ANNA UNIVERSITY, CHENNAI
NON - AUTONOMOUS COLLEGES AFFILIATED ANNA UNIVERSITY
M.E. VLSI DESIGN AND EMBEDDED SYSTEMS
REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. To enrich students in the cutting edge technologies of VLSI design and Embedded systems and create competent professionals and researchers in this field
2. To provide students with a good foundation in computer architecture principles and digital systems design as these areas are vital for the VLSI design industry
3. To understand the various applications and employ embedded systems to find solutions to them with good scientific and engineering knowledge so as to comprehend, analyze, design, and create novel products and solutions for the real life problems.
4. To provide students with an academic environment aware of excellence, leadership, ethical conduct, positive attitude, societal responsibilities and the lifelong learning needed for a successful professional career.
5. To inculcate entrepreneurial skills in setting startups serving the needs of the industry sectors that depend on VLSI design and Embedded Systems.

PROGRAM OUTCOMES (POs)

1. An ability to independently carry out research/investigation and development work to solve practical problems
2. An ability to write and present a substantial technical report/document
3. Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
4. Master the fundamentals, associated with the different specializations of VLSI and Embedded systems domain.
5. Provide solutions through research to the social relevant issues with the knowledge, techniques, skills in VLSI and Embedded systems domain using the required hardware and modern tools for the benefit of the society.
6. Pursue a successful research career in VLSI and Embedded systems field or take on challenging assignments in the industry.

PEO/PO Mapping:

PEO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
I.			✓	✓	✓	✓
II.	✓			✓	✓	✓
III.	✓	✓	✓	✓	✓	
IV.	✓	✓	✓		✓	✓
V.	✓	✓	✓	✓	✓	✓

(3-High, 2- Medium, 1- Low)

MAPPING OF COURSE OUTCOMES AND PROGRAMME OUTCOMES

		COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6
YEAR I	SEMESTER I	Graph Theory and Optimization Techniques	2	0	1	1	0	0
		Research Methodology and IPR	2	2	-	-	2	-
		Analog IC Design	1	1	2	1	2	0
		Digital CMOS VLSI Design	1	0	1.4	1	0	0
		Embedded Controllers	1	0	1	2	2	1
		Embedded System Design	1	0	2	2	3	1
		Embedded Systems Laboratory	1	1	1	1	1	1
		Analog and Digital CMOS VLSI Design Laboratory	1	1	1	1	1	1
	SEMESTER II	Design for Verification using UVM	1	0	1	1	2.5	0
		FPGA System Design	1	1	1	1	1	3
		Embedded Automation	1	3	1	1	1	3
		VLSI Structures for DSP	1	0	1	1	0	0
		Internet of Things System Design	1	0	1	1	0	0
		Professional Elective I						
		Term Paper Writing and Seminar	1	1	1	1	1	1
		Embedded Automation Laboratory	1	1	1	1	1	1
YEAR II	SEMESTER III	Professional Elective II						
		Professional Elective III						
		Professional Elective IV						
		Open Elective						
		Project Work I						
	SEMESTER IV	Project Work II						

PROFESSIONAL ELECTIVE COURSES [PEC]

S. NO.	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6
1.	ASIC Design	1	0	1	1	0	0
2.	Parallel and Reconfigurable Architectures	1	0	1	1	0	0
3.	Software for Embedded Systems	1	0	1	1	2.1	3
4.	Embedded System Security	1	0	2	2	1	0
5.	VLSI Testing	1.6	0	2	2.4	2.4	0
6.	Network on Chip	1	0	2	1	0	0
7.	Nanotechnology	1	0	1	1	0	0
8.	Low Power VLSI Design	1.6	0	2	2.4	.4	0
9	Multicore Architecture Programming	1	0	1	1	2	0
10.	Reconfigurable Computing	1	0	1	1	1	0
11.	Hardware Software Co-Design	1	0	1	1	0	0
12.	System on Chip	1	0	1	1	0	0
13.	MEMS and NEMS	1	0	1	1	0	0
14.	Automotive Electronics	1	0	1	1	0	0
15.	Embedded Wireless Sensor Networks	1	0	1	1	0	2
16.	Network Embedded Applications	1	0	1	1	1	2
17.	RFIC Design	1.6	0	2	2.4	2.4	0
18.	Sensors and Actuators	1	0	1	1	0	0
19.	Real Time Operating System	1	0	1	1	1	0
20.	Embedded Networking	1	0	1	1	1	0
21.	Deep Learning	1	0	1	2	1	0
22.	Real Time Embedded Systems	1	0	1	1	1	0
23.	Pervasive Computing	1	0	1	1	1	0
24.	Physical Design Automation	1	0	1	1	2	0

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I TO IV SEMESTERS CURRICULA AND SYLLABI
SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	VL4153	Graph Theory and Optimization Techniques	FC	3	1	0	4	4
2.	RM4151	Research Methodology and IPR	RMC	2	0	0	2	2
3.	VL4151	Analog IC Design	PCC	3	0	0	3	3
4.	VL4152	Digital CMOS VLSI Design	PCC	3	0	0	3	3
5.	VE4151	Embedded Controllers	PCC	3	0	0	3	3
6.	VE4152	Embedded System Design	PCC	3	0	0	3	3
7.		Audit Course – I*	AC	2	0	0	2	0
PRACTICALS								
8.	VE4111	Embedded Systems Laboratory	PCC	0	0	4	4	2
9.	VE4112	Analog and Digital CMOS VLSI Design Laboratory	PCC	0	0	4	4	2
			TOTAL	**19**	**1**	**8**	**28**	**22**

*Audit course is optional

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	VL4251	Design for Verification using UVM	PCC	3	0	0	3	3
2.	VE4201	FPGA System Design	PCC	3	0	2	5	4
3.	VE4202	Embedded Automation	PCC	3	0	0	3	3
4.	VE4203	VLSI Structures for DSP	PCC	3	0	0	3	3
5.	VE4204	Internet of Things System Design	PCC	3	0	0	3	3
6.		Professional Elective I	PEC	3	0	0	3	3
7.		Audit Course – II*	AC	2	0	0	2	0
PRACTICALS								
8.	VE4211	Term Paper Writing and Seminar	EEC	0	0	2	2	1
9.	VE4212	Embedded Automation Laboratory	PCC	0	0	4	4	2
			TOTAL	**20**	**0**	**8**	**28**	**22**

*Audit course is optional

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Professional Elective II	PEC	3	0	0	3	3
2.		Professional Elective III	PEC	3	0	0	3	3
3.		Professional Elective IV	PEC	3	0	2	5	4
4.		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
5.	VE4311	Project Work I	EEC	0	0	12	12	6
			TOTAL	**12**	**0**	**14**	**26**	**19**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	VE4411	Project Work II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL NO. OF CREDITS: 75

PROFESSIONAL ELECTIVES

SEMESTER II, ELECTIVE I

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	VL4071	ASIC Design	PEC	3	0	0	3	3
2.	VE4001	Parallel and Reconfigurable Architectures	PEC	3	0	0	3	3
3.	VE4002	Software for Embedded Systems	PEC	3	0	0	3	3
4.	VE4003	Embedded System Security	PEC	3	0	0	3	3
5.	VL4252	VLSI Testing	PEC	3	0	0	3	3
6.	VL4091	Network on Chip	PEC	3	0	0	3	3

SEMESTER III, ELECTIVE II

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	VL4074	Nanotechnology	PEC	3	0	0	3	3
2.	VL4291	Low Power VLSI Design	PEC	3	0	0	3	3
3.	VE4004	Multicore Architecture Programming	PEC	3	0	0	3	3
4.	VE4005	Reconfigurable Computing	PEC	3	0	0	3	3
5.	VE4071	Hardware Software Co-Design	PEC	3	0	0	3	3
6.	II4092	System on Chip	PEC	3	0	0	3	3

SEMESTER III, ELECTIVE III

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	VL4073	MEMS and NEMS	PEC	3	0	0	3	3
2.	AP4091	Automotive Electronics	PEC	3	0	0	3	3
3.	VE4006	Embedded Wireless Sensor Networks	PEC	3	0	0	3	3
4.	VE4007	Network Embedded Applications	PEC	3	0	0	3	3
5.	VL4292	RFIC Design	PEC	3	0	0	3	3
6.	AP4073	Sensors and Actuators	PEC	3	0	0	3	3

SEMESTER III, ELECTIVE IV

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	VE4008	Real Time Operating System	PEC	3	0	2	5	4
2.	VE4009	Embedded Networking	PEC	3	0	2	5	4
3.	IF4071	Deep Learning	PEC	3	0	2	5	4
4.	VE4072	Real Time Embedded Systems	PEC	3	0	2	5	4
5.	VE4010	Pervasive Computing	PEC	3	0	2	5	4
6.	VE4011	Physical Design Automation	PEC	3	0	2	5	4

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	AX4091	English for Research Paper Writing	2	0	0	0
2.	AX4092	Disaster Management	2	0	0	0
3.	AX4093	Constitution of India	2	0	0	0
4.	AX4094	நற்றமிழ் இலக்கியம்	2	0	0	0

LIST OF OPEN ELECTIVES FOR PG PROGRAMMES

SL. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	OCE431	Integrated Water Resources Management	3	0	0	3
2.	OCE432	Water, Sanitation and Health	3	0	0	3
3.	OCE433	Principles of Sustainable Development	3	0	0	3
4.	OCE434	Environmental Impact Assessment	3	0	0	3
5.	OIC431	Blockchain Technologies	3	0	0	3
6.	OIC432	Deep Learning	3	0	0	3
7.	OME431	Vibration and Noise Control Strategies	3	0	0	3
8.	OME432	Energy Conservation and Management in Domestic Sectors	3	0	0	3
9.	OME433	Additive Manufacturing	3	0	0	3
10.	OME434	Electric Vehicle Technology	3	0	0	3
11.	OME435	New Product Development	3	0	0	3
12.	OBA431	Sustainable Management	3	0	0	3
13.	OBA432	Micro and Small Business Management	3	0	0	3
14.	OBA433	Intellectual Property Rights	3	0	0	3
15.	OBA434	Ethical Management	3	0	0	3
16.	ET4251	IoT for Smart Systems	3	0	0	3
17.	ET4072	Machine Learning and Deep Learning	3	0	0	3
18.	PX4012	Renewable Energy Technology	3	0	0	3
19.	PS4093	Smart Grid	3	0	0	3
20.	CP4391	Security Practices	3	0	0	3
21.	MP4251	Cloud Computing Technologies	3	0	0	3
22.	IF4072	Design Thinking	3	0	0	3
23.	MU4153	Principles of Multimedia	3	0	0	3
24.	CX4016	Environmental Sustainability	3	0	0	3
25.	TX4092	Textile Reinforced Composites	3	0	0	3
26.	NT4002	Nanocomposite Materials	3	0	0	3
27.	BY4016	IPR, Biosafety and Entrepreneurship	3	0	0	3

FOUNDATION COURSES (FC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	VL4153	Graph Theory and Optimization Techniques	3	1	0	4	I

PROFESSIONAL CORE COURSES (PCC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	VL4151	Analog IC Design	3	0	0	3	I
2.	VL4152	Digital CMOS VLSI Design	3	0	0	3	I
3.	VE4151	Embedded Controllers	3	0	0	3	I
4.	VE4152	Embedded System Design	3	0	0	3	I
5.	VE4111	Embedded Systems Laboratory	0	0	4	2	I
6.	VE4112	Analog and Digital CMOS VLSI Design Laboratory	0	0	4	2	I
7.	VL4251	Design for Verification using UVM	3	0	0	3	II
8.	VE4201	FPGA System Design	3	0	2	4	II
9.	VE4202	Embedded Automation	3	0	0	3	II
10.	VE4203	VLSI Structures for DSP	3	0	0	3	II
11.	VE4204	Internet of Things System Design	3	0	0	3	II
12.	VE4212	Embedded Automation Laboratory	0	0	4	2	II

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	RM4151	Research Methodology and IPR	2	0	0	2	1

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	VE4211	Term Paper Writing and Seminar	0	0	2	1	II
2.	VE4311	Project Work I	0	0	12	6	III
3.	VE4411	Project Work II	0	0	24	12	IV

SUMMARY

Sl. No.	NAME OF THE PROGRAMME: M.E. VLSI DESIGN AND EMBEDDED SYSTEMS					
	SUBJECT AREA	**CREDITS PER SEMESTER**				**CREDITS TOTAL**
		I	**II**	**III**	**IV**	
1.	FC	04	00	00	00	04
2.	PCC	16	18	00	00	34
3.	PEC	00	03	10	00	13
4.	RMC	02	00	00	00	02
5.	OEC	00	00	03	00	03
6.	EEC	00	01	06	12	19
7.	Non Credit/Audit Course	✓	✓	00	00	
8.	**TOTAL CREDIT**	**22**	**22**	**19**	**12**	**75**

VL4153 GRAPH THEORY AND OPTIMIZATION TECHNIQUES L T P C
3 1 0 4

COURSE OBJECTIVES:

- To introduce graph as mathematical model to solve connectivity related problems.
- To introduce fundamental graph algorithms.
- To familiarize the students with the formulation and construction of a mathematical model for a linear programming problem in real life situation.
- To provide knowledge and training using non-linear programming under limited resources for the engineering and business problems.
- To understand the applications of simulation modelling in engineering problems.

UNIT I GRAPHS 12

Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton paths.

UNIT II GRAPH ALGORITHM 12

Graph Algorithms – Directed graphs – Some basic algorithms – Shortest path algorithms – Depth – First search on a graph – Theoretic algorithms – Performance of graph theoretic algorithms – Graph theoretic computer languages.

UNIT III LINEAR PROGRAMMING 12

Formulation – Graphical solution – Simplex method – Two-phase method – Transportation and Assignment Models.

UNIT IV NON-LINEAR PROGRAMMING 12

Constrained Problems – Equality constraints – Lagrangean Method – Inequality constraints – Karush – Kuhn-Tucker (KKT) conditions – Quadratic Programming.

UNIT V SIMULATION MODELLING 12

Monte Carlo Simulation – Types of Simulation – Elements of Discrete Event Simulation – Generation of Random Numbers – Applications to Queuing systems.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able to

1. apply graph ideas is solving connectivity related problems.
2. apply fundamental graph algorithms to solve certain optimization problems.
3. formulate and construct mathematical models for linear programming problems and solve the transportation and assignment problems.
4. model various real life situations as optimization problems and effect their solution through Non-linear programming.
5. apply simulation modeling techniques to problems drawn from industry management and other engineering fields.

REFERENCES:

1. Taha H.A, “Operation Research: An Introduction”, Ninth Edition, Pearson Education, New Delhi, 2010.

2. Gupta P. K, and Hira D.S., “Operation Research”, Revise Edition, S. Chand and Company Ltd., 2012.
3. Sharma J.K., “Operation Research”, 3rd Edition, Macmillan Publishers India Ltd., 2009.
4. Douglas B. West, “Introduction to Graph Theory”, Pearson Education, New Delhi, 2015.
5. Balakrishna R., Ranganathan. K., “ A text book of Graph Theory”, Springer Science and Business Media, New Delhi, 2012.
6. Narasingh Deo, “Graph Theory with Applications to Engineering and Computer Science”, Prentice Hall India,1997.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	2	0	1	1	0	0
2	2	0	1	1	0	0
3	2	0	1	1	0	0
4	2	0	1	1	0	0
5	2	0	1	1	0	0
Avg	(10/5)=2	0	(5/5)=1	(5/5)=1	0	0

RM4151 RESEARCH METHODOLOGY AND IPR L T P C
2 0 0 2

COURSE OBJECTIVES:

- To arrange the conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose
- To gather information in a measured and systematic manner to ensure accuracy and facilitate data analysis
- To transform and model the collected data to discover useful information for decision-making
- To create public awareness about the benefits of Intellectual property among students
- To Provide legal certainty to inventors/ Patent applicants

UNIT I RESEARCH DESIGN 6

Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II DATA COLLECTION AND SOURCES 6

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING 6

Overview of Multivariate analysis, Hypotheses testing and Measures of Association.
Presenting Insights and findings using written reports and oral presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS 6

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT V PATENTS 6

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.

TOTAL:30 PERIODS

COURSE OUTCOMES:

- Ability to arrange the conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose
- Ability to gather information in a measured and systematic manner to ensure accuracy and facilitate data analysis
- Ability to transform and model the collected data to discover useful information for decision-making
- Ability to awareness about the benefits of Intellectual property
- Ability to take up legal certainty while applying for Patent

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.

CO-PO Mapping

CO	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
1	3	2	-	-	2	-
2	3	3	-	-	1	-
3	2	3	-	-	1	-
4	1	1	-	-	3	-
5	1	1	-	-	3	-
Avg	**2**	**2**	**-**	**-**	**2**	**-**

VL4151 **ANALOG IC DESIGN** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Analog Circuits play a very crucial role in all electronic systems and due to continued miniaturization, many of the analog blocks are not getting realized in CMOS technology. The most important building blocks of all CMOS analog IC will be the topic of study in this course.
- The basic principle of operation, the circuit choices and the tradeoffs involved in the MOS transistor level design common to all analog CMOS ICs will be discussed in this course.
- The specific design issues related to single and multistage voltage, current and differential amplifiers, their output and impedance issues, bandwidth, feedback and stability will be dealt with in detail.

UNIT I SINGLE STAGE AMPLIFIERS **9**

Basic MOS physics and equivalent circuits and models, CS, CG and Source Follower, differential amplifier with active load, Cascode and Folded Cascode configurations with active load, design of Differential and Cascode Amplifiers – to meet specified SR, noise, gain, BW, ICMR and power dissipation, voltage swing, high gain amplifier structures.

UNIT II HIGH FREQUENCY AND NOISE CHARACTERISTICS OF AMPLIFIERS **9**

Miller effect, association of poles with nodes, frequency response of CS, CG and Source Follower, Cascode and Differential Amplifier stages, statistical characteristics of noise, noise in Single Stage amplifiers, noise in Differential Amplifiers.

UNIT III FEEDBACK AND SINGLE STAGE OPERATIONAL AMPLIFIERS **9**

Properties and types of negative feedback circuits, effect of loading in feedback networks, operational amplifier performance parameters, single stage Op Amps, two-stage Op Amps, input range limitations, gain boosting, slew rate, power supply rejection, noise in Op Amps.

UNIT IV STABILITY AND FREQUENCY COMPENSATION OF TWO STAGE AMPLIFIER **9**

Analysis Of Two Stage Op Amp – Two Stage Op Amp Single Stage CMOS CS as Second Stage And Using Cascode Second Stage, Multiple Systems, Phase Margin, Frequency Compensation, And Compensation Of Two Stage Op Amps, Slewing In Two Stage Op Amps, Other Compensation Techniques.

UNIT V BANDGAP REFERENCES **9**

Current sinks and sources, current mirrors, Wilson current source, Widlar current source, cascode current source, design of high swing cascode sink, current amplifiers, supply independent biasing, temperature independent references, PTAT and CTAT current generation, constant-gm biasing.

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Design amplifiers to meet user specifications 9

CO2: Analyse the frequency and noise performance of amplifiers

CO3: Design and analyse feedback amplifiers and one stage op amps

CO4: Design and analyse two stage op amps
CO5: Design and analyse current mirrors and current sinks with mos devices

TOTAL: 45 PERIODS

REFERENCES:

1. Behzad Razavi, “Design Of Analog Cmos Integrated Circuits”, Tata Mcgraw Hill, 2001.
2. Willey M.C. Sansen, “Analog Design Essentials”, Springer, 2006.
3. Grebene, “Bipolar And Mos Analog Integrated Circuit Design”, John Wiley & Sons,Inc.,2003.
4. Phillip E.Allen, Douglas R .Holberg, “Cmos Analog Circuit Design”, Oxford University Press, 2nd Edition, 2002.
5. Recorded Lecture Available at http://www.ee.iitm.ac.in/vlsi/courses/ee5320_2021/start
6. Jacob Baker “CMOS: Circuit Design, Layout, And Simulation, Wiley IEEE Press, 3rd Edition, 2010.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	2	1	0	0
2	1	0	2	1	0	0
3	1	0	2	1	0	0
4	1	0	2	1	0	0
5	1	0	2	1	0	0
Avg	(5/5)=1	0	(10/5)=2	(5/5)=1	0	0

VL4152 DIGITAL CMOS VLSI DESIGN L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the transistor level design of all digital building blocks common to all cmos microprocessors, network processors, digital backend of all wireless systems etc.
- To introduce the principles and design methodology in terms of the dominant circuit choices, constraints and performance measures
- To learn all important issues related to size, speed and power consumption

UNIT I MOS TRANSISTOR PRINCIPLES AND CMOS INVERTER 12

MOSFET characteristic under static and dynamic conditions, MOSFET secondary effects, elmore constant , CMOS inverter-static characteristic, dynamic characteristic, power, energy, and energy delay parameters, stick diagram and layout diagrams.

UNIT II COMBINATIONAL LOGIC CIRCUITS 9

Static CMOS design, different styles of logic circuits, logical effort of complex gates, static and dynamic properties of complex gates, interconnect delay, dynamic logic gates.

UNIT III SEQUENTIAL LOGIC CIRCUITS 9

Static latches and registers, dynamic latches and registers, timing issues, pipelines, clocking strategies, nonbistable sequential circuits.

UNIT IV ARITHMETIC BUILDING BLOCKS 9

Data path circuits, architectures for adders, accumulators, multipliers, barrel shifters, speed, power and area tradeoffs.

UNIT V MEMORY ARCHITECTURES 6

Memory architectures and Memory control circuits: Read-Only Memories, ROM cells, Read-Write Memories (RAM), dynamic memory design, 6 Transistor SRAM cell, sense amplifiers.

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Use mathematical methods and circuit analysis models in analysis of CMOS digital circuits

CO2: Create models of moderately sized static CMOS combinational circuits that realize specified digital functions and to optimize combinational circuit delay using RC delay models and logical effort

CO3: Design sequential logic at the transistor level and compare the tradeoffs of sequencing elements including flip-flops, transparent latches

CO4: Understand design methodology of arithmetic building blocks

CO5: Design functional units including ROM and SRAM

TOTAL:45 PERIODS

REFERENCES:

1. N.Weste, K. Eshraghian, " Principles Of Cmos VLSI Design", Addision Wesley, 2nd Edition, 1993
2. M J Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997
3. Sung-Mo Kang & Yusuf Leblebici, "CMOS Digital Integrated Circuits Analysis And Design", Mcgraw-Hill, 1998
4. Jan Rabaey, Anantha Chandrakasan, B Nikolic, " Digital Integrated Circuits: A Design Perspective", Prentice Hall Of India, 2nd Edition, Feb 2003

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1		1	1		
2	1		2	1		
3	1		1	1		
4	1		2	1		
5	1		1	1		
Avg	(5/5)=1		(7/5)=1.4	(5/5)=1		

VE4151 **EMBEDDED CONTROLLERS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To study the architecture and programming of PIC microcontrollers.
- To learn interfacing with PIC microcontrollers.
- To understand the ARM processor architecture.
- To program using ARM Instruction Set.
- To design and develop embedded applications.

UNIT I PIC MICROCONTROLLER – ARCHITECTURE 9

RISC Vs CISC Architectures – PIC Architecture and Assembly Language Programming - Program Memory Organization- Branch, Call and Time Delay Loop - PIC I/O Port Programming - Arithmetic and Logic Instructions and Programs - PIC Bank Switching, Table Processing, Macros And Modules PIC Configuration Registers-PIC Hardware Connection-ROM Loaders.

UNIT II PIC INTERFACING 9

PIC Timer / Counter Programming - Timers 0 And 1- Programming Timers 2 and 3 -Serial Port Programming -Interrupt Programming -Flash / EEPROM Programming - Standard and Enhanced CCP Modules -Compare Mode Programming - Capture Mode Programming- PWM Programming- ECCP Programming.

UNIT III ARM ARCHITECTURE 9

Introduction to ARM Processor families – Pipeline- ARM7TDMI Programmers Model- Processor Modes-Program Status Registers - Vector Table- Assembler Rules and Directives - Predefined Register Names – Macros – Assembler – Operators – Literals - Load and Store Instructions - Operand Addressing – Endianness - Arm Rotation Scheme - Loading Constants and Addresses into Registers.

UNIT IV ARM PROGRAMMING 9

ARM Instruction Set - Data Processing Instructions – Branch Instructions -– Load Store Instructions – Software Interrupt Instruction – Program Status Register Instructions – Conditional Execution - Thumb Instruction Set-Thumb Programmers Model-Thumb Branch Instructions-Thumb Data Processing Instructions-Thumb Single Register Data Transfer- Thumb Multiple Register Data Transfer Instructions - Thumb Implementation.

UNIT V EMBEDDED APPLICATIONS 9

ADC, DAC and Sensor Interfacing –LCD and Keyboard Interfacing -Calculator with Keypad – Relays and Optoisolators - Stepper Motor Interfacing - DC Motor Interfacing - PWM Motor Control with CCPDC - Motor Control With ECCP.

SUGGESTED ACTIVITIES:

1: Interfacing PIC microcontrollers with peripherals.
2: Assignments on programming ARM processors.
3: Design embedded systems for real – time applications.

COURSE OUTCOMES:

CO1: Understand the architecture of a PIC microcontroller.
CO2: Program using PIC microcontrollers.
CO3: Program using ARM processors.

CO4: Design interfacing circuits with PIC microcontrollers.
CO5: Design embedded applications to solve real world problems.

