ANNA UNIVERSITY: CHENNAI 600 025
NON AUTONOMOUS COLLEGES AFFILIATED TO ANNA UNIVERSITY
REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM

M.E. EMBEDDED SYSTEM TECHNOLOGIES

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I.	To provide students good foundation in mathematical, scientific, engineering fundamentals and hardware-software programming intelligence.
II.	To develop among students, the ability to develop embedded systems based smart solutions for purpose of system automation
III.	To promote student awareness, for life-long learning and introduce them to professional ethics and code of practice.
IV.	To encourage students, to work in interdisciplinary groups.

2. PROGRAMMEOUTCOMES (POs):

PO	Programme Outcomes
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.	Be able to design and develop Embedded system automation based on dedicated ICs that have computation, networking and control capacity.
5.	Skill to work on professional software languages, standard modeling and analysis tools & commercial packages with communication protocols and computation platforms for analysis and design of system automation.
6.	To involve in research on an industrial problem or develop an innovative smart system with automation as a consumer product through project management and finance with due concerned for socio economic values

PROGRESS THROUGH KNOWLEDGE

4. PEO/PO Mapping:

PEO	PO					
	1	2	3	4	5	6
I.	1	1	2	1	3	1
II.	1	2	1	3	2	2
III.	3	2	1	1	1	3
IV.	1	1	1	1	1	2

1,2,3,-, scale against the correlation PO's with PEO's

PROGRAM ARTICULATION MATRIX OF PG EMBEDDED SYSTEM TECHNOLOGIES

		COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6
YEAR I	SEMESTER I	Design of Embedded Systems	2	2	2	2.4	1	2
		Software for Embedded Systems	1	2	1.5	1.5	2.2	2
		Microcontroller Based System Design	1	-	2	2	1.5	-
		VLSI Design and Reconfigurable Architecture	2	1	2	2.4	2	1
		Embedded System Laboratory - I	2	2	1.4	1.2	2.5	1.5
		Embedded Programming Laboratory -I	2	1	2	1.5	2.4	1.5
	SEMESTER II	Real Time Operating System	2	2	1.8	1.5	2.2	1.75
		Embedded System Networking	2.25	2	2.7	3	2.3	1.8
		Embedded Control for Electric Drives	1	1.5	2.7	1	2.7	2
		IoT for Smart Systems	1.75	2	2.33	2.33	3	2
		Embedded System Laboratory - II	1.75	2	2.4	2.25	2	1.75
		Embedded Programming Laboratory -II	2	2.25	2.4	2.2	2.75	2.25
		Professional Elective I						
		Professional Elective II						
YEAR II	SEMESTER III	Project Phase I	2.8	3	3	3	3	3
		Professional Elective III						
		Professional Elective IV						
		Professional Elective V						
	SEMESTER IV	Project Phase II	2.8	3	3	3	3	3

PROGRESS THROUGH KNOWLEDGE

Professional Elective I & Professional Elective II

COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6
Wireless And Mobile Communication	3	3	2	2	2	2
Virtual Instrumentation	2	2.5	2.4	2.75	2	2
Embedded Processor Development	2.33	3	2.4	2	2.75	3
Automotive Embedded System	2.75	2.8	2.4	2.4	2.75	2.2
Intelligent Control and Automation	2.4	1.75	2.2	2.2	3	1.67
Unmanned Aerial Vehicle	2.5	3	2.6	3	3	2.4
DSP Based System Design	2.67	3	3	2.33	3	2.67
Machine Learning and Deep Learning	2.42	3	2.57	-	3	-

Professional Elective III, Professional Elective IV & Professional Elective V

COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6
Computer Vision	2.6	2.8	2.6	2.75	3	2.67
Multimedia Communications	2.33	-	1	2.5	2.66	2
Embedded Networking and Automation of Electrical System	2.2	1	2	2	2.66	1.25
Smart System Design	2	3	2	2	2.5	3
Embedded Computing	2.4	1.5	1.8	3	2	2.25
Embedded Systems Security	2.2	1.8	2.33	1.33	2.33	2
Robotics and Automation	1	2.5	2	2	3	2
Reconfigurable Processor and SoC Design	-	1.5	2.66	1	2	3
MEMS and NEMS Technology	3	2.6	2.8	2	2.4	2.25
Entrepreneurship and Embedded Product Development	3	2.6	3	1.5	3	2
Embedded System for Biomedical Applications	1.66	2.25	2.2	3	2.5	2.5
Python Programming for Machine Learning	2.66	1.33	2.5	3	3	2.33
Renewable Energy and Grid Integration						
Electric Vehicles and Power Management						
Smart Grid						

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M.E. EMBEDDED SYSTEM TECHNOLOGIES

I TO IV SEMESTERS CURRICULUM AND SYLLABUS

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA4103	Applied Mathematics for Embedded Systems Technologists	FC	3	1	0	4	4
2.	RM4151	Research Methodology and IPR	RMC	2	0	0	2	2
3.	ET4101	Design of Embedded Systems	PCC	3	0	0	3	3
4.	ET4102	Software for Embedded Systems	PCC	3	0	0	3	3
5.	ET4103	Microcontroller Based System Design	PCC	3	0	0	3	3
6.	ET4104	VLSI Design and Reconfigurable Architecture	PCC	3	0	0	3	3
7.		Audit Course I*	AC	2	0	0	2	0
PRACTICALS								
8.	ET4111	Embedded System Laboratory - I	PCC	0	0	4	4	2
9.	ET4112	Embedded Programming Laboratory - I	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.	ET4201	Real Time Operating System	PCC	3	0	0	3	3
2.	ET4202	Embedded System Networking	PCC	3	0	0	3	3
3.	ET4203	Embedded Control for Electric Drives	PCC	3	0	0	3	3
4.	ET4251	IoT for Smart Systems	PCC	3	0	0	3	3
5.		Professional Elective I	PEC	3	0	0	3	3
6.		Professional Elective II	PEC	3	0	0	3	3
7.		Audit Course II*	AC	2	0	0	2	0
PRACTICALS								
8.	ET4211	Embedded System Laboratory - II	PCC	0	0	4	4	2
9.	ET4212	Embedded Programming Laboratory - II	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 III	PEC	3	0	0	3	3
2.		Professional Elective IV	PEC	3	0	0	3	3
3.		Professional Elective V	PEC	3	0	0	3	3
4.		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
5.	ET4311	Project Work I	EEC	0	0	12	12	6
			TOTAL	**12**	**0**	**12**	**24**	**18**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	ET4411	Project Work II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL NO. OF CREDITS: 74

PROGRESS THROUGH KNOWLEDGE

FOUNDATION COURSES (FC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			LECTURE	TUTORIAL	PRACTICAL		
1.	MA4103	Applied Mathematics for Embedded Systems Technologists	3	1	0	4	I

PROFESSIONAL CORE COURSES (PCC)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			LECTURE	TUTORIAL	PRACTICAL		
1.	ET4101	Design of Embedded Systems	3	0	0	3	I
2.	ET4102	Software for Embedded Systems	3	0	0	3	I
3.	ET4103	Microcontroller Based System Design	3	0	0	3	I
4.	ET4104	VLSI Design and Reconfigurable Architecture	3	0	0	3	I
5.	ET4111	Embedded System Laboratory - I	0	0	4	2	I
6.	ET4112	Embedded Programming Laboratory -I	0	0	4	2	I
7.	ET4201	Real Time Operating System	3	0	0	3	II
8.	ET4202	Embedded System Networking	3	3	0	3	II
9.	ET4203	Embedded Control for Electric Drives	3	0	0	3	II
10.	ET4251	IoT for Smart Systems	3	0	0	3	II
11.	ET4211	Embedded System Laboratory - II	0	0	4	2	II
12.	ET4212	Embedded Programming Laboratory -II	0	0	4	2	II
					TOTAL CREDITS	32	

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			LECTURE	TUTORIAL	RACTICAL		
1.	RM4151	Research Methodology and IPR	2	0	0	2	I
					TOTAL CREDITS	2	

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			LECTURE	TUTORIAL	PRACTICAL		
1.	ET4311	Project Work I	0	0	12	6	III
2.	ET4411	Project Work II	0	0	24	12	IV
					TOTAL CREDITS	18	

PROFESSIONAL ELECTIVES

SEMESTER II

ELECTIVE I & II

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	ET4001	Wireless And Mobile Communication	PEC	3	0	0	3	3
2.	ET4002	Virtual Instrumentation	PEC	3	0	0	3	3
3.	ET4003	Embedded Processor Development	PEC	3	0	0	3	3
4.	ET4004	Automotive Embedded System	PEC	3	0	0	3	3
5.	ET4005	Intelligent Control and Automation	PEC	3	0	0	3	3
6.	ET4006	Unmanned Aerial Vehicle	PEC	3	0	0	3	3
7.	ET4071	DSP Based System Design	PEC	3	0	0	3	3
8.	ET4072	Machine Learning and Deep Learning	PEC	3	0	0	3	3

SEMESTER III

ELECTIVE III, IV & V

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	ET4007	Computer Vision	PEC	3	0	0	3	3
2.	ET4008	Multimedia Communication	PEC	3	0	0	3	3
3.	ET4009	Embedded Networking and Automation of Electrical System	PEC	3	0	0	3	3
4.	ET4010	Smart System Design	PEC	3	0	0	3	3
5.	ET4011	Embedded Computing	PEC	3	0	0	3	3
6.	ET4012	Embedded Systems Security	PEC	3	0	0	3	3

7.	ET4013	Robotics and Automation	PEC	3	0	0	3	3
8.	ET4014	Reconfigurable Processor and SoC Design	PEC	3	0	0	3	3
9.	ET4015	MEMS and NEMS Technology	PEC	3	0	0	3	3
10.	ET4016	Entrepreneurship and Embedded Product Development	PEC	3	0	0	3	3
11.	ET4017	Embedded System for Biomedical Applications	PEC	3	0	0	3	3
12.	PS4092	Renewable Energy and Grid Integration	PEC	3	0	0	3	3
13.	PX4291	Electric Vehicles and Power Management	PEC	3	1	0	4	4
14.	ET4073	Python Programming for Machine Learning	PEC	3	0	0	3	3
15.	PS4093	Smart Grid	PEC	3	0	0	3	3

AUDIT COURSES - I

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.	CP4391	Security Practices	3	0	0	3
17.	MP4251	Cloud Computing Technologies	3	0	0	3
18.	IF4072	Design Thinking	3	0	0	3
19.	MU4153	Principles of Multimedia	3	0	0	3
20.	DS4015	Big Data Analytics	3	0	0	3
21.	NC4201	Internet of Things and Cloud	3	0	0	3
22.	MX4073	Medical Robotics	3	0	0	3
23.	VE4202	Embedded Automation	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

SUMMARY

	Name of the Programme: M.E.EMBEDDED SYSTEMS TECHNOLOGIES					
	SUBJECT AREA	**CREDITS PER SEMESTER**				**CREDITS TOTAL**
		I	**II**	**III**	**IV**	
1.	FC	4				4
2.	PCC	16	16			32
3.	PEC		6	9		15
4.	RMC	2				2
5.	OEC			3		3
6.	EEC			6	12	18
7.	Non Credit/Audit Course	0	0			0
8.	**TOTAL CREDIT**	**22**	**22**	**18**	**12**	**74**

MA4103 APPLIED MATHEMATICS FOR EMBEDDED SYSTEMS TECHNOLOGISTS **L T P C 3 1 0 4**

OBJECTIVES :

- To understand the techniques of Fourier transform to solve partial differential equations.
- To become familiar with graph theory for modelling the embedded system.
- To understand various optimization techniques for utilizing system and network resources.
- To understand the basic concepts of probability to apply in embedded technology.
- To understand the basic concept of random variables and queuing theories to address stochastic and dynamic environment in embedded technology.

UNIT I FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS **12**

Fourier transform : Definitions - Properties – Transform of elementary functions - Dirac delta function – Convolution theorem – Parseval's identity – Solutions to partial differential equations : Heat equation - Wave equation - Laplace and Poison's equations.

UNIT II GRAPH THEORY **12**

Introduction to paths, trees, vector spaces - Matrix coloring and directed graphs - Some basic algorithms – Shortest path algorithms – Depth - First search on a graph – Isomorphism – Other Graph - Theoretic algorithms – Performance of graph theoretic algorithms – Graph theoretic computer languages.

UNIT III OPTIMIZATION TECHNIQUES **12**

Linear programming - Basic concepts – Graphical and simplex methods – Big M method - Two phase simplex method - Revised simplex method - Transportation problems – Assignment problems .

UNIT IV PROBABILITY AND RANDOM VARIABLES **12**

Probability – Axioms of probability – Conditional probability – Baye's theorem - Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Exponential, Normal distributions – Two dimensional random variables - Poisson process.

UNIT V QUEUEING THEORY **12**

Single and multiple servers - Markovian queuing models - Finite and infinite capacity queues – Finite source model – Queuing applications.

TOTAL : 60 PERIODS

OUTCOMES :

Upon Completion of the course, the students will be able to

- Apply Fourier transform techniques to solve PDE technology.
- Model the networks in embedded systems using graph theory.
- Use the ideas of probability and random variables in solving engineering problems.
- Address stochastic and dynamic behavior of data transfer using queuing theories in embedded systems technologies.

REFERENCES :

1. Taha H .A., " Operations Research: An Introduction " , 9th Edition, Pearson Education Asia, New Delhi, 2016.
2. Walpole R.E., Myer R.H., Myer S.L., and Ye, K., " Probability and Statistics for Engineers and Scientists ", 7th Edition, Pearson Education, Delhi, 2002.
3. Sankara Rao, K., " Introduction to Partial Differential Equations ", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
4. Narasingh Deo, " Graph Theory with Applications to Engineering and Computer Science ", Prentice Hall India,1997.
5. S. S. Rao, " Engineering Optimization, Theory and Practice ", 4th Edition, John Wiley and Sons, 2009.

MAPPING OF CO'S WITH PO'S

CO	PO					
	1	2	3	4	5	6
1	3	2	2	1	3	2
2	3	2	2	2	3	2
3	3	2	2	2	3	3
4	3	2	2	1	3	3
5	3	2	2	3	3	3
AVG	3	2	2	1.8	3	2.6

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

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

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.

