# HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY (An Autonomous Institution Affiliated to Anna University, Chennai) (AICTE, New Delhi, Accredited by NAAC with 'A' Grade) COIMBATORE 641 032



DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING (Academic Council Meeting Held on 03.03.2023)

**M.E APPLIED ELECTRONICS – R2020** 

# VISION AND MISSION OF THE INSTITUTION

# **VISION**

To become a premier institution by producing professionals with strong technical knowledge, innovative research skills and high ethical values.

# **MISSION**

IM1: To provide academic excellence in technical education through novelteaching methods. IM2: To empower students with creative skills and leadership qualities.IM3: To produce dedicated professionals with social responsibility.

# VISION AND MISSION OF THE DEPARTMENT

# **VISION**

To nurture Electronics and Communication Professionals with exemplary technical skills adorned with ethical values.

# **MISSION**

M1. To expand frontiers of knowledge through the provision of inspiring learning environment

M2. To develop the intellectual skills towards employability by fostering innovation, and creativity in learning.

M3. To provide a quality system for wholesome learning to achieve progress and prosperity in life along with moral values

# PROGRAM OUTCOMES (POs)

# Engineering Graduates will be able to:

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

PO 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.

PO 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.

PO 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.

PO 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.

PO 6. **The engineer and society**: Apply reasoning informed by the contextualknowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 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.

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

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

PO10.**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.

PO11.**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.

PO12.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

# PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1. Graduates will be able to provide solutions for real time embedded systems using Internet of Things to meet the global needs.

PSO 2. Graduates will have the perseverance to design and develop products using cutting edge technologies in Signal processing and Communication systems.

# PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1. To prepare the graduates to solve, analyze and develop real time engineering products by providing strong foundation in the fundamentals of Electronics and Communication Engineering.

PEO 2. To prepare the graduates to succeed in multidisciplinary dimensions by providing adequate trainings and exposure to emerging technologies.

PEO 3. To prepare the graduates to become a successful leader and innovator following ethics with the sense of social responsibility for providing engineering solutions.

# CURRICULUM



Hindusthan College of Engineering and Technology (An Autonomous Institution, Affiliated to Anna University, Chennai AICTE, New Delhi& Accredited by NAAC with 'A' Grade) Coimbatore, Tamil Nadu.



# **REGULATION-2020**

# For the students admitted during the academic year 2022-2023

S.No.	Course Code	Course Title	Category	L	т	Ρ	С	CIA	ESE	TOTAL	
		THEORY	•								
1	20MA1102	Advanced Mathematics For Electrical And Electronics Engineering	BS	3	0	0	3	40	60	100	
2	20AE1201	Advanced Digital System Design	PC	3	0	0	3	40	60	100	
3	20AE1202	Embedded System Design	PC	3	0	0	3	40	60	100	
4	20AE1203	Digital Image Processing	PC	3	0	0	3	40	60	100	
5	20AE1204	Research Methodology	PC	3	0	0	3	40	60	100	
6	20AC10XX	AUDIT COURSE I		2	0	0	0				
		PRA	CTICAL								
7	20AE1001	Electronic System Design Laboratory	PC	0	0	4	2	50	50	100	
8	20AE1002	Embedded System Laboratory	PC	0	0	4	2	50	50	100	
	MANDATORY COURSE										
	Total Credits:         17         00         08         19										

# SEMESTED I

# SEMESTER II

S.No.	Course Code	Course Title	Category	L	т	Р	С	CIA	ESE	TOTAL
	·	THE	ORY							
1	20AE2201	Analog Integrated Circuit Design	PC	3	0	0	3	40	60	100
2	20AE2202	VLSI Design Techniques	PC	3	0	0	3	40	60	100
3	20AE23XX	Professional Elective I	PE	3	0	0	3	40	60	100
4	20AE23XX	Professional Elective II	PE	3	0	0	3	40	60	100
5	20AE23XX	Professional Elective III	PE	3	0	0	3	40	60	100
6	20AC20XX	AUDIT COURSE II		2	0	0	0			
	·	PRA	ACTICAL							
7	20AE2001	VLSI Design Laboratory	PC	0	0	4	2	50	50	100
8	20AE2901	MINI PROJECT	PC	2	0	0	2	50	50	100
	Tota	al Credits:		19	00	08	19			

# LIST OF PROFESSIONAL ELECTIVES

# PROFESSIONAL ELECTIVE

S.No.	Course Code	Course Title	Category	L	Т	Р	С	CIA	ESE	TOTAL
1.	20AEX301	Intelligent Systems and Control	PE	3	0	0	3	40	60	100
2.	20AEX302	Advanced Microprocessors and Microcontrollers	PE	3	0	0	3	40	60	100
3.	20AEX303	ASIC and FPGA Design	PE	3	0	0	3	40	60	100
4.	20AEX304	Physical Design of VLSI circuits	PE	3	0	0	3	40	60	100
5.	20AEX305	High Speed Switching and Network	PE	3	0	0	3	40	60	100
6.	20AEX306	Programming Languages for Embedded Software	PE	3	0	0	3	40	60	100
7.	20AEX307	Cognitive Radio Network	PE	3	0	0	3	40	60	100
8.	20AEX308	Wireless Adhoc and Sensor Networks	PE	3	0	0	3	40	60	100
9.	20AEX309	Robotics and Intelligent Systems	PE	3	0	0	3	40	60	100
10.	20AEX310	Satellite Communication and Navigation	PE	3	0	0	3	40	60	100
11.	20AEX311	5G Technology	PE	3	0	0	3	40	60	100
12.	20AEX312	IOT System Design and Security	PE	3	0	0	3	40	60	100
13.	20AEX313	Machine Learning	PE	3	0	0	3	40	60	100
14.	20AEX314	Electronics for Solar Power	PE	3	0	0	3	40	60	100
15.	20AEX315	PCB Design and Fabrication	PE	3	0	0	3	40	60	100

# OPEN ELECTIVE

S.No.	Course Code	Course Title	Category	L	Т	Ρ	С	CIA	ESE	TOTAL
1	20AE3401	Robotics	OE	3	0	0	3	40	60	100
2	20AE3402	Artificial intelligence and Optimization Techniques	OE	3	0	0	3	40	60	100

# AUDIT COURSES – I

S.No.	Course Code	Course Title	L	Т	Ρ	С
1	20AC1091	English for Research Paper writing	2	0	0	0
2	20AC1092	Disaster Management	2	0	0	0

3	20AC1093	Sanskrit for Technical knowledge	2	0	0	0
4	20AC1094	Value Education	2	0	0	0
5	20AC1095	Constitution of India	2	0	0	0

# AUDIT COURSES - II

S.No.	Course Code	Course Title	L	т	Р	С
1	20AC2091	Pedagogy Studies	2	0	0	0
2	20AC2092	Stress Management by Yoga	2	0	0	0
3	20AC2093	Personality Development Through Life Enlightenment Skills	2	0	0	0
4	20AC2094	Unnat Bharat Abhiyan	2	0	0	0

# **REGULATION-2020**

# For the students admitted during the academic year 2021-2022

# SEMESTER III

S.No.	Course Code	Course Title	Category	L	Т	Р	С	CIA	ESE	TOTAL
		THEO	RY							
1	20AE33XX	Professional Elective IV	PE	3	0	0	3	40	60	100
2	20AE33XX	Professional Elective V	PE	3	0	0	3	40	60	100
3	20AE34XX	OPEN ELECTIVE	OE	3	0	0	3	40	60	100
		PRAC	TICAL							
4	20AE3901	DISSERTATION I	PC	0	0	20	10	50	50	100
	Т		09	00	20	19				

# SEMESTER IV

S.No.	Course Code	Course Title	Category	L	т	Ρ	С	CIA	ESE	TOTAL	
PRACTICAL											
1	20AE4901	DISSERTATION - II	PC	0	0	30	15	50	50	100	
	Т	otal Credits:		0	0	30	15				

Total No of Credits: 72

# LIST OF PROFESSIONAL ELECTIVES

# PROFESSIONAL ELECTIVE

~ ~ ~	Course	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~		_	_	_	~	~~ .		
S.No.	Code	Course Title	Category	L	Т	Р	C	CIA	ESE	TOTAL

							I			
1.	20AEX301	Intelligent Systems and Control	PE	3	0	0	3	40	60	100
2.	20AEX302	Advanced Microprocessors and Microcontrollers	PE	3	0	0	3	40	60	100
3.	20AEX303	ASIC and FPGA Design	PE	3	0	0	3	40	60	100
4.	20AEX304	Physical Design of VLSI circuits	PE	3	0	0	3	40	60	100
5.	20AEX305	High Speed Switching and Network	PE	3	0	0	3	40	60	100
6.	20AEX306	Programming Languages for Embedded Software	PE	3	0	0	3	40	60	100
7.	20AEX307	Cognitive Radio Network	PE	3	0	0	3	40	60	100
8.	20AEX308	Wireless Adhoc and Sensor Networks	PE	3	0	0	3	40	60	100
9.	20AEX309	Robotics and Intelligent Systems	PE	3	0	0	3	40	60	100
10.	20AEX310	Satellite Communication and Navigation	PE	3	0	0	3	40	60	100
11.	20AEX311	5G Technology	PE	3	0	0	3	40	60	100
12.	20AEX312	IOT System Design and Security	PE	3	0	0	3	40	60	100
13.	20AEX313	Machine Learning	PE	3	0	0	3	40	60	100
14.	20AEX314	Electronics for Solar Power	PE	3	0	0	3	40	60	100
15.	20AEX315	PCB Design and Fabrication	PE	3	0	0	3	40	60	100

# OPEN ELECTIVE

S.No.	Course Code	Course Title	Category	L	Т	Ρ	С	CIA	ESE	TOTAL
1	20AE3401	Robotics	OE	3	0	0	3	40	60	100
2	20AE3402	Artificial intelligence and Optimization Techniques	OE	3	0	0	3	40	60	100

# **CREDIT DISTRIBUTION**

Semester	I	11	111	IV	Total
Credits	19	19	19	15	72

P. Hayle Chairman, Board of Studies

Chairman - BoS ECE - HICET .

Dean Academics Dean (Academics) HICET

Principal

# SYLLABUS

For the students admitted during the academic year 2022-2023

# **SYLLABUS**

For the students admitted during the academic year 2022-2023

# **SEMESTER-I**

PROGRAMME C		COURSE CODE		NAME OF THE COURSE		Т	Р	С
N	I.E	20M	A1102	ADVANCED MATHEMATICS FOR ELECTRICAL AND ELECTRONICS ENGINEERING	3	0	0	3
Co Obj	ourse ective	1. 2. 3. 4. 5.	Apply test Formulate life situati Understan Develop tl Acquire kr	ing of hypothesis to infer outcome of experiments. and construct a mathematical model for a linear programm on. d the network modeling for planning and scheduling the pro- he ability to use the concepts of Linear Algebra and Specia nowledge of Fuzzy logic and Fuzzy Algebra.	ning p oject Il fun	oroble activi ctions	m in re ties. for	eal
Unit			-	Description		Inst I	ructio Hours	nal
	TESTIN	G OF HY	POTHESI	ES				
Ι	Sampling and F dis of attribu	g distribut stributions ites and G	ions -Type l for testing oodness of t	I and Type II errors - Tests based on Normal, t, Chi-Square of mean, variance and proportions -Tests for Independence fit.	:		9	
	LINEAI	R PROGR	RAMMING					
II	Formula Transpor	tion - Grap tation and	phical soluti Assignmer	on - Simplex method - Artificial variable Techniques - nt Models			9	
	SCHED	ULING B	Y PERT A	ND CPM				
III	Network Resource	Construct Analysis	tion - Critica in Network	al Path Method - Project Evaluation and Review technique Scheduling.	-		9	
IV	LINEAI Vector sj eigenvec inverse -	<b>R ALGEB</b> paces – no ctors - Car least squa	<b>FRA</b> rms - Inner nonical form re approxim	Products - Eigen values using QR Factorization - generalizents - singular value decomposition and applications -pseud nations -Toeplitz matrices and some applications.	ed lo		9	
V	FUZZY Basic pr	LOGIC A	<b>AND FUZZ</b> f Fuzzy logi	<b>CY ALGEBRA</b> c - Fuzzy sets of operations - Fuzzy membership Matrix.			9	
				Total Instructional Hour	rs		45	
		CO1:A	Acquire the	basic concepts of Probability and Statistical techniques for	solv	ing m	athem	atical
Co Ou	ourse tcome	cO2:A travell CO3:P	m which wi Apply transp ing. Prepare projection	Il be useful in solving engineering problems. portation and assignment models to find optimal solution ect scheduling using PERT and CPM.	n in und m	wareh	nousing	g and
		CO5:A	Apply the Fu	izzy logic in power system problems.	ind in	letilou	01 301	ving
TEXT I	BOOK	0	1.100		07			
Т1 Т2	-Richard B	ronson, G	abriel B.Co	sta, "Linear Algebra", Academic Press, Second Edition, 20 http://www.second.com/academics/for/Engineer," Prontice, H	07. [511-7	<sup>th</sup> Edit	tion	
200	-Richard 50 7.	Jillison, I		and s riobability and statistics for Engineer , richtice –	an, 7	Lun	.1011,	
T3	- Taha H.A	,"Operatio	ons Researc	h, An Introduction "8 <sup>th</sup> Edition, Pearson Education, 2008.				
REFER	ENCE BO	OOKS						
R1 R2 R3-	-Gupta S.C -Prem Kur Panner Se	C. and Kap nar Gupta, lvam,Ope	oor V.K."F D.S.Hira,"( rations Rese	undementals of Mathematical Statistics", Sultan an Sons,20 Dperations Research," S.Chand &Company Ltd, New Delhi earch",Prentice Hall of India,2002.	)01. i,3 <sup>rd</sup> e	edition	<b>,</b> 2008	

**R4**- George J.Klir and Yuan,B., Fuzzy sets and fuzzy logic, Theory and applications, Prentice Hall of India Pvt.Ltd., 1997.

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PROGRA PROGE	MME RAMME	COURSE CODE	NAME OF THE COURSE	L	Т	Р	С
Μ	I.E	20AE1201	ADVANCED DIGITAL SYSTEM DESIGN	3	0	0	3
Cc Obj	ourse ective	<ol> <li>Basic con</li> <li>Basic con</li> <li>Learn the</li> <li>Study the</li> <li>Apply th</li> </ol>	acepts of Sequential Circuit Design. Acepts of Asynchronous Sequential Circuit Design. Concepts of fault modeling and fault - tolerant syst concepts of programmable logic devices. e concepts of System Design Using Verilog and Pr	stems ogramn	nable D	evices	
Unit			Description			Instruct Hou	ional rs
Ι	SEQUE Analysis table, sta chart and	NTIAL CIRCUIT E of clocked synchron te table assignment and realization using AS	<b>DESIGN</b> nous sequential circuits and modeling- State diag ad reduction-Design of synchronous sequential circ SM.	gram, st uits -AS	ate SM	9	
п	ASYNCI Analysis transition Static, dy asynchro	HRONOUS SEQUE of asynchronous seq to table and problems ynamic and essential nous circuits – design	<b>ENTIAL CIRCUIT DESIGN</b> Juential circuit – flow table reduction-races-state a in transition table- design of asynchronous sequen hazards – data synchronizers – mixed operating n ning vending machine controller	ssignme tial circu 10de	nt- uit-	9	
Ш	FAULT Fault tab Toleranc schemes	le method-path sensi e techniques – The – Built in self test.	itization method – Boolean difference method-D a compact algorithm – Fault in PLA – Test gener	algorithi ation-D	m - )FT	9	
IV	SYNCH Program PLA/PA 4000	RONOUS DESIGN ming logic device fa L – Realization of fir	USING PROGRAMMABLE DEVICES amilies – Designing a synchronous sequential cin nite state machine using PLD – FPGA – Xilinx FP	cuit usi GA-Xili	ng inx	9	
V	SYSTEN Hardwar Modellin Synthesis simulatic circuits u Multiplie	<b>A DESIGN USING</b> e Modelling with Vering in Verilog HDL s – Synthesis of Fin on of Verilog code – using Verilog – Regi er- Divider – Design of	VERILOG erilog HDL – Logic System, Data Types and Op - Behavioral Descriptions in Verilog HDL – H ite State Machines– structural modeling – comp -Test bench - Realization of combinational and sters – counters – sequential machine – serial adde of simple microprocessor.	erators 1 DL Bas ilation a sequen er –	For sed and tial	9	
Co Ou	ourse tcome	CO1: Design and CO2: Design and CO3: Explore fau CO4: Learn of pro CO5: Design and	analysis of sequential circuit. analysis of asynchronous sequential circuit. It diagnosis and testability algorithm ogrammable logic devices. analysis of hardware description languages.	11a1 F101	11.2	40	
TEXT I	BOOKS:	U					
T1	Char	les H.Roth Jr "Funda	mentals of Logic Design" Thomson Learning 2004	4			
T2	M.D	.Ciletti , Modeling, S	ynthesis and Rapid Prototyping with the Verilog H	IDL, Pro	entice H	all, 1999	•
REFER	ENCE BC	OOKS:					
<b>R1</b>	M.G	Arnold, Verilog Dig.	ital – Computer Design, Prentice Hall (PTR), 1999	).			
R2	Para	g K.Lala "Digital sys	tem Design using PLD" B S Publications,2003				
R3	Nrip	endra N Biswas "Log	gic Design Theory" Prentice Hall of India,2001				

**R4** Parag K.Lala "Fault Tolerant and Fault Testable Hardware Design" B S Publications,2002

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PROGRAMM	ME COURSE CODE	NAME OF THE COURSE	L	Т	Р	С
M.E	20AE1202	EMBEDDED SYSTEM DESIGN	3	0	0	3
Course Objective	<ol> <li>Understand th</li> <li>Study general</li> <li>Understand bu</li> <li>Learn the emb</li> <li>Study the emb</li> </ol>	e design challenges and methodologies of embedded system and single purpose processor and its development as structures bedded system design procedures for various processes bedded software tools for RTOS				
Unit		Description		Instru Ho	ctiona ours	1
I	EMBEDDED SYSTEM OVEL Embedded System Overview Methodology, RT-Level C Custom Single-Purpose Proc	<b>RVIEW</b> 7, Design Challenges – Optimizing Design Metrics, Design combinational and Sequential Components, Optimizing essors.		9	9	
п	GENERAL AND SINGLE PU Basic Architecture, Pipelini Environment: Application-Sp Timers, Counters and watch Memory Concepts.	<b>RPOSE PROCESSOR</b> ing, Superscalar and VLIW architectures, Development becific Instruction-Set Processors (ASIPs) Microcontrollers, dog Timer, UART and Analog-to-Digital Converters,		9	9	
III	BUS STRUCTURES Basic Protocol Concepts, Mi Based I/O, Arbitration, Seria and ARM Bus, Wireless Prot	icroprocessor Interfacing – I/O Addressing, Port and Bus- al Protocols, I <sup>2</sup> C, CAN and USB, Parallel Protocols – PCI tocols – IRDA, Bluetooth, IEEE 802.11.		9	9	
IV	Basic State Machine Model. Process Model, Communica Dataflow Model, Real-time S Design Process Models.	, Finite-State Machine with Data path Model, Concurrent tion among Processes, Synchronization among processes, ystems, Automation: Synthesis, Intellectual Property Cores,		9	9	
V	<b>EMBEDDED SOFTWARE D</b> Compilation Process – Librar – Emulation and debugging t	<b>EVELOPMENT TOOLS AND RTOS</b> ries – Porting kernels – C extensions for embedded systems echniques – RTOS – System design using RTOS.		9	9	
		<b>Total Instructional Hours</b>		4	15	
Course Outcome	CO1: Identify the CO2: Evaluate the CO3: Compare va CO4: Recognize the CO5: Apply the en	various embedded system design e general and single purpose processors rious bus structures he process models mbedded software development tools				

# **TEXT BOOKS:**

- **T1** Bruce Powel Douglas, "Real time UML, second edition: Developing efficient objects for embedded systems", 3rd Edition 1999, Pearson Education.
- T2 Frank Vahid and Tony Gwargie, "Embedded System Design", John Wiley & sons, 2002.

# **REFERENCE BOOKS:**

- **R1** Daniel W.Lewis, "Fundamentals of embedded software where C and assembly meet", Pearson Education, 2002.
- **R2** Steve Heath, "Embedded System Design", Elsevier, Second Edition, 2004.
- **R3** Jonathan W.Valvano: "Embedded Microcomputer Systems Real Time Interfacing", Cengage Learning; Third of later edition
- R4 Osborn.G, "Embedded microcontroller and p0rocessor design", Pearson





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PROGRA PROGI	AMME RAMME	COURSE CODE	NAME OF THE COURSE	L	Т	Р	С
M CO OB.	4.E OURSE JECTIVE	20AE1203 1. To understa 2. To analyze 3. To study an 4. To study an 5. To understa	DIGITAL IMAGE PROCESSING and the fundamentals of Digital Image and design the Image transforms and Enhancen d analyze the operation of Image restoration and d understand the Image compression & Segmer nd color and multispectral image processing.	3 nent. d construction ntation.	0	0	3
Unit			Description		I	nstructi Houu	ional rs
I	Digital In Introducti Perception Geometric Convoluti	nage Fundamentals. on: Digital Image- Steps n -Connectivity and Relati c Operations. Mathematic on - Correlation 2D Rand	s of Digital Image Processing Systems-Eleme ions between Pixels. Simple Operations- Arithm cal Preliminaries - 2D Linear Space Invariant iom Sequence - 2D Spectrum.	ents of Visual netic, Logical, Systems - 2D		9	
II	Image Tra Image Tra FFT – Do Properties Processing Nonlinear	ansforms: 2D Orthogonal CT -Hadamard Transforms: And Examples.Image g-Spatial Filtering-In Spa Filtering-Use Of Differer	and Unitary Transforms-Properties and Examp n - Haar Transform - Slant Transform - KL Enhancement:- Histogram Equalization Tech ce And Frequency - nt Masks.	oles. 2D DFT- , Transform - nnique- Point		9	
III	Image res Image Res Matrices a By Wiene Image Res	storation and constructions to a storation: Image Observation and Its Application In Degree Filtering – Generalized I construction From Projections From Projection From Projection From Projections From Projecti	on. tion And Degradation Model, Circulant And Bl radation Model - Algebraic Approach to Restor nverse-SVD and Interactive Methods - Blind D tions.	ock Circulant ation- Inverse econvolution-		9	
IV	Image co Image Co Variable-I Lossy Tra Edge Dete Boundary Erosion, C	mpression & segmentat mpression: Redundancy A Length, Huffman, Arithmonsform (DCT) Based Cod ection - Line Detection - Representation, Region Dpening And Closing. Hit	ion And Compression Models -Loss Less And Loss etic Coding - Bit-Plane Coding, Loss Less Predi ing, JPEG Standard - Sub Band Coding. Image Curve Detection - Edge Linking And Bounda Representation And Segmentation, Morphol And Miss Algorithms Feature Analysis	sy. Loss Less- ictive Coding, Segmentation: ry Extraction, logy-Dilation,		9	
V	Color Im Different Image Pro Shaded Su	age-Processing Fundame Models. Multispectral In pressing-Computerized A urface Display.	entals, RGB Models, HSI Models, Relations nage Analysis - Color Image Processing Three xial Tomography-Stereometry-Stereoscopic In	ship Between Dimensional nage Display-		9	
			TOTAL INSTRUCTION	VAL HOURS		45	
COI OUT TE T	URSE COME XT BOOK 1 Digital	At the end of this course CO1: Identify various an CO2: Analyze the opera CO3: Design Image con CO4: Design the Image CO5: Create models for <b>S:</b> I Image Processing, Gonz	e, students will be able to rithmetic and geometrical operations of image f tion Image transforms and Enhancement. npression and restoration techniques. compression and Segmentation. color and multispectral image processing. alez.R.C & Woods. R.E., 3/e, Pearson Educatio	undamental. on, 2008.			

T2 Digital Image Processing, ContaitEntice & Woods, KEL, 5(c, Fearson Education, 1995.

# **REFERENCES:**

- R1 1. Digital Image Processing, S. Jayaraman, S. Esakkirajan, T. Veerakumar, McGraw Hill Education ,2009
- R2 2.Fundamentals of Digital image Processing, Anil Jain.K, Prentice Hall of India, 1989.
- **R3** 3.Image Processing, Sid Ahmed, McGraw Hill, New York, 1995
- R4 4.Image Processing: The Fundamentals, Maria Petrou, Costas Petrou, Wiley, 2010

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PROGRAMMI	E	COURSE CODE	NAME OF THE COURSE	L	Т	Р	C
M.E	NIC	20AE1204	RESEARCH METHODOLOGY	3	0	0	3
Cor Obje	urse ectives	<ol> <li>Impart scientifi</li> <li>Understand the</li> <li>Acquire knowl</li> <li>Confer about th</li> <li>Disseminate knowl</li> </ol>	c knowledge for carrying out research work concepts in various research designs. edge about Experimental design and Data ne multivariate analysis techniques nowledge on Research Practices and Repor	rk effectively collection rt writing.	7.		
Unit			Description		Inst	tructional	1
I	INTI	RODUCTION TO RES	SEARCH			nours	
II	Resea resea Signi <b>RES</b>	arch-Definition-Objectiv rch -Importance of resea ficance-Problems in rese EARCH DESIGN	ves of research, Meaning of research- Char arch activities- Types of research-Research earch- Qualities of good researcher- Resea	cacteristics of approaches- arch process.		9	
	Form Secon expendesig	ulation of the research of ndary resource analysis rimentation-factors affeo n - Pre-experimental- Q	design: Process-classification of research design- -Two-tiered research designValidity i cting external validity-classification of exp uasi-experimental designs.	designs- Exp n perimental	loratory	<sup>7-</sup> 9	
III	DAT Class Colle Resea	A COLLECTION ME dification of Data-Colle ection of data through Q arch applications of sec andary data-Internal –Ext	<b>THODS</b> ection of primary data-Observation-Interv Questionnaires-schedules-collection of sec condary data-Benefits and drawbacks-class ernal data sources.	view method condary data- ssification of	-	9	
IV	MUI Grow Varia analy RES	<b>CTIVARIATE ANALY</b> with of Multivariate technologies in multivariate resis-Rotation in factor and <b>EARCH PRACTICE</b> 4	SIS TECHNIQUES niques-Characteristics and applications-C analysis-Important multivariate techn alysis-R-type and Q type factor analysis-F ND REPORT WRITING	lassification- iiques-Factor Path analysis.	•	9	
	Litera Citati repor repor work	ature review-Conference ion index-h-index-Signi t-Layout of report writi t-precautions for writir -Oral presentation.	e proceedings-Journals-Journal Impact F ificance of report writing-Different step ing-Types of reports-Mechanics of writin ng research reports-Conclusion and Scop	<sup>2</sup> actor (JFI)- is in writing ig a research be for future	; L	9	
		1	Total instruc	tional hours	5	45	
Cou Outco	rse omes	CO1: Observe the var CO2: Carryout the re CO3: Evaluate the da CO4: Acknowledge t CO5: Organize the re	rious approaches to do research. search design. ta collection for research activities. he function of Multivariate Analysis Tech search activity systematically and prepare	niques research rep	ort effe	ctively.	