TOTAL:45 PERIODS

REFERENCES:

1. Muhammad Ali Mazidi, "PIC Microcontrollers and Embedded Systems using Assembly and C for PIC18 ", Pearson Education, 2016.
2. William Hohl, "ARM Assembly Language", CRC Press, Second Edition, 2015.
3. John B. Peatman, "Design with PIC Microcontrollers", Pearson Education, Singapore – 1998
4. Andrew Sloss, Dominic Symes, and Chris Wright, "ARM System Developer's Guide Designing and Optimizing System", The Morgan Kaufmann Series, 2004.
5. Steve Furber,"ARM System-on-Chip Architecture", Addison- Wesley Professional; ll Edition 2000.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	1	2	2	0
2	1	0	1	2	2	0
3	1	0	1	2	2	0
4	1	0	1	2	2	1
5	1	0	1	2	2	1
Avg	(5/5)=1	(0/0)=0	(5/5)=1	(10/2)=2	(10/2)=2	(2/2)=1

VE4152 EMBEDDED SYSTEM DESIGN L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the design challenges in embedded systems.
- To program the Application Specific Instruction Set Processors.
- To understand the bus structures and protocols.
- To model processes using a state – machine model.
- To design a real time embedded system.

UNIT I EMBEDDED SYSTEM OVERVIEW 9

Embedded System Overview, Design Challenges – Optimizing Design Metrics, Design Methodology, RT-Level Combinational and Sequential Components, Optimizing Custom Components, Optimizing Custom Single-Purpose Processors.

UNIT II GENERAL AND SINGLE PURPOSE PROCESSOR 9

Basic Architecture, Pipelining, Superscalar and VLIW Architectures, Programmer's View, Development Environment, Application-Specific Instruction-Set Processors (ASIPS)

Microcontrollers, Timers, Counters and Watchdog Timer, UART, LCD Controllers and Analog-to-Digital Converters, Memory Concepts.

UNIT III BUS STRUCTURES 9

Basic Protocol Concepts, Microprocessor Interfacing – I/O Addressing, Port and Bus - based I/O, Arbitration, Serial Protocols, I2C, CAN and USB, Parallel Protocols – PCI and ARM bus, Wireless Protocols – IRDA, Bluetooth, IEEE 802.11.

UNIT IV STATE MACHINE AND CONCURRENT PROCESS MODELS 9

Basic State Machine Model, Finite-State Machine with Data path Model, Capturing State Machine in Sequential Programming Language, Program-State Machine Model, Concurrent Process Model, Communication among Processes, Synchronization among processes, RTOS – System design using RTOS.

UNIT V SYSTEM DESIGN 9

Burglar alarm system-Design goals -Development strategy-Software development-Relevance to more complex designs- Need for emulation -Digital echo unit-Creating echo and reverb-Design requirements-Designing the codecs -The overall system design

SUGGESTED ACTIVITIES:

1: Do microcontroller based design experiments.
2: Create program –state models for different embedded applications.
3: Design and develop embedded solutions for real world problems.

COURSE OUTCOMES:

CO1: Knowledge of different protocols
CO2: Apply state machine techniques and design process models.
CO3: Apply knowledge of embedded sotware development tools and RTOS
CO4: Apply networking principles in embedded devices.
CO5: Design suitable embedded systems for real world applications.

TOTAL:45 PERIODS

REFERENCES:

1. Frank Vahid and Tony Gwargie, “Embedded System Design”, John Wiley & Sons, 2009.
2. Steve Heath, “Embedded System Design”, Elsevier, Second Edition, 2004.
3. Bruce Powel Douglas, “Real Time UML, Second Edition: Developing Efficient Objects for Embedded Systems”, 3rd Edition 2004, Pearson Education
4. Daniel W.Lewis, “Fundamentals of Embedded Software where C and Assembly Meet”, Pearson Education, 2004
5. Bruce Powel Douglas, “Real Time UML; Second Edition: Developing Efficient Objects for Embedded Systems”, 3rd Edition 1999, Pearson Education.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	2	2	3	1
2	1	0	2	2	3	1

3	1	0	2	2	3	1
4	1	0	2	2	3	1
5	1	0	2	2	3	1
Avg	(5/5)=1	(0/0)=0	(10/5)=2	(10/5)=2	(15/5)=3	(5/5)=1

VE4111 EMBEDDED SYSTEMS LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVES:

- To interface sensors and display devices with microcontroller.
- To program timers and UART in a microcontroller.
- To understand I2C and CAN protocols.
- To understand concepts of scheduling, semaphores and deadlocks using RTOS.
- To design a real – time data acquisition system.

LIST OF EXPERIMENTS:

1: Interfacing sensors and actuators with microcontroller.
2**:** Configuration and programming timers and UART in microcontroller.
3: Interfacing LCD and OLED display modules with microcontroller.
4: Simulation of I2C and CAN protocols.
5: Simple task scheduling using freeware RTOS.
6: Exploration on semaphores, deadlocks using RTOS.
7: Exploration of any one SOC architecture using RTOS.
8: Study of Edge AI platform on any one of the embedded processors.
9: Design of a real – time data acquisition system and control using a microcontroller.
10. Design of an IoT based system.

HARDWARE/SOFTWARE REQUIREMENTS

1: Any microcontroller
2: RTOS Freeware

COURSE OUTCOMES:

CO1: Interface a microcontroller with input – output devices.
CO2: Understand I2C and CAN protocols.
CO3: Explore concepts in RTOS.
CO4: Design a real – time embedded system.
CO5: Analyse design requirements of an IoT based system.

TOTAL:60 PERIODS

REFERENCES

1. Frank Vahid and Tony Gwargie, “Embedded System Design”, John Wiley & Sons, 2009.
2. Steve Heath, “Embedded System Design”, Elsevier, Second Edition, 2004.
3. Bruce Powel Douglas, “Real Time UML, Second Edition: Developing Efficient Objects for Embedded Systems”, 3rd Edition 2004, Pearson Education
4. Daniel W.Lewis, “Fundamentals of Embedded Software where C and Assembly Meet”, Pearson Education, 2004

5. Bruce Powel Douglas, “Real Time UML; Second Edition: Developing Efficient Objects for Embedded Systems”, 3rd Edition 1999, Pearson Education.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	1	1	1	1	1
2	1	1	1	1	1	1
3	1	1	1	1	1	1
4	1	1	1	1	1	1
5	1	1	1	1	1	1
Avg	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1	1

VE4112 ANALOG AND DIGITAL CMOS VLSI DESIGN LABORATORY **L T P C**
0 0 4 2

COURSE OBJECTIVES:

- To learn the principles of CMOS amplifiers
- To design single stage and multistage amplifiers and their design constrains
- To learn Hardware Descriptive Language(Verilog/VHDL)
- To learn the fundamental principles of VLSI circuit design in digital domain
- To familiarize programming on FPGAs
- To understand the critical design issues of digital logic design

LIST OF EXPERIMENTS:

Part I: Module Design and Simulation using SPICE simulator

1. Design of Common Source Amplifier
2. Design of Cascade and Cascode amplifiers
3. Design of current Mirrors
4. Design of differential pair amplifier with active load
5. Design of telescopic amplifier circuit
6. Design of two-stage amplifier circuit

Part Ii: Module Design using FPGA Implementation (Verilog/VHDL):

1. Adders and Subtractors
2. Multiplier (8-bit)
3. ALU circuit
4. Flip-flops
5. Universal Shift Registers
6. Asynchronous and synchronous Counters

7. Finite State Machine (Moore/Mealy) and its applications
8. Memories

TOTAL: 60 PERIODS

COURSE OUTCOMES:

On successful completion of this course, students will be able to

CO1: Design digital and analog Circuit using CMOS given a design specification.

CO2: Design and carry out time domain and frequency domain simulations of simple analog building blocks, study the pole zero behaviors and compute the input/output impedances

CO3: Use EDA tools for Circuit Design

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	1	1	1	1	1
2	1	1	1	1	1	1
3	1	1	1	1	1	1
4	1	1	1	1	1	1
5	1	1	1	1	1	1
Avg	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1

VL4251 DESIGN FOR VERIFICATION USING UVM L T P C

3 0 0 3

COURSE OBJECTIVES:

- To provide the students complete understanding on UVM testing
- To become proficient at UVM verification,
- To provide an experience on self checking UVM testbenches

UNIT I INTRODUCTION 9

Overview- The Typical UVM Testbench Architecture- The UVM Class Library-Transaction-Level Modeling (TLM) -Overview- TLM, TLM-1, and TLM-2.0 -TLM-1 Implementation- TLM-2.0 Implementation

UNIT II DEVELOPING REUSABLE VERIFICATION COMPONENTS 9

Modeling Data Items for Generation - Transaction-Level Components - Creating the Driver - Creating the Sequencer - Connecting the Driver and Sequencer -Creating the Monitor - Instantiating Components- Creating the Agent - Creating the Environment -Enabling Scenario Creation -Managing of Test-Implementing Checks and Coverage

UNIT III UVM USING VERIFICATION COMPONENTS 9

Creating a Top-Level Environment- Instantiating Verification Components - Creating Test Classes - Verification Component Configuration - Creating and Selecting a User-Defined Test - Creating Meaningful Tests- Virtual Sequences- Checking for DUT Correctness- Scoreboards- Implementing a Coverage Model

UNIT IV UVM USING THE REGISTER LAYER CLASSES 9

Using The Register Layer Classes - Back-Door Access -Special Registers -Integrating a Register-Model in a Verification Environment- Integrating a Register Model- Randomizing Field Values- Pre-Defined Sequences

UNIT V ASSIGNMENT IN TESTBENCHES 9

Assignment, APB: Protocol, Test bench Architecture, Driver and Sequencer, Monitor, Agent and Env; Creating Sequences, Building Test, Design and Testing of Top Module.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1:understand the basic concepts of two methodologies UVM

CO2:build actual verification components.

CO3:generate the register layer classes.

CO4:code testbenches using UVM.

CO5:understand advanced peripheral bus testbenches.

REFERENCES

1. The UVM Primer, An Introduction to the Universal Verification Methodology, Ray Salemi, 2013.
2. SystemVerilog for Verification: A Guide to Learning the Testbench Language Features, Chris Spear, Greg Tumbush, 3rd edition, 2012.
3. https://www.udemy.com/learn-ovm-UVM/ 2.
4. http://www.testbench.in/ut_00_index.html 3.
5. http://www.testbench.in/ot_00_index.html
6. https://www.accellera.org/images/downloads/standards/UVM/UVM_users_guide_1.2.pdf

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	1	1	3	0
2	1	0	1	1	2	0
3	1	0	1	1	2	0
4	1	0	1	1	2	0
5	1	0	1	1	2	0
Avg	(5/5)=1	(0/0)=0	(5/5)=1	(5/5)=1	(11/5)=2.5	(0/0)=0

VE4201 **FPGA SYSTEM DESIGN** **L T P C**
3 0 2 4

COURSE OBJECTIVES:

- Students can understand the concepts of FPGA and the need for FPGA in embedded.
- the course is to provide a thorough understanding about and hands-on practice with FPGA based digital system design and emulation
- To make the student learn, FPGA fundamentals, design and implementation of Circuits In Them
- Understanding the Role of FPGAs and ASIC In Embedded Systems

UNIT I FPGA ARCHITECTURE AND OVERVIEW 9

Embedded System Design Flow - Robot Control System - Digital Design Platforms - Microprocessor Based Design - Single-Chip Computer/Microcontroller-Based Design - Application Specific Standard Products (ASSPs) - Design Using FPGA - Robotic Rover Application - FPGA Devices - FPGA and CPLD – Architecture of a Spartan-3 ETM FPGA - Floor Plan and Routing - Timing Model for a FPGA - FPGA Power Usage.

UNIT II EMBEDDED SYSTEM DESIGN 9

FPGA-Based Embedded Processor - Design Re-Use Using On-Chip Bus Interface - Creating a Customized Microcontroller - Robot Axis Position Control - FPGA-Based Signal Interfacing And Conditioning – Motor Control Using FPGA- Case Studies for Motor Control -Prototype using FPGA- FPGA Design Test Methodology

UNIT III VERILOG CONSTRUCTS 9

VLSI Design Flow- Behavioral Style, the Dataflow Style, And Structural Style - Data Types - Constants - Assignment Statement - Operators - Conditional Expressions – Statement Types - Vector Operations – Bit Selects - Functions - Gate Level Modeling

UNIT IV VERILOG MODELING COMBINATIONAL CIRCUITS 9

Combinational Logic -Adders - Multiplexers - Decoders -Comparator -Parity Generators ALU – Three State Gate - UART Model.

UNIT V VERILOG MODELLING SEQUENTIAL CIRCUITS 9

Modelling Latches and Flip Flops-- Sequential Logic - Memory - Registers-Counters Modeling FSM Design Synchronous And Asynchronous - Shift Register- Test Bench Verification. Stepper Motor Control, Servo Motor Control.

TOTAL:45 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Design Entry Using VHDL Or Verilog Using HDL Languages of
   I. Combinational Circuits Namely 8:1 Mux/Demux, Full Adder, 8-Bit Magnitude Comparator, Encoder/Decoder, Priority Encoder.
   Ii. Sequential Circuits Namely D-FF, 4-Bit Shift Registers (SISO, SIPO, PISO, Bidirectional), 3-Bit Synchronous Counters.

2. Test Vector Generation And Timing Analysis of Sequential And Combinational Logic Design for exercise (1) above.
3. Synthesis, P&R And Post P&R Simulation of the Components Simulated In (1) Above.
4. FPGA Implementation of PCI Bus & Arbiter. .
5. Verifying Design Functionality Using Either Chipscope Feature (Xilinx) /the Signal Tap Feature (Altera)/Other Equivalent Feature . Invoke the PLL And Demonstrate the Use of the PLL Module for Clock Generation in FPGAs.

TOTAL:45+30=75 PERIODS

COURSE OUTCOMES:

CO1: students can learn the concepts of FPGA.
CO2: students can design embedded system with appropriate FPGA based on applications
CO3: students can write verilog code for combinational and sequential logics
CO4: students can design a combinational circuit using Verilog.
CO5: students can use FPGA EDA tools for design and analysis.

REFERENCES

1. Rahul Dubey, "Introduction to Embedded System Design Using Field Programmable Gate Arrays" Springer-Verlag London Limited, 2009
2. John F. Wakerly, Digital Design Principles And Practices", Pearson Education, Asia, Iii Edition, 2003.
3. Blaine Readler, "Verilog By Example: a Concise Introduction for FPGA Design", Full ARC Press,2011.
4. J. Bhasker, "a Verilog HDL Primer, Third Edition Hardcover", Star Galaxy Publishing; 3rd Edition, 2005
5. J.Bhasker, "Verilog HDL Synthesis, a Practical Primer", Star Galaxy Publishing; 3rd Edition,1998.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	1	1	0	0
2	1	0	1	1	1	3
3	1	1	1	1	1	3
4	1	1	1	1	1	3
5	1	0	1	1	1	3
Avg	(5/5)=1	(2/2)=1	(5/5)=1	(5/5)=1	(5/5)=1	(12/4)=3

VE4202 **EMBEDDED AUTOMATION** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To learn about the process involved in the design and development of real-time embedded system
- To develop the embedded C programming skills on 8-bit microcontroller
- To study about the interfacing mechanism of peripheral devices with 8-bit microcontrollers
- To learn about the tools, firmware related to microcontroller programming
- To build a home automation system

UNIT - I INTRODUCTION TO EMBEDDED C PROGRAMMING 9

C Overview and Program Structure - C Types, Operators and Expressions - C Control Flow - C Functions and Program Structures - C Pointers And Arrays - FIFO and LIFO - C Structures - Development Tools

UNIT - II AVR MICROCONTROLLER 9

ATMEGA 16 Architecture - Nonvolatile and Data Memories - Port System - Peripheral Features : Time Base, Timing Subsystem, Pulse Width Modulation, USART, SPI, Two Wire Serial Interface, ADC, Interrupts - Physical and Operating Parameters

UNIT – III HARDWARE AND SOFTWARE INTERFACING WITH 8-BIT SERIES CONTROLLERS 9

Lights and Switches - Stack Operation - Implementing Combinational Logic - Expanding I/O - Interfacing Analog To Digital Convertors - Interfacing Digital To Analog Convertors - LED Displays : Seven Segment Displays, Dot Matrix Displays - LCD Displays - Driving Relays - Stepper Motor Interface - Serial EEPROM - Real Time Clock - Accessing Constants Table - Arbitrary Waveform Generation - Communication Links - System Development Tools

UNIT – IV VISION SYSTEM 9

Fundamentals of Image Processing - Filtering - Morphological Operations - Feature Detection and Matching - Blurring and Sharpening - Segmentation - Thresholding - Contours - Advanced Contour Properties - Gradient - Canny Edge Detector - Object Detection - Background Subtraction

UNIT – V HOME AUTOMATION 9

Home Automation - Requirements - Water Level Notifier - Electric Guard Dog - Tweeting Bird Feeder - Package Delivery Detector - Web Enabled Light Switch - Curtain Automation - Android Door Lock - Voice Controlled Home Automation - Smart Lighting - Smart Mailbox - Electricity Usage Monitor -Proximity Garage Door Opener - Vision Based Authentic Entry System

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, students will be able to

CO1: analyze the 8-bit series microcontroller architecture, features and pin details

CO2: write embedded C programs for embedded system application

CO3: design and develop real time systems using AVR microcontrollers

CO4: design and develop the systems based on vision mechanism

CO5: design and develop a real time home automation system

REFERENCES:

1. Dhananjay V. Gadre, "Programming and Customizing the AVR Microcontroller", McGraw-Hill, 2001.
2. Joe Pardue, "C Programming for Microcontrollers ", Smiley Micros, 2005.
3. Steven F. Barrett, Daniel J. Pack, "ATMEL AVR Microcontroller Primer : Programming and Interfacing", Morgan & Claypool Publishers, 2012
4. Mike Riley, "Programming Your Home - Automate With Arduino, Android and Your Computer", the Pragmatic Programmers, Llc, 2012.
5. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2011.
6. Kevin P. Murphy, "Machine Learning - a Probabilistic Perspective", the MIT Press Cambridge, Massachusetts, London, 2012.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1		1	1	1	
2	1	3	1	1	1	3
3	1	3	1	1	1	3
4	1	3	1	1	1	3
5	1	3	1	1	1	3
Avg	(5/5)=1	(12/4)=3	(5/5)=1	(5/5)=1	(5/5)=1	(12/4)=3

VE4203 VLSI STRUCTURES FOR DSP **L T P C 3 0 0 3**

COURSE OBJECTIVES:

- To Understand the Fundamentals of DSP
- To Learn Various DSP Structures And Their Implementation.
- To Know Designing Constraints of Various Filters
- Design And Optimize VLSI Architectures for Basic DSP Algorithms
- To Enable Students To Design VLSI System With High Speed And Low Power.

UNIT I INTRODUCTION TO DIGITAL SIGNAL PROCESSING 9

Linear System Theory- Convolution- Correlation - DFT- FFT- Basic Concepts In FIR Filters And IIR Filters- Filter Realizations. Representation of DSP Algorithms-Block Diagram-SFG-DFG.

UNIT II ITERATION BOUND, PIPELINING AND PARALLEL PROCESSING OF FIR FILTER 9

Data-Flow Graph Representations- Loop Bound and Iteration Bound Algorithms for Computing Iteration Bound-LPM Algorithm. Pipelining and Parallel Processing: Pipelining of FIR Digital Filters Parallel Processing - Pipelining and Parallel Processing for Low Power.

UNIT III RETIMING, UNFOLDING AND FOLDING 9

Retiming: Definitions Properties and Problems- Solving Systems of Inequalities. Properties of Unfolding, Critical Path, Unfolding and Retiming Applications of Unfolding, Folding Transformation- Register Minimization Techniques, Register Minimization In Folded Architecture-Folding of Multirate System.

UNIT IV FAST CONVOLUTION 9

Cook-Toom Algorithm- Modified Cook-Toom Algorithm. Design of Fast Convolution Algorithm By Inspection

UNIT V ARITHMETIC STRENGTH REDUCTION IN FILTERS 9

Parallel FIR Filters-Fast FIR Algorithms-Two Parallel And Three Parallel. Parallel Architectures for Rank Order Filters -Odd Even Merge Sort Architecture-Rank Order Filter Architecture-Parallel Rank Order Filters-Running Order, Merge Order , Sorter , Low Power Rank Order Filter.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course student will be able

CO1: acquired knowledge about fundamentals of DSP processors.

CO2: improve the overall performance of DSP system through various transformation and optimization techniques.

CO3: foster ability to understand the need of different types of instructions for DSP.

CO4: optimize design in terms of computation complexity and speed.

CO5: understand clock based issues and design asynchronous and wave pipelined systems**.**

REFERENCES

1. K.K Parhi: “VLSI Digital Signal Processing”, John-Wiley, 2nd Edition Reprint, 2008.
2. John G.Proakis, Dimitris G.Manolakis, “Digital Signal Processing”, Prentice Hall of India, 1st Edition, 2009.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	1	1	0	0
2	1	0	1	1	0	0
3	1	0	1	1	0	0
4	1	0	1	1	0	0
5	1	0	1	1	0	0
Avg	(5/5)=1	(0/0)=0	(5/5)=1	(5/5)=1	(0/0)=0	(0/0)=0

VE4204 INTERNET OF THINGS SYSTEM DESIGN L T P C
3 0 0 3

COURSE OBJECTIVES:

- the course enables student to understand the basics of Internet of Things and protocols
- This program aims to train students to be equipped with a solid theoretical foundation, systematic professional knowledge and strong practical skills in the IoT platform and system design.
- the course focuses on understanding the vision of IoT from a global perspective, understand its applications, determine its market perspective, using gateways, devices and data management
- To understand the concepts behind building a state of art architecture in IoT.
- the course focuses on applications in commercial building automation and real world design constraints

UNIT I IOT NETWORKING CORE 9

Technologies Involved In IoT Development, Internet Web And Networking Technologies, Infrastructure, Overview of IoT Supported Hardware Platforms Such As: Raspberry Pi, ARM Cortex Processors, Arduino and Intel Galileo Boards, Wireless Networking Equipment and Configurations, Accessing Hardware and Device File Interactions

UNIT II M2M TO IOT 9

Role of M2M In IoT, M2M Value Chains, IoT Value Chains, An Emerging Industrial Structure for IoT, the International Driven Global Value Chain And Global Information Monopolies. Building Architecture, Main Design Principles and Needed Capabilities, An IoT Architecture Outline, Standards Considerations.

UNIT III IOT ARCHITECTURE -STATE OF THE ART 9

IoT Reference Model And Architecture- Functional View, Information View, Deployment and Operational View, Other Relevant Architectural Views, Middleware Introduction-Fiware etc., Remote Monitoring and Sensing, Remote Controlling And Performance Analysis, Layering Concepts, Communication Pattern, 6LoWPAN, Sensors And Sensor Node And Interfacing Using any Embedded Target Boards (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino

UNIT IV IOT APPLICATION DEVELOPMENT 9

Application Protocols: MQTT, Rest/Http, COAP, MYSQL, Back-End Application Designing Apache for Handling Http Requests, MONGODB Object Type Database, HTML, CSS & JQUERY for UI Designing, JSON Lib for Data Processing, Security & Privacy During Development

UNIT V IOT SECURITY AND CASE STUDIES 9

Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities.

TOTAL:45 PERIODS

COURSE OUTCOMES

At the end of this course, the students should will be able to:

CO1:study of basic structure lying in IoT

CO2: understand challenges in Internet of Things (IoT) system design

CO3: understand distributed embedded system hardware.

CO4: understand specifications and modeling approaches for real-time and IoT systems

CO5: obtain knowledge of IoT applications

REFERENCES

1. Vijay Madisetti and Arshdeepbahga, “Internet of Things (a Hands-On-Approach)”, 1 St Edition, Vpt, 2015

2. Adrian Mcewen, Hakim Cassimally, “Designing the Internet of Things”, November 2013, John Wiley And Sons.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	1	1	0	0
2	1	0	1	1	0	0
3	1	0	1	1	0	0
4	1	0	1	1	0	0
5	1	0	1	1	0	0
Avg	(5/5)=1	(0/0)=0	(5/5)=1	(5/5)=1	(0/0)=0	(0/0)=0

VE4211 TERM PAPER WRITING AND SEMINAR L T P C
0 0 2 1

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analysing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained.