ET4101 DESIGN OF EMBEDDED SYSTEMS LT P C
3 0 0 3

COURSE OBJECTIVES:

1. To provide knowledge on the basics, building blocks of Embedded System.
2. To discuss Input/output Interfacing & Bus Communication with processors.
3. To teach automation using scheduling algorithms and Real time operating system.
4. To discuss on different Phases & Modeling of a new embedded product.
5. To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to Embedded Systems –built in features for embedded Target Architecture - selection of Embedded processor – DMA- memory devices – Memory management methods-memory mapping, cache replacement policies- Timer and Counting devices, Watchdog Timer, Real Time Clock-Software Development tools-IDE, assembler, compiler, linker, simulator, debugger, In circuit emulator, Target Hardware Debugging- Overview of functional safety standards for embedded systems.

UNIT II EMBEDDED NETWORKING BY PROCESSORS 9

Embedded Networking: Introduction, I/O Device Ports & Buses- multiple interrupts and interrupt service mechanism – Serial Bus communication protocols -RS232 standard–RS485–USB–Inter Integrated Circuits (I^2C)- CAN Bus –Wireless protocol based on Wifi , Bluetooth, Zigbee – Introduction to Device Drivers.

UNIT III RTOS BASED EMBEDDED SYSTEM DESIGN 9

Introduction to basic concepts of RTOS- Need, Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication-context switching, interrupt latency and deadline shared memory, message passing-, Interprocess Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: VxWorks, uC/OS-II, RT Linux.

UNIT IV MODELLING WITH HARDWARE/SOFTWARE DESIGN APPROACHES 9

Modelling embedded systems- embedded software development approach --Overview of UML modeling with UML, UML Diagrams-- Hardware/Software Partitioning , Co-Design Approaches for System Specification and modeling- CoSynthesis- features comparing Single-processor Architectures & Multi-Processor Architectures--design approach on parallelism in uniprocessors & Multiprocessors.

UNIT V EMBEDDED SYSTEM APPLICATION DEVELOPMENT 9

Objective, Need, different Phases & Modelling of the EDLC.choice of Target Architectures for Embedded Application Development-for Control Dominated-Data Dominated Systems-Case studies on Digital Camera, Adaptive Cruise control in a Car, Mobile Phone software for key inputs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will

CO1: Demonstrate the functionalities of processor internal blocks, with their requirement.

CO2: Analyze that Bus standards are chosen based on interface overheads without sacrificing processor performance

CO3: Explain the role and features of RT operating system, that makes multitask execution possible by processors.
CO4: Illustrate that using multiple CPU based on either hardcore or softcore helps data overhead management with processing- speed reduction for uC execution.
CO5: Recommend Embedded consumer product design based on phases of product development.

CO	PO					
	1	2	3	4	5	6
1	-	-	3	2	1	-
2	2	-	1	2	-	-
3	-	2	2	3	-	-
4	2	-	3	3	-	-
5	2	-	1	2	-	2
Avg.	2	2	2	2.4	1	2

REFERENCES:

1. Rajkamal, 'Embedded system-Architecture, Programming, Design', TMH,2011.
2. Peckol, "Embedded system Design",JohnWiley&Sons,2010
3. Lyla B Das," Embedded Systems-An Integrated Approach",Pearson2013
4. EliciaWhite,"Making Embedded Systems",O'Reilly Series,SPD,2011
5. Bruce Powel Douglass,"Real-Time UML Workshop for Embedded Systems,Elsevier,2011
6. Advanced Computer architecture , By Rajiv Chopra, S Chand , 2010
7. Jorgen Staunstrup, Wayne Wolf ,Hardware / Software Co- Design Principles and Practice, Springer, 2009.
8. Shibu.K.V, "Introduction to Embedded Systems", TataMcgraw Hill,2009
9. Tammy Noergaard, "Embedded System Architecture, A comprehensive Guide for Engineers and Programmers", Elsevier, 2006
10. Giovanni De Micheli, Mariagiovanna Sami , Hardware / Software Co- Design, Kluwer Academic Publishers , 2002

PROGRESS THROUGH KNOWLEDGE

ET4102 SOFTWARE FOR EMBEDDED SYSTEMS LT P C
3 0 0 3

COURSE OBJECTIVES:

1. To expose the students to the fundamentals of embedded Programming
2. To Introduce the GNU C Programming Tool Chain in Linux.
3. To study the basic concepts of embedded C.
4. To teach the basics of Python Programming
5. To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts
6. 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 - Netoworking Libraries.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Demonstrate C programming and its salient features for embedded systems

CO2: Deliver insight into various programming languages/software compatible to embedded process development with improved design & programming skills.

CO3: Develop knowledge on C programming in Linux environment.

CO4: Possess ability to write python programming for Embedded applications.

CO5: Have improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded programming skills.

CO	PO					
	1	2	3	4	5	6
1	-	-	2	-	3	-
2	1	-	1	-	2	-
3	-	2	-	-	2	-
4	1	-	1	1	1	-
5	-	-	2	2	3	2
Avg.	1	2	1.5	1.5	2.2	2

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. Noel Kalicharan, "Learn to Program with C", Apress Inc., 2015.
6. Steve Oualline, "Practical C programming", O'Reilly Media, 1997.
7. Fabrizio Romano, "Learn Python Programming", Second Edition, Packt Publishing, 2018.
8. John Paul Mueller, "Beginning Programming with Python for Dummies", 2nd Edition, John Wiley & Sons Inc., 2018.
9. Mark Lutz, "Programming Python", 4th Edition, O'Reilly Media Inc., 2010.

ET4103 MICROCONTROLLER BASED SYSTEM DESIGN LT P C
3 0 0 3

COURSE OBJECTIVES:

1. To teach the architecture of PIC Microcontroller and RISC processor.
2. To compare the architecture and programming of 8,16,32 bit RISC processor.
3. To teach the implementation of DSP in ARM processor.
4. To discuss on memory management, application development in RISC processor.
5. To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts
6. acquired over the 5 Units of the subject for improved employability skills.

UNIT I PIC MICROCONTROLLER 9

Architecture – memory organization – addressing modes – instruction set – PIC programming in Assembly & C –I/O port, Data Conversion, RAM & ROM Allocation, Timer programming, practice in MP-LAB.

UNIT II ARM ARCHITECTURE 9

Architecture – memory organization – addressing modes –The ARM Programmer's model -Registers – Pipeline - Interrupts – Coprocessors – Interrupt Structure

UNIT III PERIPHERALS OF PIC AND ARM MICROCONTROLLER 9

PIC: ADC, DAC and Sensor Interfacing –Flash and EEPROM memories. ARM: I/O Memory – EEPROM – I/O Ports – SRAM –Timer –UART - Serial Communication with PC – ADC/DAC Interfacing.

UNIT IV ARM MICROCONTROLLER PROGRAMMING 9

ARM general Instruction set – Thumb instruction set –Introduction to DSP on ARM – Implementation example of Filters

UNIT V DESIGN WITH PIC AND ARM MICROCONTROLLERS 9

PIC implementation - Generation of Gate signals for converters and
Inverters - Motor Control – Controlling DC/ AC appliances – Measurement of frequency - Stand alone Data Acquisition System –ARM Implementation- Simple ASM/C programs- Loops –Look up table- Block copy- subroutines-Hamming Code.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the basics and requirement of processor functional blocks.
CO2: Observe the specialty of RISC processor Architecture.
CO3: Incorporate I/O hardware interface of a processor based automation for consumer application with peripherals.
CO4: Incorporate I/O software interface of a processor with peripherals.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in commercial embedded processors

CO	PO					
	1	2	3	4	5	6
1	-	-	2	-	-	-
2	1	-	3	2	-	-
3	-	-	1	3	1	-
4	1	-	-	1	2	-
5	-	-	2	-	-	-
Avg.	1	-	2	2	1.5	-

REFERENCES:

1. Steve Furber, 'ARM system on chip architecture', Addision Wesley,2010.
2. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield 'ARM System Developer's Guide Designing and Optimizing System Software', Elsevier 2007.
3. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey ' PIC Microcontroller and Embedded Systems using Assembly and C for PIC18', Pearson Education 2008.
4. John Iovine, 'PIC Microcontroller Project Book ', McGraw Hill 2000
5. William Hohl, ' ARMAssebly Language' Fundamentals and Techniques,2009.
6. Rajkamal,"Microcontrollers Architecture, Programming, Interfacing,& System Design,Pearson,2012
7. ARM Architecture Reference Manual, LPC213x User Manual
8. www.Nuvoton .com/websites on Advanced ARM Cortex Processors

ET4104 VLSI DESIGN AND RECONFIGURABLE ARCHITECTURE LT P C
3 0 0 3

COURSE OBJECTIVES

1. To expose the students to the fundamentals of sequential system design, synchronous and Asynchronous circuits.
2. To understand the basic concepts of CMOS and to introduce the IC fabrication methods
3. To introduce the Reconfigurable Processor technologies, To provide an insight and architecture significance of SOC.
4. To introduce the basics of analog VLSI design and its importance.
5. To learn about the programming of Programmable device using Hardware description Language.

UNIT I INTRODUCTION TO ADVANCED DIGITAL SYSTEM DESIGN 9

Modeling of Clocked Synchronous Sequential Network(CSSN), Design of CSSN, Design of Asynchronous Sequential Circuits (ASC), Designing Vending Machine Controller, Races in ASC, Static and Dynamic Hazards, Essential Hazards, Designing Hazard free circuits.

UNIT II CMOS BASICS & IC FABRICATION 9

Moore's Law-MOSFET Scaling - MOS Transistor Model-Determination of pull up / pull down ratios-CMOS based combinational logic & sequential design- Dynamic CMOS –Transmission Gates-BiCMOS- Low power VLSI – CMOS IC Fabrications - Stick Diagrams, Design Rules and Layout.

UNIT III ASIC AND RECONFIGURABLE PROCESSOR AND SoC DESIGN 9

Introduction to ASIC, ASIC design flow- programmable ASICs- Introduction to reconfigurable processor- Architecture -Reconfigurable Computing, SoC Overview, recent trends in Reconfigurable Processor & SoC, Reconfigurable processor based DC motor control.

UNIT IV ANALOG VLSI DESIGN 9

Introduction to analog VLSI- Design of CMOS 2stage-3 stage Op-Amp –High Speed and High frequency op-amps-Super MOS- Analog primitive cells- Introduction to FPAA**.**

UNIT V HDL PROGRAMMING 9

Overview of digital design with VHDL, structural, data flow and behavioural modeling concepts- logic synthesis-simulation-Design examples, Ripple carry Adders, Carry Look ahead adders, Multiplier, ALU, Shift Registers, Test Bench.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Incorporate synchronous and asynchronous switching logics, with clocked circuits design

CO2: Deliver insight into developing CMOS design techniques and IC fabrication methods.

CO3: Explain the need of reconfigurable computing, hardware-software co design and operation of SoC processor.

CO4: Design and development of reprogrammable analog devices and its usage for Embedded applications.

CO5: Illustrate and develop HDL computational processes with improved design strategies.

CO	PO					
	1	2	3	4	5	6
1	-	-	-	1	-	-
2	2	-	2	2	-	-
3	-	-	3	3	2	1
4	2	-	2	3	1	-
5	-	1	1	3	3	1
Avg.	2	1	2	2.4	2	1

REFERENCES:

1. Donald G. Givone, “Digital principles and Design”, Tata McGraw Hill 2002.
2. Charles H. Roth Jr., “Fundamentals of Logic design”, Thomson Learning, 2004.
3. Nurmi, Jari (Ed.) "Processor Design System-On-Chip Computing for ASICs and FPGAs" Springer, 2007.
4. Joao Cardoso, Michael Hübner, "Reconfigurable Computing: From FPGAs to Hardware/Software Codesign" Springer, 2011.
5. Pierre-Emmanuel Gaillardon, Reconfigurable Logic: Architecture, Tools, and Applications, 1st Edition, CRC Press , 2015
6. Mohamed Ismail ,TerriFiez, “Analog VLSI Signal and information Processing”, McGraw Hill International Editions,1994.
7. William J. Dally / Curtis Harting / Tor M. Aamodt,” Digital Design Using VHDL:A Systems Approach, Cambridge Univerity Press,2015.
8. ZainalatsedinNavabi, ‘VHDL Analysis and Modelling of Digital Systems’, 2n Edition, Tata McGraw Hill, 1998.

ET4111 **EMBEDDED SYSTEM LABORATORY – I** **L T P C**
0 0 4 2

COURSE OBJECTIVES:

1. To involve the students to Practice on Workbench /Software Tools/ Hardware Processor Boards with the supporting Peripherals.
2. To teach the concepts of algorithm development & programming on software tools and Digital processors with peripheral interfaces.
3. To encourage students to practice in open source software / packages /tools
4. To train though hands-on practices in commercial and licensed Hardware-software suites
5. Practicing through the subdivisions covered within experiments listed below to expose the students into the revising the concepts acquired from theory subjects.

DOMAIN	EXPERIMENT DETAILS	EQUIPMENT/ SUPPORTS REQUIRED
1.	Programming with 8 bit Microcontrollers # Assembly programming	8051/ other 8 bit Microcontrollers with peripherals; IDE, Board Support Software Tools / Compiler/others
2.	Programming with 8 bit Microcontrollers # C programming	8051 Microcontrollers with peripherals; IDE, Board Support Software Tools /C Compiler/others
3.	I/O Programming with 8 bit Microcontrollers I/O Interfacing : Serial port programming/ LCD/Sensor Interfacing /PWM Generation/ Motor Control	8051 Microcontrollers with peripherals; Board Support Software Tools, peripherals with interface
4.	Programming with PIC Microcontrollers : ✓ Assembly ✓ C programming	PIC Microcontrollers with peripherals; ;IDE, Board Support Software Tools /C Compiler/others
5.	I/O Programming with PIC Microcontrollers I/O Interfacing : PWM Generation/ Motor Control/ADC/DAC/ LCD/Sensor Interfacing	PIC Microcontrollers with peripherals; Board Support Software Tools, peripherals with interface

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Experiment insight into various embedded processors of CISC and RISC architecture / computational processors with peripheral interface.
CO2: Understand the fundamental concepts of how process can be controlled with uC.
CO3: Experimenting on programming logic of Processor based on software suites(simulators, emulators)
CO4: Incorporate I/O software interface of a processor with peripherals.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in interfacing and use of commercial embedded processors

CO	PO					
	1	2	3	4	5	6
1	2	1	2	1	-	-
2	-	-	1	1	2	1
3	2	3	1	2	3	-
4	2	-	2	1	2	-
5	-	-	1	1	3	2
Avg.	2	2	1.4	1.2	2.5	1.5

REFERENCES:

1. Mohamammad Ali Mazidi&Mazidi ' 8051 Microcontroller and Embedded Systems', Pearson Education
2. Mohammad Ali Mazidi, RolindMckinley and Danny Causey, 'PIC Microcontroller and Embedded Systems' Pearson Education
3. Simon Monk," Make Action-with Arduino and Raspberry Pi,SPD ,2016.
4. Wesley J.Chun,"Core Python Applications Programming,3rd ed,Pearson,2016
5. Kraig Mitzner, 'Complete PCB Design using ORCAD Capture and Layout', Elsevier
6. Vinay K.Ingle,John G.Proakis,"DSP-A Matlab Based Approach",Cengage Learning,2010.
7. Taan S.Elali,"Discrete Systems and Digital Signal Processing with Matlab",CRC Press2009.
8. JovithaJerome,"Virtual Instrumentation using Labview"PHI,2010.
9. Woon-Seng Gan, Sen M. Kuo, 'Embedded Signal Processing with the Micro Signal Architecture', John Wiley & Sons, Inc., Hoboken, New Jersey 2007
10. Dogan Ibrahim, 'Advanced PIC microcontroller projects in C', Elsevier 2008

PROGRESS THROUGH KNOWLEDGE

ET4112 EMBEDDED PROGRAMMING LABORATORY – I LT P C
0 0 4 2

COURSE OBJECTIVES:

1. To involve the students to Practice on Workbench /Software Tools/ Hardware Processor Boards with the supporting Peripherals.
2. To teach the concepts of algorithm development & programming on software tools and Digital processors with peripheral interfaces.
3. To encourage students to practice in open source softwares / packages /tools
4. To train though hands-on practices in commercial and licensed Hardware-software suites
5. Practicing through the subdivisions covered within experiments listed below to expose the students into the revising the concepts acquired from theory subjects.