# **TEXT BOOKS:**

- **T1.** C.R. Kothari, Research Methodology Methods & Techniques, NEW Age International (P) Limited, New Delhi, 2007.
- **T2.** Dr. Deepak Chawla, Dr. Neena Sondhi, Research Methodology concepts and cases, Vikas Publishing House Pvt. Ltd., New Delhi, 2011

# **REFERENCE BOOKS:**

- **R1.** K. Prathapan, Research Methodology for Scientific Research, I.K. International Publishing House Pvt. Ltd. New Delhi, 2014L.
- R2. R. Panneerselvam, Research Methodology, PHI Learning Private Limited, New Delhi, 2011.
- R3. Donald H. McBurney, Research Methods, Thomson Asia Pvt. Ltd. Singapore, 2002.

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PROGRAMME PROGRAMM	COURSE CODE	NAME OF THE COURSE	L	Т	Р	С
M.E	20AE1001	ELECTRONIC SYSTEM DESIGN LABORATORY	0	0	4	2
Course Objective	<ol> <li>Impart the knowledge of</li> <li>Testing of flash control</li> <li>Analyze of process con</li> <li>Intend and analysis of r</li> <li>Design system using in</li> </ol>	on Interfacing of different Processor. ller programming. trol and PCB designing. nodulator and demodulator. strumentation amplifier.				
Expt. No.		Description of the experiments				
1	Study of different interfaces	(using Embedded Microcontroller).				
2	Flash Controller Programmin	g Data flash, with erase, verify and Fusing.				
3	Design of Wireless Data Moo	lem.				
4	PCB layout design using CA	D tool.				
5	Design of Process Control Timer.					
6	Design of AC/DC voltage reg	gulator using SCR.				
7	Design of an Instrumentation	Amplifier.				
8	Implementation of Adaptive	filters and multistage multi-rate system in DSP p	rocessor.			
9	Sensor design using simulation tools.					
10	Design of Temperature senso	r using Instrumentation Amplifier.				

# Total Practical Hours 45

	CO1: Design various analog / digital transceiver systems and control different process.
Course Outcome	CO2: Analyze flash controller programming and wireless data modem.
	CO3: Analyze PCB designing for various circuits.
	CO4: Propose interfaces using modulator and demodulator.

CO5: Design and analysis of operational and instrumentation amplifiers.



PROGRAMME	COURSE CODE	NAME OF THE COURSE	L	Т	Р	С
M.E	20AE1002	EMBEDDED SYSTEMS LABORATORY	0	0	4	2

Course Objective	<ol> <li>Impart the knowledge on various analog / digital transceiver systems and control different process.</li> <li>Design system using 8086 and 8051 Microcontroller.</li> <li>Study and design wireless network using embedded systems.</li> <li>Study the different interfaces using Embedded Microcontroller.</li> <li>Intend and analysis of real time operating system.</li> </ol>
Expt. No.	Description of the experiments
1	System design using PIC Micro controller and its applications.
2	Testing of RTOS environment and system programming using ARM7 Processor.
3	System design using 8051 Micro Controller, 8086 Micro Processor.
4	RTC using PIC Micro Controller.
5	Elevator controller using PIC Micro Controller.
6	Modern Train Controller using PIC micro controller.
7	Study of MSP430 and 8086-16 bit Microprocessor its applications
8	Designing of Wireless Network using Embedded System.

- 9 Sensor design using simulation tools.
- Study of 32 bit ARM7 microcontroller RTOS and its applications 10

### **Total Practical Hours** 45

Course Outcome	<ul> <li>CO1: Design various analog / digital transceiver systems and control different process.</li> <li>CO2: Propose interfaces using embedded Microcontroller.</li> <li>CO3: Experiment Wireless Network Using Embedded Systems.</li> <li>CO4: Analyze the system using 8086 and 8051 Microcontroller.</li> <li>CO5: Design and Analysis of Real Time Operating System</li> </ul>
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# SEMESTER-II

	OURSE CODE	NAME OF THE COURSE	L	T P	С
M.E	20AE2201	ANALOG INTEGRATED CIRCUIT DESIGN	3	0 0	3
Course Objectives	<ol> <li>Design the si loads.</li> <li>Analyze high associated wi</li> <li>Study the dif current refere</li> <li>Gain the vari</li> <li>Learn the dif</li> </ol>	with different naracteristics Evoltage and			
Unit		Description		Instructiona	1
I SINGL	E STAGE AMPLI	IFIERS		nours	
Basic M different load, De gain, BV	OS physics and equivalent tial with active load esign of differentia W, ICMR and power	uivalent circuits and models, CS, CG and Source I d, Cascode and folded cascode configurations wi l and cascode amplifiers – to meet specified SI er dissipation, voltage swing, High gain amplifie	Follower th active R, noise, er,	9	
II HIGH I AMPLI Miller e source f	FREQUENCY AN FREQUENCY AN FIERS offect, association of follower, cascode a offect in single stage	<b>D NOISE OF CHARACTERISTICS</b> of poles with nodes, frequency response of CS, and differential pair stages, Statistical character amplifiers, noise in differential amplifiers	CG and istics of	9	
III FEEDB Properti network Two-sta	ACK AND ONE S es and types of neg s, operational ampl age Op Amps, Input	STAGE OPERATIONAL AMPLIFIERS gative feedback circuits, effect of loading in feedb lifier performance parameters, One-stage Op Am t range limitations, Gain boosting, slew rate, pow	back ps, er	9	
IV STABII AMPLI	LITY AND FRE( IFIER	QUENCY COMPENSATION OF TWO STA	AGE		
Analysis stage an Compen Amps, O	s of two stage Op as d using cascode se isation, and Compe Other compensation	mp – two stage Op amp single stage CMOS Cs a econd stage, multiple systems, Phase Margin, Fr ensation of two stage Op Amps, Slewing in two s in techniques.	s second equency stage Op	9	
V BANDO Current source, amplifie and CT/	GAP REFERENCE sinks and sources, Cascode current ers, Supply indepen	ES Current mirrors, Wilson current source, Wildar source, Design of high swing cascode sink, dent biasing, temperature independent references	current current s, PTAT	9	
und em	ff current generati	Total instruction	al hours	45	
Course	CO1: Design and a CO2: Aquire of free CO3: Familiarize th	nalysis of amplifiers. quency response and noise analysis. he Operational Amplifiers. ferent types of Biasing Circuits.			

- R1. Grebene, "Bipolar and MOS Analog Integrated Circuit Design", John Wiley & sons, Inc., 2003.
- **R2.** Phillip E.Allen, Douglas R.Holberg, "CMOS Analog Circuit Design", Oxford University Press, 2nd Edition, 2002.
- **R3.** Jacob Baker "CMOS: Circuit Design, Layout, and Simulation", Wiley IEEE Press, 3rd Edition, 2010..

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PROGRAMME PROGRAMME		COURSE CODE NAME OF THE COURS		L	Т	Р	С	
M	I.E	20AE2202	VLSI DESIGN TECHNIQUES	3	0	0	3	
COURSE OBJECTIVE		<ol> <li>To impart knowledge on</li> <li>To understand the fundamentals of MOS transistor theory.</li> <li>To analyze and design the CMOS technologies.</li> <li>To study and discuss characteristics and performance estimation.</li> <li>To study and understand the VLSI system components.</li> <li>To understand Verilog programming.</li> </ol>						
Unit			Description		In	structi Hour	ional :s	
I	INTROI MOS tran transistor gate capa DC trans	<b>INTRODUCTION TO MOS TRANSISTOR THEORY</b> MOS transistors, CMOS logic, MOS transistor theory–Introduction, Enhancement mode transistor action, Ideal I-V characteristics, Simple MOS capacitance Models, Detailed MOS gate capacitance model, Detailed MOS Diffusion capacitance model,Non ideal I-V effects, DC transfer characteristics, VLSI Design flow						
п	CMOS T CMOS fa tub proce CMOS ci and pack	<b>CMOS TECHNOLOGY AND DESIGN RULE</b> CMOS fabrication and Layout, CMOS technologies, P-Well process, N-Well process, twin- tub process, MOSlayers stick diagrams and Layout diagram, Layout design rules, Latch up in CMOS circuits, CMOS process enhancements, Technology–related CAD issues, Fabrication and packaging						
III	<b>CIRCUIT CHARACTERISATION &amp; PERFORMANCE ESTIMATION</b> Determination of Pull-up to Pull-down ratio for NMOS inverter, super buffers, Driving large capacitance loads, Circuits families, transmission gates, Delay estimation, Power dissipation, Design margin, Scaling of MOSCircuits.					9		
IV	VLSI SY Multiplez Ripple ca	VLSI SYSTEM COMPONENTS CIRCUITS Multiplexers, Decoders, comparators, priority encoders, Shift registers. Arithmetic circuits– Ripple carryadders, Carry look ahead adders, High-speed adders, Multiplier						
V	Overview concepts, modeling	v of digital design with Ver modules and port definition task & functions, Test Be		9				
			TOTAL INSTRUCTIONAL	HOURS		45		
		CO1: Identify vari	ous MOS transistor theory					

cor: lucitury	various mic	b transistor	uncory	
CO2: Analyze	the CMOS	technology	and to	design.

**COURSE OUTCOME** CO3: Design and analyze circuit characteristics and Performance.

CO4: Design the VLSI system components and circuits.

CO5: Create models using Verilog programming.

# **TEXT BOOKS:**

- T1 Neil H.E.Weste, David Harris and Ayan Banerjee, "CMOS VLSI Design a circuits and systems perspective, Third Edition, Pearson Education, 2010
- T2 Douglas A.Pucknell and Kamran Eshraghian, "Basic VLSI Design", Third Edition, Prentice-Hall of India 2004. **REFERENCES:**
- R1 Samir Palnitkar, "Verilog HDL a Guide to Digital Design and Synthesis", Second Edition, Pearson Education, 2010.
- R2 John P.Uyemura "Introduction oVLSI Circuits and Systems", Wiley India Edition, 2006.
- **R3** Neil H.E. Weste and Kamran Eshraghian, Principles of CMOS VLSI Design, Pearson Education ASIA, 2nd edition, 2000.





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PROGRAM PROGRA M.I	IMECOURSAMMEE20AE	<b>E CODE</b> E2001	NAME OF THE COURSE VLSI DESIGN LABORATORY	<b>L</b> 0	Т 0	<b>P</b> 4	С 2
Course Objective	1. 2. 3. 4. 5.	<ol> <li>Learn new software tools for VLSI.</li> <li>Study various design methods for VLSI circuits.</li> <li>Gain the knowledge about circuit designing.</li> <li>Analyze various applicationsusing VHDL and Verilog.</li> <li>Analysis the digital system and simulator.</li> </ol>					
EXPT. No		Desc	ription of the Experiments				
1.	Design and Simula	Design and Simulation of Arithmetic /logic operator circuits using verilog/VHDL					
2.	Design and 8-bit signed multiplication algorithm using verilog / VHDL						
3.	Modeling of Comb	inational/Seque	ential Circuits Using Verilog HDL				
4.	Simulation of Digit	tal Circuits usin	g Xilinx ISE.				
5.	Design and Simula	tion of Digital C	Circuits using VHDL and Porting them into FPGA.				
6.	Layout of Simple N	MOS/CMOS C	Circuits.				
7.	Analysis of Asynch	nronous and cloo	cked synchronous sequential circuits.				
8.	Design and Implem	nentation of AL	U in FPGA using VHDL and Verilog.				
9.	Modeling of Seque	ntial Digital sys	stem using Verilog and VHDL.				

10. Modeling of MAC unit using verilog / VHDL

# **Total Practical Hours**

45

Course Outcome	<ul><li>CO1: Use the software tools for designing and simulation.</li><li>CO2: Design the various VLSI circuits using VHDL programming.</li><li>CO3: Familiarize the applications of VLSI circuits.</li><li>CO4: Analysis the MAC unit using verilog.</li></ul>
Outcome	CO4: Analysis the MAC unit using verilog.
	CO5: Design the VLSI circuits using Xillinx ISE tool.

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P	rogramme ME	Course Code 20AEX301	Name of the Course INTELLIGENT SYSTEMS AND CONTROL	<b>L</b> 3	<b>T</b> 0	<b>P</b> 0	<b>C</b> 3		
Co Ob	ourse jective	<ol> <li>Introduce a</li> <li>Classify on</li> <li>To learn ab</li> <li>Gain know</li> <li>Build appli</li> </ol>	bout Neural Networks. various neural network. out Neuro controller ledge about fuzzy system cation on fuzzy controller.						
Uni	t		Description			Instruc Hou	ctional 1rs		
I	NEURAL NETWORKS – I Linear Neural network, Multilayer Neural Network, Back Propagation Algorithm, Nonlinear system analysis part I, Nonlinear System Analysis part II, Radial basis function network Adaptive learning rate, weight update rules, Recurrent Network back propagation through time self-organizing map- Multidimensional network.								
п	<ul> <li><b>NEURAL NETWORKS - II</b></li> <li>Associative memory networks: Training algorithms for pattern association. Auto associative, Hetero associative, Hopfield and iterative auto associative memory networks. Unsupervised Learning networks: Fixed weight competitive nets, Kohenen self-organizing feature map</li> </ul>								
ш	NEURO Neural co Indirect MIMO, V	<b>CONTROLLER</b> ontroller a review, l adaptive controller Visual motor co- or	-III Network Inversion and Control, Neural model for robot n of robot manipulator, Adaptive Neural for affine systemation with KSOM. Direct adaptive controller of manip	nanipulato stem SIS <sup>1</sup> ulator.	or, O,	9			
IV	FUZZY Introduct measures	<b>SYSTEMS- I</b> tion to fuzzy logic, o s - Fuzzy rule base a	classical sets, Fuzzy sets. Fuzzy relations Fuzzy arithmetic nd approximate reasoning, Fuzzy logic controller.	c and fuz:	zy	9			
V	<ul> <li>FUZZY CONTROL -II</li> <li>Fuzzy controller a review, Mamdani type flc and parameter optimization, Fuzzy controller for PH reactor, Fuzzy lyapunav controller- computing with words, Controller design for a T-S fuzzy model, Linear Controller using T-S fuzzy model.</li> </ul>								
			Total Instruction	onal Hou	irs	45	5		
	Course	CO1: Infer the co CO2: Summarize	ncepts of Neural Networks. the various neural networks architectures and its trainin	g algorith	ıms				

Outcome CO3: Design the neural network/fuzzy logic control for real time applications.

CO3: Discover the concept of fuzzy logic set theory.

CO4: Implement the fuzzy mechanism for suitable control problems.

# **TEXT BOOKS:**

**T1** Laurene V. Fausett, "Fundamentals of Neural Networks:Architectures, algorithms and applications", Pearson Education, New Delhi, 2004.

**T2** Timothy J Ross, "Fuzzy Logic with Engineering Applications", John Willey and Sons, 2005. **REFERENCE BOOKS:** 

**R1** S.N.Sivanandam & S.N Deepa., "Principles of soft computing", 2<sup>nd</sup> edition, Wiley India Pvt Ltd, 2013. **R2** George J.Klir, Bo.Yuan, "Fuzzy Sets and Fuzzy logic: Theory and Applications", PHI Learning Pvt Ltd, 2012 **R3** Zimmerman H.J., "Fuzzy set theory and its Applications", Allied Publishers, 2001.

R4 -Jack M. Zurada, "Introduction to Artificial Neural Systems", PWS Publishing Co, 2002

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PROGRAMME		ME COURSE CODE NAME OF THE COURSE	L	Т	Р	С						
	M.E.		20AEX302	ADVANCED MICROPROCESSORS & MICROCONTROLLERS	3	0	0	3				
Co Obje	<ol> <li>To expose the students to the fundamentals of microprocessor architecture.</li> <li>To explore the high performance features in CISC architecture</li> <li>To familiarize the high performance features in RISC architecture</li> <li>To introduce the basic features in Motorola microcontrollers.</li> <li>To enable the students to understand PIC Microcontroller</li> </ol>											
Unit				Description	Instructional Hours							
	MICRO	ICROPROCESSOR ARCHITECTURE										
Ι	Instruction Set – Data formats –Addressing modes – Memory hierarchy –register file – Cache – Virtual memory and paging – Segmentation- pipelining –the instruction pipeline – pipeline hazards – instruction level parallelism – reduced instruction set –Computer principles – RISC versus CISC.						- 9 s					
	HIGH P	ERF(	ORMANCE CISC ARCI	HITECTURE – PENTIUM								
п	Modes –I Program	Paging ning t	g – Multitasking – Excep the Pentium processor.	tion and Interrupts – Instruction set – addressing modes –	- 9							
TTT	HIGH P	ERFO	ORMANCE RISC ARCI	HITECTURE – ARM								
111	Instructio	n set-	- addressing modes – Prog	gramming the ARM processor.		9	,					
	MSP430	16 - I	BIT MICROCONTROL	LER								
IV	The MSF Developm MSP4301	2430 nent Micro	Architecture- CPU Regis Tools, ADC - PWM controller.	sters - Instruction Set, On-Chip Peripherals - MSP430 - - UART - Timer Interrupts - System design using		ç	)					
<b>T</b> 7	PIC MIC	ROC	CONTROLLER			c						
V	–PWM a	ntecti nd int	roduction to C-Compilers			ç	)					
				Total Instructional Hours	4	15 H	ours	5				
Cou: Outco	cCO1: CCO2: CCO3: CCO4: CCO5:	To ur To kr To kr To pe To in	nderstand the fundamental now and appreciate the hig now and appreciate the hig erceive the basic features iterpret and understand PIO	ls of microprocessor architecture. gh performance features in CISC architecture. gh performance features in RISC architecture. in Motorola microcontrollers. C Microcontroller.								

## **TEXT BOOKS:**

- T1. Daniel Tabak, "Advanced Microprocessors", McGraw Hill.Inc., 1995.
- T2. James L. Antonakos, "The Pentium Microprocessor" Pearson Education, 1997.

# **REFERENCE BOOKS:**

- R1. Steve Furber, "ARM System On Chip architecture", Addision Wesley, 2000.
- **R2.** Andrew N.Sloss, Dominic Symes and Chris Wright "ARM System Developer's Guide : Designing and Optimizing System Software", First edition, Morgan Kaufmann Publishers, 2004.
- R3 John. B. Peatman, "Design with PIC Microcontroller", Prentice hall, 1997.

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PROGRAMME PROGRAMME		COURSE CODE	NAME OF THE COURSE	L	Т	Р	С	
IN	ME	19AEX303	ASIC AND FPGA DESIGN	3	0	0	3	
Course Objective		<ol> <li>Describe the design flow of different types of ASIC and PLD</li> <li>Gain knowledge about floor planning, placement and routing in ASIC</li> <li>Implement the digital design using Verilog and VHDL</li> <li>Infer the architecture of different types of FPGA</li> <li>Describe the design issues of SOC</li> </ol>						
Unit		D	escription	Ins	struct	tional	Hours	
I	OVERVIE Types of A Technologi Antifuse - ROMs and	EW OF ASIC AND PLD ASICs - Design Flow - CAD to ies: Static RAM - EPROM and EEP EPROMs - PLA - PAL. Gate A	ols used in ASIC Design - Programming PROM Technology, Programmable Logic Devices rrays - CPLDs and FPGAs	:		9		
Π	ASIC PHY System pa Measureme Routing -	d d	1 9 1 9					
III	LOGIC SY Design Sys Language VHDL and Automatic	<b>WNTHESIS, SIMULATION A</b> stems - Logic Synthesis - Half - PLA Tools - EDIF- CFI Desi Logic Synthesis - Types of Sin Test Pattern Generation.	ND TESTING Gate ASIC -Schematic Entry - Low Level Desig gn Representation. Verilog and Logic Synthesis nulation - Boundary Scan Test - Fault Simulation	n - -		9		
IV	FPGA Field Progr Physical D / Logic Syr	ammable Gate Arrays- Logic Bl esign Tools -Technology Mappi nthesis - Controller/Data Path Sy	locks, Routing Architecture , FPGA Design : FPGA ng - Placement & Routing - Register Transfer (RT ynthesis - Logic Minimization	<b>X</b> ()		9		
V	SOC DES Design Me Techniques studies: Di	e		9				
			Total Instructional Hour	S		45		
Cou Outo	C Urse C Come C C C TEXT BOO	O1: Summarize the concepts of O2: Apply the different high per O3: Demonstrate the synthesis, s O4: Outline the different archite O5: Discuss the design issues of <b>KS</b> .	ASIC and PLD formance algorithms in ASICs simulation and testing of digital systems octures of FPGA SOC					
r L	F1 - David A	Hodges Analysis and Design (	of Digital Integrated Circuits 3rd Edition Tata Mc	Graw	<b>H</b> ill			

**T1** - David A.Hodges, Analysis and Design of Digital Integrated Circuits ,3<sup>rd</sup> Edition, Tata Mc Graw Hill , 2004.

T2 - M.J.S. Smith: Application Specific Integrated Circuits, Pearson, 2003.

# **REFERENCE BOOKS:**

R1 - Parag.K.Lala, Digital System Design using Programmable Logic Devices, BSP, 2003.

R2 - Wayne Wolf, FPGA-Based System Design, Prentice Hall PTR, 2004.

**R3** - Sudeep Pasricha and NikilDutt, On-Chip Communication Architectures System on Chip Interconnect, Elsevier,2008.

**R4** - Farzad Nekoogar and Faranak Nekoogar, From ASICs to SOCs: A Practical Approach, Prentice Hall PTR, 2003.

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<b>PROGRA</b> M M.E.	MME	COURSE CODE 20AEX307	NAME OF THE COURSE PHYSICAL DESIGN OF VLSI CIRCUIT	L S 3	<b>T</b> 0	<b>P</b> 0	С 3
Cou Obje	1. Irse ctive 2.	To introduce the packaging To study the pe	e physical design concepts such as routing, plac formance of circuits layout designs, compactio	cement, part	itioning es	; and	
Unit			Description		Instrue hou	ctional urs	l
I	NTRODU Layout Ru transistor c gate array methodolog	CTION TO VLS les-Circuit abstra chaining, Wein B s and sea of { gies Packaging-C	SI TECHNOLOGY ction Cell generation using programmable log erger arrays and gate matrices-layout of stand gates, field programmable gate array(FPGA computational Complexity - Algorithmic Paradi	gic array ard cells A)-layout gms.	ç	)	
Ш	Heuristic gular dual g nnealing placement	Ieuristic Jar dual g Inealing lacement					
ш	<ul> <li>linear placement.</li> <li>III ROUTING USING TOP DOWN APPROACH Fundamentals: Maze Running- line searching- Steiner trees Global Routing: Sequential Approaches - hierarchial approaches - multi commodity flow based techniques - Randomised Routing- One Step approach - Integer Linear Programming Detailed Routing: Channel Routing - Switch box routing. Routing in FPGA: Array</li> </ul>						
IV	<ul> <li>based FPGA- Row based FPGAs</li> <li>IV PERFORMANCE ISSUES IN CIRCUIT LAYOUT</li> <li>Delay Models: Gate Delay Models- Models for interconnected Delay- Delay in RC trees. Timing – Driven Placement: Zero Stack Algorithm- Weight based placement-Linear Programming Approach Timing riving Routing: Delay Minimization- Click Skew Problem- Buffered Clock Trees. Minimization: constrained via Minimization</li> </ul>					)	
V SINGLE I Planar su Routing- Routing chaining		YER ROUTING set problem(PSP)- Vire length and be ultiple chip modu Wein Burger Arra	CELL GENERATION AND COMPACTION Single Layer Global Routing- Single Layer de nd minimization technique – Over The Cell (O les(MCM)- programmable Logic Arrays- Trans ys- Gate matrix layout- 1D compaction- 2D con	tailed TC) sistor npaction.	Ç	)	
	U		Total instruction	al hours	4	5	

After completion of the course the learner will be able to

Course CO1: Explain different types of routing

Outcome CO2: Discuss performance issues in circuit layout

CO3: Outline 1D compaction- 2D compaction.

