н	
12	L	М	Н			М

## Mapping with PO VsPEO, PSO

Contribution L: Low / Reasonable M: Medium / Significant H:High / Strong

## FRANCIS XAVIER ENGINEERING COLLEGE M.E. – COMMUNICATION SYSTEMS - REGULATIONS 2019 Choice Based Credit System and Outcome Based Education

#### SUMMARY OF CREDIT DISTRIBUTION

S No	Category		Credits Pe	er Semester	•	Total	Credits in
0.110	cutegory	Ι	II	III IV		Credits	%
1	ES	3				3	4.2%
2	РС	17	11	3		31	43.6%
3	PE	3	9	6		18	25.3%
4	EEC		0	7	12	19	26.7%
Total		23	20	16	12	71	100%

## Minimum Number of Credits to be Acquired: 71

**ES - Engineering Sciences** 

**PC - Professional Core** 

**PE - Professional Elective** 

**EEC - Employability Enhancement Courses** 

#### <u>Francis Xavier Engineering College</u> | Dept of ECE | M.E- CS | R2019 | <u>Curriculum and Syllabi 2021</u> | Amendment 2022 FRANCIS XAVIER ENGINEERING COLLEGE

## M.E. – COMMUNICATION SYSTEMS - REGULATION 2019, Amendment 2022

#### Choice Based Credit System and Outcome Based Education

#### I- IV Semester Curriculum and Syllabi 2021

S.No	Course Code	Course Name	Catego ry	Contact Periods	L	Т	Р	С
Theory	Courses							
1	21MA1256	Applied Mathematics for Communication Engineers	ES	3	3	0	0	3
2	21CS1601	Advanced Radiation systems	PC	3	3	0	0	3
3	21CS1602	Advanced Wireless Communication	PC	3	3	0	0	3
4	21CS1603	Advanced Digital Signal Processing	PC	3	3	0	0	3
5	21CS1604	Advanced Digital Communication Techniques	PC	3	3	0	0	3
6	21CS1605	Research Methodology for Engineers	PC	3	3	0	0	3
7		Professional Elective I	PE	3	3	0	0	3
Practic	al Courses							
1	21CS1611	Communication Systems Laboratory I	PC	4	0	0	4	2
			Total	25	21	0	4	23

#### **SEMESTER I**

#### **SEMESTER II**

S.No	Course Code	Course Name	Catego ry	Contact Periods	L	Τ	Р	С
Theory	Courses		I					
1	21CS2601	Optical Communication Networks	PC	3	3	0	0	3
2	21CS2602	MIC and RF Transceiver Design	PC	3	3	0	0	3
3	21CS2603	Advanced Wireless Networks	PC	3	3	0	0	3
4		Professional Elective II	PE	3	3	0	0	3
5		Professional Elective III	PE	3	3	0	0	3
6		Professional Elective IV	PE	3	3	0	0	3
Practic	al Courses							
1	21CS2611	Communication Systems Laboratory II	PC	4	0	0	4	2
			Total	22	18	0	4	20

#### **SEMESTER III**

S.No	Course Code	Course Name	Course NameCategoContactryPeriods					С
Theor	y Courses							
1	21CS3607	Machine Learning	PC	3	3	0	0	3
2		Professional Elective V	PE	3	3	0	0	3
3		Professional Elective VI	PE	3	3	0	0	3
		Practical Courses	S					
1	21CS3911	Dissertation I	EEC	12	0	0	12	6
2	21CS3912	Term paper writing	EEC	1	0	0	2	1
			Total	22	9	0	14	16

#### **SEMESTER IV**

S.No	Course Code	Course Name	Catego ry	Contact Periods	L	Τ	Р	С
Pract	ical Courses							
1	21CS4911	Dissertation II	EEC	24	0	0	24	12
			Total	24	0	0	24	12

#### Minimum Number of Credits to be acquired: 71

List of Professional Electives Courses

S.No	Course Code	Course Name	Seme ster	L	Т	Р	С
Profes	ssional Electiv	e I					
1	21CS1701	Communication Network Security	Ι	3	0	0	3
2	21CS1702	Advanced Multimedia Compression Techniques	Ι	3	0	0	3
3	21CS1703	Advanced Digital Image Processing	Ι	3	0	0	3
4	21CS1704	Soft Computing Techniques	Ι	3	0	0	3
Profes	ssional Electiv	e II					
1	21CS2701	Advanced Wireless Sensor Networks	II	3	0	0	3
2	21CS2702	Massive MIMO and Millimeter Wave Communication	II	3	0	0	3
3	21CS2703	MIMO OFDM Systems	II	3	0	0	3
4	21CS2704	Space Time Wireless Communication	II	3	0	0	3
Profes	ssional Electiv	e III					
1	21CS2705	Software and Cognitive Radio Systems	II	3	0	0	3
2	21CS2706	Modern IOT	II	3	0	0	3
3	21CS2707	Real Time Embedded Systems	II	3	0	0	3
4	21CS2708	Smart Antennas	II	3	0	0	3
Profes	ssional Electiv	e IV					
1	21CS2709	LTE Technology and Standards	II	3	0	0	3
2	21CS2710	Modern Satellite Systems	II	3	0	0	3
3	21CS2711	Network Routing Algorithms	II	3	0	0	3
4	21CS2712	Remote Sensing	II	3	0	0	3
Profes	ssional Electiv	e V					
1	21CS3701	Embedded Wireless Sensor Networks	III	3	0	0	3
2	21CS3702	DSP Processor Architecture and Programming	III	3	0	0	3
3	21CS3703	Pattern Recognition and Machine Learning	III	3	0	0	3
4	21CS3704	High Speed Communication Networks	III	3	0	0	3
Profes	ssional Electiv	e VI			-		
1	21CS3705	Cooperative Communication	III	3	0	0	3
2	21CS3706	VLSI Architecture for Image and Video Processing	III	3	0	0	3
3	21CS3707	Mobile Robotics	III	3	0	0	3

<u>Francis Xavier Engineering College  Dept of ECE   M.E- CS   R2019  </u> <u>Curriculum and Syllabi 2021  Amendment 2022</u>											
4	21CS3708	Ivanced Radar and Navigational AIDS     III     3     0     0									
	Semester I										
S.No	Course Code	Course Name	Catego ry	Contact Periods	L	T	Р	С			
Theory	Courses							•			
1	21MA1256	Applied Mathematics for Communication Engineers	ES	3	3	0	0	3			
2	21CS1601	Advanced Radiation systems	PC	3	3	0	0	3			
3	21CS1602	Advanced Wireless Communication	PC	3	3	0	0	3			
4	21CS1603	Advanced Digital Signal Processing	PC	3	3	0	0	3			
5	21CS1604	Advanced Digital Communication Techniques	PC	3	3	0	0	3			
6	21CS1605	Research Methodology for Engineers	PC	3	3	0	0	3			
7		Professional Elective I	PE	3	3	0	0	3			
Practic	cal Courses										
1	21CS1611	Communication Systems Laboratory I	PC	4	0	0	4	2			
			Total	25	21	0	4	23			

<u>Fr</u>	ancis Xavier Engine <u>Curriculum</u>	eering College  Dept of ECE   M.E- and Syllabi 2021  Amendment 2	<u>CS   R2019</u> 022	91			
21MA1256	APPLIED MAT	HEMATICS FOR COMMUNIC ENGINEERS	ATION	L	T	P	C
Prerequisites	for the course			3	U	U	5
The pre Method	-requisite knowledge s, Probability and Ra	e required by the Students to study andom Processor.	this Course	are N	umer	ical	
Objectives							
<ol> <li>To dem statistic</li> <li>To iden tools.</li> <li>To dem engineer</li> </ol>	onstrate various anal s of problem solving tify, formulate, abstr onstrate various num	ytical skills in applied mathematics and logical thinking applicable in act and solve problems in electrica nerical solutions of Differential equ	s and extens communica l engineerir ation applic	sive ex ation e ng usir cable i	kperie ngine ig ma n cor	ence w eering. hthema nmuni	vith the atical ication
4. To iden 5. To stud	tify the probability a v about the Oueuing	nd Random process variable applic model	ation.				
UNIT I		LINEAR ALGEBRA				9	
Vector Spaces Eigen Vectors Square approxi	Norms-Inner Produ- Canonical Forms-S- mation	cts-Eigen Values using transformatingle value decomposition and	tion-QR Fa	actoriz 1s-Pset	ation udo	-Gene	eralized e-Least
UNIT II	L	NEAR PROGRAMMING				9	
Formulation-G models	raphical Solution-Si	mplex Method-Big M Method-T	ransportatio	on Pro	blem	ı-Assi	gnment
UNIT III	NUMERI DIFF	CAL SOLUTION OF ORDINAR ERENTIAL EQUATIONS	Y			9	
Runge-Kutta n Adams-Bashfo method	nethod of fourth ord rth multistep metho	der for system of IVPs-Numerica d-shooting method BVP- Finite I	l stability Difference	of Ru metho	nge-I d an	Kuttan d coll	nethod- ocation
UNIT IV	PROBABII	<b>ITY AND RANDOM VARIABI</b>	LES			9	
Probability- R distribution – 1 Regression cur	andom Variables- Marginal and condit ve-correlation	Probability function- Two dime ional distributions- Function of tw	ensional ra vo dimensio	ndom onal R	var Rando	iables om va	- Joint riables-
UNIT V		QUEUEING MODELS				9	
Poisson proces analysis	ss- Markovian queu	es- Single and Multi –server mo	dels- Little	's fori	nula	Stead	ly state
		Tota	l Periods			45	
Suggestive As	ssessment Method	s	1				
Continuous A (30 Mai	ssessment Test rks)	Formative Assessment Test (10 Marks)	End Sem (60 M	ester arks)	Exar	ns	
1.Description 2.Formative I questions	Questions Multiple choice	1.Assignment 2.Online Quizzes 3.Problem solving Activities	1.Descrip 2.Format question	otion tive M s	Que: Iultij	stions ple ch	oice
Upon comnle	tion of the course	the students will be able to:					
opon comple	tion of the course,	the statents will be able to.					

- CO256.1 To be able to analyze the fundamental of Linear algebra
- CO256. 2 To be able to analyze the linear programming.
- CO256. 3 To be able to design numerical solution
- CO256.4 To be able to analyze the performance of Probability and Random variable.
- CO256.5 To be able to analyzeQueuing model .

#### **Text Books**

- 1. Bronson, R. and Costa, G. B., "Linear Algebra", 2nd Edition, Academic Press, 2007.
- 2. Burden, R. C. and Faires, J. D., "Numerical Analysis ", 9th Edition, Cengage Learning, 2016.
- 3. Gross, D., Shortle, J.F., Thompson, J. M. and Harris, C. M., "Fundamentals of Queueing Theory ", 4th Edition, Wiley, 2014.

#### **Reference Books**

- 1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
- 2. Sastry, S. S., "Introductory Methods of Numerical Analysis ", 5th Edition, PHI Learning, 2015..

#### Web Resources

- https://nptel.ac.in/courses/111/105/111105121/
- https://nptel.ac.in/courses/111/105/111105035/
- https://nptel.ac.in/courses/108/108/108108109/

#### CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2			1				2	3	3	1	2	
2	3	2	2	1	2				2		3	3			1
3	3	1	1		2					2	1	3	1		
4	3	3	2		2			1		2	2	3		2	1
5	2	3	2	1						2	3	3	3	1	2

21CS1601

#### **ADVANCED RADIATON SYSTEMS**

L T P C

#### Prerequisites for the course

• The pre-requisite knowledge required by the Students to study this Course are RF and Microwave System, Antenna and Amplifiers.

#### Objectives

- 1. To understand the antenna fundamentals.
- 2. To understand about the antenna elements
- 3. To understand the various components that constitute an antenna array.
- 4. To know the basic patch techniques needed for evaluating the performance antenna.
- 5. To know the concepts electromagnetic radiation and antenna design.

<u>Fr</u>	<u>rancis Xavier Engine</u> Curriculum	<u>ering College  Dept of ECE   M.E-</u> and Syllabi 2021  Amendment 20	<u>CS   R2019</u> 022	<u>)  </u>
UNIT I	AN	FENNA FUNDAMENTALS		9
Antenna funda bandwidth, po techniques, Ba	mental parameters: For the second sec	Radiation pattern, power density, r a efficiency, effective aperture. ansformer, Introduction to numeric	adiation int Reciproci al technique	ensity, directivity, gain, ty theorem, Matching es.
UNIT II		ANTENNA ELEMENTS		9
Single antenna Reflector anter satellite applica	a element– monopol nna, aperture blockag ations, Simulations.	e, dipole. Micro-strip patch ante e, and design consideration, Pract	nna, Slot a ical Design	antenna; Horn antenna; - High gain antenna for
UNIT III	ANTE	ENNA ARRAY		9
Introduction, T Yagi-uda anter	Two element array, nna array.Smart anten	linear antenna arrays, General struna for Mobile stations	ucture of br	oadside, end-fire array,
UNIT IV	PATCH PE	RFORMANCE ENHANCEME	NT	9
Improvement- Micro-strip dip UNIT V Antenna measu	Multilayer substrat	e antenna,Excitationtechniques;Rensism from patchApplication of Mic MEASUREMENTS AND DESIGE Instation – Gain. Impedance and anternation	ectangular cro-strip arra CN tenna factor	patch, Circular patch, ay antenna. 9 measurement: Antenna
Design, EM si wireless applic	imulation with CST ation.	Microwave studio, Antenna Prot	otype deve	lopment of antenna for
		Tota	l Periods	45
Suggestive As	ssessment Method	S	End Com	a store France
Continuous A (30 Mai	rks)	(10 Marks)	End Sem (60 M	arks)
1.Description 2.Formative questions	1 Questions Multiple choice	1.Assignment 2.Online Quizzes 3.Problem solving Activities	1.Descrip 2.Format question	otion Questions tive Multiple choice s
Outcomes		<u> </u>		
Upon comple	etion of the course,	the students will be able to:		
CO601.1	To be able to analy	ze the antenna elements	lem	
CO601. 2	To be able to desig	n antenna array		
CO601.4	To be able to analy	ze the performance of Micro-strip	antenna and	d its characteristics.
CO601.5	To be able to analy	ze antenna measurements and desi	gn.	
Text Books				
1. Hubreg Newyo 2. Zhijun Ltd, No	gt.J.Visser "Antenn rk,2012. Zhang" Antenna D ewyork,2011.	a Theory and Applications" 1st	Edition, Jo dition, Joh	hn Wiley & Sons Ltd, n Wiley & Sons (Asia)
Reference Bo	ooks			
1. Xavier Sons L 2. Balani 3. Kraus	r Begaud, "Ultra W .td, Newyork,2013. is.A, "Antenna Theo s.J.D. "Antennas". I	ide Band Antennas", 1st Edition ry Analysis and Design", John W I edition, John Wiley and sons, N	on, ISTE L Viley and S New York, 1	td and John Wiley & ons, New York, 1982. 1997.
	· , · · · · · · · · · · · · · · · · · ·	14		

- 4. I.J. Bahl and P. Bhartia," Micro-strip Antennas", Artech House, Inc., 1980
- 5. W.L.Stutzman and G.A.Thiele,"Antenna Theory and Design", 2nd Edition, John Wiley & Sons Inc., 1998.
- 6. S.Drabowitchet.al.:,"Modern Antennas", 2nd Edition Springer science business Media, Inc.2005.

#### Web Resources

- https://interferencetechnology.com/antenna-fundamentals/
- https://www.antenna-theory.com/basics/main.php
- https://www.3ds.com/products-services/simulia/products/cst-studio-suite/

#### CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2			1				2	3	3	1	2	
2	3	2	2	1	2				2		3	3			1
3	3	1	1		2					2	1	3	1		
4	3	3	2		2			1		2	2	3		2	1
5	2	3	2	1						2	3	3	3	1	2

#### 21CS1602

## ADVANCED WIRELESS COMMUNICATION

L	Т	Р	С
3	0	0	3

#### Prerequisites for the course

• The pre-requisite knowledge required by the Students to study this Course is basic knowledge in Wireless Communication.

#### Objectives

- 1. Understand the basics of propagation of EM signals and its mechanisms in Wireless channels.
- 2. Learn the capacity equations of wired and wireless channels.
- 3. Study the various diversity and equalization techniques.
- 4. Explore the fundamentals of spatially diversified Communication systems.
- 5. Realize the concepts of Multi-user systems

UNIT I	WIRELESS PROPOGATION CHANNELS AND	9
	MODELS	

Propagation Mechanisms – reflection, diffraction, scattering indoor and outdoor propagation models, Small –scale fading, Multipath fading distributions, Rayleigh, Rician, Nakagami distribution, Clarkes's fading model ,Link power budget analysis,Propagation of EM signals in wireless channel,Reflection, diffraction and Scattering, Free space model,Two ray propagation model,Channel classificationchannel models, COST-231 Hata model, Longley-Rice Model,NLOS Multipath Fading Models:Rayleigh, Rician, Nakagami, Composite Fading, Shadowing Distributions and Link power

budget Analysis

UNIT II	CAPACI	<b>FY OF WIRELESS CHANNELS</b>		9				
Capacity in AV	WGN, Capacity of fl	at fading channel.Channel and Syste	em Model	Channel Distribution				
Information (C	CDI) Known,Channe	el Side Information at Transmitter	r and Re	eceiver.Capacity with				
Receiver Diversity, CapacityComparisons, Capacity of frequency selective fading channels, Time-								
Invariant Channels, Time-Varying Channels.								
UNIT III	DIVER	SITY AND EQUALIZATION		9				
Realization of independent fading paths, Receiver Diversity: Introduction, Receiver Diversity: System								
model,Selection Combining, Threshold Combining,Maximum-ratio Combining,Equal gain								
Combining,Tra	nsmitter Diversity :]	Introduction, Channel known at trans	mitter,Ch	annel unknown at the				
transmitter: A	lamouti scheme a	nd Equalization.Directly linear an	nd non	linear equalizers in				
communication	Receiver, Algorithm	s for Adaptive Equalization, timing a	and tracki	ng.				
UNIT IV	MI	MO COMMUNICATIONS		9				
Fundamentals	of MIMO,Narrowb	and MIMO Model, and Parallel I	Decompos	sition of the MIMO				
channel,MIMO	channel capacity,	Static Channels, Fading Channels, N	/IMO D	iversity Gain, Beam				
forming and D	iversity-Multiplexin	g trade-offs,Space time Modulation	and codi	ng,ML Detection and				
Pairwise Error	Probability,Rank a	nd Determinant Criterion, Space-Ti	ime Trell	is,BlockCodes,Spatial				
Multiplexing and BLAST Architectures.								
UNIT V	UNIT V MULTI USER SYSTEMS 9							
Review of Multiple Access Techniques-FDMA, TDMA, CDMA, Space-Division, Hybrid Techniques,								
Scheduling, Power control, Downlink (Broadcast) Channel Capacity: Channel Model, Channel Capacity								
in AWGN,Con	nmon Data, Capacity	in fading, capacity with multiple and	ntennas a	nd uplink (Broadcast)				
Channel Capa	acity, Channel Capa k/Downlink Duality	acity in AWGN, Capacity in fa	adıng,capa	acity with multiple				
antennas, o pini	K/DOWIIIIK Duality,	Total F	Periods	45				
Suggestive As	sessment Method	S						
Continuous A	ssessment Test	Formative Assessment Test	End Sei	nester Exams				
(30 Mai	rks)	(10 Marks)	(60 Ma	rks)				
1.Description	Questions	1.Assignment	1.Descr	ription Questions				
2.Formative	Multiple choice	2.Online Quizzes	2.Form	ative Multiple				
questions		3.Problem solving Activities	choice	questions				
Outcomes								
Upon comple	tion of the course,	the students will be able to:						
CO602. 1	Use the various fad	ing models for performance analysis	s of wirele	ess communication				
	systems.							
CO602. 2	Design a wireless c	ommunication system of desired capa	acity					
CO602. 3	Design the equaliz	zation techniques in advanced alg	orithms f	for automation of				
	wireless receivers.							
CO602.4	Analyze the applica	tions involving multi antenna system	is.					
CO602. 4 Analyze the applications involving multi-antenna systems. CO602. 5 Interpret the Multiuser transceiver concepts.								
00002. 5	Interpret the Multiu	ser transceiver concepts.						

#### **Text Books**

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.

2. Rappaport. T.S., "Wireless Communication", Pearson Education, 2003.

#### **Reference Books**

- 1. Andreas.F. Molisch, "Wireless Communication" John Wiley, India, 2006..
- 2. ArogyaswamiPaulraj, et al, "Introduction to Space-Time Wireless Communications", Cambridge University Press, 2003.
- 3. Simon Haykin& Michael Mohar, "Modern Wireless Communications" Pearson Education, 2007.
- 4. Gordon L. Stuber, "Principles of Mobile Communication", Springer International Ltd., 2001.

#### Web Resources

- <u>http://www.nptelvideos.in/2012/11/advanced-3g-and-4g-wireless-mobile.html</u>
- https://www.egr.msu.edu/~tongli/Introduction-WCN.pdf

#### CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3										3	1	2	
2	3		3									3	2		3
3				3								3			
4	3				3	3						3		2	1
5				3	3	3	3					3	3	1	2

21CS1603	ADVANCED DIGITAL SIGNAL PROCESSING	L	Τ	Р	С		
		3	0	0	3		
Prerequisites	for the course						
• The pre	-requisite knowledge required by the students to study this Course	e is ba	sic k	nowle	dge in		
Signal	Processing.						
Objectives							
1. The stu signals.	dent understands mathematical description and modelling of discre	ete tin	ne rai	ndom			
2. The St	udent will be able to understand the spectral estimation						
3. The stu	dent is conversant with important concepts in various types of filte	ers.					
4. The stu	dent learns various adaptive filters and its applications.						
5. The stu	dent is familiar with multirate concepts, techniques and wavelet tra	ansfor	ms				
UNIT I         DISCRETE RANDOM SIGNAL PROCESSING         9							
		•					

<u>Francis Xavier Engineering College  Dept of ECE   M.E- CS   R2019  </u> Curriculum and Syllabi 2021  Amendment 2022								
Discrete Random Processes. Ensemble Averages Stationary processes Bias and Estimation Auto								
covariance Autocorrelation Parseval's theorem Wiener Khintchine relation White noise Power								
Covariance, Autocorrelation, Parseval's theorem, where Kinnichine relation, while holse, Power								
Dressesses ADMA AD MA Harmania Dresses								
Processes – ARMA, AR, MA – Harmonic Process								
UNIT II SI	UNIT II SPECTRAL ESTIMATION 9							
Estimation of spectra from finite c	luration signals, Nonparametric met	nods – Periodogram, Modified						
periodogram, Bartlett, Welch and	Blackman-Tukey methods, Parametr	ic methods – ARMA, AR and $\cdot \cdot \cdot$						
MA model based spectral estimation, Solution using Levinson-Durbin algorithm								
UNIT III LINEAR E	STIMATION AND PREDICTION	9						
Linear prediction – Forward and I	Backward prediction, Solution of Pr	ony's normal equations, Least						
mean-squared error criterion, Wier	ner filter for filtering and prediction	h, FIR and IIR Wiener filters,						
Discrete Kalman filter								
	ADAPTIVE FILTERS	9						
FIR adaptive filters – adaptive filte	r based on steepest descent method-	Widrow-Hoff LMS algorithm						
Normalized LMS algorithm, Adaj	ptive channel equalization, Adaptiv	e echo cancellation, Adaptive						
noise cancellation, RLS adaptive al	gorithm.							
UNIT V MULTIRATE D	DIGITAL SIGNAL PROCESSING	AND 9						
Multirate system –Decimator Interpolators – Polyphase structure - Multistage implementation of								
multirate system – Wavelet trans	form: Discrete Wavelet transform	one dimension (Haar Wavelet						
transform) - wavelet packets - Appl	ication to subband coding	( )						
	 Total F	eriods 45						
Suggestive Assessment Method	S							
Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)						
1 Description Questions	1 Assignment	1 Description Questions						
2.Formative Multiple choice	2.Online Ouizzes	2.Formative Multiple						
questions	3.Problem solving Activities	choice questions						
Outcomes		-						
Upon completion of the course.	the students will be able to:							
CO603.1 To understand the	various special types of Random H	rocesses in communication						
receiver								
CO603. 2 To understand the F	Power Spectrum							
CO603.3 To design optimum	n filters in various applications of sign	al processing						
CO603.4 To design adaptive	filters	1 0						
CO603. 5 To understand mul	tirate systems and wavelet transforms							
Text Books	-							
1. 1.Monson H. Hayes, 'Stat	istical Digital Signal Processing an	d Modeling, Wiley India (P)						
Ltd. 2008								
2. P. P. Vaidyanathan, "Multirate Systems and Filter Banks". Prentice Hall, 1992.								
<b>Reference Books</b>								

- 1. Simon Haykin, TelagarapuPrabhaka "Adaptive Filter Theory" Prentice Hal,2014
- 2. Saeed V. Vaseghi "Advanced digital signal processing and noise reduction: fourth edition, Wiley, 2008
- 3. John.G.Proakis, Dimitris.G.Manolakis "Digital signal Processing-Prinicples, Algorithms and Applications" Pearson, 2014

#### Web Resources

- <u>https://nptel.ac.in/courses/117/101/117101001/</u>
- <u>http://www.nptelvideos.in/2012/12/advanced-digital-signal-processing.html</u>

### CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1								3	3	1	2	
2	3	3	1								3	3			3
3	3	3	1								3	3	3	2	
4	3	3	1								3	3			1
5	3	3	1								3	3	3	1	2

21CS1604
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## ADVANCED DIGITAL COMMUNICATION TECHNIQUES

L	Т	Р	С
3	0	0	3

## Prerequisites for the course

• The pre-requisite knowledge required by the students to study this Course is basic knowledge in Digital Communication.

#### Objectives

- 1. To extend the theory of Constant envelope modulation to M-ary schemes and to familiarize the concept of Spread Spectrum.
- 2. To develop the mathematical and algorithmic foundations of the error detecting and error correcting codes used in modern communications systems.
- 3. To demonstrate the concept of Convolution coding in form of Tree diagram and trellis code.
- 4. To study about the Viterbi algorithm in Turbo coding
- 5. To develop the spread spectrum signal concept in Digital communication.