DOMAIN	EXPERIMENT DETAILS	EQUIPMENT/ SUPPORTS REQUIRED
1.	Programming in Higher Level Languages/Open Source Platforms	C/C++/Java/Embedded C/Embedded Java/ Compilers &Platforms/cloud
2.	Programming with Arduino Microcontroller Board	Arduino Boards with peripherals ;IDE, Board Support Software Tools /Compiler/others
3.	HDL Programming in FPGA processors	Processor Boards with Board Support Tools & Interfaces
4.	Programming & Simulation in Simulators /Tools/others	Simulation Tools as Proteus/ ORCAD
5.	Programming & Simulation in Simulators /Tools/others	Simulation Tools as MATLAB /others

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will demonstrate the ability in

CO1: Developing Optimized code for embedded processor

CO2: Understanding the fundamental concepts of how process can be realized using Software Modules

CO3: Circuit and System level simulators to develop solution for embedded based applications.

CO4: Incorporate I/O software interface of a processor with peripherals.

CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on Embedded computing and algorithm development with programming concepts.

CO	PO					
	1	2	3	4	5	6
1	2	1	1	2	2	1
2	2	-	2	-	3	2
3	2	1	3	1	2	2
4	2	1	2	2	2	-
5	-	-	2	-	3	1
Avg.	2	1	2	1.5	2.4	1.5

ET4201 REAL TIME OPERATING SYSTEM LT P C
3 0 0 3

COURSE OBJECTIVES:

1. To expose the students to the fundamentals of interaction of OS with a computer and User computation.
2. To teach the fundamental concepts of how process are created and controlled with OS.
3. To study on programming logic of modeling Process based on range of OS features
4. To compare types and Functionalities in commercial OS, application development using RTOS
5. To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I REVIEW OF OPERATING SYSTEMS 9

Basic Principles - Operating System structures – System Calls – Files – Processes – Design and Implementation of processes – Communication between processes – Introduction to Distributed operating system – Embedded operating systems

UNIT II OVERVIEW OF RTOS 9

RTOS Task and Task state –Multithreaded Preemptive scheduler- Process Synchronization- Message queues– Mail boxes -pipes – Critical section – Semaphores – Classical synchronization problem – Deadlocks

UNIT III REALTIME MODELS AND LANGUAGES 9

Event Based – Process Based and Graph based Models – Real Time Languages – RTOS Tasks – RT scheduling - Interrupt processing – Synchronization – Control Blocks – Memory Requirements.

UNIT IV REALTIME KERNEL 9

Principles – Design issues – Polled Loop Systems – RTOS Porting to a Target – Comparison and Basic study of various RTOS like – VX works – Linux supportive RTOS – C Executive.

UNIT V APPLICATION DEVELOPMENT 9

Discussions on Basics of Linux supportive RTOS – uCOS-C Executive for development of RTOS Application – Case study

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Outline Operating System structures and types.
CO2: Insight into scheduling, disciplining of various processes execution.
CO3: Illustrate knowledge on various RTOS support modelling
CO4: Demonstrate commercial RTOS Suite features to work on real time processes design.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in RTOS and embedded automation design.

CO	PO					
	1	2	3	4	5	6
1	2	-	1	-	2	-
2	-	-	2	-	3	1
3	2	-	2	1	2	2
4	2	2	3	2	1	3
5	-	-	1	-	3	1
Avg.	2	2	1.8	1.5	2.2	1.75

REFERENCES:

1. Silberschatz,Galvin,Gagne" Operating System Concepts,6th ed,John Wiley,2003
2. Charles Crowley, "Operating Systems-A Design Oriented approach" McGraw Hill,1997
3. Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill,2006.
4. Karim Yaghmour,Building Embedded Linux System",O'reilly Pub,2003
5. MukeshSighal and N G Shi "Advanced Concepts in Operating System", McGraw Hill,2000

ET4202 EMBEDDED SYSTEM NETWORKING L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To expose the students to the fundamentals of wired embedded networking techniques.
2. To introduce the concepts of embedded ethernet.
3. To expose the students to the fundamentals of wireless embedded networking.
4. To discuss the fundamental building blocks of digital instrumentation.
5. To introduce design of Programmable measurement & control of electrical Device.

UNIT I EMBEDDED PROCESS COMMUNICATION WITH INSTRUMENT BUS 9

Embedded networking: Introduction – Cluster of instruments in System: Introduction to bus protocols – comparison of bus protocols – RS 232C, RS 422, RS 485 and USB standards – embedded ethernet – MOD bus, LIN bus and CAN bus.

UNIT II EMBEDDED ETHERNET 9

Elements of a network – Inside Ethernet – Building a Network : Hardware options – Cables, Connections and network speed – Ethernet controllers – Inside the internet protocol – Exchanging messages using UDP and TCP – Email for Embedded systems using FTP – Keeping devices and network secure

UNIT III WIRELESS EMBEDDED NETWORKING 9

Wireless sensor networks – Introduction – Node architecture – Network topology -Localization – Time synchronization – Energy efficient MAC protocols – SMAC – Energy efficient and robust routing – Data centric routing - WSN Applications - Home Control - Building Automation - Industrial Automation

UNIT IV BUILDING SYSTEM AUTOMATION 9

Sensor Types & Characteristics: Sensing Voltage, Current, flux, Torque, Position, Proximity, Accelerometer - Data acquisition system- Signal conditioning circuit design- Uc Based & PC based data acquisition – UC for automation and protection of electrical appliances –processor based digital controllers for switching Actuators: Stepper motors, Relays –System automation with multi-channel Instrumentation and interface

UNIT V COMMUNICATION FOR LARGE ELECTRICAL SYSTEM AUTOMATION 9

Data Acquisition, Monitoring, Communication, Event Processing, and Polling Principles, SCADA system principles – outage management– Decision support application - substation automation, extended control feeder automation, Performance measure and response time, SCADA Data Models, need, sources, interface

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1 Analyze the different bus communication protocols used for embedded networking

CO 2 Explain the basic concepts of embedded networking

CO 3 Apply the embedded networking concepts in wireless networks

CO 4 Relate different data acquisition concepts

CO 5 Build a system automation for different applications

CO	PO					
	1	2	3	4	5	6
1	1	2	-	-	3	1
2	-	2	-	-	2	1
3	3	2	2	3	2	3
4	2	-	3	3	-	2
5	3	-	3	3	-	2
Avg.	2.25	2	2.7	3	2.3	1.8

REFERENCES :

1. Mohammad Ilyas And ImadMahgoub, 'Handbook of sensor Networks: Compact wireless and wired sensing systems', CRC Press,2005
2. Peter W Gofton , "Understanding Serial Communication", Sybes International, 2000
3. Jan Axelson 'Embedded Ethernet and Internet Complete', Penram publications
4. Krzysztof Iniewski,"Smart Grid ,Infrastructure& Networking",TMcGH,2012
5. Control and automation of electrical power distribution systems, James Northcote-Green, Robert Wilson, CRC, Taylor and Francis, 2006

ET4203 EMBEDDED CONTROL FOR ELECTRIC DRIVES L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To provide the control concept for electrical drives
2. To emphasis the need for embedded system for controlling the electrical drives
3. To provide knowledge about various embedded system based control strategy for electrical drives
4. To Impart the knowledge of optimization and machine learning techniques used for electrical drives
5. To familiarize the high performance computing for electrical drives.

UNIT I INTRODUCTION ELECTRICAL DRIVES 9

Electric drive and its classifications, Four-quadrant drive, Dependence of load torque on various factors, Dynamics of motor-load combination-Solid State Controlled Drives-Machine learning and optimization techniques for electrical drives- IoT for Electrical drives applications.

UNIT II OVERVIEW OF EMBEDDED PROCESSOR 9

Embedded Processor architecture-RTOS – Hardware/software co-design-Programming with SoC processors.

UNIT III INDUCTION MOTOR CONTROL 9

Types- Speed control methods-PWM techniques- VSI fed three-phase induction motor- Fuzzy logic Based speed control for three phase induction motor-FPGA based three phase induction motor control.

UNIT IV BLDC MOTOR CONTROL 9

Overview of BLDC Motor -Speed control methods -PWM techniques- ARM processor based BDLC motor control- ANN for BLDC Motor control and operation.

UNIT V SRM MOTOR CONTROL 9

Overview of SRM Motor -Speed control methods -PWM techniques- FPGA based SRM motor control-DNN for SRM Motor control and operation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Interpret the significance of embedded control of electrical drives
CO2: Deliver insight into various control strategy for electrical drives.
CO3: Developing knowledge on Machine learning and optimization techniques for motor control.
CO4: Develop embedded system solution for real time application such as Electric vehicles and UAVs.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded system skills required for motor control strategy.

CO	PO					
	1	2	3	4	5	6
1	1	-	2	-	2	-
2	1	1	3	-	-	2
3	2	-	-	-	3	-
4	1	2	3	1	-	-
5	-	-	-	-	3	-
AVg.	1.66	1.5	2.7	1	2.7	2

REFERENCES:

1. R.Krishnan, “Electric Motor Drives – Modeling, Analysis and Control”,Prentice-Hall of India Pvt. Ltd., New Delhi,2010.
2. VedamSubramanyam, “Electric Drives – Concepts and Applications”, Tata McGraw- Hill publishing company Ltd., New Delhi, 2002
3. K. Venkataratnam ,Special Electrical Machines, Universities Press, 2014.
4. Steve Furber, ‘ARM system on chip architecture’, Addision Wesley,2010.
5. Ron Sass and AnderewG.Schmidt, “ Embedded System design with platform FPGAs: Principles and Practices”, Elsevier, 2010.
6. Steve Kilts, "Advanced FPGA Design: Architecture, Implementation, and Optimization" Willey, 2007

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

CO	PO					
	1	2	3	4	5	6
1	1	2	1	-	-	-
2	-	2	-	-	-	-
3	1	2	-	1	3	-
4	2		3	3	3	3
5	3	2	3	3	3	3
Avg.	1.75	2	2.33	2.33	3	2

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.

ET4211 **EMBEDDED SYSTEM LABORATORY - II** **LT P C**
0 0 4 2

COURSE OBJECTIVES:

- To involve the students to Practice on Workbench /Software Tools/ Hardware Processor Boards with the supporting Peripherals.
- To teach the concepts of algorithm development & programming on software tools and Digital processors with peripheral interfaces.
- To encourage students to practice in open source softwares / packages /tools
- To train though hands-on practices in commercial and licensed Hardware-software suites
- Practicing through the subdivisions covered within experiments listed below to expose the students into the revising the concepts acquired from theory subjects.

Sl.No	EXPERIMENT DETAIL	EQUIPMENT/ SUPPORTS REQUIRED
1.	Programming ARM processor : ARM7 / ARM9/ARM Cortex Study on Incircuit Emulators, crosscompilers, debuggers	Microcontrollers with peripherals; ;IDE, Board Support Software Tools /Keil/uCOS Compiler/others
2	I/O Programming with ARM processor : ARM7 / ARM9/ARM Cortex Microcontrollers I/O Interfacing : Timers/ Interrupts/ Serial port programming/PWM Generation/ Motor Control/ADC/DAC/ LCD/ RTC Interfacing/ Sensor Interfacing	ARM processor : ARM7 / ARM9/ARM Cortex Microcontrollers with peripherals; Board Support Software Tools, peripherals with interface
3.	Programming with Rasberry Pi Microcontroller Board : Study on incircuit Emulators, crosscompilers, debuggers	Rasberry Pi Boards with peripherals ;IDE, Board Support Software Tools /Compiler/others
4.	I/O Programming with Arduino ,Rasberry Pi Microcontroller Boards I/O Interfacing : Timers/ Interrupts/ Serial port programming/PWM Generation/ Motor Control/ADC/DAC/ LCD/ RTC Interfacing/ Sensor Interfacing/IoT Applications	Arduino,Rasberry Pi Microcontroller Boards with peripherals; Board Support Software Tools, peripherals with interface
5.	Programming with DSP processors	Processor Boards with Board Support Tools & Interfaces
6	Study of one type of Real Time Operating Systems (RTOS)	Compilers & Platforms with VXWorks/ Keil/ Android/ Tiny OS/ Linux Support/any RTOS/Java Semaphore implementations

TOTAL : 60 PERIODS

COURSE OUTCOMES:

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

CO1: Experiment and demonstrate with simulators, in programming processor boards, processor interfacing/ designing digital controllers

CO2: Design & simulate Arithmetic ,Logic programs, Filters, Signal analysis with simulators/experiments ,in programming processor boards, processor interfacing/ Tools

CO3: Develop real time solution for embedded applications.

CO4: Program and compile in various tools & software domains.

CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in commercial embedded processors and its programmable interfacing.