# **REFERENCE BOOKS:**

- **R1**. Preas M. Lorenzatti, "Physical Design and Automation of VLSI systems", The Benjamin Cummins Publishers, 1998.
- R2. Sarafzadeh, C.K. Wong, "An Introduction to VLSI Physical Design", McGraw Hill Int. Edition 1995

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PROGRAMME PROGRAMME	COURSE CODE	COURSE CODENAME OF THE COURSE				С	
<b>FK</b> C	M.E.	20AEX305	High Speed Switching and Network	3	0	0	3
Co Obje	urse ective	<ol> <li>To understand the basics on networks and IP networks</li> <li>To understand the different</li> <li>To understand the concepts</li> <li>To learn the fundamentals of</li> <li>To exploit and integrate the</li> </ol>	f switching technologies and their implementation LAN queuing strategies and their impact on the blocking perfo of various packet switching architectures of Optical Switching Architectures best features of different architectures for high speed sw	√s, AT rmanc vitchin	ΓM es.		
Unit			Description	Inst ]	ruc Hot	tion trs	al
Ι	LAN SW Switchin forward,	ITCHING TECHNOLOGY g Concepts, LAN Switching, sw Layer 3 switching, Loop Resoluti	itch forwarding techniques - cut through and store and on, Switch Flow control, virtual LANs.		9	)	
II	<b>QUEUES</b> Internal	9					
Ш	Architec stage sw	9					
IV	<ul> <li>Suge swhenning, Optical Facket swhenning, Ownenning Rabite on a entry, Internally Suffered Crossbars</li> <li>OPTICAL SWITCHING ARCHITECTURES</li> <li>Need for Multilayered Architecture-, Layers and Sub-layers, Spectrum partitioning, Optical Network Nodes, Network Access Stations, Overlay Processor, Logical network overlays</li> </ul>						
V	Connect IP SWIT Addressi	ion Management and Control CHING ing model, IP Switching types - flo	ow driven and topology driven solutions, IP Over ATM		9	)	
	address a	and next hop resolution, multicasti	ng, Ipv6 over ATM. Total Instructional Hours	45	5 H(	ours	1
Cou Outco	rse ome	After completion of the course CO1: Familiar with the basics of Optical networks. CO2: Familiar with the different CO3: Able to analyze switchin complexities. CO4: Able to identify suitable sw CO5: To apply switching technol communication networks and am	the learner will be able to switching technologies and their implementation in LAN switching architectures and queuing strategies ig networks based on their blocking performances a vitch architectures for a specified networking scenario blogies, architectures and buffering strategies for designing blogies their performance	√s, AT nd im ng hig	'M , pleı ;h sj	, IP ment	and tation
R1 R2	REFEREN AchillePa Ltd, New Thomas I	<b>ICE BOOKS :</b> attavina, "Switching Theory: Arch York. 1998 E. Stern, Georgios Ellinas, Krish	itectures and performance in Broadband ATM networks ' na Bala, "Multiwavelength Optical Networks – Archite	',John ecture,	Wil De	ley esign	Sons and
R3	control", Rich Sief Publishin	Cambridge University Press, 2nd Fert, Jim Edwards, "The All New g, Inc., 2nd Edition, 2008	Edition, 2009. Switch Book – The Complete Guide to LAN Switching	; Tech	nole	ogy"	,Wiley

- **R4** Elhanany M. Hamdi, "High Performance Packet Switching architectures", Springer Publications, 2007.
- **R5** Christopher Y Metz, "Switching protocols & Architectures", McGraw Hill Professional Publishing, New York, 1998.

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### PROGRAMME COURSE CODE NAME OF THE COURSE L Т Programming Languages For M.E

Embedded Software

20AEX306

Course outcomes:

At the end of the course the student will be able to

CO1: To develop drivers for low speed peripherals.

CO2: To describe OOPS concepts.

CO3: To develop CPP programming.

CO4: To Illustrate Inheritance, overloading concepts.

CO5: To explain PERL scripting.

UNIT-I

**Embedded Peripherals** 

Embedded 'C' Programming, Bitwise operations, Dynamic memory allocation, OS services, Linked stack and queue, Sparse matrices, Binary tree, Interrupt handling in C, Code optimization issues, Writing LED drivers, Drivers for serial port communication, Embedded Software Development Cycle and Methods (Waterfall, Agile).

# UNIT-II

**OOPs Programming techniques** 

Object Oriented Programming: Introduction to procedural, modular, object-oriented and generic programming techniques, Limitations of procedural programming, objects, classes, data members, methods, data Encapsulation, data abstraction and information hiding, inheritance, polymorphism.

# UNIT-III

Memory allocation techniques

CPP Programming: 'cin', 'cout', formatting and I/O manipulators, new and delete Operators, Defining a class, data members and methods, 'this' pointer, constructors, destructors, friend Function, dynamic memory allocation.

# UNIT-IV

**Overloading and Inheritance** 

Need of operator overloading, overloading the assignment, Overloading using friends, type conversions, single inheritance, base and derived classes, friend classes, types of inheritance, hybrid inheritance, multiple inheritance, virtual base class, polymorphism, virtual functions.

# UNIT-V

Templates

Function template and class template, member function templates and template Arguments, Multiple Exceptions. Scripting Languages, PERL: Operators, Statements Pattern Matching.

# **Text Books**

1. Michael J. Pont, Embedded C, Pearson Education, 2 nd Edition, 2008.

2. Michael Berman, Data structures via C++, Oxford University Press, 2002.

3. Randal L. Schwartz, Learning Perl, O'Reilly Publications, 6 th Edition 2011.

# 9 hours

9 hours

# 9 hours

# 9 hours

# 9 hours

Р С 3 0 0 3 References

- 1. Robert Sedgewick, Algorithms in C++ , Addison Wesley Publishing Company, 1999. 20 M.Tech. in VLSI Design and Embedded Systems
- 2. Abraham Silberschatz, Peter B, Greg Gagne, Operating System Concepts, John Willey& Sons, 2005.
- 3. C.M. Krishna, Kang G. Shin, "Real Time Systems", McGraw Hill International Editions, 1997
- 4. By Albert M. K. Cheng , "Real-time systems: scheduling, analysis, and verification" wiley

P. Haylec Chairman, Board of Studies Chairman - BoS ECE - HICET



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PRO	GRAMME	COURSE CODE	NAME OF THE COURSE	L	Т	Р	С				
	M.E	20AEX307	COGNITIVE RADIO NETWORK	3	0	0	3				
O Ol	Course ojective	<ol> <li>To understan platforms.</li> <li>To enable the and the enab</li> <li>To enable the software defi</li> <li>To analyze the 5. To exemplify applications</li> </ol>	d the fundamentals of Software Defined radio and compa- e student to understand the evolving paradigm of cognitive ling technologies for its implementation. e student to understand the essential functionalities and re- ined radios and their usage for cognitive communication ne various methods of implementing the Cognitive Radio is y the research challenges in designing a Cognitive Radio N	l radio and compare various SDR adigm of cognitive radio communica ctionalities and requirements in desig communication Cognitive Radio functions Cognitive Radio Network and the							
Unit			Description		Inst	tructi Hour	onal s				
Ι	SOFTWA Definition architectur architectur interfaces, COGNIT	<b>ARE DEFINED RADIO</b> as and potential benefits, re implications. Essenti re, Computational proce interface topologies amo <b>IVE RADIOS AND ITS</b> radio self-aware, cognit	AND ITS ARCHITECTURE software radio architecture evolution, technology tradeoff al functions of the software radio, basic SDR, hard ssing resources, software architecture, top level compo- ong plug and play modules. SARCHITECTURE ive techniques – position awareness, environment awarene	s and ware onent ess in		9					
Π	cognitive Radio – phases, I Software SPECTRI	cognitive radios, optimization of radio resources, Artificial Intelligence Techniques, Cognitive       9         Radio – functions, components and design rules, Cognition cycle – orient, plan, decide and act       9         phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on       9         Software defined Radio Architechture.       8         SPECTRUM SENSING AND IDENTIFICATION       9									
Ш	I Overview-Classification-Matched Filter, waveform based sensing - cyclo stationary based sensing -Energy detector based sensing - Radio Identifier - Cooperative Sensing -Spectrum Opportunity Detection, Fundamental Trade-offs: Performance versus Constraint, MAC Layer Performance Measures, Global Interference Model, Local Interference Model, Fundamental Trade-offs: Sensing Accuracy versus Sensing Overhead. USER COOPERATIVE COMMUNICATIONS										
IV	User Co Wireless Network	operation and Cognitive S Relay Channel, User Cooperative Wireless N	Systems, Relay Channels: General Three-Node Relay Cha Cooperation in Wireless Networks: Two-User Cooper Network, Multihop Relay Channel	nnel, ative		9					
V	Types of C Controlled in Large Opportunit	Cognitive Behavior, Inter Behavior: Spectrum Und Networks: Scaling L stic Interference Cancella	ference-Avoiding Behavior: Spectrum Interweave, Interfe derlay, Underlay in Small Networks: Achievable Rates, Un aws, Interference-Mitigating Behavior: Spectrum Ov ation, Asymmetrically Cooperating Cognitive Radio Chan	rence- derlay /erlay nels.	- 7	9					
Cu OU	OURSE TCOME	After completion of the CO1: Appreciate the mo strategies. CO2: Demonstrate unde CO3: Demonstrate unde designing software defi CO4: Evolve new techn validations and simulati CO5: Interpret the impa design.	<b>Total Instructional H</b> e course the learner will be able to otivation and the necessity for cognitive radio communicat erstanding of the enabling technologies for its implementate erstanding of the essential functionalities and requirements ned radios and their usage for cognitive communication. iques and demonstrate their feasibility using mathematical on tools. ct of the evolved solutions in future wireless network	ours ion ion in		45					
REFE R1 R2 R3 R4	RENCE BO Alexander Networks Kwang-Ch Khattab, A Practice", J. J. Mitola, '	DOKS: M. Wyglinski, Maziar N - Principles And Practice leng Chen and Ramjee P hmed, Perkins, Dmitri, F Springer Series, Analog 'Cognitive Radio: An Int	lekovee, And Y. Thomas Hou, "Cognitive Radio Commur ", Elsevier Inc., 2010. rasad, "Cognitive Radio Networks", John Wiley & Sons, I Bayoumi, Magdy, "Cognitive Radio Networks - From The Circuits and Signal Processing, 2009. regrated Agent Architecture for software defined radio", D	icatio Ltd, 20 ory to Doctor	ons an 009. of	d					

R5 Simon Haykin, "Cognitive Radio: Brain –empowered wireless communications", IEEE Journal on selected areas in communications, Feb 2005.

**R6** Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, "Next generation / dynamic spectrum access / cognitive radio wireless networks: A Survey Elsevier Computer Networks", May 2006.

P. Hayle Chairman, Board of Studies Chairman - BoS ECE - HICET



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Model         20AEX308         WIRELESS ADHOC AND SENSOR NETWORKS         3         0         0         3           1         To understand the basics of Ad-hoc & Sensor Networks.         3         0         0         3           2         To learn various findamential and emerging protocols of all layers         3         0         0         3           Objectives         3         To study about the issues pertaining to major obstacles in establishment and efficient management of Ad-hoc and Sensor networks.         4         To understand various security practices and protocols of Ad-hoc and Sensor Networks.           Unit         Description         Instructional Hor         Instructional Hor           MAC & TCP IN AD HOC NETWORKS         Fundamentals of WLANs - IEEE 80.211 Architecture - Self configuration and Auto         1         configuration-Issues in Ad-Hoc Wireless Networks.         9           Networks - Contention Based Horocols - TCP over Ad-Hoc Networks.         MAC HOC NETWORKS         9         9           Routing in Ad-Hoc Networks - Introduction-Topology based versus Position based Approaches-Proteity: Refield directional Rooding - Hierachical Routing: Issues and Challenges in providing OdS.         MAC ROUTING FACOS IN WIRPLESS SENSOR NETWORSS         9         9           Introduction - Architecture - Single node architecture - Sensor network design considerations - Achitecture - Single Protocols - IEEE 80.215.4 Zigbee - Link         9         1	PROGRAM	IME DANGE	COURSE CODE	NAME OF THE COURSE	L	Т	Р	С		
1       To understand the basics of Ad-hoc & Sensor Networks.       0       0       0         2       To learn various fundamental and emerging protocols of all layers       3       To study about the issues pertaining to major obstacles in establishment and efficient management of Ad-hoc and sensor networks.         4       To understand the nature and applications of Ad-hoc and sensor networks.       5       To understand the nature and applications of Ad-hoc and sensor networks.         5       To understand the nature and applications of Ad-hoc and sensor networks.       5       Instructional Hours         Mark C AT CP IN AD HOC NETWORKS         Fundamentals of WLANS – IEEE 802.11 Architecture - Self configuration and Auto         Instructional Hours         MAC & TCP IN ADHOC NETWORKS         Routing in Ad-Hoc Networks.         ROUTING IN AD HOC NETWORKS         Routing in Ad-Hoc Networks.         ROUTING IN AD HOC NETWORKS         Routing in Ad-Hoc Networks.         ROUTING IN AD HOC NETWORKS         Routing in Ad-Hoc Networks.         ROUTING IN AD HOC NETWORKS         Routing in addition service - Grid - Forwarding strategics - Grocedy packet forwarding - Restricted directional flooding. Hierarchical Routing issues and Challeges to providing QoS.         MAC R	PROC	FRAMME M E	20AEX308 WI	RELESS ADHOC AND SENSOR NETWORKS	3	0	0	3		
<ul> <li>2 To learn various fundamental and emerging protocols of all layers</li> <li>To study about the issues pertaining to major obstacles in establishment and efficient management of Ad-hoc and sensor networks.</li> <li>3 To understand the nature and applications of Ad-hoc and sensor networks.</li> <li>5 To understand various scurity practices and protocols of Ad-hoc and Sensor Networks.</li> <li>1 Configuration-Issues in Ad-Hoc Wireless Networks. AAC Protocols for Ad-Hoc Wireless 9</li> <li>Networks - Contention Based Protocols - TCP over Ad-Hoc Networks. TCP protocol overview</li> <li>- TCP and MANETA - Solutions for TCP over Ad-Hoc Networks. TCP protocol overview</li> <li>- TCP and MANETA - Solutions for TCP over Ad-Hoc Networks. TCP protocol overview</li> <li>- TCP and MANETA - Solutions for TCP over Ad-Hoc Networks. TCP protocol overview</li> <li>- TCP and MANETA - Solutions for TCP over Ad-Hoc Networks.</li> <li>ROUTING IN AD HOC NETWORKS</li> <li>Routing in Ad-Hoc Networks. Introduction-Topology based versus Position based</li> <li>Approaches Proactive, Reactive, Hybrid Routing Approach-Principles and issues - Location 9</li> <li>packet forwarding - Restricted directional flooding. Hierarchical Routing: Issues and Challenges in providing COS.</li> <li>MAC, ROUTING &amp; QOS IN WIRELESS SENSOR NETWORKS</li> <li>Introduction - Architecture - Single noda architecture - Sensor Matomations - Achitecture - Sensor Networks.</li> <li>9</li> <li>Restricted directional flooding. Therapeutical Routing: Issues and Challenges in providing COS.</li> <li>WAC, ROUTING &amp; QOS IN WIRELESS SENSOR NETWORKS</li> <li>Introduction - Architecture - Sensor Networks.</li> <li>9</li> <li>Restroctention Based Networking - Transport Protocols For WSN - Physical Layer :</li> <li>10</li> <li>11</li> <li>12</li> <li>12</li> <li>12</li> <li>12</li> <li>13</li> <li>14</li> <li>14</li> <li>14</li> <li>14</li></ul>		1	To understand the basics of	Ad-hoc & Sensor Networks	5	0	0	5		
Course Objectives       To study about the issues pertaining to major obstacles in establishment and efficient management of Objectives         Ad-hoc and sensor networks.       To understand the nature and applications of Ad-hoc and sensor networks.         To understand the nature and applications of Ad-hoc and sensor networks.       Instructional Hours         Unit       Description         MAC & TCP IN AD HOC NETWORKS       Fundamentals of WLANs – IEEE 802.11 Architecture - Self configuration and Auto Onfiguration-Issues in Ad-Hoc Wireless Networks – MAC Protocols for Ad-Hoc Wreivess       9         Networks – Contention Based Protocols - TCP over Ad-Hoc Networks.       TCP and MANETS – Solutions for TCP over Ad-Hoc Networks.       9         Networks – Contention Based Protocols - TCP over Ad-Hoc Networks.       Fundamentals of VLANS – IEEE 802.11       9         Networks – Contention Based Protocols - TCP over Ad-Hoc Networks.       9       9         Networks – Contention Based Protocols - TCP over Ad-Hoc Networks.       9       9         Routing in Ad-Hoc NETWORKS       Routing - Restricture Ad-Hoc Networks.       9         Routing in Ad-Hoc NETWORKS       Routing - Restricture Ad-Hoc Networks.       9         II Cread MAJNIG & QOS IN WIRELESS SENSOR NETWORKS       Introduction - Architecture - Single node architecture - Sensor network design considerations - Energy Efficient Design printiples for WNS in Protocols A QOS - Congestion Courtol issues - Application adpositioning – Operating systems and Sensor Network protand Layer		2	To learn various fundament	al and emerging protocols of all layers						
Objectives       3       Ad-hoc and sensor networks.         4       To understand the nature and applications of Ad-hoc and sensor networks.       5         To understand the nature and applications of Ad-hoc and Sensor Networks.       5         Unit       Description         MaC & TCP IN AD HOC NETWORKS       Fundamentals of WLANS - IEEE 802.11 Architecture - Self configuration and Auto         1       configuration-Issues in Ad-Hoc Wrotess.         Putmotine-Contention Based Protocols - TCP over Ad-Hoc Networks.       9         Networks - Contention Based Protocols - TCP over Ad-Hoc Networks.       9         ROUTING IN AD HOC NETWORKS       Routing in Ad-Hoc Networks.       9         Approaches-Proactive, Reactive, Hybrid Routing Approaches-Protocol overview       - TCP and MANETs - Solutions for TCP over Ad-Hoc Networks.         II       Approaches-Proactive, Reactive, Hybrid Routing, Approaches-Proactive, Reactive, Hybrid Routing, Phyroaches-Ical Routing - Steuses and Challenges in providing QoS.         MAC, ROUTING & QOS IN WIRELESS SENSOR NETWORKS       10         III       Transceiver Design considerations - MAC Layer Protocols of WSN - Physical Layer :         III       Transceiver Design considerations - MAC Layer Protocols - IEEE 802.15 A Zigbe - Link 9         Layer and Error Control issues - Routing Protocols - Mobile Nodes and Mobile Robots - Data Centric & Routention Based Networking - Transport Protocols & COS - Congestion Control issues - Application Layer	Cou	rse	To study about the issues p	ertaining to major obstacles in establishment and e	fficien	t man	ageme	nt of		
<ul> <li>4 To understand the nature and applications of Ad-hoc and sensor networks.</li> <li>5 To understand various security practices and protocols of Ad-hoc and Sensor Networks.</li> <li>Unit Description MAC &amp; TCP IN AD HOC NETWORKS Fundamentals of WLANs - HEEE 802.11 Architecture - Self configuration and Auto onfiguration-Issues in Ad-Hoc Wireless Networks MAC Protocols for Ad-Hoc Wireless 9 Networks - Contention Based Protocols - TCP over Ad-Hoc Networks.</li> <li>Configuration-Issues in Ad-Hoc Wireless Networks - MAC Protocols for Ad-Hoc Wireless 9 Networks - Contention Based Protocols - TCP over Ad-Hoc Networks.</li> <li>ROUTING IN AD HOC NETWORKS ROUTING IN AD HOC NETWORKS</li> <li>ROUTING IN AD-HOC NETWORKS</li> <li>ROUTING IN AD-HOC NETWORKS</li> <li>ROUTING A QOS IN WIRELESS SENSOR NETWORKS</li> <li>Mack &amp; Contention Based Protocols - Grid - Forwarding strategies - Greedy packet forwarding - Restricted directional flooding- Hierarchical Routing- Issues and Challenges in providing QoS.</li> <li>MAC, ROUTING &amp; QOS IN WIRELESS SENSOR NETWORKS</li> <li>Introduction - Architecture - Single node architecture - Sensor network design considerations - Energy Efficient Design roinciples for VSNS - Protocols for WSN - Physical Layer :         <ul> <li>IT Transceiver Design considerations - MAC Layer Protocols - UNING &amp; QOS - Physical Layer :             <ul> <li>IT Transceiver Design considerations - MAC Layer Protocols - BEEE 802.15.4 Zigbee - Link 9             <ul> <li>Layer and Error Control issues - Adving Drotocols and Sensor Network design considerations - Energy Efficient Design roution and positioning - Operating systems and Sensor Network programming - Sensor Network Simulators.</li> <li>SECURITY IN AD HOC AND SENSOR NETWORKS</li> <li>Security in Ad-Hoc and Sensor networks.</li> <li>COI Identify different issues in wireless ad hoc and sensor networks.</li> <li>COI Identify</li></ul></li></ul></li></ul></li></ul>	Object	tives <sup>3</sup>	Ad-hoc and sensor network	S.			U			
5     To understand various security practices and protocols of Ad-hoc and Sensor Networks.       Unit     Description     Instructional Hours       MAC & CTCP IN AD HOC NETWORKS     Fundamentals of WLANs – IEEE 802.11 Architecture - Self configuration and Auto configuration-Issues in Ad-Hoc Wireless Networks – MAC Protocols for Ad-Hoc Wireless     9       Networks – Contention Based Protocols - TCP over Ad-Hoc Networks.     9     9       ROUTING IN AD HOC NETWORKS     8     9       ROUTING A COMPUTENDENCE     8     9       III Sproach-Principles and issues – Location service – Grid – Forwarding strategies – Greedy packet forwarding – Restricted directional flooding. Hierarchical Routing: Issues and Challenges in providing QoS.     9       IIII Transceiver Design considerations – MAC Layer Protocols – MSN – Physical Layer : Transcore Design considerations – Acriticetur – Sensor network design considerations – Increay: Efficient Design ensiderations – Note Layer Protocols – IEEE 802.15 4.7gbe – Link 9       Layer and Error Control issues - Routing Protocols – Mobile Nodes and Mobile Robots - Data Centric & Contention Based Networking – Transport Protocols & QOS – Congestion Control issues – Application - Localization and positioning – Operating systems and Sensor Network from growing protocols – BESIS ON INCHOCOLS – Time system and Sensor Network is Security in Ad-Hoc and Sensor netw		4	To understand the nature an	nd applications of Ad-hoc and sensor networks.						
Unit     Description     Instructional Hours       MAC & TCP IN AD HOC NETWORKS     Fundamentals of WLANS = IEEE 802.11 Architecture - Self configuration and Auto configuration-Issues in Ad-Hoc Wireless Networks - MAC Protocols for Ad-Hoc Wireless > Networks - Contention Based Protocols - TCP over Ad-Hoc Networks. ROUTING IN AD HOC NETWORKS     9       Routing in Ad-Hoc Networks - Introduction-Topology based versus Position based Approaches-Proactive, Reactive, Hybrid Routing Approach-Principles and issues - Location services - DREAM – Qoorums based location service - Grid - Forwarding strategies - Greedy packet forwarding - Restricted directional flooding- Hierarchical Routing: Issues and Challenges in providing 005.     9       Introduction - Architecture - Single node architecture - Sensor network design considerations - Energy Efficient Design principles for WSNs - Protocols for WSN - Physical Layer : Transceiver Design considerations - MAC Layer Protocols - IEEE 802.15,4 / Zipbe - Link Layer and Error Control issues - Routing Protocols - Mobile Robots - And Wobile Robots - Data Centric & Contention Based Networking - Transport Protocols & QOS - Congestion Control issues - Application Layer support SENSOR MANAGEMENT     9       W     Sensor Management - Topology Control Protocols and Sensing Mode Selection Protocols - 9     9       V     Sensor Management - Topology Control Protocols - METWORKS     9       Security in Ad-Hoc and Sensor network S- Key Distribution and Management - Software Secure Adhoc routing protocols - SPINS     45       Columents     CO1     Identify different issues in wireless and no cand sensor     9       Outcoments     CO1     Identify different issue		5	To understand various secur	rity practices and protocols of Ad-hoc and Sensor N	Jetworl	ks.				
MAC & TCP IN AD HOC NETWORKS       Fundamentals of WLANS - IEEE 802.11 Architecture - Self configuration and Auto configuration-Issues in Ad-Hoc Wireless Networks - MAC Protocols for Ad-Hoc Wireless 9 Networks - Contention Based Protocols - TCP and MANETS - Solutions for TCP over Ad-Hoc Networks.       9         TCP and MANETS - Solutions for TCP over Ad-Hoc Networks.       8000000000000000000000000000000000000	Unit	,		Description		Instructio Hours		onal 's		
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<ul> <li>Networks - Contention Based Protocols - TCP over Ad-Hoc networks-TCP protocol overview         <ul> <li>TCP and MANETs - Solutions for TCP over Ad-Hoc Networks.</li> <li>ROUTING IN AD HOC NETWORKS</li> <li>Routing in Ad-Hoc Networks - Introduction-Topology based versus Position based</li> <li>Approaches-Proactive, Reactive, Hybrid Routing Approach-Principles and issues - Location services - DREAM - Quorums based location service - Grid - Forwarding strategies - Greedy packet forwarding - Restricted directional flooding - Hierarchical Routing - Issues and Challenges in providing QoS.</li> <li>MAC, ROUTING &amp; QOS IN WIRELESS SENSOR NETWORKS</li> <li>Introduction - Architecture - Single node architecture - Sensor network design considerations - Energy Efficient Design principles for WSNs - Protocols for WSN - Physical Layer :</li> <li>Transceiver Design considerations - MAC Layer Protocols - IEE 802.15.4 Zigbee - Link 9</li> <li>Layer and Error Control issues - Routing Protocols - Mobile Nodes and Mobile Robots - Data Centric &amp; Contention Based Networking - Transport Protocols &amp; QOS - Congestion Control issues - Application Layer support SENSOR MANAGEMENT</li> <li>Sensor Management - Topology Control Protocols and Sensing Mode Selection Protocols - 9</li> <li>Security in Ad-Hoc and Sensor networks - Key Distribution and Management - Software Security in Ad-Hoc and Sensor Networks - Key Distribution and Management - Software Security in Ad-Hoc and Sensor networks - Key Distribution and Management - Software Secure Adhoc routing protocols - Broadcast authentication WSN protocols - TESLA - Biba - Sensor Network Security Protocols - SPINS Total Instructional Hours 45</li> <li>CO1 Identify different issues in wireless Alboc and Sensor networks.</li> <li>CO2 Analyze protocols developed for al hoc and sensor networks.</li> <li>CO3 Understand the security i</li></ul></li></ul>	Ι	configu	ration-Issues in Ad-Hoc Win	eless Networks - MAC Protocols for Ad-Hoc W	ireless		9			
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<ul> <li>Time synchronization - Localization and positioning – Operating systems and Sensor Network programming – Sensor Network Simulators.</li> <li>SECURITY IN AD HOC AND SENSOR NETWORKS         Security in Ad-Hoc and Sensor networks – Key Distribution and Management – Software based Anti-tamper techniques – water marking techniques – Defense against routing attacks - 9         Secure Adhoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba         – Sensor Network Security Protocols – SPINS      </li> <li>Course Outcomes         Outcomes         CO3         Identify different issues in wireless ad hoc and sensor networks.         CO3         Identify and address the security threats in ad hoc and sensor         CO4         Establish a Sensor network environment for different type of applications.         CO5         Understand the security in Ad hoc Wireless Networks – Architectures and Protocols", Pearson         Education, 2004.     </li> <li>T1</li> <li>C.Siva Ram Murthy and B.S.Manoj, "Ad Hoc Wireless Networks – Architectures and Protocols", Pearson         Education, 2004.</li> <li>Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", John         Wiley and Sons, 2010.</li> <li>REFERENCE BOOKS:</li> <li>Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc and Sensor Networks: Theory and Applications         (2nd Edition), World Scientific Publishing, 2011.</li> <li>R2</li> <li>C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 2002.</li> <li>Holger Karl, Andrea's willig, "Protocols and Architectures for Wireless Sensor Networks, John Wiley &amp; Sons, Inc         .2005.</li> <li>R4</li> <li>Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, "Ad Hoc Mobile Wireless Networks", Auerbach         Publications, 2008.</li> </ul>	IV	Sensor	Sensor Management - Topology Control Protocols and Sensing Mode Selection Protocols -							
<ul> <li>SECURITY IN AD HOC AND SENSOR NETWORKS         Security in Ad-Hoc and Sensor networks – Key Distribution and Management – Software         based Anti-tamper techniques – water marking techniques – Defense against routing attacks - 9         Secure Adhoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba         – Sensor Network Security Protocols – SPINS         Total Instructional Hours 45         CO1 Identify different issues in wireless ad hoc and sensor networks.         CO2 Analyze protocols developed for ad hoc and sensor networks.         CO2 Analyze protocols developed for ad hoc and sensor networks.         CO3 Identify and address the security threats in ad hoc and sensor         CO4 Establish a Sensor network environment for different type of applications.         CO5 Understand the security in Ad hoc and Sensor networks         TEXT BOOKS:         T1 C.Siva Ram Murthy and B.S.Manoj, "Ad Hoc Wireless Networks – Architectures and Protocols", Pearson         Education, 2004.         Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", John         Wiley and Sons, 2010.         REFERENCE BOOKS:         Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc and Sensor Networks: Theory and Applications         (2nd Edition), World Scientific Publishing, 2011.         R2         C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 2002.         R3         Holger Karl, Andrea's willig, "Protocols and Architectures for Wireless Sensor Networks, John Wiley &amp; Sons, Inc              .2005.         R4         Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, "Ad Hoc Mobile Wireless Networks", Auerbach         Publications, 2008.         Conselement Sater, T G Basavaraju, C Puttamadappa, "Ad Hoc Mobile Wireless Networks", Auerbach         Publications, 2008.         Conselement         Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, "Ad Hoc Mobile Wireless Networks", Auerbach         Publications, 2008.</li></ul>	- '	Time s	Time synchronization - Localization and positioning – Operating systems and Sensor Network							
<ul> <li>Security in Ad-Hoc and Sensor networks – Key Distribution and Management – Software</li> <li>v based Anti-tamper techniques – water marking techniques – Defense against routing attacks - 9 Secure Adhoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba – Sensor Network Security Protocols – SPINS</li> <li>Total Instructional Hours 45</li> <li>Course Outcomes</li> <li>CO1 Identify different issues in wireless ad hoc and sensor networks.</li> <li>CO2 Analyze protocols developed for ad hoc and sensor networks.</li> <li>CO3 Identify and address the security threats in ad hoc and sensor</li> <li>CO4 Establish a Sensor network environment for different type of applications.</li> <li>CO5 Understand the security in Ad hoc and Sensor networks</li> <li>TEXT BOOKS:</li> <li>T1 C.Siva Ram Murthy and B.S.Manoj, "Ad Hoc Wireless Networks – Architectures and Protocols", Pearson Education, 2004.</li> <li>T2 Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", John Wiley and Sons, 2010.</li> <li>REFERENCE BOOKS:</li> <li>R1 Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing, 2011.</li> <li>R2 C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 2002.</li> <li>R3 Holger Karl, Andrea's willig, "Protocols and Architectures for Wireless Sensor Networks, John Wiley &amp; Sons, Inc .2005.</li> <li>R4 Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, "Ad Hoc Mobile Wireless Networks", Auerbach Publications, 2008.</li> </ul>		program SECU	programming – Sensor Network Simulators.							
<ul> <li>V based Anti-tamper techniques – water marking techniques – Defense against routing attacks - 9 Secure Adhoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba – Sensor Network Security Protocols – SPINS</li> <li>Course Course Outcomes</li> <li>CO1 Identify different issues in wireless ad hoc and sensor networks. CO3 Identify and address the security threats in ad hoc and sensor networks. CO4 Establish a Sensor network environment for different type of applications. CO5 Understand the security in Ad hoc and Sensor networks</li> <li>T1 C.Siva Ram Murthy and B.S.Manoj, "Ad Hoc Wireless Networks – Architectures and Protocols", Pearson Education, 2004.</li> <li>T2 Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", John Wiley and Sons, 2010.</li> <li>REFERENCE BOOKS:</li> <li>R1 Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing, 2011.</li> <li>R2 C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 2002.</li> <li>R3 Holger Karl, Andrea's willig, "Protocols and Architectures for Wireless Sensor Networks, John Wiley &amp; Sons, Inc .2005.</li> <li>R4 Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, "Ad Hoc Mobile Wireless Networks", Auerbach Publications, 2008.</li> </ul>		Securit	v in Ad-Hoc and Sensor net	works – Key Distribution and Management – So	ftware					
Secure Adhoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba – Sensor Network Security Protocols – SPINS         Total Instructional Hours       45         Course Outcome       CO1 Identify different issues in wireless ad hoc and sensor networks.         COURSE CO2 Analyze protocols developed for ad hoc and sensor networks.         CO3 Identify and address the security threats in ad hoc and sensor CO4 Establish a Sensor network environment for different type of applications. CO5 Understand the security in Ad hoc and Sensor networks         TI C.Siva Ram Murthy and B.S.Manoj, "Ad Hoc Wireless Networks – Architectures and Protocols", Pearson Education, 2004.         T2 Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", John Wiley and Sons, 2010.         REFERENCE BOOKS:         Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing, 2011.         R1 Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing, 2011.         R1 Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc and Sensor Networks; John Wiley & Sons, Inc (2nd Edition), World Scientific Publishing, 2011.         R2 C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 2002.         Molger Karl, Andrea's willig, "Protocols and Architectures for Wireless Sensor Ne	V	based A	Anti-tamper techniques – wate	r marking techniques – Defense against routing at	tacks -		9			
<ul> <li>Sensor Network Security Protocols – SPINS</li> <li>Total Instructional Hours 45</li> <li>Course Outcomes</li> <li>CO1 Identify different issues in wireless ad hoc and sensor networks.</li> <li>CO2 Analyze protocols developed for ad hoc and sensor networks.</li> <li>CO3 Identify and address the security threats in ad hoc and sensor networks.</li> <li>CO3 Identify and address the security threats in ad hoc and sensor networks.</li> <li>CO3 Uderstand the security in Ad hoc and Sensor networks</li> <li>TEXT BOOKS</li> <li>T1 C.Siva Ram Murthy and B.S.Manoj, "Ad Hoc Wireless Networks – Architectures and Protocols", Pearson Education, 2004.</li> <li>T2 Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", John Wiley and Sons, 2010.</li> <li>REFERENCE BOOKS:</li> <li>R1 Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing, 2011.</li> <li>R2 C.K. Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 2002.</li> <li>R3 Holger Karl, Andrea's willig, "Protocols and Architectures for Wireless Sensor Networks, John Wiley &amp; Sons, Inc 2005.</li> <li>R4 Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, "Ad Hoc Mobile Wireless Networks", Auerbach Publications, 2008.</li> </ul>		Secure	Adhoc routing protocols – B	roadcast authentication WSN protocols – TESLA -	- Biba	)a				
<ul> <li>         Total Instructional Hours 45         Add particle in the instructional Hours 45         Add particle instructional Hours 4         Add particle instruction Hours 4         Add Hour Hours</li></ul>		– Senso	or Network Security Protocols	- SPINS						
<ul> <li>Course Outcomes</li> <li>Course Outcomes</li> <li>Course Outcomes</li> <li>CO2</li> <li>CO3</li> <li>CO4</li> <li>CO3</li> <li>CO4</li> <li>CO4</li> <li>CO5</li> <li>CO5</li> <li>CO5</li> <li>CO6</li> <li>CO6</li> <li>CO6</li> <li>CO6</li> <li>CO6</li> <li>CO6</li> <li>CO6</li> <li>CO6</li> <li>CO7</li> <li>CO7</li> <li>CO8</li> <li>CO6</li> <li>Co7</li> <li>Co7</li> <li>Co7</li> <li>Co7</li> <li>Co7</li> <li>Co8</li> <li>Co8</li> <li>Co9</li> <li>Co9</li> <li>Co8</li> <li>Co9</li> <li>Co9</li> <li>Co9</li> <li>Co9</li> <li>Co9</li> <li>Co9</li> <li>Co9</li></ul>				Total Instructional	Hours		45			
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OutcomesCOSIdentify and address the security threats in ad floc and sensorCO4Establish a Sensor network environment for different type of applications. CO5CO5Understand the security in Ad hoc and Sensor networksTEXT BOOKS:T1C.Siva Ram Murthy and B.S.Manoj, "Ad Hoc Wireless Networks – Architectures and Protocols", Pearson Education, 2004.T2Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", John Wiley and Sons, 2010.REFERENCE BOOKS:R1Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing, 2011.R2C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 2002.R3Holger Karl, Andrea's willig, "Protocols and Architectures for Wireless Sensor Networks, John Wiley & Sons, Inc .2005.R4Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, "Ad Hoc Mobile Wireless Networks", Auerbach Publications, 2008.	Cour	se CO2	Analyze protocols develope	ed for ad hoc and sensor networks.						
<ul> <li>CO3 Understand the security in Ad hoc and Sensor networks</li> <li>TEXT BOOKS:</li> <li>T1 C.Siva Ram Murthy and B.S.Manoj, "Ad Hoc Wireless Networks – Architectures and Protocols", Pearson Education, 2004.</li> <li>T2 Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", John Wiley and Sons, 2010.</li> <li>REFERENCE BOOKS:</li> <li>R1 Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing, 2011.</li> <li>R2 C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 2002.</li> <li>R3 Holger Karl, Andrea's willig, "Protocols and Architectures for Wireless Sensor Networks, John Wiley &amp; Sons, Inc. 2005.</li> <li>R4 Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, "Ad Hoc Mobile Wireless Networks", Auerbach Publications, 2008.</li> </ul>	Outcom	res CO3	Establish a Sensor network	any interest in au not and sensor						
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<ul> <li>T1 C.Siva Ram Murthy and B.S.Manoj, "Ad Hoc Wireless Networks – Architectures and Protocols", Pearson Education, 2004.</li> <li>T2 Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", John Wiley and Sons, 2010.</li> <li>REFERENCE BOOKS:</li> <li>R1 Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing, 2011.</li> <li>R2 C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 2002.</li> <li>R3 Holger Karl, Andrea's willig, "Protocols and Architectures for Wireless Sensor Networks, John Wiley &amp; Sons, Inc .2005.</li> <li>R4 Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, "Ad Hoc Mobile Wireless Networks", Auerbach Publications, 2008.</li> </ul>	TEXT B	OOKS:	Chaerstand the security in I							
<ul> <li>Fin Education, 2004.</li> <li>Fin Education, 2004.</li> <li>Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", John Wiley and Sons, 2010.</li> <li>REFERENCE BOOKS:</li> <li>R1 Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing, 2011.</li> <li>R2 C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 2002.</li> <li>R3 Holger Karl, Andrea's willig, "Protocols and Architectures for Wireless Sensor Networks, John Wiley &amp; Sons, Inc .2005.</li> <li>R4 Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, "Ad Hoc Mobile Wireless Networks", Auerbach Publications, 2008.</li> </ul>	т <u>т</u> С.	Siva Ram N	Jurthy and B.S.Manoj, "Ad	Hoc Wireless Networks - Architectures and F	rotoco	ls", I	Pearsor	1		
<ul> <li>T2 Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", John Wiley and Sons, 2010.</li> <li>REFERENCE BOOKS:</li> <li>R1 Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing, 2011.</li> <li>R2 C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 2002.</li> <li>R3 Holger Karl, Andrea's willig, "Protocols and Architectures for Wireless Sensor Networks, John Wiley &amp; Sons, Inc. 2005.</li> <li>R4 Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, "Ad Hoc Mobile Wireless Networks", Auerbach Publications, 2008.</li> </ul>	Ed Ed	lucation, 200	)4.							
<ul> <li>Wiley and Sons, 2010.</li> <li>REFERENCE BOOKS: <ul> <li>Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing, 2011.</li> <li>R2 C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 2002.</li> <li>R3 Holger Karl, Andrea's willig, "Protocols and Architectures for Wireless Sensor Networks, John Wiley &amp; Sons, Inc. 2005.</li> <li>R4 Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, "Ad Hoc Mobile Wireless Networks", Auerbach Publications, 2008.</li> </ul> </li> </ul>	T2 W	altenegus Da	argie, Christian Poellabauer, "	Fundamentals of Wireless Sensor Networks Theory	and Pr	ractic	e", Joh	n		
<ul> <li>REFERENCE BOOKS:</li> <li>Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing, 2011.</li> <li>R2 C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 2002.</li> <li>R3 Holger Karl, Andrea's willig, "Protocols and Architectures for Wireless Sensor Networks, John Wiley &amp; Sons, Inc .2005.</li> <li>R4 Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, "Ad Hoc Mobile Wireless Networks", Auerbach Publications, 2008.</li> </ul>	W	iley and Sor	ns, 2010.							
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<b>R4</b> Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, "Ad Hoc Mobile Wireless Networks", Auerbach Publications, 2008.	<b>R3</b> Ho	olger Karl, A 005.	andrea's willig, "Protocols and	d Architectures for Wireless Sensor Networks, John	1 Wiley	y & S	ons, In	c		
	R4 Su Pu	bir Kumar blications, 2	Sarkar, T G Basavaraju, C 2008.	Puttamadappa, "Ad Hoc Mobile Wireless Net	works'	", At	ierbach	1		