UNIT I	DETECTION	9

<u>Francis Xavier Engine</u> Curriculum	<u>Francis Xavier Engineering College  Dept of ECE   M.E- CS   R2019  </u> Curriculum and Syllabi 2021  Amendment 2022							
Bass hand Transmission model	Bass hand Transmission model. Cram Schmidt arthogonalization procedure. Coompating Interpretation							
Pass band Transmission model - Gran Schmidt of nogonalization procedure, Geometric interpretation								
of signals, Response of bank of C	of signals, Response of bank of correlators to a noisy input-Detection of Known signals in noise -							
of amor	correlation Receiver- Matched Filter Receiver - Detection of signals with unknown phase- Probability							
of error.								
UNIT II CONSTA	UNIT IL CONSTANT ENVELOPE MODULATION 9							
Advantages of Constant Envelope	Modulation - Minimum Shift Key	ino- Gau	ssian Minimum Shift					
Kaving Mary Pulse Amplitude M	adulation Mary Quadrature Amplit	ude Mod	ulation Mary Phase					
Shift Keering Mars Engranges Shi	f Kasing New Calescent and delation							
Shift Keying- M-ary Frequency Shi	It Keying, Non Coherent modulation	Techniqi	ies.					
UNIT III CO	NVOLUTIONAL CODING		9					
Representation of codes using Po	olynomial- State diagram- Tree dia	igram- a	nd Trellis diagram –					
Maximum likelihood Decoding -	Distance properties - Sequential de	coding. (	Coded modulation for					
bandwidth-constrained channels-T	rellis coded modulation- Set Partiti	oning, Fo	our state trellis-coded					
modulation with 8-PSK signal co	instellation, Eight-state trellis code	for code	d 8-PSK modulation,					
Eight-state trellis for rectangular Q	AM signal constellations.							
UNIT IV	TURBO CODING		9					
Introduction-Turbo Encoder- UMTS Turbo Code- cdma2000 Turbo Code - Turbo Decoder, Iterative								
Turbo Decoding Principles; Modifications of the MAP Algorithm-The Soft-Output Viterbi Algorithm								
(SOVA);Turbo Coded BPSK Perf	ormance over Gaussian channels, Tu	urbo Cod	ing Performance over					
Rayleigh Channels.								
UNIT V SPREAD SP	ECTRUM SIGNALS FOR DIGITA	L	9					
COMMUNICATION								
Model of spread Spectrum Digital Communication System-Direct Sequence Spread Spectrum Signals-								
Error rate performance of the co-	der- Generation of PN Sequences a	ind its p	roperties - Frequency					
Hopped Spread Spectrum Signals-	Performance of FH Spread Spectrum	Signals in	n an AWGN Channel-					
CDMA system based on FH spread	spectrum signals- Synchronization o	f Spread	Spectrum Systems.					
	Total F	Periods	45					
Suggestive Assessment Method	S							
Continuous Assessment Test	Formative Assessment Test	End Se	mester Exams					
(30 Marks)	(10 Marks)	(60 Ma	rks)					
1 Description Questions	1 Assignment	1.Desci	rintion Questions					
2. Formative Multiple choice	2.Online Ouizzes	2.Form	ative Multiple					
questions	3.Problem solving Activities	choice	questions					
Outcomes			4					
Upon completion of the course	the students will be able to:							
CO604 1 To Narrate coheren	t and non coherent detection in detail							
CO604.2 Analyze the performan	ce of a pass hand digital communication syst	em in term	s of error rate and					
spectral efficiency	ee of a pass band arginal communication syst		, or error rule und					
CO604. 3 Identify the major of	classes of error detecting and error con	rrecting c	odes and how they					
are used in practice.								
CO604. 4 Explain the concepts of	CO604. 4 Explain the concepts of Turbo coding.							
CO604. 5 To Apply Spread Sp	ectrum Techniques in Wireless Commun	ication Te	chnologies					
Text Books								

- 1. Simon Haykin, "Digital Communications", John Wiley, 2006.
- 2. Simon Haykin, "Digital Communication System", Wiley Student Edition, 2013
- 3. Bernard Sklar., "Digital Communications", Pearson Education, second edition, 2001

#### **Reference Books**

- 1. John G. Proakis., "Digital Communication", McGraw Hill Publication, 4th edition, 2001
- 2. S.Lin&D.J.Costello, Error Control Coding (2/e) Pearson, 2005.
- 3. L. Hanzo, T.H. Liew&B.L. Yeap, "Turbo Coding, Turbo Equalization & Space-Time Coding", Wiley, 2002.
- 4. Theodore S.Rappaport., "Wireless Communications", Pearson Education, 2nd edition 2002.
- 5. Stephen G. Wilson., "Digital Modulation and Coding", Pearson Education, First Indian Reprint, 2003.
- 6. 9. Rodger E. Ziemer, Roger L. Peterson, David E. Borth , "Introduction to Spread Spectrum Communications", Prentice Hall,1995.

#### Web Resources

- https://onlinecourses.nptel.ac.in/noc17\_ee17/
- https://eprints.soton.ac.uk/271238/2/Turbo-coding-equalization-chapter-1-3-13-18.pdf

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1								3	3	1	2	
2	3	3	1							2	1	3			3
3	3	3	1								2	3	3	2	
4	3	3	1							2	3	3			1
5	3	3	1								3	3	3	1	2

21CS1605	<b>RESEARCH METHODOLOGY FOR ENGINEERS</b>				
		3	0	0	3
Prerequisites for	r the course				
NIL					
Objectives					
1. To understa	and some basic concepts of engineering research and its method	lologie	es.		
2. To identify	various sources of information for literature review.				

LTPC

3. To familiarize the various procedures for analysis and optimization of research techniques         4. To understand report writing and presentation skills.         5. To understand about intellectual property rights         UNIT I       INTRODUCTION TO RESEARCH METHODOLOGY       9         Research -uypes of research-research process, engineering research- objectives, motivation, types, research question , formulating a research problem       9         UNIT II       LITERATURE REVIEW       9         New and Existing Knowledge, Analysis and Synthesis, Types of Publications, Bibliographic Databases, Measures of Research impact, keywords, Types of Plagiarism, Software Used for Identifying Plagiarism Techniques to Avoid Plagiarism , ethics in engineering research       9         WINT III       ANALYSIS AND OPTIMIZATION       9         Research tools, Statistics-one dimensional, two dimensional, multidimensional, Optimization Methods – Two parameter, multi parameter, cost function. Survey research methods       9         UNIT IV       TECHNICALWRITING /PRESENTATION       9         Technical writing – attributes and reasons, writing strategies, Journal Paper: Structure and Approach, Language Skills, Writing Style, and Editing, Rules of Mathematical Writing, Attributions and Citations, Acknowledgments, patents.       9         Introduction, Significance, Requirements for Patentability, Application Preparation and Filing, Forms of IPR, IPR and Licensing, patent – examples       10 Marks)       10 Marks)         10.Description Questions       1.Assi	<u>Fr</u>	<u>ancis Xavier Enginee</u> Curriculum a	ring College  Dept of ECE   M.E- CS nd Svllabi 2021  Amendment 2022	R2019 2	Į
UNIT I         INTRODUCTION TO RESEARCH METHODOLOGY         9           Research -types of research-research process, engineering research- objectives, motivation, types, research question , formulating a research problem         9           UNIT II         LITERATURE REVIEW         9           New and Existing Knowledge, Analysis and Synthesis, Types of Publications, Bibliographic Databases, Measures of Research impact, keywords, Types of Plagiarism, Software Used for Identifying Plagiarism Techniques to Avoid Plagiarism , ethics in engineering research         9           UNIT III         ANALYSIS AND OPTIMIZATION         9           Research tools, Statistics-one dimensional, two dimensional, multidimensional, Optimization Methods – Two parameter, multi parameter, cost function. Survey research methods         9           UNIT IV         TECHNICALWRITING /PRESENTATION         9           Technical writing – attributes and reasons, writing strategies, Journal Paper: Structure and Approach, Language Skills, Writing Style, and Editing, Rules of Mathematical Writing, Attributions and Citations, Acknowledgments, patents.         9           INIT V         INTELLECTUAL PROPERTY RIGHTS         9           Introduction, Significance,Requirements for Patentability,Application Preparation and Filing, Forms of IPR, IPR and Licensing, patent – examples         45           Suggestive Assessment Test (30 Marks)         End Semester Exams (60 Marks)         1.Description Questions 2.Formative Multiple choice 3.Problem solving Activities 0.Formative Multiple choice 3.Problem solving Activities 0	<ol> <li>To family</li> <li>To under</li> <li>To under</li> </ol>	liarize the various pro erstand report writing a erstand about intellectu	cedures for analysis and optimizatio and presentation skills. al property rights	n of resea	rch techniques
Research -types       of research-research process, engineering research- objectives, motivation, types, research question , formulating a research problem         UNIT II       LITERATURE REVIEW       9         New and Existing Knowledge, Analysis and Synthesis, Types of Publications, Bibliographic Databases, Measures of Research impact, keywords, Types of Plagiarism, Software Used for Identifying Plagiarism Techniques to Avoid Plagiarism, ethics in engineering research         UNIT III       ANALYSIS AND OPTIMIZATION       9         Research tools, Statistics-one dimensional, two dimensional, multidimensional, Optimization Methods – Two parameter, multi parameter, cost function. Survey research methods       9         UNIT IV       TECHNICALWRITING /PRESENTATION       9         Technical writing – attributes and reasons, writing strategies, Journal Paper: Structure and Approach, Language Skills, Writing Style, and Editing, Rules of Mathematical Writing, Attributions and Citations, Acknowledgments, patents.       9         UNIT V       INTELLECTUAL PROPERTY RIGHTS       9         Introduction, Significance, Requirements for Patentability, Application Preparation and Filing, Forms of IPR, IPR and Licensing, patent – examples       10 Marks)         Continuous Assessment Test (10 Marks)       End Semester Exams (60 Marks)       1.Description Questions 2.Formative Multiple choice questions         2.Formative Multiple choice questions       3.Problem solving Activities       1.Description Questions 2.Formative the concepts of engineering research and its methodologies.	UNITI	INTRODUCTI	ON TO RESEARCH METHODO	LOGY	9
UNIT II         LITERATURE REVIEW         9           New and Existing Knowledge, Analysis and Synthesis, Types of Publications, Bibliographic Databases, Measures of Research impact, keywords, Types of Plagiarism, Software Used for Identifying Plagiarism Techniques to Avoid Plagiarism , ethics in engineering research         UNIT III         ANALYSIS AND OPTIMIZATION         9           Research tools, Statistics-one dimensional, two dimensional, multidimensional, Optimization Methods – Two parameter, multi parameter, cost function. Survey research methods         9           UNIT IV         TECHNICALWRITING /PRESENTATION         9           Technical writing – attributes and reasons, writing strategies, Journal Paper: Structure and Approach, Language Skills, Writing Style, and Editing, Rules of Mathematical Writing, Attributions and Citations,Acknowledgments, patents.         9           UNIT V         INTELLECTUAL PROPERTY RIGHTS         9           Introduction, Significance,Requirements for Patentability,Application Preparation and Filing, Forms of IPR, IPR and Licensing, patent – examples         9           Continuous Assessment Methods         1.0escription Questions         1.Assignment           2.Formative Multiple choice         3.Problem solving Activities         1.Description Questions           2.Formative Multiple choice         2.Problem solving Activities         2.Formative Multiple choice questions           0.tocompletion of the course, the students will be able to: CO605.1         Demonstrate the concepts of engineering research and its methodo	Research –typ types,research	pes of research-resequestion, formulating	earch process, engineering rese a research problem	arch- ob	jectives, motivation,
New and Existing Knowledge, Analysis and Synthesis, Types of Publications, Bibliographic Databases,         Measures of Research impact, keywords, Types of Plagiarism, Software Used for Identifying Plagiarism         Techniques to Avoid Plagiarism, ethics in engineering research         UNIT III       ANALYSIS AND OPTIMIZATION         9         Research tools, Statistics-one dimensional, two dimensional, multidimensional, Optimization Methods –         Two parameter, multi parameter, cost function. Survey research methods         UNIT IV       TECHNICALWRITING /PRESENTATION         9         Technical writing – attributes and reasons, writing strategies, Journal Paper: Structure and Approach, Language Skills, Writing Style, and Editing, Rules of Mathematical Writing, Attributions and Citations, Acknowledgments, patents.         UNIT V       INTELLECTUAL PROPERTY RIGHTS         9       Introduction, Significance,Requirements for Patentability,Application Preparation and Filing, Forms of IPR, IPR and Licensing, patent – examples         Continuous Assessment Methods       End Semester Exams (60 Marks)         1.Description Questions       1.Assignment         2.Formative Multiple choice       3.Problem solving Activities         Upon completion of the course, the students will be able to:       CO605.1         Upnor completion of the course, the students will be able to:       CO605.3         CO605.3       Formulate appropriate research problem and conduct the	UNIT II		LITERATURE REVIEW		9
Measures of Research impact, keywords, Types of Plagiarism, Software Used for Identifying Plagiarism         Techniques to Avoid Plagiarism, ethics in engineering research         UNIT III       ANALYSIS AND OPTIMIZATION       9         Research tools, Statistics-one dimensional, two dimensional, multidimensional, Optimization Methods –       7         Two parameter, multi parameter, cost function. Survey research methods       9         UNIT IV       TECHNICALWRITING /PRESENTATION       9         Technical writing – attributes and reasons, writing strategies, Journal Paper: Structure and Approach, Language Skills, Writing Style, and Editing, Rules of Mathematical Writing, Attributions and Citations, Acknowledgments, patents.       9         Introduction, Significance,Requirements for Patentability,Application Preparation and Filing, Forms of IPR, IPR and Licensing, patent – examples       9         Suggestive Assessment Methods       60 Marks)       1.Description Questions         2.Formative Multiple choice       1.Assignment       2.Online Quizzes         3.Problem solving Activities       2.Formative Multiple choice       2.Formative Multiple choice         Quotenees       Upon completion of the course, the students will be able to:       2.Formative Multiple choice         Upon completion of the course, the students will be able to:       CO605.1       Demonstrate the concepts of engineering research and its methodologies.         CO605.1       Understand the various methods u	New and Exist	ing Knowledge, Analy	ysis and Synthesis, Types of Publica	ations, Bil	bliographic Databases,
UNIT III         ANALVSIS AND OPTIMIZATION         9           Research tools, Statistics-one dimensional, two dimensional, multidimensional, Optimization Methods – Two parameter, multi parameter, cost function. Survey research methods         –           UNIT IV         TECHNICALWRITING /PRESENTATION         9           Technical writing – attributes and reasons, writing strategies, Journal Paper: Structure and Approach, Language Skills, Writing Style, and Editing, Rules of Mathematical Writing, Attributions and Citations,Acknowledgments, patents.         9           UNIT V         INTELLECTUAL PROPERTY RIGHTS         9           Introduction, Significance,Requirements for Patentability,Application Preparation and Filing, Forms of IPR, IPR and Licensing, patent – examples         9           Suggestive Assessment Methods         Total Periods         45           Suggestive Assessment Test (30 Marks)         Formative Assessment Test (10 Marks)         End Semester Exams (60 Marks)           1.Description Questions 2.Formative Multiple choice questions         1.Assignment 2.Online Quizzes 3.Problem solving Activities         2.Formative Multiple choice questions           Outcomes         Upon completion of the course, the students will be able to: CO605.1         Demonstrate the concepts of engineering research and its methodologies.           CO605.2         Understand the various methods used to collect the data for research. CO605.3         Formulate appropriate research problem and conduct the experiments using analysis and optimization CO605.5         <	Measures of Re Techniques to A	esearch impact, keywo Avoid Plagiarism , eth	ords, Types of Plagiarism, Software ics in engineering research	Used for	Identifying Plagiarism
Research tools, Statistics-one dimensional, two dimensional, multidimensional, Optimization Methods –         Two parameter, multi parameter, cost function. Survey research methods         UNIT IV       TECHNICALWRITING /PRESENTATION       9         Technical writing – attributes and reasons, writing strategies, Journal Paper: Structure and Approach, Language Skills, Writing Style, and Editing, Rules of Mathematical Writing, Attributions and Citations, Acknowledgments, patents.         UNIT V       INTELLECTUAL PROPERTY RIGHTS       9         Introduction, Significance, Requirements for Patentability, Application Preparation and Filing, Forms of IPR, IPR and Licensing, patent – examples         Total Periods       45         Suggestive Assessment Methods         Continuous Assessment Test (30 Marks)       Formative Assessment Test (10 Marks)       End Semester Exams (60 Marks)         1.Description Questions         2.Formative Multiple choice         CO605.1	UNIT III	ANA	LYSIS AND OPTIMIZATION		9
Two parameter, multi parameter, cost function. Survey research methods         UNIT IV       TECHNICALWRITING /PRESENTATION       9         Technical writing – attributes and reasons, writing strategies, Journal Paper: Structure and Approach, Language Skills, Writing Style, and Editing, Rules of Mathematical Writing, Attributions and Citations,Acknowledgments, patents.       9         UNIT V       INTELLECTUAL PROPERTY RIGHTS       9         Introduction, Significance,Requirements for Patentability,Application Preparation and Filing, Forms of IPR, IPR and Licensing, patent – examples       9         Total Periods       45         Suggestive Assessment Methods         Continuous Assessment Test (30 Marks)       Formative Assessment Test (10 Marks)       End Semester Exams (60 Marks)         1.Description Questions       1.Assignment       1.Description Questions       2.Formative Multiple choice (2.001110 Quizzes (3.Problem solving Activities)       2.Formative Multiple choice (2.0012)       2.Formative Multiple choice (2.0012)       2.Formative Multiple (2.0012)	Research tools,	Statistics-one dimens	sional, two dimensional, multidimen	sional, Op	otimization Methods –
UNIT IV       TECHNICALWRITING /PRESENTATION       9         Technical writing – attributes and reasons, writing strategies, Journal Paper: Structure and Approach, Language Skills, Writing Style, and Editing, Rules of Mathematical Writing, Attributions and Citations, Acknowledgments, patents.       9         UNIT V       INTELLECTUAL PROPERTY RIGHTS       9         Introduction, Significance, Requirements for Patentability, Application Preparation and Filing, Forms of IPR, IPR and Licensing, patent – examples       9         Suggestive Assessment Methods       Total Periods       45         Continuous Assessment Test (30 Marks)       Formative Assessment Test (10 Marks)       1.Description Questions         2.Formative Multiple choice questions       3.Problem solving Activities       2.Formative Multiple choice concepts of engineering research and its methodologies.         Outcomes       Upon completion of the course, the students will be able to:       CO605.1       Demonstrate the concepts of engineering research and its methodologies.         CO605.2       Understand the various methods used to collect the data for research.       CO605.3       Formulate appropriate research problem and conduct the experiments using analysis and optimization         CO605.5       Understand the concepts of intellectual property rights.	Two parameter	, multi parameter, cost	t function. Survey research methods		
Technical writing – attributes and reasons, writing strategies, Journal Paper: Structure and Approach, Language Skills, Writing Style, and Editing, Rules of Mathematical Writing, Attributions and Citations, Acknowledgments, patents.         UNIT V       INTELLECTUAL PROPERTY RIGHTS       9         Introduction, Significance,Requirements for Patentability,Application Preparation and Filing, Forms of IPR, IPR and Licensing, patent – examples       9         Total Periods       9         Total Periods       45         Suggestive Assessment Methods         Continuous Assessment Test (30 Marks)       Formative Assessment Test (10 Marks)       60 Marks)         1.Description Questions       1.Assignment       2.Formative Multiple choice       3.Problem solving Activities       1.Description Questions         2.Formative Multiple choice       3.Problem solving Activities       1.Description Questions       2.Formative Multiple         C0605.1       Demonstrate the concepts of engineering research and its methodologies.       CO605.2       Understand the various methods used to collect the data for research.       CO605.3       Formulate appropriate research problem and conduct the experiments using analysis and optimization         C0605.5       Understand the concepts of intellectual property rights.       Taxt Books	UNIT IV	TECHNI	CALWRITING /PRESENTATIO	N	9
UNIT V       INTELLECTUAL PROPERTY RIGHTS       9         Introduction, Significance,Requirements for Patentability,Application Preparation and Filing, Forms of IPR, IPR and Licensing, patent – examples       Total Periods       45         Suggestive Assessment Methods       Total Periods       45         Continuous Assessment Test (30 Marks)       Formative Assessment Test (10 Marks)       End Semester Exams (60 Marks)         1.Description Questions       1.Assignment       1.Description Questions         2.Formative Multiple choice questions       1.Assignment       2.Formative Multiple choice questions         Outcomes       3.Problem solving Activities       2.Formative Multiple choice questions         Upon completion of the course, the students will be able to:       CO605.1       Demonstrate the concepts of engineering research and its methodologies.         CO605.2       Understand the various methods used to collect the data for research.       CO605.3         CO605.3       Formulate appropriate research problem and conduct the experiments using analysis and optimization       and optimization         CO605.4       Write quality research in engineering.       CO605.5       Understand the concepts of intellectual property rights.	Language Skil Citations,Ackn	lls, Writing Style, a owledgments, patent	nd Editing, Rules of Mathematic ts.	al Writin	g, Attributions and
Introduction, Significance,Requirements for Patentability,Application Preparation and Filing, Forms of IPR, IPR and Licensing, patent – examples           Total Periods         45           Suggestive Assessment Methods         Formative Assessment Test (30 Marks)         End Semester Exams (60 Marks)           1.Description Questions         1.Assignment         1.Description Questions           2.Formative Multiple choice         3.Problem solving Activities         1.Description Questions           0utcomes         3.Problem solving Activities         Choice questions           0utcomes         Upon completion of the course, the students will be able to:         CO605.1           CO605.2         Understand the various methods used to collect the data for research.           CO605.3         Formulate appropriate research problem and conduct the experiments using analysis and optimization           CO605.4         Write quality research in engineering.           CO605.5         Understand the concepts of intellectual property rights.	UNIT V	INTELI	LECTUAL PROPERTY RIGHTS		9
Total Periods       45         Suggestive Assessment Methods       Formative Assessment Test (30 Marks)       End Semester Exams (60 Marks)         1.Description Questions       1.Assignment       1.Description Questions         2.Formative Multiple choice       2.Online Quizzes       2.Formative Multiple choice questions         Questions       3.Problem solving Activities       Coice questions         Outcomes       Upon completion of the course, the students will be able to: CO605.1       Co605.1         CO605.2       Understand the various methods used to collect the data for research. CO605.3       Co605.3         CO605.4       Write quality research in engineering. CO605.5       Understand the concepts of intellectual property rights.	Introduction, S IPR, IPR and L	ignificance,Requireme icensing, patent – exa	ents for Patentability, Application Patentabilit	reparation	and Filing, Forms of
Suggestive Assessment Methods         Continuous Assessment Test (30 Marks)       Formative Assessment Test (10 Marks)       End Semester Exams (60 Marks)         1.Description Questions       1.Assignment       1.Description Questions         2.Formative Multiple choice questions       1.Assignment       2.Formative Multiple choice questions         3.Problem solving Activities       2.Formative Multiple choice questions         Outcomes       Upon completion of the course, the students will be able to:       coice questions         CO605.1       Demonstrate the concepts of engineering research and its methodologies.         CO605.2       Understand the various methods used to collect the data for research.         CO605.3       Formulate appropriate research problem and conduct the experiments using analysis and optimization         CO605.4       Write quality research in engineering.         CO605.5       Understand the concepts of intellectual property rights.			Total	Periods	45
Continuous Assessment Test (30 Marks)Formative Assessment Test (10 Marks)End Semester Exams (60 Marks)1.Description Questions 2.Formative Multiple choice questions1.Assignment 2.Online Quizzes 3.Problem solving Activities1.Description Questions 2.Formative Multiple choice questionsOutcomes3.Problem solving ActivitiesCoice questionsUpon completion of the course, the students will be able to: CO605.1Demonstrate the concepts of engineering research and its methodologies.CO605.2Understand the various methods used to collect the data for research. CO605.3CO605.4Write quality research in engineering. CO605.5Understand the concepts of intellectual property rights.Text Books	Suggestive As	sessment Methods			
1.Description Questions 2.Formative Multiple choice questions1.Assignment 2.Online Quizzes 3.Problem solving Activities1.Description Questions 2.Formative Multiple choice questionsOutcomesUpon completion of the course, the students will be able to: CO605.1Demonstrate the concepts of engineering research and its methodologies.CO605.2Understand the various methods used to collect the data for research. CO605.3CO605.3Formulate appropriate research problem and conduct the experiments using analysis and optimizationCO605.4Write quality research in engineering. CO605.5CO605.5Understand the concepts of intellectual property rights.	Continuous A (30 Mai	ssessment Test rks)	Formative Assessment Test (10 Marks)	End Ser (60 Ma	mester Exams rks)
Outcomes         Upon completion of the course, the students will be able to:         CO605.1       Demonstrate the concepts of engineering research and its methodologies.         CO605.2       Understand the various methods used to collect the data for research.         CO605.3       Formulate appropriate research problem and conduct the experiments using analysis and optimization         CO605.4       Write quality research in engineering.         CO605.5       Understand the concepts of intellectual property rights.	1.Description 2.Formative I questions	Questions Multiple choice	1.Assignment 2.Online Quizzes 3.Problem solving Activities	1.Desci 2.Form choice	ription Questions ative Multiple questions
Upon completion of the course, the students will be able to:CO605.1Demonstrate the concepts of engineering research and its methodologies.CO605.2Understand the various methods used to collect the data for research.CO605.3Formulate appropriate research problem and conduct the experiments using analysis and optimizationCO605.4Write quality research in engineering.CO605.5Understand the concepts of intellectual property rights.	Outcomes				
<ul> <li>CO605.1 Demonstrate the concepts of engineering research and its methodologies.</li> <li>CO605.2 Understand the various methods used to collect the data for research.</li> <li>CO605.3 Formulate appropriate research problem and conduct the experiments using analysis and optimization</li> <li>CO605.4 Write quality research in engineering.</li> <li>CO605.5 Understand the concepts of intellectual property rights.</li> </ul>	Upon comple	tion of the course, t	he students will be able to:		
<ul> <li>CO605.2 Understand the various methods used to collect the data for research.</li> <li>CO605.3 Formulate appropriate research problem and conduct the experiments using analysis and optimization</li> <li>CO605.4 Write quality research in engineering.</li> <li>CO605.5 Understand the concepts of intellectual property rights.</li> </ul>	CO605.1	Demonstrate the con	cepts of engineering research and its	s methodo	logies.
<ul> <li>CO605.3 Formulate appropriate research problem and conduct the experiments using analysis and optimization</li> <li>CO605.4 Write quality research in engineering.</li> <li>CO605.5 Understand the concepts of intellectual property rights.</li> </ul>	CO605.2	Understand the vario	ous methods used to collect the data	for researc	ch.
CO605.4       Write quality research in engineering.         CO605.5       Understand the concepts of intellectual property rights.	CO605.3	Formulate appropria and optimization	te research problem and conduct the	e experime	ents using analysis
CO605.5 Understand the concepts of intellectual property rights.	CO605.4	Write quality researc	ch in engineering.		
Tavt Books	CO605.5	Understand the conc	epts of intellectual property rights.		
I CAL DUUNJ	Text Books		· · · · · ·		

- 1. Dipankar Deb, RajeebDey, Valentina E. Balas."Engineering Research Methodology A Practical Insight for Researchers",Springer.2019
- 2. David V. Thiel, "Research Methods for Engineers", cambridge university press, 2014
- 3. VinayakBairagiMousami V. Munot ,"Research Methodology A Practical And Scientific Approach", CRC Press, 2019

#### **Reference Books**

1. RanjitKumar,"Research Methodologya step-by-step guide for beginners"SAGE publications, Fifth edition,2019

#### Web Resources

- <u>https://nptel.ac.in/courses/107/108/107108011/</u>
- <u>https://onlinecourses.swayam2.ac.in/cec20 hs17/preview</u>

#### CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1								3	3	2	1	1
2	3	3	1								3	3	2	1	1
3	3	3	1								3	3	2	1	1
4	3	3	1								3	3	2	1	1
5	3	3	1								3	3	2	1	1

#### 1→Low 2→Medium 3→High

		L	Т	P	C
21CS1611	COMMUNICATION SYSTEMS LABORATORY - I	4	0	4	2
Prerequisites f	for the course				

• The pre-requisite knowledge required by the Students to study this Course is basic knowledge in Digital Communication lab.