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	**1**	3	**1**	1	2	1
2	-	**1**	2	-	-	-
3	**1**	**-**	3	**2**	**3**	-
4	**2**	2	**3**	**3**	**3**	**3**
5	**3**	**2**	**3**	**3**	**3**	**3**
Avg.	1.75	2	2.4	2.25	2.75	1.75

PROGRESS THROUGH KNOWLEDGE

ET4212 EMBEDDED PROGRAMMING LABORATORY - II LT P C
0 0 4 2

COURSE OBJECTIVES:

1. To involve the students to Practice on Workbench /Software Tools/ Hardware Processor Boards with the supporting Peripherals.
2. To teach the concepts of algorithm development & programming on software tools and Digital processors with peripheral interfaces.
3. To encourage students to practice in open source softwares / packages /tools
4. To train though hands-on practices in commercial and licensed Hardware-software suites
5. Practicing through the subdivisions covered within experiments listed below to expose the students into the revising the concepts acquired from theory subjects.

Sl.No	EXPERIMENT DETAIL	EQUIPMENT/ SUPPORTS REQUIRED
1.	Programming in Freeware softwares/ Platforms	Programming Compilers&Platforms on freeware
2.	Software & Modelling tools ✓ Study on MEMS Tools ✓ Study on process Controller modeling ✓ PLC/SCADA/PCB ✓ one type CAD Tool	Personal Computers, Software & programming/modelling tools
3.	Programming & Simulation in GUI Simulators /Tools/others ✓ Graphical User interface simulations & modeling of instrumentation & controllers	Simulation Tools as Labview /others
4.	Programming & Simulation in Python Simulators/Tools/others	Programming in Python Platform
5	Programming with wired/wireless communication protocol/Network Simulators	Learning Communication Protocols & Support Software Tools for BUS & network communication
6	Linux programming Tool chain	PC with Linux OS

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will demonstrate the ability in
CO1: Developing Optimized algorithms for embedded processor on IDE and compilers.
CO2: Outline the concepts of how process can be realized using Software Modules.

CO3: Compare and analyze device, Circuit and System level simulators/emulators to develop embedded applications.
CO4: Incorporate I/O software interface using IDE and High level languages with processor.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on Embedded programming concepts.

CO	PO					
	1	2	3	4	5	6
1	**2**	2	**1**	1	2	1
2	-	**3**	2	2	-	-
3	**2**	**3**	3	**2**	**3**	2
4	**-**	1	**3**	**3**	**3**	**3**
5	**-**	**-**	**3**	**3**	**3**	**3**
Avg.	2	2.25	2.4	2.2	2.75	2.25

ET4311 **PROJECT WORK I** **L T P C**
0 0 12 6

ET4411 **PROJECT WORK II** **L T P C**
0 0 24 12

COURSE OBJECTIVES

1. To provide a hands on skills by training on domains of embedded systems technologies
2. To improve the design ability and the oral, written presentation skills of the students
3. To provide an insight of developing optimized embedded solution for system automation
4. To emphasize the need of Hardware &Software design tools usage for real time applications.
5. To enhance capacity to compete for placement and developing ability for entrepreneurships.

COURSE OUTCOMES:

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

CO1: Any of the listed Domains their Design, Development capability in Building Automation for a process through Hardware & Software Tools.
CO2: Interpreting Pre-Requisites insists choice of project title from the enlisted broad domain of research topics for Project work:
CO3: Demonstrate project work to enhance students' capacity to work in Research Areas of the Department interests or of Industrial importance.
CO4: Demonstrate the skill in Oral and Written Communication as presented in the Thesis Book via Viva-Voce Examination
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation with getting skilled up through learning & practicing in Design / development through simulation/ experimental analysis with project report submission (relevant to the candidates project area) by individuals.

ANNA UNIVERSITY
PROGRESS THROUGH KNOWLEDGE

CO	PO					
	1	2	3	4	5	6
1	3	3	3	3	3	3
2	3	-	-	-	-	-
3	3	-	-	-	-	3
4	3	3	3	3	3	3
5	2	3	3	3	3	3
Avg.	2.8	3	3	3	3	3

ET4001 WIRELESS AND MOBILE COMMUNICATION L T P C
3 0 0 3

COURSE OBJECTIVES:

The objectives of this course are to make the student

1. To study the Channel planning for Wireless Systems
2. To study the Mobile Radio Propagation and Equalization and Diversity
3. T o study the Equalization and Diversity
4. To provide insight about wideband code division based access.
5. To study the Wireless multiple access and IP

UNIT I THE CELLULAR CONCEPT 9

System Design Fundamentals: Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies-Prioritizing Handoffs, Practical Handoff Considerations, Interference and system capacity –Co channel Interference and system capacity, Channel planning for Wireless Systems, Adjacent Channel interference, Power Control for Reducing interference, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems-Cell Splitting, Sectoring.

UNIT II MOBILE RADIO PROPAGATION: LARGE-SCALE PATH LOSS: 9

Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, Diffraction-Fresnel Zone Geometry, Knife edge Diffraction Model, Multiple knife-edge Diffraction, Scattering, Outdoor Propagation Models-Longley-Ryce Model, Okumura Model, Hata Model, Indoor Propagation Models-Partition losses, Partition losses between Floors, Log-distance path loss model, Ericsson Multiple Breakpoint Model, Attenuation Factor Model, Signal penetration into buildings, Ray Tracing and Site Specific Modelling.

UNIT III MOBILE RADIO PROPAGATION: 9

Small –Scale Fading and Multipath: Small Scale Multipath propagation-Factors influencing small scale fading, Doppler shift, Impulse Response Model of a multipath channel-Relationship between Bandwidth and Received power, Small-Scale Frequency Domain Channels Sounding, Parameters of Mobile Multipath Channels-Time Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time, Types of Small-Scale Fading-Fading effects Due to Multipath Time Delay Spread, Flat fading, Frequency selective fading, Fading effects Due to Doppler Spread-Fast fading, slow fading, Fundamentals of Equalization, Training A Generic Adaptive Equalizer, Equalizers in a communication Receiver, Linear Equalizers, Nonlinear Equalization

UNIT IV WIDEBAND CODE DIVISION MULTIPLE ACCESS 9

CDMA system overview -air interface –physical and logical channel–speech coding, multiplexing and channel coding –spreading and modulation: frame structure, spreading codes-uplink-downlink –

physical layer procedures: cell search and synchronization-establishing a connection-power control-handover-overload control.

UNIT V IP MOBILITY FRAMEWORK 9

Challenges of IP Mobility -Address Management -Dynamic Host Configuration Protocol and Domain Name Server Interfaces –Security –Mobility-Based AAA Protocol -IP Mobility Architecture Framework -x Access Network -IPv6 Challenges for IP Mobility.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Understand Cellular communication concepts

CO2: Explain the mobile radio propagation

CO3: Perceive the wireless network different type of MAC protocols

CO4: Analyse the Equalization and Diversity

CO5: Build the Wireless multiple access and IP

CO	PO					
	1	2	3	4	5	6
1	3	3	2	1	-	-
2	3	3	2	2	-	-
3	3	3	2	3	2	2
4						
5						
Avg.	3	3	2	2	2	2

REFERENCES:

1. Wireless Communications, Principles, Practice –Theodore, S. Rappaport, 2nd Ed., 2002, PHI.
2. Wireless Communications Andrea Goldsmith, 2005 Cambridge University Press.
3. Principles of Wireless Networks –KavehPahLaven and P. Krishna Murthy, 2002, PE
4. Mobile Cellular Communication –GottapuSasibhushana Rao, Pearson Education, 2012.
5. Wireless Digital Communications –KamiloFeher, 1999, PHI.
6. Wireless Communication and Networking –William Stallings, 2003, PHI

PROGRESS THROUGH KNOWLEDGE

ET4002 VIRTUAL INSTRUMENTATION L T P C
3 0 0 3

COURSE OBJECTIVES:

1. Understanding the difference between conventional and graphical programming.
2. Introducing the basics of Lab VIEW and programming concepts.
3. Differentiating the real time and virtual instrument.
4. Represent and review signals acquire process in digital domain.
5. Analyzing the basics of data acquisition and learning the concepts of data acquisition with Lab VIEW.

UNIT I FUNDAMENTALS OF VIRTUAL INSTRUMENTATION 9

Fundamental Concepts of Virtual Instrumentation (VI) and Graphical Programming - Virtual instruments and Traditional instruments, Hardware and Software in virtual instrumentation, Data Flow Programming - Data Types – Customization of VI Properties - VI Documentation.

UNIT II VI PROGRAMMING STRUCTURES 9

Software Environment - Modular programming - Formula Nodes - Loops - Shift Registers - Local and Global Variables – Case and Sequence Structures - Arrays and Clusters - Graphs and Charts - State Machines - String and File I/O.

UNIT III DATA ACQUISITION AND INTERFACING STANDARDS 10

PC based data acquisition – DAQ hardware and software architecture – DAQ hardware configuration, sampling methods and grounding techniques, analog I/O, digital I/O, counter/timer - Communication: Interfacing of external instruments to a PC - RS232 - RS485 - GPIB – System Interface Buses: USB-PCI, PXI; Introduction to bus protocols of MOD bus and CAN bus - Industrial Ethernet.

UNIT IV ADVANCED PROGRAMMING 10

Introduction, Definition of State Machine, A Simple State Machine, Event Structures. File Input / Output: Introduction, File Formats, File I/O Functions, Path Functions, Sample VIs to Demonstrate File WRITE and READ Function String Handling: Introduction, String Functions, Lab VIEW String Formats, Typical examples Use of analysis tools and application of VI: Fourier transforms, Power spectrum, Simulation of systems using VI: Development of Control system, Image acquisition and processing.

UNIT V CASE STUDIES 7

Temperature Monitoring System using PC based Data Acquisition System - Machine vision, Motion control, Configuration of Real-Time I/O Hardware in MAX - Host & Target VI – Prioritization of Tasks – Timed Programming Structures in Lab VIEW – Real-Time Application Deployment using my RIO – Run-time Interaction with Deployed Applications – Running Web Services in my RIO.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Infer and Interpret the fundamentals of Virtual Instrumentation and data Acquisition.

CO2: Explain the difference between the traditional and virtual instrumentation.

CO3: Illustrate the theoretical concepts to realize practical systems.

CO4: Analyze and evaluate the performance of Virtual Instrumentation Systems

CO5: Build a VI system to solve real time problems using data acquisition.

CO	PO					
	1	2	3	4	5	6
1	-	2	1	2	-	-
2	-	-	2	-	-	-
3	1	3	3	3	1	1
4	2	2	3	3	2	2
5	3	3	3	3	3	3
Avg.	2	2.5	2.4	2.75	2	2

REFERENCES:

1. Jovitha Jerome, ―Virtual Instrumentation using Lab VIEW‖, PHI Learning Pvt. Ltd., 2010.
2. Sanjay Gupta and Joseph John, "Virtual Instrumentation Using Lab VIEW", Tata McGraw Hill, 2008.
3. Gary Johnson and Richard Jennings, ―Lab VIEW Graphical Programming‖, McGraw Hill Inc., Fourth Edition, 2006.
4. Rick Bitter, Taqi Mohiuddin and Matt Nawrocki, "Lab VIEW Advanced Programming

Techniques", CRC Press, 2009.
5. Lisa. K. Wills, "Lab VIEW for Everyone", Prentice Hall of India, 2nd Edition, 2008.
6. William Buchanan, —Computer Buses Design and Application‖, CRC Press, 2000.
7. Clyde F Coombs, —Electronic Instruments Handbook, McGraw Hill Inc., Third Edition, 1999.

ET4003 EMBEDDED PROCESSOR DEVELOPMENT LT P C
3 0 0 3

COURSE OBJECTIVES

1. To learn about basic concepts of embedded system
2. To learn about ARM architecture
3. To learn C language and assembly programming.
4. To learn Object orientation for programming and C++.
5. To learn software modelling fundamentals.

UNIT I EMBEDDED CONCEPTS 9

Introduction to embedded systems, Application Areas, Categories of embedded systems, Overview of embedded system architecture, Specialties of embedded systems, recent trends in embedded systems, Architecture of embedded systems, Hardware architecture, Software architecture, Application Software, Communication Software, Development and debugging Tools.

UNIT II ARM ARCHITECTURE AND OVERVIEW OF CORTEX 9

Background of ARM Architecture, Architecture Versions, Processor Naming, Instruction Set Development, Thumb-2 and Instruction Set Architecture. Overview of Cortex-M3.
Cortex-M3 Basics: Registers, General Purpose Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector.
Tables, Stack Memory Operations, Reset Sequence. Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions. Cortex-M3 Implementation Overview: Pipeline, Block Diagram, Bus Interfaces on Cortex-M3, I-Code Bus, D-Code Bus, System Bus, External PPB and DAP Bus.

UNIT III CORTEX-M3/M4 PROGRAMMING 9

Overview, Typical Development Flow, Using C, CMSIS (Cortex Microcontroller Software Interface Standard), Using Assembly Exception Programming: Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation. Memory Protection Unit and other Cortex-M3 features: MPU Registers, Setting Up the MPU, Power Management, Multiprocessor Communication.

UNIT IV UNIFIED MODELING LANGUAGE 9

Connecting the object model with the use case model – Key strategies for object identification – UML basics. Object state behaviour – UML state charts – Role of scenarios in the definition of behaviour – Timing diagrams – Sequence diagrams – Event hierarchies – types and strategies of operations – Architectural design in UML concurrency design – threads in UML.

UNIT V EMBEDDED SOFTWARE DEVELOPMENT TOOLS AND RTOS 9

The compilation process – libraries – porting kernels – C extensions for embedded systems – emulation and debugging techniques – RTOS - system design using RTOS .

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Demonstrate about basic concepts of embedded system
CO 2: Build ARM architecture
CO 3: Understand C language and assembly programming.
CO 4: Build and compile Object orientation for programming and C++.
CO 5: Create software modelling

CO	PO					
	1	2	3	4	5	6
1	2	3	1	1	-	3
2	3	-	3	3	2	-
3	-	-	2	2	3	-
4	-	-	3	-	3	-
5	2	-	3	2	3	-
Avg.	2.33	3	2.4	2	2.75	3

REFERENCES:

1. The Definitive Guide to the ARM Cortex-M3, Joseph Yiu, econd Edition, Elsevier Inc. 2010.
2. Embedded/Real Time Systems Concepts, Design and Programming Black Book,Prasad, KVK.
3. David Seal "ARM Architecture Reference Manual", 2001 Addison Wesley, England; Morgan Kaufmann Publishers
4. Andrew N Sloss, Dominic Symes, C0hris Wright, "ARM System Developer's Guide -Designing and Optimizing System Software", 2006, Elsevier.
5. Steve Furber, "ARM System-on-Chip Architecture", 2ndEdition, Pearson Education.
6. Cortex-M series-ARM Reference Manual .
7. Cortex-M3 Technical Reference Manual (TRM).
8. STM32L152xx ARM Cortex M3 Microcontroller Reference Manual.
9. ARM Company Ltd. "ARM Architecture Reference Manual–RM DDI 0100E".
10. ARM v7-M Architecture Reference Manual (ARM v7-M ARM).
11. Ajay Deshmukh, "Microcontroller -Theory & Applications", Tata McGraw Hill.
12. Arnold. S. Berger, "Embedded Systems Design -An introduction to Processes, Tools and Techniques", Easwer Press.
13. David E. Simon, "An Embedded Software Primer", Pearson Education, 2003.