Activities to be carried out

Activity	Instructions	Submission week	Evaluation
Selection of area of interest and Topic Stating an Objective	You are requested to select an area of interest, topic and state an objective	2nd week	**3 %** Based on clarity of thought, current relevance and clarity in writing
Collecting Information about your area & topic	1. List 1 Special Interest Groups or professional society 2. List 2 journals 3. List 2 conferences, symposia or workshops 4. List 1 thesis title 5. List 3 web presences (mailing lists, forums, news sites) 6. List 3 authors who publish regularly in your area 7. Attach a call for papers (CFP) from your area.	3rd week	**3%** (the selected information must be area specific and of international and national standard)
Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter	• You have to provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar • When picking papers to read - try to: • Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them, • Favour papers from well-known journals and conferences, • Favour "first" or "foundational" papers in the field (as indicated in other people's survey paper), • Favour more recent papers, • Pick a recent survey of the field so you can quickly gain an overview, • Find relationships with respect to each other and to your topic area (classification scheme/categorization) • Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered	4th week	**6%** (the list of standard papers and reason for selection)
Reading and notes for first 5	Reading Paper Process • For each paper form a Table	5th week	**8%** (the table given

papers	answering the following questions: • What is the main topic of the article? • What was/were the main issue(s) the author said they want to discuss? • Why did the author claim it was important? • How does the work build on other's work, in the author's opinion? • What simplifying assumptions does the author claim to be making? • What did the author do? • How did the author claim they were going to evaluate their work and compare it to others? • What did the author say were the limitations of their research? • What did the author say were the important directions for future research? Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)		should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for next5 papers	Repeat Reading Paper Process	6th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for final 5 papers	Repeat Reading Paper Process	7th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	8th week	**8%** (this component will be evaluated based on the linking and classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	9th week	**6%** (Clarity, purpose and conclusion) **6%** Presentation &

			Viva Voce
Introduction Background	Write an introduction and background sections	10th week	**5%** (clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11thweek	**10%** (this component will be evaluated based on the linking and classification among the papers)
Your conclusions	Write your conclusions and future work	12th week	**5%** (conclusions – clarity and your ideas)
Final Draft	Complete the final draft of your paper	13th week	**10%** (formatting, English, Clarity and linking) **4%** Plagiarism Check Report
Seminar	A brief 15 slides on your paper	14th & 15th week	**10%** (based on presentation and Viva-voce)

TOTAL: 30 PERIODS

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	1	1	1	1	1
2	1	1	1	1	1	1
3	1	1	1	1	1	1
4	1	1	1	1	1	1
5	1	1	1	1	1	1
Avg	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1

VE4212 EMBEDDED AUTOMATION LABORATORY **L T P C**
0 0 4 2

COURSE OBJECTIVES:

- To learn about the design and development of different automation systems
- To enhance the embedded C programming skills
- To study about the interfacing mechanism of peripheral devices with microcontrollers
- To improve the programming skills related to computer vision
- To build a home automation system

LIST OF EXPERIMENTS:

1. Water level controller
2. Unauthorized entry identifier
3. Tweeting bird feeder
4. Package delivery detector
5. Web enabled light switch
6. Curtain automation
7. Android door lock
8. Voice controlled home automation
9. Smart lighting
10. Smart mailbox
11. Proximity garage door opener
12. Wi Fi Managed Vehicle Parking and Theft Control

TOTAL: 60 PERIODS

COURSE OUTCOMES:

On successful completion of this course, students will be able to

CO1: design and develop real time systems using microcontrollers

CO2: design and develop the systems based on vision mechanism

CO3: to be able to build large, complex systems

CO4: design and develop a real time home automation system

CO5: students should be able to know the different embedded tools

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	1	1	1	1	1
2	1	1	1	1	1	1
3	1	1	1	1	1	1
4	1	1	1	1	1	1
5	1	1	1	1	1	1
Avg	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1

VL4071 **ASIC DESIGN** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To Focus on the Semi-Custom IC Design and introduces the Principles of Design Logic Cells, I/O Cells and Interconnect Architecture, with Equal Importance given to FPGA and ASIC styles.
- To deal with the entire FPGA and ASIC Design Flow from the Circuit and Layout Design Point of View

UNIT I INTRODUCTION TO ASICS, CMOS LOGIC AND ASIC LIBRARY DESIGN **9**

Types of Asics - Design Flow - CMOS Transistors - Combinational Logic Cell – Sequential Logic Cell - Data Path Logic Cell - Transistors as Resistors - Transistor Parasitic Capacitance- Logical Effort.

UNIT II PROGRAMMABLE ASICS, PROGRAMMABLE ASIC LOGIC CELLS AND PROGRAMMABLE ASIC I/O CELLS **9**

Anti Fuse - Static Ram - EPROM and EEPROM Technology - ACTEL ACT- Xilinx LCA – ALTERA FLEX - ALTERA MAX DC & AC Inputs and Outputs - Clock & Power Inputs - Xilinx I/O Blocks.

UNIT III PROGRAMMABLE ASIC ARCHITECTURE **9**

Architecture and Configuration of ARTIX / Cyclone and KINTEX Ultra Scale / STRATIX FPGA – Micro-Blaze / NIOS Based Embedded Systems – Signal Probing Techniques.

UNIT IV LOGIC SYNTHESIS, PLACEMENT AND ROUTING **9**

Logic Synthesis - Floor Planning Goals and Objectives, Measurement of Delay in Floor Planning, Floor Planning Tools, I/O and Power Planning, Clock Planning, Placement Algorithms. Routing: Global Routing, Detailed Routing, Special Routing.

UNIT V SYSTEM-ON-CHIP DESIGN **9**

SoC Design Flow, Platform-Based and IP Based SoC Designs, Basic Concepts of Bus-Based Communication Architectures, High Performance Filters using Delta-Sigma Modulators. Case Studies: Digital Camera, SDRAM, High Speed Data standards.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be

CO1: able to apply Logical Effort Technique for predicting Delay, Delay Minimization and FPGA Architectures

CO2: able to Design Logic Cells and I/O Cells

CO3: able to analyze the various resources of recent FPGAs

CO4: able to use Algorithms for Floor Planning and Placement of Cells and to Apply Routing Algorithms for Optimization of Length and Speed.

CO5: able to analyze High Performance Algorithms Available for ASICs

REFERENCES

1. M.J.S.Smith, "Application Specific Integrated Circuits", Pearson, 2003.
2. Steve Kilts, “Advanced FPGA Design,” Wiley Inter-Science,2006
3. Roger Woods, John Mcallister, Dr. Ying Yi, Gaye Lightbod, “FPGA-Based Implementation of Signal Processing Systems”, Wiley, 2008.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	1	1	0	0

2	1	0	1	1	0	0
3	1	0	1	1	0	0
4	1	0	1	1	0	0
5	1	0	1	1	0	0
Avg	(5/5)=1	0	(5/5)=1	(5/5)=1	0	0

VE4001 PARALLEL AND RECONFIGURABLE ARCHITECTURES **L T P C**
3 0 0 3

COURSE OBJECTIVE:

- To Educate the Students to the Fundamentals of Parallel Processing
- To Teach the Fundamentals of Network Topologies for Multiprocessors
- To Introduce Different Pipeline Designs
- To Introduce Features of Parallel Processors , Memory Technologies, OS for Multi-programmed Computer
- To Involve Discussions/ Practice/Exercise Onto Revising & Familiarizing the Concepts Acquired Over the 5 Units of the Subject for Improved Employability Skills

UNIT - I THEORY OF PARALLELISM **9**

Parallel Computer Models – the State of Computing-Introduction to Parallel Processing-Parallelism in Uniprocessor & Multiprocessors, Parallel Architectural Classification Schemes-Speedup Performance Laws- -Program and Network Properties-H/W-S/W Parallelism.

UNIT - II SYSTEM INTERCONNECT ARCHITECTURES **9**

Integration – FPGA Design Flow – Logic Synthesis – LUT Based Technology Mapping – Modeling – Temporal Partitioning Algorithms – Offline and Online Temporal Placement – Managing Device's Free and Occupied Spaces.

UNIT – III PIPELINING AND SUPERSCALAR TECHNOLOGIES **9**

Pipeline Principle and Implementation-Classification of Pipeline Processor - Introduction of Arithmetic, Instruction, Processor Pipelining-Pipeline Mechanisms-Hazards.

UNIT – IV HARDWARE TECHNOLOGIES **9**

Introduction to Features of Advanced Embedded Processors through basic comparative study: of Architectures -Addressing Modes -Instruction Types performance of- Parallel and Scalable Architectures, Multiprocessor and SIMD, MIMD Computers, RISC, CISC, Superscalar, VLIW , Vector, Systolic Processors of their unique features -scalable, Multithreaded and Dataflow Architectures inter PE Communication-Interconnection Networks- Array & Vector Processors, Vector Instruction Types Performance Modeling-Design of Vectorising Compiler- Case Architecture of Itanium Processor, Pentium Processor, SPARC Processor

UNIT – V OS ISSUES FOR MULTI PROCESSOR **9**

Introduction-Need for Preemptive OS – Synchronising and Scheduling in Multiprocessor OS-, usual OS Scheduling Techniques, Threads – Classification of Multiprocessor OS – Software Requirements of Multiprocessor OS, Distributed Scheduler – PVM – PT Threads in Shared Memory Systems.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be

CO1: Able to understand the operations of Multiprocessor and Multicomputer Systems.

CO2: Able to understand the various Advanced Processor Technology, Pipelining and Scalable Architectures.

CO3: Able to know the working of Superscalar Pipeline, Cache Memory Organization.

CO4: Able to understand the principles of Multithreading, Multi Thread Architecture, Static and Dynamic Dataflow.

CO5: To improve employability and entrepreneurship capacity due to knowledge upgradation on recent trends in Embedded Systems Design.

REFERENCES

1. Kai Hwang "Advanced Computer Architecture".Tata Mcgraw Hill
2. Rajiv Chopra, 'Advanced Computer Architecture" S Chand , 2010
3. John L. Hennessy, David A. Petterson, "Computer Architecture: A Quantitative Approach", 4thedition, Elsevier, 2007
4. Dezsosima, Terence Fountain, Peter Kacsuk, "Advanced Computer Architecture – A Designspace Approach". Pearson Education,2003.
5. Sajjan G. Shiva "Advanced Computer Architecture", Taylor & Francis, 2008

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	1	1	0	0
2	1	0	1	1	0	0
3	1	0	1	1	0	0
4	1	0	1	1	0	0
5	1	0	1	1	0	0
Avg	(5/5)=1	0	(5/5)=1	(5/5)=1	0	0

VE4002 SOFTWARE FOR EMBEDDED SYSTEMS **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To Expose the Students to the fundamentals of Embedded Programming
- To introduce the GNU C Programming Tool Chain in Linux.
- To study the basic Concepts of Embedded C.
- To teach the basics of Python Programming
- To involve Discussions/ Practice/Exercise onto Revising & familiarizing the concepts acquired over the 5 units of the subject for Improved Employability Skills.

UNIT I BASIC C PROGRAMMING 9

Typical C Program Development Environment - Introduction to C Programming – Structured Program Development in C - Data Types and Operators - C Program Control - C Functions - Introduction to Arrays.

UNIT II EMBEDDED C 9

Adding Structure to 'C' Code: Object Oriented Programming with C, Header Files for Project and Port, Examples. Meeting Real-Time Constraints: Creating Hardware Delays - Need for Timeout Mechanism - Creating Loop Timeouts - Creating Hardware Timeouts.

UNIT III C PROGRAMMING TOOL-CHAIN IN LINUX 9

C Preprocessor - Stages of Compilation - Introduction to GCC - Debugging with GDB - the Make Utility - GNU Configure and Build System - GNU Binary Utilities - Profiling - Using GPROF - Introduction to GNU C Library.

UNIT IV PYTHON PROGRAMMING 9

Introduction - Parts of Python Programming Language - Control Flow Statements - Functions - Strings - Lists - Dictionaries - Tuples and Sets.

UNIT V MODULES, PACKAGES AND LIBRARIES IN PYTHON 9

Python Modules and Packages - Creating Modules and Packages - Practical Example – Libraries for Python - Library for Mathematical Functionalities and Tools - Numerical Plotting Library – GUI Libraries for Python - Imaging Libraries for Python – Networking Libraries.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be

CO1: able to understand C Programming and its Salient Features for Embedded Systems

CO2: able to learning Process Delivers Insight Into Various Programming Languages/Software Compatible to Embedded Process Development with Improved Design & Programming Skills.

CO3: able to develop knowledge on C Programming in Linux environment.

CO4: able to write Python Programming for Embedded applications.

CO5: able to improve Employability and Entrepreneurship Capacity due to knowledge upgradation on recent trends in Embedded Programming Skills.

REFERENCES

1. Paul Deitel and Harvey Deitel, "C How to Program", 8th Edition, Pearson Education Limited, 2016.
2. Michael J Pont, "Embedded C", Addison-Wesley, An Imprint of Pearson Education, 2002.
3. William Von Hagen, "the Definitive Guide to GCC", 2nd Edition, Apress Inc., 2006.
4. Gowrishankar S and Veena A, "Introduction to Python Programming", CRC Press, Taylor & Francis Group, 2019
5. John Paul Mueller, "Beginning Programming with Python for Dummies", 2nd Edition, John Wiley & Sons Inc., 2018.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	1	1	3	0
2	1	0	1	1	2	0
3	1	0	1	1	2	0
4	1	0	1	1	2	0
5	1	0	1	1	2	3
Avg	(5/5)=1	(0/0)=0	(5/5)=1	(5/5)=1	(11/5)=2.1	(3/1)=3

VE4003 EMBEDDED SYSTEM SECURITY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce Embedded Security issue. Security Major Concerns Data, Design and System Protection.
- To learn Cryptographic Concepts in the Context of Embedded Systems and their Unique Constraints and Requirements.
- To expose Forensics Procedures and Digital Data Acquisition Mechanisms using FKT and FRED

UNIT I INTRODUCTION 9

the CIA Triad, Identification, Authentication and Authorization, Security Principles and Models. Network Attacks - Types and Sources, Architecture Security, Secure Network Design, Firewalls, Introduction to Intrusion Controls (IDS/IPS), Introduction to Wireless LAN Security Standards, the One-Time Pad, Cryptographic Modes, Block Ciphers, Authenticated Encryption, Public Key Cryptography, Key Agreement, Public Key Authentication

UNIT II EMBEDDED CRYPTOGRAPHY 9

Elliptic Curve Cryptography, Cryptographic Hashes, Message Authentication Codes, Random Number Generation, Key Management for Embedded Systems, Cryptographic Certifications. Introduction to Data Protection Protocols for Embedded Systems. Internet Security for Embedded Systems, IPsec., **Data at-Rest Protocols.**

UNIT III EMBEDDED SYSTEMS SECURITY REQUIREMENTS AND ISSUES 9

Embedded System Security Requirements and Issues, Embedded Software Attacks and Countermeasures, Hardware Security in Embedded Systems, Secured Hardware Architectures for Embedded Systems, Tamper- Resistant Hardware, Introduction to Trust Models for Secure Embedded Hardware and Software Embedded Processing Architectures for Security, Communications Security in Embedded Systems.

UNIT IV DIGITAL FORENSICS 9

The Six A's, Forensic Types: Disk Forensics, Network Forensics, Mobile Device Forensics, Live Forensics, Memory Forensics, Multimedia Forensics, Internet Forensics, Cyber Crime Investigations and Digital Forensics, Disk Based Forensics, Cybercrime, Forensic Process and Methodology, Digital Evidence, Incident Response, Searching and Analysis Tools, Email & Browsers, Intrusion Detection, Attack Trace-Back, Packet Inspection, Log Analysis, Hashing Issues, Anti-Forensics (Encryption and Stealth Techniques), Forensics in Embedded Systems.

UNIT V PRACTICE WITH FORENSIC TOOLS 9

Data Acquisition Hardware Tools, Use Fred to Create Images on Different Media, Recovering the Deleted Files, Investigative Tools (Open Source and Proprietary), Using Forensic Software Such as FTK/Encase Etc. Use FTK Preview Evidence, Export Evidence Files, Create Forensic Images and Convert Existing Images, Create a Case in FTK, Use FTK to Process and Analyze Documents, Metadata, Graphics and E-Mail, Use the FTK Data Carving Feature to Recover Files from Unallocated Disk Space. Web/E-Mail Forensics analysis, Mobile Evidence, Extracting and Analysing Mobile Evidence.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, students will demonstrate the ability to:

CO1: Recognize vulnerabilities, attacks and need of protection mechanisms for embedded systems

CO2: Analyze and evaluate software vulnerabilities and attacks on Operating Systems

CO3: Identify terms/concepts relevant to Embedded Cryptography.

CO4: Develop and deploy solutions for Security of Embedded Software and Data Protection.

REFERENCES

1. David Kleidermacher, Mike Kleidermacher, Embedded Systems Security - Practical Methods for Safe and Secure Software and Systems Development, Newnes, Elsevier, 2012.
2. Charlie Kaufman, Radia Perlman, and Mike Speciner, Network Security: Private Communication in a Public World, Prentice Hall,1995
3. Francine Krief (Editor), Communicating Embedded Systems: Networks Applications, Wiley, 2013.
4. John Sammons, Digital Forensics with the Access data Forensic Toolkit (FTK), McGraw Hill Companies,2016
5. CEH: Certified Ethical Hacker Version 8 Study Guide By Sean-Philip Oriyano (Author) Publisher Sybex,2014

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	2	2	1	0
2	1	0	2	2	1	0
3	1	0	2	2	1	0
4	1	0	2	2	1	0

5	1	0	2	2	1	0
Avg	(5/5)=1	0	(10/5)=2	(10/5)=2	(5/5)=1	0

VL4252 VLSI TESTING L T P C
3 0 0 3

COURSE OBJECTIVES:

- to introduce the VLSI testing.
- to introduce logic and fault simulation and testability measures
- to study the test generation for combinational and sequential circuits
- to study the design for testability.
- to study the fault diagnosis

UNIT I INTRODUCTION TO TESTING 9

Introduction – VLSI Testing Process and Test Equipment – Challenges in VLSI Testing - Test Economics and Product Quality – Fault Modeling – Relationship Among Fault Models.

UNIT II LOGIC & FAULT SIMULATION & TESTABILITY MEASURES 9

Simulation for Design Verification and Test Evaluation – Modeling Circuits for Simulation – Algorithms for True Value and Fault Simulation – Scoap Controllability and Observability

UNIT III TEST GENERATION FOR COMBINATIONAL AND SEQUENTIAL CIRCUITS 9

Algorithms and Representations – Redundancy Identification – Combinational ATPG Algorithms – Sequential ATPG Algorithms – Simulation Based ATPG – Genetic Algorithm Based ATPG

UNIT IV DESIGN FOR TESTABILITY 9

Design for Testability Basics – Testability Analysis - Scan Cell Designs – Scan Architecture – Built-in Self-Test – Random Logic Bist – DFT for Other Test Objectives.

UNIT V FAULT DIAGNOSIS 9

Introduction and Basic Definitions – Fault Models for Diagnosis – Generation of Vectors for Diagnosis – Combinational Logic Diagnosis - Scan Chain Diagnosis – Logic BIST Diagnosis.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students should will be able to:

CO1: Understand VLSI Testing Process
CO2:Develop Logic Simulation and Fault Simulation
CO3: Develop Test for Combinational and Sequential Circuits
CO4: Understand the Design for Testability
CO5: Perform Fault Diagnosis.

REFERENCES

1. Laung-Terng Wang, Cheng-Wen Wu and Xiaoqing Wen, “VLSI Test Principles and Architectures”, Elsevier, 2017
2. Michael L. Bushnell and Vishwani D. Agrawal, “Essentials of Electronic Testing for Digital, Memory & Mixed-Signal VLSI Circuits” , Kluwer Academic Publishers, 2017.

3. Niraj K. Jha and Sandeep Gupta, “Testing of Digital Systems”, Cambridge University Press, 2017.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	2	0	2	3	3	0
2	2	0	2	2	3	0
3	1	0	2	2	3	0
4	1	0	2	3	2	0
5	2	0	2	2	1	0
Avg	(8/5)=1.6	(0/0)=0	(10/5)=2	(12/5)=2.4	(12/5)=2.4	(0/0)=0

VL4091 **NETWORK ON CHIP** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

The students should be made to:

- Understand the concept of Network - on - Chip
- Learn router architecture designs
- Study fault tolerance Network - on – Chip

UNIT I INTRODUCTION TO NOC 9

Introduction to NOC – OSI Layer Rules in NOC - Interconnection Networks in Network-On-Chip Network Topologies - Switching Techniques - Routing Strategies - Flow Control Protocol Quality-of-Service Support

UNIT II ARCHITECTURE DESIGN 9

Switching Techniques and Packet Format - Asynchronous FIFO Design - GALS Style of Communication - Wormhole Router Architecture Design - VC Router Architecture Design - Adaptive Router Architecture Design

UNIT III ROUTING ALGORITHM 9

Packet Routing-QOS, Congestion Control and Flow Control – Router Design – Network Link Design – Efficient and Deadlock-Free Tree-Based Multicast Routing Methods - Path-Based Multicast Routing For 2D and 3D Mesh Networks- Fault-Tolerant Routing Algorithms - Reliable and Adaptive Routing Algorithms

UNIT IV TEST AND FAULT TOLERANCE OF NOC 9

Design-Security in Networks-On-Chips-Formal Verification of Communications in Networks-On Chips-Test and Fault Tolerance For Networks-On-Chip Infrastructures-Monitoring Services For Networks-On-Chips

UNIT V THREE-DIMENSIONAL INTEGRATION OF NETWORK-ON-CHIP 9

Three-Dimensional Networks-On-Chips Architectures – A Novel Dimensionally-Decomposed Router for On-Chip Communication in 3D Architectures - Resource Allocation For QOS On-Chip Communication – Networks-On-Chip Protocols-On-Chip Processor Traffic Modeling For Networks-On-Chip

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1:Compare different architecture design

CO2: Discuss different routing algorithms

CO3:Explain three dimensional Networks on Chip architectures

CO4: Test and design fault tolerant NOC

CO5: Design three dimensional architectures of NOC

REFERENCES

1. ChrysostoMOSnicopoulos, Vijaykrishnan Narayanan, Chita R.Das" Networks-On - Chip " Architectures Holistic Design Exploration", Springer.
2. Fayezgebali, Haythamelmiligi, Hqhahedwatheq E1-Kharashi "Networks-On-Chips Theory and Practice CRC Press
3. Konstantinos Tatas and Kostas Siozios "Designing 2D and 3D Network-On-Chip Architectures" 2013
4. Palesi, Maurizio, Daneshtalab, Masoud "Routing Algorithms in Networks-On-Chip" 2014

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	2	1	0	0
2	1	0	2	1	0	0
3	1	0	2	1	0	0
4	1	0	2	1	0	0
5	1	0	2	1	0	0
Avg	(5/5)=1	0	(10/5)=2	(5/5)=1	0	0

VL4074 NANOTECHNOLOGY

L T P C
3 0 0 3

COURSE OBJECTIVES:

- Provides knowledge of various industrial applications of Nanotechnology
- Introduces the theory and practice on Nanomaterials
- Imparting the state of art of nanotechnology to the society and to the environmental implication
- To exercise the students' knowledge and imagination of Nanoscience and nanotechnology toward engineering applications coupled with detailed justifications.

UNIT I NANOTECHNOLOGY 9

Background, what is Nanotechnology, types of Nanotechnology and Nano-machines, top down and bottom up techniques, atomic manipulation-Nanodots, semi-conductor quantum dots, self-assembly monolayers, simple details of characterization tools- SEM, TEM, STM, AFM.

UNIT II NANOMATERIALS 9

What are Nanomaterials? Preparation of Nanomaterials- solid state reaction method, Chemical Vapor Deposition, SOL-GELS techniques, electrodeposition, ball milling, introduction to lithography, Pulse Laser Deposition (PLD), applications of Nanomaterials

UNIT III CARBON TUBES 9

New forms of carbon, carbon tubes-types of Nanotubes, formation of Nanotubes, assemblies, purification of carbon Nanotubes, properties of Nanotubes, applications of Nanotubes

UNIT IV OPTICS, PHOTONICS AND SOLAR ENERGY 9

Light and Nanotechnology, interaction of light and Nanotechnology, Nanoholes and photons, solar cells, optically useful Nanostructured polymers, photonic crystals.

UNIT V FUTURE APPLICATIONS 9

MEMS, Nanomachines, Nanodevices, Quantum Computers, Opto-electronic Devices, Quantum Electronic devices, environmental and biological applications.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students should will be able to:

CO1: understand the bases for introduction to Nanotechnology
CO2: understand the synthesis of Nanomaterials and their application and the impact of Nanomaterials on environment
CO3: acquire knowledge about various kind of Nano materials
CO4: understand the Nanotechnology devices used and their structures
CO5: understand and improve the application of Nanotechnology

REFERENCES

1. Mick Wilson, Kamali Kannangra Geoff Smith, Michelle Simons and Burkhard Raguse,"Nanotechnology-Basic Science and Emerging Technologies", Overseas Press, 2002
2. Mark Ratner and Daniel Ratner, "Nanotechnology-a Gentle Introduction to The Next Big Idea",Prentice Hall,2003
3. Rebecca L Johnson,"Nanotechnology", Lerner Publications,2003

4. Charles P. Poole Jr., “Introduction to Nanotechnogy”,Chapman and Hall/CRS,2003

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	1	1	0	0
2	1	0	1	1	0	0
3	1	0	1	1	0	0
4	1	0	1	1	0	0
5	1	0	1	1	0	0
Avg	(5/5)=1	0	(5/5)=1	(5/5)=1	0	0

VL4291 **LOW POWER VLSI DESIGN** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- identify sources of power in an IC.
- identify the power reduction techniques based on technology independent and technology dependent methods
- identify suitable techniques to reduce the power dissipation
- estimate power dissipation of various MOS logic circuits
- develop algorithms for low power dissipation

UNIT I POWER DISSIPATION IN CMOS **9**

Hierarchy of Limits of Power – Sources of Power Consumption – Physics of Power Dissipation in CMOS FET Devices – Basic Principle of Low Power Design.

UNIT II POWER OPTIMIZATION **9**

Logic Level Power Optimization – Circuit Level Low Power Design – Gate Level Low Power Design –Architecture Level Low Power Design – VLSI Subsystem Design of Adders, Multipliers, PLL, Low Power Design

UNIT III DESIGN OF LOW POWER CMOS CIRCUITS **9**

Computer Arithmetic Techniques for Low Power System – Reducing Power Consumption in Combinational Logic, Sequential Logic, Memories – Low Power Clock – Advanced Techniques – Special Techniques, Adiabatic Techniques – Physical Design, Floor Planning, Placement and Routing.

UNIT IV POWER ESTIMATION **9**

Power Estimation Techniques, Circuit Level, Gate Level, Architecture Level, Behavioral Level, – Logic Power Estimation – Simulation Power Analysis –Probabilistic Power Analysis

UNIT V SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER CMOS CIRCUITS **9**

Synthesis for Low Power – Behavioral Level Transform –Algorithms for Low Power – Software Design for Low Power.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students should will be able to:

CO1: able to find the power dissipation of MOS circuits

CO2: design and analyze various MOS logic circuits

CO3 :apply low power techniques for low power dissipation

CO4: able to estimate the power dissipation of ICs

CO5: able to develop algorithms to reduce power dissipation by software.