-P. Hayle Chairman, Board of Studies Chairman - BoS ECE - HiCET .



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PROGRAM	ME	COURSE CODE	NAME OF THE COURSE	L	Т	Р	С
Course Objectiv	$\begin{array}{c} 1 \\ 1.E \\ 2 \\ 2 \\ 2 \\ 2 \\ 7 \\ 7 \\ 8 \\ 4 \\ 5 \end{array}$	20AEX309 To Teach the basic conc To expose the various de To make learn various de To impart knowledge on To apply robot based con	ROBOTICS AND INTELLIGENT SYSTEMS epts in robotics. esign aspects in robot grippers. rives and control systems. machine vision systems. ncepts for automation	3	0	0	3
Unit			Description		]	Instruct Hou	tional
Ι	INTROE Basic Co Robotic accuracy, Automati an Autom automatic BOBOT	PUCTION ncepts such as Definition Systems i.e. Robot anator repeatability, dexterity, on in Production System, nated System, Advanced A on productivity. CRIPPERS	, three laws, DOF, Misunderstood devices etc., El omy, Classification, Associated parameters i.e. in compliance, RCC device, etc. Automation-Conce Principles and Strategies of Automation, Basic El Automation Functions, Levels of Automations, intro	ements of resolution ept, Need ements of duction t	of n, l, of o	9	
п	Types of Sensors for application Control of DRIVES	Grippers, Design aspect to or Robots:- Characteristics ons of sensors. Types of Se a robot. AND CONTROL SYST	for gripper, Force analysis for various basic grippes s of sensing devices, Selections of sensors, Classific ensors, Need for sensors and vision system in the work <b>EMS</b>	er system cation an orking an	n. d d	9	
Ш	Types of transmiss .Control Discrete-J its Forms	<sup>5</sup> Drives, Actuators and ion systems, Control Syste Technologies in Automat Manufacturing Industries, Control System Compon NE VISION SYSTEM	its selection while designing a robot system. ems -Types of Controllers, Introduction to closed locion:- Industrial Control Systems, Process Industri Continuous Verses Discrete Control, Computer Prents such as Sensors, Actuators and others.	Types of op contro es Verse rocess an	of l s d	9	
IV	Vision Sy programm command and VAL MODEL Introducti Plant Mo	ystem Devices, Robot Pro- ning, motion interpolation ls, subroutines, Programm II etc, Features of type an <b>ING AND SIMULATIO</b> tion, need for system Mo- dern Tools- Artificial	ogramming: - Methods of robot programming, lea on, branching capabilities, WAIT, SIGNAL and hing Languages: Introduction to various types such d development of languages for recent robot system <b>N FOR MANUFACTURING PLANT AUTOM</b> odeling, Building Mathematical Model of a man neural networks in manufacturing automation	d throug DELA a as RAI as. ATION ufacturin AI i	h Y L g	9	
V	manufact automatic and appl Economic updates in	uring, Fuzzy decision a on. Artificial Intelligence:- ication of AI. Other Top cal aspects for robot design a robotics	and control, robots and application of ro Introduction to Artificial Intelligence, AI techniq pics in Robotics:- Socio-Economic aspect of rol n, Safety for robot and associated mass, New Trend	bots fo ues, Nee ootisatior s & recer	or d 1. nt	9	
Course Outcome	CO1 CO2 CO3 S CO4	Ability to implement sim Ability to use various Ro Ability to use kinematics Ability to implement cor	<b>Total Instruction</b> apple concepts associated with Robotics and Automa obotic sub-systems and dynamics to design exact working pattern of r nputer vison algorithms for robots	<b>nal Hour</b> tion obots	S	45	i
TEXT BO T1 Johr T2 Mik Inter	COS OKS: 1 J. Craig," ell P. Gro rnational, 1	<sup>1</sup> Introduction to Robotics over et. Al., "Industrial H 1986	ed recent updates in Robotics (Mechanics and Control)", Addison-Wesley, 2nd E Robotics: Technology, Programming and Applicat	dition, 20 ions", M	004 [cGr	aw – H	ill
R1 Shir	non Y. No	f , "Handbook of Industria	al Robotics", John Wiley Co,2001.				
R2 Auto R3 Rich Pren R4 R.C	omation, " hard D. Kla htice Hall I . Dorf. "Ha	Production Systems and C after , Thomas A. Chemiel ndia, 2002. andbook of design, manufa	omputer Integrated Manufacturing", M.P. Groover, lewski, Michael Negin, "Robotic Engineering : An acturing & Automation" John Wiley and Sons.	Pearson Integrate	Edu d Ap	cation. proach'	·,

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	M.E	20AEX310	SATELLITE COMMUNICATIONS AND 3 0 NAVIGATION SYSTEMS	0 3
COUF	SE OBJECTIVE	To impart knowle 1. Unders transmi 2. Unders link de 3. Expose scenar	edge on tand the necessity for satellite based communication, the essential elements ssion methodologies. stand the different interferences and attenuation mechanisms affectin sign. e the advances in satellite based navigation, GPS and the different ap tos	involved and the og the satellite oplication
Unit		Descrip	tion	Instructional Hours
Ι	<b>ELEMENTS OF</b> Satellite Systems, Satellite in a GSG keeping, Satellite	<b>SATELLITE C</b> Orbital description O, Antennas and – description of d	<b>OMMUNICATION</b> on and Orbital mechanics of LEO, MEO and GSO, Placement of a earth coverage, Altitude and eclipses, Satellite drift and station ifferent Communication subsystems, Bandwidth allocation.	9
Π	SATELLITE SP. Introduction; attit communication su Access: Demand a	ACE SEGMENT ude and orbit co bsystems, antenn assigned FDMA -	<b>FAND ACCESS</b> ntrol system; telemetry, tracking and command; power systems, a subsystem, equipment reliability and space qualification, Multiple spade system - TDMA - satellite switched TDMA –CDMA.	9
III	<b>SATELLITE LIP</b> Basic link analys characteristics, Li C/N, Link Design	NK DESIGN is, Interference and nk Design: Syste with and without	analysis, Rain induced attenuation and interference, Ionospheric m noise temperature and G/T ratio, Downlink and uplink design, frequency reuse, link margins, Error control for digital satellite link.	9
IV	<b>SATELLITE BA</b> VSAT Network f Mobile and Persor Satellite Systems,	SED BROADBA for Voice and Da nal Communicatio UAVs.	AND COMMUNICATION ata – TDM/TDMA, SCPC/DAMA, Elements of VSAT Network, on Services, Satellite based Internet Systems, Multimedia Broadband	9
V	SATELLITE NA Radio and Satelli Satellite Signal A Sensing and ISRC	VIGATION AN te Navigation, G cquisition, GPS GPS Systems.	<b>D GLOBAL POSITIONING SYSTEM</b> PS Position Location Principles of GPS Receivers and Codes, Receiver Operation and Differential GPS, INS, Indian Remote	9
			TOTAL INSTRUCTIONAL HOURS	45
COUI	RSE OUTCOME	After comple CO1: Demon the essential o CO2: Familia communication CO3: Demon mechanisms a CO4: Demon applications of	tion of the course the learner will be able to strate an understanding of the basic principles of satellite based elements involved and the transmission methodologies. urize with satellite orbits, placement and control, satellite link design on system components. strate an understanding of the different interferences and attenuation affecting the satellite link design. strate an understanding of the different communication, sensing and of satellite.	communication and the navigational

NAME OF THE COURSE

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CO5: Familiarize with the implementation aspects of existing satellite based systems.

# **REFERENCES:**

PROGRAMME

**COURSE CODE** 

- **R1** Wilbur L. Pritchard, Hendri G. Suyderhoud and Robert A. Nelson, "Satellite Communication Systems Engineering", Prentice Hall/ Pearson, 2007.
- **R2** Timothy Pratt and Charles W.Bostain, "Satellite Communications", John Wiley and Sons, 2<sup>nd</sup> Edition, 2012.
- **R3** D.Roddy, "Satellite Communication", McGraw Hill, 4<sup>th</sup> Edition (Reprint), 2009
- **R4** Tri T Ha, "Digital Satellite Communication", McGraw Hill, 2<sup>nd</sup> Edition, 1990.

- **R5** B.N.Agarwal, "Design of Geosynchronous Spacecraft", Prentice Hall, 1993.
- **R6** Brian Ackroyd, "World Satellite Communication and Earth Station Design", BSP Professional Books, 1990.

-P. Hayle Chairman, Board of Studies Dean Academics Chairman - BoS ECE - HICET (Academics) Dean HICET

PROGR	AMME	COURSE CODE	NAME OF THE COURSE	L	Т	Р	С
M.E	Ξ	20AEX311	5G Technology	3	0	0	3
	1	To introduce students with c	oncepts, design issues in 5G networks				
G	2	To study about architecture wireless network technologie	s and protocols and the state-of-the-art deves.	velopments	in n	ext gei	neration
Objective	s 3	To Study various Multiple A	ccess techniques for wireless channels.				
	4	To understand the relevance	of MIMO techniques				
Unit			Description	Instru	uction	alHou	rs
5	G CHA	NNEL MODEL					
I	Mode Propa Comj	eling requirements and scena agation scenarios, METIS c parison of Models	rios, Channel model requirements and Me hannel models, Map-based model, stocha	asurements stic mode	s, l,	9	
и	AULTI- Filter struct Princ Gene diagr	<b>CARRIER WAVEFORMS</b> -bank based multi-carrier (F ture, Resource structure, alloca iples, Transceiver structure, ralized frequency division r am, Frame structure, Resource	FOR 5G BMC)- Principles, Transceiver block diagration, mapping. Universal filtered multi carrie Frame and Resource structure, allocation nulticarrier (GFDM) – Principles, Transce structure, allocation, mapping, MIMO-GFDI	ram, Fram er (UFMC) n, mapping eiver Bloc M.	e )- g. k	9	
III C C N	<b>IULTII</b> Thallenge Cancellat	PLE ACCESS TECHNIQUE es in OFDM- NOMA – Pri ion, Power Domain NOMA, S Cooperative NOMA- Benefits	<b>S IN 5G</b> nciple- Superposition Coding, Successive Sparse Code NOMA- types, Power Domain S and Challenges.	Interference Sparse Coc	ce le	9	
IV N	A SSIV	TE MIMO	-				
IV IV	Intro	duction-pilot design and chann	el estimation- uplink data transmission and de	ownlink			
	data t	ransmission for Single cell sys	stems and multi cell systems – capacity analys	sis.			
						9	
C	COOPE	RATIVE COMMUNICATIO	)N				
V	Mach Narro NOM forwa	ine Type Communication (M owband IoT, Cloud Computing IA- Benefits and Challenges, H and relaying, Decode and forwa Applysic Connectivy Applysic	TC), Device to Device Communication (D2D) g architecture and Protocols, Relaying: Coope Half duplex relaying, Full duplex relaying, An ard relaying, Decode and forward relaying wi	), 5G rative nplify and th PLNC,		9	
	DLK	Analysis, Capacity Analysis.				45	
	CO1	Able to analyze the perform	Total Instruction	onal Hour 5G wireles	'S Is svet	45 ems	
Course	CO2	Able to design a transceiver	for Multicarrier waveforms		is syst	C1113	
Outcomes	CO3	Able to analyze multiple acc	ess techniques in 5G networks				
	CO4	Able to design a pilot, estima Massive MIMO	ate channels and analyze capacity for single co	ell and mul	ticell		
	CO5	Able to analyze different typ	es of cooperative communications				

# **REFERENCE BOOKS :**

- **R1** AfifOsseiran, Jose.F.Monserrat and Patrick Marsch, "5G Mobile and Wireless Communications Technology", Cambridge University Press, 2016.
- R2 Robert W. Heath Jr., Nuria González-Prelcic, SundeepRangan, WonilRoh, and Akbar M. Sayeed, "An Overview of Signal Processing Techniques for Millimeter Wave MIMO Systems", IEEE Journal of Selected Topics in Signal Processing, Vol. 10, No. 3, April 2016
- **R3** MinChulJu and Il-Min Kim, "Error Performance Analysis of BPSK Modulation in Physical- Layer Network-Coded Bidirectional Relay Networks", IEEE Transactions on Communications, Vol. 58, No. 10, October 2010.
- R4 Shengli Zhang, Soung-Chang Liew, Patrick P.Lam, "Physical Layer Network Coding", Mobicom \_06, Proceeding of the 12th International Conference on Mobile Computing and Networking, pp.358-365, Los Angeles, CA, USA, Sep.23-29,2006

**R5** Thomas L. Marzetta, Erik G. Larsson, Hong Yang, HienQuoc Ngo, "Fundamentals of Massive MIMO", Cambridge University Press, 1 st Edition, 2016..