ET4004 AUTOMOTIVE EMBEDDED SYSTEM LT P C
3 0 0 3

COURSE OBJECTIVES:

1. To expose the students to the fundamentals and building of Electronic Engine Control systems**.**
2. To teach on functional components and circuits for vehicles.
3. To discuss on programmable controllers for vehicles management systems.
4. To teach logics of automation & commercial techniques for vehicle communication.
5. To introduce the embedded systems concepts for E-vehicle system development.

UNIT I BASIC OF ELECTRONIC ENGINE CONTROL SYSTEMS 9

Overview of Automotive systems, fuel economy, air-fuel ratio, emission limits and vehicle performance; Automotive microcontrollers- Electronic control Unit- Hardware & software selection and

requirements for Automotive applications – open source ECU- RTOS - Concept for Engine management-Standards; Introduction to AUTOSAR and Introduction to Society SAE- Functional safety ISO 26262- Simulation and modeling of automotive system components.

UNIT II SENSORS AND ACTUATORS FOR AUTOMOTIVES 9

Review of sensors- sensors interface to the ECU, conventional sensors and actuators, Modern sensor and actuators - LIDAR sensor- smart sensors- MEMS/NEMS sensors and actuators for automotive applications.

UNIT III VEHICLE MANAGEMENT SYSTEMS 9

Electronic Engine Control-engine mapping, air/fuel ratio spark timing control strategy, fuel control, electronic ignition- Adaptive cruise control - speed control-anti-locking braking system-electronic suspension - electronic steering , Automatic wiper control- body control system ; Vehicle system schematic for interfacing with EMS, ECU. Energy Management system for electric vehicles- Battery management system , power management system-electrically assisted power steering system- Adaptive lighting system- Safety and Collision Avoidance.

UNIT IV ONBOARD DIAGONSTICS AND TELEMATICS 9

On board diagnosis of vehicles -System diagnostic standards and regulation requirements Vehicle communication protocols Bluetooth, CAN, LIN, FLEXRAY, MOST, KWP2000 and recent trends in vehicle communications- Navigation- Connected Cars technology – Tracking- Security for data communication- dashboard display and Virtual Instrumentation, multimedia electronics- Role of IOT in Automotive systems

UNIT V ELECTRIC VEHICLES 9

Electric vehicles –Components- Plug in Electrical vehicle- Charging station – Aggregators- Fuel cells/Solar powered vehicles- Autonomous vehicles.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Insight into the significance of the role of embedded system for automotive applications.

CO2: Illustrate the need, selection of sensors and actuators and interfacing with ECU

CO3: Develop the Embedded concepts for vehicle management and control systems.

CO4: Demonstrate the need of Electrical vehicle and able to apply the embedded system technology for various aspects of EVs

CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design and its application in automotive systems.

CO	PO					
	1	2	3	4	5	6
1	-	2	1	1	-	2
2	2	3	2	2	2	3
3	3	3	3	3	3	2
4	3	3	3	3	3	2
5	3	3	3	3	3	2
Avg.	2.75	2.8	2.4	2.4	2.75	2.2

REFERENCES:

1. William B. Ribbens ,"Understanding Automotive Electronics", Elseiver,2012
2. Ali Emedi, Mehrdedehsani, John M Miller , "Vehicular Electric power system- land, Sea, Air and Space Vehicles" Marcel Decker, 2004.
3. L.Vlacic,M.Parent,F.Harahima,"Intelligent VehiclTechnologies",SAE International,2001.
4. Jack Erjavec,JeffArias,"Alternate Fuel Technology-Electric ,Hybrid& Fuel Cell Vehicles",Cengage ,2012.
5. Electronic Engine Control technology – Ronald K Jurgen Chilton's guide to Fuel Injection – Ford.
6. Automotive Electricals / Electronics System and Components, Tom Denton, 3rd Edition, 2004.
7. Uwe Kiencke, Lars Nielsen, "Automotive Control Systems: For Engine, Driveline, and Vehicle", Springer; 1 edition, March 30, 2000.
8. Automotive Electricals Electronics System and Components, Robert Bosch Gmbh, 4th Edition, 2004.
9. Automotive Hand Book, Robert Bosch, Bently Publishers, 1997.
10. Jurgen, R., Automotive Electronics Hand Book.

ET4005 INTELLIGENT CONTROL AND AUTOMATION L T P C
3 0 0 3

COURSE OBJECTIVES

- To Impart the knowledge of various optimization techniques and hybrid schemes.
- To introduce the concept, Analysis and implementation of ANN and Fuzzy logic controllers.
- To Emphasis the need for Genetic algorithm and its role for automation.
- To provide the basics of automation and its requirements
- To demonstrate the role of Intelligent controller in automation applications.

UNIT I ARTIFICIAL NEURAL NETWORK & FUZZY LOGIC 9

ARTIFICIAL NEURAL NETWORK: Learning with ANNs, single-layer networks, multi-layer perceptrons, Back propagation algorithm (BPA) ANNs for identification, ANNs for control, Adaptive neuro controller. Fuzzy Logic Control: Introduction, fuzzy sets, fuzzy logic, fuzzy logic controller design, Fuzzy Modelling & identification, Adaptive Fuzzy Control Design.

UNIT II GENETIC ALGORITHM 9

Basic concept of Genetic algorithm and detail algorithmic steps- Hybrid genetic algorithm - Solution for typical control problems using genetic algorithm. Concept on some other search techniques like Tabu search, Ant-colony search and Particle Swarm Optimization

UNIT III HYBRID CONTROL SCHEMES 9

Fuzzification and rule base using ANN–Neuro fuzzy systems-ANFIS–Optimization of membership function and rule base using Genetic Algorithm and Particle Swarm Optimization.

UNIT IV AUTOMATION 9

Introduction to Automation - Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations- Industrial Automation -computer vision for automation- PLC and SCADA based Automation- IoT for automation- Industry 4.0.

UNIT V INTELLIGENT CONTROLLER FOR AUTOMATION APPLICATION 9

Applications of Intelligent controllers in Industrial Monitoring, optimization and control- Smart Appliances- Automation concept for Electrical vehicle- Intelligent controller and Automation for Power System.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Demonstrate the basic architectures of NN and Fuzzy logics
CO2: Design and implement GA algorithms and know their limitations.
CO3: Explain and evaluate hybrid control schemes and PSO
CO4: Interpret the significance of Automation concepts.
CO5: Develop the intelligent controller for automation applications.

CO	PO					
	1	2	3	4	5	6
1	1	1	1	1	-	1
2	2	2	3	3	3	2
3	3	2	2	2	-	-
4	3	2	2	2	-	-
5	3	-	3	3	-	2
Avg.	2.4	1.75	2.2	2.2	3	1.67

REFERENCES:

1. Laurene V.Fausett, “Fundamentals of Neural Networks, Architecture, Algorithms, and Applications”, Pearson Education, 2008.
2. Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, Wiley, Third Edition, 2010.
3. David E.Goldberg, “Genetic Algorithms in Search, Optimization, and Machine Learning”, Pearson Education, 2009.
4. W.T.Miller, R.S.Sutton and P.J.Webrose, “Neural Networks for Control”, MIT Press, 1996.
5. Srinivas Medida, Pocket Guide on Industrial Automation for Engineers and Technicians, IDC Technologies.
6. ChanchalDey and Sunit Kumar Sen, Industrial Automation Technologies, 1st Edition,CRC Press, 2022.

ET4006 **UNMANNED AERIAL VEHICLE** **LT P C**
3 0 0 3

COURSE OBJECTIVES:

1. To make the students to understand the basic concepts and components of UAV systems.
2. To teach the UAV design concepts.
3. To provide an insight about the hardware structure for UAVs.
4. To emphasis the communication protocol requirements and control strategy for UAVs.
5. To highlight the need and the role of UAVs for real time applications and development of real time UAVs.

UNIT I INTRODUCTION TO UAV **9**

Overview and background - History of UAV –classification – societal impact and future outlook Unmanned Aerial System (UAS) components --models and prototypes – System Composition-applications

UNIT II THE DESIGN OF UAV SYSTEMS **9**

Introduction to Design and Selection of the System- Aerodynamics and Airframe Configurations- Characteristics of Aircraft Types- Design Standards-Regulatories and regulations - Design for Stealth--control surfaces-specifications.

UNIT III HARDWAREs for UAVs **9**

Real time Embedded processors for UAVs - sensors-servos-accelerometer –gyros-actuators- power supply- integration, installation, configuration, and testing –MEMS/NEMS sensors and actuators for UAVs- Autopilot – AGL.

UNIT IV COMMUNICATION PAYLOADS AND CONTROLS **9**

Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range –modems-memory system-simulation-ground test-analysis-trouble shooting

UNIT V THE DEVELOPMENT OF UAV SYSTEMS **9**

Waypoints navigation-ground control software- System Ground Testing- System In-flight Testing- Mini, Micro and Nano UAVs- Case study: Agriculture- Health- Surveying- Disaster Management and Defense.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Identify different hardware for UAV.
CO2: Determine preliminary design requirements for an unmanned aerial vehicle.
CO3: Design UAV system.
CO4: Identify and Integrate various systems of unmanned aerial vehicle.
CO5: Design micro aerial vehicle systems by considering practical limitations.

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	1	3	2	-	-	2
2	3	3	3	-	-	2
3	3	3	3	3	3	3
4	-	-	2	3	3	2
5	3	-	3	3	3	3
Avg.	2.5	3	2.6	3	3	2.4

REFERENCES:

1. Reg Austin “Unmanned Aircraft Systems UAV design, development and deployment”, Wiley, 2010.
2. Paul G Fahlstrom, Thomas J Gleason, “Introduction to UAV Systems”, UAV Systems, Inc, 1998
3. Dr. Armand J. Chaput, “Design of Unmanned Air Vehicle Systems”, Lockheed Martin Aeronautics Company, 2001
4. Kimon P. Valavanis, “Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy”, Springer, 2007
5. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.

ET4071 DSP BASED SYSTEM DESIGN L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To understand various representation methods of DSP system
2. To provide insight about different DSP algorithms
3. To familiarize the various architectures of DSP system
4. To perform analysis of DSP architectures and to learn the implementation of DSP system in programmable hardware
5. To learn the details of DSP system interfacing with other peripherls

UNIT I REPRESENTATION OF DSP SYSTEM 9

Single Core and Multicore, Architectural requirement of DSPs - high throughput, low cost, low power, small code size, embedded applications. Representation of digital signal processing systems - block diagrams, signal flow graphs, data-flow graphs, dependence graphs. Techniques for enhancing computational throughput - parallelism and pipelining.

UNIT II DSP ALGORITHMS 9

DSP algorithms - Convolution, Correlation, FIR/IIR filters, FFT, adaptive filters, sampling rate converters, DCT, Decimator, Expander and Filter Banks. DSP applications. Computational characteristics of DSP algorithms and applications, Numerical representation of signals-word length effect and its impact, Carry free adders, Multiplier.

UNIT III SYSTEM ARCHITECTURE 9

Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Features for External Interfacing. VLIW architecture. Basic performance issue in pipelining, Simple implementation of MIPS, Instruction Level Parallelism, Dynamic Scheduling, Dynamic Hardware Prediction, Memory hierarchy.Study of FIxed point and floating point DSP architectures

UNIT IV ARCHITECTURE ANALYSIS ON PROGRAMMABLE HARDWARE 9

Analysis of basic DSP Architectures on programmable hardwares. Algorithms for FIR , IIR, Lattice filter structures, architectures for real and complex fast Fourier transforms, 1D/2D Convolutions, Winograd minimal filtering algorithm. FPGA: Architecture, different sub-systems, design flow for DSP system design, mapping of DSP algorithms onto FPGA.

UNIT V SYSTEM INTERFACING 9

Examples of digital signal processing algorithms suitable for parallel architectures such as GPUs and multiGPUs. Interfacing: Introduction, Synchronous Serial Interface CODE, A CODEC Interface Circuit, ADC interface.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

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

CO 1: Evaluate the DSP system using various methods.
CO 2: Design algorithm suitable for different DSP applications.
CO 3: Explain various architectures of DSP system.
CO 4: Implement DSP system in programmable hardware.
CO 5: Build interfacing of DSP system with various peripherals.

CO	PO					
	1	2	3	4	5	6
1	-	3	-	-	-	-
2	3	3	3	2	3	2
3	-	3	-	-	-	-
4	3	-	3	3	3	3
5	2	-	3	2	3	3
Avg.	2.67	3	3	2.33	3	2.67

REFERENCES

1. Sen M Kuo, Woon Seng S Gan, Digital Signal Processors
2. Digital Signal Processing and Application with C6713 and C6416 DSK, Rulph Chassaing, Worcester Polytechnic Institute, A Wiley Interscience Publication
3. Architectures for Digital Signal Processing, Peter Pirsch John Weily, 2007
4. DSP Processor and Fundamentals: Architecture and Features. Phil Lapsley, JBier, AmitSohan, Edward A Lee; Wiley IEEE Press
5. K. K. Parhi - VLSI Digital Signal Processing Systems - Wiley – 1999.
6. RulphChassaing, Digital signal processing and applications with C6713 and C6416 DSK, Wiley, 2005
7. Keshab K Parhi, VLSI Digital Signal Processing Systems:Design and Implementation, student Edition, Wiley, 1999.
8. Nasser Kehtarnavaz, Digital Signal Processing System Design: LabVIEW-Based Hybrid Programming, Academic Press, 2008

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.

CO	PO					
	1	2	3	4	5	6
1	1	3	1	-	-	-
2	2	3	2	-	-	-
3	3	-	3	-	3	-
4	2	3	3	-	-	-
5	3	3	3	-	3	-
6	3	3	3	-	3	-
7	3	3	3	-	3	-
Avg.	2.42	3	2.57	-	3	-

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.

ET4007 COMPUTER VISION L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To introduce the fundamentals of Human and Computer Vision.
2. To introduce the major ideas, concepts, methods and techniques in Computer Vision.
3. To impart Computer Vision knowledge by way of learning related algorithms.
4. To make them familiar with both the Theoretical and Practical aspects of Computing with Images.
5. To provide the student with programming experience for implementing Computer Vision and algorithms.