REFERENCES

1. Kaushik Roy and S.C.Prasad, “Low Power CMOS VLSI Circuit Design”, Wiley, 2000
2. J.B.Kulo and J.H Lou, “Low Voltage CMOS VLSI Circuits”, Wiley 1999.
3. James B.Kulo, Shih-Chia Lin, “Low Voltage SOI CMOS VLSI Devices and Circuits”, John Wiley and Sons, Inc. 2001
4. J.Rabaey, “Low Power Design Essentials (Integrated Circuits and Systems)”, Springer, 2009

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	2	0	2	3	3	0
2	2	0	2	2	3	0
3	1	0	2	2	3	0
4	1	0	2	3	2	0
5	2	0	2	2	1	0
Avg	(8/5)=1.6	(0/0)=0	(10/5)=2	(12/5)=2.4	(12/5)=2.4	(0/0)=0

VE4004 MULTICORE ARCHITECTURE PROGRAMMING **L T P C 3 0 0 3**

OBJECTIVES:

- Understand the challenges in parallel and multi-threaded programming.
- Learn about the various parallel programming paradigms, and solutions.

UNIT I MULTI-CORE PROCESSORS **9**

Single Core To Multi-Core Architectures – SIMD And MIMD Systems – Interconnection Networks - Symmetric And Distributed Shared Memory Architectures – Cache Coherence - Performance Issues –Parallel Program Design

UNIT II PARALLEL PROGRAM CHALLENGES 9

Performance – Scalability – Synchronization And Data Sharing – Data Races – Synchronization Primitives (Mutexes, Locks, Semaphores, Barriers) – Deadlocks And Livelocks – Communication Between Threads (Condition Variables, Signals, Message Queues And Pipes).

UNIT III SHARED MEMORY PROGRAMMING WITH OPENMP 9

Openmp Execution Model – Memory Model – Openmp Directives – Work-Sharing Constructs – Library Functions – Handling Data And Functional Parallelism – Handling Loops - Performance Considerations

UNIT IV DISTRIBUTED MEMORY PROGRAMMING WITH MPI 9

MPI Program Execution – MPI Constructs – Libraries – MPI Send and Receive – Point-To Point and Collective Communication – MPI Derived Datatypes – Performance Evaluation

UNIT V PARALLEL PROGRAM DEVELOPMENT 9

Case Studies - N-Body Solvers – Tree Search – Openmp and MPI Implementations and Comparison

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

CO1:Illustrate the challenges in parallel and multi threaded programming
CO2:Explain the various parallel programming paradigms and solutions.
CO3:Develop shared memory programs using openmp
CO4:Develop distributed memory programs using mpi
CO5:Compare and contrast programming for serial processors and parallel processors.

REFERENCES

1. Peter S. Pacheco, “An Introduction To Parallel Programming”, Morgan-Kauffman/Elsevier, 2011.
2. Darryl Gove, “Multicore Application Programming for Windows, Linux, And Oracle Solaris”, Pearson, 2011
3. Michael J Quinn, “Parallel Programming In C With MPI And Openmp”, Tata McGraw Hill,2003.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	1	1	0	0
2	1	0	1	1	0	0
3	1	0	1	1	2	0
4	1	0	1	1	2	0
5	1	0	1	1	0	0
Avg	(5/5)=1	(0/0)=0	(5/5)=1	(5/5)=1	(4/2)=2	(0/0)=0

VE4005 **RECONFIGURABLE COMPUTING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the need for reconfigurable computing
- To expose the students to various device architectures
- To examine the various reconfigurable computing systems
- To expose the students to HDL programming and familiarize with the development environment
- To develop applications with FPGAs

UNIT I DEVICE ARCHITECTURE 9

General Purpose Computing Vs Reconfigurable Computing – Simple Programmable Logic Devices – Complex Programmable Logic Devices – FPGAs– Device Architecture - Case Studies.

UNIT II RECONFIGURABLE COMPUTING ARCHITECTURES AND SYSTEMS 9

Reconfigurable Processing Fabric Architectures – RPF Integration Into Traditional Computing Systems – Reconfigurable Computing Systems – Case Studies – Reconfiguration Management.

UNIT III PROGRAMMING RECONFIGURABLE SYSTEMS 9

Compute Models - Programming FPGA Applications In HDL – Compiling C for Spatial Computing – Operating System Support for Reconfigurable Computing.

UNIT IV MAPPING DESIGNS TO RECONFIGURABLE PLATFORMS 9

the Design Flow - Technology Mapping – FPGA Placement And Routing – Configuration Bit stream Generation – Case Studies with Appropriate Tools.

UNIT V APPLICATION DEVELOPMENT WITH FPGAS 9

Case Studies of FPGA Applications – System On a Programmable Chip (SOPC) Designs- Signal and image processing - Bioinformatics - Security - Special Topics - Partial Reconfiguration - Numerical Analysis -Performance Analysis/Prediction - Fault Tolerance

TOTAL:45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to
CO1:Identify the need for reconfigurable architectures
CO2:Discuss the architecture of FPGAs
CO3:Point out the salient features of different reconfigurable architectures
CO4:Build basic modules using any HDL
CO5:Develop applications using any HDL and appropriate tools
CO6:Design and build an SOPC for a particular application

REFERENCES

1. Maya B. Gokhale and Paul S. Graham, “Reconfigurable Computing: Accelerating Computation With Field-Programmable Gate Arrays”, Springer, 2005.
2. Scott Hauck and Andre Dehon (Eds.), “Reconfigurable Computing – the Theory and Practice of FPGA-Based Computation”, Elsevier / Morgan Kaufmann, 2008.

3. Christophe Bobda, “Introduction To Reconfigurable Computing – Architectures, Algorithms and Applications”, Springer, 2010.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	1	1	0	0
2	1	0	1	1	0	0
3	1	0	1	1	0	0
4	1	0	1	1	1	0
5	1	0	1	1	1	0
Avg	(5/5)=1	(0/0)=0	(5/5)=1	(5/5)=1	(2/2)=1	(0/0)=0

VE4071 HARDWARE SOFTWARE CO-DESIGN L T P C
3 0 0 3

COURSE OBJECTIVES:

- To acquire the knowledge about system specification and modelling
- To learn the formulation of partitioning
- To study the different technical aspects about prototyping and emulation

UNIT I SYSTEM SPECIFICATION AND MODELLING 9

Embedded Systems, Hardware/Software Co-Design, Co-Design for System Specification And Modeling, Co-Design for Heterogeneous Implementation - Processor Synthesis, Single-Processor Architectures With One ASIC, Single-Processor Architectures With Many ASICs, Multi-Processor Architectures, Comparison of Co-Design Approaches, Models of Computation, Requirements for Embedded System Specification.

UNIT II HARDWARE/SOFTWARE PARTITIONING 9

The Hardware/Software Partitioning Problem, Hardware-Software Cost Estimation, Generation of the Partitioning Graph, Formulation of the HW/SW Partitioning Problem, Optimization, HW/SW Partitioning Based On Heuristic Scheduling, HW/SW Partitioning Based On Genetic Algorithms.

UNIT III HARDWARE/SOFTWARE CO-SYNTHESIS 9

The Co-Synthesis Problem, State-Transition Graph, Refinement and Controller Generation, Distributed System Co-Synthesis Hardware software synthesis algorithms: hardware – software partitioning, distributed system co-synthesis.

UNIT IV PROTOTYPING AND EMULATION 9

Introduction, Prototyping And Emulation Techniques, Prototyping and Emulation Environments, Future Developments In Emulation and Prototyping, Target Architecture, Architecture Specialization Techniques, System Communication Infrastructure, Target Architectures and Application System Classes, Architectures for Control-Dominated Systems, Architectures for Data-Dominated Systems, Mixed Systems and Less Specialized Systems.

UNIT V DESIGN SPECIFICATION AND VERIFICATION 9

Concurrency, Coordinating Concurrent Computations, Interfacing Components, Verification, Languages for System-Level Specification and Design System-Level Specification, Design Representation for System Level Synthesis, System Level Specification Languages, Heterogeneous Specification and Multi-Language Co-Simulation

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students should will be able to:

CO1: describe the broad range of system architectures and design methodologies that currently exist and define their fundamental attributes.

CO2: discuss the dataflow models as a state-of-the-art methodology to solve co-design problems and to optimize the balance between software and hardware.

CO3: understand in translating between software and hardware descriptions through co-design methodologies.

CO4: understand the state-of-the-art practices in developing co-design solutions to problems using modern hardware/software tools for building prototypes.

CO5: understand the concurrent specification from an algorithm, analyze its behavior and partition the specification into software (C code) and hardware (HDL) components

REFERENCES

1. Patrick Schaumont, “a Practical Introduction To Hardware/Software Codesign”, Springer,2010.
2. Ralf Niemann, “Hardware/Software Co-Design for Data Flow Dominated Embedded Systems”, Kluwer Academic Publisher, 1998.
3. Jorgen Staunstrup, Wayne Wolf, “Hardware/Software Co-Design: Principles And Practice”, Kluwer Academic Publisher,1997.
4. Giovanni De Micheli, Rolf Ernst Morgon, “Reading In Hardware/Software Co-Design”, Kaufmann Publisher,2001.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	1	1	0	0
2	1	0	1	1	0	0
3	1	0	1	1	0	0
4	1	0	1	1	0	0
5	1	0	1	1	0	0
Avg	(5/5)=1	(0/0)=0	(5/5)=1	(5/5)=1	(0/0)=0	(0/0)=0

II4092 SYSTEM ON CHIP L T P C

3 0 0 3

COURSE OBJECTIVE:

- To introduce architecture and design concepts underlying system on chips.
- Students can gain knowledge of designing SoCs.

- To impart knowledge about the hardware-software design of a modest complexity chip allthe way from specifications, modeling, synthesis and physical design.

UNIT I SYSTEM ARCHITECTURE: OVERVIEW 9

Components of the system – Processor architectures – Memory and addressing – system levelinterconnection – SoC design requirements and specifications – design integration – design complexity – cycle time, die area and cost, ideal and practical scaling, area-time-power tradeoff in processor design, Configurability.

UNIT II PROCESSOR SELECTION FOR SOC 9

Overview – soft processors, processor core selection. Basic concepts – instruction set, branches, interrupts and exceptions. Basic elements in instruction handling – Minimizing pipeline delays – reducing the cost of branches – Robust processors – Vector processors, VLIW processors, Superscalar processors.

UNIT III MEMORY DESIGN 9

SoC external memory, SoC internal memory, Scratch pads and cache memory – cache organization and write policies – strategies for line replacement at miss time – split I- and Dcaches – multilevel caches – SoC memory systems – board based memory systems – simple processor/memory interaction.

UNIT IV INTERCONNECT ARCHITECTURES AND SOC CUSTOMIZATION 9

Bus architectures – SoC standard buses – AMBA, CoreConnect – Processor customization approaches – Reconfigurable technologies – mapping designs onto reconfigurable devices - FPGA based design – Architecture of FPGA, FPGA interconnect technology, FPGA memory, Floor plan and routing.

UNIT V FPGA BASED EMBEDDED PROCESSOR 9

Hardware software task partitioning – FPGA fabric Immersed Processors – Soft Processors andHard Processors – Tool flow for Hardware/Software Co-design –Interfacing Processor with memory and peripherals – Types of On-chip interfaces – Wishbone interface, Avalon Switch Matrix, OPB Bus Interface, Creating a Customized Microcontroller - FPGA-based Signal Interfacing and Conditioning.

TOTAL:45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the program the students shall

- Explain all important components of a System-on-Chip and an embedded system, i.e.
- digital hardware and embedded software;
- Outline the major design flows for digital hardware and embedded software;
- Discuss the major architectures and trade-offs concerning performance, cost and power
- consumption of single chip and embedded systems;
-

REFERENCES:

1. Wayne Wolf, “Modern VLSI Design – System – on – Chip Design”, Prentice Hall, 3rd Edition, 2008.
2. Wayne Wolf , “Modern VLSI Design – IP based Design”, Prentice Hall, 4th Edition, 2008

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	1	1	0	0
2	1	0	1	1	0	0
3	1	0	1	1	0	0
4	1	0	1	1	0	0
5	1	0	1	1	0	0
Avg	(5/5)=1	(0/0)=0	(5/5)=1	(5/5)=1	(0/0)=0	(0/0)=0

VL4073 **MEMS AND NEMS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- to introduce the concepts of Micro Electro Mechanical devices.
- to know the fabrication process of microsystems.
- to know the design concepts of micro sensors and micro actuators.
- to familiarize concepts of Quantum Mechanics and Nano systems.

UNIT I OVERVIEW **9**

New trends in Engineering and Science: Micro and Nanoscale systems, introduction to design of MEMS and NEMS, MEMS and NEMS – applications, devices and structures. Materials for MEMS: Silicon, Silicon compounds, polymers, metals

UNIT II MEMS FABRICATION TECHNOLOGIES **9**

Microsystem Fabrication Processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin Film Depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching Techniques: Dry and Wet Etching, Electrochemical Etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect- Ratio (LIGA and LIGA-Like) Technology; Packaging: Microsystems Packaging, Essential Packaging Technologies, Selection of Packaging Materials

UNIT III MICRO SENSORS **9**

MEMS Sensors: Design of Acoustic Wave Sensors, Resonant Sensor, Vibratory Gyroscope, Capacitive and Piezo Resistive Pressure Sensors- Engineering Mechanics Behind These Microsensors. Case Study: Piezo-Resistive Pressure Sensor.

UNIT IV MICRO ACTUATORS **9**

Design of Actuators: Actuation Using Thermal Forces, Actuation Using Shape Memory Alloys, Actuation Using Piezoelectric Crystals, Actuation using Electrostatic Forces (Parallel Plate, Torsion Bar, Comb Drive Actuators), Micromechanical Motors and Pumps. Case Study: Comb Drive Actuators.

UNIT V NANOSYSTEMS AND QUANTUM MECHANICS 9

Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Schrodinger Equation and Wave Function Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their Quantization, Molecular Wires and Molecular Circuits

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of this course, the student will be able to:

CO1:Discuss micro sensors
CO2:Explain micro actuators
CO3:Outline nanosystems and Quantum mechanics
CO4:Design micro actuators for different applications
CO5:Analyze atomic structures

REFERENCES

1. Chang Liu, “Foundations of MEMS”, Pearson Education India Limited, 2006.
2. Marc Madou, “Fundamentals of Microfabrication”, CRC Press 1997.
3. Stephen D. Senturia,” Micro System Design”, Kluwer Academic Publishers,2001
4. Sergey Edward Lyshevski, “MEMS and NEMS: Systems, Devices, and Structures” CRC Press, 2002.
5. Tai Ran Hsu ,”MEMS and Microsystems Design and Manufacture” ,Tata Mcraw Hill, 2002.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	1	1	0	0
2	1	0	1	1	0	0
3	1	0	1	1	0	0
4	1	0	1	1	0	0
5	1	0	1	1	0	0
Avg	(5/5)=1	(0/0)=0	(5/5)=1	(5/5)=1	(0/0)=0	(0/0)=0

AP4091 AUTOMOTIVE ELECTRONICS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To explain the principle of electronic management system and different sensors used in the systems.
- To know the concepts and develop basic skills necessary to diagnose automotive electronic problems.
- To know Starting, and charging, lighting systems, advanced automotive electrical systems.
- To include electronic accessories and basic computer control.
- To explore practically about the components present in an Automotive electrical and electronics system.

UNIT I FUNDAMENTALS 9

Components for electronic engine management system, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. Switches, active resistors, Transistors, Current mirrors/amplifiers, Voltage and current references, Comparator, Multiplier. Amplifier, filters, A/D and D/A converters.

UNIT II MODERN SENSORS 9

Film sensors, micro-scale sensors, Particle measuring systems, Vibration Sensors, SMART sensors, Machine Vision, Multi-sensor systems Applications of Sensors: Applications and case studies of Sensors in Automobile Engineering, Aeronautics, Machine tools and Manufacturing processes.

UNIT III CHARGING SYSTEM 9

Generation of Direct Current- Shunt Generator Characteristics- Armature Reaction- Third Brush Regulation- Cutout. Voltage and Current Regulators- Compensated Voltage Regulator Alternators Principle and Constructional Aspects and Bridge Rectifiers- New Developments.

UNIT IV AUTOMOTIVE TRANSMISSION CONTROL SYSTEMS 9

Transmission control - Cruise control – Braking control – Traction control –Suspension control – Steering control – Stability control – Integrated engine control.

UNIT V ELECTRONICS SYSTEMS 9

Current Trends in Automotive Electronic Engine Management System- Types of EMS Electromagnetic interference Suppression- Electromagnetic Compatibility- Electronic Dashboard Instruments- Onboard Diagnostic System- Security - Warning System infotainment and Telematics.

SUGGESTED ACTIVITIES:

1. Testing of battery, starting systems, charging systems, ignition systems and body controller systems
2. Study of various sensors and actuators used in two wheelers and four wheelers for electronic control.
3. Study of Development of Embedded Systems projects.

COURSE OUTCOMES:

At the end of this course the students will be able to:

CO1: Explain the fundamentals, operation, function of various sensors and actuators in engine management systems.

CO2: Explain the Automotive Transmission Control Systems.

CO3: Enumerate the principles, application, construction and specification of different sensors and actuators usable in typical automobile by suitable testing.

CO4: List out the principles and characteristics of charging system components and demonstrate their working with suitable tools.

CO5: Describe the principles and architecture of electronics systems and its components present in an automobile related to instrumentation, control, security and warning systems.

TOTAL: 45 PERIODS

REFERENCES

1. Allan Bonnick, “Automotive Computer Controlled Systems”, Butterworth-Heinemann, Elsevier, Indian Edition, 2011.
2. Eric Chowanietz, “Automobile Electronics” by SAE Publications, 1995
3. Tom Weather Jr and Cland C. Hunter, “Automotive Computers and Control System” Prentice Hall Inc.,1984 New Jersey.
4. R.K. Jurgen, “Automotive Electronics Handbook”, McGraw Hill 2 nd Edition,1995.
5. William B Ribbens, “understanding automotive electronics”, 5th edition - Butter worth Heinemann Woburn, 1998.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	1	1	0	0
2	1	0	1	1	0	0
3	1	0	1	1	0	0
4	1	0	1	1	0	0
5	1	0	1	1	0	0
Avg	(5/5)=1	(0/0)=0	(5/5)=1	(5/5)=1	(0/0)=0	(0/0)=0

VE4006 EMBEDDED WIRELESS SENSOR NETWORKS **L T P C 3 0 0 3**

COURSE OBJECTIVES:

- To discuss the overview of wireless sensor networks
- To familiarize the architecture of different networks
- To get knowledge about various physical layer and MAC protocols
- To acquire knowledge about different types of smart sensors used for designing the embedded system
- To know about the implementation of protocols on WSN in various applications

UNIT I OVERVIEW OF WIRELESS SENSOR NETWORKS **9**

Challenges for Wireless Sensor Networks - Characteristics Requirements - Required Mechanisms, Difference Between Mobile Ad-Hoc and Sensor Networks- Enabling Technologies for Wireless Sensor Networks. Single-Node Architecture - Hardware Components - Energy Consumption Sensor Nodes Operating Systems and Execution Environments - Sensor Node Examples: Eyes, Mica, Micaz Motes.

UNIT II NETWORK ARCHITECTURE **9**

Single node architecture.-Hardware components-Energy consumption of sensor nodes- Operating systems and execution environments- Some examples of sensor nodes-Sensor Network Scenarios – Optimization Goals and Figure of Merit – Design Principles for WSNs – Gateway Concepts.

UNIT III PHYSICAL LAYER AND MAC PROTOCOLS **9**

Wireless Channel and Communication Fundamentals – Physical Layer and Transceiver Design Considerations In WSN – Fundamentals of MAC Protocols low Duty Cycle Protocols and Wakeup Concepts – Contention Based Protocols - Schedule Based Protocols – IEEE 802.15.4 MAC Protocol.

UNIT IV SMART SENSORS **9**

Introduction To Smart Sensors – Signal Conditioning Circuits – Architecture of Smart Sensors Humidity Sensors – Soil Moisture Sensors– Temperature Sensors – Color Sensors – Level sensors.

UNIT V APPLICATIONS AND PROTOCOL IMPLEMENTATION ON WSN **9**

Home Control - Medical Applications - Civil And Environmental Engineering Applications – Wildfire Monitoring - Habitat Monitoring. Embedding Leach Protocol On ARM 7 TDM Microcontroller Using Embedded C Language - Embedding Cryptographic Algorithms On ARM 7 TDM Microcontroller Using Embedded C Language – FPGA Based Customizable Event Driven Architecture

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students should will be able to:

CO1:Explain the basics of wireless sensor networks.

CO2:Discuss about the sensor network components, architecture and design principles of WSN

CO3:Explain the need of physical layer design challenges and MAC protocols.

CO4:Design the smart sensors and applications of WSN.

CO5:Improved employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded systems design.

REFERENCES

1. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.
2. Kazemsohraby, Daniel Minoli, & Taiebznati, “Wireless Sensor Networks technology, Protocols and Applications”, John Wiley, 2012.
3. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.
4. Bhaskar Krishnamachari, “Networking Wireless Sensors”, Cambridge Press, 2005.
5. Mohammad Ilyas and Imad Mahgaob, “Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems”, CRC Press, 2005.
6. Hdger Karl Andreas Willig,”Protocols and Architectures for Wireless Sensor Networks”, Wiley 2007

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	1	1	0	0

2	1	0	1	1	0	0
3	1	0	1	1	0	0
4	1	0	1	1	0	2
5	1	0	1	1	0	2
Avg	(5/5)=1	(0/0)=0	(5/5)=1	(5/5)=1	(0/0)=0	(4/2)=2

VE4007 NETWORK EMBEDDED APPLICATIONS **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To give an introduction to and developing deeply embedded systems
- To familiarize the architecture and protocols in WSN
- To briefly study the application areas of network embedded systems

UNIT I NETWORK EMBEDDED SYSTEMS: AN INTRODUCTION 9

Networked Embedded Systems: Networking of Embedded Systems- Automotive Networked-Embedded Systems Networks-Embedded Systems in Industrial Automation- Wireless Sensor Networks- Networked Embedded Systems in Building Automation - Middleware Design and Implementation for Networked Embedded Systems- Introduction- Middleware Solution Space
ORB Middleware for Networked Embedded Systems: A Case Study Design Recommendations and Trade-Offs

UNIT II WIRELESS SENSOR NETWORKS 9

Introduction To WSNS- Architecture for WSNS- Localization & Synchronization for WSN- Time Sync Issues & Resource Aware Localization

UNIT III POWER AND ENERGY IN WSN 9

Networking In WSN Power Aware Routing Issues & Protocols- MAC for WSN Energy Efficient MAC Protocols- Distributed Signal Processing In Sensor Networks- Sensor Network Security

UNIT IV AUTOMOTIVE NETWORKED EMBEDDED SYSTEMS 9

Time – Triggered Communication- Networks In Automotive Systems - Controller Area Networks, Flex Ray Communications, Lin Self-Study Automotive Examples Volcano

UNIT V INDUSTRIAL AUTOMATION 9

Introduction To Industrial Automation-Fieldbus Bus - What Is a Fieldbus- Communication Fundamentals— The OSI Model Fieldbus Characteristics - Networking Networks—Interconnection in Heterogeneous Environments - Industrial Ethernet-The New Fieldbus- Real-Time Ethernet-Home Automation Home Automation- Introduction-Structure of the IEC Standardization- Real-Time Requirements -Practical Realizations

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students should will be able to:

CO1: understand the basics of network systems

CO2:discuss about the sensor network components, architecture and design principles of WSN

CO3:Explain the need MAC protocols and energy conservation

CO4:application of networked automotive system

CO5:design and development of home automation

REFERENCES

1. R.Zurawski, Network Embedded Systems, Crc Press, 2009.
2. G.Pottie, W.Kaiser, Principles of Embedded Networked System Design
3. Raj Kamal, Embedded Systems, Tata McGraw Hill, New Delhi, 2003
4. Francine Krief,"Communicating Embedded System" Wiley 2010**.**

CO-PO Mapping

CO	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
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2	1	0	1	1	0	0
3	1	0	1	1	0	0
4	1	0	1	1	0	2
5	1	0	1	1	1	2
Avg	(5/5)=1	(0/0)=0	(5/5)=1	(5/5)=1	(1/1)=1	(4/2)=2

VL4292 **RFIC DESIGN** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- to study the various impedance matching techniques used in RF circuit design.
- to understand the functional design aspects of LNAs, Mixers, PLLs and VCOs.
- to understand frequency synthesis.

UNIT I IMPEDANCE MATCHING IN AMPLIFIERS 9

Definition of 'Q', Series Parallel Transformations of Lossy Circuits, Impedance Matching Using 'L', 'Pi' and T Networks, Integrated Inductors, Resistors, Capacitors, Tunable Inductors, Transformers

UNIT II AMPLIFIER DESIGN 9

Noise Characteristics of MOS Devices, Design of CG LNA and Inductor Degenerated LNAs. Principles of RF Power Amplifiers Design

UNIT III ACTIVE AND PASSIVE MIXERS 9

Qualitative Description of the Gilbert Mixer - Conversion Gain, and Distortion and Noise , Analysis of Gilbert Mixer – Switching Mixer - Distortion in Unbalanced Switching Mixer -Conversion Gain in Unbalanced Switching Mixer - Noise in Unbalanced Switching Mixer - a Practical Unbalanced Switching Mixer. Sampling Mixer - Conversion Gain in Single Ended Sampling Mixer - Distortion in Single Ended Sampling Mixer - Intrinsic Noise in Single Ended Sampling Mixer - Extrinsic Noise in Single Ended Sampling Mixer.