#### Objectives

- 1. To analyze the performance of wired and wireless transceivers.
- 2. To design and test different types of Microstrip antennas
- 3. To analyze the different types of modulation techniques.
- 4. To design the channel equalizer algorithms.
- 5. To design and estimate the cancellation using MATLAB

S.No	List of Experiments	СО

	<u>Francis Xavier Engineering College  Dept of ECE   M.E- CS   F</u> Curriculum and Syllabi 2021  Amendment 2022	2019
	LIST OF EXPERIMENTS USING MATLAB & NETWORK ANALYZER	
1	Design and performance analysis of error control encoder and decode (CRC and Convolution Codes) using MATLAB	er 1
2	Design and Analysis of Spectrum Estimators (Bartlett, Welch) using MATLAB	1
3	Channel equalizer design using MATLAB (LMS, RLS algorithms)	2
4	BER performance Analysis of M-ary digital Modulation Techniques (coherent & non coherent) in AWGN Environment using MATLAB	2
5	Design and performance analysis of Lossless Coding Techniques - Huffman Coding and Lempel Ziv Algorithm using MATLAB.	3
6	OFDM transceiver design using MATLAB	3
7	Design and Simulation of a Broadside Microstrip Array	4
8	Design and Simulation of an End Fire Microstrip Array	4
9	Construction and simulation a Fractal Structure	4
10	Noise / Echo cancellation using MATLAB (LMS / RLS algorithms)	5
		Total Periods :60
Sugges	tive Assessment Methods	
Lab Cor (50 Ma	mponents AssessmentsEnd Semester Earks)(50 Marks)	Exams
1.Experi 2.Model	iment l lab exam	b exam
Outcon	nes	
Upon c	completion of the course, the students will be able to:	
CO6	11.1 Apply mathematical formulation to analyze spectrum estimation rate determination of a transmission link.	on of a signal and bit
CO6	11. 2 Analyze various modulation and coding techniques.	
CO6	11.3 Design the transceiver for wired and wireless channel	acture for the desired
	frequencies	
CO6	11. 5 Analyze the performance of optimization algorithms for equal noise/echocancellation	izing the channel or
Softwa	re Requirements	
Softwar • I • I	re Requirement : Network Analyzer MATLAB	
Refere	nce Books	

1. J.G.Proakis, M.Salehi, —Fundamentals of Communication SystemsI, Pearson

#### Education 2014.

- 2. Simon Haykin, —Communication Systems<sup>II</sup>, 4th Edition, Wiley, 2014
- 3. B.P.Lathi, —Modern Digital and Analog Communication Systems<sup>II</sup>, 3rd Edition, Oxford University Press, 2007.

#### Web Resources

- vlab.co.in/ba-nptel-labs-electronics-and-communications
- <u>https://nptel.ac.in/courses/117/102/117102059/</u>
- <u>https://nptel.ac.in/courses/117/101/117101002/</u>

#### CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	<b>PO10</b>	PO11	PO12	PSO1	PSO2	PSO3
1	1		2							2					
2	2									2			2		
3		2												2	
4	1		2							1					1
5		2	1										3	1	2

#### **SEMESTER II**

S.No	Course Code	Course Name	Catego ry	Contact Periods	L	Т	Р	С
Theory	Courses							
1	21CS2601	Optical Communication Networks	PC	3	3	0	0	3
2	21CS2602	MIC and RF Transceiver Design	PC	3	3	0	0	3
3	21CS2603	Advanced Wireless Networks	PC	3	3	0	0	3
4		Professional Elective II	PE	3	3	0	0	3
5		Professional Elective III	PE	3	3	0	0	3
6		Professional Elective IV	PE	3	3	0	0	3
Practic	al Courses							
1	21CS2611	Communication Systems Laboratory II	PC	4	0	0	4	2
			Total	22	18	0	4	20

<u>Fr</u>	ancis Xavier Engineering College  Dept of ECE   M.E- CS   R201 Curriculum and Syllabi 2021  Amendment 2022	91			
		L	Τ	Р	С
21CS2601	OPTICAL COMMUNICATION NETWORKS				
		3	0	0	3
Prerequisites	for the course				
1. The pre-	-requisite knowledge required by the Students to study this Course	e is ba	sic k	nowl	edge in
Advance	ed Wireless Communication and Communication Systems Labora	tory I	•		
Objectives		1.0			
1. Make st	udents to learn the basic optical components for realizing any opti-	ical fu	nctio	on.	
2. Enable	the students to identify and formulate different networking topolo	gies.			
J. Ellable	the students to design Optical Network Routing Algorithms.	0011 0	ort o	fand	to and
4. Make u	nication and analyze the time division multiplexing in optical dom	ally so	ло	i enu	to end
5 Make th	he atudents to manage the optical networks in its configuration fail	iaiii. ilt and	ner	forma	nce
			i pen	0	nce.
Light propagat	ion in optical fibers – Loss & handwidth Dispersion effect		n_I ii	Jear d	offects
Solitons- Optic	al Network Components – Couplers Isolators & Circulators N	Jultin	lexe	rs &	Filters
Optical Amplif	iers. Switches. Wavelength Converters.	iunp	iene		1 11(015,
option i impili	leis, S menes, mareiengar Converteis.				
UNIT II	OPTICAL NETWORK ARCHITECTURES			9	
Introduction to	Optical Networks: SONET / SDH standards, Metropoliton Ar	ea Ne	etwoi	ks, L	ayered
Architecture- F	Broadcast and Select Networks- Topologies for Broadcast Net	tworks	s, M	edia	Access
Control Protoco	ols, Testbeds for WDM; Outline of Wavelength Routing Architect	ure.			
UNIT III	WAVELENGTH ROUTING NETWORKS			9	
Optical layer,	Node Designs, Routing and Wavelength Assignment, Vir	tual	topol	logy	design
problem,Regula	ar virtual topology design- Predetermined Virtual topology a	nd Li	ght	path	routes-
Architectural va	ariations.			_	
UNIT IV	PACKET SWITCHING AND ACCESS NETWORKS			9	
Photonic Packe	et Switching - OTDM, Multiplexing and Demultiplexing, Sync	hronis	atio	n, Bro	padcast
OTDM network	cs, Switch-based networks- Access Networks – Network Architec	cture c	verv	iew, 9	OTDM
networks- Opti	cal Access Network Architectures- Future Access Networks, F	ГТН S	Scena	ario i	n India
and Foreign Co	untries.				
				0	
UNIT V	NETWORK DESIGN AND MANAGEMENT			,	
UNIT V Transmission S	NETWORK DESIGN AND MANAGEMENT           System Engineering – System model, Power penalty - transm	itter,	recei	ver,	Optical
UNIT V Transmission S amplifiers, cros	<b>NETWORK DESIGN AND MANAGEMENT</b> System Engineering – System model, Power penalty - transm stalk, dispersion- Wavelength stabilization; Overall design consi	itter, derati	recei ons-	ver, Cont	Optical rol and

Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety.

Su										Tota	l Perio	ds	4	- <b>5</b>	
	ggesti	ve As	sessm	ent M	ethod	S									
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0ι	itcome	es													
Uŗ	on coi	nplet	ion of	the co	ourse,	the st	udent	s will b	e abl	le to:					
	CO601	. 1	Apply	knowl	edge o	fbasic	optical	compor	nents	for real	izing an	y optica	al functi	on.	
	CO601	. 2	Identif	y and t	formul	ate dif	ferent r	networki	ng To	opologi	es.				
	CO601	. 3	Design	1 Optic	al Net	work R	louting	Algorit	hms.				_		
	CO601	. 4	Apply	the l	oasic	Netwo	rking	knowled	lge t	o reali	ze any	sort o	of end	to end	
	<b>a a a a</b>	_	comm	unicati	on and	Analy	ze the	Time div	visior	n multip	lexing i	n optica	al domai	in.	
_	CO601	5	Manag	ge the c	optical	netwo	rks in i	ts config	guratio	on, faul	t and pe	rformar	nce.		
Re	eterenc	e Boo	oks		• •	•	<b>~</b> •	•			<u> </u>				
	1. Ra	ajiv R	lamasv	vami,	Kuma	r N.	Sivara	jan and	i Gal	len H.	Sasaki	"Optic	al Netv	works :	Α
	Pr	actica	Il Pers	pective	е", На	rcourt	Asia I	vt. Ltd	., 1 hi	ird Edi	tion 201		C	• ,	
	2. M	oham	mad	llyas,	Huss	ein I	I. MIO	uftah,	"Hai	ndbook	( 01 (	optical	Comn	nunicat	ion
questions       3.Problem solving Activities       choice questions         Outcomes       Upon completion of the course, the students will be able to:       CO601.1       Apply knowledge ofbasic optical components for realizing any optical function.         CO601.2       Identify and formulate different networking Topologies.       CO601.3       Design Optical Network Routing Algorithms.         CO601.4       Apply the basic Networking knowledge to realize any sort of end to end communication and Analyze the Time division multiplexing in optical domain.         CO601.5       Manage the optical networks in its configuration, fault and performance.         Reference Books       I. Rajiv Ramaswami, Kumar N. Sivarajan and Galen H. Sasaki "Optical Networks : A Practical Perspective", Harcourt Asia Pvt. Ltd., Third Edition 2010.         2.       Mohammad Ilyas, Hussein T. Mouftah, "Handbook of Optical Communication Networks", Taylor and Francis, First Edition, 2007.         3.       C.Siva Ram Moorthy and Mohan Gurusamy, "WDM Optical Networks :Concept, Design and Algorithms", Prentice Hall of India, First Edition, 2002.         4.       Biswanath Mukherjee, "Optical Communication Networks", McGrawHill Revised Edition 2006.         5.       P.E. Green, Jr., "Fiber Optic Networks", Prentice Hall, NJ, 1993. 6. Rajiv Ramaswami and Kumar N. Sivarajan and Galen H. Sasaki "Optical Networks : A Practical Perspective", Harcourt Asia Pvt. Ltd., First Edition 2005.         Web Resources       •       •       •         •       Www.nextgenerationopti															
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2	1CS20	602		Μ	IC AND R	F TRA	ANSCEI	VER I	DESIGN	J	3	0	Р 0	L 3
Pr	erequ	isites	for th	e cou	rse									
	1.	. The	pre-re	quisite	e knowledg	e req	uired by	y the	Student	s to sti	udy this	6 Cour	se is	basic
		knov	wledge	in Mi	crowave En	gineer	ing							
Ob	ojectiv	ves												
	1. T	o desig	gn and	analyz	e different	nicrov	vave con	nponen	ts					
	2. T	o use	SMITH	I chart	to analyze	the re	egion of	stabilit	y and i	nstabilit	y for de	esignin	g amp	lifiers
	aı	nd osci	illators	•										
	3. D	esign (	of RF c	circuits	and RFIC	system	1 ~	1	~ ~					
	4. D	esign	passive	e and a	ctive micro	wave (	Circuits a	and MI	C Syste	ms				
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	UNIT	1	N	AICRO	JWAVE T	KANS DI	SISTOR SICN	AND A	AMPLI	FIER			9	
Co	onstant	Gain c	circles:	Bilater	al case- Op	erating	g and Av	ailable	Power	Gain Ci	rcles- D	C Bias	Netw	orks
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No	oise in	Two p	ort Ne	twork-	Constant I	loise l	Figure C	ircles-	Broadba	and Am	plifier I	Design-	High	power
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Francis Xavier Engineering College | Dept of ECE | M.E- CS | R2019 | Curriculum and Syllabi 2021 | Amendment 2022 QoS Challenges in Wireless IP Networks - QoS in 3GPP - QoS Architecture, Management and Classes -QoS Attributes - Management of End-to-End IP QoS - EPS BearersandQoSin LTE networks. **Total Periods** 45 **Suggestive Assessment Methods Formative Assessment Test Continuous Assessment Test End Semester Exams** (30 Marks) (10 Marks) (60 Marks) **1.Description Questions 1.Assignment 1.Description Questions** 2.Formative Multiple choice 2.Online Quizzes **2.Formative Multiple** questions **3.Problem solving Activities** choice questions **Outcomes** Upon completion of the course, the students will be able to: Familiar with the latest 4G networks and LTE CO603.1 Understand about the wireless IP architecture and LTE network architecture. CO603.2 CO603.3 Familiar with the adaptive link layer and network layer graphs and protocol. CO603.4 Understand about the mobility management and cellular network. CO603.5 Understand about the wireless sensor network architecture and its concept. **Text Books** 1. AymanElNashar, Mohamed El-saidny, Mahmoud Sherif, "Design, Deployment and Performance of 4G-LTE Networks: A Practical Approach", John Wiley & Sons, 2014 2. Crosspoint Boulevard, "Wireless and Mobile All-IP Networks", Wiley Publication, 2005 3. Jyh-Cheng Chen and Tao Zhang, "IP-Based Next-Generation Wireless Networks Systems, Architectures, and Protocols", John Wiley & Sons, Inc. Publication, 2006 4. Minoru Etoh. "Next Generation Mobile Systems3G and Bevond," Wilev Publications,2005. **Reference Books** 1. StefaniaSesia, IssamToufik and Matthew Baker, "LTE – The UMTS Long Term Evolution From Theory to Practice", John Wiley & Sons, Inc. Publication, Second Edition, 2011 2. SavoGlisic," advanced wireless networks-technology and business models", Third Edition, John Wiley & Sons, Ltd, 2016 3. SavoGlisic,"Advanced Wireless Networks-4G Technologies", John Wiley & Sons, Ltd,2006 Web Resources https://nptel.ac.in/courses/117/104/117104099/ https://nptel.ac.in/courses/117/102/117102062/ • https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs09/ CO Vs PO Mapping and CO Vs PSO Mapping CO **PO1** PO2 PO3 **PO4** PO5 PO6 **PO7 PO8 PO9 PO10** PO11 PO12 PSO1 PSO2 PSO3 2 1 2 3 2 2 3 3 3 1 2 3 3 2 2 2 3 3 3 3 2 3 3 3 3 2 2 2 3

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3	}	Simulation of spatially separated Signal in the presence of Additive       2         Correlated / Uncorrelated White Noise using MATLAB       2																
4		Analysi Bayes F algorith	s of pe Estimat m usin	erform or, Ma	ance of AP Esti TLAB.	the Est mator	stimatio , Expec	on tech	niques Maxir	s - ML nizatio	E, MN n (EM	ISE, [)			2			
5		Simulat MATL	ion an AB.	d perfo	ormanc	e evalı	ation	of a CI	DMA S	System	using				3			
6	•	Study o	f BER	and e	ve natte	ern in t	he onti	1		1.					0			
					ye pull	<u> </u>		ical sys	tem si	mulati	on.				3			

		<u>F</u>	rancis	Xavie Cur	<u>r Engi</u> ricului	neerin n and	g Colle Syllab	ege  De i 2021	ept of l   Ame	ECE   M ndment	.E- CS   : 2022	R2019	Ļ									
	8	Simul	ation a	nd per	formar	ice eva	luatior	n of Wi	–Fi L	AN.		5										
	9	Simul / SPIH	ation o IT.	of Wav	elet Tra	ansforr	n base	d Imag	e codi	ng algor	ithm - H	EZW										
	10	Simul a) Cor b) Lin	ation o npandi ear Pre	f Audi ing tecl edictive	o and s hnique e Codii	speech s. ng tech	compi	ression	algori	thms		4										
												•	Гotal Р	eriods	:60							
Su	ggest	ive As	sessm	ent M	ethod	S																
La (5	b Con 0 Mai	npone rks)	nts As	sessn	ients				 	End Ser 50 Mar	nester ks)	Exams										
1.E 2.N	Experi Model	ment lab exa	ım						1	.End set	mester l	ab exan	ı									
La So	pon co CO61 CO61 CO61 CO61 CO61 borat ftware • N • N	omple 1. 1 1. 2 1. 3 1. 4 1. 5 cory Ro e Requ letwor IATLA	tion o Deter Desig Apply chara Devel Analy equire k Anal B	f the c mine t n and s mathe cterist op cor ze the ement nt : yzer	course the cha simula ematic cics of v npress perfor <b>s</b>	e, the s aracter te pas cal forr wirele sion al cmance	studen sive R nulationss com gorithme of va	nts wil of micr F subs on to a munic ms for rious t	l be al rowav ystem nalyze cation data li cransfo	ble to: e compo signal. ike audi orms.	onents raluate lo, spee	the spec	ctral image.									
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CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3							
1	1		2							2			1	2								
2	2									2			2		3							
3		2												2								
4	1		2							1				2	1							

		<u>F</u>	rancis 2	Xavier Engir	<u>neering C</u>	ollege D	ept of E	<u>ECE   M.F</u>	<u>E- CS</u>	<u>S   R2019  </u> 2	L			
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			o mapt		V31501	аррінд								
		1				SEMES	TER III							
	S.No	Co Co	urse ode		Course	Name		Categ ry	go	Contact Periods	L	T	P	C
1	Theory	y Cour	ses					•	E					
	1	210	S3607	Machine L	earning			PC		3	3	0	0	3
	2			Professiona	al Electiv	e V		PE		3	3	0	0	3
	3			Professiona	al Electiv	e VI		PE		3	3	0	0	3
		•			]	Practical	Cours	es						
	1	21C	S3911	Dissertatio	n I			EEC		12	0	0	12	6
	2	21C	S3912	Term Pape	r Writing			EEC	7	1	0	0	2	1
								Tot	tal	18h + 8 weeks	6	0	14	16
												T	Р	С
	21CS3	3607			MAC	HINE LE	ARNIN	NG			2			3
Р	rerea	uisite	 s for tł	1e course							5		U	5
	•	The provident	e-requis	site knowled	ge require	ed by the	student	s to stud	y th	is Course i	s bas	ic kr	nowled	lge in
-				0										

Francis Xavier Engineering College | Dept of ECE | M.E- CS | R2019 | Curriculum and Syllabi 2021 | Amendment 2022 1. To understand the concepts and mathematical foundations of machine learning and types of problems tackled by machine learning 2. To explore the different supervised learning techniques including ensemble methods 3. To learn different aspects of unsupervised learning and reinforcement learning To learn the role of probabilistic methods for machine learning 4. To understand the basic concepts of neural networks and deep learning 5. INTRODUCTION AND MATHEMATICAL FOUNDATIONS **UNIT I** 9 What is Machine Learning? Need –History – Definitions – Applications - Advantages, Disadvantages & Challenges -Types of Machine Learning Problems – Mathematical Foundations - Linear Algebra & Analytical Geometry -Probability and Statistics- Bayesian Conditional Probability -Vector Calculus & Optimization - Decision Theory - Information theory UNIT II SUPERVISED LEARNING 9 Introduction-Discriminative and Generative Models -Linear Regression - Least Squares -Under-fitting / Overfitting -Cross-Validation - Lasso Regression- Classification - Logistic Regression- Gradient Linear Models -Support Vector Machines -Kernel Methods - Instance based Methods - K-Nearest Neighbours -Tree based Methods – Decision Trees – ID3 – CART - Ensemble Methods – Random Forest - Evaluation of Classification Algorithms UNIT III UNSUPERVISED LEARNING AND REINFORCEMENT 9 LEARNING Introduction - Clustering Algorithms -K - Means - Hierarchical Clustering - Cluster Validity -Dimensionality Reduction - Principal Component Analysis - Recommendation Systems - EM algorithm. Reinforcement Learning – Elements - Model based Learning – Temporal Difference Learning **PROBABILISTIC METHODS FOR LEARNING** UNIT IV 9 Introduction -Naïve Bayes Algorithm -Maximum Likelihood -Maximum Apriori -Bayesian Belief Networks -Probabilistic Modelling of Problems -Inference in Bayesian Belief Networks - Probability Density Estimation - Sequence Models - Markov Models - Hidden Markov Models NEURAL NETWORKS AND DEEP LEARNING 9 UNIT V Neural Networks - Biological Motivation- Perceptron - Multi-layer Perceptron - Feed Forward Network – Back Propagation-Activation and Loss Functions- Limitations of Machine Learning – Deep Learning- Convolution Neural Networks - Recurrent Neural Networks - Use cases **Total Periods** 45 **Suggestive Assessment Methods Continuous Assessment Test Formative Assessment Test End Semester Exams** (60 Marks) (30 Marks) (10 Marks) **1.Description Questions 1.Assignment 1.Description Questions** 2.Formative Multiple choice 2.Online Ouizzes **2.Formative Multiple** questions **3.Problem solving Activities** choice questions Outcomes Upon completion of the course, the students will be able to: Understand and outline problems for each type of machine learning CO603.1 CO603.2 Design a Decision tree and Random forest for an application CO603.3 Implement Probabilistic Discriminative and Generative algorithms for an application and analyze the results. CO603.4 Use a tool to implement typical Clustering algorithms for different types of applications.