UNIT I INTRODUCTION TO COMPUTER VISION 9

Digital Image Processing – Various Fields that use Image Processing – Fundamentals Steps in Digital Image Processing – Components of an Image Processing System. Applications of Computer Vision – Recent Research in Computer Vision. Introduction to Computer Vision and Basic Concepts of Image Formation: Introduction and Goals – Image Formation and Radiometry – Geometric Transformation – Geometric Camera Models – Image Reconstruction from a Series of Projections.

UNIT II IMAGE PROCESSING CONCEPTS AND IMAGE FEATURES 9

Image Processing Concepts: Fundamentals – Image Transforms – Image Filtering – Colour Image Processing – Mathematical Morphology – Image Segmentation. Image Descriptors and Features: Texture Descriptors – Colour Features – Edge Detection – Object Boundary and Shape Representation – Interest or Cornet Point Detectors – Histogram Oriented Gradients – Scale Invariant Feature Transform.

UNIT III IMAGE PROCESSING WITH OPENCV 9

Introduction to OpenCV and Python: Setting up OpenCV – Image Basics in OpenCV – Handling Files and Images – Constructing Basic Shapes in OpenCV. Image Processing in OpenCV: Image Processing Techniques – Constructing and Building Histograms – Thresholding Techniques.

UNIT IV OBJECT DETECTION 9

Models and types – Importance of Object Detection. The Working: Inputs and outputs – Basic Structure – Model Architecture Overview – Object Detection on the Edge. Use Cases and Applications: Video Surveillance – Self-driving Cars. Embedded Boards: Connecting Cameras to Embedded Boards – Simple algorithms for processing Images and Videos.

UNIT V APPLICATIONS AND CASE STUDIES 9

Applications: Machine Learning algorithms and their Applications in Medical Image Segmentation – Motion Estimation and Object Tracking – Face and Facial Expression Recognition – Image Fusion. Case Studies: Face Detection – Object Tracing – Eye Tracking – Handwriting Recognition with HoG.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the major concepts and techniques in computer vision and image processing
CO2: Infer known principles of human visual system
CO3: Demonstrate a thorough knowledge of Open CV
CO4: Develop real-life Computer Visions Applications.
CO5: Build design of a Computer Vision System for a specific problem.

CO	PO					
	1	2	3	4	5	6
1	2	3	2	-	-	-
2	2	2	2	2	-	-
3	3	3	3	3	3	2
4	3	3	3	3	3	3
5	3	3	3	3	3	3
Avg.	2.6	2.8	2.6	2.75	3	2.67

REFERENCES:

1. "Digital Image Processing", 4th Edition (Global Edition), Rafael C Gonzalez and Richard E Woods, Pearson Education Limited, 2018.
2. "Computer Vision and Image Processing - Fundamentals and Applications", Manas Kamal Bhuyan, CRC Press, 2020.
3. "Mastering OpenCV 4 with Python", Alberto FernándezVillán, Packt Publishing, 2019.
4. "Practical Python and Open CV: Case Studies", 3rd Edition, Adrian Rosebrock, PyImageSearch, 2016.

ET4008 **MULTIMEDIA COMMUNICATIONS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

1. To define the Multimedia Communication Models
2. To explain Multimedia Transport in Wireless Networks
3. To Solve the Security issues in multimedia networks
4. To Illustrate real-time multimedia network applications.
5. To explain different network layer based application

UNIT I INTRODUCTION TO MULTIMEDIA COMMUNICATIONS 9

Introduction, multimedia information representation, multimedia networks, multimedia applications, Application and networking terminology, network QoS and application QoS, Digitization principles,. Text, images, audio and video.

UNIT II COMPRESSION TECHNIQUES FOR TEXT AND IMAGE 9

Text and image compression,, compression principles, text compression- Runlength, Huffman, LZW, Document Image compression using T2 and T3coding, image compression- GIF, TIFF and JPEG.

UNIT III COMPRESSION TECHNIQUES FOR AUIDO AND VIDEO 9

Audio and video compression, audio compression – principles, DPCM, ADPCM, Adaptive and Linear predictive coding, Code-Excited LPC, Perceptual coding, MPEG and Dolby coders video compression, video compression principles.

UNI IV STANDARDS AND FRAMEWORK 9

Video compression standards: H.261, H.263, MPEG, MPEG 1, MPEG 2, MPEG-4 and Reversible VLCs, MPEG 7 standardization process of multimedia content description, MPEG 21 multimedia framework.

UNIT V SYNCHRONIZATION AND MANAGEMENT 9

Notion of synchronization, presentation requirements, reference model for synchronization, Introduction to SMIL, Multimedia operating systems, Resource management, process management techniques.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Deploy the right multimedia communication models.
CO2: Apply QoS to multimedia network applications with efficient routing techniques.
CO3: Solve the security threats in the multimedia networks.
CO4: Develop the real-time multimedia network applications
CO5: Improve to synchronize and manage the multimedia systems.

CO	PO					
	1	2	3	4	5	6
1	2	-	1	-	3	-
2	2	-	1	3	2	2
3	3	-	-	-	-	-
4	-	-	-	2	3	2
5	2	-	-	-	-	-
Avg	2.25	-	1	2.5	2.66	2

REFERENCES

1. Fred Halsall, “Multimedia Communications”, Pearson education,2001.
2. Raif Steinmetz, Klara Nahrstedt, “Multimedia: Computing, Communications and Applications”,Pearsoneducation,2002.

ET4009	EMBEDDED NETWORKING AND AUTOMATION OF ELECTRICAL SYSTEM	LT P C 3 0 0 3

COURSE OBJECTIVES:

1. To discuss the fundamentals building blocks of a digital instrument.
2. Introduce wired, WSN for configuring metering network
3. Discuss requirements for grid automation using meters.
4. To discuss networking configuration to develop PAN.
5. To discuss the functions of digital instrument Power quality monitoring

UNIT I BUILDING SYSTEM AUTOMATION 9

Sensor Types & Characteristics: Sensing Voltage, Current, flux, Torque, Position, Proximity, Accelerometer - Data acquisition system- Signal conditioning circuit design- Uc Based & PC based data acquisition – uC for automation and protection of electrical appliances –processor based digital controllers for switching Actuators: Stepper motors, Relays –System automation with multi channel Instrumentation and interface .

UNIT II EMBEDDED NETWORKING OF INSTRUMENT CLUSTER 9

Embedded Networking: Introduction – Cluster of Instruments in System- Comparison of bus protocols – RS 232C- embedded ethernet - MOD bus and CAN bus, LIN BUS- Introduction to WSN-– Commercially available sensor nodes-Zigbee protocol -Network Topology Energy efficient MAC protocols –SMAC –Data Centric routing Applications of sensor networks- Database perspective on sensor networks- IoT Applications .

UNIT III AUTOMATION OF SUBSTATION 9

Substation automation- Distribution SCADA system principles -role of PMU,RTU, IEDs, BUS for smart Substation automation- Introduction to Role of IEC 61850,IEEEC37.118 std- Interoperability and IEC 61850-challenges of Substations in Smart Grid - challenges of Energy Storage and Distribution Systems monitoring - Communication Challenges in monitoring electric utility asset .

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UNIT IV METERING OF SMART GRID 9

Characteristics of Smart Grid- Generation by Renewable Energy Sources based on solar grid-Challenges in Smart Grid and Microgrids- electrical measurements with AMI -Smart meters for EV plug in electric vehicles power management -Home Area Netmetering and Demand side Energy Management applications.

UNIT V SMART METERS FOR PQ MONITORING 9

Power Quality issues of Grid connected Renewable Energy Sources -Smart meters for Power Quality monitoring and Control - Power Quality issues -Surges – Flicker - Interharmonics - Transients – Power Quality Benchmarking – Power Quality Meters- Meter data management In Smart Grid-, communication enabled Power Quality metering

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Demonstrate criteria of choice of sensors, components to build meters.

CO2: Illustrate the demand for BUS communication protocols are introduced

CO3: Analyse the need and standards in Substation automation

CO4: Deployment of PAN for metering networked commercial applications

CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded networked communications.

CO	PO					
	1	2	3	4	5	6
1	3	1	2	1	2	1
2	1	-	2	2	3	1
3	3	1	2	-	-	-
4	2	-	2	3	3	2
5	2	1	2	-	-	3
Avg.	2.2	1	2	2	2.66	1.25

REFERRENCES:

1. Control and automation of electrical power distribution systems, James Northcote-Green, Robert Wilson, CRC, Taylor and Francis, 2006
2. Krzysztof Iniewski,"Smart Grid ,Infrastructure& Networking",TMcGH,2012
3. Robert Faludi,"Building Wireless Sensor Networks,O'Reilly,2011
4. Mohammad Ilyas And ImadMahgoub, 'Handbook of sensor Networks: Compact wireless and wired sensing systems', CRC Press,2005
5. Shih-Lin Wu,Yu-Chee Tseng,{"Wireless Ad Hoc Networking,PAN,LAN,SAN,Aurebach Pub,2012
6. Sanjay Gupta, "Virtual Instrumentation, LABVIEW", TMH, New Delhi, 2003
7. Ernest O. Doeblin and Dhanesh N Manik, " Measrement Systems – Application and Design", 5th Edn, TMH, 2007.
8. BhaskarKrishnamachari, 'Networking wireless sensors', Cambridge press 2005

PROGRESS THROUGH KNOWLEDGE

ET4010 SMART SYSTEM DESIGN L T P C

3 0 0 3

COURSE OBJECTIVES:

1. To understand about the smart system technologies and its role in real time applications
2. To expose students to different open-source platforms and attributes.
3. To teach the architecture and requirements of Home Automation.
4. To provide an insight into smart appliances and energy management concepts.
5. To familiarize the design and development of embedded system based system design.

UNIT I INTRODUCTION 9

Overview of a smart system - Design Requirements - Hardware and software selection & co-design - Smart sensors and Actuators – Communication protocols used in smart systems – Data Analytics: Need & Types – Open-source Analytics Platform for embedded systems (IFTTT &Thingspeak) – Smart Microcontrollers - Embedded system for Smart card design and development – Recent trends.

UNIT II HOME AUTOMATION 9

Home Automation – Design Considerations: Control Unit, Sensing Requirements, Communication, Data Security - System Architecture - Essential Components - Linux and Raspberry Pi – Design and Real-Time implementation.

UNIT III SMART APPLIANCES AND ENERGY MANAGEMENT 9

Energy Management: Demand-side Load Management: Energy scheduling – Significance of smart appliances in energy management - Embedded and Integrated Platforms for Energy Management - Smart Meters: Significance, Architecture & Energy Measurement Technique - Smart Networks for Embedded Appliances – Security Considerations.

UNIT IV SMART WEARABLE DEVICES 9

Application of Smart Wearables in Healthcare & Activity Monitoring - Functional requirements– Selection of body sensors, Hardware platform, OS and Software platform – Selection of suitable communication protocol. Case Study: Design of a wearable, collecting heart-beat, temperature and monitoring health status using a smartphone application.

UNIT V EMBEDDED SYSTEMS AND ROBOTICS 9

Robots and Controllers components - Aerial Robotics - Mobile Robot Design - Three-Servo Ant Robot - Autonomous Hex copter System.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the concepts of smart system design and its present developments.
CO2: Illustrate different embedded open-source and cost-effective techniques for developing solution for real time applications.
CO3: Acquire knowledge on different platforms and Infrastructure for Smart system design.
CO4: Infer about smart appliances and energy management concepts.
CO5: Apply and improve Employability and entrepreneurship capacity due to knowledge upgradation on embedded system technologies.

CO	PO					
	1	2	3	4	5	6
1	-	3	2	-	-	-
2	2	-	-	-	2	3
3	-	-	-	2	3	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
AVg.	2	3	2	2	2.5	3

REFERENCES:

1. Thomas Bräunl, Embedded Robotics, Springer, 2003.
2. Grimm, Christoph, Neumann, Peter, Mahlknech and Stefan, Embedded Systems for Smart Appliances and Energy Management, Springer 2013.
3. Raj Kamal, Embedded Systems - Architecture, Programming and Design, McGraw- Hill, 2008
4. NilanjanDey, Amartya Mukherjee, Embedded Systems and Robotics with Open-Source Tools, CRC press, 2016.
5. Karim Yaghmour, Embedded Android, O'Reilly, 2013.
6. Steven Goodwin, Smart Home Automation with Linux and Raspberry Pi, Apress, 2013
7. C.K.Toh, AdHoc mobile wireless networks, Prentice Hall, Inc, 2002.

8. KazemSohraby, Daniel Minoli and TaiebZnati, Wireless Sensor Networks Technology,Protocols, and Applications, John Wiley & Sons, 2007.
9. Anna Ha´c, Wireless Sensor Network Designs, John Wiley & Sons Ltd, 2003.
10. Robert Faludi, Wireless Sensor Networks, O'Reilly, 2011.

ET4011 EMBEDDED COMPUTING LT P C
3 0 0 3

COURSE OBJECTIVES:

1. To expose the students to the fundamentals of Network communication technologies.
2. To teach the fundamentals of Java , Internet and Java card
3. To develop distributed embedded system with Java
4. To teach the smart card and Apps development
5. To involve Discussions/ Practice in familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

UNIT I NETWORK INFRASTRUCTURE 9

Broad Band Transmission facilities –Open Interconnection standards – networking devices Network diagram –Network management – Network Security – Cluster computers.

UNIT II JAVA TECHNOLOGY FOR EMBEDDED SYSTEMS 9

Basic concepts of Java - IO streaming – Object serialization – Networking – Threading – RMI – distributed databases –– Advantages and limitations of Internet – Web architecture for embedded systems – security model for embedded systems.

UNIT III SMART CARD TECHNIQUES 9

Smart Card basics – Java card technology overview – Java card Types - Card components SMART CARD MICROCONTROLLERS - Contactless Cards - Smart Card Operating Systems– smart card Security Techniques.

UNIT IV ANDROID FRAMEWORK 9

Android SDK – Access to Hardware - Framework development - Peer-to-Peer communication- Android security design and architecture – Case study.

UNIT V DEVELOPING DISTRIBUTED REAL-TIME SYSTEM APPLICATIONS 9

Developing MATLAB Real-Time Targets - Using the xPC Target - Building various Distributed Real Time Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Deliver insight into involving JAVA concepts& internet based Communication to establish decentralized control mechanism of system
CO2: Interpret the software and hardware architecture for distributed computing
CO3: Develop solution for smart card
CO4: Develop Apps based on android SDK.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded system computing environment.