UNIT IV OSCILLATORS 9

LC Oscillators, Voltage Controlled Oscillators, Ring Oscillators, Delay Cells, Tuning Range in Ring Oscillators, Tuning in LC Oscillators, Tuning Sensitivity, Phase Noise in Oscillators, Sources of Phase Noise

UNIT V PLL AND FREQUENCY SYNTHESIZERS 9

Phase Detector/Charge Pump, Analog Phase Detectors, Digital Phase Detectors, Frequency Dividers, Loop Filter Design, Phase Locked Loops, Phase Noise in PLL, Loop Bandwidth, Basic Integer-N Frequency Synthesizer, Basic Fractional-N Frequency Synthesizer

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: to understand the principles of operation of an RF receiver front end
CO2: to design and apply constraints for LNAs, Mixers and frequency synthesizers
CO3: to analyze and design mixers
CO4: to design different types of oscillators and perform noise analysis
CO5: to design PLL and frequency synthesizer

REFERENCES

1. B.Razavi ,"RF Microelectronics" , Prentice-Hall ,1998
2. Bosco H Leung "VLSI for Wireless Communication", Pearson Education, 2002
3. Behzad Razavi, "Design of Analog CMOS Integrated Circuits" Mcgraw-Hill, 1999
4. Jia-Sheng Hong, "Microstrip Filters for RF/Microwave Applications", Wiley, 2001
5. Thomas H.Lee, "The Design of CMOS Radio –Frequency Integrated Circuits', Cambridge University Press ,2003

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	2	0	2	3	3	0
2	2	0	2	2	3	0
3	1	0	2	2	3	0
4	1	0	2	3	2	0
5	2	0	2	2	1	0
Avg	(8/5)=1.6	(0/0)=0	(10/5)=2	(12/5)=2.4	(12/5)=2.4	(0/0)=0

AP4073 SENSORS AND ACTUATORS L T P C
3 0 0 3

COURSE OBJECTIVES:

- Understand static and dynamic characteristics of measurement systems.
- Study various types of sensors.
- Study different types of actuators and their usage.
- Study State-of-the-art digital and semiconductor sensors.

UNIT I INTRODUCTION TO MEASUREMENT SYSTEMS 9

Introduction to measurement systems: general concepts and terminology, measurement systems, sensor classification, general input-output configuration, methods of correction, performance characteristics: static and dynamic characteristics of measurement systems, zero-order, first-order, and second-order measurement systems and response.

UNIT II RESISTIVE AND REACTIVE SENSORS 9

Resistive sensors: potentiometers, strain gages, resistive temperature detectors, magneto resistors, light-dependent resistors, Signal conditioning for resistive sensors: Wheatstone bridge, sensor bridge calibration and compensation, Instrumentation amplifiers, sources of interference and interference reduction, Reactance variation and electromagnetic sensors, capacitive sensors, differential, inductive sensors, linear variable differential transformers (LVDT), magneto elastic sensors, hall effect sensors, Signal conditioning for reactance-based sensors & application to LVDT.

UNIT III SELF-GENERATING SENSORS 9

Self-generating sensors: thermoelectric sensors, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors, Signal conditioning for self-generating sensors: chopper and low-drift amplifiers, offset and drifts amplifiers, electrometer amplifiers, charge amplifiers, noise in amplifiers.

UNIT IV ACTUATORS DRIVE CHARACTERISTICS AND APPLICATIONS 9

Relays, Solenoid drive, Stepper Motors, Voice-Coil actuators, Servo Motors, DC motors and motor control, 4-to-20 mA Drive, Hydraulic actuators, variable transformers: synchros, resolvers, Inductosyn, resolver-to-digital and digital-to-resolver converters.

UNIT V DIGITAL SENSORS AND SEMICONDUCTOR DEVICE SENSORS 9

Digital sensors: position encoders, variable frequency sensors – quartz digital thermometer, vibrating wire strain gages, vibrating cylinder sensors, Sensors based on semiconductor junctions: thermometers based on semiconductor junctions, magneto diodes and magneto transistors, MOSFET transistors, CCD imaging sensors , ultrasonic sensors, fiber-optic sensors.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course the student will be able to :

CO1: Compare Actuators with various drive characteristics.

CO2: Evaluate digital sensors and semiconductor device sensors performance metrics.

CO3: Characterize the performance of Self-generating sensors.

CO4: Analyze the performance of self-generating Sensors.

CO5: Analyze the performance of resistive and reactive sensors.

REFERENCES:

1. Andrzej M. Pawlak Sensors and Actuators in Mechatronics Design and Applications, 2006.
2. D. Johnson, “Process Control Instrumentation Technology”, 8th Ed, 2014, John Wiley and Sons.
3. D.Patranabis, “Sensors and Transducers”, TMH 2003.
4. E.O. Doeblin, “Measurement System: Applications and Design”, McGraw Hill publications,1996
5. Graham Brooker, Introduction to Sensors for ranging and imaging, Yesdee, 2009.
6. Herman K.P. Neubrat, “Instrument Transducers – An Introduction to Their Performance and Design”, Oxford University Press. 22,1999.
7. Ian Sinclair, Sensors and Transducers, Elsevier, 3rd Edition, 2011.
8. Jon Wilson , “Sensor Technology Handbook”, Newne 2004.
9. Kevin James, PC Interfacing and Data acquisition, Elsevier, 2011.
10. Ramon PallásAreny, John G. Webster, “Sensors and Signal conditioning”, 2nd edition, John Wiley and Sons, 2000.
11. Sensors and Actuators: Control System Instrumentation, Clarence W. de Silva CRC Press, 2007

12. CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	1	1	0	0
2	1	0	1	1	0	0
3	1	0	1	1	0	0
4	1	0	1	1	0	0
5	1	0	1	1	0	0
Avg	(5/5)=1	(0/0)=0	(5/5)=1	(5/5)=1	(0/0)=0	(0/0)=0

VE4008 **REAL TIME OPERATING SYSTEMS** **L T P C**
3 0 2 4

COURSE OBJECTIVES:

- To learn about significance and usage of Real Time Operating System
- To learn about different scheduling strategies and optimization principles
- To learn about the resource allocation or sharing process involved in RTOS
- To study about the different firmware and tools related to RTOS development
- To design and develop an innovative real time embedded system

UNIT I REAL TIME EMBEDDED SYSTEMS 9

Introduction - History of Real Time Systems And Embedded Systems - Real Time Services and Standards - System Resources - Analysis - Service Utility - Scheduling Classes - Cyclic Executive - Scheduler Concepts- Real Time Operating System - Thread Safe Reentrant Functions

UNIT II RESOURCES AND SERVICES 9

Processing - Resources - Memory –Multiresource Services : Blocking, Deadlock, Livelock, Critical Sections To Protect Shared Resources, Priority Inversion, Power Management And Processor Clock Modulation - Soft Real Time Services : Missed Deadlines, Quality of Service, Alternatives To Rate Monotonic Policy, Mixed Hard and Soft Real Time Services

UNIT III REAL TIME EMBEDDED COMPONENTS 9

Hardware Components - Firmware Components - RTOS System Software - Software Application Components - Traditional Hard Real Time Operating Systems : Asymmetric Multicore Processing And Symmetric Multi-Core Processing - Processor Core Affinity - SMP Support Models - RTOS Hypervisors - Open Source Real Time Operating Systems

UNIT IV INTEGRATING EMBEDDED LINUX 9

Integrating Embedded Linux Into Real Time Systems - Debugging Components - Performance Tuning - High Availability And Reliability Design - Hierarchical Approaches for Fail-Safe Design.

UNIT V CASE STUDIES 9

System Life Cycle - Continuous Media Applications - Video and Audio Processing - Robotic Applications - Computer Vision Applications

TOTAL: 45 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

Laboratory Exercises On Task Scheduling

1. Implement a Linux process that is executed at the default priority for a user-level application and waits on a binary semaphore to be given by another application. Run this process and verify its state using the ps command to list its process descriptor. Now, run a separate process to give the semaphore causing the first process to continue execution and exit. Verify completion.
2. Create An Application That Creates Two Tasks That Wait On a Timer Whilst the Main Task Loops.
3. Develop an Applications Using Linux
4. Design of Plant Control System

TOTAL:45+30=75 PERIODS

COURSE OUTCOMES:

On successful completion of this course, students will be able to

CO1: complete understanding of scheduling algorithm and process

CO2: better understanding on firmware and tools related to the development of RTOS

CO3: to be able to design and develop an embedded system with RTOS functionality

CO4: to be able to design and develop the systems in Linux environments

CO5: to be able to develop large real-time embedded systems

REFERENCES:

1. Sam Siewert, John Pratt, "Real-Time Embedded Components and Systems With Linux And Rtos", Mercury Learning And Information Llc, 2016.
2. Jonathan W. Valvano, "Embedded Systems: Real Time Operating Systems for ARM Cortex-M Microcontrollers", Createspace Independent Publishing Platform, Fourth Edition, 2017.
3. Giorgio C. Buttazzo, "Hard Real-Time Computing Systems - Predictable Scheduling Algorithms And Applications", Springer Science+Buisness Media, LLC, Third Edition, 2011.
4. Albert M. K. Cheng, "Real-Time Systems - Scheduling, Analysis And Verification", a John Wiley & Sons Inc Publication, 2002.
5. Wang K.C., “Embedded And Real Time Operating System”, Springer, 2017

CO-PO Mapping

CO	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
1	1	0	1	1	1	0
2	1	0	1	1	1	0
3	1	0	1	1	1	0
4	1	0	1	1	1	0
5	1	0	1	1	1	0
Avg	(5/5)=1	(0/0)=0	(5/5)=1	(5/5)=1	(5/5)=1	(0/0)=0

VE4009 **EMBEDDED NETWORKING** **L T P C**
3 0 2 4

COURSE OBJECTIVES:

- To learn the concepts of serial and parallel communication protocols
- To understand the application development using USB and CAN bus for PIC microcontrollers
- To learn the basics of ethernet
- To learn the application development using embedded internet
- To learn the wireless sensor network communication protocols

UNIT – I COMMUNICATION PROTOCOLS 9

Serial/Parallel Communication – Serial Communication Protocols -RS 232 Standard – RS 485 – Synchronous Serial Protocols -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – PC Parallel Port Programming - PCI Bus Protocol.

UNIT – II USB AND CAN BUS 9

USB Bus – Introduction – Speed Identification On the Bus – USB States – USB Bus Communication: Packets –Data Flow Types –Enumeration –Descriptors –PIC Microcontroller USB Interface – CAN Bus – Introduction - Basic Concepts & Definitions-Identifiers & Arbitration-Robustness & Flexibility-Message Formats-Error Handling -PIC Microcontroller CAN Interface –a Simple Application With CAN.

UNIT – III ETHERNET BASICS 9

Elements of a Network – Inside Ethernet – Building a Network: Hardware Options – Cables, Connections and Network Speed – Design Choices: Selecting Components –Ethernet Controllers – Using the Internet In Local And Internet Communications – Inside the Internet Protocol.

UNIT – IV EMBEDDED ETHERNET 9

Exchanging Messages Using UDP And TCP – Serving Web Pages With Dynamic Data – Serving Web Pages That Respond To User Input – Email for Embedded Systems – Using FTP.

UNIT – V EMBEDDED WIRELESS SENSOR NETWORKS 9

Wireless Sensor Networks –Introduction To WSN-Challenges for WSNs - Characteristic Requirements - Required Mechanisms - Single-Node Architecture -Hardware Components-Energy Consumption of Sensor Nodes-Operating Systems and Execution Environments-Some Examples of Sensor Nodes.

TOTAL: 45 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Write a Simple Application Program USB and PIC Interface.
2. Write a Simple Application Program Using CAN And PCI.
3. Write a Program for Email Transferring Using UDP And TCP
4. Write a Program for Energy Harvesting In WSN Node
5. Develop An Application Using Embedded Wireless Sensor Networks

TOTAL:45+30=75 PERIODS

COURSE OUTCOMES:

On successful completion of this course, students will be able to

CO1:analyze the wired and wireless network protocols

CO2:Design an application using embedded networking

CO3:Analyze the basics of Ethernet

CO4:incorporate networks in embedded systems

CO5:Analyze the basics of wireless sensor networks

REFERENCES:

1. Jan Axelson, “Embedded Ethernet and Internet Complete”, Penram Publications, 2003.
2. Bhaskar Krishnamachari, Networking, Wireless Sensors - Cambridge Press 2005.
3. Olaf Pfeiffer, Andrew Ayre and Christian Keydel, “Embedded Networking With CAN And CAN Open”, Second Edition Published By Copperhill Media Corporation, 2003.
4. Holgerkarl, Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley,2005
5. Frank Vahid, Tony Givargis, “Embedded Systems Design: a Unified Hardware/Software Introduction” - John & Wiley Publications, 2006
6. Jan Axelson, “Parallel Port Complete: Programming, Interfacing and Using the PCs Parallel Printer Port” - Penram Publications, 1996.
7. Dogan Ibrahim, “Advanced PIC Microcontroller Projects In C: From USB To RTOS With the PIC18f Series” - Elsevier 2008.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	1	1	1	0
2	1	0	1	1	1	0
3	1	0	1	1	1	0
4	1	0	1	1	1	0
5	1	0	1	1	1	0
Avg	(5/5)=1	(0/0)=0	(5/5)=1	(5/5)=1	(5/5)=1	(0/0)=0

IF4071 DEEP LEARNING L T P C
3 0 2 4

COURSE OBJECTIVES:

- Develop and Train Deep Neural Networks.
- Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
- Build and train RNNs, work with NLP and Word Embeddings
- The internal structure of LSTM and GRU and the differences between them
- The Auto Encoders for Image Processing

UNIT I DEEP LEARNING CONCEPTS 6

Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.

UNIT II NEURAL NETWORKS 9

About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Overfitting and

Underfitting. Hyperparameters.

UNIT III CONVOLUTIONAL NEURAL NETWORK 10

About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers. Dense Layers. Backpropagation Through the Convolutional Layer. Filters and Feature Maps. Backpropagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, Microsoft ResNet Model. R-CNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO

UNIT IV NATURAL LANGUAGE PROCESSING USING RNN 10

About NLP & its Toolkits. Language Modeling . Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Co-occurrence Statistics–based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation GloVe. Backpropagation Through Time. Bidirectional RNNs (BRNN) . Long Short Term Memory (LSTM). Bi-directional LSTM. Sequence-to-Sequence Models (Seq2Seq). Gated recurrent unit GRU.

UNIT V DEEP REINFORCEMENT & UNSUPERVISED LEARNING 10

About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Autoencoding. Convolutional Auto Encoding. Variational Auto Encoding. Generative Adversarial Networks. Autoencoders for Feature Extraction. Auto Encoders for Classification. Denoising Autoencoders. Sparse Autoencoders

SUGGESTED ACTIVITIES :(Experiments in Lab) 30

1: Feature Selection from Video and Image Data
2: Image and video recognition
3: Image Colorization
4: Aspect Oriented Topic Detection & Sentiment Analysis
5: Object Detection using Autoencoder

COURSE OUTCOMES:

CO1: Feature Extraction from Image and Video Data
CO2: Implement Image Segmentation and Instance Segmentation in Images
CO3: Implement image recognition and image classification using a pretrained network (Transfer Learning)
CO4: Traffic Information analysis using Twitter Data
CO5: Autoencoder for Classification & Feature Extraction

TOTAL: 45+30=75 PERIODS

REFERENCES

1. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc.2017
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
3. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017
5. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	0	1	2	1	0
2	1	0	1	2	1	0
3	1	0	1	2	1	0
4	1	0	1	2	1	0
5	1	0	1	2	1	0
Avg	(5/5)=1	(0/0)=0	(5/5)=1	(10/5)=2	(5/5)=1	(0/0)=0

VE4072 REAL TIME EMBEDDED SYSTEMS **L T P C**
3 0 2 4

COURSE OBJECTIVES:

- To understand the basics of embedded system and ARM architecture
- To understand the RTOS concepts like scheduling and memory management related to the embedded system
- To learn about the programming aspects of RTOS
- To learn the different protocols of embedded wireless application
- To understand concepts involved in the design of hardware and software components for an embedded system

UNIT I INTRODUCTION **9**

Real Time System – Embedded Systems – Architecture of Embedded System – Simple Programming for Embedded System – Process of Embedded System Development – Pervasive Computing – Information Access Devices – Smart Cards – Microcontrollers – ARM Processor - Real Time Microcontrollers.

UNIT II EMBEDDED/REAL TIME OPERATING SYSTEM **9**

Operating System Concepts: Processes, Threads, Interrupts, Events - Real Time Scheduling Algorithms - Memory Management – Overview of Operating Systems for Embedded, Real Time Handheld Devices – Target Image Creation – Programming In Linux, Rtlinux, Vxworks, Microcontroller Operating System Overview.

UNIT III CONNECTIVITY **9**

Wireless Connectivity - Bluetooth – Other Short Range Protocols – Wireless Application Environment – Service Discovery – Middleware.

UNIT IV REAL TIME UML 9

The Rapid Object-Oriented Process for Embedded Systems (ROPES) Process. MDA and Platform-Independent Models- Scheduling Model-Based Projects- Model Organization Principles-Working with Model-Based Projects - Object Orientation with UML 2.0-Structural Aspects-Object Orientation with UML 2.0-Dynamic Aspects-UML Profile for Schedulability, Performance, and Time. Requirements Analysis – Object Identification Strategies – Object Behaviour – Real Time Design Patterns.

UNIT V SOFTWARE DEVELOPMENT AND APPLICATION 9

Concurrency – Exceptions – Tools – Debugging Techniques – Optimization –Interfacing Digital Camera With USB Port. Interfacing of Sensors and Actuators for a Real Time Industrial Application.

TOTAL: 45 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Read Input From Switch And Automatic Control/Flash LED for ARM Processor
2. Laboratory Exercises On Task Scheduling
3. Simple Program In Linux, Rtlinux And Vxworks
4. Develop a Real Time Security Monitoing System

COURSE OUTCOMES:

On successful completion of this course, students will be able to

CO1:Make a choice of suitable embedded processor for a given application

CO2:Design the hardware and software for the embedded system

CO3:Design and develop the real time kernel/operating system functions, task control block structure and analyze different task states

CO4:Implement different types of inter task communication and synchronization techniques

CO5:Know about the aspects embedded connectivity in real time systems

TOTAL:45+30=75 PERIODS

REFERENCES:

1. R.J.a.Buhr, D.L.Bailey, “An Introduction To Real-Time Systems”, Prentice-Hall International,1999.
2. David E-Simon, “An Embedded Software Primer”, Pearson Education, 2007.
3. C.M.Krishna, Kang G.Shin, “Real Time Systems”, Mc-Graw Hill, 2010.
4. B.P.Douglass, “Real Time Uml - Advances In the UML for Real-Time Systems, 3rd Edition Addison-Wesley, 2004.
5. K.V.K. Prasad, “Embedded/Real Time Systems: Concepts, Design And Programming”, Dream Tech Press, Black Book, 2005.
6. R.Barnett, L.O.Cull, S.Cox, “Embedded C Programming and the Microchip PIC ”, Thomason Learning, 2004.
7. Wayne Wolf, “Computers As Components - Principles of Embedded Computer System Design”, Mergen Kaufmann Publisher, 2006.
8. Sriram V Iyer, Pankaj Gupta, “Embedded Real Time Systems Programming”, Tata Mc-Graw Hill, 2004.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6

1	1	0	1	1	1	0
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3	1	0	1	1	1	0
4	1	0	1	1	1	0
5	1	0	1	1	1	0
Avg	(5/5)=1	(0/0)=0	(5/5)=1	(5/5)=1	(5/5)=1	(0/0)=0

VE4010 **PERVASIVE COMPUTING** **L T P C**
3 0 2 4

OBJECTIVES:

- To understand the characteristics and principles of pervasive computing and the solutions that are in use
- To realize the role of wireless protocols in shaping the future internet
- To design and implement pervasive applications
- To introduce the enabling technologies of pervasive computing

UNIT I PERVASIVE COMPUTING CONCEPTS 9

Perspectives of Pervasive Computing, Challenges, Technology; the Structure and Elements of Pervasive Computing Systems: Infrastructure and Devices, Middleware for Pervasive Computing Systems, Pervasive Computing Environments

UNIT II CONTEXT COLLECTION, USER TRACKING, AND CONTEXT REASONING 9

Resource Management In Pervasive Computing: Efficient Resource Allocation In Pervasive Environments, Transparent Task Migration, Implementation and Illustrations.

UNIT III HCI INTERFACE IN PERVASIVE ENVIORNMENTS 9

HCI Service and Interaction Migration, Context- Driven HCI Service Selection, Scenario Study: Video Calls At a Smart Office, a Web Service– Based HCI Migration Framework .

UNIT IV PERVASIVE MOBILE TRANSACTIONS 9

Mobile Transaction Framework, Context-Aware Pervasive Transaction Model, Dynamic Transaction Management, Formal Transaction Verification, Evaluations

UNIT V CASE STUDIES 9

ICAMPUS Prototype, IPSPACE: AN IPV6-Enabled Intelligent Space

TOTAL:45 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. To Design the Software for Mobile Phones Using Symbion Os
   i. Text String Handling
   ii. Graphical Application
   iii. Dialog Application
   iv. Drawing Application
   v. File Handling Operations

2. Application Level- To Study New HCI Techniques for Small Mobile Devices And Embedded Devices.
3. Case Studies- Projects In Pervasive Computing- To Explore Wearable And Handheld Computing And Their Enabling Technologies

COURSE OUTCOMES:

At the end of this course, the students should will be able to:

CO1:Outline the basic problems, performance requirements of pervasive computing applications, and the trends of pervasive computing and its impacts on future computing applications and society

CO2:Analyze and compare the performance of different data dissemination techniques and algorithms for mobile real-time applications

CO3:Analyze the performance of different sensor data management and routing algorithms for sensor networks

CO4:Develop an attitude to propose solutions with comparisons for problems related to pervasive computing system through investigation

CO5:Study on application on IPv6.

TOTAL:45+30=75 PERIODS

REFERENCES

1. Minyi Guo, Jingyu Zhou, Feilong Tang, Yao Shen ,"Pervasive Computing: Concepts, Technologies And Applications", CRC Press, 2016.
2. Obaidat, Mohammad S., Mieso Denko, And Isaac Woungang, Eds. Pervasive Computing And Networking. John Wiley & Sons, 2011.
3. Laurence T. Yang, Handbook On Mobile and Ubiquitous Computing Status and Perspective, 2012, CRC Press
4. Seng Loke, Context-Aware Computing Pervasive Systems, Auerbach Pub., New York, 2007.
5. Uwe Hansmann Etl , Pervasive Computing, Springer, New York,2001.

CO-PO Mapping

CO	POs					
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Avg	(5/5)=1	(0/0)=0	(5/5)=1	(5/5)=1	(5/5)=1	(0/0)=0

VE4011 **PHYSICAL DESIGN AUTOMATION** **L T P C**
3 0 2 4

COURSE OBJECTIVES:

- Understand the concepts of physical design process such as partitioning, floorplanning, placement and routing.
- Discuss the concepts of design optimization algorithms and their application to physical design automation.
- Understand the concepts of simulation and synthesis in VLSI design automation
- Formulate CAD design problems using algorithmic methods

UNIT I INTRODUCTION **9**

Layout and Design Rules, Materials for VLSI Fabrication, Basic Algorithmic Concepts for Physical Design, Physical Design Processes and Complexities. Partition: Kernigham-Lin's Algorithm, Fiduccia Mattheyes Algorithm, Krishnamurthy Extension, Hmetis Algorithm, Multilevel Partition Techniques.

UNIT II FLOOR-PLANNING: **9**

Planning: Hierarchical Design, Wire Length Estimation, Slicing and Non-Slicing Floor Plan, Polar Graph Representation, Operator Concept, Stockmeyer Algorithm for Floor Planning, Mixed Integer Linear Program.

UNIT III PLACEMENT **9**

Design Types: ASICS, SOC, Microprocessor RLM; Placement Techniques: Simulated Annealing, Partition Based, Analytical, and Hall's Quadratic; Timing and Congestion Considerations

UNIT IV ROUTING **9**

Detailed, Global and Specialized Routing, Channel Ordering, Channel Routing Problems and Constraint Graphs, Routing Algorithms, Yoshimura And Kuh's Method, Zone Scanning and Net Merging, Boundary Terminal Problem, Minimum Density Spanning Forest Problem, Topological Routing, Cluster Graph Representation.

UNIT V SEQUENTIAL LOGIC OPTIMIZATION AND CELL BINDING **9**

State Based Optimization, State Minimization, Algorithms; Library Binding and Its Algorithms, Concurrent Binding.

TOTAL:45 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

1. Graph Algorithms
   - Graph Search Algorithms
   - Spanning Tree Algorithm
   - Shortest Path Algorithm
   - Steiner Tree Algorithm
2. Partitioning Algorithms
   - Group Migration Algorithms
   - Simulated Annealing And Evolution Algorithms
   - Metric Allocation Method

3. Floor Planning Algorithms
   - Constraint Based Methods
   - Integer Programming Based Method
   - Rectangular Dualization Based Methods
   - Hierarchical Tree Based Methods
   - Simulated Evolution Algorithms
   - Time Driven Floor planning Algorithms
4. Routing Algorithms
   - Two Terminal Algorithms
   - Multi Terminal Algorithm

COURSE OUTCOMES:

At the end of this course, the students should will be able to:

CO1:Students can know how to place the blocks and how to partition the blocks while for designing the layout for IC.

CO2:Students can solve the performance issues in circuit layout.