<u>F</u>	rancis Xavier Engineering College  Dept of ECE   M.E- CS   R2019				
	<u>Curriculum and Syllabi 2021   Amendment 2022</u>				
CO603.5	Design and implement an HMM for a Sequence Model type of applic	catic	on.		
Text Books					
1. Stephe	n Marsland, "Machine Learning: An Algorithmic Perspectiv	/e".	Ch	anma	in &
Hall/C	RC. 2nd Edition. 2014.	- ,		···I··	
2 Kevin	Murnhy "Machine Learning: A Probabilistic Perspective" MIT P	res	× 20	12	
2. Revin 3. Ethom	Alnovdin "Introduction to Machina Learning" Third H	i est i dit	, 20 ion	12 A.d.	ntivo
J. Ethem	Apayum, Introduction to Machine Learning, Innu I	Juit	1011,	Aua	ipuve
	nation and Machine Learning Series, WITT Fress, 2014.				
Reference Bo					
4. Tom N	I Mitchell, "Machine Learning", McGraw Hill Education, 2013.				
5. Peter	Flach, "Machine Learning: The Art and Science of Algorithms the	iat .	Mak	ke Ser	ise of
Data",	First Edition, Cambridge University Press, 2012.				
6. Shai S	Shalev-Shwartz and Shai Ben-David, "Understanding Machine	Le	earn	ing:	From
Theory	v to Algorithms", Cambridge University Press, 2015.				
7. Christ	opher Bishop, "Pattern Recognition and Machine Learning", Sprin	iger	, 200	07.	
8. Hal Da	umé III, "A Course in Machine Learning", 2017 (freely available o	onlir	ne)		
Web Resource	ces				
• <u>https://r</u>	ptel.ac.in/courses/106106139				
• https://r	ptel.ac.in/courses/106106184				
• https://r	ptel.ac.in/courses/106105152				
1100000					
		L	Τ	Р	С
21CS3902	TERM PAPER WRITING				
		0	0	2	1
In this c	course, students will develop their scientific and technical reading and writing	g ski	lls th	at the	y need
to unde	rstand and construct research articles. A term paper requires a student to obtain	in in	form	ation	from a
variety	of sources (i.e., Journals, dictionaries, reference books) and then place it ir	ı loş	gicall	y dev	eloped
ideas. T	he work involves the following steps:				
1. Selec	ting a subject, narrowing the subject into a topic				
2. Stati	ng an objective.				
3. Colle	cting the relevant bibliography (atleast 15 journal papers)				
4. Prepa	ring a working outline.				
5. Study	ving the papers and understanding the authors contributions and critically and	ılysi	ng ea	ach pa	per. 6.
Preparin	ng a working outline				
7. Linki	ng the papers and preparing a draft of the paper.				
8. Prepa	ring conclusions based on the reading of all the papers.				
9. Writi	ng the Final Paper and giving final Presentation				
Please l	teep a file where the work carried out by you is maintained. Activities to be ca	arrie	d out	t	
	~ **				
	36				
Activity	Instructions	Submission week	Evaluation		
---	--	----------------------	---		
Selection of area of interest and TopicStatingan Objective	You are requested to select an area of interest, topic and state an objective	2 <sup>nd</sup> week	3 % Based on clarity of thought, current relevance and clarity in writing		
Collecting Information about your area & topic	<ol> <li>List 1 Special Interest Groups or professional society</li> <li>List 2 journals</li> <li>List 2 conferences, symposia or workshops 4. List 1 thesis title</li> <li>List 3 web presences (mailing lists, forums, news sites)</li> <li>List 3 authors who publish regularly in your area</li> <li>Attach a call for papers (CFP) from your area.</li> </ol>	3 <sup>rd</sup> week	3% ( the selected information must be area specific and of international and national standard)		
Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter	<ul> <li>You have to provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar</li> <li>When picking papers to read - try to:</li> <li>Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them,</li> <li>Favour papers from well-known journals and conferences,</li> <li>Favour "first" or "foundational" papers in the field (as indicated in other people's survey paper),</li> <li>Favour more recent papers,</li> <li>Pick a recent survey of the field so you can quickly gain an overview,</li> <li>Find relationships with respect to each other and to your topic area (classification scheme/categorization)</li> <li>Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered</li> </ul>	4 <sup>th</sup> week	6% ( the list of standard papers and reason for selection)		
Reading and notes for first 5 papers	<ul> <li>Reading Paper Process</li> <li>For each paper form a Table answering the following questions: • What is the main topic of the article?</li> <li>What was/were the main issue(s) the author said they want to discuss?</li> </ul>	5 <sup>th</sup> week	8% ( the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about		

<u>Francis X</u>	Kavier Engineering College  Dept of ECE Curriculum and Syllabi 2021  Amendm	<u>  M.E- CS   R20</u> ent 2022	<u>19  </u>
	• Why did the author claim it was		each paper)
	important?		
	• How does the work build on other's work,		
	in the author's opinion?		
	• What simplifying assumptions does the		
	author claim to be making?		
	• What did the author do?		
	• How did the author claim they were going		
	to evaluate their work and compare it to		
	others?		
	• What did the author say were the limitations of their research?		
	• What did the author say were the		
	important directions for future research?		
	Conclude with limitations/issues not		
	addressed by the paper ( from the		
	perspective of your survey)		
Reading and notes	Repeat Reading Paper Process	6 <sup>th</sup> week	8% ( the table given
for next5 papers			should indicate your
			understanding of the
			paper and the
			evaluation is based on
			your conclusions about
			each paper)
Reading and notes	Repeat Reading Paper Process	7 <sup>th</sup> week	8% ( the table given
for final 5 papers			should indicate your
			understanding of the
			paper and the
			evaluation is based on
			vour conclusions about
			each paper)
Draft outline 1 and	Prepare a draft Outline, your survey goals.	8 <sup>th</sup> week	8% ( this component
Linking papers	along with a classification / categorization		will be evaluated based
<b>U</b> T T	diagram		on the linking and
			classification among
			the papers)
Abstract	Prepare a draft abstract and give a	9 <sup>th</sup> week	6% (Clarity, purpose
	presentation		and conclusion) 6%
			Presentation & Viva
			VoceIntroduction
			Background
Introduction	Write an introduction and background	10 <sup>th</sup> week	5% ( clarity)
Background	sections	10 WCCK	
Sections of the	Write the sections of your paper based on	11 <sup>th</sup> week	10% (this component
paper	the classification / categorization diagram		will be evaluated based
	in keeping with the goals of your survey		on the linking and

<u>Francis</u>	Xavier Engineering College  Dept of ECI Curriculum and Syllabi 2021  Amendu	<u>E   M.E- CS   R2</u> ment 2022	<u>019  </u>
			classification among the papers)
Your conclusions	Write your conclusions and future work	12 <sup>th</sup> week	5% ( conclusions - clarity and your ideas)
Final Draft	Complete the final draft of your paper	13 <sup>th</sup> week	10% (formatting English, Clarity and linking) 4% Plagiarism Check Report
Seminar	A brief 15 slides on your paper	14 <sup>th</sup> week	10% (based or presentation and Viva voce)
			Total : 30 Periods

# **SEMESTER IV**

S.No	Course Code	Course Name	Catego ry	Contact Periods	L	Τ	Р	C		
Practic	Practical Courses									
1	21CS4911	Dissertation II	EEC	24	0	0	24	12		
			Total	24	0	0	24	12		

# List of Professional Electives Courses

S.No	Course Code	Course Name	Seme ster	L	Т	Р	С					
Profes	Professional Elective I											
1	21CS1701	Communication Network Security	Ι	3	0	0	3					
2	21CS1702	Advanced Multimedia Compression Techniques	Ι	3	0	0	3					
3	21CS1703	Advanced Digital Image Processing	Ι	3	0	0	3					
4	21CS1704	Soft Computing Techniques	Ι	3	0	0	3					
Profes	ssional Electiv	e II					•					

	<u>Francis X</u>	Cavier Engineering College  Dept of ECE   M.E- CS Curriculum and Syllabi 2021  Amendment 202	<u>5   R201</u> 2	9						
1	21CS2701	Advanced Wireless Sensor Networks	II	3	0	0	3			
2	21CS2702	Massive MIMO and Millimeter Wave Communication	II	3	0	0	3			
3	21CS2703	MIMO OFDM Systems	II	3	0	0	3			
4	21CS2704	Space Time Wireless Communication	II	3	0	0	3			
Profes	ssional Electiv	e III								
1	21CS2705	Software and Cognitive Radio Systems	II	3	0	0	3			
2	21CS2706	Modern IOT	II	3	0	0	3			
3	21CS2707	Real Time Embedded Systems	II	3	0	0	3			
4	21CS2708	Smart Antennas	II	3	0	0	3			
Profes	Professional Elective IV									
1	21CS2709	LTE Technology and Standards	II	3	0	0	3			
2	21CS2710	Modern Satellite Systems	II	3	0	0	3			
3	21CS2711	Network Routing Algorithms	II	3	0	0	3			
4	21CS2712	Remote Sensing	II	3	0	0	3			
Profes	ssional Electiv	e V								
1	21CS3701	Embedded Wireless Sensor Networks	III	3	0	0	3			
2	21CS3702	DSP Processor Architecture and Programming	III	3	0	0	3			
3	21CS3703	Pattern Recognition and Machine Learning	III	3	0	0	3			
4	21CS3704	High Speed Communication Networks	III	3	0	0	3			
Profes	ssional Electiv	e VI								
1	21CS3705	Cooperative Communication	III	3	0	0	3			
2	21CS3706	VLSI Architecture for Image and Video Processing	III	3	0	0	3			
3	21CS3707	Mobile Robotics	III	3	0	0	3			
4	21CS3708	Advanced Radar and Navigational AIDS	III	3	0	0	3			

## List of Professional Electives I

S.No	Course Code	Course Name	Seme ster	L	Т	Р	С					
Profes	Professional Elective I											
1	21CS1701	Communication Network Security	Ι	3	0	0	3					
2	21CS1702	Advanced Multimedia Compression Techniques	Ι	3	0	0	3					
3	21CS1703	Advanced Digital Image Processing	Ι	3	0	0	3					
4	21CS1704	Soft Computing Techniques	Ι	3	0	0	3					

21CS1701	COMMUNICATION NETWORK SECURITY	L	Т	Р	С
		3	0	0	3

#### Prerequisites for the course

• The pre-requisite knowledge required by the Students to study this Course is basic knowledge in Network security.

#### **Objectives**

- 1. To learn security mechanisms and techniques to provide security services.
- 2. To be exposed to symmetric & asymmetric key algorithms and key management aspects.
- 3. To be aware of the need for security in different layers and wireless network security.
- 4. To study the various network and Web security.
- 5. To be aware about the wireless network security.
- UNIT I SECURITY SERVICES AND MECHANISMS

Security Goals, Types of Attacks: Passive attack, active attack, attacks on confidentiality, attacks on Integrity and availability. Security services – Confidentiality, Integrity, Authentication, Nonrepudiation& Access control and Mechanisms- Encipherment, Data Integrity, Digital Signature, Authentication Exchange, Traffic Padding, Routing Control, Notarization & Access Control.

9

# UNIT IISYMMETRIC & ASYMMETRIC KEY ALGORITHMS9Substitutional Ciphers, Transposition Ciphers, Stream and Block Ciphers, Data Encryption Standards

(DES), Advanced Encryption Standard (AES), RC4, Principle of Asymmetric key algorithms, RSA Cryptosystem.

UNIT III		INTEGRITY, AUTHENTICATION AND KEY MANAGEMENT						9		
		4	111	ANAGI						
Message Int	egrity,	Hash	functions:	SHA,	Digital	signatures:	Digital	signature	standards,	
Authenticatio	Authentication: Entity Authentication: Biometrics, Key management Techniques.									

UNIT IV	NETWORK SECURITY , FIREWALLS AND WEB	9
	SECURITY	

<u>F</u> 1	<u>rancis Xavier Engine</u> Curriculum	eering College  Dept of ECE   M.E- C and Syllabi 2021  Amendment 202	<u>S   R201</u> 22	91
Introduction o	n Firewalls. Types o	f Firewalls, Firewall Configuration	and Lim	itation of Firewall. IP
Security Over	view, IP security	Architecture, authentication Heade	er, Secur	ity payload, security
associations, 1	Key Management.	Web security requirement, secure	sockets	layer, transport layer
security.				• • • •
UNIT V	WIRE	LESS NETWORK SECURITY		9
Security Attack	k issues specific to W	vireless systems: Worm hole, Tunnel	ling, DoS	. WEP for Wi-Fi
network, Secur	rity for 4G networks:	Secure Ad hoc Network, Secure Sen	sor Netw	ork.
		Total I	Periods	45
Suggestive As	ssessment Method	S	_	
Continuous A (30 Ma	lssessment Test rks)	Formative Assessment Test (10 Marks)	End Se (60 Ma	mester Exams rks)
1.Description 2.Formative questions	n Questions Multiple choice	1.Assignment 2.Online Quizzes 3.Problem solving Activities	1.Desc 2.Form choice	ription Questions ative Multiple questions
Outcomes				
Upon comple	tion of the course,	the students will be able to:		
CO701. 1	Identify and differe	ntiate security attacks.		
CO701. 2	Apply various Encr	yption, Authentication and Digital Si	gnature A	Algorithms
CO701. 3	Configure firewalls	based on the security requirements a	nd secure	e the perimeter.
CO701.4	Deal with different	general purpose and application spe	cific Sec	urity Protocols and
CO701 5	Techniques.	vices at different layers for various r	otwork	rahitaaturaa
CO/01. 5	Flovide security ser	vices at different layers for various h	etwork a	iciniectures.
Text Books				
1. Behrou Tata M 2. Willian Prentic 3. AtulKa 2008	iz A. Forouzan ,Do IcGraw- Hill, Secon n Stallings, ''Cryp ce Hall of India, Nev ahate , "Cryptograp	ebdeepMukhopadhyay,"Cryptogra d Edition, 2011. otography and Network security v Delhi, Sixth Edition, 2013. ohy and Network security", Tata N	phy and : Princi McGraw	l Network security", ples and Practice'', - Hill, Third Edition,
Reference Bo	ooks			
1. R.F	K.Nichols and P.C.	Lekkas," Wireless Security Mod	lels, Thr	reats and Solutions",
Tat	ta McGraw- Hill, Fi	rst Edition, 2006.		
2. H.	Yang et al., "Securi	ty in Mobile Ad Hoc Networks: Ch	allenges	and Solution", IEEE
Wi	reless Communicati	ons, Feb. 2004.		
3. L. 2	Zhou and Z. J. Haa	s , "Securing Ad Hoc Networks", l	EEE Ne	twork Magazine, vol.
13,	no. 6, pp. 24-30, De	cember 1999.	~ •	
<b>4.</b> Dav	vid Boyle and The	omas Newe, "Securing Wireless	Sensor I	Networks – Security
Arc	chitecture", Journal	of networks, Vol.3. No. 1. pp. 65 -7	/6, Jan 2	UU8 - Seeres N. ( - 1 **
5. Per	rig, A., Stankovic,	J. And Wagner, D., "Security in	Wireles	s Sensor Networks",
Col	mmunications of the	e AUNI, Vol. No.47, Issue. 6, pp 53-	57,2004	

# Web Resources

- <u>http://highered.mcgraw-hill.com/sites/0072870222/student\_view0/</u>
- <u>http://williamstallings.com/Crypto/Crypto4e.html</u>

CO	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	<b>PO9</b>	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2							2	2	3	1	2	
2	3	3	2	1	2						2	3	2		1
3	3	3	3		2					2	2	3		2	
4	3	3	2		2					2	2	3			1
5	3	3	2	1						2	2	3	3	1	2

21CS1702	ADVANCED MULTIMEDIA COMPRESSION	L	T	Р	C
	TECHNIQUES	3	0	0	3
Prerequisites	s for the course				
• The pre	-requisite knowledge required by the Students to study this Course	e is ba	sic k	nowle	edge in
Multim	edia compression.				
Objectives					
1. To get t	amiliarized with the multimedia concepts				
<b>2.</b> To get	acquainted with various compression techniques for text.				
<b>3.</b> To stud	y the various compression techniques in audio,				
<b>4.</b> To und	erstand the various compression techniques in image				
<b>5.</b> To get t	amiliarized with various video compression methods.				
UNIT I	MULTIMEDIA CONCEPTS			9	
Special feature	s of Multimedia – Graphics and Image Data Representations – Fu	ndam	ental	Conc	epts in
Video and Dig	ital Audio – Storage requirements for multimedia applications -N	eed fo	or Co	ompre	ssion -
Taxonomy of a	compression techniques - Overview of source coding, source mo	dels,	scala	r and	vector
quantization th	eory – Evaluation techniques – Error analysis and methodologies.				
UNIT II	TEXT COMPRESSION			9	
Compaction to	echniques – Huffmann coding – Adaptive Huffmann Codin	g –	MN	P5-Ad	laptive
Arithmetic cod	ing — Dictionary techniques – LZW –WINRAR – exe compresso	rs			
UNIT III	AUDIO COMPRESSION			9	
Audio compres	ssion techniques - µ- Law and A- Law companding. Frequency of	lomai	in an	d filte	ering –
Basic sub-band	l coding -speech coding standard - G.722 - Audio coding stand	dard–	MP	EG 4	audio,
speech compre	ssion techniques – Formant and CELP VocodersAAC- Dolby AC	23			

		_		-				-							
		<u>_C</u>	Curricu	ılum	and Sy	/llabi 2	2021	Ameno	dment 2	<u>.022</u>					
UNI	T IV			I	MAGE	E CON	<b>IPRE</b> S	SSION	1				9		
Lapped	d transfo	rms – L	OT-LI	BT- 1	Fransfo	orm ba	ased in	nage o	compres	sion –J	PEG-E1	nbeddeo	l zero t	ree	
coding	- fracta	l based i	image	comp	pressio	n – pa	rtition	ed IFS	- Design	n of Filt	ter bank	as – War	velet ba	sed	
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Video	compress	sion tech	niques	and s	standa	rds –M	IPEG -	- 4 and	17 - Mc	otion est	imation	and con	npensat	ion	
techniq	ques – H	.261 Star	ndard	-DV	'I tech	nology	/ – PL	V perf	formanc	e – DV	I real ti	me con	pressio	n –	
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1.Desc	cription	Questio	ons		1.Ass	signm	ent			1.D	escrip	tion Qu	estions	5	
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Upon	complet	tion of t	he cou	ırse,	the st	udent	ts will	be ab	le to:						
CO	702. 1	To anal	yze the	e requ	ireme	nt of c	ompres	ssion ii	n differe	nt real t	ime app	olication	s.		
CO	702. 2	То Арр	ly vari	ious c	ompac	tion te	chniqu	les for	text con	npressio	on.				
CO	702. 3	To unde	rstand	the p	erform	ance o	of audio	o comp	pression	techniq	ues.				
CO	702.4	To study	y the pe	erforr	nances	s of va	rious a	lgorith	ms for i	mage co	ompress	ion			
CO	702. 5	To anal	yze the	e diffe	erent s	tandar	ds appl	icable	for vide	o comp	ression.				
Text B	Books														
1.	1.David	Salomor	ı,"Dat	ta Co	mpres	sion -	- The	Comp	lete Re	ference	", Spri	nger Ve	erlag, N	ew	
	York In	ic., Four	th Edi	ition,	2014.										
2.	Khalid	Sayood,	"Intro	ducti	ion to	Data	Comp	ressio	n", Moi	gan Ka	auffmai	n Harco	ourt Ind	lia,	
	Fourth	Edition,	2012												
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	CO	703.3	Des	cribe in	mage v	arious	featur	e extra	ction to	echniqu	es for in	nage ana	alysis.		
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	rancis Xavier Engine Curriculum	eering College  Dept of ECE   M.E- C	<u>S   R2019</u> 2	91
1 Un	derstand Soft Compu	ting concerts, technologies, and appli	<u>L</u>	
1. Ult	derstand the underlyi	ng principle of soft computing with it	$\frac{1}{5}$ usage i	n various
2. On	blications	ing principle of soft computing with it	s usage 1	li various
3. Un	derstand different sof	t computing tools to solve real life pro-	oblems.	
4. Un	derstand the concept	of Genetic algorithm and its applicati	on.	
5. Une	derstand AI searchin	g strategies.		
UNIT I	INTRODU	JCTION TO SOFT COMPUTING		9
Overview of S	Soft Computing, Dif	fference between Soft and Hard con	mputing,	Brief descriptions of
different comp	ponents of soft com	puting including Artificial intelligen	nce syste	ems Neural networks,
fuzzy logic, g	genetic algorithms.	Artificial neural networks Vs Biolo	ogical ne	eural networks, ANN
architecture, B	Basic building block	of an artificial neuron, Activation fu	unctions,	Introduction to Early
ANN architect	ures (basics only)-M	cCulloch & Pitts model, Perceptron, A	ADALIN	E, MADALINE.
UNIT II	ARTIF	ICIAL NEURAL NETWORKS		9
Artificial Neu	ral Networks: Super	vised Learning: Introduction and h	ow brain	works, Neuron as a
simple compu	iting element, The	perceptron, Backpropagation netw	orks: ar	chitecture, multilayer
perceptron, ba	ckpropagation learni	ing-input layer, accelerated learning	in multi	layer perceptron, The
Hopfield netw	ork. Bidirectional ass	ociative memories (BAM). RBF Neu	ral Netwo	ork
	ANN	& FUZZY LOGIC SYSTEMS		9
Artificial Neur	al Networks: Unsun	ervised Learning: Hebbian Learning	General	ized Hebbian learning
algorithm Co	mpetitive learning	Self- Organizing Computational N	Jans Ka	ohonenNetwork Fuzzy
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		TENETIC ALCODITHM		0
				7
L-onotio algor	rithma haaia aanaa	nts anapping fitness function	roproduc	tion Doulatta whool
Genetic algor	rithms basic conce	epts, encoding, fitness function,	reproduc	ction-Roulette wheel,
Boltzmann, to	rithms basic conce urnament, rank, and	epts, encoding, fitness function, steady state selections, Convergence	reproducter of GA	tion-Roulette wheel, , Applications of GA
Genetic algoi Boltzmann, to case studies. Ir	rithms basic conce urnament, rank, and ntroduction to genetic	epts, encoding, fitness function, steady state selections, Convergenc programming- basic concepts.	reproduce e of GA	ction-Roulette wheel, , Applications of GA
Genetic algor Boltzmann, to case studies. Ir UNIT V	rithms basic conce urnament, rank, and ntroduction to genetic <b>AI-S</b>	epts, encoding, fitness function, steady state selections, Convergence programming- basic concepts. EARCHING STRATEGIES	reproduce of GA	Applications of GA
Genetic algoi Boltzmann, to case studies. Ir UNIT V Search Strateg	rithms basic conce urnament, rank, and ntroduction to genetic AI-S ies- Hill climbing - B	epts, encoding, fitness function, steady state selections, Convergence programming- basic concepts. EARCHING STRATEGIES Backtracking - Graph search - Properti	reproduct re of GA	tion-Roulette wheel, , Applications of GA 9 algorithm -
Genetic algor Boltzmann, to case studies. Ir UNIT V Search Strateg Monotone rest	rithms basic conce urnament, rank, and ntroduction to genetic <b>AI-S</b> ies- Hill climbing - B riction - Specialized	epts, encoding, fitness function, steady state selections, Convergence programming- basic concepts. EARCHING STRATEGIES Backtracking - Graph search - Properti production systems - AO* algorithm.	reproduct e of GA	etion-Roulette wheel, , Applications of GA 9 algorithm -
Genetic algoi Boltzmann, to case studies. Ir UNIT V Search Strateg Monotone rest	rithms basic conce urnament, rank, and ntroduction to genetic <b>AI-S</b> ies- Hill climbing - B riction - Specialized	epts, encoding, fitness function, steady state selections, Convergence programming- basic concepts. EARCHING STRATEGIES Backtracking - Graph search - Properti production systems - AO* algorithm. Total P	reproductive of GA	tion-Roulette wheel, , Applications of GA 9 algorithm - 45
Genetic algoi Boltzmann, to case studies. Ir UNIT V Search Strateg Monotone rest	rithms basic conce urnament, rank, and ntroduction to genetic AI-S ies- Hill climbing - B riction - Specialized ssessment Method	epts, encoding, fitness function, steady state selections, Convergence programming- basic concepts. EARCHING STRATEGIES Backtracking - Graph search - Properti production systems - AO* algorithm. Total P	reproduct e of GA	tion-Roulette wheel, , Applications of GA 9 algorithm - 45
Genetic algoi Boltzmann, to case studies. Ir UNIT V Search Strateg Monotone rest Suggestive As Continuous A	rithms basic conce urnament, rank, and ntroduction to genetic AI-S ies- Hill climbing - B riction - Specialized p ssessment Method Assessment Test	epts, encoding, fitness function, steady state selections, Convergence programming- basic concepts. EARCHING STRATEGIES Backtracking - Graph search - Properti production systems - AO* algorithm. Total P s Formative Assessment Test	reproduction of GA	etion-Roulette wheel, , Applications of GA 9 algorithm - 45 mester Exams
Genetic algoi Boltzmann, to case studies. Ir UNIT V Search Strateg Monotone rest Suggestive As Continuous A (30 Ma	rithms basic conce urnament, rank, and ntroduction to genetic AI-S ies- Hill climbing - B riction - Specialized ssessment Method Assessment Test rks)	epts, encoding, fitness function, steady state selections, Convergence programming- basic concepts. EARCHING STRATEGIES Backtracking - Graph search - Properti production systems - AO* algorithm. Total P s Formative Assessment Test (10 Marks)	reproduct e of GA les of A* Periods End Set (60 Ma	tion-Roulette wheel, , Applications of GA 9 algorithm - 45 mester Exams rks)
Genetic algor Boltzmann, to case studies. Ir UNIT V Search Strateg Monotone rest Suggestive As Continuous A (30 Ma 1.Description	rithms basic conce urnament, rank, and ntroduction to genetic AI-S ies- Hill climbing - B riction - Specialized p ssessment Method Assessment Test rks) n Questions	epts, encoding, fitness function, steady state selections, Convergence programming- basic concepts. EARCHING STRATEGIES Backtracking - Graph search - Properti production systems - AO* algorithm. Total P s Formative Assessment Test (10 Marks) 1.Assignment	reproduction repro	etion-Roulette wheel, , Applications of GA 9 algorithm - 45 mester Exams rks) ription Questions
Genetic algoi Boltzmann, to case studies. Ir UNIT V Search Strateg Monotone rest Suggestive As Continuous A (30 Ma 1.Description 2.Formative	rithms basic conce urnament, rank, and ntroduction to genetic AI-S ies- Hill climbing - B riction - Specialized ssessment Method Assessment Test rks) n Questions Multiple choice	epts, encoding, fitness function, steady state selections, Convergence programming- basic concepts. EARCHING STRATEGIES Backtracking - Graph search - Properti production systems - AO* algorithm. Total P s Formative Assessment Test (10 Marks) 1.Assignment 2.Online Quizzes	reproduct re of GA des of A* Periods End Set (60 Ma 1.Desct 2.Form	tion-Roulette wheel, , Applications of GA 9 algorithm - 45 mester Exams rks) ription Questions hative Multiple
Genetic algor Boltzmann, to case studies. In UNIT V Search Strateg Monotone rest Suggestive As Continuous A (30 Ma 1.Description 2.Formative questions	rithms basic conce urnament, rank, and ntroduction to genetic AI-S ies- Hill climbing - B riction - Specialized p ssessment Method Assessment Test rks) n Questions Multiple choice	epts, encoding, fitness function, steady state selections, Convergence programming- basic concepts. EARCHING STRATEGIES Backtracking - Graph search - Properti production systems - AO* algorithm. Total P s Formative Assessment Test (10 Marks) 1.Assignment 2.Online Quizzes 3.Problem solving Activities	reproduct e of GA des of A* Periods End Set (60 Ma 1.Desct 2.Form choice	etion-Roulette wheel, , Applications of GA 9 algorithm - 45 mester Exams rks) ription Questions lative Multiple questions
Genetic algoi Boltzmann, to case studies. In UNIT V Search Strateg Monotone rest Suggestive As Continuous A (30 Ma 1.Description 2.Formative questions Outcomes	rithms basic conce urnament, rank, and ntroduction to genetic AI-S ies- Hill climbing - B riction - Specialized p ssessment Method Assessment Test rks) n Questions Multiple choice	epts, encoding, fitness function, steady state selections, Convergence programming- basic concepts. EARCHING STRATEGIES Backtracking - Graph search - Properti- production systems - AO* algorithm. Total P s Formative Assessment Test (10 Marks) 1.Assignment 2.Online Quizzes 3.Problem solving Activities	reproduct re of GA des of A* Periods End Set (60 Ma 1.Desct 2.Form choice	etion-Roulette wheel, , Applications of GA 9 algorithm - 45 mester Exams rks) ription Questions lative Multiple questions
Genetic algor Boltzmann, to case studies. In UNIT V Search Strateg Monotone rest Suggestive As Continuous A (30 Ma 1.Description 2.Formative questions Outcomes	rithms basic conce urnament, rank, and ntroduction to genetic AI-S ies- Hill climbing - B riction - Specialized j ssessment Method Assessment Test rks) n Questions Multiple choice	epts, encoding, fitness function, steady state selections, Convergence programming- basic concepts. EARCHING STRATEGIES Backtracking - Graph search - Properti production systems - AO* algorithm. Total P S Formative Assessment Test (10 Marks) 1.Assignment 2.Online Quizzes 3.Problem solving Activities	reproduct e of GA des of A* Periods End Set (60 Ma 1.Desct 2.Form choice	etion-Roulette wheel, , Applications of GA 9 algorithm - 45 mester Exams rks) ription Questions lative Multiple questions
Genetic algoi Boltzmann, to case studies. In UNIT V Search Strateg Monotone rest Suggestive A Continuous A (30 Ma 1.Description 2.Formative questions Outcomes Upon comple CO704. 1	rithms basic conce urnament, rank, and ntroduction to genetic <b>AI-S</b> ies- Hill climbing - B riction - Specialized p ssessment Method Assessment Test rks) n Questions Multiple choice	epts, encoding, fitness function, steady state selections, Convergence programming- basic concepts. EARCHING STRATEGIES Backtracking - Graph search - Properti production systems - AO* algorithm. Total P S Formative Assessment Test (10 Marks) 1.Assignment 2.Online Quizzes 3.Problem solving Activities	reproduct re of GA des of A* Periods End Set (60 Ma 1.Desct 2.Form choice	tion-Roulette wheel, , Applications of GA 9 algorithm - 45 mester Exams rks) ription Questions lative Multiple questions
Genetic algon Boltzmann, to case studies. In UNIT V Search Strateg Monotone rest Suggestive A Continuous A (30 Ma 1.Description 2.Formative questions Outcomes Upon comple CO704. 1	rithms basic conce urnament, rank, and ntroduction to genetic <b>AI-S</b> ies- Hill climbing - B riction - Specialized p ssessment Method Assessment Test rks) n Questions Multiple choice etion of the course, Develop application Neural network	epts, encoding, fitness function, steady state selections, Convergence programming- basic concepts. EARCHING STRATEGIES Backtracking - Graph search - Propertiproduction systems - AO* algorithm. Total P S Formative Assessment Test (10 Marks) 1.Assignment 2.Online Quizzes 3.Problem solving Activities the students will be able to: n on different soft computing technique	reproduct e of GA des of A* Periods End Set (60 Ma 1.Descr 2.Form choice	tion-Roulette wheel, , Applications of GA 9 algorithm - 45 mester Exams rks) ription Questions lative Multiple questions
Genetic algoi Boltzmann, to case studies. In UNIT V Search Strateg Monotone rest Suggestive A Continuous A (30 Ma 1.Description 2.Formative questions Outcomes Upon comple CO704. 1	rithms basic conce urnament, rank, and ntroduction to genetic <b>AI-S</b> ies- Hill climbing - B riction - Specialized p ssessment Method Assessment Test rks) n Questions Multiple choice etion of the course, Develop application Neural network Understand Neural	epts, encoding, fitness function, steady state selections, Convergence programming- basic concepts. EARCHING STRATEGIES Backtracking - Graph search - Properti- production systems - AO* algorithm. Total P S Formative Assessment Test (10 Marks) 1.Assignment 2.Online Quizzes 3.Problem solving Activities the students will be able to: n on different soft computing technique Networks	reproduct e of GA des of A* Periods End Set (60 Ma 1.Desct 2.Form choice	tion-Roulette wheel, , Applications of GA 9 algorithm - 45 mester Exams rks) ription Questions lative Multiple questions
Genetic algor Boltzmann, to case studies. In UNIT V Search Strateg Monotone rest Suggestive A Continuous A (30 Ma 1.Description 2.Formative questions Outcomes Upon comple CO704. 1 CO704. 2 CO704. 3	rithms basic conce urnament, rank, and ntroduction to genetic <b>AI-S</b> ies- Hill climbing - B riction - Specialized p ssessment Method Assessment Test rks) n Questions Multiple choice etion of the course, Develop application Neural network Understand Neural Implement-Fuzzy a	epts, encoding, fitness function, steady state selections, Convergence programming- basic concepts. EARCHING STRATEGIES Backtracking - Graph search - Properti- production systems - AO* algorithm. Total P S Formative Assessment Test (10 Marks) 1.Assignment 2.Online Quizzes 3.Problem solving Activities the students will be able to: n on different soft computing technique Networks nd Neuro-Fuzzy	reproduction of GA ies of A* Periods End Set (60 Ma 1.Descr 2.Form choice	tion-Roulette wheel, , Applications of GA 9 algorithm - 45 mester Exams rks) ription Questions ative Multiple questions
Genetic algon Boltzmann, to case studies. In UNIT V Search Strateg Monotone rest Suggestive A Continuous A (30 Ma 1.Description 2.Formative questions Outcomes Upon comple CO704. 1 CO704. 2 CO704. 3 CO704. 4	rithms basic conce urnament, rank, and ntroduction to genetic <b>AI-S</b> ies- Hill climbing - B riction - Specialized p ssessment Method Assessment Test rks) n Questions Multiple choice etion of the course, Develop application Neural network Understand Neural Implement-Fuzzy a Implement GA Exp	epts, encoding, fitness function, steady state selections, Convergence programming- basic concepts. EARCHING STRATEGIES Backtracking - Graph search - Properti- production systems - AO* algorithm. Total P s Formative Assessment Test (10 Marks) 1.Assignment 2.Online Quizzes 3.Problem solving Activities the students will be able to: n on different soft computing techniqu Networks nd Neuro-Fuzzy pert system	reproduct e of GA des of A* Periods End Set (60 Ma 1.Desct 2.Form choice	tion-Roulette wheel, , Applications of GA 9 algorithm - 45 mester Exams rks) ription Questions lative Multiple questions