P. Hayle Chairman, Board of Studies

Chairman - BoS ECE - HiCET

1 KOOI	KAIVIIVI 4 E	E	COURSE CODE	NAME OF THE COURSE		T	P	C
IV	1.E	1	20AEA312 To understand the basic	IOT SYSTEM DESIGN AND SECURITY	3	0	0	3
		1	To understand the basic					
Cours	e	2	To get an idea about the	e various services provided by io1.				
Objectiv	ves	3	To familiarize themselv	ves with various communication techniques.				
		4	To get an idea of some	application area where lol can be applied.				
		3	To understand the vario	bus issues in 101.		1	[	4
Unit				Description		J	Instruc	cuona
	INTR	ω	ΠΟΤΙΟΝ ΤΟ ΙΝΤΕΡΝΙ	FT OF THINGS			Ποι	115
	Rise	f th	= machines $-$ Evolution of	of IoT – Web 3.0 view of IoT – Definition and chara	cteristic	2		
Ι	of IoT	-P	hysical design of $IoT - L$	ogical design of $IoT - IoT$ enabling technologies – I	oT levels	5	9	1
	and de	plo	yment templates – A pana	aromic view of IoT applications.				
	ARCI	HIT	ECTURE OF IoT					
	Identi	facti	on and Access to objects	s and services in the IoT environment( Current tech	nnologie	s		
	for Io	Τn	aming-Solutions propose	ed by research projects-Research and Future dev	elopmen	t		
	trends	and	1 forecast) – Middleware	e technologies for IoT system (IoT Ecosystem Ov	erview -	-		
II	Horizo	onta	l Architecture Approach	for IoT Systems-SOA-based IoT Middleware)Mi	ddlewar	e	9	I
	archite	ectu	re of RFID,WSN,SC	CADA, M2M–Challenges Introduced by 5G	in lo'l	ľ		
	Middl	ewa	re(Technological Requi	irements of 5G Systems-5G-based Io1 Servi	ces and	1		
	Midd1	caulo ewa	re Approach Toward 5G	(COMPaaS Middleware) – Resource management i	n IoT	1		
	SECU	IRI'	<b>FY CONSIDERATION</b>	S IN IOT SMART AMBIENT SYSTEMS	11 10 1			
	Securi	tv ir	Smart Grids and Smart S	Spaces for Smooth IoT Deployment in 5G (5G and th	e Interne	t		
	of Thi	ngs	-Smart Spaces-Smart Gri	ds Security and Privacy - Services that Need to Be	Secure	-	0	
111	Securi	ity F	Requirements -Security A	ttacks-Security Measures and Ongoing Research) -	Security	y	9	/
	Challe	enge	s in 5G-Based IoT Mic	ddleware Systems(Security in 5G-Based IoT Mic	Idleware	-		
	Securi	ity C	Challenges Toward 5G).					
	IOT I	ENA	BLERS AND THEIR S	SECURITY AND PRIVACY ISSUES				
IV	Intern	et o	f Things layer wise Proto	cols and Standards- EPCglobal( architecture, speci	fications	,	9	)
	indust	ry a	daptation, security and v	ulnerabilities, advantages and disadvantages)Wirele	SSHART	-	-	
	Zigbe	e-IN6	ear Field Communication	-6LowPAN-Dash/-Comparative Analysis.				
	APPL	ICA	ATIONS AND CASE ST	TUDIES				
V	Home	aut	omations - Smart cities -	- Environment – Energy – Retail – Logistics – Agri	culture -	-	9	)
	Indust	ry -	Health and life style – Ca	ase study				
				Total Instruction	al Hour:	S	45	5
	CO	D1	Articulate the main con	cepts, key technologies, strength and limitations of I	loT. CO2	2:		
Course	C	D2	Identify the architecture	e, infrastructure models of IoT.				
Outcome	CC	)3	Analyze the core issues	of IoT such as security, privacy and interoperability	1.			
Jucome	° CO	D4	Analyze and design diff	ferent models for network dynamics.				
	CC	)5	Identify and design the	new models for market strategic interaction.				
ГЕХТ В	OOKS	:						
<b>Г1</b> Но	nbo Zh	ou, '	'Internet of Things in the	cloud: A middleware perspective", CRC press 2012	•			
<b>Г2</b> Vii	av Mad	liset	ti and Arshdeep Bahga. "	Internet of Things (A Hands-onApproach)", VPT, 1	st Editic	on. 2	2014	
PEFEB.	FNCE	RO	nks.			, -		
Co	nstandi	nos	X. Mavromoustakis. Geo	rge Mastorakis, Jordi Mongay Batalla, "Internet of	Things (	IoT)	in 5G	
	bile Te	chn	ologies" Springer Interna	tional Publishing, Switzerland, 2016.	1111165 (1		mee	
R1 Mc	• • -	-	biogles Springer Interna					
$\begin{array}{ccc} \mathbf{R1} & \mathbf{Mc} \\ \mathbf{R2} & \mathbf{Die} \\ \mathbf{R2} & \mathbf{Dm} \end{array}$	eter Uck	celm	ann, Mark Harrison, Flor	rian Michahelles, "Architecting the Internet of Thin	gs", Spri	ngei	r-Verlag	g
$\begin{array}{ccc} \mathbf{R1} & \mathbf{Mc} \\ \mathbf{R2} & \mathbf{Die} \\ \mathbf{R3} & \mathbf{hff} \end{array}$	eter Ucl rlin Hei	celn delt	ann, Mark Harrison, Flor perg, 2011.	rian Michahelles, "Architecting the Internet of Thin	gs", Spri	ngei	r-Verlag	g



PROGE	RAMM	E COURSE CODE	NAME	C OF THE COURSE	L	T	P	C
М	.E.	20AEX313	Μ	achine Learning	3	0	0	3
Course Objective	es	<ol> <li>To study the Mathemat</li> <li>To enable the student to</li> <li>To learn the fundament</li> <li>To know the machine loss</li> <li>To expose the student to and unsupervised learning</li> </ol>	ical background o o understand the c als of different Ne earning applicatio be familiar with a g algorithms.	f machine learning oncept of machine learning eural network architectures n in wireless communication set of well-known supervised	and bio-medica l, semi-supervis	ıl. sed		
Uni	t		Description	n		Ins	structi Houi	ional rs
Μ	ATHE	MATICAL BACKGROUN	D				1100	5
I	Linear decom distrib Probal	r Algebra – Arithmetic of nposition, Pseudo inverse, pution, conditional probabili bilistic models.	f matrices, Norr Componer ty, Chain rule, I	ns, Eigen decomposition, S at analysis. Probability theor Bayes rule, Information theo	Singular value y – probability ory, Structured		9	
Μ	ACHI	NE LEARNING BASICS						
п	Superv Valida Vector neight	vised and Unsupervised le ation, Linear regression, Lo r Machines (SVM), Decisi bor.	earning, Capacit ogistic Regression on tree, Random	y, Overfitting and Underfin, Regularization, Naive Ba n forest, K-Means Clusterin	tting, Cross yes, Support g, k nearest		9	
N	EURA1	L NETWORKS	agation Convolu	tional Naural Naturarka LaN	at AlayNat		0	
111	ZF-Ne Back J Neura Gradie	et, VGGNet, GoogLeNet, Repropagation, Deep Dream, Dell Network(RNN) – Back propagation, Deep Dream, Dell Network(RNN) – Back propents.	sNet, Visualizing eep Art, Fooling ( pagation through	Convolutional Neural Networks-Leve Convolutional Neural Networ time (BPTT), Vanishing and	rks, Guided ks. Recurrent Exploding		9	
Μ	L IN V	VIRELESS AND SECURIT	ſΥ					
IV	Water OFDM downl in Side	-filling power allocation, Op A systems. Optimization in b link beamforming. Application e channel analysis.	otimization for MI beamformer desig on: Radar for targ	MO Systems, OFDM Syster n – Robust receive beamforn et detection, Array Processing	ns and MIMO- ning, Transmit g, MUSIC, ML		9	
Μ	L IN B	BIO-MEDICAL			<b>.</b>			
V	Machi Auton Monit	nated ECG Noise Detection coring. Techniques for Electro	n and Classification on charter of the second secon	tion System for Unsupervised (EHR) Analysis	Beep Learning sed Healthcare		9	
	CO	1 Demonstrate understandin	ng of the mathema	atical principles underlying m	achine		45	
Course	CO2	2 Familiar with the different 3 In a position to formulate	t machine learnin machine learning	g techniques and their use cas problems corresponding to d	ses. lifferent applica	tion	5	
Outcomes	, CO4	4 Able to recognize the chara problems.	acteristics of mach	nine learning techniques that	are useful to sol	ve re	eal-wo	rld
	COS	5 In a position to read curren	t research papers,	understand the issues and the	e machine learn	ing t	based	
RE	FEREN	solution approaches. NCE BOOKS :						
	<b>R1</b> .	Ian Goodfellow, Yoshua B 2017	engio, and Aaron	Courville, "Deep learning",C	Cambridge,MA,	MIT	Press	,
	R2.	Tom M. Mitchell, "Machir	e Learning", Mc	Graw Hill, 1997.				
	R3.	Ethem Alpaydın, "Introduc	ction to machine l	earning", MIT Press, 3rd Edit	ion, 2014.			
	K4.	M. N. Wernick, Y. Yang, J Medical Imaging" IEEE S	. G. Brankov, G. ignal Processing ]	Yourganov and S. C. Strother Magazine vol 27 no 4 nm (	, "Machine Lea 25-38 July 201	irnin O	g in	
	R5.	Ravi et al., "Deep Learning Informatics, vol. 21, no. 1,	g for Health Inform	matics," IEEE Journal of Bioi	nedical and He	alth		
	R6.	Satija, B. Ramkumar and M IEEE Journal of Biomedical	I. S. Manikandan,	"Automated ECG Noise Determatics PP(99) March 2017	ection and Class	sifica	ation",	
	R6	-"System for Unsupervised I Informatics, vol. 22, no. 3, p	Healthcare Monito p. 722-732, May	oring," IEEE Journal of Biom 2018	edical and Heal	th		
		,,,, p		λ				
		Chairman, Board of Studies	SEWIC COURS	Dast				
		ECE - HICET	( ( man)	Dean (Academic HiCET	s)			

PROG	RAMME 1.E.	COURSE CODE 20AEX314	NAME OF THE COURSE ELECTRONICS FOR SOLAR POWER	L 3	Т 0	<b>P</b> 0	С 3
-						Ū	
	1	Study the behavior of ph	otovoltaic solar energy systems, focusing on the behav	vior of	"stand	-alone	."
Course	- 2	Do a first order concent	ual design of a stand alone system for a location anyw	horo in	India		
Objectiv	$e^{2}$	Introduce the hardware e	lements and their behavior		muia		
Objectiv	4	Select battery for a PV sy	vstem and hattery sizing				
	5	Simulate standalone and	grid tied PV system				
Unit			Description		Ins	tructi Hour	onal s
	INTROI	<b>DUCTION TO SOLAR P</b>	OWER				
Ι	Semicono - Basic ch - Sun pat - Maximu voltaic sy	ductor – properties - energ haracteristics of sunlight - S h diagrams – Equivalent ci im power point, Vmp, IMP rstem, PV array sizing.	y levels - basic equations of semiconductor devices pholar angles - day length - angle of incidence on tilted su rcuit of PV cell, PV cell characteristics (VI curve, PV c y, Voc, ISC – types of PV cell - Block diagram of solar	iysics irface urve) photo		9	
II	DC-DC Principle buckboos Resonant	CONVERTER s of step-down and step-u at and Cuk converters – the and quasi – resonant conv	up converters – Analysis and design issues of buck, me ratio and current limit control – Full bridge convergences.	boost, erter –		9	
	MAXIM	UM POWER POINT TH	RACKING				
ш	Direct Er Function Fractiona Developr	ergy transmission, Imped of MPPT, P&O method l short circuit current me nent of hardware, algorith	ance Matching, Maximum Power Point Tracking (MP I, INC Method, Fractional Open circuit voltage me ethod, parasitic capacitance and other MPPT techni ms using processors for Standalone and Grid tied syste	PT) - ethod, iques, ems.		9	
IV	BATTEI Types of dischargi Charge E discharge Battery a	<b>XY</b> Battery, Battery Capacing rate on battery capacificiency, Charging methods, Circondo Sector 2010, Circond sizing.	ity – Units of Battery Capacity-impact of charging city-Columbic efficiency-Voltage Efficiency, Charg ods, State of Charge, Charging Rates, Discharging - De cuits for Battery Management System (BMS), selecti	g and ing – pth of on of		9	
	SIMULA	ATION OF PV MODULI	E & CONVERTERS				
V	Simulation	on of PV module - VI Pl	ot, PV Plot, finding VMP, IMP, Voc, Isc of PV me	odule,		9	
	orid tied	on of DC to DC converter -	buck, boost, buck-boost and Cuk converters, standalor	ie and			
	Silution	photo voltale system.	Total Instructional H	Hours		45	
	CO1	Ability to collect solar po	wer characteristics at a given location				
Course	CO2	Ability to design and reali	ze dc-dc converters for solar power utilization				
Outcomes	CO3	Ability to design algorithm	ns for improving solar power utilization				
	CO4	Ability to deal with batter	y issues and selection				
техт і	BOOKS	Aunity to design and simi	nate r v systems to vandate its performance.				
T1 Cł	netan Sing	h Solanki, "Solar Photovo	ltaic: Fundamentals, Technologies and Applications".	PHI Lt	d., 201	13.	
<b>T2</b> To	ommarkva	rt, Luis castaner, "Solar ce	ells; materials, manufacture and operation", Elsevier, 2	.005.			
REFER	ENCE B	OOKS:	-				
<b>R1</b> G.	D .Rai, "S	olar energy utilization ", I	Khanna publishes, 1993.				
Ne	ad Mohan	Undeland and Robbin "P	ower Electronics: converters Application and				

**R2** Ned Mohan, Undeland and Robbin, "Power Electronics: converters, Application and Design", John Wiley and sons.Inc, Newyork, 1995.



	5	To expose the students to the state of art technology in PCB design and manufacturing.	
Unit		Description	Instructiona Hours
Ι	BASIC Printed Photolit the PCl (Gerber and Typ	<b>S OF PCB DESIGN AND TOOLS</b> Circuit Board Fabrication- PCB cores and layer stack-up. PCB fabrication process- thography and chemical etching, Mechanical Layer registration. Function of the Layout in B Design Process. Design Files Created by Layout - Layout format files, Post process of files, PCB assembly layers and files. Introduction to the Standards Organizations, Classes pees of PCBs.	9
II	PCB D Overvie Schema Capture netlist i Perform Manual	<b>ESIGN FLOW USING CAD TOOL</b> ew of Computer-Aided Design. Project structures and the layout toolset- Project Setup and atic Entry Details, the Layout Environment and Tool Set. Creating a Circuit Design with e-Starting a new project placing parts, Wiring (connecting) the parts, creating the Layout in Capture. Designing the PCB with Layout- Starting Layout and importing the netlist, ning a design rule check, Making a board outline, Placing the parts, Auto routing the board routing, Cleanup Locking traces, Post processing the board design for manufacturing.	9
ш	DESIG PCB A Compor SMDs, Manufa Devices between	<b>EN FOR MANUFACTURING</b> Assembly and Soldering Processes- Component Placement and Orientation Guide, nent Spacing for Through-hole Devices. Component Spacing for Surface Mounted Devices Mixed THD and SMD Spacing Requirements. Footprint and Padstack Design for PCB acturability- Land Patterns for Surface-Mounted Devices- Land Patterns for Through-hole s, Padstack design, Hole-to-lead ratio, PTH land dimension (annular ring width), Clearance in plane layers and PTHs Soldermask and solder paste dimensions.	9
IV	PCB D Circuit and Gro capture Constru	<b>ESIGN FOR SIGNAL INTEGRITY</b> Design Issues Not Related to PCB Layout, Issues Related to PCB Layout, Ground Planes ound Bounce, PCB Electrical Characteristics, PCB Routing Topics, Making and editing parts, The Capture Part Libraries, Types of Packaging, Pins, Part Editing Tools, acting Capture Parts, making and editing layout footprints.	9
V	EMER Fundam manufa (FDM), side Pri Prototy	<b>GING ADDITIVE PROCESSES FOR PCB MANUFACTURING</b> nentals of additive manufacturing, classification, advantages and standards on Additive cturing. Stereo lithography (SL), Stereo lithography (SL), Fused Deposition Modelling Three Dimensional Printing (3DP), Materials, Applications. Voltera-V-one PCB double inter, Bot Factory- SV2-multi layer PCB printer, LPKF circuit board plotter and LDS ping.	9
Cours Outcom	CO1 CO2 CO3 es CO4	<b>Total Instructional Hours</b> To understand the basics, industry standards organizations related to the design and fabric Leads new users of the software through a very simple design To know and guide in designing plated through-holes, surface-mount lands, and Layout for general. To know to construct Capture parts using the Capture Library Manager and Part Editor ar	45 eation of PCBs potprints in ad the PSpice
TEXT	CO5 BOOKS	Model Editor. To understand and to fabricate PCBs	a the i Spice
$\begin{array}{c} T1 \\ T2 \\ H \\ \end{array}$	Kraig Mitz Simon Mo Education	ener, "Complete PCB Design Using OrCad Capture and Layout", Newness, 1st Edition, 200 nk, "Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards" TAB; 2nd Edition, 2017.	9. , McGraw-Hil
REFE R1 I	KENCE I	BUURS: rooks "Signal Integrity Issues and Printed Circuit Roard Design" Prentice Hall PTR 2003	
$\mathbf{R2}  \mathbf{R2}  \mathbf{S2}$	Lee W. Ri System De	tchey, John Zasio, Kella J. Knack, "Right the First Time: a Practical Handbook on High S sign", Speeding Edge, 2003.	peed PCB and

P. Hayle Chairman, Board of Studies Chairman - BoS ECE - HICET

Dean Academics Dean (Academics) HICET

PROGRAMME	COURSE CODE	NAME OF THE COURSE	L
M.E.	20AEX315	PCB DESIGN AND FABRICATION	3

С Т Р 0 0 3 3

- To expose the students to the basics of PCB design 1
- 2 To lead the new users of the software through a very simple design
- To address the mechanical aspect of PCB design and to aid in understanding the design issues, 3 manufacturing processes
- 4 To address the electrical aspect of PCB design

Course

Objectives

- 11
- d

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# **OPEN ELECTIVE**

PROGRAM	ME COURSE CODE	NAME OF THE COURSE	L	Т	Р	С
M.E.	20AE3401	ROBOTICS	3	0	0	3
Course Objective	<ol> <li>Understand robot locomo</li> <li>Articulate perception in a</li> <li>Outline mobile robot loca</li> <li>Understand mobile robot</li> <li>Explain robot planning at</li> </ol>	otion and mobile robot kinematics. robotics alization. mapping. nd navigation.				
Unit		Description		Instru H	uctiona ours	al
	LOCOMOTION AND KINEMATICS	5			ours	
Ι	Introduction to Robotics – key issues in r – aerial mobile robots – introduction to maneuverability	obot locomotion – legged robots – wheeled a kinematics – kinematics models and constant	nobile robots raints – robot		9	
п	<b>ROBOT PERCEPTION</b> Sensors for mobile robots – vision for rob – structure from motion – optical flow – linear variable differential transformers	ootics – cameras – image formation – structur - color tracking – place recognition – range (LVDT), Hall Effect sensors.	e from stereo data sensors,		9	
ш	<b>MOBILE ROBOT LOCALIZATION</b> Introduction to localization – challenges representation – map representation – pr – EKF localization – UKF localization –	in localization – localization and navigation obabilistic map-based localization – Markov - Grid localization – Monte Carlo localization	ı – belief v localization m –		9	
IV	MOBILE ROBOT MAPPING Autonomous map building – occupancy extended Kalman Filter SLAM – graph information filter – fast SLAM algorithm	y grip mapping – MAP occupancy mappin -based SLAM – particle filter SLAM – spa n.	g – SLAM – arse extended		9	
v	<b>PLANNING AND NAVIGATION</b> Introduction to planning and navigation avoidance techniques – navigation archi	on – planning and reacting – path plannin tectures – basic exploration algorithms	ig – obstacle		9	
		Total Instruc	tional Hours		45	
C	CO1: Understand robot locom CO2: Understand perception i	otion and mobile robot kinematics. n robotics.				

Outcomes CO3: Apply robot localization techniques.

- CO4: Apply robot mapping techniques.
  - CO5: Explain planning and navigation in robotics.

# **TEXT BOOKS:**

**T1**. Gregory Dudekand Michael Jenkin, "Computational Principles of Mobile Robotics", Second Edition, Cambridge University Press, 2010.

**T2**. Howie Choset et al., "Principles of Robot Motion: Theory, Algorithms, and Implementations", A Bradford Book, 2005.

## **REFERENCE BOOKS:**

**R1**. Maja J. Mataric, "The Robotics Primer", MIT Press, 2007.

R2. Roland Seigwart, "Introduction to autonomous mobile robots", Second Edition, MIT Press, 2011.

R3. Sebastian Thrun, Wolfram Burgard, and Dieter Fox, "Probabilistic Robotics", MIT Press, 2005.

R4. Mikell.P.Groover, "Industrial Robotics – Technology, Programming and applications", Tata McGraw Hill 2008.

PROGRAMME PROGRAMM	IE NAME OF THE COURSE L	Т	Р	C
	COURSE CODE			
M.E.	20AE3402 ARTIFICIAL INTELLIGENCE AND OPTIMIZATION 3	0	0	3
Course Objectives	<ol> <li>To introduce the techniques of computational methods inspired by nature, such as neural a algorithms and other evolutionary computation systems, ant swarm optimization and artif systems.</li> <li>To present main rules underlying in these techniques.</li> <li>To present selected case studies.</li> <li>To adopt these techniques in solving problems in the real world.</li> </ol>	networ icial ir	ks, gene nmune	etic
Unit	Description	Inst	ruction: Tours	al
Ι	<b>NEURAL NETWORKS</b> Neural Networks: Back Propagation Network, generalized delta rule, Radial Basis Function Network, interpolation and approximation RBFNS, comparison between RBFN and BPN, Support Vector Machines: Optimal hyperplane for linearly separable patterns, optimal hyperplane for nonlinearly separable patterns, Inverse Modeling.		9	
п	<b>FUZZY LOGIC SYSTEMS</b> Fuzzy Logic System: Basic of fuzzy logic theory, crisp and fuzzy sets, Basic set operation like union, interaction, complement, T-norm, T-conorm, composition of fuzzy relations, fuzzy if- then rules, fuzzy reasoning, Neuro-Fuzzy Modeling: Adaptive Neuro-Fuzzy Inference System (ANFIS), ANFIS architecture, Hybrid Learning Algorithm.		9	
Ш	<b>EVOLUTIONARY COMPUTATION &amp; GENETIC ALGORITHMS</b> Evolutionary Computation (EC) – Features of EC – Classification of EC – Advantages – Applications. Genetic Algorithms: Introduction – Biological Background – Operators in GA-GA Algorithm – Classification of GA – Applications		9	
IV	ANT COLONY OPTIMIZATION Ant Colony Optimization: Introduction – From real to artificial ants- Theoretical considerations – Convergence proofs – ACO Algorithm – ACO and model based search – Application principles of ACO.		9	
V	PARTICLE SWARM OPTIMIZATION Particle Swarm Optimization: Introduction – Principles of bird flocking and fish schooling – Evolution of PSO – Operating principles – PSO Algorithm – Neighborhood Topologies – Convergence criteria – Applications of PSO, Honey Bee Social Foraging Algorithms, Bacterial Foraging Optimization Algorithm.		9	
	Total Instructional Hours		45	
	CO1: Ability to design and train neural networks with different rules			

Course Outcomes CO2: Ability to devise fuzzy logic rules CO3: Ability to implement genetic algorithms CO4: Ability to implement ANT colony optimization technique for various problems CO5: Ability to use PSO technique

## **TEXT BOOKS:**

T1 David E. Goldberg, "Genetic Algorithms in search, Optimization & Machine Learning", Pearson Education, 2006

T2 Christopher M. Bishop, "Neural Networks for Pattern Recognition", Oxford University Press, 1995 REFERENCE BOOKS:

- **R1** N P Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2005.
- R2 Engelbrecht, A.P., "Fundamentals of Computational Swarm Intelligence", Wiley, 2005.
- R3 Kenneth A DeJong, "Evolutionary Computation A Unified Approach", Prentice Hall of India, New Delhi, 2006.
- R4 Marco Dorigo and Thomas Stutzle, "Ant Colony optimization", Prentice Hall of India, New Delhi, 2004.