CO3:Students are able to analyze physical design problems and employ appropriate automation algorithms for partitioning, floor planning, placement and routing

CO4:Students can decompose large mapping problem into pieces, including logic optimization with partitioning, placement and routing

CO5:Students can analyze circuits using both analytical and CAD tools

TOTAL:45+30=75 PERIODS

REFERENCES

1. Sarrafzadeh, M. and Wong, C.K, “An Introduction to VLSI Physical Design”, 4th Edition, Mc Graw-Hill
2. Wolf. W, “Modern VLSI Design System on Silicon”, 2nd Ed., Pearson Education.
3. Dreschler, “Evolutionary Algorithms for VLSI CAD ”, 3rd Edition, Springer.
4. Sait, S.M, And Youssef, “VLSI Physical Design Automation: Theory And Practice”, 1999, World Scientific Publishing Company.
5. Sherwani, “Algorithms for VLSI Physical Design Automation”, 2nd Edition, Kluwer

CO-PO Mapping

CO	POs					
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4	1	0	1	1	2	0
5	1	0	1	1	2	0
Avg	(5/5)=1	(0/0)=0	(5/5)=1	(5/5)=1	(10/5)=2	(0/0)=0

AUDIT COURSES

AX4091 ENGLISH FOR RESEARCH PAPER WRITING L T P C
2 0 0 0

COURSE OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III TITLE WRITING SKILLS 6

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission

TOTAL: 30 PERIODS

COURSE OUTCOMES

CO1 –Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

REFERENCES:

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	1	1	1	1	1
2	1	1	1	1	1	1
3	1	1	1	1	1	1
4	1	1	1	1	1	1
5	1	1	1	1	1	1
Avg	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1

AX 4092 DISASTER MANAGEMENT L T P C
2 0 0 0

COURSE OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION 6

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA 6

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT 6

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

COURSE OUTCOMES:

CO1: Ability to summarize basics of disaster

CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.

CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

CO5: Ability to develop the strengths and weaknesses of disaster management approaches

REFERENCES:

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	1	1	1	1	1
2	1	1	1	1	1	1
3	1	1	1	1	1	1
4	1	1	1	1	1	1
5	1	1	1	1	1	1
Avg	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1

AX4093 CONSTITUTION OF INDIA L T P C

2 0 0 0

COURSE OBJECTIVES:

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization
- of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	1	1	1	1	1
2	1	1	1	1	1	1
3	1	1	1	1	1	1
4	1	1	1	1	1	1
5	1	1	1	1	1	1
Avg	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1

AX4094 **நற்றமிழ் இலக்கியம்** **L T P C**
2 0 0 0

UNIT I **சங்க இலக்கியம்** **6**

1.தமிழின் துவக்க நூல் தொல்காப்பியம்
– எழுத்து, சொல், பொருள்
2.அகநானூறு (82)
- இயற்கை இன்னிசை அரங்கம்
3.குறிஞ்சிப் பாட்டின் மலர்க்காட்சி
4.புறநானூறு (95,195)
- போரை நிறுத்திய ஔவையார்

UNIT II **அறநெறித் தமிழ்** **6**

1. அறநெறி வகுத்த திருவள்ளுவர்
- அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புரவறிதல், ஈகை, புகழ்
2. பிற அறநூல்கள் - இலக்கிய மருந்து
– ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை (தூய்மையை வலியுறுத்தும் நூல்)

UNIT III **இரட்டைக் காப்பியங்கள்** **6**

1. கண்ணகியின் புரட்சி
- சிலப்பதிகார வழக்குரை காதை
2. சமூகசேவை இலக்கியம் மணிமேகலை
- சிறைக்கோட்டம் அறக்கோட்டமாகிய காதை

UNIT IV **அருள்நெறித் தமிழ்** **6**

1. சிறுபாணாற்றுப்படை
- பாரி முல்லைக்குத் தேர் கொடுத்தது, பேகன் மயிலுக்குப் போர்வை கொடுத்தது, அதியமான் ஔவைக்கு நெல்லிக்கனி கொடுத்தது, அரசர் பண்புகள்

2. நற்றிணை
   - அன்னைக்குரிய புன்னை சிறப்பு
3. திருமந்திரம் (617, 618)
   - இயமம் நியமம் விதிகள்
4. தர்மச்சாலையை நிறுவிய வள்ளலார்
5. புறநானூறு
   - சிறுவனே வள்ளலானான்
6. அகநானூறு (4) - வண்டு
   நற்றிணை (11) - நண்டு
   கலித்தொகை (11) - யானை, புறா
   ஐந்திணை 50 (27) - மான்

ஆகியவை பற்றிய செய்திகள்

UNIT V **நவீன தமிழ் இலக்கியம்** **6**

1. உரைநடைத் தமிழ்,
   - தமிழின் முதல் புதினம்,
   - தமிழின் முதல் சிறுகதை,
   - கட்டுரை இலக்கியம்,
   - பயண இலக்கியம்,
   - நாடகம்,
2. நாட்டு விடுதலை போராட்டமும் தமிழ் இலக்கியமும்,
3. சமுதாய விடுதலையும் தமிழ் இலக்கியமும்,
4. பெண் விடுதலையும் விளிம்பு நிலையினரின் மேம்பாட்டில் தமிழ் இலக்கியமும்,
5. அறிவியல் தமிழ்,
6. இணையத்தில் தமிழ்,
7. சுற்றுச்சூழல் மேம்பாட்டில் தமிழ் இலக்கியம்.

TOTAL: 30 PERIODS

<u>தமிழ் இலக்கிய வெளியீடுகள் / புத்தகங்கள்</u>

1. தமிழ் இணைய கல்விக்கழகம் (Tamil Virtual University)
   - www.tamilvu.org
2. தமிழ் விக்கிப்பீடியா (Tamil Wikipedia)
   -https://ta.wikipedia.org
3. தர்மபுர ஆதீன வெளியீடு
4. வாழ்வியல் களஞ்சியம்
   - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்
5. தமிழ்கலைக் களஞ்சியம்
   - தமிழ் வளர்ச்சித் துறை (thamilvalarchithurai.com)
6. அறிவியல் களஞ்சியம்
   - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	1	1	1	1	1
2	1	1	1	1	1	1
3	1	1	1	1	1	1
4	1	1	1	1	1	1
5	1	1	1	1	1	1
Avg	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1	(5/5)=1

OPEN ELECTIVES

OCE431 INTEGRATED WATER RESOURCES MANAGEMENT L T P C
3 0 0 3

OBJECTIVE

- Students will be introduced to the concepts and principles of IWRM, which is inclusive of the economics, public-private partnership, water & health, water & food security and legal & regulatory settings.

UNIT I CONTEXT FOR IWRM 9

Water as a global issue: key challenges – Definition of IWRM within the broader context of development – Key elements of IWRM - Principles – Paradigm shift in water management - Complexity of the IWRM process – UN World Water Assessment - SDGs.

UNIT II WATER ECONOMICS 9

Economic view of water issues: economic characteristics of water good and services – Non-market monetary valuation methods – Water economic instruments – Private sector involvement in water resources management: PPP objectives, PPP models, PPP processes, PPP experiences through case studies.

UNIT III LEGAL AND REGULATORY SETTINGS 9

Basic notion of law and governance: principles of international and national law in the area of water management - Understanding UN law on non-navigable uses of international water courses – International law for groundwater management – World Water Forums – Global Water Partnerships - Development of IWRM in line with legal and regulatory framework.

UNIT IV WATER AND HEALTH WITHIN THE IWRM CONTEXT 9

Links between water and health: options to include water management interventions for health – Health protection and promotion in the context of IWRM – Global burden of Diseases - Health impact assessment of water resources development projects – Case studies.

UNIT V AGRICULTURE IN THE CONCEPT OF IWRM 9

Water for food production: 'blue' versus 'green' water debate – Water foot print - Virtual water trade for achieving global water and food security –- Irrigation efficiencies, irrigation methods - current water pricing policy– scope to relook pricing.

TOTAL: 45 PERIODS

OUTCOMES

- On completion of the course, the student is expected to be able to

CO1	Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.
CO2	Select the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.
CO3	Apply law and governance in the context of IWRM.
CO4	Discuss the linkages between water-health; develop a HIA framework.
CO5	Analyse how the virtual water concept pave way to alternate policy options.

REFERENCES:

1. Cech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York. 2003.
2. Mollinga .P. etal " Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006.
3. Technical Advisory Committee, Integrated Water Resources management, Technical Advisory Committee Background Paper No: 4. Global water partnership, Stockholm, Sweden. 2002.
4. Technical Advisory Committee, Dublin principles for water as reflected in comparative assessment of institutional and legal arrangements for Integrated Water Resources Management, Technical Advisory Committee Background paper No: 3. Global water partnership, Stockholm, Sweden. 1999.
5. Technical Advisory Committee, Effective Water Governance". Technical Advisory Committee Background paper No: 7. Global water partnership, Stockholm, Sweden, 2003.

OCE432 WATER, SANITATION AND HEALTH L T P C

3 0 0 3

OBJECTIVES:

• Understand the accelerating health impacts due to the present managerial aspects and initiatives in water and sanitation and health sectors in the developing scenario

UNIT I FUNDAMENTALS WASH 9

Meanings and Definition: Safe Water- Health, Nexus: Water- Sanitation - Health and Hygiene – Equity issues-Water security - Food Security. Sanitation And Hygiene (WASH) and Integrated Water Resources Management (IWRM) - Need and Importance of WASH

UNIT II MANAGERIAL IMPLICATIONS AND IMPACT 9

Third World Scenario – Poor and Multidimensional Deprivation--Health Burden in Developing Scenario -Factors contribute to water, sanitation and hygiene related diseases-Social: Social Stratification and Literacy Demography: Population and Migration- Fertility - Mortality-Environment: Water Borne-Water Washed and Water Based Diseases - Economic: Wage - Water and Health Budgeting -Psychological: Non-compliance - Disease Relapse - Political: Political Will.

UNIT III CHALLENGES IN MANAGEMENT AND DEVELOPMENT 9

Common Challenges in WASH - Bureaucracy and Users- Water Utilities -Sectoral Allocation:-Infrastructure- Service Delivery: Health services: Macro and Micro- level: Community and Gender Issues- Equity Issues - Paradigm Shift: Democratization of Reforms and Initiatives.

UNIT IV GOVERNANCE 9

Public health -Community Health Assessment and Improvement Planning (CHA/CHIP)- Infrastructure and Investments on Water, (WASH) - Cost Benefit Analysis – Institutional Intervention-Public Private Partnership - Policy Directives - Social Insurance -Political Will vs Participatory Governance -

UNIT V INITIATIVES 9

Management vs Development -Accelerating Development- Development Indicators -Inclusive Development-Global and Local- Millennium Development Goal (MDG) and Targets - Five Year Plans - Implementation - Capacity Building - Case studies on WASH.

TOTAL: 45 PERIODS

OUTCOMES:

CO1	Capture to fundamental concepts and terms which are to be applied and understood all through the study.
CO2	Comprehend the various factors affecting water sanitation and health through the lens of third world scenario.
CO3	Critically analyse and articulate the underlying common challenges in water, sanitation and health.
CO4	Acquire knowledge on the attributes of governance and its say on water sanitation and health.
CO5	Gain an overarching insight in to the aspects of sustainable resource management in the absence of a clear level playing field in the developmental aspects.

REFERENCES

1. Bonitha R., Beaglehole R.,Kjellstorm, 2006, “Basic Epidemiology”, 2nd Edition, World Health Organization.

2. Van Note Chism, N. and Bickford, D. J. (2002), Improving the environment for learning: An expanded agenda. New Directions for Teaching and Learning, 2002: 91–98. doi: 10.1002/tl.83Improving the Environment for learning: An Expanded Agenda

3. National Research Council. *Global Issues in Water, Sanitation, and Health: Workshop Summary***.** Washington, DC: The National Academies Press, 2009.

4. Sen, Amartya 1997. On Economic Inequality. Enlarged edition, with annex by JamesFoster and Amartya Sen, Oxford: Claredon Press, 1997.

5. Intersectoral Water Allocation Planning and Management, 2000, World Bank Publishers www. Amazon.com

6. Third World Network.org (www.twn.org).

OCE433 PRINCIPLES OF SUSTAINABLE DEVELOPMENT L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge on environmental, social and economic dimensions of sustainability and the principles evolved through landmark events so as to develop an action mindset for sustainable development.

UNIT I SUSTAINABILITY AND DEVELOPMENT CHALLEGES 9

Definition of sustainability – environmental, economical and social dimensions of sustainability - sustainable development models – strong and weak sustainability – defining development-millennium development goals – mindsets for sustainability: earthly, analytical, precautionary, action and collaborative– syndromes of global change: utilisation syndromes, development syndromes, and sink syndromes – core problems and cross cutting Issues of the 21 century - global, regional and local environmental issues – social insecurity - resource degradation –climate change – desertification.

UNIT II PRINCIPLES AND FRAME WORK 9

History and emergence of the concept of sustainable development - our common future - Stockholm to Rio plus 20– Rio Principles of sustainable development – Agenda 21 natural step-peoples earth charter – business charter for sustainable development –UN Global Compact - Role of civil society, business and government – United Nations' 2030 Agenda for sustainable development – 17 sustainable development goals and targets, indicators and intervention areas

UNIT III SUSTAINABLE DEVELOPMENT AND WELLBEING 9

The Unjust World and inequities - Quality of Life - Poverty, Population and Pollution - Combating Poverty - - Demographic dynamics of sustainability - Strategies to end Rural and Urban Poverty and Hunger – Sustainable Livelihood Framework- Health, Education and Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities and Industry for Prevention, Precaution , Preservation and Public participation.

UNIT IV SUSTAINABLE SOCIO-ECONOMIC SYSTEMS 10

Sustainable Development Goals and Linkage to Sustainable Consumption and Production – Investing in Natural Capital- Agriculture, Forests, Fisheries - Food security and nutrition and sustainable agriculture- Water and sanitation - Biodiversity conservation and Ecosystem integrity – Ecotourism - Sustainable Cities – Sustainable Habitats- Green Buildings - Sustainable Transportation –– Sustainable Mining - Sustainable Energy– Climate Change –Mitigation and Adaptation - Safeguarding Marine Resources - Financial Resources and Mechanisms

UNIT V ASSESSING PROGRESS AND WAY FORWARD 8

Nature of sustainable development strategies and current practice**-** Sustainability in global, regional and national context –Approaches to measuring and analysing sustainability– limitations of GDP-Ecological Footprint- Human Development Index- Human Development Report – National initiatives for Sustainable Development - Hurdles to Sustainability - Science and Technology for sustainable development –Performance indicators of sustainability and Assessment mechanism – Inclusive Green Growth and Green Economy – National Sustainable Development Strategy Planning and National Status of Sustainable Development Goals

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1	Explain and evaluate current challenges to sustainability, including modern world social, environmental, and economic structures and crises.
CO2	Identify and critically analyze the social environmental, and economic dimensions of sustainability in terms of UN Sustainable development goals
CO3	Develop a fair understanding of the social, economic and ecological linkage of Human well being, production and consumption

CO4	Evaluate sustainability issues and solutions using a holistic approach that focuses on connections between complex human and natural systems.
CO5	Integrate knowledge from multiple sources and perspectives to understand environmental limits governing human societies and economies and social justice dimensions of sustainability.

REFERENCES:

1. Tom Theis and Jonathan Tomkin, Sustainability: A Comprehensive Foundation, Rice University, Houston, Texas, 2012
2. A guide to SDG interactions:from science to implementation, International Council for Science, Paris,2017
3. Karel Mulder, Sustainable Development for Engineers - A Handbook and Resource Guide, Rouledge Taylor and Francis, 2017.
4. The New Global Frontier - Urbanization, Poverty and Environmentin the 21st Century - *George Martine,Gordon McGranahan,Mark Montgomery and Rogelio Fernández-Castilla,* IIED and UNFPA, Earthscan, UK, 2008
5. Nolberto Munier, Introduction to Sustainability: Road to a Better Future, Springer, 2006
6. Barry Dalal Clayton and Stephen Bass, Sustainable Development Strategies- a resource book", Earthscan Publications Ltd, London, 2002.

OCE434 ENVIRONMENTAL IMPACT ASSESSMENT L T P C

3 0 0 3

OBJECTIVES:

- To make the students to understand environmental clearance, its legal requirements and to provide knowledge on overall methodology of EIA, prediction tools and models, environmental management plan and case studies.

UNIT I INTRODUCTION 9

Historical development of Environmental Impact Assessment (EIA). Environmental Clearance- EIA in project cycle. legal and regulatory aspects in India – types and limitations of EIA –EIA process-screening – scoping - terms of reference in EIA- setting – analysis – mitigation. Cross sectoral issues –public hearing in EIA- EIA consultant accreditation.

UNIT II IMPACT INDENTIFICATION AND PREDICTION 10

Matrices – networks – checklists – cost benefit analysis – analysis of alternatives – expert systems in EIA. prediction tools for EIA – mathematical modeling for impact prediction – assessment of impacts – air – water – soil – noise – biological — cumulative impact assessment

UNIT III SOCIO-ECONOMIC IMPACT ASSESSMENT 8

Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. communities in transition-rehabilitation

UNIT IV EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN 9

Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment

UNIT V CASE STUDIES 9

Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1	Understand need for environmental clearance, its legal procedure, need of EIA, its types, stakeholders and their roles
CO2	Understand various impact identification methodologies, prediction techniques and model of impacts on various environments
CO3	Understand relationship between social impacts and change in community due to development activities and rehabilitation methods
CO4	Document the EIA findings and prepare environmental management and monitoring plan
CO5	Identify, predict and assess impacts of similar projects based on case studies

REFERENCES:

1. EIA Notification 2006 including recent amendments, by Ministry of Environment, Forest and Climate Change, Government of India

2. Sectoral Guidelines under EIA Notification by Ministry of Environment, Forest and Climate Change, Government of India

3. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996

4. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey. 2003

5. Lee N. and George C. 2000. Environmental Assessment in Developing and Transitional Countries. Chichester: Willey

6. World Bank –Source book on EIA ,1999

7. Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification Assessment and Control, 4th Edition, Butterworth Heineman, 2012.

OIC431 BLOCKCHAIN TECHNOLOGIES L T P C

3 0 0 3

COURSE OBJECTIVES:

- This course is intended to study the basics of Blockchain technology.
- During this course the learner will explore various aspects of Blockchain technology like application in various domains.
- By implementing, learners will have idea about private and public Blockchain, and smart contract.

UNIT I INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN 9

Introduction to Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.

UNIT II BITCOIN AND CRYPTOCURRENCY 9

Introduction to Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, Blockchain and Digital Currency, Transactional Blocks, Impact of Blockchain Technology on Cryptocurrency.

UNIT III INTRODUCTION TO ETHEREUM 9

Introduction to Ethereum, Consensus Mechanisms, Metamask Setup, Ethereum Accounts, , Transactions, Receiving Ethers, Smart Contracts.

UNIT-IV INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING 10

Introduction to Hyperledger, Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer. Solidity - Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types.

UNIT V BLOCKCHAIN APPLICATIONS 8

Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After the completion of this course, student will be able to

CO1: Understand and explore the working of Blockchain technology

CO2: Analyze the working of Smart Contracts

CO3: Understand and analyze the working of Hyperledger

CO4: Apply the learning of solidity to build de-centralized apps on Ethereum

CO5: Develop applications on Blockchain

REFERENCES:

1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018.

2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction” Princeton University Press, 2016

3. Antonopoulos, Mastering Bitcoin, O’Reilly Publishing, 2014. .

4. Antonopoulos and G. Wood, “Mastering Ethereum: Building Smart Contracts and Dapps”, O’Reilly Publishing, 2018.

5. D. Drescher, Blockchain Basics. Apress, 2017.

OIC432 **DEEP LEARNING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Develop and Train Deep Neural Networks.
- Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
- Build and train RNNs, work with NLP and Word Embeddings
- The internal structure of LSTM and GRU and the differences between them
- The Auto Encoders for Image Processing

UNIT I DEEP LEARNING CONCEPTS **6**

Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.

UNIT II NEURAL NETWORKS **9**

About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Overfitting and Underfitting. Hyperparameters.

UNIT III CONVOLUTIONAL NEURAL NETWORK **10**

About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers. Dense Layers. Backpropagation Through the Convolutional Layer. Filters and Feature Maps. Backpropagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, Microsoft ResNet Model. R-CNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO

UNIT IV NATURAL LANGUAGE PROCESSING USING RNN **10**

About NLP & its Toolkits. Language Modeling . Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Co-occurrence Statistics–based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation GloVe. Backpropagation Through Time. Bidirectional RNNs (BRNN) . Long Short Term Memory (LSTM). Bi-directional LSTM. Sequence-to-Sequence Models (Seq2Seq). Gated recurrent unit GRU.

UNIT V DEEP REINFORCEMENT & UNSUPERVISED LEARNING **10**

About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Autoencoding. Convolutional Auto Encoding. Variational Auto Encoding. Generative Adversarial Networks. Autoencoders for Feature Extraction. Auto Encoders for Classification. Denoising Autoencoders. Sparse Autoencoders

COURSE OUTCOMES:

CO1: Feature Extraction from Image and Video Data
CO2: Implement Image Segmentation and Instance Segmentation in Images
CO3: Implement image recognition and image classification using a pretrained network (Transfer

Learning)
CO4: Traffic Information analysis using Twitter Data
CO5: Autoencoder for Classification & Feature Extraction

TOTAL : 45 PERIODS

REFERENCES

1. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc.2017
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
3. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017
5. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017

OME431 VIBRATION AND NOISE CONTROL STRATEGIES L T P C
3 0 0 3

OBJECTIVES

- To appreciate the basic concepts of vibration in damped and undamped systems
- To appreciate the basic concepts of noise, its effect on hearing and related terminology
- To use the instruments for measuring and analyzing the vibration levels in a body
- To use the instruments for measuring and analyzing the noise levels in a system
- To learn the standards of vibration and noise levels and their control techniques

UNIT- I BASICS OF VIBRATION 9

Introduction – Sources and causes of Vibration-Mathematical Models - Displacement, velocity and Acceleration - Classification of vibration: free and forced vibration, undamped and damped vibration, linear and non-linear vibration - Single Degree Freedom Systems - Vibration isolation - Determination of natural frequencies

UNIT- II BASICS OF NOISE 9

Introduction - Anatomy of human ear - Mechanism of hearing - Amplitude, frequency, wavelength and sound pressure level - Relationship between sound power, sound intensity and sound pressure level - Addition, subtraction and averaging decibel levels - sound spectra -Types of sound fields - Octave band analysis - Loudness.

UNIT- III INSTRUMENTATION FOR VIBRATION MEASUREMENT 9

Experimental Methods in Vibration Analysis.- Vibration Measuring Instruments - Selection of Sensors - Accelerometer Mountings - Vibration Exciters - Mechanical, Hydraulic, Electromagnetic and Electrodynamics – Frequency Measuring Instruments -. System Identification from Frequency Response -Testing for resonance and mode shapes

UNIT- IV INSTRUMENTATION FOR NOISE MEASUREMENT AND ANALYSIS 9

Microphones - Weighting networks - Sound Level meters, its classes and calibration - Noise measurements using sound level meters - Data Loggers - Sound exposure meters - Recording of noise - Spectrum analyser - Intensity meters - Energy density sensors - Sound source localization.

UNIT- V METHODS OF VIBRATION CONTROL, SOURCES OF NOISE AND ITS CONTROL 9

Specification of Vibration Limits – Vibration severity standards - Vibration as condition Monitoring Tool – Case Studies - Vibration Isolation methods - Dynamic Vibration Absorber – Need for Balancing - Static and Dynamic Balancing machines – Field balancing - Major sources of noise - Noise survey techniques – Measurement technique for vehicular noise - Road vehicles Noise standard – Noise due to construction equipment and domestic appliances – Industrial noise sources and its strategies – Noise control at the source – Noise control along the path – Acoustic Barriers – Noise control at the receiver -- Sound transmission through barriers – Noise reduction Vs Transmission loss - Enclosures

TOTAL: 45 PERIODS

OUTCOMES:

On Completion of the course the student will be able to

1. apply the basic concepts of vibration in damped and undamped systems
2. apply the basic concepts of noise and to understand its effects on systems
3. select the instruments required for vibration measurement and its analysis
4. select the instruments required for noise measurement and its analysis.
5. recognize the noise sources and to control the vibration levels in a body and to control noise under different strategies.

REFERENCES:

1. Singiresu S. Rao, “Mechanical Vibrations”, Pearson Education Incorporated, 2017.
2. Graham Kelly. Sand Shashidhar K. Kudari, “Mechanical Vibrations”, Tata McGraw –Hill Publishing Com. Ltd., 2007.
3. Ramamurti. V, “Mechanical Vibration Practice with Basic Theory”, Narosa Publishing House, 2000.
4. William T. Thomson, “Theory of Vibration with Applications”, Taylor & Francis, 2003.
5. G.K. Grover, “Mechanical Vibrations”, Nem Chand and Bros.,Roorkee, 2014.
6. A.G. Ambekar, “Mechanical Vibrations and Noise Engineering”, PHI Learning Pvt. Ltd., 2014.
7. David A. Bies and Colin H. Hansen, “Engineering Noise Control – Theory and Practice”, Spon Press, London and New York, 2009.

OME432 ENERGY CONSERVATION AND MANAGEMENT IN DOMESTIC SECTORS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To learn the present energy scenario and the need for energy conservation.
2. To understand the different measures for energy conservation in utilities.
3. Acquaint students with principle theories, materials, and construction techniques to create energy efficient buildings.
4. To identify the energy demand and bridge the gap with suitable technology for sustainable habitat
5. To get familiar with the energy technology, current status of research and find the ways to optimize a system as per the user requirement

UNIT I ENERGY SCENARIO 9

Primary energy resources - Sectorial energy consumption (domestic, industrial and other sectors), Energy pricing, Energy conservation and its importance, Energy Conservation Act-2001 and its features – Energy star rating.

UNIT II HEATING, VENTILLATION & AIR CONDITIONING 9

Basics of Refrigeration and Air Conditioning – COP / EER / SEC Evaluation – SPV system design & optimization for Solar Refrigeration.

UNIT III LIGHTING, COMPUTER, TV 9

Specification of Luminaries – Types – Efficacy – Selection & Application – Time Sensors – Occupancy Sensors – Energy conservation measures in computer – Television – Electronic devices.