#### **Text Books**

- 1. L. Fausett, Fundamentals of Neural Networks, Prentice Hall
- 2. T. Ross, Fuzzy Logic with Engineering Applications, Tata McGraw Hill

#### **Reference Books**

- 1. Haykin, S.S., Neural Networks and Learning Machines, 3rd ed., PHI Learning, 2013.
- 2. Ross, T.J., Fuzzy Logic with Engineering Applications, 3rd ed., JohnWiley& Sons, 2013

#### Web Resources

- <u>https://nptel.ac.in/courses/106/105/106105173/</u>
- <u>https://onlinecourses.nptel.ac.in/noc21\_cs11/preview</u>
- https://nptel.ac.in/courses/106/106/106106184/

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	3						2	1	1	2	
2	3	3	3	3	3						2	1	2		3
3	3	3	3	3	3						2	1			
4	3	3	3	3	3						2	1		2	1
5	3	3	3	3	3						2	1	3	1	

## List of Professional Electives II

S.No	Course Code	Course Name	Seme ster	L	Т	Р	С
1	21CS2701	Advanced Wireless Sensor Networks	II	3	0	0	3
2	21CS2702	Massive MIMO and Millimeter Wave Communication	II	3	0	0	3
3	21CS2703	MIMO OFDM Systems	II	3	0	0	3
4	21CS2704	Space Time Wireless Communication	II	3	0	0	3

21CS2701

ADVANCED WIRELESS SENSOR NETWORKS

L	Т	Р	С
3	0	0	3

Prerequisites for the course

<u>F</u> 1	<u>rancis Xavier Engine</u> Curriculum	eering College  Dept of ECE   M.E- C and Syllabi 2021  Amendment 202	<u>S   R201</u> 2	91
•	The pre-requisite k	powledge required by the Students	to study	this Course is basic
·	knowledge in Wirele	ess networks computer networks Ne	tworking	this course is busic
Objectives	knowledge in where	255 networks, computer networks, ive	tworking	
		·		
$\begin{array}{c} 1.  10 \text{ Ana} \\ 2  \text{Te Class} \end{array}$	lyse the MAC issues	in wireless sensor networks	tion	
2.10 Class	ign sensor network	e operation of the fouring and localiza	uon	
4 To anal	lyse self-configuratio	n and auto configuration in mesh net	works	
5. To ider	tify the necessity of I	heterogeneous and vehicular mesh ne	tworks	
UNIT I	V V	VIRELESS NETWORKS		9
Introduction – protocols, Mul	- Issues in Wireless ti-channel MAC	s Networks. MAC Protocols – Is	sues, Cla	assifications of MAC
UNIT II	NET	WORK ROUTING & TCP		9
Issues -	- Classifications of r	outing protocols – Hierarchical and	Power aw	are. Multicast routing
<ul> <li>Classificatio</li> <li>based, TCP Bu</li> </ul>	ns, Tree based, Mes Is.	sh based. Transport Layer Issues. T	CP Over	Ad Hoc – Feedback
UNIT III		WSN -MAC		9
Introduction – organizing, Hy	Sensor Network Ar	chitecture, Data dissemination, Gatl and CSMA.	nering. N	IAC Protocols – self-
UNIT IV	WSN ROU	<b>UTING, LOCALIZATION &amp; QOS</b>		9
Issues in WSN	routing – Indoor and	Sensor Network Localization. QoS	in WSN.	
UNIT V		MESH NETWORKS		9
Necessity for	Mesh Networks – I	MAC enhancements – IEEE 803.1	ls Archit	ecture –Opportunistic
routing - Self	configuration and A	Auto configuration – Capacity Mode	ls – Fair	ness – Heterogeneous
Mesh Network	s – Vehicular Mesh I	Networks.		
		Total I	Periods	45
Suggestive A	ssessment Method	S		
Continuous A (30 Ma	Assessment Test rks)	Formative Assessment Test (10 Marks)	End Se (60 Ma	mester Exams rks)
1.Description 2.Formative questions	n Questions Multiple choice	1.Assignment 2.Online Quizzes 3.Problem solving Activities	1.Desc 2.Form choice	ription Questions ative Multiple questions
Outcomes				
Upon comple	tion of the course,	the students will be able to:		
CO701. 1	Analyse the MAC i	ssues in wireless sensor networks		
CO701.2	Classify and describ	be the operation of the routing and lo	calization	l
CO701.3	Design sensor netw	ork for indoor applications		
CO701.4	Analyseself-configu	aration and auto configuration in mes	h networ	ks
CO701. 5	Identify the necessi	ty of heterogeneous and vehicular me	esh netwo	orks
Text Books				
1. C.Siva Protoc 2. Feng Publis	Ram Murthy and colsII, Pearson Educa Zhao and Leonida hers, 3004.	B.S. Manoj, —Ad Hoc Wireless N ation, 3004. as Guibas, —Wireless Sensor No	letworks etworks	– Architectures and , Morgan Kaufman
Reference Bo	ooks			

- 1. C.K.Toh, —Ad Hoc Mobile Wireless Networksl, Pearson Education, 3003.
- 2. Thomas Krag and SebastinBuettrich, —Wireless Mesh Networkingl, O'Reilly Publishers, 3007

#### Web Resources

- <u>https://nptel.ac.in/courses/106/105/106105160/</u>
- https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs09/

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3			1				3	3	3	1	2	
2	3	3	3	1	3				3		3	3	2		3
3	3	1	1		3					3	1	3		2	
4	3	3	3		3			1		3	3	3			1
5	3	3	3	1						3	3	3	3	1	2

21CS2702	MASSIVE MIMO AND MILLIMETER WAVE	L	T	Р	C
210.02702	COMMUNICATION	3	0	0	3
Prerequisi	es for the course			•	
• The j	re-requisite knowledge required by the Students to study this Course	e is ba	sic k	nowle	edge in
Adva	nced Wireless Communication.				
Objectives					
1. T	o understand the principles and challenges involved in the desig	n of	Mas	sive 1	MIMO
S	vstems.				
2. T	o understand the propagation aspects of Millimeter wave signals ar	nd the	func	lamen	tals of
Ν	fillimeter wave devices and circuits.				
3. T	o understand the various components of Millimeter wave MIMO sys	tems.			
4. T	o understand the Millimeter wave communication systems.				
5.	o understand the Millimeter wave MIMO systems.				
UNIT I	INTRODUCTION			9	
MIMO wire	ess communication- MIMO channel and signal model- A fundame	ental 1	rade	-off- ]	MIMO
transceiver c	esign- MIMO in wireless networks- Large MIMO systems: Opport	unitie	s in I	large ]	MIMO
systems- Ch	nnel hardening in large dimensions- Technological challenges and s	olutio	n ap	proacl	nes.
UNIT II	MIMO ENCODING AND DETECTION			9	
Spatial mult	plexing- Space-time coding: Space-time block codes, High-rate N	O-ST	BCs,	NO-S	STBCs
from CDAs	Spatial modulation: SM, SSK, GSM- MIMO detection- Optim	um c	letec	tion-	Linear
detection- In	terference cancelation-LR-aided linear detection				
UNIT III	mmWAVE PROPAGATION			9	

<u>Francis Xavier Engineering College  Dept of ECE   M.E- CS   R2019  </u> <u>Curriculum and Syllabi 2021  Amendment 2022</u>										
Millimeter wave characteristics- n	Millimeter wave characteristics- millimeter wave wireless, implementation challenges, Radio wave									
propagation for mm wave: Large	scale propagation channel effects	, small scale channel effects,								
Outdoor and Indoor channel models, Emerging applications of millimeter wave communications.										
UNIT IVmmWAVE COMMUNICATION SYSTEMS9										
Modulations for millimeter wave c	ommunications: OOK, PSK, FSK, Q	AM, OFDM, Millimeter wave								
link budget, Transceiver archited	cture, Transceiver without mixer,	Receiver without Oscillator,								
millimeter wave calibration, produc	tion and manufacture, Millimeter wa	ve design considerations								
UNIT V mm	WAVE MIMO SYSTEMS	9								
Massive MIMO Communications,	Spatial diversity of Antenna Arrays	s, Multiple Antennas, Multiple								
Transceivers, Noise coupling in M	AIMO system, Potential benefits for	or mm wave systems, Spatial,								
Temporal and Frequency divers	sity, Dynamic spatial, frequency	and modulation allocation,								
Beamforming for MmWave comm	nunications: Analogbeamforming, di	gital beamforming and hybrid								
Beamforming.										
	Total F	Periods 45								
Suggestive Assessment Method	S									
<b>Continuous Assessment Test</b>	Formative Assessment Test	End Semester Exams								
(30 Marks)	(10 Marks)	(60 Marks)								
<b>1.Description Questions</b>	1.Assignment	<b>1.Description Questions</b>								
2.Formative Multiple choice	2.Online Quizzes	2.Formative Multiple								
questions	3.Problem solving Activities	choice questions								
Outcomes										
Upon completion of the course,	the students will be able to:									
CO702. 1 Ability to apprec	ciate Massive MIMO: characteri	stics and implementation								
challenges.										
CO702. 2 Understand the need	d and impact of different detection ap	proaches.								
CO702. 3 Understand the need	d and impact of different precoding a	pproaches.								
CO702. 4 Ability to character	ize propagation issues at Millimeter v	vave frequencies.								
CO702. 5 Ability to estimate l	ink budget and identity Millimeter w	ave devices and circuits								
Specifications.										
Text Books										
1. Chockalingam and B. Su	ndarRajan, "Large MIMO Syste	ms ", Cambridge University								
Press, 2014.										
2. EzioBiglieri, Robert C	alderbank, Anthony Constanti	nides, Andrea Goldsmith,								
ArogyaswamiPaulraj, Vir	cent Poor, "MIMO Wireless Co	ommunications", Cambridge								
University Press, 2006.										
3. T.S. Rappaport, R.W. He	eath Jr., R.C. Daniels and J.N.	Murdock, "Millimeter Wave								
Wireless Communications	: Systems and Circuits", 2015.									
Reference Books										
1. I. Robertson, N. Somjit an	d M. Chongcheawchamnan, "Mic	rowave and Millimetre-Wave								
Design for Wireless Comm	1. 1. Robertson, N. Somjit and M. Chongcheawchamhan, "Microwave and Millimetre-Wave Design for Wireless Communications" 2016									
2. AlxelJantsch, "Modeling Embedded Systems and SOC's. Concurrency and Time in										
2. AlxelJantsch, "Modeling Embedded Systems and SOC's. Concurrency and Time in										
Models of Computation", 1	Embedded Systems and SOC's. MK, 2004.	Concurrency and Time in								
Models of Computation", I 3. K.C. Huang, Z. Wang, "N	funications", 2016. Embedded Systems and SOC's. MK, 2004. Aillimeter Wave Communication S	Concurrency and Time in Systems", Wiley-IEEE Press,								

## 2011.

- 4. Robert W. Heath, Robert C. Daniel, James N. Theodore S. Rappaport, Murdock,"Millimeter Wave Wireless Communication", Prentice Hall, 2014.
- 5. Xiang, W; Zheng, K; Shen, X.S; "5G Mobile Communications", Springer, 2016

## Web Resources

- <u>https://nptel.ac.in/courses/117/105/117105139/</u>
- <u>https://onlinecourses.nptel.ac.in/noc21\_ee12/preview</u>

# CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3							1	3	1		
2	3	3	3	3							1	3			3
3	3	3	3	3							1	3	3	2	
4	3	3	3	3							1	3		2	1
5	3	3	3	3							1	3	3		2
6	3	3	3	3							1	3	1	2	

## MIMO OFDM SYSTEMS

L	Т	Р	С
3	0	0	3

## Prerequisites for the course

• The pre-requisite knowledge required by the Students to study this Course is basic knowledge in Wireless Communication.

## Objectives

- 1. To describe the concepts of MIMO OFDM Wireless communication systems.
- 2. To determine the capacity of MIMO OFDM system for a given power delay profile of the MIMO channel
- 3. To study the SISO and MIMO channel model
- 4. To Estimate the channel impulse response using least square, MMSE and Robust MMSE estimation algorithms
- 5. To Estimate and correct the timing and frequency offset in the signal received in the MIMO OFDM receivers and Analyze the performance of MIMO OFDM physical channel in Wi-Max/LTE wireless standards.

UNIT IST CHANNEL AND SIGNAL MODELS9Introduction-physical scattering model for ST channels,Extended channel models, Statistical propertiesof H, Sampled Signal model for SISO, SIMO, MISO and MIMO,ST multiuser and ST interferencechannels, ST channel estimation

UNIT II	CAPACITY OF WIRELESS CHANNELS	9

<u>Francis Xavier Engineering College  Dept of ECE   M.E- CS   R2019  </u> Curriculum and Syllabi 2021  Amendment 2022										
AWGN channel capacity-Resources of AWGN Channel, Linear time invariant guassian channels.										
Capacity of fading channels.		- III v ui iu	int gaussian chamicis,							
UNIT III SISO AN	D MIMO CHANNEL MODELS		9							
SISO channel models-Indoor and o	utdoor models. MIMO channel mode	els-Statis	tical MIMO model, 1-							
METRO MIMO, SCM MIMO channel model.										
UNIT IV OFDM A	AND ITS SYNCHRONIZATION		9							
Single Carrier Vs Multi Carrier Transmission, Basic principle of OFDM, OFDMA, Effect and										
Estimation Techniques for STO and	I CFO.									
UNIT V C	HANNEL ESTIMATION		9							
Pilot structure, Training symbol ba	sed channel estimation, DFT based	and Deci	ision directed Channel							
estimation.Advanced channel estim	ation techniques.									
	Total F	eriods	45							
Suggestive Assessment Method	S									
Continuous Assessment Test	Formative Assessment Test	End Se	mester Exams							
	(10 Marks)									
1.Description Questions	1.Assignment	1.Desc	ription Questions							
2.Formative Multiple choice	2.011111111111122285 3 Problem solving Activities	choice questions								
questions	5.1 1 Oblem Solving Activities	choice	questions							
Outcomes										
Upon completion of the course,	the students will be able to:	<b>6</b> MI								
CO703. 1 The student would	be able to analyze the complexity	OT MII	MO OFDM spatial							
CO702 2 The student would	tis.	anity of	f SISO and SIMO							
systems	t be able to study the channel ca	Jacity Of								
CO703 3 The student would l	$\mathbf{x}$ able to analyze the SISO and MIN	[O mode]	le							
CO703 4 The student would l	be able to fundamentals of OFDM an	d Its syn	chronization							
CO703. 5 The student would l	be able to analyse the channel estimate	tion tech	niques							
Text Books										
1. Chockalingam and B. Su	ndarRaian, "Large MIMO Syste	ms ". C	ambridge University							
Press, 2014.		, , ,								
2. EzioBiglieri, Robert C	alderbank, Anthony Constanti	nides.	Andrea Goldsmith,							
ArogyaswamiPaulraj, Vir	icent Poor, "MIMO Wireless Co	ommuni	cations", Cambridge							
University Press, 2006.										
T.S. Rappaport, R.W. H	eath Jr., R.C. Daniels and J.N.	Murdocl	k, "Millimeter Wave							
Wireless Communications	: Systems and Circuits", 2015.		,							
Reference Books	•									
1. Robertson, N. Somjit	and M. Chongcheawchamnan, "	Microw	ave and Millimetre-							
Wave Design for Wirel	ess Communications", 2016.									
2. AlxelJantsch, "Modeli	ng Embedded Systems and SOC'	s. Concu	urrency and Time in							
Models of Computation	n", MK, 2004.									
3. K.C. Huang, Z. Wan	g, "Millimeter Wave Communic	ation Sy	stems", Wiley-IEEE							
Press, 2011.										
		_								

- 4. Robert W. Heath, Robert C. Daniel, James N. Theodore S. Rappaport, Murdock,"Millimeter Wave Wireless Communication", Prentice Hall, 2014.
- 5. Xiang, W; Zheng, K; Shen, X.S; "5G Mobile Communications", Springer, 2016

## Web Resources

- <u>https://nptel.ac.in/courses/117/104/117104115/</u>
- https://nptel.ac.in/noc/courses/noc17/SEM2/noc17-ee19/

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3							1	3	1	2	
2	3	3	3	3							1	3	2		3
3	3	3	3	3							1	3	3		
4	3	3	3	3							1	3		2	1
5	3	3	3	3							1	3	3		

21CS2704	SPACE TIME WIRELESS COMMUNICATION	L	Т	Р	С				
21002704		3	0	0	3				
Prerequisites	s for the course								
• The pre	-requisite knowledge required by the Students to study this Course	e is ba	sic k	nowle	dge in				
advance	ed wireless communication and advanced wireless sensor network.	•							
Objectives									
1. Tou	understand the multipath fading channel models.								
2. To a	analysis the channel capacity and bit error rate.								
3. To u	understand the spatial diversity at transmitter and receiver.								
4. To u	understand channel estimation and timing & frequency synchronization	ation.							
5. To a	analysis analyze OFDM & Spread Spectrum modulation.								
UNIT I	SAMPLED SIGNAL AND MULTIPATH FADING			9					
	CHANNEL MODELS								
Physical scatte	ring models - Extended channel models -Signal model for SISO	) - SII	MO ·	- MIS	O and				
MIMO- ITU C	hannel Models - 3GPP Channel Models - Extended ITU Models- S	Spatia	l Cha	annel	Model				
SCM Extension	n Channel Model - WINNER Channel Model.								
UNIT II	CAPACITY ANALYSIS & BIT ERROR RATE			9					
Conceity in En	ANALYSIS	Fadin			DED				
Capacity in Fre	equency Flat Fading channel - Capacity in Frequency Selective	Fadin	g Cn		- BEK				
Analysis for Sp	bace Time Coding - Transmit Beam forming - Receiver Selection	Comb	oining	g - Re	ceiver				
Equal Combini	ng - Receiver Maximal Ratio Combining.								
UNIT III	SPATIAL DIVERSITY AT TRANSMITTER AND 9 RECEIVER 9								
		•							

<u>Francis Xavier Engine</u> <u>Curriculum</u>	eering College  Dept of ECE   M.E- C and Syllabi 2021  Amendment 202	<u>S   R2019</u> 22	9 [						
Diversity gain - Transmit and recei	ve Antenna diversity - Diversity orde	er and per	formance - Combined						
space and path diversity- Indirect	transmit diversity - space time codin	g for free	quency flat channels -						
frequency selective channels - Rec	eivers – frequency flat and selective	e channel	s in SISO, SIMO and						
MIMO.	1								
UNIT IV CHANNE	L ESTIMATION AND TIMING &		9						
FREQU	JENCY SYNCHRONIZATION								
LS Estimation - MMSE Estimation	n - Robust MMSE Estimation -Coars	se Time S	Synchronization - Fine						
Time Synchronization - Coarse Frequency Synchronization - Fine Frequency Synchronization.									
UNIT V OFDM AND S	PREAD SPECTRUM MODULAT	ION	9						
SISO-OFDM - MIMO OFDM - S	ISO SS modulation - MISO SS mod	ulation -	Model - capacity and						
receiver gain of MIMO MAC - MI	MO BC - MIMO MU.								
	Total I	Periods	45						
Suggestive Assessment Method	S								
Continuous Assessment Test	Formative Assessment Test	End Ser	mester Exams						
(30 Marks)	(10 Marks)	(60 Ma	rks)						
1.Description Questions	1.Assignment	1.Desci	ription Questions						
2.Formative Multiple choice	2.Online Quizzes	2.Form	ative Multiple						
questions	3.Problem solving Activities	choice	questions						
Outcomes	l								
Upon completion of the course	, the students will be able to:								
CO704. 1 Model multipath ch	annel for wireless systems.								
CO704. 2 Analyze channel ca	pacity and BER of wireless commun	ication sy	vstems.						
CO704. 3 Apply diversity tec	hniques at transmitters and receivers.								
CO704. 4 Estimate channels	using equalizer algorithms.								
CO704. 5 Analyze OFDM &	Spread Spectrum modulation.								
Text Books									
1. Paulraj, R. Nabar and D	Gore, "Introduction to Space-Time	e Wireles	ss Communications",						
Cambridge University Pre	ess,2003.								
2. E. Biglieri, R. Calderbank	, A. Constantinides, A. Goldsmith,	A. Paulr	aj, ''MIMO Wireless						
Communications", Camb	ridge.								
<b>Reference Books</b>									
1. Erik. G. Larsson, "	Space Time Block Coding for	Wireless	6 Communications",						
Cambridge University	Press, 2008.								
2. Y.S.Cho, J.Kim, Wor	n Young Yang, Chung G. Kang	, "MIM	O OFDM Wireless						
Communications with	MATLAB", John Wiley &sons(As	a) privat	te Ltd, 2010.						
3. L. Hanzo, Y.A. Li Wa	ang, M. Jiang "MIMO-OFDM for	· LTE, V	Vi-Fi and WiMAX",						
John Wiley & Sons Lte	d, 2011.								
Web Resources									
<ul> <li><u>https://nptel.ac.in/content/st</u></li> </ul>	orage2/courses/117104115/Assignme	ent_4Wire	eless.pdf.						
<ul> <li><u>https://www.youtube.com/watch?v=Fy9wOF2M-oE</u>.</li> </ul>									
<u>https://nptel.ac.in/courses/1</u>	17/105/117105132/.								
CO Vs PO Mapping and CO Vs PSC	) Mapping								

	<u>Francis Xavier Engineering College  Dept of ECE   M.E- CS   R2019  </u> Curriculum and Syllabi 2021  Amendment 2022														
CO	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1		1				2	1	2		2	
2	3	2	1	1		1				2	1	2	2		3
3	3	2	2	1		1				2	1	2		2	
4	3	2	1	1		1				2	1	2			1
5	3	2	2	1		1				2	1	2	3	1	2
4 5	3	2 2	1 2	1		1				2 2	1	2 2	3	1	1 2