# **SYLLABUS**

For the students admitted during the academic year 2021-2022

PROGRAMME	COURSE CODE	NAME OF THE COURSE	L	Т	Р	С
M.E	20AE3901	<b>DISSERTATION - I</b>	0	0	20	10

- 1. Analyze a methodology to select a project and able to develop a hardware/software project.
- 2. Transform the ideas behind the project with clarity.

Course Objective

3. Validate the technical report.

## **Description of the project work**

A candidate is permitted to work on projects in an Industrial / Research Organization, on the recommendations of the Head of the Department concerned.

A project must be selected either from research literature published list or the students themselves may propose suitable topics in consultation with their guide.

The aim of the project work is to strengthen the comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation or a design problem.

The project work shall be supervised by a supervisor of the department, (and an expert in industry if it is a industrial project), and the student shall be instructed to meet the supervisor periodically and to attend the review committee meeting for evaluation of the progress.

In case of candidates not completing Phase-I of project work successfully, the candidates can undertake Phase-I again in the subsequent semester. In such cases the candidates can enroll for Phase-II, only after successful completion of Phase-I.

The Project report shall be prepared and submitted according to the approved guidelines as given by the Controller of Examination and bonafied duly signed by Supervisor and the Head of the Department.

CO1: Realize the skills acquired in the previous semesters to solve complex engineering problems.CO2: Build up an innovative model / prototype of an idea related to the field of specialization.CO3: Create the work individually to identify, troubleshoot and build products for environmental and societal issues.

Course Outcome

CO4: Effective presentation of ideas with clarity.

CO5: Evaluate surveys towards developing a product which helps in life time learning.

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# SEMESTER IV

PROGRAMME	COURSE CODE	NAME OF THE COURSE	L	Т	Р	С
M.E	20AE4901	DISSERTATION - II	0	0	30	15

1. Analyze a methodology to select a project and able to develop a hardware/software project.

Course 2. Transform the ideas behind the project with clarity.

Objective 3. Validate the technical report.

# Description of the project work

The Project work (Phase II) shall be pursued for a minimum prescribed period as per regulation.

The project work shall be supervised by a supervisor of the department, (and an expert in industry if it is a industrial project), and the student shall be instructed to meet the supervisor periodically and to attend the review committee meeting for evaluation of the progress.

The Project report shall be prepared and submitted according to the approved guidelines as given by the Controller of Examination and bonafied duly signed by Supervisor and the Head of the Department.

CO1: Realize the skills acquired in the previous semesters to solve complex engineering problems.CO2: Build up an innovative model / prototype of an idea related to the field of specialization.CO3: Create the work individually to identify, troubleshoot and build products for environmental and societal issues.

# Course Outcome

CO4: Effective presentation of ideas with clarity.

CO5: Evaluate surveys towards developing a product which helps in life time learning.







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Progr N	<b>amme</b> IE	Course Code 20AEX301	Name of the Course INTELLIGENT SYSTEMS AND CONTROL	<b>L</b> 3	Т 0	<b>P</b> 0	<b>C</b> 3
Cours Objecti	e ve	<ol> <li>Introduce about Ne</li> <li>Classify on various</li> <li>To learn about Neu</li> <li>Gain knowledge ab</li> <li>Build application or</li> </ol>	ural Networks. neural network. ro controller out fuzzy system n fuzzy controller.				
Unit			Description			Instruc Hou	ctional urs
Ι	NEUR Linear system Adapti self-or	<b>RAL NETWORKS</b> – Neural network, Mu n analysis part I, Nor ive learning rate, weig ganizing map- Multid	[ Itilayer Neural Network, Back Propagation Algorithm, nlinear System Analysis part II, Radial basis function ht update rules, Recurrent Network back propagation thro mensional network.	Nonline networ ough tim	ear rk, ne,	9	I
II	ME       20AEX301       INTELLIGENT SYSTEMS AND CONTROL       3       0         Image: State of the state o	9					
III	Neural Indired MIMC	l controller a review, N ct adaptive controller ), Visual motor co- ord	-III Network Inversion and Control, Neural model for robot ma of robot manipulator, Adaptive Neural for affine syst lination with KSOM. Direct adaptive controller of manipu	orithm, Nonlinear unction network, ion through time, Auto associative, cs. Unsupervised iture map obot manipulator, ne system SISO, manipulator. hmetic and fuzzy controller for PH for a T-S fuzzy tructional Hours	or, O,	9	I
IV	FUZZ Introdu measu	<b>Y SYSTEMS- I</b> uction to fuzzy logic, c res - Fuzzy rule base a	lassical sets, Fuzzy sets. Fuzzy relations Fuzzy arithmetic nd approximate reasoning, Fuzzy logic controller.	3 ( thm, Nonlinear action network, n through time, uto associative, . Unsupervised are map oot manipulator, system SISO, anipulator. metic and fuzzy ontroller for PH for a T-S fuzzy uctional Hours	zy	9	I
v	Course Objective       1.Introduce about Neural Networks.         2.Classify on various neural network.       3.To learn about Neuro controller         4.Gain knowledge about fuzzy system       5.Build application on fuzzy controller.         Jnit       Description         MEURAL NETWORKS - I       Linear Neural network, Multilayer Neural Network, Back Propagation 4         I       system analysis part I, Nonlinear System Analysis part II , Radial bas Adaptive learning rate, weight update rules, Recurrent Network back propagelf-organizing map- Multidimensional network.         NEURAL NETWORKS - II       Associative memory networks: Training algorithms for pattern association Hetero associative, Hopfield and iterative auto associative memory networks: Fixed weight competitive nets, Kohenen self-organizing NEURO CONTROLLER -III         III       Neural controller a review, Network Inversion and Control, Neural model f Indirect adaptive controller of robot manipulator, Adaptive Neural for MIMO, Visual motor co- ordination with KSOM. Direct adaptive controller         IV       Introduction to fuzzy logic, classical sets, Fuzzy sets. Fuzzy relations Fuzzy measures - Fuzzy rule base and approximate reasoning, Fuzzy logic control         FUZZY CONTROL -II       V         IV       Fuzzy controller a review, Mamdani type flc and parameter optimization, Ft reactor, Fuzzy lyapunav controller - computing with words, Controller de model, Linear Controller using T-S fuzzy model.         IV       Fuzzy Controller a review, Mamdani type flc and parameter optimization, Ft reactor, Fuzzy lyapunav controller - co	amdani type flc and parameter optimization, Fuzzy control ntroller- computing with words, Controller design for a ng T-S fuzzy model.	ller for P T-S fuz	РН zy	9	I	
			Total Instruction	nal Hou	irs	4	5
		CO1: Infer the co	ncepts of Neural Networks.				

CO2: Summarize the various neural networks architectures and its training algorithms Course

CO3: Design the neural network/fuzzy logic control for real time applications. Outcome CO3: Discover the concept of fuzzy logic set theory.

CO4: Implement the fuzzy mechanism for suitable control problems.

**TEXT BOOKS:** 

T1 Laurene V. Fausett, "Fundamentals of Neural Networks: Architectures, algorithms and applications", Pearson Education, New Delhi, 2004.

T2 Timothy J Ross, "Fuzzy Logic with Engineering Applications", John Willey and Sons, 2005. **REFERENCE BOOKS:** 

R1 S.N.Sivanandam & S.N Deepa., "Principles of soft computing", 2<sup>nd</sup> edition, Wiley India Pvt Ltd, 2013. R2 George J.Klir, Bo.Yuan, "Fuzzy Sets and Fuzzy logic: Theory and Applications", PHI Learning Pvt Ltd, 2012

R3 Zimmerman H.J., "Fuzzy set theory and its Applications", Allied Publishers, 2001.

R4 -Jack M. Zurada, "Introduction to Artificial Neural Systems", PWS Publishing Co, 2002



MME	COURSE CODE	NAME OF THE COURSE	L	Т	Р	С
	20AEX302	ADVANCED MICROPROCESSORS & MICROCONTROLLERS	3	0	0	3
1.To 2.To 3.To 4.To 5.To	expose the students to the fu explore the high performance familiarize the high perform introduce the basic features enable the students to under	indamentals of microprocessor architecture. ce features in CISC architecture nance features in RISC architecture in Motorola microcontrollers. rstand PIC Microcontroller				
		Description	Ins	struc Hoi	ction urs	al
CROPR ruction tual men struction	OCESSOR ARCHITECT Set – Data formats –Address nory and paging – Segmentat a level parallelism – reduced	URE sing modes – Memory hierarchy –register file – Cache – ion- pipelining –the instruction pipeline – pipeline hazards instruction set –Computer principles – RISC versus CISC.		9	)	
GH PER U Archit des –Paş grammir	<b>FORMANCE CISC ARCI</b> ecture- Bus Operations – Pipe ging – Multitasking – Except ng the Pentium processor.	<b>HITECTURE – PENTIUM</b> elining – Brach predication – floating point unit- Operating tion and Interrupts – Instruction set – addressing modes –		9	)	
GH PER anizatio ruction	FORMANCE RISC ARCI n of CPU – Bus architecture - set- addressing modes – Prog	HITECTURE – ARM -Memory management unit - ARM instruction set- Thumb ramming the ARM processor.		9	)	
<b>P430 16</b> MSP43 velopmen P430Mi	<b>- BIT MICROCONTROL</b> 30 Architecture- CPU Regis nt Tools, ADC - PWM crocontroller.	<b>LER</b> ters - Instruction Set, On-Chip Peripherals - MSP430 - - UART - Timer Interrupts - System design using		9	)	
C MICR J Archit VM and	OCONTROLLER ecture – Instruction set – inter introduction to C-Compilers	rupts- Timers- I2C Interfacing –UART- A/D Converter		9	)	
		<b>Total Instructional Hours</b>	4	15 H	ours	;
CO1: To CO2: To CO3: To CO4: To CO5: To	o understand the fundamental know and appreciate the hig know and appreciate the hig perceive the basic features is interpret and understand PIG	s of microprocessor architecture. gh performance features in CISC architecture. gh performance features in RISC architecture. n Motorola microcontrollers. C Microcontroller.				
	MME 1.To 2.To 3.To 4.To 5.To CROPR ruction Stual men istruction GH PER U Archited des –Pag grammin GH PER (anizatio) ruction St P430 16 MSP43 Velopmen P430 Mic CMICR U Archited WM and CO1: To CO2: To CO3: To CO3: To CO3: To CO5: To	MMECOURSE CODE.20AEX3021.To expose the students to the fu 2.To explore the high performand 3.To familiarize the high perform 4.To introduce the basic features 5.To enable the students to underCROPROCESSOR ARCHITECTU ruction Set – Data formats –Address tual memory and paging – Segmentat struction level parallelism – reduced GH PERFORMANCE CISC ARCH U Architecture- Bus Operations – Piped des –Paging – Multitasking – Except gramming the Pentium processor.GH PERFORMANCE RISC ARCH panization of CPU – Bus architecture- ruction set- addressing modes – Prog P430 16 - BIT MICROCONTROL e MSP430 Architecture- CPU Regis yelopment Tools, ADC - PWM P430Microcontroller.CO1: To understand the fundamental CO2: To know and appreciate the hig CO3: To know and appreciate the hig CO4: To perceive the basic features i CO5: To interpret and understand PIG	MME       COURSE CODE       NAME OF THE COURSE         20AEX302       ADVANCED MICROPROCESSORS & MICROCONTROLLERS         1.To expose the students to the fundamentals of microprocessor architecture.       2.To explore the high performance features in CISC architecture         3.To familiarize the high performance features in RISC architecture       4.To introduce the basic features in Motorola microcontrollers.         5.To enable the students to understand PIC Microcontroller       Description         CROPROCESSOR ARCHITECTURE         ruction Set – Data formats –Addressing modes – Memory hierarchy –register file – Cache – tual memory and paging – Segmentation- pipelining –the instruction pipeline – pipeline hazards struction level parallelism – reduced instruction set – Computer principles – RISC versus CISC.         GH PERFORMANCE CISC ARCHITECTURE – PENTIUM         U Architecture- Bus Operations – Pipelining – Brach predication – floating point unit-Operating des –Paging – Multitasking – Exception and Interrupts – Instruction set – addressing modes – gramming the Pentium processor.         GH PERFORMANCE RISC ARCHITECTURE – ARM         mization of CPU – Bus architecture – Memory management unit - ARM instruction set - Thumb ruction set - addressing modes – Programming the ARM processor.         P430 16 - BIT MICROCONTROLLER         * MICROCONTROLLER         * MICROCONTROLLER         * MICROCONTROLLER         * MICROCONTROLLER         * MICROCONTROLLER         * MICROCONTROLLER <td>MME       COURSE CODE       NAME OF THE COURSE       L         20AEX302       ADVANCED MICROPROCESSORS &amp; MICROCONTROLLERS       3         1. To expose the students to the fundamentals of microprocessor architecture.       3. To familiarize the high performance features in RISC architecture       3. To familiarize the high performance features in RISC architecture       4. To introduce the basic features in Motorola microcontrollers.       5. To enable the students to understand PIC Microcontrollers.       5. To enable the students to understand PIC Microcontroller         Ime         CROPROCESSOR ARCHITECTURE         Introduce the basic features in CISC architecture         Addressing modes – Memory hierarchy –register file – Cache – tual memory and paging – Segmentation - pipelining –the instruction pipeline – pipeline hazards struction level parallelism – reduced instruction set – Computer principles – RISC versus CISC.         GH PERFORMANCE CISC ARCHITECTURE – PENTIUM         U Architecture - Bus Operations – Pipelining – Brach predication – floating point unit- Operating des –Paging – Multitasking – Exception and Interrupts – Instruction set – addressing modes – gramming the Pentium processor.         GH PERFORMANCE RISC ARCHITECTURE – ARM         anization of CPU – Bus architecture – Memory management unit - ARM instruction set – Thumb ruction set - addressing modes – Programming the ARM processor.         P43016 - BIT MICROONTROLLER         MOR4300 Architecture - CPU Regist</td> <td>MME       COURSE CODE       NAME OF THE COURSE       L       T         20AEX302       ADVANCED MICROPROCESSORS &amp; MICROCONTROLLERS       3       0         1. To expose the students to the fundamentals of microprocessor architecture.       3. To familiarize the high performance features in RISC architecture       3. To familiarize the high performance features in RISC architecture       4. To introduce the basic features in Motorola microcontrollers.       5. To enable the students to understand PIC Microcontrollers.       5. To enable the students to understand PIC Microcontrollers.       5. To enable the students to understand PIC Microcontroller       Instruct         CROPROCESSOR ARCHITECTURE         Instruction Set – Data formats – Addressing modes – Memory hierarchy –register file – Cache – tual memory and paging – Segmentation – pipelining –the instruction pipeline – pipeline hazards struction level parallelism – reduced instruction set –Computer principles – RISC versus CISC.       GH PERFORMANCE CISC ARCHITECTURE – PENTIUM       9         U Architecture- Bus Operations – Pipelining – Brach predication – floating point unit-Operating des –Paging – Multitasking – Exception and Interrupts – Instruction set – addressing modes – gramming the Pentium processor.       9         GH PERFORMANCE RISC ARCHITECTURE – ARM         anization of CPU – Bus architecture –Memory management unit - ARM instruction set - Thumb ruction set - addressing modes – Pogramming the ARM processor.       9         P43016 - BIT MICROCONTROLLER       9         9/30Microcontt</td> <td>MME       COURSE CODE       NAME OF THE COURSE       L       T       P         20AEX302       ADVANCED MICROPROCESSORS &amp; MICROCONTROLLERS       3       0       0         1. To expose the students to the fundamentals of microprocessor architecture.       2. To explore the high performance features in CISC architecture       3. To familiarize the high performance features in RISC architecture       3. To familiarize the high performance features in RISC architecture       3. To familiarize the high performance features in RISC architecture       3. To familiarize the high performance features in RISC architecture       4. To introduce the basic features in Motorola microcontrollers.       5. To enable the students to understand PIC Microcontroller         Instruction         Instruction and performance features in CISC architecture         ALT of any anging – Segmentation - pipelining – the instruction pipeline – pipeline hazards struction level parallelism – reduced instruction set – Computer principles – RISC versus CISC.       9         GH PERFORMANCE CISC ARCHITECTURE – PENTUM         UArchitecture – Memory management unit - ARM instruction set – addressing modes – Programming the ARM processor.         PAJ016 - BIT MICROCONTROLLER         Total Instruction set – interrupts – Timers - I2C Interfacing –UART - A/D Converter       9         VMICROCONTROLLER         COI: To understand the fundamentals of microprocessor architecture.</td>	MME       COURSE CODE       NAME OF THE COURSE       L         20AEX302       ADVANCED MICROPROCESSORS & MICROCONTROLLERS       3         1. To expose the students to the fundamentals of microprocessor architecture.       3. To familiarize the high performance features in RISC architecture       3. To familiarize the high performance features in RISC architecture       4. To introduce the basic features in Motorola microcontrollers.       5. To enable the students to understand PIC Microcontrollers.       5. To enable the students to understand PIC Microcontroller         Ime         CROPROCESSOR ARCHITECTURE         Introduce the basic features in CISC architecture         Addressing modes – Memory hierarchy –register file – Cache – tual memory and paging – Segmentation - pipelining –the instruction pipeline – pipeline hazards struction level parallelism – reduced instruction set – Computer principles – RISC versus CISC.         GH PERFORMANCE CISC ARCHITECTURE – PENTIUM         U Architecture - Bus Operations – Pipelining – Brach predication – floating point unit- Operating des –Paging – Multitasking – Exception and Interrupts – Instruction set – addressing modes – gramming the Pentium processor.         GH PERFORMANCE RISC ARCHITECTURE – ARM         anization of CPU – Bus architecture – Memory management unit - ARM instruction set – Thumb ruction set - addressing modes – Programming the ARM processor.         P43016 - BIT MICROONTROLLER         MOR4300 Architecture - CPU Regist	MME       COURSE CODE       NAME OF THE COURSE       L       T         20AEX302       ADVANCED MICROPROCESSORS & MICROCONTROLLERS       3       0         1. To expose the students to the fundamentals of microprocessor architecture.       3. To familiarize the high performance features in RISC architecture       3. To familiarize the high performance features in RISC architecture       4. To introduce the basic features in Motorola microcontrollers.       5. To enable the students to understand PIC Microcontrollers.       5. To enable the students to understand PIC Microcontrollers.       5. To enable the students to understand PIC Microcontroller       Instruct         CROPROCESSOR ARCHITECTURE         Instruction Set – Data formats – Addressing modes – Memory hierarchy –register file – Cache – tual memory and paging – Segmentation – pipelining –the instruction pipeline – pipeline hazards struction level parallelism – reduced instruction set –Computer principles – RISC versus CISC.       GH PERFORMANCE CISC ARCHITECTURE – PENTIUM       9         U Architecture- Bus Operations – Pipelining – Brach predication – floating point unit-Operating des –Paging – Multitasking – Exception and Interrupts – Instruction set – addressing modes – gramming the Pentium processor.       9         GH PERFORMANCE RISC ARCHITECTURE – ARM         anization of CPU – Bus architecture –Memory management unit - ARM instruction set - Thumb ruction set - addressing modes – Pogramming the ARM processor.       9         P43016 - BIT MICROCONTROLLER       9         9/30Microcontt	MME       COURSE CODE       NAME OF THE COURSE       L       T       P         20AEX302       ADVANCED MICROPROCESSORS & MICROCONTROLLERS       3       0       0         1. To expose the students to the fundamentals of microprocessor architecture.       2. To explore the high performance features in CISC architecture       3. To familiarize the high performance features in RISC architecture       3. To familiarize the high performance features in RISC architecture       3. To familiarize the high performance features in RISC architecture       3. To familiarize the high performance features in RISC architecture       4. To introduce the basic features in Motorola microcontrollers.       5. To enable the students to understand PIC Microcontroller         Instruction         Instruction and performance features in CISC architecture         ALT of any anging – Segmentation - pipelining – the instruction pipeline – pipeline hazards struction level parallelism – reduced instruction set – Computer principles – RISC versus CISC.       9         GH PERFORMANCE CISC ARCHITECTURE – PENTUM         UArchitecture – Memory management unit - ARM instruction set – addressing modes – Programming the ARM processor.         PAJ016 - BIT MICROCONTROLLER         Total Instruction set – interrupts – Timers - I2C Interfacing –UART - A/D Converter       9         VMICROCONTROLLER         COI: To understand the fundamentals of microprocessor architecture.

- T1. Daniel Tabak, "Advanced Microprocessors", McGraw Hill.Inc., 1995.
- T2. James L. Antonakos, "The Pentium Microprocessor" Pearson Education, 1997.

# **REFERENCE BOOKS:**

- **R1.** Steve Furber, "ARM System On Chip architecture", Addision Wesley, 2000.
- **R2.** Andrew N.Sloss, Dominic Symes and Chris Wright "ARM System Developer's Guide : Designing and Optimizing System Software", First edition, Morgan Kaufmann Publishers, 2004.
- **R3** John. B. Peatman, "Design with PIC Microcontroller", Prentice hall, 1997.

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PRO	OGRAMM	IE COURSE CODE	NAME OF THE COURSE	L	Т	Р	С
	ME	19AEX303	ASIC AND FPGA DESIGN	3	0	0	3
Co Obj	ourse ective	1.Describe the design flow of differ 2.Gain knowledge about floor plan 3.Implement the digital design usin 4.Infer the architecture of different 5.Describe the design issues of SO	rent types of ASIC and PLD ning, placement and routing in ASIC g Verilog and VHDL types of FPGA C				
Unit		Des	scription	In	struc	tional	Hours
Ι	OVERVE Types of Technolo Antifuse ROMs an	IEW OF ASIC AND PLD ASICs - Design Flow - CAD too gies: - Static RAM - EPROM and EEPR d EPROMs - PLA - PAL. Gate Arr	ls used in ASIC Design - Programming ROM Technology, Programmable Logic Devices rays - CPLDs and FPGAs	:		9	
II	ASIC PE System p Measurer Routing	<b>EVSICAL DESIGN</b> partition -Partitioning - Partitionin nent of Delay - Floor Planning - I - Special Routing - Circuit Extract	ng Methods - Interconnect Delay Models and Placement - Routing : Global Routing - Detailed ion - DRC	1 1		9	
ш	LOGIC S Design S Language VHDL ar Automati	SYNTHESIS, SIMULATION AN ystems - Logic Synthesis - Half G e - PLA Tools - EDIF- CFI Desig d Logic Synthesis - Types of Simu c Test Pattern Generation.	<b>D TESTING</b> tate ASIC -Schematic Entry - Low Level Design n Representation. Verilog and Logic Synthesis alation - Boundary Scan Test - Fault Simulation	n - -		9	
IV	<b>FPGA</b> Field Prog Physical J / Logic S	grammable Gate Arrays- Logic Blo Design Tools -Technology Mapping ynthesis - Controller/Data Path Syr	cks, Routing Architecture , FPGA Design : FPGA g - Placement & Routing - Register Transfer (RT) tthesis - Logic Minimization	)		9	
V	SOC DE Design M Techniqu studies: D	SIGN lethodologies – Processes and Flov es for SOC Testing – Configurabl Digital Camera, Bluetooth Radio / M	ws - Embedded Software Development for SOC le SOC – Hardware / Software CoDesign - Case Modem, SDRAM and USB.	-		9	
			Total Instructional Hour	S		45	
Cor Outo	urse come	CO1: Summarize the concepts of A CO2: Apply the different high perfo CO3: Demonstrate the synthesis, si CO4: Outline the different architect CO5: Discuss the design issues of S	SIC and PLD ormance algorithms in ASICs mulation and testing of digital systems tures of FPGA SOC				
] 2	ΓΕΧΤ ΒΟ Γ1 - David 2004. Γ2 - ΜΙ Ο	<b>JKS:</b> A.Hodges, Analysis and Design of	Digital Integrated Circuits ,3 <sup>rd</sup> Edition, Tata Mc	Graw	Hill ,		
	12 - MIJ.S.	Simul: Application Specific Integr	aled Circuits, Pearson, 2003.				