UNIT IV ENERGY EFFICIENT BUILDINGS 9

Conventional versus Energy efficient buildings – Landscape design – Envelope heat loss and heat gain – Passive cooling and heating – Renewable sources integration.

UNIT V ENERGY STORAGE TECHNOLOGIES 9

Necessity & types of energy storage – Thermal energy storage – Battery energy storage, charging and discharging– Hydrogen energy storage & Super capacitors – energy density and safety issues – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Understand technical aspects of energy conservation scenario.
2. Energy audit in any type for domestic buildings and suggest the conservation measures.
3. Perform building load estimates and design the energy efficient landscape system.
4. Gain knowledge to utilize an appliance/device sustainably.
5. Understand the status and current technological advancement in energy storage field.

REFERENCES:

1. Yogi Goswami, Frank Kreith, Energy Efficiency and Renewable energy Handbook, CRC Press, 2016
2. ASHRAE Handbook 2020 – HVAC Systems & Equipment
3. Paolo Bertoldi, Andrea Ricci, Anibal de Almeida, Energy Efficiency in Household Appliances and Lighting, Conference proceedings, Springer, 2001
4. David A. Bainbridge, Ken Haggard, Kenneth L. Haggard, Passive Solar Architecture: Heating, Cooling, Ventilation, Daylighting, and More Using Natural Flows, Chelsea Green Publishing, 2011.
5. Guide book for National Certification Examination for Energy Managers and Energy Auditors

(Could be downloaded from www.energymanagertraining.com)

6. Ibrahim Dincer and Mark A. Rosen, Thermal Energy Storage Systems and Applications, John Wiley & Sons 2002.
7. Robert Huggins, Energy Storage: Fundamentals, Materials and Applications, 2nd edition, Springer, 2015

8. Ru-shiliu, Leizhang, Xueliang sun, Electrochemical technologies for energy storage and conversion, Wiley publications, 2012.

OME433 ADDITIVE MANUFACTURING L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Need - Development - Rapid Prototyping Rapid Tooling – Rapid Manufacturing – Additive Manufacturing. AM Process Chain- Classification – Benefits.

UNIT II DESIGN FOR ADDITIVE MANUFACTURING 9

CAD Model Preparation - Part Orientation and Support Structure Generation -Model Slicing - Tool Path Generation Customized Design and Fabrication - Case Studies.

UNIT III VAT POLYMERIZATION 9

Stereolithography Apparatus (SLA)- Materials -Process -Advantages Limitations- Applications. Digital Light Processing (DLP) - Materials – Process - Advantages - Applications. Multi Jet Modelling (MJM) - Principles - Process - Materials - Advantages and Limitations.

UNIT IV MATERIAL EXTRUSION AND SHEET LAMINATION 9

Fused Deposition Modeling (FDM)- Process-Materials - Applications and Limitations. Sheet Lamination Process: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding – Thermal Bonding- Materials- Application and Limitation - Bio-Additive Manufacturing Computer Aided Tissue Engineering (CATE) – Case studies

POWDER BASED PROCESS

Selective Laser Sintering (SLS): Process –Mechanism– Typical Materials and Application- Multi Jet Fusion - Basic Principle-– Materials- Application and Limitation - Three Dimensional Printing - Materials -Process - Benefits and Limitations. Selective Laser Melting (SLM) and Electron Beam Melting (EBM): Materials – Process - Advantages and Applications. Beam Deposition Process: Laser Engineered Net Shaping (LENS)- Process -Material Delivery - Process Parameters - Materials -Benefits -Applications.

UNIT V CASE STUDIES AND OPPORTUNITIES ADDITIVE MANUFACTURING PROCESSES 9

Education and training - Automobile- pattern and mould - tooling - Building Printing-Bio Printing - medical implants -development of surgical tools Food Printing -Printing Electronics. Business Opportunities and Future Directions - Intellectual Property.

TOTAL: 45 PERIODS

REFERENCES:

1. Andreas Gebhardt and Jan-Steffen Hötter “Additive Manufacturing: 3D Printing for Prototyping and Manufacturing”, Hanser publications, United States, 2015, ISBN: 978-1- 56990-582-1.
2. Ian Gibson, David W. Rosen and Brent Stucker “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, 2nd edition, Springer., United States, 2015, ISBN13: 978-1493921126.
3. Amit Bandyopadhyay and Susmita Bose, “Additive Manufacturing”, 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590

4. Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing”, Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
5. Chua C.K., Leong K.F., and Lim C.S., “Rapid prototyping: Principles and applications”, Third edition, World Scientific Publishers, 2010.

OME434 ELECTRIC VEHICLE TECHNOLOGY L T P C
3 0 0 3

UNIT I NEED FOR ELECTRIC VEHICLES 9

History and need for electric and hybrid vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies, comparison of diesel, petrol, electric and hybrid vehicles, limitations, technical challenges

UNIT II ELECTRIC VEHICLE ARCHITECHTURE 9

Electric vehicle types, layout and power delivery, performance – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, Concepts of hybrid electric drive train, architecture of series and parallel hybrid electric drive train, merits and demerits, mild and full hybrids, plug-in hybrid electric vehicles and range extended hybrid electric vehicles, Fuel cell vehicles.

UNIT III ENERGY STORAGE 9

Batteries – types – lead acid batteries, nickel based batteries, and lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, Battery modeling and equivalent circuit, battery charging and types, battery cooling, Ultra-capacitors, Flywheel technology, Hydrogen fuel cell, Thermal Management of the PEM fuel cell

UNIT IV ELECTRIC DRIVES AND CONTROL 9

Types of electric motors – working principle of AC and DC motors, advantages and limitations, DC motor drives and control, Induction motor drives and control, PMSM and brushless DC motor - drives and control , AC and Switch reluctance motor drives and control – Drive system efficiency – Inverters – DC and AC motor speed controllers

UNIT V DESIGN OF ELECTRIC VEHICLES 9

Materials and types of production, Chassis skate board design, motor sizing, power pack sizing, component matching, Ideal gear box – Gear ratio, torque–speed characteristics, Dynamic equation of vehicle motion, Maximum tractive effort – Power train tractive effort Acceleration performance, rated vehicle velocity – maximum gradability, Brake performance, Electronic control system, safety and challenges in electric vehicles. Case study of Nissan leaf, Toyota Prius, tesla model 3, and Renault Zoe cars.

TOTAL: 45 PERIODS

REFERENCES:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, 2nd edition CRC Press, 2011.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

3. James Larminie, John Lowry, Electric Vehicle Technology Explained - Wiley, 2003.
4. Ehsani, M, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2005

OME435	NEW PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Applying the principles of generic development process; and understanding the organization structure for new product design and development.

2. Identfying opportunity and planning for new product design and development.

3. Conducting customer need analysis; and setting product specification for new product design and development.

4. Generating, selecting, and testing the concepts for new product design and development.

5. Appling the principles of Industrial design and prototype for new product design and development.

UNIT I INTRODUCTION TO PRODUCTDESIGN & DEVELOPMENT 9

Introduction – Characteristics of Successful Product Development – People involved in Product Design and Development – Duration and Cost of Product Development – The Challenges of Product Development – The Product Development Process – Concept Development: The Front-End Process – Adapting the Generic Product Development Process – Product Development Process Flows – Product Development Organizations.

UNIT II OPPORTUNITY DENTIFICATION & PRODUCT PLANNING 9

Opportunity Identification: Definition – Types of Opportunities – Tournament Structure of Opportunity Identification – Effective Opportunity Tournaments – Opportunity Identification Process – Product Planning: Four types of Product Development Projects – The Process of Product Planning.

UNIT III IDENTIFYING CUSTOMER NEEDS & PRODUCT SPECIFICATIONS 9

Identifying Customer Needs: The Importance of Latent Needs – The Process of Identifying Customer Needs. Product Specifications: Definition – Time of Specifications Establishment – Establishing Target Specifications – Setting the Final Specifications

UNIT IV CONCEPT GENERATION, SELECTION & TESTING 9

Concept Generation: Activity of Concept Generation – Structured Approach – Five step method of Concept Generation. Concept Selection: Methodology – Concept Screening and Concepts Scoring. Concept testing: Seven Step activities of concept testing.

UNITV INDUSTRIAL DESIGN & PROTOTYPING 9

Industrial Design: Need and Impact–Industrial Design Process. Prototyping – Principles of Prototyping – Prototyping Technologies – Planning for Prototypes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Apply the principles of generic development process; and understand the organization structure for new product design and development.

2. Identify opportunity and plan for new product design and development.

3. Conduct customer need analysis; and set product specification for new product design and development.

4. Generate, select, and test the concepts for new product design and development.

5. Apply the principles of Industrial design and prototype for design and develop new products.

TEXT BOOK:

1. Ulrich K.T., Eppinger S. D. and Anita Goyal, "Product Design and Development "McGraw-Hill Education; 7 edition, 2020.

REFERENCES:

1. Belz A., 36-Hour Course: "Product Development" McGraw-Hill, 2010.

2. Rosenthal S.,"Effective Product Design and Development", Business One Orwin,Homewood, 1992,ISBN1-55623-603-4.

3. Pugh.S,"Total Design Integrated Methods for Successful Product Engineering", Addison Wesley Publishing,1991,ISBN0-202-41639-5.

4. Chitale, A. K. and Gupta, R. C., Product Design and Manufacturing, PHI Learning, 2013.

5. Jamnia, A., Introduction to Product Design and Development for Engineers, CRC Press, 2018.

OBA431 SUSTAINABLE MANAGEMENT LT P C
3 0 0 3

COURSE OBJECTIVES:

- To provide students with fundamental knowledge of the notion of corporate sustainability.
- To determine how organizations impacts on the environment and socio-technical systems, the relationship between social and environmental performance and competitiveness, the approaches and methods.

UNIT I MANAGEMENT OF SUSTAINABILITY 9

Management of sustainability -rationale and political trends: An introduction to sustainability management, International and European policies on sustainable development, theoretical pillars in sustainability management studies.

UNIT II CORPORATE SUSTAINABILITY AND RESPONSIBILITY 9

Corporate sustainability parameter, corporate sustainability institutional framework, integration of sustainability into strategic planning and regular business practices, fundamentals of stakeholder engagement.

UNIT III SUSTAINABILITY MANAGEMENT: STRATEGIES AND APPROACHES 9

Corporate sustainability management and competitiveness: Sustainability-oriented corporate strategies, markets and competitiveness, Green Management between theory and practice, Sustainable Consumption and Green Marketing strategies, Environmental regulation and strategic postures; Green Management approaches and tools; Green engineering: clean technologies and innovation processes; Sustainable Supply Chain Management and Procurement.

UNIT IV SUSTAINABILITY AND INNOVATION 9

Socio-technical transitions and sustainability, Sustainable entrepreneurship, Sustainable pioneers in green market niches, Smart communities and smart specializations.

UNIT V SUSTAINABLE MANAGEMENT OF RESOURCES, COMMODITIES AND COMMONS 9

Energy management, Water management, Waste management, Wild Life Conservation, Emerging trends in sustainable management, Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: An understanding of sustainability management as an approach to aid in evaluating and minimizing environmental impacts while achieving the expected social impact.
CO2: An understanding of corporate sustainability and responsible Business Practices
CO3: Knowledge and skills to understand, to measure and interpret sustainabilityperformances.
CO4: Knowledge of innovative practices in sustainable business and community management
CO5: Deep understanding of sustainable management of resources and commodities

REFERENCES:

1. Daddi, T., Iraldo, F., Testa, Environmental Certification for Organizations and Products: Management, 2015
2. Christian N. Madu, Handbook of Sustainability Management 2012
3. Petra Molthan-Hill, The Business Student's Guide to Sustainable Management: Principles and Practice, 2014
4. Margaret Robertson, Sustainability Principles and Practice, 2014
5. Peter Rogers, An Introduction to Sustainable Development, 2006

OBA432 MICRO AND SMALL BUSINESS MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES

- To familiarize students with the theory and practice of small business management.
- To learn the legal issues faced by small business and how they impact operations.

UNIT I INTRODUCTION TO SMALL BUSINESS 9

Creation, Innovation, entrepreneurship and small business - Defining Small Business –Role of Owner – Manager – government policy towards small business sector –elements of entrepreneurship –evolution of entrepreneurship –Types of Entrepreneurship – social, civic, corporate - Business life cycle - barriers and triggers to new venture creation – process to assist start ups – small business and family business.

UNIT II SCREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN 9

Concepts of opportunity recognition; Key factors leading to new venture failure; New venture screening process; Applying new venture screening process to the early stage small firm Role planning in small business – importance of strategy formulation – management skills for small business creation and development.

UNIT III BUILDING THE RIGHT TEAM AND MARKETING STRATEGY 9

Management and Leadership – employee assessments – Tuckman's stages of group development - The entrepreneurial process model - Delegation and team building - Comparison of HR management in small and large firms - Importance of coaching and how to apply a coaching model.

Marketing within the small business - success strategies for small business marketing - customer delight and business generating systems, - market research, - assessing market performance-sales management and strategy - the marketing mix and marketing strategy.

UNIT IV FINANCING SMALL BUSINESS 9

Main sources of entrepreneurial capital; Nature of 'bootstrap' financing - Difference between cash and profit - Nature of bank financing and equity financing - Funding-equity gap for small firms. Importance of working capital cycle - Calculation of break-even point - Power of gross profit margin- Pricing for profit - Credit policy issues and relating these to cash flow management and profitability.

UNIT V VALUING SMALL BUSINESS AND CRISIS MANAGEMENT 9

Causes of small business failure - Danger signals of impending trouble - Characteristics of poorly performing firms - Turnaround strategies - Concept of business valuation - Different valuation measurements - Nature of goodwill and how to measure it - Advantages and disadvantages of buying an established small firm - Process of preparing a business for sale.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1. Familiarise the students with the concept of small business

CO2. In depth knowledge on small business opportunities and challenges

CO3. Ability to devise plans for small business by building the right skills and marketing strategies

CO4. Identify the funding source for small start ups

CO5. Business evaluation for buying and selling of small firms

REFERENCES

1. Hankinson,A.(2000). "The key factors in the profile of small firm owner-managers that influence business performance. The South Coast Small Firms Survey, 1997-2000." Industrial and Commercial Training 32(3):94-98.

2. Parker,R.(2000). "Small is not necessarily beautiful: An evaluation of policy support for small and medium-sized enterprise in Australia." Australian Journal of Political Science 35(2):239-253.

3. Journal articles on SME's.

OBA433 INTELLECTUAL PROPERTY RIGHTS L T P C
3 0 0 3

COURSE OBJECTIVE

- To understand intellectual property rights and its valuation.

UNIT I INTRODUCTION 9

Intellectual property rights - Introduction, Basic concepts, Patents, Copyrights, Trademarks, Trade Secrets, Geographic Indicators; Nature of Intellectual Property, Technological Research, Inventions and Innovations, History - the way from WTO to WIPO, TRIPS.

UNIT II PROCESS 9

New Developments in IPR, Procedure for grant of Patents, TM, GIs, Patenting under Patent Cooperation Treaty, Administration of Patent system in India, Patenting in foreign countries.

UNIT III STATUTES 9

International Treaties and conventions on IPRs, The TRIPs Agreement, PCT Agreement, The Patent Act of India, Patent Amendment Act (2005), Design Act, Trademark Act, Geographical Indication Act, Bayh- Dole Act and Issues of Academic Entrepreneurship.

UNIT IV STRATEGIES IN INTELLECTUAL PROPERTY 9

Strategies for investing in R&D, Patent Information and databases, IPR strength in India, Traditional Knowledge, Case studies.

UNIT V MODELS 9

The technologies Know-how, concept of ownership, Significance of IP in Value Creation, IP Valuation and IP Valuation Models, Application of Real Option Model in Strategic Decision Making, Transfer and Licensing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: Understanding of intellectual property and appreciation of the need to protect it
CO2: Awareness about the process of patenting
CO3: Understanding of the statutes related to IPR
CO4: Ability to apply strategies to protect intellectual property
CO5: Ability to apply models for making strategic decisions related to IPR

REFERENCES

1. V. Sople Vinod, Managing Intellectual Property by (Prentice hall of India Pvt.Ltd), 2006.
2. Intellectual Property rights and copyrights, EssEss Publications.
3. Primer, R. Anita Rao and Bhanoji Rao, Intellectual Property Rights, Lastain Book company.
4. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2006.
5. WIPO Intellectual Property Hand book.

OBA434 ETHICAL MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVE

- To help students develop knowledge and competence in ethical management and decision making in organizational contexts.

UNIT I ETHICS AND SOCIETY 9

Ethical Management- Definition, Motivation, Advantages-Practical implications of ethical management. Managerial ethics, professional ethics, and social Responsibility-Role of culture and society's expectations- Individual and organizational responsibility to society and the community.

UNIT II ETHICAL DECISION MAKING AND MANAGEMENT IN A CRISIS 9

Managing in an ethical crisis, the nature of a crisis, ethics in crisis management, discuss case studies, analyze real-world scenarios, develop ethical management skills, knowledge, and competencies. Proactive crisis management.

UNIT III STAKEHOLDERS IN ETHICAL MANAGEMENT 9

Stakeholders in ethical management, identifying internal and external stakeholders, nature of stakeholders, ethical management of various kinds of stakeholders: customers (product and service issues), employees (leadership, fairness, justice, diversity) suppliers, collaborators, business, community, the natural environment (the sustainability imperative, green management, Contemporary issues).

UNIT IV INDIVIDUAL VARIABLES IN ETHICAL MANJAGEMENT 9

Understanding individual variables in ethics, managerial ethics, concepts in ethical psychology-ethical awareness, ethical courage, ethical judgment, ethical foundations, ethical emotions/intuitions/intensity. Utilization of these concepts and competencies for ethical decision-making and management.

UNIT V PRACTICAL FIELD-GUIDE, TECHNIQUES AND SKILLS 9

Ethical management in practice, development of techniques and skills, navigating challenges and dilemmas, resolving issues and preventing unethical management proactively. Role modelling and creating a culture of ethical management and human flourishing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: Role modelling and influencing the ethical and cultural context.
CO2: Respond to ethical crises and proactively address potential crises situations.
CO3: Understand and implement stakeholder management decisions.
CO4: Develop the ability, knowledge, and skills for ethical management.
CO5: Develop practical skills to navigate, resolve and thrive in management situations

REFERENCES

1. Brad Agle, Aaron Miller, Bill O' Rourke, The Business Ethics Field Guide: the essential companion to leading your career and your company, 2016.

2. Steiner & Steiner, Business, Government & Society: A managerial Perspective, 2011.

3. Lawrence & Weber, Business and Society: Stakeholders, Ethics, Public Policy, 2020.

ET4251 **IoT FOR SMART SYSTEMS** **LT P C**
3 0 0 3

COURSE OBJECTIVES:

1. To study about **Internet of Things** technologies and its role in real time applications.
2. To introduce the infrastructure required for IoT
3. To familiarize the accessories and communication techniques for IoT.
4. To provide insight about the embedded processor and sensors required for IoT
5. To familiarize the different platforms and Attributes for IoT

UNIT I INTRODUCTION TO INTERNET OF THINGS 9

Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.

UNIT II IOT ARCHITECTURE 9

IoT reference model and architecture -Node Structure - Sensing, Processing, Communication, Powering, Networking - Topologies, Layer/Stack architecture**,** IoT standards, Cloud computing for IoT, Bluetooth, Bluetooth Low Energy beacons.

UNIT III PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT 9

PROTOCOLS:

NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe GSM, CDMA, LTE, GPRS, small cell.

Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems-Recent trends.

UNIT IV IOT PROCESSORS 9

Services/Attributes: Big-Data Analytics for IOT, Dependability,Interoperability, Security, Maintainability.

Embedded processors for IOT :Introduction to Python programming -Building IOT with RASPERRY PI and Arduino.

UNIT V CASE STUDIES 9

Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Analyze the concepts of IoT and its present developments.
CO2: Compare and contrast different platforms and infrastructures available for IoT
CO3: Explain different protocols and communication technologies used in IoT
CO4: Analyze the big data analytic and programming of IoT
CO5: Implement IoT solutions for smart applications

REFERENCES:

1. ArshdeepBahga and VijaiMadisetti : A Hands-on Approach “Internet of Things”,Universities Press 2015.
2. Oliver Hersent , David Boswarthick and Omar Elloumi “ The Internet of Things”, Wiley,2016.
3. Samuel Greengard, “ The Internet of Things”, The MIT press, 2015.
4. Adrian McEwen and Hakim Cassimally“Designing the Internet of Things “Wiley,2014.
5. Jean- Philippe Vasseur, Adam Dunkels, “Interconnecting Smart Objects with IP: The Next Internet” Morgan Kuffmann Publishers, 2010.
6. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, John Wiley and sons, 2014.
7. Lingyang Song/DusitNiyato/ Zhu Han/ Ekram Hossain,” Wireless Device-to-Device Communications and Networks, CAMBRIDGE UNIVERSITY PRESS,2015.
8. OvidiuVermesan and Peter Friess (Editors), “Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers Series in Communication, 2013.
9. Vijay Madisetti , ArshdeepBahga, “Internet of Things (A Hands on-Approach)”, 2014.
10. Zach Shelby, Carsten Bormann, “6LoWPAN: The Wireless Embedded Internet”, John Wiley and sons, 2009.
11. Lars T.Berger and Krzysztof Iniewski, “Smart Grid applications, communications and security”, Wiley, 2015.
12. JanakaEkanayake, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama and Nick Jenkins, “ Smart Grid Technology and Applications”, Wiley, 2015.
13. UpenaDalal,”Wireless Communications & Networks,Oxford,2015.

ET4072 MACHINE LEARNING AND DEEP LEARNING L T P C

3 0 0 3

COURSE OBJECTIVES:

The course is aimed at

1. Understanding about the learning problem and algorithms
2. Providing insight about neural networks
3. Introducing the machine learning fundamentals and significance
4. Enabling the students to acquire knowledge about pattern recognition.
5. Motivating the students to apply deep learning algorithms for solving real life problems.

UNIT I LEARNING PROBLEMS AND ALGORITHMS 9

Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms

UNIT II NEURAL NETWORKS 9

Differences between Biological and Artificial Neural Networks - Typical Architecture, Common Activation Functions, Multi-layer neural network, Linear Separability, Hebb Net, Perceptron, Adaline, Standard Back propagation Training Algorithms for Pattern Association - Hebb rule and Delta rule, Hetero associative, Auto associative, Kohonen Self Organising Maps, Examples of Feature Maps, Learning Vector Quantization, Gradient descent, Boltzmann Machine Learning.

UNIT III MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS 9

Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1- Score, the curse of dimensionality, training, testing, validation, cross validation, overfitting, under-fitting the data, early stopping, regularization, bias and variance. Feature Selection, normalization, dimensionality reduction, Classifiers: KNN, SVM, Decision trees, Naïve Bayes, Binary classification, multi class classification, clustering.

UNIT IV DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS 9

Feed forward networks, Activation functions, back propagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.

UNIT V DEEP LEARNING: RNNS, AUTOENCODERS AND GANS 9

State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs

TOTAL : 45 PERIODS

COURSE OUTCOMES (CO):

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

CO1 : Illustrate the categorization of machine learning algorithms.

CO2: Compare and contrast the types of neural network architectures, activation functions

CO3: Acquaint with the pattern association using neural networks

CO4: Elaborate various terminologies related with pattern recognition and architectures of convolutional neural networks

CO5: Construct different feature selection and classification techniques and advanced neural network architectures such as RNN, Autoencoders, and GANs.

REFERENCES:

1. J. S. R. Jang, C. T. Sun, E. Mizutani, Neuro Fuzzy and Soft Computing - A Computational Approach to Learning and Machine Intelligence, 2012, PHI learning
2. Deep Learning, Ian Good fellow, YoshuaBengio and Aaron Courville, MIT Press, ISBN: 9780262035613, 2016.
3. The Elements of Statistical Learning. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Second Edition. 2009.
4. Pattern Recognition and Machine Learning. Christopher Bishop. Springer. 2006.
5. Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017.

PX4012 RENEWABLE ENERGY TECHNOLOGY L T P C

3 0 0 3

OBJECTIVES:

To impart knowledge on

- Different types of renewable energy technologies
- Standalone operation, grid connected operation of renewable energy systems

UNIT I INTRODUCTION 9

Classification of energy sources – Co2 Emission - Features of Renewable energy - Renewable energy scenario in India -Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment Per Capital Consumption - CO_2 Emission - importance of renewable energy sources, Potentials – Achievements– Applications.

UNIT II SOLAR PHOTOVOLTAICS 9

Solar Energy: Sun and Earth-Basic Characteristics of solar radiation- angle of sunrays on solar collector-Estimating Solar Radiation Empirically - Equivalent circuit of PV Cell- Photovoltaic cell-characteristics: P-V and I-V curve of cell-Impact of Temperature and Insolation on I-V characteristics-Shading Impacts on I-V characteristics-Bypass diode -Blocking diode.

UNIT III PHOTOVOLTAIC SYSTEM DESIGN 9

Block diagram of solar photo voltaic system : Line commutated converters (inversion mode) - Boost and buck-boost converters - selection of inverter, battery sizing, array sizing - PV systems classification- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.

UNIT IV WIND ENERGY CONVERSION SYSTEMS 9

Origin of Winds: Global and Local Winds- Aerodynamics of Wind turbine-Derivation of Betz's limit-Power available in wind-Classification of wind turbine: Horizontal Axis wind turbine and Vertical axis wind turbine- Aerodynamic Efficiency-Tip Speed-Tip Speed Ratio-Solidity-Blade Count-Power curve of wind turbine - Configurations of wind energy conversion systems: Type A, Type B, Type C and Type D Configurations- Grid connection Issues - Grid integrated SCIG and PMSG based WECS.