#### List of Professional Electives III

S.No	Course	Course Name	Seme	L	Т	Р	C
	Code		ster				
1	21CS2705	Software andCognitive Radio Systems	II	3	0	0	3
2	21CS2706	Modern IOT	II	3	0	0	3
3	21CS2707	Real Time Embedded Systems	II	3	0	0	3
4	21CS2708	Smart Antennas	II	3	0	0	3

21CS2705	SOFTWARE AND COGNITIVE RADIO SYSTEMS	L	Т	Р	C					
		3	0	0	3					
Prerequisites	for the course									
• The pre-requisite knowledge required by the Students to study this Course is basic knowledge in										
Cognitive Radio.										
Objectives										

Francis Xavier Engine	eering College   Dept of ECE   M.E- C	<u>S   R201</u>	91					
	and Syllabl 2021 Amendment 202	<u>∠</u>						
1. To apply and implement the	e design methodologies in the wireless	applicat	ions.					
2. To learn about software defined and the architecture	ined radio and cognitive radio systems	8.						
4. To understand the OFDM D	Dynamic Spectrum Access.							
5. To learn about the application	on of cognitive radio.							
UNIT I	SOFTWARE RADIO		9					
Evolution- architecture perspect	ives- Software radio concepts-SDR	front en	nd technology:					
Transmitter specifications- Rece	eiver specifications- operating freq	uency b	ands- receiver					
design considerations- transmitte	er design considerations- Candidate	architec	ture for SDR-					
Multimode SDR architecture.								
UNIT II	COGNITIVE RADIO		9					
Introduction to cognitive radios -	economics of cognitive radio-spectru	m aware	ness, spectrum					
subleasing, spectrum sharing-	cognitive networks: motivation &r	equireme	ents-foundation					
&related works in cognitive radio	- cognitive radio implementation.							
UNIT III COGNI	TIVE RADIO ARCHITECTURE		9					
SDR technology underlying cog	nitive radio- CR architecture- CR c	omponer	nts- CR design					
rules- cognitive cycle- building	g cognitive radio on SDR architec	ture- fu	ture directions					
Software based radio architectur	re for Cognitive radio-SDR & Cogn	itive rela	tionship, ideal					
SDR architecture, realistic SDF	R architecture. Software tunableanal	log radio	o components-					
antenna systems-reconfigurable	digital radio technologies: economic	value 1	nodel-example					
scenarios.								
UNIT IV DYN.	AMIC SPECTRUM ACCESS		9					
Centralized dynamic spectrum ac	ccess - Distributed dynamic spectrum	access -	Coexistence of					
dissimilar secondary radio system	ns-impact of QoS& interference-code	s for dyn	amic spectrum					
access- coexistence & access pi	roblems in Cognitive radios-spectrum	n sensin	g methods for					
Cognitive radios- spectrum sensit	ng in current wireless standards- Cog	nitive Ol	FDM standards					
and technologies. 802.11 AD star	ndard a case study.							
UNIT V COGNI	TIVE RADIO APPLICATIONS		9					
Cognitive radios in wireless comr	nunication- Mobility management- l	ocation (	estimation & sensing					
UWB Cognitive radio.								
	Total P	eriods	45					
Suggestive Assessment Method	s							
Continuous Assessment Test	Formative Assessment Test	End Se	mester Exams					
(30 Marks)	(10 Marks)	(60 Ma	rks)					
1.Description Questions	1.Assignment	1.Desc	ription Questions					
2.Formative Multiple choice 2.Online Quizzes 2.Formative Multiple Suestions 3.Problem solving Activities choice questions								
questions	3.Problem solving Activities	choice	questions					
Outcomes								
Upon completion of the course,	, the students will be able to:							
	ture of Software and Cognitive Radio	Systems						
CO705. 1 Design the architec								
CO705. 1 Design the architec CO705. 2 Analyze the perform	mance of Cognitive Radio Systems							
CO705. 1 Design the architec CO705. 2 Analyze the perform CO705. 3 Apply the spectrum	mance of Cognitive Radio Systems a sensing and Cognitive Radio archited	cture.						
<ul><li>CO705. 1 Design the architec</li><li>CO705. 2 Analyze the perform</li><li>CO705. 3 Apply the spectrum</li><li>CO705. 4 Access the spectrum</li></ul>	mance of Cognitive Radio Systems a sensing and Cognitive Radio archited and dynamically through centralized	cture. and dis	tributed manner in					

CO705. 5 Identify the applications of Cognitive Radio Systems.

## Text Books

- 1. EkramHossain, DusitNiyato, Zhu Han, "Dynamic Spectrum Access and Management in Cognitive Radio Networks", Cambridge University Press, First Edition, 2009.
- 2. Kwang-Cheng Chen, Ramjee Prasad, "Cognitive Radio Networks", John Wiley & Sons Ltd., First Edition, 2009.

#### **Reference Books**

- 1. Bruce Fette, "Cognitive Radio Technology", Elsevier, Second Edition, 2009.
- 2. HuseyinArslan, "Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems", Springer, First Edition, 2007.
- 3. Francisco Rodrigo Porto Cavalcanti, SorenAndersson "Optimizing Wireless Communication Systems" Springer, First Edition, 2009.
- 4. Linda Doyle, "Essentials of Cognitive Radio", Cambridge University Press, First Edition, 2009

## Web Resources

- 1. http://www.springer.com/engineering/signals/book/978-1-4020-5541-6
- 2. <u>http://www.cept.org/ecc/topics/cognitive-radio-systems-and-software-defined-radio</u>

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2		1	1					2	2	2	1	2	
2	2	2	1	2	2					2			2		3
3	2	1	1	2	2	1				2	2	2		2	
4	2	1	3	2	1	1				2	2	2			1
5	2	2	1	2	2	1				1	2	2	3	1	2

21CS2706	MODERN IOT	L	Т	Р	C
1001/00		3	0	0	3
Prerequisite	s for the course		L		
• The pro	e-requisite knowledge required by the Students to study this Co	ourse is ba	sic k	nowle	edge in
Embed	ded Systems				

Objectives

- 1. Assess the genesis and impact of IoT applications, architectures in real world.
- 2. Illustrate diverse methods of deploying smart objects and connect them to network.
- 3. Compare different Application protocols for IoT.
- 4. Infer the role of Data Analytics and Security in IoT.
- 5. Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry.

UNIT I	INTRODUCTION TO IOT ARCHITECTURES	9
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Francis Xavier Engineering	College	Dept of	f ECE	M.E-CS	R2019
<u>Curriculum and S</u>	yllabi 20	)21  Am	<u>endm</u>	<u>ent 2022</u>	

Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.

UNIT II	IOT S	ENSORS AND ACTUATORS		9
Smart Objects	: The "Things" in	IoT, Sensors, Actuators, and Sma	ırt Objec	ts, Sensor Networks,
Connecting Sn	nart Objects, Commu	nications Criteria, IoT Access Techn	ologies.	
UNIT III	IOT CO	MMUNICATION PROTOCOLS		9
IP as the Id	oT Network Layer,	The Business Case for IP, The	need for	Optimization,
Optimizing	IP for IoT, Profile	s and Compliances, Application F	rotocols	for IoT, The
Transport La	yer, IoT Application	Transport Methods		
UNIT IV	IMPACT	OF IOT ON DATA ANALYITICS		9
Data and Anal	ytics for IoT, An In	troduction to Data Analytics for IoT	, Machir	ne Learning, Big Data
Analytics Tool	s and Technology, E	dge Streaming Analytics, Network A	nalytics,	Securing IoT, A Brief
History of OT	Security, Common	Challenges in OT Security, How IT	and OT	Security Practices and
Systems Vary	, Formal Risk Anal	sis Structures: OCTAVE and FAI	R, The F	Phased Application of
Security in an	Operational Environ	nent		
UNIT V	DESIGNING IC	T APPLICATIONS USING ARD	JINO	9
		AND RASPBERRY PI		
IoT Physical	Devices and Endpo	vints - Arduino UNO: Introductior	ı to Ard	uino, Arduino UNO,
Installing the S	Software, Fundament	als of Arduino Programming. IoT Ph	ysical De	evices and Endpoints -
RaspberryPi: I	ntroduction to Raspb	erryPi, About the RaspberryPi Board	d: Hardw	are Layout, Operating
Systems on Ra	aspberryPi, Configur	ing RaspberryPi, Programming Rasp	oberryPi	with Python, Wireless
Temperature N	Monitoring System U	Jsing Pi, DS18B20 Temperature Ser	nsor, Cor	nnecting Raspberry Pi
via SSH, Acce	essing Temperature f	from DS18B20 sensors, Remote acc	ess to Ra	aspberryPi, Smart and
Connected Cit	ies, An IoT Strategy	for Smarter Cities, Smart City IoT A	chitectur	e, Smart City Security
Architecture, S	Smart City Use-Case	Examples.		
		Total F	<b>'</b> eriods	45
Suggestive A	ssessment Method	S	-	
Continuous A (30 Ma	lssessment Test rks)	Formative Assessment Test (10 Marks)	End Se (60 Ma	mester Exams rks)
1.Description	n Questions	1.Assignment	1.Desc	ription Questions
2.Formative	Multiple choice	2.Online Quizzes	2.Form	ative Multiple
questions		3.Problem solving Activities	choice	questions
Outcomes				
Upon comple	ction of the course,	the students will be able to:		
CO706. 1	Interpret the impa	ct and challenges posed by IoT	network	s leading to new
	architectural model	S.		
CO706. 2	Compare and cont	rast the deployment of smart object	ets and t	he technologies to
	connect them to net	work.		
CO706. 3	Appraise the role of	f IoT protocols for efficient network of	communi	cation.
CO706. 4	Elaborate the need	for Data Analytics and Security in Io	Г.	
CO706. 5	Illustrate different	sensor technologies for sensing real	world e	ntities and identify
	the applications of I	oT in Industry.		

#### Text Books

- 1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1 stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)
- 2. Srinivasa K G, "Internet of Things", CENGAGE Leaning India, 2017
- 3. ArshdeepBahga, Vijay Madisetti —Internet of Things A hands-on approach, Universities Press, 2015.

#### **Reference Books**

- 1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1 stEdition, VPT, 2014. (ISBN: 978-8173719547)
- 2. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224)

#### Web Resources

- 1. <u>https://onlinecourses.nptel.ac.in/noc21\_cs17/preview</u>
- 2. https://www.coursera.org/specializations/iot
- 3. https://www.edx.org/course/introduction-to-the-internet-of-things-iot

CO	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3		3	2				2		2	1	2	
2	3	3	3		3	2				2		2	2		3
3	3	3	3		3	2				2		2			
4	3	3	3		3	2				2		2		2	1
5	3	3	3		3	2				2		2	3	1	2

21CS2707	REAL TIME EMBEDDED SYSTEMS	L	Т	Р	С
		3	0	0	3
Prerequisit	es for the course				
• The p	re-requisite knowledge required by the Students to study this Course	e is ba	sic k	nowle	dge in
Micro	processors & Microcontrollers.				
Objectives					
1. T	o gain knowledge on popular embedded processors				
2. T	o understand the Networking in Embedded systems.				
3. T	o acquire essential skills for developing an embedded system.				
4. T	o understand the RTOS concepts in depth				
5. T	o develop skills in working with μc/OS–II RTOS				
UNIT I	EMBEDDED PROCESSORS			9	
Embedding (	Computers- Characteristics of Embedded Computing Applications- C	hallen	ges i	n Emb	edded
Computing	System-Performance in Embedded Computing- ARM process	or fu	ndan	nental	s and
architecture-	Registers-CPSR-Pipelining- Exceptions, Interrupts, and the Vector T	able-	ARM	1 instr	ruction

set - LPC 214x Family ARM pr	rocessor- Block diagram	& Features	-Peripherals - Introduction to Al	RM
9, ARM Cortex M3				

UNIT II	EM	BEDDED NETWORKING		9
Basic protocol	concepts- Port and B	us-based I/O – Memory mapped I/O &	& Standar	d I/O- Microprocessor
interfacing: Int	errupts, DMA - Arbit	ration - Serial protocols: I <sup>2</sup> C, CAN, E	thernet, F	ieldbus, USB- Parallel
protocols: PCI,	, ARM bus – Wireles	s protocols – IrDA, Bluetooth, IEEE	802.11- N	Memory hierarchy and
cache- Develop	oment and Debugging	-System-Level Performance Analysis	-Design E	Example: Alarm Clock
UNIT III	EMBEDDED F	PROGRAM DESIGN AND ANALY	SIS	9
Program design	n – Model of program	s – Assembly and Linking – Basic con	mpilation	techniques – Analysis
and optimization	on of program level &	software performance, execution fir	ne, powe	r, energy and program
size – Program	validation and testing	g = Design example : Software Moden	n	0
		S CONCEPTS AND µC/OS-II	Duita uiti a	9 Calculations Deal
Foreground/Ba	ckground process –	Resources – Tasks – Multitasking –	Priorities	s – Scheduling Karnal
- Exclusion -	Intertask communica	tion – Interrupts – Clock ticks – Intr	roduction	to $\mu C/OS_{-}II_{-}Features$
Goals- uC/OS-	- II Kernel structure –	$\mu C/OS = II Initialization = Starting \mu C$	C/OS - II	to µC/05-11-1 catures,
		uC/OS-II FUNCTIONS		9
Task Managem	ent: Creating Tasks -	- Task Stacks – Stack Checking – Tas	sk's Prior	ity – Suspending Task
– Resuming T	ask. Time Managem	ent: Delaying a Task – Resuming a	Delayed	Task – System Time.
Event Control	Blocks- Placing a Tas	sk in the ECB Wait List – Removing	a Task fr	om an ECB wait List .
Memory Mana	agement: Memory Co	ontrol Blocks - Creating Partition-	Obtaining	g a Memory Block –
Returning a Me	emory Block			
		Total F	Periods	45
Suggestive As	ssessment Methods			
Continuous A	ssessment Test	Formative Assessment Test	End Ser	nester Exams
(30 Mai	rks)	(10 Marks)	(60 Ma	rks)
1.Description	Questions	1.Assignment	1.Descr	ription Questions
2.Formative	Multiple choice	2.Online Quizzes	2.Form	ative Multiple
questions		3.Problem solving Activities	choice	questions
Outcomes				
Upon comple	tion of the course,	the students will be able to:		
CO707.1	Understand the con	ncept of embedded systems in popul	lar embed	lded ARM family
	processors			
CO707. 2	Apply apt interfacing	ng protocols in networking embedded	processor	rs.
CO707.3	Understand how	embedded programs can be des	signed a	nd analysed for
CO707 4	I earn the real time	operating system concepts and how to	annly th	em in uC/OS-II
CO707.5	Learn to perform ta	sk time and memory management in		
Toyt Books	Learn to perform ta	sk; time and memory management m	μ0/05-Π	
1 Andres	N SLOSS "ADM ST	stam Davelonars Cuido Dosigning a	nd Ontin	nizing System
I. Anurev Softwa	v 11.51035, AINIVI Syl re". Elsevier	stem Developers Guide-Designing a	na Ohun	nzing system
2. Lvla R	Das. "Embedded Sy	vstem". Pearson. 2013		
3. Frank	Vahid, Tony Givarg	is, "Embedded System Design". Wil	ley Stude	nt Edition,2001.
4. Wayne	wolf, "Computer as	<b>Components-Principles of Embedd</b>	led Comp	outing System
Design	" Elsevier, 2nd edition	)n		

Re	5. Jo feren	ean J. ce Boo	Labro oks	sse," N	/licro(	C/OS –	II The	e Real	Time	Kernel'	', CMP	Boo	ks,	2nd E	ditior	1998
	1. D 2. P 20 3. St	avid E hillip )08. teve H	2. Simo A. Laj ealth, '	on, "An plante, " Emb	n Emb , "Rea edded	edded l–Tim Syten	Softw e Syst n Desig	are Pr ems D gn", E	ımer" esign lsevier	, Pearso and Ar , Secon	on Educ alysis" d editio	catio , Jol n, 2(	n, 2 1n V )04	007. Wiley	& So	ns, Inc
W	eb Res	Source	es mun de	uniu o	o in/nu	blio/fr	ontoco		reamat	arial/ar	haddad	ovoto		Chan	51.01	Ema
	• <u>ht</u>	<u>.tps://w</u>	<u>ww.da</u> ww.di	<u>gimat.</u> i	in/npte	l/cours	ses/vid	eo/106	10519	<u>3/L09.h</u>	tml	<u>syst</u>	51115/	<u>Chap</u>	<u>JL21</u>	
CO	Vs PC	) Mapr	oing ar	d CO V	vs PSO	Mapr	oing									
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO	12	PSO1	PSO	)2 PS
1	1	102	2	104	1	100	2	100	1	3	1011	2		1	2	/2 15
2	2	2	2		1		2		1	3		2		2		
3	1		3	2	3	1	2		1	3		2		3	2	
4			3	2	1	1	2		1	3		2			2	1
5			3	2	1	1	2		1	3		2		3	1	2
Ot	• T R <b>ojectiv</b> 1. T 2 T	he pre- F and I res o give	-requisi Microv insight	te kno vave S	wledge ystem,	e requi Anten physic	red by na and s and r	the Stu Ampl adiatio	udents ifiers.	to study	this Co	ourse	is b	pasic ki	nowle	dge in
	3. T	o creat	e awar	eness a	about p	ropaga	ation of	f radio	waves			unter	ina j	purum		
	4. T 5. T	o selec o desig	t appro gn dipo	priate le, Yag	antenn gi and j	a appli patch a	ication	s a for a :	small a	pplicati	on					
_	UNIT	Ι		-	AN'	TENN.	A FUN	NDAM	ENTA	LS					9	
De Re int	finitio sistanc ensity,	n of an e, Ban Solid a	ntenna nd wid angle a	param th, Be nd bea	eters - eam with m widt	-Radia idth, I th. Pola	tion pa nput I arizatio	attern, mpeda on misi	Gain, nce, P natch,	Directiv olarizati Antenn	ion Rad	liatio temp	n p rat	perture ower ( ture.	e, Rac densit	liation y and
<b>T</b> ·	UNIT	II		1		D		AYS	1.6			6.51		1	9	.•
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# List of Professional Electives IV

S.No	Course	Course Name	Seme	L	Т	Р	С
	Code		ster				
1	21CS2709	LTE Technology and Standards	II	3	0	0	3
2	21CS2710	Modern Satellite Systems	II	3	0	0	3
3	21CS2711	Network Routing Algorithms	II	3	0	0	3
4	21CS2712	Remote Sensing	II	3	0	0	3

21CS2709	LTE TECHNOLOGY AND STANDARDS	L	Т	Р	C						
		3	0	0	3						
Prerequisites for the course											
• The pre	-requisite knowledge required by the Students to study this Course	e is bas	sic k	nowle	dge in						
Wireles	s Networks.										
Objectives											

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OFDM, S	Single	carrier FDMA, Sing	le carrier FDE, Channel Dependent N	Multiuser	Resource Scheduling,							
UNIT	Ι	KEY EN	ABLERS FOR LTE FEATURES		9							
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<b>4.</b> A	nalyze	the main factors af	fecting LTE performance including	mobile s	peed and transmission							
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Referen	nce Books
1.	LTE for UMTS Evolution to LTE-Advanced' HarriHolma and AnttiToskala, Second
	Edition - 2011, John Wiley & Sons, Ltd. Print ISBN: 9780470660003.

- 2. 'EVOLVED PACKET SYSTEM (EPS) ; THE LTE AND SAE EVOLUTION OF 3G UMTS' by Pierre Lescuyer and Thierry Lucidarme, 2008, John Wiley & Sons, Ltd. Print ISBN:978-0-470-05976-0.
- 3. 'LTE The UMTS Long Term Evolution ; From Theory to Practice' by StefaniaSesia, IssamToufik, and Matthew Baker, 2009 John Wiley & Sons Ltd, ISBN 978-0-470-69716-0.

## Web Resources

- <u>http://www.cl.cam.ac.uk/techreports/UCAM-CL-TR-696.pdf</u>
- http://www.siriusxm.com/ •
- http://www.ciscopress.com/articles/article.asp?p=31948&seqNum=3 •

CO	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	2	2	2	1					2	1	1	2	
2	2	3	1	2	2		1		1		1	3	2		3
3	2	2	1	2	1	2						2	3	2	
4	3	3	2	2	1	1					1	1		2	1
5	2	2	1	2	1	1					2	1	3	1	2

21CS2710	MODERN SATELLITE SYSTEMS	L	Τ	Р	C
		3	0	0	3
Prerequisites	for the course				
• The pre	-requisite knowledge required by the Students to study this Course	e is ba	sic k	nowle	edge in
Wireles	s Communication.				
Objectives					
1. To anal	yse the performance of any satellite network				
2. To appl	y the orbital concepts in navigational systems				
3. To unde	rstand the remote sensing system and technique.				
4. To appl	y the concept of broadcast systems.				
5. To learn	about the satellite networking system with IPV6.				
UNIT I	NAVIGATION, TRACKING AND SAFETY SYSTEMS			9	
Global Navigat segment, GPS spoofing (AS). of time, Interd SARSAT- INM	ion Satellite Systems - Basic concepts of GPS. Space segment, constellation, GPS measurement characteristics, Selective A Applications of Satellite and GPS for 3D position, Velocity, det sciplinary applications. Regional Navigation Systems- Distress IARSAT Distress System- Location - Based service.	Contro vailab ermin and S	ol se ility ation afety	gmen (SA) as fu - CO	t, User , Anti inction SPAS-
UNIT II	INERTIAL NAVIGATION AND DIFFERENTIAL GPS			9	
	SVSTEMS	1			

Guiffealain												
Introduction to Inertial Navigation- Inertial Sensors - Navigation Coordinates-System Implementations-												
System-Level Error Models- Intro	duction to Differential GPS- LADG	PS- WA	DGPS-WAAS - GEO									
Uplink Subsystem (GUS) - GEO	Uplink Subsystem (GUS) Clock Ste	ering Alg	gorithms - GEO Orbit									
Determination – Problems.												
UNIT III REMOTE SEN	SING SYSTEMS AND TECHNIQ	UES	9									
Introduction - Commercial Imagin	ng - DigitalGlobe – GeoEye - Me	eteorolog	y - Meteosat - Land									
Observation – LandsatRemote Ser	ising Data- Sensors- Overview - O	ptical Sei	nsors: Cameras- Non-									
Optical Sensors- Image Processing	- Image Interpretation- System Chara	cter1st1cs										
	ROADCAST SYSTEMS	G . 111	9									
Introduction - Satellite Radio Syste	ms - XM Satellite Radio Inc Siriu	s Satellite	e Radio -Worldspace -									
Direct Multimedia Broadcast- MBCO and TU Multimedia - European Initiatives - Direct-to-Home												
Television - Implementation Issu	les - DIH Services- Representati	ve DIH	Systems - Military									
Multimedia Broadcasts - US Glo	bal Broadcast Service (GBS)- Bus	siness IV	(BIV), GRAMSAI,									
UNIT V SATELLITE N	eo comerencing, internet.	DV6	0									
UNITV SATELLITEN			<u> </u>									
Wechenisms Addresses for Hosts of	of Saternie Inclusions - Migration and	UUEXIST	d Route Management									
Configuration Methods Dynamic U	ost Configuration Protocol for IDy6	$-$ IDv6 $\circ$	nd Related Protocola									
IPv6 Header Format- Traffic Classe		- II VO a	ind Related 110100015-									
IPv6 Header Format- Traffic Classes. Total Periods 45												
Total Periods     45       Suggestive Assessment Methods     1												
Continuous Assossment Test	S	End Co	mostor Evomo									
(20 Morks)	(10 Morks)	End Se	mester Exams									
(SU Marks)		(00 Ma	1 K5 J									
1.Description Questions	1.Assignment	1.Desci	ription Questions									
2.Formative Multiple choice	2.Online Quizzes	ative Multiple										
questions	3.Problem solving Activities	choice	questions									
Outcomes												
Upon completion of the course,	the students will be able to:											
CO710. 1 Analyze different n	avigational services											
CO710. 2 Apply remote sensi	ng concepts for different applications	5										
CO710. 3 Acquire knowledge	on satellite broadcast systems											
CO710.4 Acquire knowledge	on satellite broadcast systems											
CO710. 5 Evaluate the perform	nance of satellite networks											
Text Books	···· ··· ··· ···											
1 Mohinder & Grewel "	Global Positioning Systems Inortic	al Navioa	tion and									
Integration." Californi	a State University at Fullerton, A J	ohn Wild	ev & Sons. Inc.									
Publication, First Editi	on. 2004.											
2. MadhavendraRichharia.	"Satellite systems for personal Ap	plication	s", A John Wilev									
and Sons, Ltd., Publicati	on, Third Edition, 2010	1	, J									
Reference Books												
1. Daniel Minoli, "Satellit	e Systems Engineering in an IPv6	Environr	nent", CRC Press,									
First Edition, 2009.												
2. Dennis Roddy, "Satellite Communication", McGraw Hill International, Forth Edition,												
2006.												
3. Wilbur L. Pritchard, H	lendri G. Suyderhoud, Robert A. N	elson, "S	Satellite									
Communication Systems Engineering", Prentice Hall, First Edition, 2007.												