**REFERENCE BOOKS:** 

**R1** - Parag.K.Lala, Digital System Design using Programmable Logic Devices, BSP, 2003.

**R2** - Wayne Wolf, FPGA-Based System Design, Prentice Hall PTR, 2004.

**R3** - Sudeep Pasricha and NikilDutt, On-Chip Communication Architectures System on Chip Interconnect, Elsevier,2008.

**R4** - Farzad Nekoogar and Faranak Nekoogar, From ASICs to SOCs: A Practical Approach, Prentice Hall PTR, 2003.





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PROGRAMME	COURSE CODE	NAME OF THE COURSE	L	Т	Р	С
M.E.	20AEX307	PHYSICAL DESIGN OF VLSI CIRCUITS	3	0	0	3

1.To introduce the physical design concepts such as routing, placement, partitioning and Course packaging

Objective 2. To study the performance of circuits layout designs, compaction techniques

Unit	Description	Instructional hours
Ι	INTRODUCTION TO VLSI TECHNOLOGY Layout Rules-Circuit abstraction Cell generation using programmable logic array transistor chaining, Wein Berger arrays and gate matrices-layout of standard cells gate arrays and sea of gates, field programmable gate array(FPGA)-layout methodologies Packaging-Computational Complexity - Algorithmic Paradigms.	9
Π	PLACEMENT USING TOP-DOWN APPROACH Partitioning: Approximation of Hyper Graphs with Graphs, Kernighan-Lin Heuristic Ratio cut partition with capacity and i/o constrants. Floor planning: Rectangular dual floor planning hierarchical approach- simulated annealing- Floor plan sizing Placement: Cost function- force directed method- placement by simulated annealing partitioning placement- module placement on a resistive network – regular placement	9
III	Inear placement. ROUTING USING TOP DOWN APPROACH Fundamentals: Maze Running- line searching- Steiner trees Global Routing: Sequential Approaches - hierarchial approaches - multi commodity flow based techniques - Randomised Routing- One Step approach - Integer Linear Programming Detailed Routing: Channel Routing - Switch box routing. Routing in FPGA: Array based FPGA- Row based FPGAs	9
IV	PERFORMANCE ISSUES IN CIRCUIT LAYOUT Delay Models: Gate Delay Models- Models for interconnected Delay- Delay in RC trees. Timing – Driven Placement: Zero Stack Algorithm- Weight based placement- Linear Programming Approach Timing riving Routing: Delay Minimization- Click Skew Problem- Buffered Clock Trees. Minimization: constrained via Minimization unconstrained via Minimization- Other issues in minimization SINGLE LAYER POLITING. CELL GENERATION AND COMPACTION	9
v	Planar subset problem(PSP)- Single Layer Global Routing- Single Layer detailed Routing- Wire length and bend minimization technique – Over The Cell (OTC) Routing Multiple chip modules(MCM)- programmable Logic Arrays- Transistor chaining- Wein Burger Arrays- Gate matrix layout- 1D compaction- 2D compaction.	9
	Total instructional hours	45

After completion of the course the learner will be able to

CO1: Explain different types of routing Course

CO2: Discuss performance issues in circuit layout Outcome

CO3: Outline 1D compaction- 2D compaction.

**REFERENCE BOOKS:** 

- Preas M. Lorenzatti, "Physical Design and Automation of VLSI systems", The Benjamin Cummins **R1**. Publishers, 1998.
- R2. Sarafzadeh, C.K. Wong, "An Introduction to VLSI Physical Design", McGraw Hill Int. Edition 1995

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	M.E.	20AEX305 High Spe	eed Switching and Network	3 0 0 3	
Co Obje	urse ective	<ul><li>1.To understand the basics of switching technologies and and IP networks</li><li>2.To understand the different queuing strategies and their</li><li>3.To understand the concepts of various packet switching</li><li>4.To learn the fundamentals of Optical Switching Archite</li><li>5.To exploit and integrate the best features of different and</li></ul>	their implementation LANs, ATM ner r impact on the blocking performances g architectures tectures rchitectures for high speed switching.	etworks 3.	
Unit		Description		Instructional Hours	
Ι	LAN	SWITCHING TECHNOLOGY		0	
	Swit forw	ching Concepts, LAN Switching, switch forwarding tech ard, Layer 3 switching, Loop Resolution, Switch Flow con	iniques - cut through and store and ntrol, virtual LANs.	9	
II	QUE	UES IN HIGH SPEED SWITCHES		0	
	Inter Inpu	nal Queueing -Input, output and shared queueing, multiple t, output and shared queueing - performance analysis of Q	e queueing networks – combined ueued switches	9	
III	PACE	<b>KET SWITCHING ARCHITECTURES</b>		0	
	Arch stage Cros	itectures of Internet Switches and Routers- Bufferless and e switching, Optical Packet switching; Switching fabric on sbars	buffered Crossbar switches, Multi- a chip; Internally buffered	9	
IV	. OPT	ICAL SWITCHING ARCHITECTURES			
	Need Netw Com	l for Multilayered Architecture-, Layers and Sub-layers, S work Nodes, Network Access Stations, Overlay Processor, nection Management and Control	pectrum partitioning, Optical Logical network overlays,	9	
V	IP SV	VITCHING		0	
	Add	ressing model, IP Switching types - flow driven and topolo	ogy driven solutions, IP Over ATM	7	
	addr	ess and next hop resolution, multicasting, Ipv6 over ATM	Total Instructional Hours	45 Hours	
Cou Outco	rse ome	After completion of the course the learner will be CO1: Familiar with the basics of switching technolog Optical networks. CO2: Familiar with the different switching architectu CO3: Able to analyze switching networks based complexities.	<b>able to</b> gies and their implementation in LANs ares and queuing strategies on their blocking performances an	3, ATM , IP and	

NAME OF THE COURSE

LTPC

CO4: Able to identify suitable switch architectures for a specified networking scenario

CO5: To apply switching technologies, architectures and buffering strategies for designing high speed communication networks and analyse their performance

## **REFERENCE BOOKS :**

PROGRAMME

**COURSE CODE** 

- **R1** AchillePattavina, "Switching Theory: Architectures and performance in Broadband ATM networks ",John Wiley Sons Ltd, New York. 1998
- **R2** Thomas E. Stern, Georgios Ellinas, Krishna Bala, "Multiwavelength Optical Networks Architecture, Design and control", Cambridge University Press, 2nd Edition, 2009.
- **R3** Rich Siefert, Jim Edwards, "The All New Switch Book The Complete Guide to LAN Switching Technology", Wiley Publishing, Inc., 2nd Edition, 2008
- R4 Elhanany M. Hamdi, "High Performance Packet Switching architectures", Springer Publications, 2007.
- R5 Christopher Y Metz, "Switching protocols & Architectures", McGraw Hill Professional Publishing, New York, 1998.

**R6** Rainer Handel, Manfred N Huber, Stefan Schroder, "ATM Networks - Concepts Protocols, Applications", Addison Wesley, New York, 3rd Edition, 1999







# PROGRAMME COURSE CODE

M.E 20AEX306

Course outcomes:

At the end of the course the student will be able to

CO1: To develop drivers for low speed peripherals.

CO2: To describe OOPS concepts.

CO3: To develop CPP programming.

CO4: To Illustrate Inheritance, overloading concepts.

CO5: To explain PERL scripting.

# UNIT-I

**Embedded Peripherals** 

Embedded 'C' Programming, Bitwise operations, Dynamic memory allocation, OS services, Linked stack and queue, Sparse matrices, Binary tree, Interrupt handling in C, Code optimization issues, Writing LED drivers, Drivers for serial port communication, Embedded Software Development Cycle and Methods (Waterfall, Agile).

NAME OF THE COURSE

**Programming Languages For** 

Embedded Software

# UNIT-II

**OOPs Programming techniques** 

Object Oriented Programming: Introduction to procedural, modular, object-oriented and generic programming techniques, Limitations of procedural programming, objects, classes, data members, methods, data Encapsulation, data abstraction and information hiding, inheritance, polymorphism.

# UNIT-III

Memory allocation techniques

CPP Programming: 'cin', 'cout', formatting and I/O manipulators, new and delete Operators, Defining a class, data members and methods, 'this' pointer, constructors, destructors, friend Function, dynamic memory allocation.

# UNIT-IV

**Overloading and Inheritance** 

Need of operator overloading, overloading the assignment, Overloading using friends, type conversions, single inheritance, base and derived classes, friend classes, types of inheritance, hybrid inheritance, multiple inheritance, virtual base class, polymorphism, virtual functions.

# UNIT-V

Templates

Function template and class template, member function templates and template Arguments, Multiple Exceptions. Scripting Languages, PERL: Operators, Statements Pattern Matching.

# Text Books

1. Michael J. Pont, Embedded C, Pearson Education, 2 nd Edition, 2008.

2. Michael Berman, Data structures via C++, Oxford University Press, 2002.

3. Randal L. Schwartz, Learning Perl, O'Reilly Publications, 6 th Edition 2011.

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# 9 hours

9 hours

9 hours

9 hours

9 hours

References

- 1. Robert Sedgewick, Algorithms in C++ , Addison Wesley Publishing Company, 1999. 20 M.Tech. in VLSI Design and Embedded Systems
- 2. Abraham Silberschatz, Peter B, Greg Gagne, Operating System Concepts , John Willey& Sons, 2005.
- 3. C.M. Krishna, Kang G. Shin, "Real Time Systems", McGraw Hill International Editions, 1997
- 4. By Albert M. K. Cheng , "Real-time systems: scheduling, analysis, and verification" wiley

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### С PROGRAMME **COURSE CODE** NAME OF THE COURSE L Т Р COGNITIVE RADIO NETWORK M.E 20AEX307 3 0 0 3

1.To understand the fundamentals of Software Defined radio and compare various SDR platforms. 2. To enable the student to understand the evolving paradigm of cognitive radio communication and the enabling technologies for its implementation. Objective 3.To enable the student to understand the essential functionalities and requirements in designing software

defined radios and their usage for cognitive communication

4. To analyze the various methods of implementing the Cognitive Radio functions

Course

5.To exemplify the research challenges in designing a Cognitive Radio Network and the applications

### Instructional Description Unit Hours SOFTWARE DEFINED RADIO AND ITS ARCHITECTURE Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and 9 I architecture implications. Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules. COGNITIVE RADIOS AND ITS ARCHITECTURE Marking radio self-aware, cognitive techniques - position awareness, environment awareness in cognitive radios, optimization of radio resources, Artificial Intelligence Techniques, Cognitive Π 9 Radio - functions, components and design rules, Cognition cycle - orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architechture. SPECTRUM SENSING AND IDENTIFICATION Overview-Classification-Matched Filter, waveform based sensing - cyclo stationary based ш 9 sensing -Energy detector based sensing - Radio Identifier - Cooperative Sensing -Spectrum Opportunity Detection, Fundamental Trade-offs: Performance versus Constraint, MAC Layer Performance Measures, Global Interference Model, Local Interference Model, Fundamental Trade-offs: Sensing Accuracy versus Sensing Overhead. USER COOPERATIVE COMMUNICATIONS User Cooperation and Cognitive Systems, Relay Channels: General Three-Node Relay Channel, IV Wireless Relay Channel, User Cooperation in Wireless Networks: Two-User Cooperative 9 Network, Cooperative Wireless Network, Multihop Relay Channel INFORMATION THEORETICAL LIMITS ON CR NETWORKS Types of Cognitive Behavior, Interference-Avoiding Behavior: Spectrum Interweave, Interference-V Controlled Behavior: Spectrum Underlay, Underlay in Small Networks: Achievable Rates, Underlay 9 in Large Networks: Scaling Laws, Interference-Mitigating Behavior: Spectrum Overlay, Opportunistic Interference Cancellation, Asymmetrically Cooperating Cognitive Radio Channels. **Total Instructional Hours** 45 After completion of the course the learner will be able to CO1: Appreciate the motivation and the necessity for cognitive radio communication COURSE strategies. OUTCOME CO2: Demonstrate understanding of the enabling technologies for its implementation CO3: Demonstrate understanding of the essential functionalities and requirements in designing software defined radios and their usage for cognitive communication. CO4: Evolve new techniques and demonstrate their feasibility using mathematical validations and simulation tools. CO5: Interpret the impact of the evolved solutions in future wireless network design.

# **REFERENCE BOOKS:**

- **R1** Alexander M. Wyglinski, Maziar Nekovee, And Y. Thomas Hou, "Cognitive Radio Communications and Networks Principles And Practice", Elsevier Inc., 2010.
- R2 Kwang-Cheng Chen and Ramjee Prasad, "Cognitive Radio Networks", John Wiley & Sons, Ltd, 2009.
- **R3** Khattab, Ahmed, Perkins, Dmitri, Bayoumi, Magdy, "Cognitive Radio Networks From Theory to Practice", Springer Series, Analog Circuits and Signal Processing, 2009.
- **R4** J. Mitola, "Cognitive Radio: An Integrated Agent Architecture for software defined radio", Doctor of Technology thesis, Royal Inst. Technology, Sweden 2000.
- **R5** Simon Haykin, "Cognitive Radio: Brain –empowered wireless communications", IEEE Journal on selected areas in communications, Feb 2005.
- **R6** Ian F. Akyildiz, Won Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, "Next generation / dynamic spectrum access / cognitive radio wireless networks: A Survey Elsevier Computer Networks", May 2006.

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PROGR	AMME	COURSE CODE	NAME OF THE COURSE	L	Т	Р	С
М	E	20AEX308	WIRELESS ADHOC AND SENSOR NETWORKS	3	0	0	3
	1	To understand the bas	sics of Ad-hoc & Sensor Networks.				
~	2	To learn various fund	amental and emerging protocols of all layers				
Course	3	To study about the is	sues pertaining to major obstacles in establishment and e	efficient	man	ageme	nt of
Objective	-5 /	To understand the ne	ture and applications of Ad has and sensor networks				
	4	To understand variou	s security practices and protocols of Ad-hoc and Sensor N	Networl	<b>7</b> 8		
Unit	5		Description	1000001	Ins	structi	onal
	MAC	& TCP IN AD HOC N	ETWORKS			nour	5
	Funda	mentals of WLANs –	IEEE 802.11 Architecture - Self configuration and	l Auto			
Ι	config	uration-Issues in Ad-Ho	oc Wireless Networks – MAC Protocols for Ad-Hoc W	vireless		9	
	Netwo	orks – Contention Based	Protocols - TCP over Ad-Hoc networks-TCP protocol over	erview			
	- TCP	and MANETs - Solutio	ns for TCP over Ad-Hoc Networks.				
	ROU	FING IN AD HOC NE	ГWORKS				
	Routi	ng in Ad-Hoc Netwo	orks- Introduction-Topology based versus Position	based			
II	Appro	baches-Proactive, Reactive	ve, Hybrid Routing Approach-Principles and issues – Lo	ocation		9	
	servic	es - DREAM – Quorums	based location service – Grid – Forwarding strategies – (	Jreedy			
	challenges in providing OoS						
		" ROUTING & OOS I	N WIRELESS SENSOR NETWORKS				
	Introd	uction – Architecture - S	lingle node architecture – Sensor network design consider	rations			
	– Ene	rgy Efficient Design pr	rinciples for WSNs – Protocols for WSN – Physical I	Layer :			
III	Trans	ceiver Design considerat	tions – MAC Layer Protocols – IEEE 802.15.4 Zigbee	– Link	9		
	Layer	and Error Control issues	s - Routing Protocols – Mobile Nodes and Mobile Robots	- Data			
	Centr	Centric & Contention Based Networking – Transport Protocols & QOS – Congestion Control					
	issues	– Application Layer sup	oport				
	SENS	OR MANAGEMENT		1			
IV	Senso	r Management - Topolo	gy Control Protocols and Sensing Mode Selection Proto	ocols -		9	
	progr	Synchronization - Locan	rk Simulators	etwork			
	SECI	IRITY IN AD HOC AN	IN SIMULATIS.				
	Secur	ity in Ad-Hoc and Sens	or networks – Key Distribution and Management – So	oftware			
$\mathbf{V}$	based	Anti-tamper techniques	- water marking techniques - Defense against routing at	ttacks -		9	
	Secur	e Adhoc routing protoco	ls - Broadcast authentication WSN protocols - TESLA	– Biba			
	– Sen	sor Network Security Pro	otocols – SPINS				
	001	<b>T</b> 1	Total Instructional	Hours		45	
	COL	Identify different issu	es in wireless ad hoc and sensor networks.				
Course	CO2	Identify and address f	be security threats in ad hea and sensor				
Outcomes	CO3	Establish a Sensor net	twork environment for different type of applications				
	C04	Understand the secur	ity in Ad hoc and Sensor networks				
TEXT BOC	KS:	chacistana ine secur	ny mina noe and bensor networks				
T1 C.Siv	a Ram	Murthy and B.S.Manoj	, "Ad Hoc Wireless Networks - Architectures and I	Protocol	ls", F	<b>'</b> earsor	1
Educ	ation, 2	)04.					
T2 Walt	enegus I	Dargie, Christian Poellaba	auer, "Fundamentals of Wireless Sensor Networks Theory	y and Pr	actice	e", Joh	n
Wile	y and So	ons, 2010.					

# **REFERENCE BOOKS:**

- **R1** Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing, 2011.
- R2 C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 2002.
- **R3** Holger Karl, Andrea's willig, "Protocols and Architectures for Wireless Sensor Networks, John Wiley & Sons, Inc .2005.
- **R4** Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, "Ad Hoc Mobile Wireless Networks", Auerbach Publications, 2008.



PROGRAMME		COURSE CODE	NAME OF THE COURSE	L	Т	Р	С
Cours Objecti	M.E 1 2 2 3 2 3 2 3 2 3 4 5	20AEX309 To Teach the basic cond To expose the various d To make learn various d To impart knowledge on To apply robot based co	ROBOTICS AND INTELLIGENT SYSTEMS cepts in robotics. esign aspects in robot grippers. Irives and control systems. In machine vision systems. In cepts for automation	3	0	0	3
Unit			Description		Ι	nstruct	ional
	INTROD	UCTION				поц	15
I	Basic Con Robotic S accuracy, Automatic an Autom automatic	ncepts such as Definition Systems i.e. Robot anat repeatability, dexterity, on in Production System, ated System, Advanced A on productivity.	a, three laws, DOF, Misunderstood devices etc., Ele omy, Classification, Associated parameters i.e. re compliance, RCC device, etc. Automation-Concep , Principles and Strategies of Automation, Basic Ele Automation Functions, Levels of Automations, introd	ments o solution ot, Need ments o luction to	of 1, l, of 0	9	
п	ROBOT Types of Sensors for application	GRIPPERS Grippers, Design aspect or Robots:- Characteristic ns of sensors. Types of So a robot	for gripper, Force analysis for various basic gripper s of sensing devices, Selections of sensors, Classifica ensors, Need for sensors and vision system in the wor	t system ation and king and	ı. d d	9	
PROGRAMME PROGRAMME Medication Procession P	9						
IV	MACHIN Vision Sy programm command and VAL	<b>NE VISION SYSTEM</b> <i>y</i> stem Devices, Robot Pro- ning, motion interpolations, subroutines, Programm II etc, Features of type ar	ogramming: - Methods of robot programming, lead on, branching capabilities, WAIT, SIGNAL and ning Languages: Introduction to various types such ad development of languages for recent robot systems	through DELAY as RAII s.	h Ľ	9	
v	MODEL Introducti Plant,Moo manufactu automatice and appli Economic updates in	ING AND SIMULATIO on, need for system Me dern Tools- Artificial uring,Fuzzy decision on.Artificial Intelligence:- cation of AI. Other To cal aspects for robot design robotics.	<b>DN FOR MANUFACTURING PLANT AUTOMA</b> odeling, Building Mathematical Model of a manu neural networks in manufacturing automation, and control, robots and application of rob- Introduction to Artificial Intelligence, AI techniqu pics in Robotics:- Socio-Economic aspect of robo- n, Safety for robot and associated mass, New Trends	TION facturing AI in oots fo es, Need otisation & recen	g r d ı.	9	
	CO1	A bility to implement sin	Total Instruction	al Hour	S	45	
Cours Outcome TEXT BO T1 Joh	e CO2 e CO3 es CO4 CO5 OOKS: n J. Craig."	Ability to use various Ro Ability to use kinematic Ability to implement con Be aware of the associat Introduction to Robotics	obotic sub-systems s and dynamics to design exact working pattern of ro mputer vison algorithms for robots ed recent updates in Robotics (Mechanics and Control)". Addison-Wesley. 2nd Ed	bots	004		
T2 Mil Inte	kell P. Gro ernational, 1	over et. Al., "Industrial ] 986	Robotics: Technology, Programming and Application	ons", M	cGra	w – H	ill
R1 Shi	mon Y. Noi	f, "Handbook of Industria	al Robotics", John Wiley Co,2001.				
R2 Aut R3 Ric Pre	tomation, "I hard D. Kla ntice Hall I	Production Systems and C after , Thomas A. Chemie ndia, 2002.	Computer Integrated Manufacturing", M.P. Groover, I lewski, Michael Negin, "Robotic Engineering : An In	Pearson ntegrate	Educ d Ap	cation. proach'	,

**R4** R.C. Dorf, "Handbook of design, manufacturing & Automation" John Wiley and Sons.

P. Haylec Chairman, Board of Studies Chairman - BoS ECE - HICET .





PR	DGRAMME M.E	COURSE CODE 20AEX310	NAME OF THE COURSE SATELLITE COMMUNICATIONS AND NAVIGATION SYSTEMS	L 3	<b>T</b> 0	<b>P</b> 0	C 3
COUF OBJE	RSE CTIVE	To impart knowledge of 1.Understand the necessi transmission methodolog 2.Understand the diffe design.	on ty for satellite based communication, the essential elements i gies. rent interferences and attenuation mechanisms affection	nvolve g the	ed and satell	the ite link	
Unit		Description	s in saterine based havigation, GPS and the different ap	pricat	Ion sc In	structi	ional
Ι	<b>ELEMENTS C</b> Satellite System Satellite in a G keeping, Satellite	<b>DF SATELLITE COMP</b> as, Orbital description and SO, Antennas and eart ate – description of different	MUNICATION ad Orbital mechanics of LEO, MEO and GSO, Placem h coverage, Altitude and eclipses, Satellite drift and ent Communication subsystems, Bandwidth allocation.	ent of statio	a Dn	9	5
п	SATELLITE S Introduction; at communication Access: Demand	PACE SEGMENT AN titude and orbit control subsystems, antenna sub d assigned FDMA - space	<b>DACCESS</b> system; telemetry, tracking and command; power s system, equipment reliability and space qualification, N le system - TDMA - satellite switched TDMA –CDMA	ystem Aultip	ıs, le	9	
III	<b>SATELLITE I</b> Basic link anal characteristics, C/N, Link Desig	<b>JINK DESIGN</b> ysis, Interference analy Link Design: System no gn with and without frequ	rsis, Rain induced attenuation and interference, Iono bise temperature and G/T ratio, Downlink and uplink tency reuse, link margins, Error control for digital satell	ospher desig ite lin	ic n, k.	9	
IV	SATELLITE E VSAT Network Mobile and Pers Satellite System	<b>BASED BROADBAND</b> for Voice and Data – onal Communication Set is, UAVs.	<b>COMMUNICATION</b> TDM/TDMA, SCPC/DAMA, Elements of VSAT N rvices, Satellite based Internet Systems, Multimedia Bro	etwor badbai	k, nd	9	
V	SATELLITE N Radio and Sate Satellite Signal Sensing and ISF	AVIGATION AND G llite Navigation, GPS I Acquisition, GPS Rece RO GPS Systems.	<b>LOBAL POSITIONING SYSTEM</b> Position Location Principles of GPS Receivers and G iver Operation and Differential GPS, INS, Indian R	Codes emote	,	9	
			TOTAL INSTRUCTIONAL HOURS			45	
COUI	RSE OUTCOM	After completion of CO1: Demonstrate the essential eleme CO2: Familiarize communication sy CO3: Demonstrate mechanisms affect CO4: Demonstrate	of the course the learner will be able to e an understanding of the basic principles of satellite ba ents involved and the transmission methodologies. with satellite orbits, placement and control, satellite lin estem components. e an understanding of the different interferences and att ting the satellite link design. e an understanding of the different communication, sen	used k desi renuat sing a	ign ar ion	commond the	inication
		applications of sat CO5: Familiarize	DE       NAME OF THE COURSE       L       T       P         SATELLITE COMMUNICATIONS AND       3       0       0         nowledge on       the necessity for satellite based communication, the essential elements involved and the nethodologies.       1       1         1 the different interferences and attenuation mechanisms affecting the satellite link.       1       1       1         scription       Instruction       Instruction       1       1         FE COMMUNICATION       ription and Orbital mechanics of LEO, MEO and GSO, Placement of a and earth coverage, Altitude and eclipses, Satellite drift and station of different Communication subsystems, Bandwidth allocation.       9         IENT AND ACCESS       9       0       0         wit control system; telementry, tracking and command; power systems, tenna subsystem, equipment reliability and space qualification, Multiple MA - spade system - TDMA - satellite switched TDMA - CDMA.       9         No       0       0       0       0       0         No trequency reuse, link margins, Error control for digital satellite link.       9       0         No trequency reuse, link margins, Error control for digital satellite link.       9       0         System noise temperature and G/T ratio, Downlink and uplink design, hout frequency reuse, link margins, Error control for digital satellite link.       9       0         DBAD COMMUNICATION				
R1	REFERENCES Wilbur L. Pritc	: hard, Hendri G. Suyderł	noud and Robert A. Nelson, "Satellite Communication	Systei	ms Er	ngineer	ing",
R2 R3	Prentice Hall/ I Timothy Pratt a D.Roddy "Sate	Pearson, 2007. and Charles W.Bostain, ' ellite Communication''	"Satellite Communications", John Wiley and Sons, 2 <sup>nd</sup> McGraw Hill, 4 <sup>th</sup> Edition (Reprint) 2009	Editio	on, 20	012.	-
R4 R5	Tri T Ha, "Dig B.N.Agarwal, '	ital Satellite Communica 'Design of Geosynchron	ation", McGraw Hill, 2 <sup>nd</sup> Edition, 1990. ous Spacecraft", Prentice Hall, 1993.				