UNIT V OTHER RENEWABLE ENERGY SOURCES 9

Qualitative study of different renewable energy resources: ocean, Biomass, Hydrogen energy systems, Fuel cells, Ocean Thermal Energy Conversion (OTEC), Tidal and wave energy, Geothermal Energy Resources.

TOTAL : 45 PERIODS

OUTCOMES:

After completion of this course, the student will be able to:

CO1: Demonstrate the need for renewable energy sources.

CO2: Develop a stand-alone photo voltaic system and implement a maximum power point tracking in the PV system.

CO3: Design a stand-alone and Grid connected PV system.

CO4: Analyze the different configurations of the wind energy conversion systems.

CO5: Realize the basic of various available renewable energy sources

REFERENCES:

1. S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford UniversityPress, 2009.

2. Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.

3. Rai. G.D," Solar energy utilization", Khanna publishes, 1993.

4. Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Private Limited, 2012.

5. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006

6. Gray, L. Johnson, “Wind energy system”, prentice hall of India, 1995.
7. B.H.Khan, " Non-conventional Energy sources", , McGraw-hill, 2nd Edition, 2009.
8. Fang Lin Luo Hong Ye, " Renewable Energy systems", Taylor & Francis Group,2013.

PS4093 SMART GRID L T P C
3 0 0 3

COURSE OBJECTIVES

- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To know about the function of smart grid.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications
- To get familiarized with the communication networks for Smart Grid applications

UNIT I INTRODUCTION TO SMART GRID 9

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Comparison of Micro grid and Smart grid, Present development & International policies in Smart Grid, Smart Grid Initiative for Power Distribution Utility in India – Case Study.

UNIT II SMART GRID TECHNOLOGIES 9

Technology Drivers, Smart Integration of energy resources, Smart substations, Substation Automation, Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV) – Grid to Vehicle and Vehicle to Grid charging concepts.

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU) & their application for monitoring & protection. Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID 9

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Unit V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9

Architecture and Standards -Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), PLC, Zigbee, GSM, IP based Protocols, Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.

TOTAL : 45 PERIODS

COURSE OUTCOME:

Students able to

CO1: Relate with the smart resources, smart meters and other smart devices.

CO2: Explain the function of Smart Grid.

CO3: Experiment the issues of Power Quality in Smart Grid.

CO4: Analyze the performance of Smart Grid.

CO5**:** Recommend suitable communication networks for smart grid applications

REFERENCES

1. Stuart Borlase 'Smart Grid: Infrastructure, Technology and Solutions', CRC Press 2012.
2. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, 'Smart Grid: Technology and Applications', Wiley, 2012.
3. Mini S. Thomas, John D McDonald, 'Power System SCADA and Smart Grids', CRC Press, 2015
4. Kenneth C.Budka, Jayant G. Deshpande, Marina Thottan, 'Communication Networks for Smart Grids', Springer, 2014
5. SMART GRID Fundamentals of Design and Analysis, James Momoh, IEEE press, A John Wiley & Sons, Inc., Publication.

CP4391	SECURITY PRACTICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the core fundamentals of system and web security concepts
- To have through understanding in the security concepts related to networks
- To deploy the security essentials in IT Sector
- To be exposed to the concepts of Cyber Security and cloud security
- To perform a detailed study of Privacy and Storage security and related Issues

UNIT I SYSTEM SECURITY 9

Model of network security – Security attacks, services and mechanisms – OSI security architecture -A Cryptography primer- Intrusion detection system- Intrusion Prevention system - Security web applications- Case study: OWASP - Top 10 Web Application Security Risks.

UNIT II NETWORK SECURITY 9

Internet Security - Intranet security- Local Area Network Security - Wireless Network Security - Wireless Sensor Network Security- Cellular Network Security - Mobile security - IOT security - Case Study - Kali Linux.

UNIT III SECURITY MANAGEMENT 9

Information security essentials for IT Managers- Security Management System - Policy Driven System Management- IT Security - Online Identity and User Management System. Case study: Metasploit

UNIT IV CYBER SECURITY AND CLOUD SECURITY 9

Cyber Forensics- Disk Forensics – Network Forensics – Wireless Forensics – Database Forensics – Malware Forensics – Mobile Forensics – Email Forensics- Best security practices for automate Cloud infrastructure management – Establishing trust in IaaS, PaaS, and SaaS Cloud types. Case study: DVWA

UNIT V PRIVACY AND STORAGE SECURITY 9

Privacy on the Internet - Privacy Enhancing Technologies - Personal privacy Policies - Detection of Conflicts in security policies- privacy and security in environment monitoring systems. Storage Area Network Security - Storage Area Network Security Devices - Risk management - Physical Security Essentials.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Understand the core fundamentals of system security
CO2: Apply the security concepts to wired and wireless networks
CO3: Implement and Manage the security essentials in IT Sector
CO4: Explain the concepts of Cyber Security and Cyber forensics
CO5: Be aware of Privacy and Storage security Issues.

REFERENCES

1. John R. Vacca, Computer and Information Security Handbook, Third Edition, Elsevier 2017

2. Michael E. Whitman, Herbert J. Mattord, Principles of Information Security, Seventh Edition, Cengage Learning, 2022

3. Richard E. Smith, Elementary Information Security, Third Edition, Jones and Bartlett Learning, 2019

4. Mayor, K.K.Mookhey, Jacopo Cervini, Fairuzan Roslan, Kevin Beaver, Metasploit Toolkit for Penetration Testing, Exploit Development and Vulnerability Research, Syngress publications, Elsevier, 2007. ISBN : 978-1-59749-074-0

5. John Sammons, “The Basics of Digital Forensics- The Primer for Getting Started in Digital Forensics”, Syngress, 2012

6. Cory Altheide and Harlan Carvey, “Digital Forensics with Open Source Tools”,2011 Syngress, ISBN: 9781597495875.

7. Siani Pearson, George Yee "Privacy and Security for Cloud Computing" Computer Communications and Networks, Springer, 2013.

MP4251 CLOUD COMPUTING TECHNOLOGIES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To gain expertise in Virtualization, Virtual Machines and deploy practical virtualization solution
- To understand the architecture, infrastructure and delivery models of cloud computing.

- To explore the roster of AWS services and illustrate the way to make applications in AWS
- To gain knowledge in the working of Windows Azure and Storage services offered by Windows Azure
- To develop the cloud application using various programming model of Hadoop and Aneka

UNIT I VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE 6

Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines –Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization –Management Virtualization –– Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization- Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation

UNIT II CLOUD PLATFORM ARCHITECTURE 12

Cloud Computing: Definition, Characteristics - Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Architectural Design Challenges

UNIT III AWS CLOUD PLATFORM - IAAS 9

Amazon Web Services: AWS Infrastructure- AWS API- AWS Management Console - Setting up AWS Storage - Stretching out with Elastic Compute Cloud - Elastic Container Service for Kubernetes- AWS Developer Tools: AWS Code Commit, AWS Code Build, AWS Code Deploy, AWS Code Pipeline, AWS code Star - AWS Management Tools: Cloud Watch, AWS Auto Scaling, AWS control Tower, Cloud Formation, Cloud Trail, AWS License Manager

UNIT IV PAAS CLOUD PLATFORM 9

Windows Azure: Origin of Windows Azure, Features, The Fabric Controller – First Cloud APP in Windows Azure- Service Model and Managing Services: Definition and Configuration, Service runtime API- Windows Azure Developer Portal- Service Management API- Windows Azure Storage Characteristics-Storage Services- REST API- Blops

UNIT V PROGRAMMING MODEL 9

Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster- Aneka: Cloud Application Platform, Thread Programming, Task Programming and Map-Reduce Programming in Aneka

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Employ the concepts of virtualization in the cloud computing
CO2: Identify the architecture, infrastructure and delivery models of cloud computing
CO3: Develop the Cloud Application in AWS platform
CO4: Apply the concepts of Windows Azure to design Cloud Application
CO5: Develop services using various Cloud computing programming models.

REFERENCES

1. Bernard Golden, Amazon Web Service for Dummies, John Wiley & Sons, 2013.

2. Raoul Alongi, AWS: The Most Complete Guide to Amazon Web Service from Beginner to Advanced Level, Amazon Asia- Pacific Holdings Private Limited, 2019.

3. Sriram Krishnan, Programming: Windows Azure, O'Reilly,2010.

4. Rajkumar Buyya, Christian Vacchiola, S.Thamarai Selvi, Mastering Cloud Computing , MCGraw Hill Education (India) Pvt. Ltd., 2013.

5. Danielle Ruest, Nelson Ruest, —Virtualization: A Beginner"s Guide‖, McGraw-Hill Osborne Media, 2009.

6. Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.

7. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.

8. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.

9. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.

IF4072 **DESIGN THINKING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To provide a sound knowledge in UI & UX
- To understand the need for UI and UX
- Research Methods used in Design
- Tools used in UI & UX
- Creating a wireframe and prototype

UNIT I **UX LIFECYCLE TEMPLATE** **8**

Introduction. A UX process lifecycle template. Choosing a process instance for your project. The system complexity space. Meet the user interface team. Scope of UX presence within the team. More about UX lifecycles. Business Strategy. Value Innovation. Validated User Research. Killer UX Design. The Blockbuster Value Proposition. What Is a Value Proposition?.

UNIT II **CONTEXTUAL INQUIRY** **10**

The system concept statement. User work activity data gathering. Look for emotional aspects of work practice. Abridged contextual inquiry process. Data-driven vs. model-driven inquiry. Organizing concepts: work roles and flow model. Creating and managing work activity notes. Constructing your work activity affinity diagram (WAAD). Abridged contextual analysis process. History of affinity diagrams.

UNIT III **DESIGN THINKING, IDEATION, AND SKETCHING** **9**

Design-informing models: second span of the bridge . Some general "how to" suggestions. A New example domain: slideshow presentations. User models. Usage models. Work environment models. Barrier summaries. Model consolidation. Protecting your sources. Abridged methods for

design-informing models extraction. Design paradigms. Design thinking. Design perspectives. User personas. Ideation. Sketching

UNIT IV **UX GOALS, METRICS, AND TARGETS** **8**

Introduction. UX goals. UX target tables. Work roles, user classes, and UX goals. UX measures. Measuring instruments. UX metrics. Baseline level. Target level. Setting levels. Observed results. Practical tips and cautions for creating UX targets. How UX targets help manage the user experience engineering process.

UNIT V **ANALYSING USER EXPERIENCE** **10**

Sharpening Your Thinking Tools. UX Research and Strength of Evidence. Agile Personas. How to Prioritize Usability Problems. Creating Insights, Hypotheses and Testable Design Ideas. How to Manage Design Projects with User Experience Metrics. Two Measures that Will Justify Any Design Change. Evangelizing UX Research. How to Create a User Journey Map. Generating Solutions to Usability Problems. Building UX Research Into the Design Studio Methodology. Dealing with Common objections to UX Research. The User Experience Debrief Meeting. Creating a User Experience Dashboard.

SUGGESTED ACTIVITIES:

1: Hands on Design Thinking process for a product
2: Defining the Look and Feel of any new Project
3: Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
4: Identify a customer problem to solve.
5: Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1: Build UI for user Applications
CO2: Use the UI Interaction behaviors and principles
CO3: Evaluate UX design of any product or application
CO4: Demonstrate UX Skills in product development
CO5: Implement Sketching principles

REFERENCES

1. UX for Developers: How to Integrate User-Centered Design Principles Into Your Day-to-Day Development Work, Westley Knight. Apress, 2018

2. The UX Book: Process and Guidelines for Ensuring a Quality User Experience, Rex Hartson, Pardha Pyla. Morgan Kaufmann, 2012

3. UX Fundamentals for Non-UX Professionals: User Experience Principles for Managers, Writers, Designers, and Developers, Edward Stull. Apress, 2018

4. Lean UX: Designing Great Products with Agile Teams, Gothelf, Jeff, Seiden, and Josh. O'Reilly Media, 2016

5. Designing UX: Prototyping: Because Modern Design is Never Static, Ben Coleman, and Dan Goodwin. SitePoint, 2017

MU4153 **PRINCIPLES OF MULTIMEDIA** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To get familiarity with gamut of multimedia and its significance
- To acquire knowledge in multimedia components.
- To acquire knowledge about multimedia tools and authoring.
- To acquire knowledge in the development of multimedia applications.
- To explore the latest trends and technologies in multimedia

UNIT I INTRODUCTION **9**

Introduction to Multimedia – Characteristics of Multimedia Presentation – Multimedia Components – Promotion of Multimedia Based Components – Digital Representation – Media and Data Streams – Multimedia Architecture – Multimedia Documents, Multimedia Tasks and Concerns, Production, sharing and distribution, Hypermedia, WWW and Internet, Authoring, Multimedia over wireless and mobile networks.

Suggested Activities:

1. Flipped classroom on media Components.
2. External learning – Interactive presentation.

Suggested Evaluation Methods:

1. Tutorial – Handling media components
2. Quizzes on different types of data presentation.

UNIT II ELEMENTS OF MULTIMEDIA **9**

Text-Types, Font, Unicode Standard, File Formats, Graphics and Image data representations – data types, file formats, color models; video – color models in video, analog video, digital video, file formats, video display interfaces, 3D video and TV: Audio – Digitization, SNR, SQNR, quantization, audio quality, file formats, MIDI; Animation- Key Frames and Tweening, other Techniques, 2D and 3D Animation.

Suggested Activities:

1. Flipped classroom on different file formats of various media elements.
2. External learning – Adobe after effects, Adobe Media Encoder, Adobe Audition.

Suggested Evaluation Methods:

1. Demonstration on after effects animations.
2. Quizzes on file formats and color models.

UNIT III MULTIMEDIA TOOLS **9**

Authoring Tools – Features and Types – Card and Page Based Tools – Icon and Object Based Tools – Time Based Tools – Cross Platform Authoring Tools – Editing Tools – Painting and Drawing Tools – 3D Modeling and Animation Tools – Image Editing Tools – Sound Editing Tools – Digital Movie Tools.

Suggested Activities:

1. Flipped classroom on multimedia tools.
2. External learning – Comparison of various authoring tools.

Suggested Evaluation Methods:

1. Tutorial – Audio editing tool.
2. Quizzes on animation tools.

UNIT IV MULTIMEDIA SYSTEMS 9

Compression Types and Techniques: CODEC, Text Compression: GIF Coding Standards, JPEG standard – JPEG 2000, basic audio compression – ADPCM, MPEG Psychoacoustics, basic Video compression techniques – MPEG, H.26X – Multimedia Database System – User Interfaces – OS Multimedia Support – Hardware Support – Real Time Protocols – Play Back Architectures – Synchronization – Document Architecture – Hypermedia Concepts: Hypermedia Design – Digital Copyrights, Content analysis.

Suggested Activities:

1. Flipped classroom on concepts of multimedia hardware architectures.
2. External learning – Digital repositories and hypermedia design.

Suggested Evaluation Methods:

1. Quizzes on multimedia hardware and compression techniques.
2. Tutorial – Hypermedia design.

UNIT V MULTIMEDIA APPLICATIONS FOR THE WEB AND MOBILE PLATFORMS 9

ADDIE Model – Conceptualization – Content Collection – Storyboard–Script Authoring Metaphors – Testing – Report Writing – Documentation. Multimedia for the web and mobile platforms. Virtual Reality, Internet multimedia content distribution, Multimedia Information sharing – social media sharing, cloud computing for multimedia services, interactive cloud gaming. Multimedia information retrieval.

Suggested Activities:

1. External learning – Game consoles.
2. External learning – VRML scripting languages.

Suggested Evaluation Methods:

1. Demonstration of simple interactive games.
2. Tutorial – Simple VRML program.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1: Handle the multimedia elements effectively.
CO2: Articulate the concepts and techniques used in multimedia applications.
CO3: Develop effective strategies to deliver Quality of Experience in multimedia applications.
CO4: Design and implement algorithms and techniques applied to multimedia objects.
CO5: Design and develop multimedia applications following software engineering models.

REFERENCES:

1. Li, Ze-Nian, Drew, Mark, Liu, Jiangchuan, “Fundamentals of Multimedia”, Springer, Third Edition, 2021.
2. Prabhat K.Andleigh, Kiran Thakrar, “MULTIMEDIA SYSTEMS DESIGN”, Pearson Education, 2015.
3. Gerald Friedland, Ramesh Jain, “Multimedia Computing”, Cambridge University Press, 2018. (digital book)
4. Ranjan Parekh, “Principles of Multimedia”, Second Edition, McGraw-Hill Education, 2017

CX4016 ENVIRONMENTAL SUSTAINABILITY

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION **9**

Valuing the Environment: Concepts, Valuing the Environment: Methods, Property Rights, Externalities, and Environmental Problems

UNIT II CONCEPT OF SUSTAINABILITY **9**

Sustainable Development: Defining the Concept, the Population Problem, Natural Resource Economics: An Overview, Energy, Water, Agriculture

UNIT III SIGNIFICANCE OF BIODIVERSITY **9**

Biodiversity, Forest Habitat, Commercially Valuable Species, Stationary - Source Local Air Pollution, Acid Rain and Atmospheric Modification, Transportation

UNIT IV POLLUTION IMPACTS **9**

Water Pollution, Solid Waste and Recycling, Toxic Substances and Hazardous Wastes, Global Warming.

UNIT V ENVIRONMENTAL ECONOMICS **9**

Development, Poverty, and the Environment, Visions of the Future, Environmental economics and policy by Tom Tietenberg, Environmental Economics

TOTAL : 45 PERIODS

REFERENCES

1. Andrew Hoffman, Competitive Environmental Strategy - A Guide for the Changing Business Landscape, Island Press.
2. Stephen Doven, Environment and Sustainability Policy: Creation, Implementation, Evaluation, the Federation Press, 2005
3. Robert Brinkmann., Introduction to Sustainability, Wiley-Blackwell., 2016
4. Niko Roorda., Fundamentals of Sustainable Development, 3rd Edn, Routledge, 2020
5. Bhavik R Bakshi., Sustainable Engineering: Principles and Practice, Cambridge University Press, 2019

TX4092 TEXTILE REINFORCED COMPOSITES

L	T	P	C
3	0	0	3

UNIT I REINFORCEMENTS **9**

Introduction – composites –classification and application; reinforcements- fibres and its properties; preparation of reinforced materials and quality evaluation; preforms for various composites

UNIT II MATRICES **9**

Preparation, chemistry, properties and applications of thermoplastic and thermoset resins; mechanism of interaction of matrices and reinforcements; optimization of matrices

UNIT III COMPOSITE MANUFACTURING **9**

Classification; methods of composites manufacturing for both thermoplastics and thermosets- Hand layup, Filament Winding, Resin transfer moulding, prepregs and autoclave moulding, pultrusion, vacuum impregnation methods, compression moulding; post processing of

composites and composite design requirements

UNIT IV TESTING 9

Fibre volume and weight fraction, specif ic gravity of composites, tensile, f lexural, impact, compression, inter laminar shear stress and fatigue properties of thermoset and thermoplastic composites.

UNIT V MECHANICS 9

Micro mechanics, macro mechanics of single layer, macro mechanics of laminate, classical lamination theory, failure theories and prediction of inter laminar stresses using at ware

TOTAL: 45 PERIODS

REFERENCES

1. BorZ.Jang,"Advanced Polymer composites",ASM International,USA,1994.

2. Carlsson L.A. and Pipes R.B., "Experimental Characterization of advanced composite Materials",SecondEdition,CRCPress,NewJersey,1996.

3. George LubinandStanley T.Peters, "Handbook of Composites", Springer Publications,1998.

4. Mel. M. Schwartz, "Composite Materials", Vol. 1 &2, Prentice Hall PTR, New Jersey,1997.

5. RichardM.Christensen,"Mechanics of compositematerials",DoverPublications,2005.

6. Sanjay K. Mazumdar, "Composites Manufacturing: Materials, Product, and Process Engineering",CRCPress,2001

NT4002 NANOCOMPOSITE MATERIALS L T P C
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UNIT I BASICS OF NANOCOMPOSITES 9

Nomenclature, Properties, features and processing of nanocomposites. Sample Preparation and Characterization of Structure and Physical properties. Designing, stability and mechanical properties and applications of super hard nanocomposites.

UNIT II METAL BASED NANOCOMPOSITES 9

Metal-metal nanocomposites, some simple preparation techniques and their properties. Metal-Oxide or Metal-Ceramic composites, Different aspects of their preparation techniques and their final properties and functionality. Fractal based glass-metal nanocomposites, its designing and fractal dimension analysis. Core-Shell structured nanocomposites

UNIT III POLYMER BASED NANOCOMPOSITES 9

Preparation and characterization of diblock Copolymer based nanocomposites; Polymer Carbon nanotubes based composites, their mechanical properties, and industrial possibilities.

UNIT IV NANOCOMPOSITE FROM BIOMATERIALS 9

Natural nanocomposite systems - spider silk, bones, shells; organic-inorganic nanocomposite formation through self-assembly. Biomimetic synthesis of nanocomposites material; Use of synthetic nanocomposites for bone, teeth replacement.

UNIT V NANOCOMPOSITE TECHNOLOGY 9

Nanocomposite membrane structures- Preparation and applications. Nanotechnology in Textiles and Cosmetics-Nano-fillers embedded polypropylene fibers – Soil repellence, Lotus effect - Nano finishing in textiles (UV resistant, anti-bacterial, hydrophilic, self-cleaning, flame retardant finishes), Sun-screen dispersions for UV protection using titanium oxide – Colour cosmetics. Nanotechnology in Food Technology - Nanopackaging for enhanced shelf life - Smart/Intelligent packaging.

TOTAL : 45 PERIODS

REFERENCES:

1. Introduction to Nanocomposite Materials. Properties, Processing, Characterization- Thomas E. Twardowski. 2007. DEStech Publications. USA.
2. Nanocomposites Science and Technology - P. M. Ajayan, L.S. Schadler, P. V.Braun 2006.
3. Physical Properties of Carbon Nanotubes- R. Saito 1998.
4. Carbon Nanotubes (Carbon , Vol 33) - M. Endo, S. Iijima, M.S. Dresselhaus 1997.
5. The search for novel, superhard materials- Stan Vepr¡ek (Review Article) JVST A, 1999
6. Nanometer versus micrometer-sized particles-Christian Brosseau, Jamal BeN Youssef, Philippe Talbot, Anne-Marie Konn, (Review Article) J. Appl. Phys, Vol 93, 2003
7. Diblock Copolymer, - Aviram (Review Article), Nature, 2002
8. Bikramjit Basu, Kantesh Balani Advanced Structural Ceramics, A John Wiley & Sons, Inc.,
9. P. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead publication, London, 2006

BY4016 IPR, BIOSAFETY AND ENTREPRENEURSHIP L T P C

3 0 0 3

UNIT I IPR 9

Intellectual property rights – Origin of the patent regime – Early patents act & Indian pharmaceutical industry – Types of patents – Patent Requirements – Application preparation filing and prosecution – Patentable subject matter – Industrial design, Protection of GMO's IP as a factor in R&D,IP's of relevance to biotechnology and few case studies.

UNIT II AGREEMENTS, TREATIES AND PATENT FILING PROCEDURES 9

History of GATT Agreement – Madrid Agreement – Hague Agreement – WIPO Treaties – Budapest Treaty – PCT – Ordinary – PCT – Conventional – Divisional and Patent of Addition – Specifications – Provisional and complete – Forms and fees Invention in context of "prior art" – Patent databases – Searching International Databases – Country-wise patent searches (USPTO,espacenet(EPO) – PATENT Scope (WIPO) – IPO, etc National & PCT filing procedure – Time frame and cost – Status of the patent applications filed – Precautions while patenting – disclosure/non-disclosure – Financial assistance for patenting – Introduction to existing schemes Patent licensing and agreement Patent infringement – Meaning, scope, litigation, case studies

UNIT III BIOSAFETY 9

Introduction – Historical Backround – Introduction to Biological Safety Cabinets – Primary Containment for Biohazards – Biosafety Levels – Biosafety Levels of Specific Microorganisms – Recommended Biosafety Levels for Infectious Agents and Infected Animals – Biosafety guidelines – Government of India.

UNIT IV GENETICALLY MODIFIED ORGANISMS 9

Definition of GMOs & LMOs – Roles of Institutional Biosafety Committee – RCGM – GEAC etc. for GMO applications in food and agriculture – Environmental release of GMOs – Risk Analysis – Risk Assessment – Risk management and communication – Overview of National Regulations and relevant International Agreements including Cartegana Protocol.

UNIT V ENTREPRENEURSHIP DEVELOPMENT 9

Introduction – Entrepreneurship Concept – Entrepreneurship as a career – Entrepreneurial personality – Characteristics of successful Entrepreneur – Factors affecting entrepreneurial growth – Entrepreneurial Motivation – Competencies – Mobility – Entrepreneurship Development Programmes (EDP) - Launching Of Small Enterprise - Definition, Characteristics – Relationship between small and large units – Opportunities for an Entrepreneurial career – Role of small enterprise in economic development – Problems of small scale industries – Institutional finance to entrepreneurs - Institutional support to entrepreneurs.

TOTAL : 45 PERIODS

REFERENCES

1. Bouchoux, D.E., “Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets for the Paralegal”, 3rd Edition, Delmar Cengage Learning, 2008.

2. Fleming, D.O. and Hunt, D.L., “Biological Safety: Principles and Practices”, 4th Edition, American Society for Microbiology, 2006.

3. Irish, V., “Intellectual Property Rights for Engineers”, 2nd Edition, The Institution of Engineering and Technology, 2005.

4. Mueller, M.J., “Patent Law”, 3rd Edition, Wolters Kluwer Law & Business, 2009.

5. Young, T., “Genetically Modified Organisms and Biosafety: A Background Paper for Decision-Makers and Others to Assist in Consideration of GMO Issues” 1st Edition, World Conservation Union, 2004.

6. S.S Khanka, “Entrepreneurial Development”, S.Chand & Company LTD, New Delhi, 2007.