# Web Resources

- <u>http://www.cl.cam.ac.uk/techreports/UCAM-CL-TR-696.pdf</u>
- <u>http://www.siriusxm.com/</u>

• <a href="http://www.ciscopress.com/articles/article.asp?p=31948&seqNum=3">http://www.ciscopress.com/articles/article.asp?p=31948&seqNum=3</a>

CO	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	<b>PO9</b>	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	2	2	2	1					2	1	1	2	
2	2	3	1	2	2		1		1		1	3			3
3	2	2	1	2	1	2						2		2	
4	3	3	2	2	1	1					1	1	2		2
5	2	2	1	2	1	1					2	1	3	3	2

21CS2711	NETWORK ROUTING ALGORITHMS	L	Τ	Р	С						
		3	0	0	3						
Prerequisites	for the course										
• The pre	-requisite knowledge required by the Students to study this Course	e is ba	sic k	nowle	dge in						
Advanc	ed Wireless Communication.										
Objectives											
1. To get familiarized with different protocols in internet routing and optical WDM networks.											
2. To get acquainted with the concepts of supporting protocols in Mobile-IP networks.											
3. To	differentiate the routing processes involved in mobile ad-hoc r	netwo	rks a	and w	ireless						
sens	sor networks from conventional networks.										
4. To u	understand the concept routing in mobile ad –hoc networks.										
5. To u	understand the concept of routing in wireless sensor networks.										
UNIT I	<b>ROUTING IN TELEPHONE NETWORKS AND</b>	9									
	INTERNET										
General Classi	fication of routing, Routing in telephone networks, Dynamic Nor	n-hier	archi	ical R	outing						
(DNHR), Trur	ak status map routing (TSMR), Real-Time Network Routing	(RTN	R),	Hiera	chical						
routing.Exterio	r Routing Protocols: Exterior Gateway Protocol (EGP) and Bor	der G	latew	ay Pr	otocol						
(BGP). Multica	ast Routing: Pros and cons of Multicast and Multiple Unicast Rou	uting,	Dist	ance '	Vector						
Multicast Rout	ing Protocol (DVMRP), Multicast Open Shortest Path First (MC	OSPF)	, ME	BONE	, Core						
Based Tree Roy	uting.										
UNIT II	ROUTING IN OPTICAL WDM NETWORKS			9							
Classification	of RWA algorithms, RWA algorithms, Fairness and Admission	n Con	trol,	Distr	ibuted						
Control Protoco	ols, Permanent Routing and Wavelength Requirements, Waveleng	th Re	routi	ng- Bo	enefits						
and Issues, Light path Migration, Rerouting Schemes, Algorithms- AG, MWPG.											
UNIT III	<b>ROUTING IN MOBILE - IP NETWORKS</b>			9							
Macro-mobility	Macro-mobility Protocols, Micro-mobility protocol: Tunnel based: Hierarchical Mobile IP, Intra										
domain Mobil	ity Management, Routing based: Cellular IP, Handoff Wire	eless	Acco	ess Ir	nternet						

Infrastructure (HAWAII)

UNIT IV ROUTING I	N MOBILE AD -HOC NETWORK	KS	9							
Internet based mobile ad-hoc netwo	orking, communication strategies, rou	ting algo	rithms – Table-driven							
routing - Destination Sequenced	Distance Vector (DSDV), Source	initiated	on-demand routing-							
Dynamic Source Routing (DSR), A	Ad-hoc On-demand Distance Vector	(AODV)	routing, Hierarchical							
based routing- Cluster Head Gat	eway Switch Routing (CGSR) and	Tempora	ally-Ordered Routing							
Algorithm (TORA), Quality of Serv	vice.									
UNIT V ROUTING IN	WIRELESS SENSOR NETWOR	KS	9							
Routing Protocols- Energy-Efficient	nt Routing - Power-Aware Many-to-	Many Ro	uting (PAMR), Low-							
Energy Adaptive Clustering Hierarchy (LEACH), Geographic Routing.Data-centric protocols,										
Hierarchical protocols, Location-based protocols - directed Diffusion, Network flow and QoS-aware										
protocols.										
Total Periods 45										
Suggestive Assessment Method	S									
<b>Continuous Assessment Test</b>	Formative Assessment Test	End Ser	nester Exams							
(30 Marks)	(10 Marks)	(60 Ma	rks)							
1.Description Questions	1.Assignment	1.Descr	ription Questions							
2.Formative Multiple choice	2.Online Quizzes	2.Form	ative Multiple							
questions	3.Problem solving Activities	choice	questions							
Outcomes										
Upon completion of the course,	the students will be able to:									
CO/11.1 Identify various ro	outing schemes and their application	s to the	real world circuit-							
switched networks			1							
CO/11. 2 To understand varia	bus routing techniques in optical wD	M networ	KS							
CO711. 4 To loom come nout	ous routing protocols of mobile ip ne	tworks.								
CO711.4 To learn some rout	ing protocols of mobile adnoc networ	KS.	and to							
Tourt Paola	bus routing protocols of whereas sens	sor netwo	JIKS.							
1 M Steen Struck "Douting	in Communication notwork? Duon	the Hal	I International New							
1. M. Steen Strub, "Kouting Vork 1995	In Communication network", Pren	luce – Ha	li International, New							
101K, 1995. 2 S. Koshay "An anginaar	ing approach to Computer Netwo	orking.	ATM Notworks the							
2. S. Kesnav, An engineer	a Notwork" Addison Woslov 1907	orking. <i>r</i>								
3 William Stallings "High s	sneed Networks TCP/IP and ATM	Design P	rinciples" Prentice							
Hall Second Edition 2002		Design	incipies , i tentice							
4 C F Perkins "Ad hoc Ne	 tworking" Addison-Wesley 2001									
5. C.Siva Ram Murthy and	B.S.Manoi. "Ad hoc Wireless	Networks	s Architectures and							
protocols". Pearson Educa	ation. Second Edition. 2007									
Reference Books										
1. KazemSohraby, Daniel N	Ainoli and TaiebZnati, "Wireless	Sensor	Networks", A John							
Wiley & Sons Inc. Publica	tion, First Edition, 2007.		,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,,							
2. Holger Karl and Andrea	as Willig, "Protocols and Archit	ectures f	for Wireless Sensor							
2. Horger Karr and Andreas wing, Frotocols and Arcintectures for wireless Sensor Networks", John Wiley, 2007.										
Networks'', John Wiley, 2	007.									

- 3. Ian F. Akyildiz, Jiang Xie and ShantidevMohanty, "A Survey of mobility Management in Next generation All IP- Based Wireless Systems", IEEE Wireless Communications Aug.2004, pp 16-28.
- 4. A.T Campbell et al., "Comparison of IP Micromobility Protocols," IEEE Wireless Communications Vol No.9, Issue 1, Feb.2002, pp 72-82.
- 5. C.Siva Rama Murthy and Mohan Gurusamy, "WDM Optical Networks Concepts, Design and Algorithms", Prentice Hall of India Pvt. Ltd, 2002.

#### Web Resources

- <u>http://users.ecs.soton.ac.uk/sqc/EL336/CNL-10.pdf</u>
- <u>http://www.cs.ccsu.edu/~stan/classes/CS490/Slides/Networks4-Ch4-4.pdf</u>
- http://www.cse.iitk.ac.in/users/dheeraj/cs425/lec12.html/
- <u>http://www.csi.ucd.ie/staff/jmurphy/networks/csd8\_7-routing.pdf</u>

CO	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	<b>PO10</b>	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	2							1	3	1	2	
2	3	2	3	2							1	3	2		3
3	3	2	3	2							1	3		2	
4	3	2	3	2							1	3	2		1
5	3	2	3	2							1	3	1	1	2
6	3	2	3	2							1	3	1	2	

21CS2712	REMOTE SENSING	L	Τ	Р	C			
Prerequisites	for the course							
• The pre	-requisite knowledge required by the Students to study this Course	e is ba	sic k	nowle	dge in			
Total Q	uality Management.							
Objectives								
1. To understand the various remote sensing and GIS technological applications in the field								
ofEnvir	onmental Engineering.							
2. To stud	y Water Quality Management							
3. To stud	y Air Quality and Noise Management							
4. To Stuc	y Solid Waste Management							
5. To unde	erstand Global Prospective and Climate Change							
UNIT I	SATELLITE FOR ENVIRONMENTAL MANAGEMENT			9				
Introduction - Environmental satellite Mission: GEOS, NOAA, AVHRR, CZCS, Ocean sat,								
Kalpanaand others - Spectral characteristics - Data Products - Analysis Tools - Monitoring land,								
water, atmosphere and ocean using Remote Sensing Data.								
UNIT II WATER QUALITY MANAGEMENT 9								

Francis Xavier Engineering College | Dept of ECE | M.E- CS | R2019 | Curriculum and Syllabi 2021 | Amendment 2022 Classification of water quality - Sampling procedure - Quality analysis and GIS modelling PipeNetwork Design using GIS - Spectral responses of clear and contaminated water -AquiferVulnerability: Intrinsic and specific vulnerability - DRASTIC, SINTACS - Ground Water QualityModelling: MODFLOW, MT3D – Sea water Intrusion Modelling – pollution diffusion model in river - Case studies. **UNIT III AIR QUALITY AND NOISE MANAGEMENT** 9 Air Quality Standards - Chemical and Physical Components - Sampling - Mapping of atmosphericpollution - Air pollution due to industrial activity - Plume behaviours - Dispersion model: GaussianPlume model - Remote Sensing to monitor atmosphere constituents - Case Studies. Noisepollution: Standards - Measurement of noise and its intensity - Sources - Effects noise modelling. SOLID WASTE MANAGEMENT **UNIT IV** Definition - sources - identification of storage and collection location - Analysis of collection route - Site selection: Transfer station, Disposal site - Waste allocation - design of leach ate and gas collection in sanitary landfills - leach ate model - case studies. **GLOBAL PROSPECTIVE AND CLIMATE CHANGE** 9 UNIT V Prevention and Control measures - Carbon footprints and sinks, carbon trading, carbon credits and marketing, Indian and international status - case studies - Definitions- Climate, Climate system, climate change – Drivers of Climate change – Characteristics of climate systemcomponents - Green house effect - Carbon cycle - case studies. **Total Periods** 45 **Suggestive Assessment Methods Continuous Assessment Test** Formative Assessment Test **End Semester Exams** (30 Marks) (10 Marks) (60 Marks) **1.Description Questions 1.Assignment 1.Description Questions 2.Formative Multiple** 2.Formative Multiple choice 2.Online Quizzes questions **3.Problem solving Activities** choice questions **Outcomes** Upon completion of the course, the students will be able to: CO712.1 Acquire knowledge of various components of environment and assessment of their quality. CO712.2 Gain exposure to current and future satellite missions used for environmental assessmentandmodelling. Understand the various methods in Air Quality and Noise Management. CO712.3 Demonstrate the concepts of Solid Waste Management CO712.4 Demonstrate the concepts and understand Global Prospective and Climate Change CO712.5 **Text Books** 1. David N.Miclsen, Environmental Site Characterization and Ground water Monitoring, 2<sup>nd</sup>edition, CRC Press, 2005, ISBN: 978-1566705899 2. Donald L.Wise, Remediation for Hazardous waste contaminated soils, CRC Press; 1<sup>st</sup>Edition (1994) **Reference Books** 1. Dr Owen Harrop, "Air Quality Assessment & Management", CRC Press; 1st edition, 2001 2. Ian L.Pepper, Charles P.Gerbaand Mark L.Brusseau, Environmental and Pollution science, Academic Press, 2nd Edition, 2006. ISBN : 978-0125515030 3. Michele Campagna, GIS for sustainable development, CRC Press; 1st Edition, 2005. 4. Robert Scally, "GIS for Environmental Management", ESRI Press, 2006

- 5. Roger D.Griffin, Principles of Air Quality Management, 2nd edition, 2006, CRC Press
- 6. Shukla P R , Subobh K Sarma, NH Ravindranath, AmitGarg and SumanaBhattacharya,Climate Change and India: Vulnerability assessment and adaptation, University Press(India) Pvt Ltd, Hyderabad.

7. Tchobanoglous George, Hilary Theisen, Samuel Vigi, Integrated Solid Waste Management, McGraw – Hill Inc, Singapore. 1993.

#### Web Resources

- https://nptel.ac.in/courses/105/108/105108077/
- https://nptel.ac.in/courses/121/107/121107009/

#### CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	2	2							2	1	1	2	
2	2	3	1	2							1	3	2		3
3	2	2	1	2							1	2		2	
4	3	3	2	2							1	1	2		3
5	2	2	1	2							2	1	2	1	1

#### List of Professional Electives V

S.No	Course	Course Name	Seme	L	Т	Р	С
	Code		ster				
1	21CS3701	Embedded Wireless Sensor Networks	III	3	0	0	3
2	21CS3702	DSP Processor Architecture and Programming	III	3	0	0	3
3	21CS3703	Pattern Recognition and Machine Learning	III	3	0	0	3
4	21CS3704	High Speed Communication Networks	III	3	0	0	3

21CS3701	EMBEDDED WIRELESS SENSOR NETWORKS	L	Т	Р	С			
		3	0	0	3			
Prerequisites for the course								
• The pre-requisite knowledge required by the Students to study this Course is basic knowledge in								
Advanced Wireless Communication, Advanced Wireless Network and Communication Systems								
Laboratory I..

#### Objectives

- 1. Make students to learn the basic of wireless sensor networks.
- 2. Enable the students to understand the sensor network components, architecture and design principles of WSN
- 3. Enable the students to know the the need of Physical layer design challenges and MAC Protocals
- 4. Make the students to design the Smart Sensors.
- 5. Make the students to apply the basic Embedded knowledge to Implement WSN.
- UNIT IOVERVIEW OF WIRELESS SENSOR NETWORKS9

Challenges for Wireless Sensor Networks - Characteristics requirements - Required mechanisms, Difference between mobile ad-hoc and sensor networks- Enabling Technologies for Wireless Sensor Networks.Single-Node Architecture - Hardware Components - Energy Consumption Sensor Nodes Operating Systems and Execution Environments - Sensor Node Examples: EYES, MICA, MICAZ motes.

#### NETWORK ARCHITECTURE

Sensor Network Scenarios – Optimization goals and Figure of Merit – Design principles for WSNs - Gateway concepts.

UNIT III	PHYSICAL LAYER AND MAC PROTOCALS	9

Wireless Channel and communication fundamentals – Physical layer and transceiver designconsiderations in WSN – Fundamentals of MAC Protocols- Low duty cycle protocols and wakeupconcepts – Contention based protocols - Schedule based protocols – IEEE 802.15.4 MACprotocol.

UNIT II

#### **SMART SENSORS**

9

9

Introduction to Smart Sensors – Signal Conditioning Circuits – Architecture of Smart SensorsHumidity Sensors – Soil Moisture Sensors– Temperature Sensors – Color Sensors – LevelSensors.

UNIT V	APPLICATIONS AND PROTOCOL	9
	IMPLEMENTATIONONWSN	

Home control - Medical Applications - Civil and Environmental Engineering applications – Wildfiremonitoring - Habitat monitoring. Embedding LEACH protocol on ARM7 TDM microcontroller usingembedded C language - Embedding Cryptographic algorithms on ARM 7 TDM microcontroller usingembedded C language – FPGA based customizable event driven architecture.

	45						
Suggestive Assessment Methods							
Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)		End Semester Exams (60 Marks)				
1.Description Questions 2.Formative Multiple choice questions	1.Assignment 2.Online Quizzes 3.Problem solving Activities	1.Description Questions 2.Formative Multiple choice questions					
Outcomes							
Upon completion of the course, the students will be able to:							
CO701.1 Explain the basics of wireless sensor networks.							

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	CO70	1.2	Discus	ss abou	t the s	ensor r	networ	k comp	onents	, archite	ecture a	nd de	esig	n princ	ciples	of	
			WSN.														
	CO70	1.3	Explai	Explain the need of Physical layer design challenges and MAC Protocols.													
	CO70	1.4	Design	n the S	mart S	ensors.											
	CO70	1.5	Apply	the ba	sic Em	beddee	d knov	vledge	to imp	lementV	VSN.						
Те	xt Bo	oks				~			~								
	1. F	eng Zl	180 &	Leonio	las J.	Guiba	s, "Wi	ireless	Sensor	r Netwo	orks- Ai	n Ini	orn	nation	Proc	essi	ng
		pproa	ch'', E	lsevier	;,2007.		о <b>т</b> •			7• 1	C	NT				1	
	2. K	azems	sohrab	by, Da	niel N	linoli,		ebZna	ti, "W	ireless	Sensor	Ne	two	rks- 🗌	lechr	1010§	<b>3y</b> ,
	<u>r</u>	rotoco	ls and	Appli	cation	s", Joh	in Wil	ey,201	2.								
ке	teren	<u>ce Bo</u>		((****)*					• •	<b>T I X</b>	<u></u>						
	1.	Ann	a Hac	, "Wir	eless S	ensor	Netwo	ork Des	signs",	, John V	viley,20	JU3.	• 1	р	200	-	
	2.	Bha Mal	skarK	rishna	macha	11, "N	etwor	king V	vireles	s Senso	rs", Ca	mbr	idge	e Pres	s,200:	5.	
	3.	Mor	amma	ad Ilya	as and	I Ima	dMah	gaob,	"Hand	dbook	of Sens	sor	Net	works	: Co	mpa	ict
	1.0	Wir	eless a	nd Wi	red Se	nsing	Systen	ns", Cl	RC Pr	ess, 200	5.						
W	eb Res	source	es etcl.co	:		06/105	/10610	5160/									
	• <u>n</u>	<u>.tps://n</u>	ptel.ac	<u>.1n/cou</u>	<u>rses/10</u>	<u>10/105/</u>	010010	<u>15160/</u>	~								
	• <u>ht</u>	tps://w	/ww.yo	outube.	<u>com/w</u>	vatch?v	=sx0U	PzztC	<u>50</u>								
	• <u>ht</u>	<u>tps://w</u>	/ww.yo	outube.	com/w	vatch?v	<u>rmql</u>	EWtm	<u>yUo</u>								
CO	Vs PC	) Mapp	oing ar	nd CO V	/s PSO	Марр	ing										
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	РО	12	PSO1	PS	02	PSO3
1	3	2	1	1		1				2	1	2		1	2	2	
2	3	2	1	1						2	1	2		2			3
3	3	2	2	1		1				2	1	2			3	5	
4	3	2	1	1						2	1	2					1
5	3	2	2	1		1				2	1	2		2	2	2	2
													L	Т	Р		c ]
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						PRO	OGRA	MMI	NG				3	0	0	3	
Pr	erequ	isites	for th	e cour	se												
	• T	he pre-	requisi	ite kno	wledge	e requi	red by	the Stu	udents	to study	this Co	ourse	is b	asic k	nowle	edge	in
Oh																	
	1		now v	arious		chitect	tures a	nd thei	r annli	cations							
	1. 2		ecome	skiller	at the	archit	ectural	l featur	r appil es of T	SP prov	resente						
	2. 3		ddreee	the ice	i at the	how to	interf	ace me	es of L	nerinha	rale ont	<u>א</u> ט	Pm	rocess	ore		
	5. To address the issues of now to interface memory, peripherals onto DSP processors.																
	4. To understand the concept of ADSP BF532 processor.																
	ן. נואוד	IUa		VFRV		<b>)E UI</b>				RUCE	SSINC	[			9		
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Francis Xavier Engineering College   De	pt of ECE	M.E-CS	R2019
Curriculum and Syllabi 2021	Amendm	ent 2022	

Advantages of DSP over analog systems, salient features and characteristics of DSP systems, applications of DSP systems. Common features of DSP processors, numeric representations in DSP processor, data path of a DSP processor, memory structures in DSP processors, VLIW architecture, special addressing modes in DSP processors, pipelining concepts, on-chip peripherals found in DSP processors

UNIT II	TMS320C5X PROCESSOR	9
Architecture -	Assembly language syntax - Addressing modes - Assembly la	inguage Instructions -
Pipeline struct	ure, Operation - Block Diagram of DSP starter kit - Appl	lication Programs for
processing real	time signals	

UNIT IIITMS320C6748 PROCESSOR9Architecture – DSP subsystem: Mega module, memory map, advanced event triggering-DMA<br/>subsystem-System Interconnect-System Memory-DSP memories, shared RAM memory, external<br/>memories, internal peripherals, peripherals- Memory protection unit- device clocking-power<br/>management- Instruction set -addressing modes-Assembly language Instructions - application programsUNIT IVADSP BF532 PROCESSOR9

Features-architecture overview-Blackfin processor core-DMA controllers-Timers-serial port interfaceparallel peripheral interface-dynamic power management-Serial port controller - UART port controller - Real- time clock

UNIT V PROGRAMMING USING ADSP BF533 PROCESSOR

9

Assembly language syntax– program flow control-load/store- move- stack control-control code bit management logical operations-bit operations- shift / rotate operations- arithmetic operations- external event management – cache control –video pixel operations- vector operations-parallel issue instructions, applications programs.

	Total	Periods	45	
Suggestive Assessment Method	S			
Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)		
1.Description Questions 2.Formative Multiple choice questions	1.Assignment 2.Online Quizzes 3.Problem solving Activities	1.Desci 2.Form choice	ription Questions ative Multiple questions	
<b>A</b> 1				

Outcomes

Upon completion of the course, the students will be able to:

CO702. 1 Analyze the data addressing capabilities of programmable DSP processors.

CO702. 2 Narrate the architectures of programmable TMS320C5X DSP processors.

CO702. 3 Narrate the architectures of programmable TMS320C6748 DSP processors.

CO702. 4 Narrate the architectures of programmable BF532 DSP processors

CO702. 5 Create application oriented programming using BF533 DSP processors.

**Text Books** 

1. Avatar Singh and S.Srinivasan, "Digital signal processing", Thomson books, 2004.

2. K.K Parhi, "VLSI DSP Systems", John Wiley, 2008.

**Reference Books** 

- 1. http://www.analog.com/static/imported-files/processor\_manuals/bf533\_hwr\_Rev3.4.pdf
- 2. http://read.pudn.com/downloads111/doc/462195/Analog%20Devices%20Blackfin.pdf
- 3. http://www.analog.com/static/imported-files/data\_sheets/ADSP-BF531\_BF532\_BF533.pdf
- 4. http://www.ti.com/lit/ug/spru732j/spru732j.pdf
- 5. https://www.analog.com/en/products/adsp-bf532.html#product-documentation
- 6. https://www.analog.com/media/en/dsp-documentation/processor-manuals/ADSP-BF533 hwr rev3.6.pdf

## Web Resources

- https://nptel.ac.in/content/storage2/courses/108105057/Pdf/Lesson-7.pdf •
- https://onlinecourses.nptel.ac.in/noc19 ee70/preview
- https://www.kdkce.edu.in/pdf/DSP\_Processor\_\_\_Architecture\_compressed.pdf

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3											3	1	2	
2	3		3	2							2	3	2		3
3	3		3	2						1		3		2	
4	3		3	2							2	3	2		1
5	3		3	3							1	3	1	1	2

21CS3703	PATTERN RECOGNITION AND MACHINE LEARNING	L	Τ	Р	C
		3	0	0	3
Prerequisites	s for the course				

The pre-requisite knowledge required by the Students to study this Course is basic knowledge in Neural Network.

#### **Objectives**

- 1. To discuss different learning techniques.
- 2. To understand various machine learning procedures.
- 3. To understand the concept of Neural Networks.
- 4. To understand the concept of Kernel Method.
- 5. To understand the mixture model and combining model.

	-	
UNIT I	PATTERN RECOGNITION FUNDAMENTALS	9
Patterns and	Pattern Recognition – Pattern Recognition System – significance -	– Configurations –
Representati	on of Patterns and Machine recognition - Model Selection - The C	urse of
Dimensional	ity - Decision Theory - Information Theory.	
UNIT II	LINEAR MODELS FOR REGRESSION	9
	ANDCLASSIFICATION	l

Francis Xavier Engine	eering College  Dept of ECE   M.E- C	S   R2019	9					
Curriculum	and Syllabi 2021 Amendment 202	22						
Regression: Linear Basis Function Models - The Bias-Variance Decomposition - Bayesian Linear								
Regression -Bayesian Model Comparison - Limitations of Fixed Basis Functions. Classification:								
Discriminant Functions - Probabilistic Generative Models - Probabilistic Discriminative Models -								
The Laplace Approximation - Bayesian Logistic Regression.								
	NEURAL NETWORKS		9 The Heating					
Matrix - Regularization in Neural	S - Network Training - Error Back pro	bpagation	- The Hessian					
Maura- Regularization in Neural	Networks- Dayesian Neural Networ	KS.						
UNIT IV	KERNEL METHODS		9					
Dual Representations - Construct	ting Kernels -Radial Basis Function I	Networks	- Gaussian Processes					
- Maximum Margin Classifiers -	Relevance Vector Machines.							
UNIT V MIXTURE M	ODELS AND COMBININGMOD	ELS	9					
K-means Clustering - Mixtures of	Gaussians - Bayesian Model Averag	ging - Co	mmittees - Boosting -					
Tree-based Models - Conditional M	ixture Models.	_	-					
	Total I	Periods	45					
Suggestive Assessment Method	S							
Continuous Assessment Test	Formative Assessment Test	End Ser	mester Exams					
(30 Marks)	(10 Marks)	(60 Ma	rks)					
1.Description Questions	1.Assignment	1.Desci	ription Questions					
2.Formative Multiple choice	2.Online Quizzes	2.Form	mative Multiple ce questions					
questions	3.Problem solving Activities	choice						
Outcomes		1						
Upon completion of the course,	the students will be able to:							
CO703. 1 Apply the Pattern R	ecognition techniques to Image App	lications.						
CO703. 2 Solve problems of I	Regression and Classification							
CO703. 3 Apply Neural netwo	orks for real world applications							
CO703. 4 Apply suitable kern	el methods to a specific problem.							
CO703. 5 Apply suitable kern	el methods to a specific problem.							
Text Books								
1. C. M. Bishop, "Pattern Re	ecognition and Machine Learning"	, Springe	r, 2007					
2. Sing-tze Bow, "Pattern	<b>Recognition and Image Preproce</b>	ssing", 2	and Edition, Marcel					
Dekker, Inc , 2002.								
3. Richard O.Duda, Peter E.	Hart and David G.Stork, "Pattern	Classifie	cation", 2nd Edition,					
Wiley India, 2006.								
4. Stephen Marsland, "Mach	ine Learning - An Algorithmic Pe	erspective	e" 2nd Edition, CRC					
Press, 2015								
Reference Books								
1. EthemAlpaydin, "Introduction to Machine Learning", 3rd Edition, MIT Press, 2014.								
2. K. P. Murphy, "Machine Learning: A probabilistic perspective", MIT Press, 2012.								
3. P. Flach, "Machine Learning: The art and science of algorithms that make sense of data",								
Cambridge University Press, 2012								
4. Tom M. Mitchell, "Machin	ne Learning", McGraw Hill, 1997.							