CO	PO					
	1	2	3	4	5	6
1	2	-	1	-	2	2
2	2	3	2	-	-	-
3	3	1	2	3	2	3
4	3	1	2	3	2	3
5	2	1	2	-	-	3
Avg.	2.4	1.5	1.8	3	2	2.25

REFERENCES:

1. AmitavaGupta , Anil Kumar Chandra and Peter Luksch " Real-Time and Distributed Real-Time Systems Theory and Applications " CRC Press 2016 International Standard Book Number-13: 978-1-4665-9849-2 (eBook - PDF)
2. Wolfgang Rankl and Wolfgang Effing "Smart Card Handbook" John Wiley & Sons Ltd , Third Edition , 2003
3. Reto Meier "Professional Android application development" Wiley Publishing , Inc , 2009.
4. Joshua " Android hacker's Handbook" John Wiley & sons , 2014
5. Dietel&Dietel, "JAVA how to program", Prentice Hall 1999.
6. SapeMullender, "Distributed Systems", Addison-Wesley, 1993

ET4012 EMBEDDED SYSTEMS SECURITY LT P C
3 0 0 3

COURSE OBJECTIVES:

1. To introduce the fundamentals related to Cryptography and Data Security
2. To teach the mathematical foundations for Cryptography.
3. To impart knowledge about Embedded Cryptography and Data Protection Protocols
4. To make them understand the practical aspects of Embedded System Security.
5. To involve the students in Discussions/Tutorials/Programming to familiarize the concepts for improved employability skills.

UNIT I BACKGROUND AND INTRODUCTION 9

Computer and Network Security Concepts: Computer Security Concepts – The OSI Security Architecture – Security Attacks – Security Services – Security Mechanisms – Fundamentals of Security Design Principles – Attack Surfaces and Attack Trees – A Model for Network Security. Introduction to Number Theory: Divisibility and the Division Algorithm – The Euclidean Algorithm – Modular Arithmetic – Prime Numbers – Fermet's and Euler's Theorems – Testing for Primality – The Chinese Remainder Theorem – Discrete Logarithms.

UNIT II SYMMETRIC CIPHERS 9

Classical Encryption Techniques: Symmetric Cipher Model – Substitution Techniques – Transposition Techniques. Block Ciphers and the Data Encryption Standard (DES): Traditional Block Cipher Structure – The Data Encryption Standard – A DES Example – Strength of DES. Advanced Encryption Standard: Finite Field Arithmetic – AES Structure – AES Transformation Functions – AES Key Expansion – An AES Example – AES Implementation.

UNIT III EMBEDDED SYSTEMS SECURITY 9

Embedded Security Trends – Security Policies – Security Threats. System Software Considerations: The Role of Operating System – Microkernel versus Monolithic – Core Embedded OS Security Requirements – Access Control and Capabilities – Hypervisors and System Virtualization – I/O Virtualization – Remote Management – Assuring Integrity of the TCB.

UNIT IV EMBEDDED CRYPTOGRAPHY AND DATA PROTECTION PROTOCOLS 9

The One-time Pad – Cryptographic Modes – Block Ciphers – Authenticated Encryption – Public Key Cryptography – Key Agreement – Public Key Authentication – Elliptic Curve Cryptography – Cryptographic Hashes – Message Authentication Codes – Random Number Generation – Key Management for Embedded Systems – Cryptographic Certifications. Data Protection Protocols for Embedded Systems: Data-in-Motion Protocols – Data-at-Rest Protocols. Emerging Applications: Embedded Network Transactions – Automotive Security – Secured Android.

UNIT V PRACTICAL EMBEDDED SYSTEM SECURITY 9

Network Communications Protocols and Built-in Security – Security Protocols and Algorithms – The Secured Socket Layer – Embedded Security – Wireless – Application-Layer and Client/Server Protocols – Choosing and Optimizing Cryptographic Algorithms for Resource-Constrained Systems – Hardward Based Security.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the significance of Security.
CO2: Understand the major concepts and techniques related to Cryptography.
CO3: Demonstrate thorough knowledge about the aspects of Embedded System Security.
CO4: Delivers insight onto role of Security Aspects during Data Transfer and Communication.
CO5: Applying the Security Algorithms for Real-time Applications.

CO	PO					
	1	2	3	4	5	6
1	1	1	-	1	1	-
2	3	2	2	-	-	2
3	1	3	-	1	-	-
4	3	1	2	-	3	1
5	3	2	3	2	3	3
Avg.	2.2	1.8	2.33	1.33	2.33	2

REFERENCES:

1. "Cryptography and Network Security Principles and Practice", 7th Edition – Global Edition, William Stallings, Pearson Education Limited, 2017.
2. "Embedded Systems Security - Practical Methods for Safe and Secure Software and Systems Development", David Kleidermacher and Mike Kleidermacher, Newnes (an imprint of Elsevier), 2012.
3. "Practical Embedded Security - Building Secure Resource-Constrained Systems", Timothy Stapko, Newnes (an imprint of Elsevier), 2008.

ET4013 **ROBOTICS AND AUTOMATION** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

1. To teach the need of embedded system technology for robot building
2. To study the Various Parts of Robots and Fields of Robotics.
3. To study the Various Kinematics and Inverse Kinematics of Robots.
4. To study the Trajectory Planning for Robot.
5. To study the Control of Robots for Some Specific Applications.

UNIT I INTRODUCTION TO ROBOTICS & AUTOMATION 9

Overview of Robotics & Automation – Principles and Strategies of Automation System –Hardware and software for Automation- Embedded Processors for Automation-Different Types of Robots – Various Generations of Robots - Asimov's Laws Of Robotics – Key components of a robot - Design Criteria for Selection of a Robot – Role of embedded system in Robotics and Automation - Recent trends.

UNIT II SENSORS AND DRIVE SYSTEMS 9

Hydraulic, Pneumatic And Electric Drive Systems – Understanding how motor power, current torque, friction co-efficient affect the design of a Robot - Determination of Motor HP and Gearing Ratio – Variable Speed Arrangements. Sensors – Classification based on sensing type (including Optical, Acoustic, Magnetic) - Proximity Sensors – Ranging Sensors – Speed & Displacement Sensing - Tactile Sensors – Vision Sensing - Smart Sensors - MEMS sensors.

UNIT III MANIPULATORS AND GRIPPERS 9

Introduction to Manipulators - Joints and Degrees of Freedom - Construction of Manipulators – Manipulator Dynamics And Force Control – Electronic And Pneumatic Manipulator Control Circuits – End Effectors – Various Types Of Grippers – Design Considerations.

UNIT IV KINEMATICS AND PATH PLANNING 9

Kinematic Equations – Forward and Inverse Kinematics - Solution Of Inverse Kinematics Problem – Jacobian based Velocity Kinematics– Various Path Planning Algorithms – Hill Climbing Techniques - Robot Operating System - Simulation and modeling of a simple Path Planning application.

UNIT V CASE STUDIES 9

Robot Cell Design - Humanoid Robot - Robots in healthcare applications – Robot Machine Interface – Robots in Manufacturing and Non-Manufacturing Applications - Self balancing robots - Micro/nano robots.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Choose suitable embedded boards for robots

CO2: Demonstrate the concepts of robotics & automation and Working of Robot

CO3: Analyze the Function of Sensors and actuators In the Robot

CO4: Develop Program to Use a Robot for a Typical Application

CO5: Apply and improve Employability and entrepreneurship capacity due to knowledge upgradation on Embedded system based robot development

CO	PO					
	1	2	3	4	5	6
1	1	2	-	3	-	-
2	-	3	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	2	3	1
5	-	-	2	1	-	3
Avg.	1	2.5	2	2	3	2

REFERENCES:

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., "Industrial Robotics", Mc Graw-Hill Singapore, 1996.
2. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.
3. Deb. S.R.,"Robotics Technology And Flexible Automation", John Wiley, USA 1992.
4. Klafter R.D., Chimielewski T.A., Negin M., "Robotic Engineering – An Integrated Approach", Prentice Hall of India, New Delhi, 1994.
5. Mc Kerrow P.J. "Introduction to Robotics", Addison Wesley, USA, 1991.
6. Issac Asimov "Robot", Ballantine Books, New York, 1986.
7. Barry Leatham – Jones, "Elements of Industrial Robotics" PITMAN Publishing, 1987.
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9. Fu K.S. Gonzaleaz R.C. And Lee C.S.G., "Robotics Control Sensing, Vision and Intelligence" McGraw Hill International Editions, 1987

ET4014 RECONFIGURABLE PROCESSOR AND SoC DESIGN LT P C
3 0 0 3

COURSE OBJECTIVES:

1. To familiarize the need and role of Reconfigurable Processor for embedded system applications.
2. To introduce the Reconfigurable Processor technologies
3. To teach the salient features and architecture of FPGA.
4. To provide an insight and architecture significance of SoC.
5. To impart the knowledge of Reconfigurable embedded Processor for real time applications.

UNIT I INTRODUCTION 9

Introduction to reconfigurable processor- Reconfigurable Computing-Programming elements and Programming Tools for Reconfigurable Processors, ASIC design flow- Hardware/Software Co-design- FPAA Architecture overview- recent trends in Reconfigurable Processor &SoC.

UNIT II FPGA TECHNOLOGIES 9

FPGA Programming technology - Alternative FPGA architectures: MUX Vs LUT based logic blocks – CLB Vs LAB Vs Slices- Fast carry chains- Embedded RAMs- Routing for FPGAs- Circuits and Architectures for Low-Power FPGAs- Physical Design.

UNIT III FPGA ARCHITECTURE 9

FPGA architecture overview- Challenges of FPGA processor design-Opportunities of FPGA processor design- Designing SoftCore Processors – Designing Hardcore Processors –hardware/software co simulation- FPGA to multi core embedded computing- FPGA based on-board computer system.

UNIT IV RECONFIGURABLE SOC PROCESSORS 9

SoC Overview –Architecture and applications of Virtex II pro ,Zynq-7000, Excalibur, Cyclone V - A7, E5- FPSLIC- Multicore SoCs.

UNIT V RECONFIGURABLE PROCESSOR AND SOC APPLICATIONS 9

Reconfigurable processor based DC motor control- digital filter design- mobile phone development- High Speed Data Acquisition -Image Processing application-controller implementation for mobile robot- Crypto-processor.

TOTAL: 45 PERIODS

COURSE OUTCOMES :

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

CO1: Illustrate the need of reconfigurable computing and hardware-software co design

CO2: Demonstrate the significance of FPGA technology

CO3: Apply the concept of FPGA technology and understand FPGA architectures.

CO4: Interpret the operation of SoC processor.

CO5: Relate and improve Employability and entrepreneurship capacity due to knowledge up-gradation on reconfigurable computing and SoC design.

CO	PO					
	1	2	3	4	5	6
1	-	-	-	-	-	-
2	-	2	3	-	-	-
3	-	-	2	1	2	-
4	-	1	3	-	-	-
5	-	-	-	-	-	3
AVg.	0	1.5	2.66	1	2	3

REFERENCES:

1. Nurmi, Jari (Ed.) "Processor Design System-On-Chip Computing for ASICs and FPGAs" Springer, 2007.
2. Ian Grout , “Digital system design with FPGAs and CPLDs” Elsevier, 2008
   Joao Cardoso, Michael Hübner, "Reconfigurable Computing: From FPGAs to Hardware/Software Codesign" Springer, 2011.
3. Ron Sass and AnderewG.Schmidt, “ Embedded System design with platform FPGAs: Principles and Practices”, Elsevier, 2010.
4. Steve Kilts, "Advanced FPGA Design: Architecture, Implementation, and Optimization" Willey, 2007
5. Pierre-Emmanuel Gaillardon, Reconfigurable Logic: Architecture, Tools, and Applications, 1st Edition, CRC Press , 2015

ET4015 MEMS and NEMS TECHNOLOGY LT P C
3 0 0 3

COURSE OBJECTIVES:

1. To introduce the diverse technological and functional approaches of MEMS/NEMS and applications.
2. To understand the microstructures and fabrication methods.
3. To provide an insight of micro and nano sensors, actuators.
4. To emphasis the need for NEMS techology.
5. To update the ongoing trends and real time applications of MEMS and NEMS technology.

UNIT I INTRODUCTION TO MEMS and NEMS 9

Overview of Micro electro mechanical systems and Nano Electro mechanical systems, devices and technologies, Laws of scaling- Survey of materials- Smart Sensors-Applications of MEMS and NEMS.

UNIT II MICRO-MACHINING AND MICROFABRICATION TECHNIQUES 9

Photolithography- Film deposition, Etching Processes- wafer bonding- Bulk micro machining, silicon surface micro machining- LIGA process.

UNIT III MICRO SENSORS AND MICRO ACTUATORS 9

Transduction mechanisms in different energy domain- Micromachined capacitive, Piezoelectric , piezoresistive and Electromechanical and thermal sensors/actuators and applications

UNIT IV NEMS TECHNOLOGY 9

Atomic scale precision engineering- Nano Fabrication techniques - NEMS in measurement, sensing, actuation and systems design.

UNIT V MEMS and NEMS APPLICATION 9

Introduction to Micro/Nano Fluids and applications- Bio MEMS- Optical NEMS- Micro and Nano motors- Recent trends in MEMS and NEMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the material properties and the significance of MEMS and NEMS for industrial automation.
CO2: Demonstrate knowledge delivery on micromachining and micro fabrication.
CO3: Apply the fabrication mechanism for MEMS sensor and actuators.
CO4: Apply the concepts of MEMS and NEMS to models ,simulate and process the sensors and actuators.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on MEMS and NEMS technology.

CO	PO					
	1	2	3	4	5	6
1	3	2	3	-	2	-
2	3	3	2	-	2	2
3	3	3	3	-	2	2
4	3	3	3	-	3	2
5	3	2	3	2	3	3
AVg.	3	2.6	2.8	2	2.4	2.25

REFERENCES:

1. Chang Liu, “Foundations of MEMS”, Pearson International Edition, 2006.
2. Marc F madou“ Fundamentals of micro fabrication” CRC Press 2002 2nd Edition Marc Madou.
3. M.H.Bao “Micromechanical transducers :Pressure sensors, accelerometers and gyroscopes”,Elsevier, Newyork, 2000.
4. Maluf, Nadim “An introduction to Micro Electro-mechanical Systems Engineering “AR Tech house, Boston 2000.
5. Mohamed Gad – el – Hak “MEMS Handbook” Edited CRC Press 2002 2. Sabriesolomon “Sensors Handbook”, Mc Graw Hill 1998.
6. Tai-.Ran Hsu, “MEMS and Microsystems: design , manufacture, and Nanoscale”- 2nd Edition, John Wiley & Sons, Inc., Hoboken, New Jersey, 2008
7. Lyshevski, S.E. “ Nano- and Micro-Electromechanical Systems: Fundamentals of Nano-and Microengineering “ (2nd ed.). CRC Press,2005.