**R6** Brian Ackroyd, "World Satellite Communication and Earth Station Design", BSP Professional Books, 1990.

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PROGRA	MME	COURSE CODE	NAME OF THE COURSE	L	Т	Р	С
M.E		20AEX311	5G Technology	3	0	0	3
	1	To introduce students with To study about architecture	concepts, design issues in 5G networks s and protocols and the state-of-the-art develo	opment	s in ne	ext ger	neration
_	2	wireless network technologie	vs.	pinena	5 111 11	ent ger	crution
Course Objectives	3	To Study various Multiple A	ccess techniques for wireless channels.				
5	4	To understand the relevance	of MIMO techniques				
U <b>nit</b>			Description	Instr	uction	alHou	rs
50	G CHAI	NNEL MODEL					
Ι	Mode Propa Comp	ling requirements and scena gation scenarios, METIS cl parison of Models	rios, Channel model requirements and Measur hannel models, Map-based model, stochastic	rement mode	s, el,	9	
М	IULTI- Filter struct Princi Gener diagra	CARRIER WAVEFORMS I -bank based multi-carrier (F ure, Resource structure, alloca ples, Transceiver structure, ralized frequency division m am, Frame structure, Resource	FOR 5G BMC)- Principles, Transceiver block diagram ttion, mapping. Universal filtered multi carrier ( Frame and Resource structure, allocation, m nulticarrier (GFDM) – Principles, Transceive structure, allocation, mapping, MIMO-GFDM.	, Fram UFMC napping r Bloc	ne )- g. ek	9	
M III Ch Ca NG	ULTIP nallenge ncellati OMA, C	<b>LE ACCESS TECHNIQUE</b> s in OFDM- NOMA – Pri on, Power Domain NOMA, S Cooperative NOMA- Benefits	<b>S IN 5G</b> nciple- Superposition Coding, Successive Inte Sparse Code NOMA- types, Power Domain Spar and Challenges.	erferend rse Cod	ce le	9	
IV M	ASSIV	E MIMO					
	Introc	luction-pilot design and chann	el estimation- uplink data transmission and dowr	ılink			
	data t	ransmission for Single cell sys	tems and multi cell systems – capacity analysis.				
						9	
CO	OOPEF	RATIVE COMMUNICATIO	)N				
	Mach	ine Type Communication (MT	TC), Device to Device Communication (D2D), 50	G			
V	Narro NOM forwa BER	wband IoT, Cloud Computing A- Benefits and Challenges, H rd relaying, Decode and forwa Analysis, Capacity Analysis.	architecture and Protocols, Relaying: Cooperative Ialf duplex relaying, Full duplex relaying, Ampli and relaying, Decode and forward relaying with P	ve fy and 'LNC,		9	
			Total Instructiona	al Hour	s	45	
	CO1	Able to analyze the perform	nance of different channel models adopted in 5G	wireles	ss syst	ems	
Course	CO2	Able to design a transceiver f	for Multicarrier waveforms				
Outcomes	CO3	Able to analyze multiple account	ess techniques in 5G networks				
	CO4	Able to design a pilot, estima Massive MIMO	te channels and analyze capacity for single cell a	ind mu	lticell		
	CO5	Able to analyze different type	es of cooperative communications				
	RENC	E BOOKS :	Marsh "50 Makila and Window Orange"		-h1		and state
Univ	versity F	ress, 2016.	vitatisch, 50 woone and wireless Communicati	ions re	cimolo	, gy , C	amoridg

- R2 Robert W. Heath Jr., Nuria González-Prelcic, SundeepRangan, WonilRoh, and Akbar M. Sayeed, "An Overview of Signal Processing Techniques for Millimeter Wave MIMO Systems", IEEE Journal of Selected Topics in Signal Processing, Vol. 10, No. 3, April 2016
- **R3** MinChulJu and Il-Min Kim, "Error Performance Analysis of BPSK Modulation in Physical- Layer Network-Coded Bidirectional Relay Networks", IEEE Transactions on Communications, Vol. 58, No. 10, October 2010.
- R4 Shengli Zhang, Soung-Chang Liew, Patrick P.Lam, "Physical Layer Network Coding", Mobicom \_06, Proceeding of the 12th International Conference on Mobile Computing and Networking, pp.358-365, Los Angeles, CA, USA, Sep.23-29,2006
- **R5** Thomas L. Marzetta, Erik G. Larsson, Hong Yang, HienQuoc Ngo, "Fundamentals of Massive MIMO", Cambridge University Press, 1 st Edition, 2016..

PROGRAMME		AMME	COURSE CODE	NAME OF THE COURSE	L	Т	Р	С
M.E		E	20AEX312	IOT SYSTEM DESIGN AND SECURITY	3	0	0	3
1 Course 2		1	To understand the basic	cs of IoT.				
		2	To get an idea about the	e various services provided by IoT.				
Obj	ective	es 3	To familiarize themselv	ves with various communication techniques.				
5		4	To get an idea of some	application area where IoT can be applied.				
		5	To understand the varie	bus issues in IoT.				
Un	it			Description		J	nstruc Llor	tional
		INTROL	UCTION TO INTERNI	FT OF THINGS			по	115
_		Rise of th	e machines – Evolution o	f IoT – Web 3.0 view of IoT – Definition and charac	teristic	s		
Ι		of IoT – F	Physical design of IoT – L	ogical design of IoT – IoT enabling technologies – Io	T level	s	9	
		and deplo	yment templates – A pana	aromic view of IoT applications.				
		ARCHIT	ECTURE OF IoT					
		Identifact	ion and Access to objects	s and services in the IoT environment( Current tech	nologie	s		
		for IoT 1	naming-Solutions propose	ed by research projects-Research and Future deve	lopmen	nt		
п		trends an	d forecast) – Middleward	for LeT System SOA based LeT Middlewere Middlewere	rview	_	0	
11		nonzonu architectu	architecture Approach	10F 101 Systems-SOA-based 101 Middleware)Mid ADA M2M Challenges Introduced by 5G	in Io'	е г	9	
		Middlew	are(Technological Requi	rements of 5G Systems-5G-based IoT Service	res an	ı d		
		Applicati	ons Requirements-5G-bas	sed Challenges for IoT Middleware) - Perspective	s and a	a		
		Middlewa	are Approach Toward 5G	(COMPaaS Middleware) - Resource management in	IoT			
		SECURI	TY CONSIDERATION	S IN IOT SMART AMBIENT SYSTEMS				
		Security in	n Smart Grids and Smart S	Spaces for Smooth IoT Deployment in 5G (5G and the	Interne	et		
II	I of Things-Smar		-Smart Spaces-Smart Gri	ds Security and Privacy - Services that Need to Be	Secure	-	9	
		Security I	Requirements -Security A	ttacks-Security Measures and Ongoing Research) -	Securit	У		
		Challenges in 5G-Based IoT Middleware Systems(Security in 5G-Based IoT Middleware- Security Challenges Toward 5G)						
		IOT ENA	BLERS AND THEIR S	ECURITY AND PRIVACY ISSUES				
	Internet of Things laver wise Protocols and Standards- EPCglobal( architecture, specification				ications	5,	0	
11		industry adaptation, security and vulnerabilities, advantages and disadvantages)WirelessHART-				-	9	
		Zigbee-Near Field Communication-6LoWPAN-Dash7-Comparative Analysis.						
		APPLICATIONS AND CASE STUDIES						
V		Home automations - Smart cities - Environment - Energy - Retail - Logistics - Agriculture -					9	
		Industry -	Health and life style – C	ase study				
				Total Instructiona	l Hour	S	4	5
		CO1	Articulate the main con	cepts, key technologies, strength and limitations of Io	T. CO	2:		
C	nirse	CO2	Identify the architecture	e, infrastructure models of IoT.				
Outc	omes	CO3	Analyze the core issues	of IoT such as security, privacy and interoperability.				
		CO4	Analyze and design diff	erent models for network dynamics.				
TEX	T RO	048	Identify and design the	new models for market strategic interaction.				
T1	Hon	bo Zhou,	"Internet of Things in the	cloud: A middleware perspective", CRC press 2012.				
T2	Viia	v Madiset	ti and Arshdeep Bahga. "	Internet of Things (A Hands-onApproach)". VPT. 1s	t Editio	on. 🤇	2014	
REF	ERE	NCE BO	OKS.			, -		
R1	Con	standinos	X. Mavromoustakis, Geo	rge Mastorakis, Jordi Mongay Batalla, "Internet of T	'nings (	IoT)	in 5G	
	Noter Lekalmann Mark Herrigen Elerion Michahalles "Architecting the Internet of Things" Serie				ingo	-Vorla	σ	
R2	Berl	in Heidell	berg. 2011.	than whenanenes, second country the internet of Timig	s , spi	ingel	v ci id	5
R3	http:	//www.cs	e.wustl.edu/~jain/cse570-	15/ftp/iot_prot/index.html				
	1		5	1				

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# **PROFESSIONAL ELECTIVE V**

PROGRAMM M.E.	E COURSE CODE 20AEX313	NAME OF THE COURSE Machine Learning	<b>L</b> 3	<b>T</b> 0	<b>P</b> 0	С 3
Course Objectives	<ol> <li>To study the Mathemat</li> <li>To enable the student to</li> <li>To learn the fundament</li> <li>To know the machine l</li> <li>To expose the student to and unsupervised learning</li> </ol>	tical background of machine learning o understand the concept of machine learning tals of different Neural network architectures earning application in wireless communication a be familiar with a set of well-known supervised, ng algorithms.	nd bio-medica semi-supervia	ıl. sed		
Unit		Description		Inst	tructi Hour	ional rs
MATHE Linea decon distrit Proba	MATICAL BACKGROUN Algebra – Arithmetic o position, Pseudo inverse, ution, conditional probabili pilistic models.	ND f matrices, Norms, Eigen decomposition, Si Component analysis. Probability theory ity, Chain rule, Bayes rule, Information theor	ingular value – probability y, Structured		9	
MACHI Super II Valid Vecto	MACHINE LEARNING BASICS Supervised and Unsupervised learning, Capacity, Overfitting and Underfitting, Cross Validation, Linear regression, Logistic Regression, Regularization, Naive Bayes, Support Vector Machines (SVM), Decision tree, Random forest, K-Means Clustering, k nearest					
NEURA III Feedf ZF-N Back Neura	Networks , Back prop ward Networks , Back prop t, VGGNet, GoogLeNet, Re propagation, Deep Dream, D Network(RNN) – Back pro	pagation, Convolutional Neural Networks-LeNet ssNet, Visualizing Convolutional Neural Network peep Art, Fooling Convolutional Neural Networks pagation through time (BPTT), Vanishing and E	, AlexNet, ss, Guided s. Recurrent xploding		9	
ML IN V Water OFDM IV down in Sid	INTS. IRELESS AND SECURI filling power allocation, Op 1 systems. Optimization in ink beamforming. Application e channel analysis.	<b>FY</b> ptimization for MIMO Systems, OFDM Systems beamformer design – Robust receive beamform on: Radar for target detection, Array Processing,	s and MIMO- ing, Transmit MUSIC, ML		9	
ML IN F Mach V Autor Monit	IO-MEDICAL ne Learning in Medical Ima nated ECG Noise Detection oring. Techniques for Electro	aging. Deep Learning for Health Informatics. D on and Classification System for Unsupervise onic Health Record (EHR) Analysis	eep Learning d Healthcare		9	
Course CO Outcomes CO CO CO CO	Demonstrate understandi learning. Familiar with the differen In a position to formulate Able to recognize the char problems. In a position to read curren	rotal Instruction ng of the mathematical principles underlying ma nt machine learning techniques and their use case e machine learning problems corresponding to dif racteristics of machine learning techniques that ar nt research papers, understand the issues and the	chine chine s. fferent applica e useful to so machine learr	tions lve rea	45 al-wo ased	orld
REFERE	solution approaches. ICE BOOKS :					
R1.	Ian Goodfellow, Yoshua E 2017.	Bengio, and Aaron Courville, "Deep learning",Ca	mbridge,MA,	MIT	Press	3,

- **R2.** Tom M. Mitchell, "Machine Learning", McGraw Hill, 1997.
- R3. Ethem Alpaydın, "Introduction to machine learning", MIT Press, 3rd Edition, 2014.
- **R4.** M. N. Wernick, Y. Yang, J. G. Brankov, G. Yourganov and S. C. Strother, "Machine Learning in Medical Imaging", IEEE Signal Processing Magazine, vol. 27, no. 4, pp. 25-38, July 2010.
- **R5.** Ravì et al., "Deep Learning for Health Informatics," IEEE Journal of Biomedical and Health Informatics, vol. 21, no. 1, pp. 4-21, Jan. 2017.
- **R6.** Satija, B. Ramkumar and M. S. Manikandan, "Automated ECG Noise Detection and Classification", IEEE Journal of Biomedical and Health Informatics PP(99), March 2017.

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PROGRAMME		MME	E COURSE CODE NAME OF THE COURSE L		Т	Р	С	
M.E.			20AEX314	ELECTRONICS FOR SOLAR POWER	3	0	0	3
		1	Study the behavior of ph systems.	notovoltaic solar energy systems, focusing on the behav	ior of	"stand	-alone	."
Coι	ırse	2	Do a first order, concept	ual design of a stand-alone system for a location anywh	ere in	India		
Objec	ctives	3	Introduce the hardware e	elements and their behavior.				
		4	Select battery for a PV s	ystem and battery sizing				
		5	Simulate standalone and	grid tied PV system				
Unit				Description		Ins	tructi Hour	onal s
Ι	IN Se - B - S - N vo	INTRODUCTION TO SOLAR POWER Semiconductor – properties - energy levels - basic equations of semiconductor devices physics - Basic characteristics of sunlight - Solar angles - day length - angle of incidence on tilted surface - Sun path diagrams – Equivalent circuit of PV cell, PV cell characteristics (VI curve, PV curve) - Maximum power point, Vmp, IMP, Voc, ISC – types of PV cell - Block diagram of solar photo voltaic system, PV array sizing.					9	
п	DC Pri bu Re	C-DC C inciples ckboos sonant	CONVERTER of step-down and step-1 t and Cuk converters – ti and quasi – resonant con	up converters – Analysis and design issues of buck, b me ratio and current limit control – Full bridge conver verters.	ooost, rter –		9	
III	M Di Fu Fra De BA	MAXIMUM POWER POINT TRACKING Direct Energy transmission, Impedance Matching, Maximum Power Point Tracking (MPPT) - Function of MPPT, P&O method, INC Method, Fractional Open circuit voltage method, Fractional short circuit current method, parasitic capacitance and other MPPT techniques, Development of hardware, algorithms using processors for Standalone and Grid tied systems.					9	
IV	Ty dis Ch dis Ba	<b>BATTERY</b> Types of Battery, Battery Capacity – Units of Battery Capacity-impact of charging and discharging rate on battery capacity-Columbic efficiency-Voltage Efficiency, Charging – Charge Efficiency, Charging methods, State of Charge, Charging Rates, Discharging - Depth of discharge-Discharge Methods, Circuits for Battery Management System (BMS), selection of Battery and size					9	
v	SI Sin Sin gri	SIMULATION OF PV MODULE & CONVERTERS Simulation of PV module - VI Plot, PV Plot, finding VMP, IMP, Voc, Isc of PV module, Simulation of DC to DC converter -buck, boost, buck-boost and Cuk converters, standalone and grid tied photo voltaic system.					9	
Cour Outcon	rse nes	CO1 CO2 CO3 CO4 CO5	Ability to collect solar po Ability to design and real Ability to design algorith Ability to deal with batter Ability to design and sim	Instructional H wer characteristics at a given location ize dc-dc converters for solar power utilization ms for improving solar power utilization ry issues and selection ulate PV systems to validate its performance.	lours		45	
TEX	г во	OKS:		• •				
T1	Cheta	n Singł	n Solanki, "Solar Photovo	ltaic: Fundamentals, Technologies and Applications", I	PHI Lt	d., 20	13.	
T2	Tomn	narkvar	t, Luis castaner, "Solar co	ells; materials, manufacture and operation", Elsevier, 20	)05.			
KEF	CD	CE B(	JUKS: olar operatu utilization "	Khanna publishas 1003				
R2	Ned N Desig	Aohan, Nohan, n", Joh	Undeland and Robbin, "I n Wiley and sons.Inc, Ne	Power Electronics: converters, Application and wyork, 1995.				

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	BASICS Printed Photolit	<b>S OF PCB DESIGN AND TOOLS</b> Circuit Board Fabrication- PCB cores and layer stack-up. PCB fabrication process-					
I	the PCB (Gerber)	B Design Process. Design Files Created by Layout - Layout format files, Post process files, PCB assembly layers and files. Introduction to the Standards Organizations, Classes es of PCBs	9				
	PCB DE	ESIGN FLOW USING CAD TOOL					
	Overvie	w of Computer-Aided Design. Project structures and the layout toolset- Project Setup and					
	Schemat	tic Entry Details, the Layout Environment and Tool Set. Creating a Circuit Design with					
II	Capture-	-Starting a new project placing parts, Wiring (connecting) the parts, creating the Layout	9				
	netlist in	1 Capture. Designing the PCB with Layout- Starting Layout and importing the netlist,					
	Manual	ing a design rule check, Making a board outline, Placing the parts, Auto routing the board routing. Cleanup Locking traces. Post processing the board design for manufacturing					
	DESIG	N FOR MANIFACTURING					
	PCB A	ssembly and Soldering Processes- Component Placement and Orientation Guide,					
	Compon	ent Spacing for Through-hole Devices. Component Spacing for Surface Mounted Devices					
III	SMDs, 1	Mixed THD and SMD Spacing Requirements. Footprint and Padstack Design for PCB	9				
	Manufac	cturability- Land Patterns for Surface-Mounted Devices- Land Patterns for Through-hole					
	Devices,	, Padstack design, Hole-to-lead ratio, PTH land dimension (annular ring width), Clearance					
	PCB DF	SIGN FOR SIGNAL INTEGRITY					
	Circuit I	Design Issues Not Related to PCB Layout, Issues Related to PCB Layout, Ground Planes					
IV	and Gro	und Bounce, PCB Electrical Characteristics, PCB Routing Topics, Making and editing	9				
	capture	parts, The Capture Part Libraries, Types of Packaging, Pins, Part Editing Tools,					
	Construe	cting Capture Parts, making and editing layout footprints.					
	EMER	GING ADDITIVE PROCESSES FOR PCB MANUFACTURING					
	manufac	sturing Stereo lithography (SL) Stereo lithography (SL) Fused Deposition Modelling					
V	(FDM). Three Dimensional Printing (3DP). Materials. Applications. Voltera-V-one PCB doub						
	side Printer, Bot Factory- SV2-multi layer PCB printer, LPKF circuit board plotter and LDS						
	Prototyp	ving.					
	CO1	Total Instructional Hours	45				
	CO1	Leads new users of the software through a very simple design	uton of rCDs.				
a	CO3	To know and guide in designing plated through-holes, surface-mount lands, and Layout fo	otprints in				
Course		general.	1				
Outcomes	° CO4	To know to construct Capture parts using the Capture Library Manager and Part Editor and Model Editor.	1 the PSpice				
теут і	CO5	To understand and to fabricate PCBs					
	raio Mitzi	ner "Complete PCB Design Using OrCad Capture and Layout" Newness, 1st Edition, 2009	)				
Si	mon Mor	ik, "Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards".	McGraw-Hill				
T Ed	lucation 7	ΓAB; 2nd Edition, 2017.					

# Description DAGICS OF DCD DESIGN AND TOOLS

M.E.

Course

Objectives

Unit

PROGRAMME COURSE CODE

20AEX315

- To expose the students to the basics of PCB design 1
- To lead the new users of the software through a very simple design
- 2 To address the mechanical aspect of PCB design and to aid in understanding the design issues, 3 manufacturing processes

NAME OF THE COURSE

PCB DESIGN AND FABRICATION

- To address the electrical aspect of PCB design 4
- 5 To expose the students to the state of art technology in PCB design and manufacturing.

- Instructional Hours

С Т Р 0 0

3

L

3

# **REFERENCE BOOKS:**

- **R1** Douglas Brooks, "Signal Integrity Issues and Printed Circuit Board Design", Prentice Hall PTR, 2003.
- **R2** Lee W. Ritchey, John Zasio, Kella J. Knack, "Right the First Time: a Practical Handbook on High Speed PCB and System Design", Speeding Edge, 2003.

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# **OPEN ELECTIVE**

PROGRAMM	IE COURSE CODE	E COURSE CODE NAME OF THE COURSE	L	Т	Р	С	
M.E.	20AE3401	ROBOTICS	3	0	0	3	
Course Objectives	1.Understand robo 2.Articulate perce 3.Outline mobile ro 4.Understand mobi 5.Explain robot pla	t locomotion and mobile robot kinematics. ption in robotics obot localization. ile robot mapping. inning and navigation.					
Unit		Description		Instructi		al	
	LOCOMOTION AND KINEM	ATICS		110	Juis		
Ι	Introduction to Robotics – key issu – aerial mobile robots – introduct	ies in robot locomotion – legged robots – wheeled me ion to kinematics – kinematics models and constrain	obile robots ints – robot		9		
	maneuverability						
П	Sensors for mobile robots – vision for robotics – cameras – image formation – structure from stereo – structure from motion – optical flow – color tracking – place recognition – range data sensors, linear variable differential transformers (LVDT). Hell Effect sensors						
	MORILE ROBOT LOCALIZA						
III	Introduction to localization – challenges in localization – localization and navigation – belief representation – map representation – probabilistic map-based localization – Markov localization – EKF localization – UKF localization – Grid localization – Monte Carlo localization – localization in dynamic environments <b>MOBILE ROBOT MAPPING</b> Autonomous map building – occupancy grip mapping – MAP occupancy mapping – SLAM – extended Kalman Filter SLAM – graph-based SLAM – particle filter SLAM – sparse extended information filter – fast SLAM algorithm.						
IV							
	PLANNING AND NAVIGATION						
V	Introduction to planning and na	vigation – planning and reacting – path planning	– obstacle		9		
	avoidance techniques – navigation architectures – basic exploration algorithms <b>Total Instructional Hours</b>						
Co	urse cO2: Understand robot CO2: Understand perce CO3: Apply robot local	locomotion and mobile robot kinematics. ption in robotics. ization techniques.					

- CO4: Apply robot mapping techniques.
  - CO5: Explain planning and navigation in robotics.

# **TEXT BOOKS:**

**T1**. Gregory Dudekand Michael Jenkin, "Computational Principles of Mobile Robotics", Second Edition, Cambridge University Press, 2010.

**T2**. Howie Choset et al., "Principles of Robot Motion: Theory, Algorithms, and Implementations", A Bradford Book, 2005.

## **REFERENCE BOOKS:**

R1. Maja J. Mataric, "The Robotics Primer", MIT Press, 2007.

R2. Roland Seigwart, "Introduction to autonomous mobile robots", Second Edition, MIT Press, 2011.

R3. Sebastian Thrun, Wolfram Burgard, and Dieter Fox, "Probabilistic Robotics", MIT Press, 2005.

R4. Mikell.P.Groover, "Industrial Robotics – Technology, Programming and applications", Tata McGraw Hill 2008.





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PROGRAMME		COURSE CODE	NAME OF THE COURSE	L	Т	Р	С	
M.E.		20AE3402	ARTIFICIAL INTELLIGENCE AND OPTIMIZATION TECHNIQUES	3	0	0	3	
Course Objectives	1 g in s 2 3	.To introduce the tec eneticalgorithms and mmune systems. .To present main rul .To present selected To adopt these tech	chniques of computational methods inspired by nature, such as neur d other evolutionary computation systems, ant swarm optimization es underlying in these techniques. case studies.	al r anc	networks l artifici	,, al		
Unit	4.16 adopt these techniques in solving problems in the real world. Description					Instructional Hours		
I	NEURAI Neural N Network, Vector M nonlinear	NETWORKS etworks: Back Prop interpolation and app achines: Optimal h y separable patterns	agation Network, generalized delta rule, Radial Basis Function proximation RBFNS, comparison between RBFN and BPN, Suppor operplane for linearly separable patterns, optimal hyperplane for Inverse Modeling.	1 t r	9			
п	<b>FUZZY LOGIC SYSTEMS</b> Fuzzy Logic System: Basic of fuzzy logic theory, crisp and fuzzy sets, Basic set operation like union, interaction, complement, T-norm, T-conorm, composition of fuzzy relations, fuzzy if- then rules, fuzzy reasoning, Neuro-Fuzzy Modeling: Adaptive Neuro-Fuzzy Inference System (ANFIS), ANFIS architecture, Hybrid Learning Algorithm.				9			
III	<b>EVOLUT</b> Evolution Application Algorithm	<b>TIONARY COMPU</b> ary Computation (EC ons. Genetic Algorith - Classification of	<b>TATION &amp; GENETIC ALGORITHMS</b> C) – Features of EC – Classification of EC – Advantages – ams: Introduction – Biological Background – Operators in GA-GA GA – Applications	<u>.</u>	9			
IV	ANT CO Ant Color – Converg principles	LONY OPTIMIZA by Optimization: Intr gence proofs – ACO of ACO.	<b>TION</b> oduction – From real to artificial ants- Theoretical considerations Algorithm – ACO and model based search – Application		9			
V	<b>PARTICLE SWARM OPTIMIZATION</b> Particle Swarm Optimization: Introduction – Principles of bird flocking and fish schooling – Evolution of PSO – Operating principles – PSO Algorithm – Neighborhood Topologies – Convergence criteria – Applications of PSO, Honey Bee Social Foraging Algorithms, Bacterial Foraging Optimization Algorithm.							
			Total Instructional Hours	5	45	i		
	Course	CO1: Ability to c CO2: Ability to c	esign and train neural networks with different rules levise fuzzy logic rules mplement genetic algorithms					

COURSE Outcomes CO3: Ability to implement genetic algorithms CO4: Ability to implement ANT colony optimization technique for various problems CO5: Ability to use PSO technique

# **TEXT BOOKS:**

- T1 David E. Goldberg, "Genetic Algorithms in search, Optimization & Machine Learning", Pearson Education, 2006
- T2 Christopher M. Bishop, "Neural Networks for Pattern Recognition", Oxford University Press, 1995

# **REFERENCE BOOKS:**

- **R1** N P Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2005.
- R2 Engelbrecht, A.P., "Fundamentals of Computational Swarm Intelligence", Wiley, 2005.
- R3 Kenneth A DeJong, "Evolutionary Computation A Unified Approach", Prentice Hall of India, New Delhi, 2006.
- R4 Marco Dorigo and Thomas Stutzle, "Ant Colony optimization", Prentice Hall of India, New Delhi, 2004.

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