# Web Resources

- 1. https://nptel.ac.in/courses/106106046/
- $2. \ https://onlinecourses.nptel.ac.in/noc18\_cs26/$

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1					2	2	3	1	2	
2	3	2	2	2	2					2	2	3			1
3	3	3	2	2	2					2	2	3		1	
4	2	3	3	2	1					2	2	3	2		1
5	2	2	2	2	2					1	2	3	1	1	2

21CS3704	HIGH SPEED COMMUNICATION NETWORKS	L	Τ	Р	С
		3	0	0	3
Prerequisites	for the course				
• The pre	-requisite knowledge required by the Students to study this Course	e is ba	sic k	nowle	dge in
Commu	nication Networks.				
Objectives					
1. To unde	erstand the high speed network architectures				
2. To stud	whigh speed access and admission control				
3. To unde	erstand shaping and scheduling algorithms				
4. To disc	uss queuing and congestion control for high speed architectures				
5. To unde	erstand flow and congestion control				
UNIT I	9				
Frame Relay N	Jetworks – Asynchronous transfer mode – ATM Protocol Arch	itectu	re, A	TM	logical
Connection, A	ГМ Cell – ATM Service Categories – AAL, High Speed LANs	: Eme	ergen	ce of	High-
Speed LANs, C	igabit Ethernet, WDM systems, Optical LANs, SONET.				
UNIT II	ADMISSION AND ACCESS CONTROL			9	
CAC for A Guaranteed Algorithms Generic Cell	TM VBR Services - Worst-Case Traffic Model and CAC, E Quality of Service, Controlled-LoadService, ATM Traffic - Traffic Contract, PCR Conformance, SCR, and BT, Cell Dela Rate Algorithm.	ffecti Contr ayVar	ve B act a iation	andw and C n Tole	idth, - Control erance,
UNIT III	SHAPING AND SCHEDULING			9	
An ATM Shap	ing Multiplexer -Dual Leaky Bucket, Algorithm, An Integrated P	acket	Shap	per - l	Basics,
Integrating Tra	ffic Shaping and WFI Scheduling, Logical Structure and imple	menta	tion	of th	e WFI
Packet Shaper,	Packet Scheduling – FIFO, RR, Rate-Controlled Static Priorit	y, GF	PS-W	FQ, '	Virtual
Clock, Self-Clo	ocked Fair Queuing, Worst-case Fair Weighted Fair Queuing, Second	chedu	ling	Algor	ithm -
Shaped Virtual	Clock Algorithm				
UNIT IV	QUEUING & BUFFER MANAGEMENT			9	

Conceptual Framework and Design Issues, Sequencer - Store Cells in Logical Queues, Sort Priorities Using a Sequencer, RAM-Based Searching Engine - Hierarchical Searching, Design of the RSE, RSE Operations, Write-in Operation, Reset Operation, Search Operation: A Look at ATM Networks - Self-Calibrating Pushout, TCP/IP over ATM\_UBR, Dynamic Threshold with Single Loss Priority, A Look at the Internet - Tail Drop, Drop on Full, Random Early Detection, Differential Dropping: RIO, LQD.

UNIT VFLOW AND CONGESTION CONTROL9Window-BasedFlowControl, Rate-BasedFlowControl, PredictiveControlMechanism, ATMNetworks - ABRFlowControl, TCP/IPNetworks - TCPCongestionControl- TCPwithExplicitCongestionNotification, Rate-BasedFlowControlScheme, FrameRelayControl.

		Total I	Periods	45
Suggestiv	e Assessment Method	S		
Continuo	us Assessment Test	Formative Assessment Test	End Se	mester Exams
(30	Marks)	(10 Marks)	(60 Ma	rks)
1.Descrip	tion Questions	1.Assignment	1.Desc	ription Questions
2.Formati	ve Multiple choice	2.Online Quizzes	2.Form	ative Multiple
questions		3.Problem solving Activities	choice	questions
Outcomes	6			
Upon com	pletion of the course,	the students will be able to:		
CO704.	1 To Differentiate ar	chitectures of various protocols		
CO704.	2 To Apply techniqu	es involved to support real-time traff	ic and acc	cess control
CO704.	3 Tounderstand differ	rent scheduling employed to support	high spee	d architectures
CO704.	4 To understand the	framework required to solve queuin	g and but	ffer management in
	high speed network	S		
CO704.	5 To Compare the	different mechanisms available f	or provi	sion of flow and
	congestion control i	n high speed networks		
Text Book	KS			
1. Jea	n Walrand and	PravinVariaya, "High Per	formanc	e Communication
Net	works",Morgankaufm	ann Publishers, Second Edition, 20	00	
2. H.	Jonathan Chao and Xia	oleiGuo, "Quality of Service Cont	rol in Hi	gh-Speed Networks",
Joh	n Wiley & Sons, Inc., F	First Edition, 2002		
Reference	e Books			
1. Wi	lliam Stallings, "High	Speed Networks and Internet",	Pearson	Education, Second
Edi	ition, 2002.			
2. Rai	iner Handel, Manfred	N Huber and Stefan Schroder, "	'ATM N	etworks - Concepts,
Pro	otocols Applications'', A	ddison Wesley, New York, Third I	Edition 1	999.
3. Leo	on Garcia and Widj	aja, "Communication Network",	Tata	McGraw Hill, New
Del	hi,Second Edition, 2003	3		
Nader .F	Mir ," Computer Com	nunication Networks" Pearson edu	cation 20	)14
Web Reso	ources		10	
• <u>http</u>	os://nptel.ac.in/content/st	prage2/courses/106105080/pdf/M1L	l.pdf	
• <u>http</u>	os://nptel.ac.in/courses/10	06/105/106105082/		
• <u>http</u>	os://onlinecourses.nptel.a	c.in/noc20_cs23/preview_		
CO Vs PO I	Mapping and CO Vs PSO	Mapping		

	<u>Francis Xavier Engineering College  Dept of ECE   M.E- CS   R2019  </u> Curriculum and Syllabi 2021  Amendment 2022														
CO	PO1	PO2	PO3	PO4	PO5	<b>PO6</b>	PO7	PO8	<b>PO9</b>	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1								3	3	1	2	
2	3	3	1								3	3			1
3	3	3	1								3	3		2	
4	3	3	1								3	3	2		1
5	3	3	1								3	3	1	1	2

## List of Professional Electives VI

S.No	Course	Course Name	Seme	L	Т	Р	С
	Code		ster				
1	21CS3705	Cooperative Communication	III	3	0	0	3
2	21CS3706	VLSI Architecture for Image and Video Processing	III	3	0	0	3
3	21CS3707	Mobile Robotics	III	3	0	0	3
4	21CS3708	Advanced Radar and Navigational AIDS	III	3	0	0	3

21CS37	705		L	Т	Р	С								
210037	05	COOPERATIVE COMMUNICATION	3	0	0	3								
Prerequ	Prerequisites for the course													
• W	vireles	s Communication												
Objectiv	Dbjectives													
<b>1.</b> E	Enable the student to understand the evolving paradigm of cooperative communication,													
<b>2.</b> To ne	To understand the challenges and trade-offs involved in cooperative communication networks.													
<b>3.</b> E Re	xpose equire	the student to the usage of various Relay selection schemes ac ement	ccord	ing to	o the									
<b>4.</b> Se	erve a	s a platform to design novel cooperative protocols and routing	algor	ithm	IS.									
<b>5.</b> To	o desi	gn routing algorithms for cooperative communication												
UNIT	UNIT I INTRODUCTION TO COOPERATIVE COMMUNICATIONS 9 SYSTEMS AND COOPERATIVE DIVERSITY													

<u>Francis Xavier Engineering College  Dept of ECE   M.E- CS   R2019  </u> <u>Curriculum and Syllabi 2021  Amendment 2022</u>												
Conversion	in Wireless Notwork	Cooperation protocols - Hierarch	ical coor	peration Coonerative								
Communicati	ions with single rela	w. Multi-node cooperative commu	nication	s Canacity theorems								
for the relay	channel snatial dive	rsity in wireless networks Cooperative	ative st	rategies and canacity								
theorems for	relay networks Can	acity hounds for cooperative diverse	auve su	allegies and capacity								
	Telay networks, cap	acity bounds for cooperative divers	sity									
UNIT II	COOL	PERATIVE DEMODULATION		9								
Modulation a	and demodulation f	or cooperative diversity in wirele	ess syste	ems, performance of								
cooperative	demodulation with	decode-and-forward relays, Syn	nbol err	or probabilities for								
general coop	general cooperative links											
UNIT III	COOPE	RATIVE SPACE-TIME CODING		9								
Space-Time	Codes for High Data	a Rate Wireless Communication, I	Distribut	ed space-time-coded								
protocols, Fa	ding relay channels	: performance limits and space-tin	ne signa	al design, Space-time								
diversity enh	ancements using col	laborative communications										
UNIT IV	DISTRIB	UTED COOPERATIVE ROUTING		9								
Network Mo	del, Cooperation bas	sed routing protocol, Source-chan	nel codi	ng with cooperation,								
Broadband of	cooperative commu	nications - System model - Cooj	perative	protocol and relay								
assignment s	cheme											
UNIT V	(	CHANNEL ACCESS ISSUE		9								
Cooperative	Multiple Access Com	munication ,Relay channel and pro	tocol ,Re	lay selection, Energy								
1	efficiency, Conte	ent-aware Cooperative multiple acc	ess prote	ocol								
Cuggostivo A	account Mathad		erious	45								
Suggestive A												
Continuous	Assessment lest	Formative Assessment Test	End Se	mester Exams								
1 Descriptio	n Questiens	(10 Marks)		rintion Questions								
2 Formative	Multinle choice	2 Anline Auizzes	2 Form	ativo Multinlo								
auestions	multiple choice	2.011111 Quizzes 3 Problem solving Activities	choice	auestions								
Quitcomes		Si Toblem Solving Activities	choice	questions								
Upon compl	etion of the course	the students will be able to:										
CO302 1	Evaluato the differen	t cooperative communication prot		their trade-offe								
CO705 2	Applying the reference	a cooperative communication prote										
C0705.2	Analyse the perform		uechniqu									
CU/US. 3	Ennance the diversit	y using collaborative communicatio	on									
CO705.4	Modelling the broad	band cooperative communication										
CO705.5 Analyse the performance of cooperative multiple access protocol												
CO705.5	Analyse the perform	ance of cooperative multiple access	protoco	01								
CO705. 5	Analyse the perform	ance of cooperative multiple access	protoco									
CO705. 5 Text Books 1. K.J.R.	Analyse the perform Liu, A.K. Sadek, W. Su	ance of cooperative multiple access 1, A. Kwasinski, Cooperative Commu	a protoco unicatior	ns and								
CO705. 5 Text Books 1. K.J.R. 1 Netwo	Analyse the perform Liu, A.K. Sadek, W. Su orking,Cambridge Un	ance of cooperative multiple access , A. Kwasinski, Cooperative Commu iversity Press, 2016	inication	ns and								
CO705. 5 <b>Text Books</b> <b>1.</b> K.J.R. 1 Netwo <b>2.</b> Misch	Analyse the perform Liu, A.K. Sadek, W. Su orking,Cambridge Un aDohler, Yonghui Li,	ance of cooperative multiple access n, A. Kwasinski, Cooperative Commu iversity Press, 2016 "Cooperative Communications: Han	inication	ns and Channel & PHY",								
CO705. 5 Text Books 1. K.J.R. J Netwo 2. Misch John V	Analyse the perform Liu, A.K. Sadek, W. Su orking,Cambridge Un aDohler, Yonghui Li, Viley & Sons, 2010	ance of cooperative multiple access , A. Kwasinski, Cooperative Commu iversity Press, 2016 "Cooperative Communications: Han	inicatior	ns and Channel & PHY",								
CO705. 5 Text Books 1. K.J.R. 1 Netwo 2. Misch John V 3. Yan Zl	Analyse the perform Liu, A.K. Sadek, W. Su orking,Cambridge Un aDohler, Yonghui Li, Viley & Sons, 2010 hang, Hsiao-Hwa Che	ance of cooperative multiple access , A. Kwasinski, Cooperative Commu iversity Press, 2016 "Cooperative Communications: Har en, Mohsen Guizan,"Cooperative Wi	inication rdware, reless	ns and Channel & PHY",								
CO705. 5 Text Books 1. K.J.R. J Netwo 2. Misch John V 3. Yan Z Comm	Analyse the perform Liu, A.K. Sadek, W. Su orking,Cambridge Un aDohler, Yonghui Li, Viley & Sons, 2010 hang, Hsiao-Hwa Che nunications'''Auerbac	ance of cooperative multiple access , A. Kwasinski, Cooperative Commu iversity Press, 2016 "Cooperative Communications: Han en, Mohsen Guizan,"Cooperative Wi ch Publications 2017	nication rdware, r reless	ns and Channel & PHY",								
CO705. 5 Text Books 1. K.J.R. Metwork 2. Misch John W 3. Yan Zh Comm 4. S. Hay	Analyse the perform Liu, A.K. Sadek, W. Su orking,Cambridge Un aDohler, Yonghui Li, Viley & Sons, 2010 hang, Hsiao-Hwa Che nunications'''Auerbac kin and K.J.R. Liu, Ed	ance of cooperative multiple access , A. Kwasinski, Cooperative Commu iversity Press, 2016 "Cooperative Communications: Han en, Mohsen Guizan,"Cooperative Wi ch Publications 2017 s., Handbook on Array Processing a	nication rdware, reless	ns and Channel & PHY", or Networks, IEEE								
CO705. 5 Text Books 1. K.J.R. I Netwo 2. Misch John V 3. Yan ZI Comm 4. S. Hay Wiley	Analyse the perform Liu, A.K. Sadek, W. Su orking,Cambridge Un aDohler, Yonghui Li, Viley & Sons, 2010 hang, Hsiao-Hwa Che nunications'''Auerbac kin and K.J.R. Liu, Ed , 2019.	ance of cooperative multiple access n, A. Kwasinski, Cooperative Commu iversity Press, 2016 "Cooperative Communications: Han en, Mohsen Guizan,"Cooperative Wi ch Publications 2017 s., Handbook on Array Processing a	nicatior rdware, reless	ns and Channel & PHY", or Networks, IEEE								
CO705. 5 Text Books 1. K.J.R. Metwo 2. Misch John W 3. Yan Zh Comm 4. S. Hay Wiley Reference B	Analyse the perform Liu, A.K. Sadek, W. Su orking,Cambridge Un aDohler, Yonghui Li, Viley & Sons, 2010 hang, Hsiao-Hwa Che nunications'''Auerbac kin and K.J.R. Liu, Ed , 2019. ooks	ance of cooperative multiple access , A. Kwasinski, Cooperative Commu iversity Press, 2016 "Cooperative Communications: Han en, Mohsen Guizan,"Cooperative Wi ch Publications 2017 s., Handbook on Array Processing a	nicatior unicatior rdware, reless und Sens	ns and Channel & PHY", or Networks, IEEE								

- **1.** . K.J.R. Liu and B. Wang, Cognitive Radio Networking and Security: A Game Theoretical View, Cambridge University Press, 2010.
- **2.** H. V. Zhao, W.S. Lin, and K.J.R. Liu, Behavior Dynamics in Media-Sharing Social Networks, Cambridge University Press, 2011Cambridge University Press, 2016
- **3.** Kwang-Cheng Chen and Ramjee Prasad, "Cognitive Radio Networks", John Wiley & Sons, 2009

## Web Resources

- 1. <u>https://www.jhuapl.edu/Content/techdigest</u>
- 2. https://www.commsp.ee.ic.ac.uk/~wiser/publications

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	<b>PO6</b>	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1		2							2			1	2	
2	2									2			3		1
3		2												3	
4	1		2							1					1
5		2	1										1		2

## 21CS3706

VLSI ARCHITECTURE FOR IMAGE AND VIDEO PROCESSING 
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#### Prerequisites for the course

• The pre-requisite knowledge required by the Students to study this Course is basic knowledge in Mathematics.

#### Objectives

- 1. To provide the basic understanding of the digital image formation and visualization.
- 2. To provide the visualization of relationships between spatial and frequency.
- 3. To provide the understanding of mapping the signal processing techniques to the digital image.
- 4. To provide an idea of multimedia data (image,video).
- 5. To provide an exposure to various image and video compression standards

UNIT I	FUNDAMENTALS OF IMAGE PROCESSING AND	9
	IMAGE TRANSFORMS	

Basic steps of Image processing system sampling and quantization of an Image –Basic relationship between pixels Image Transforms: 2 –D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms

UNIT II	IM		9								
Image Enhancement: Spatial Domain methods: Histogram Processing, Fundamentals of Spatia											
Filtering, Smoothing Spatial filters, Sharpening Spatial filters Frequency Domain methods: Basics of											
filtering in fr	equency dom	ain, image	smoothin	ng, image	sharpening,	selective	filtering	Image			
Segmentation:	Segmentation	concepts,	point, line	and Edge	detection, T	hresholdir	ng, region	based			
segmentation											

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UNIT III	MAGE COMPRESSION		9	
Image compression fundamen	ntals -coding Redundancy, spatia	l and tempo	oral redundancy.	
Compression models: Lossy and	d Lossless, Huffmann coding, Arithr	netic coding,	LZW coding, run	
standarda	ng, transform coding, predictive co	ding, wavel	et coding, JPEG	
Standards     UNIT IV     BASIC S	TEPS OF VIDEO PROCESSING		9	
Analog video Digital Video Time	varying Image Formation models :	3D motion m	odels Geometric	
Image formation, Photometric Ima	ge formation, sampling of video sign	als, filtering op	perations	
UNIT V 2-I	D MOTION ESTIMATION		9	
Optical flow, general methodologic	es, pixel based motion estimation, B	ock matching	algorithm, Mesh	
based motion Estimation, global M	lotion Estimation, Region based mot	on estimation	, multi resolution	
motion estimation. Waveform ba	ased coding, Block based transfor	m coding, pi	redictive coding,	
Application of motion estimation	in video coding.Blocks of a VLSI	circuit: Comp	uter architecture,	
memory architectures, communicat	ion interfaces, mixed signal interface	5.		
	Total I	eriods	45	
Suggestive Assessment Method	S			
Continuous Assessment Test	Formative Assessment Test	End Semest	ter Exams	
(30 Marks)	(10 Marks)	(60 Marks)		
1 Description Questions	1 Assignment	1 Description Out		
2.Formative Multiple choice	2.Online Ouizzes	2.Formativ	e Multiple	
questions	3.Problem solving Activities	choice ques	stions	
Outcomes				
Upon completion of the course	the students will be able to:			
CO706 1 Apply spatial and f	requency domain image filters for im	age enhancem	ent	
CO706 2 Comprehend imag	e degradation models for image t	estoration and	d color space	
transforms for colo	r image processing.	cotoration and	eolor space	
CO706. 3 Interpret and apply recognition.	edge detection, image segmentation	and representa	tion for image	
CO706.4 Demonstrate the	use of image and video processir	g algorithms	for different	
applications				
CO706. 5 Apply various imag	ge and video compression standards.			
Text Books				
1. Gonzalez and Woods,	"Digital Image Processing ", 3rded	tion , Pearson	1	
2. Yao wang, JoemOs	tarmann and Ya –quin Zhan	g, "Video	processing and	
communication ",1st e	dition , PHI			
3. Essentials of VLSI	Circuits and Systems, K. Eshrag	hian, Dougla	as A. Pucknell,	
SholehEshraghian, 200	05, PHI Publications.			
Reference Books				
1. M. Tekalp ,"Digital video	Processing". Prentice Hall Internat	ional.		
2. AnerozdemiR.''Inverse	Synthetic Aperture Radar	Imaging w	ith MATLAB	
Algorithms"John Wiley &	& Sons	88		
3. 3. Chris Solomon. Tohy R	reckon .''Fundamentals of Digital	mage Proces	sing A Practical	
Approach with Examples	in Matlah"John Wiley & Sons			

# Web Resources

- <u>https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-ee44/</u>
- <u>https://nptel.ac.in/courses/108/105/108105118/</u>

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2								1	2	3	1	2	
2	3	2	2								2	3	3		1
3	3	2								1	2	3		3	
4	3	2	2							1	2	3			
5	3	2	2							1	2	3			2

• The pre- Robotics	for the course	3	0		1
• The pre- Robotics	for the course		U	0	3
• The pre- Robotics					
Robotics	requisite knowledge required by the Students to study this Course	e is ba	sic k	nowle	dge
Objectives					
1. The	course will give students an opportunity to design and fabric	cate a	ı mo	bile r	obot
platfe	orm and program it to apply learned theoretical concepts in practic	ce as a	a pro	ject.	
2. To u	nderstand the concept of mobile robot kinematics and dynamics.				
3. To aj	pply the concept of Robotic Perception.				
4. To u	nderstand and estimation methods of Localization.				
5. To u	nderstand the concept planning and Navigation.				
UNIT I	<b>ROBOT LOCOMOTION</b>			9	
Types of loc controllabili	comotion, hopping robots, legged robots, wheeled robots, stabi ty.	ility, 1	mano	beuvra	ıbili
UNIT II	MOBILE ROBOT KINEMATICS AND DYNAMICS			9	
Forward and	l inverse kinematics, holonomic and nonholonomic constraints,	, kine	mati	c mod	lels
simple car a	nd legged robots, dynamics simulation of mobile robots.				
UNIT III	<b>ROBOTIC PERCEPTION</b>			9	
Propriocepti	ve/Exteroceptive and passive/active sensors, performance measure	res of	sens	sors, s	enso
for mobile re	obots like global positioning system (GPS), Doppler effect-based	l sens	ors,	vision	bas
sensors, unc	ertainty in sensing, filtering;				
UNIT IV	LOCALIZATION			9	
Odometric r	position estimation, belief representation, probabilistic mapping,	, Mar	kov	localiz	zatio
Bayesian loc	calization, Kalman localization, positioning beacon systems.				

		<u>Fra</u>	ancis X	<u>Kavier</u> Curri	<u>Engine</u> culum	eering and Sy	Colleg yllabi 1	<u>e  Der</u> 2021	ot of E( Ameno	CE   M.E dment 2	- CS   R 2022	<u>2019  </u>			
	UNIT	V	INT	RODU	JCTIO	N TO	PLAN	INING	G AND	NAVIO	GATIO	N		9	
Pa	th plar	ning a	lgorith	ms ba	sed on	A-star	, Dijks	stra, V	oronoi	diagran	ns, prob	abilistic	roadma	ps (PR	M),
rap	oidly e	explori	ng rar	ndom	trees (	(RRT),	Mark	xov D	ecision	Proces	sses (M	IDP), s	tochasti	c dynai	nic
pro	ogrami	ning (S	SDP).												
										Tota	l Perio	ods	4	-5	
Su	ggesti	ive As	sessm	ent M	ethod	S									
Со	ntinu (3	ous As 0 Mar	ssessn ks)	nent I	lest	Forn	native (10	Asses Mark	ssmen s)	t Test	Enc (60	d Seme Marks	ster Ex 5)	ams	
<b>1.</b> I	Descri	iption	Quest	tions		1.As	signm	ent			1.D	escrip	tion Qu	estions	5
2.I	Forma	tive M	<b>Iultip</b>	le cho	ice	2.0n	line Q	uizze	S		<b>2.</b> F	ormati	ve Mul	tiple	
qu	estio	ns				3.Pro	oblem	i solvi	ng Act	ivities	cho	oice qu	estions		
Ou	itcom	es				•					•				
Up	on co	mplet	tion of	f the c	ourse,	the st	tuden	ts will	be ab	le to:					
	CO70	7.1	Under	stand t	he diff	erent t	ypes of	f mobi	le robo	ts and fu	inctiona	ıl desigr	1		
	CO70	7.2	Analy effecto	zing R ors	obot K	inema	tics and	d dyna	mics th	rough d	ifferent	manipu	lators a	nd end	
	CO70	7.3	Under	stand v	various	senso	rs and	applica	ations						
	CO70	7.4	Analy	zing th	e robo	tic loca	alizatio	on & m	apping	,					
	CO70	7.5	Analyz	zing pat	h plann	ing and	l navig	ation of	robots						
Те	xt Bo	oks													
	1. R	. Sieg	wart, l	[. <b>R</b> . N	lourba	khsh,	"Intro	oductio	on to A	Autonor	nous M	obile <b>R</b>	lobots",	The M	IT
	Р	ress, 2	011.												
	2. P	eter (	Corke	, Rob	otics,	Visior	and	Cont	rol: Fu	undame	ntal A	lgorithi	ns in I	MATLA	AB,
	S	pringe	er Trac	ets in A	Advano	ced Ro	botics	, 2011.	•						
	<b>3.</b> S	. M. I	LaVall	e, "Pl	anning	g Algo	orithm	is", Ca	ambric	lge Uni	versity	Press,	2006.	(Availa	ble
	0	nline h	ttp://p	olanniı	1g.cs.u	iuc.ed	u/)								
	4. <b>T</b>	hrun,	S., Bu	rgard	,W., aı	nd Fox	, D., I	Probab	oilistic	Roboti	es. MIT	Press,	Cambr	idge, M	IA,
	2	005.													
Re	feren	ce Bo	oks												
	1. M	Ielgar,	, E. R.,	, Diez,	C. C.,	Ardui	no an	d Kine	ect Pro	jects: D	esign, I	Build, B	low Th	eir Min	ds,
	2	012.													
	2. H	[. Cho	set, K.	<b>M.</b> L	ynch,	S. Hu	tchins	on, G.	Kanto	or, W. 1	Burgar	d, L. E	. Kavra	ki, and	<b>S.</b>
	Т	hrun,	Princi	ples o	f Robo	ot Mot	ion: T	heory	, Algoi	rithms a	and Im	plemen	tations,	PHI L	td.,
	2	005L.	Fauset	t, Fun	damer	ntals of	f Neur	al Net	works,	Prenti	e Hall				
W	eb Re	source	es												
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1.Description Questions 2.Formative Multiple choice questions					ice	1.Assignment 2.Online Quizzes 3.Problem solving Activities				1.D 2.Fe cho	1.Description Questions 2.Formative Multiple choice questions				
Out	tcom	es													
Up	on co	mplet	ion of	the co	ourse,	the st	tudents w	ill be ab	le to:						
(	CO708	8.1	Ana	alyze t	he Fun	ndamer	ntals of RA	DAR Sy	stems.						
(	CO708	8.2	Ana	alyse N	MTI an	d puls	e DOPPLE	R radar.							
(	CO708	8.3	Cre	eate the	e algor	ithm fo	or RADAR	signal p	rocessin	g					
(	CO708	8.4	Ana	alyse N	Naviga	tional	and Remot	e Sensing	g RADA	R					
(	CO708	8.5	Арр	ply the	e learnt	algori	thms to an	alyze nav	vigationa	al aids					
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