ET4016 ENTREPRENEURSHIP AND EMBEDDED PRODUCT DEVELOPMENT LT P C
3 0 0 3

COURSE OBJECTIVES

1. To develop an understanding on business promotion process.
2. To expose students on the skills required for success in business.
3. To impart embedded system technology based entrepreneurship. Architecture
4. Creative thinking in developing automation into consumer products of market value
5. Developing an embedded product with hardware-software components.

UNIT I INTRODUCTION TO ENTREPRENEURSHIP 9

Entrepreneurial culture and structure -theories of entrepreneurship - entrepreneurial motivation - establishing entrepreneurial systems - financial information and intelligence, rewards and motivation - concept bank -Role of industrial Fairs- challenges in entrepreneurship.

UNIT II RESPONSIBILITIES IN ENTREPRENEURSHIP 9

Steps for starting a small industry -selection of type of organization -Incentives and subsidies - Central Govt. schemes and State Govt. Schemes -incentives to SSI -registration, Registration and Licensing requirements for sales tax, CST, Excise Duty -Power -Exploring export possibilities- incentives for exports -import of capital goods and raw materials- Entrepreneurship development programmes in India- Role and Improvement in Indian Economy.

UNIT III CONCEPTS OF PRODUCT DEVELOPMENT 9

Generic product Development Phases- Product Development Process Flows- Basics of Concept Generation-Five Step Method- Creative thinking methods and problem solving- design concepts– Product Architecture- component standardization –Bill of materials-Product development management- Portfolio Architecture- Benchmarking

UNIT IV APPROACHES FOR NEW PRODUCT DEVELOPMENT 9

Idea Generation- Industrial Design -Brainstorming Methods - SWOT Analysis-Concept Development & Testing- Risk Management Process- Critical Path Analysis & PERT- Reverse Engineering Methodology- need for Involving CAE, CAD, CAM tools -Prototype basics - Rapid Prototyping - Prototyping Techniques - Planning for prototypes- Economic & Cost Analysis

UNIT V SCOPE IN EMBEDDED SYSTEM FIELD 9

Entrepreneurship opportunities in Embedded system technologies - Embedded system Product development -Entrepreneurial skills for embedded system hardware and software architecture, software and hardware co-design and challenges; problems of entrepreneurship in Embedded system field- case studies: Mobile phone development- automation components-Washing machine- Food Processing system and devices- High Performance embedded computers- Industrial Controllers

TOTAL : 45 PERIODS

COURSE OUTCOMES :

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

CO1: Analyze the internal/external factors affecting a business/organization to evaluate business opportunities.

CO2: Demonstrate extemporaneous speaking skills developed through in-class discussion of text materials, case study analyses, and current entrepreneurship-related issues.

CO3: Apply and Relate Key concepts underpinning entrepreneurship and its application in the recognition and exploitation of product/ service/ process opportunities.

CO4: Interpret various aspects of design such as industrial design, design of Consumer specific product , its Reverse Engineering manufacture ,economic analysis through

CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

CO	PO					
	1	2	3	4	5	6
1	3	2	-	-	-	3
2	3	3	-	-	-	-
3	3	3	-	-	-	1
4	3	3	-	1	-	1
5	3	2	3	2	3	3
AVg.	3	2.6	3	1.5	3	2

REFERENCES

1 Kuratko, Enmterpreneurship : A Contemporary Approach, Thomson Learning, 2001.
2 Thomas Zimmerer et.al., Essentials of Entrepreneurship and small business Management 3rd Ed. Pearson Education, 2002.
3 Greene, Entrepreneurship: Ideas in Action, Thomson Learning, Mumbai, 2000
4 Jeffry Timmons, New Ventrure creation, McGraw Hill, 1999.
5 Gupta and Smivasan, Entrepreneurial Development, New Delhi, Sultan Chand, 1992
6 James K.peckol ," Embedded Systems: A contemporary Design Tool", Wiley,2014.
7 Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development", 4th Edition,2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9
8 George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill International Edition,4th Edition, 2009, ISBN 978-007-127189-9

PROGRESS THROUGH KNOWLEDGE

ET4017 EMBEDDED SYSTEM FOR BIOMEDICAL APPLICATIONS LT P C
3 0 0 3

COURSE OBJECTIVES:

1. To Introduce Fundamentals of Biomedical Engineering
2. To understand the concept of wearable health devices
3. To study the hardware for image processing applications
4. To have a basic knowledge of Embedded system in diagnostic applications
5. To study about the various assist devices used in the hospitals.

UNIT I INTRODUCTION TO BIOMEDICAL ENGINEERING 9

Origin of bio potential and its propagation- Resting and Action Potential – Bio signals characteristics- Types of electrodes - Types of transducers and applications-Bio-amplifiers- Types of recorders- components of a biomedical system.

UNIT II WEARABLE HEALTH DEVICES 9

Concepts of wearable technology in health care-Components of wearable devices- Biosensors- Blood glucose sensors - Head worn- Hand worn- Body worn-pulse oxymeter- Cardiac pacemakers – Hearing aids and its recent advancements-wearable artificial kidney.

UNIT III EMBEDDED SYSTEM FOR MEDICAL IMAGE PROCESSING 9

Introduction to embedded image processing . ASIC vs FPGA - memory requirement-, power consumption- parallelism - Design issues in VLSI implementation of Image processing algorithms - interfacing. Hardware implementation of image processing algorithms: Segmentation and compression

UNIT IV EMBEDDED SYSTEM FOR DIAGNOSTIC APPLICATIONS 9

ICCU patient monitoring system – ECG-EEG-EMG acquisition system-MRI scanner - CT scanner- Sonography.

UNIT V CASE STUDY 9

Respiratory measurement using spirometer- IPPB unit for monitoring respiratory parameters - ventilators- -Defibrillator- Glucometer-Heart- Lung machine.

TOTAL: 45 PERIODS

PROGRESS THROUGH KNOWLEDGE

COURSE OUTCOMES:

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

CO1: Demonstrate the fundamental art of biomedical engineering.
CO2: Illustrate about wearable health devices and its importance.
CO3: Implement image processing applications using software and hardware.
CO4: Compare various embedded diagnostic applications.
CO5: Build and analyze of some biomedical equipment.

CO	PO					
	1	2	3	4	5	6
1	1	2	3	-	-	-
2	-	3	2	3	-	-
3	-	-	2	-	3	3
4	3	1	1	-	2	2
5	1	3	3	-	-	-
AVg.	1.66	2.25	2.2	3	2.5	2.5

REFERENCES:

1. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice Hall of India, New Delhi, 2007.
2. John G.Webster, “Medical Instrumentation Application and Design”, 3rd Edition, Wiley India Edition, 2007
3. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw Hill, New Delhi, 3rd Edition, 2014.
4. L.A Geddes and L.E.Baker, Principles of Applied Biomedical Instrumentation, 3rd Edition, John Wiley and Sons, Reprint 2008.
5. Richard S.Cobbold, Transducers for Biomedical Measurements; Principle and applications-John Wiley and sons, 1992.

PS4092 RENEWABLE ENERGY AND GRID INTEGRATION L T P C
3 0 0 3

COURSE OBJECTIVES:

- To provide knowledge about the stand alone and grid connected renewable energy systems.
- To equip with required skills to derive the criteria for the design of power converters for renewable energy applications.
- To analyse and comprehend the various operating modes of wind electrical generators and solar energy systems.
- To design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.
- To develop maximum power point tracking algorithms.

UNIT I INTRODUCTION 9

Introduction to renewable energy systems, environmental aspects of electric energy conversion, impacts of renewable energy penetration to grid. Grid Codes in India and other countries . Basic power electronic converters for renewable energy integration to grid-Qualitative analysis -Boost and buck-boost converters, three phase AC voltage controllers- AC-DC-AC converters, PWM Inverters, Grid Interactive Inverters-matrix converters.

UNIT II PHOTO VOLTAIC ENERGY CONVERSION SYSTEMS 9

Introduction, Photo Voltaic (PV) effect, Solar Cell, Types, Equivalent circuit of PV cell, PV cell characteristics (I/V and P/V) for variation of insolation, temperature and shading effect,Stand-alone PV system, Grid connected PV system, Design of PV system-load calculation, array sizing, selection of converter/inverter, battery sizing.

UNIT III WIND ENERGY CONVERSION SYSTEMS 9

Introduction, Power contained in wind, Efficiency limit in wind, types of wind turbines, Wind control strategies, Power curve and Operating area, Types of wind generators system based on Electrical machines-Induction Generator and Permanent Magnet Synchronous Generator(PMSG), Grid Connected-Single and Double output system, Self-excited operation of Induction Generator and Variable Speed PMSG.

UNIT IV MPPT TECHNIQUES IN SOLAR AND WIND SYSTEMS 9

Case studies of PV-Maximum Power Point Tracking (MPPT) and Wind Energy system

UNIT V HYBRID STORAGE SYSTEMS AND GRID MANAGEMENT 9

Energy Storage systems, Need for Hybrid Systems, Features of Hybrid Systems, Range and types of Hybrid systems (Wind-Diesel, PV-Diesel and Wind-PV),

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1 Relate the power generation of different renewable energy sources to grid impact and grid codes
CO2 Explain the design principles of solar energy management systems
CO3 Understand the power conversion system of wind generators
CO4 Analyze the different Maximum Power Point tracking Techniques
CO5 Build grid connected and stand alone renewable energy management system

REFERENCES:

1. S.N.Bhadra, D. Kastha, & S. Banerjee “Wind Electrical Systems”, Oxford University Press, 2009.
2. Haitham Abu-Rub, Mariusz Malinowski and Kamal Al-Haddad, “Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications”, IEEE Press and John Wiley & Sons Ltd Press, 2014.
3. Rashid .M. H “power electronics Hand book”, Academic press, 2001.
4. Rai. G.D, “Non-conventional energy sources”, Khanna publishes, 1993
5. Gray, L. Johnson, “Wind energy system”, prentice hall linc, 1995
6. Non-conventional Energy sources B.H.Khan Tata McGraw-hill Publishing Company, New Delhi.

CO-PO MAPPING

	PO					
CO	**1**	**2**	**3**	**4**	**5**	**6**
CO1	1	2	1	-	1	-
CO2	1	1	2	-	1	-
CO3	2	-	1	1	1	2
CO4	1	2	1	2	-	2
CO5	3	3	2	-	2	-
AVG	1.6	2	1.4	1.5	1.25	2

PROGRESS THROUGH KNOWLEDGE

PX4291	ELECTRIC VEHICLES AND POWER MANAGEMENT	L T P C 3 1 0 4

OBJECTIVES:

- To understand the concept of electric vehicles and its operations
- To present an overview of Electric Vehicle (EV), Hybrid Electric vehicle (HEV) and their architecture
- To understand the need for energy storage in hybrid vehicles
- To provide knowledge about various possible energy storage technologies that can be used in electric vehicles

UNIT I ELECTRIC VEHICLES AND VEHICLE MECHANICS 12

Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings- Comparisons of EV with internal combustion Engine vehicles- Fundamentals of vehicle mechanics.

UNIT II ARCHITECTURE OF EV's AND POWER TRAIN COMPONENTS 12

Architecture of EV's and HEV's – Plug-n Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes.

UNIT III POWER ELECTRONICS AND MOTOR DRIVES 12

Electric drive components – Power electronic switches- four quadrant operation of DC drives – Induction motor and permanent magnet synchronous motor-based vector control operation – Switched reluctance motor (SRM) drives- EV motor sizing.

UNIT IV BATTERY ENERGY STORAGE SYSTEM 12

Battery Basics- Different types- Battery Parameters-Battery life & safety impacts -Battery modeling-Design of battery for large vehicles.

UNIT V ALTERNATIVE ENERGY STORAGE SYSTEMS 12

Introduction to fuel cell – Types, Operation and characteristics- proton exchange membrane (PEM) fuel cell for E-mobility– hydrogen storage systems –Super capacitors for transportation applications.

TOTAL : 60 PERIODS

OUTCOMES:

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

CO1: Understand the concept of electric vehicle and energy storage systems.
CO2: Describe the working and components of Electric Vehicle and Hybrid Electric Vehicle
CO3: Know the principles of power converters and electrical drives
CO4: Illustrate the operation of storage systems such as battery and super capacitors
CO5: Analyze the various energy storage systems based on fuel cells and hydrogen storage

REFERENCES:

1. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Second Edition" CRC Press, Taylor & Francis Group, Second Edition (2011).
2. Ali Emadi, Mehrdad Ehsani, John M.Miller, "Vehicular Electric Power Systems", Special

Indian Edition, Marcel dekker, Inc 2010.
3. Mehrdad Ehsani, YiminGao, Sebastian E. Gay, Ali Emadi, 'Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design', CRC Press, 2004.
4. C.C. Chan and K.T. Chau, 'Modern Electric Vehicle Technology', OXFORD University Press, 2001.
5. Wie Liu, “Hybrid Electric Vehicle System Modeling and Control”,Second Edition, John Wiley & Sons, 2017.

CO-PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	3	2
CO2	3	3	3	2	3	2
CO3	3	3	3	2	3	2
CO4	3	3	3	2	3	2
CO5	3	3	3	2	3	2
AVG.	**3**	**3**	**3**	**2**	**3**	**2**

ET4073 PYTHON PROGRAMMING FOR MACHINE LEARNING L T P C
3 0 0 3

COURSE OBJECTIVES:

1. Students will understand and be able to use the basic programming principles such as data types, variable, conditionals, loops, recursion and function calls.
2. Students will learn how to use basic data structures such as List, Dictionary and be able to manipulate text files and images.
3. To make the students familiar with machine learning concepts & techniques.
4. Students will understand the process and will acquire skills necessary to effectively attempt a machine learning problem and implement it using Python.
5. To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved research/employability skills

UNIT I INTRODUCTION TO MACHINE LEARNING AND PYTHON 9

Introduction to Machine Learning: Significance, Advantage and Applications – Categories of Machine Learning – Basic Steps in Machine Learning: Raw Data Collection, Pre-processing, Training a Model, Evaluation of Model, Performance Improvement

Introduction to Python and its significance – Difference between C, C++ and Python Languages; Compiler and Interpreters – Python3 Installation & Running – Basics of Python Programming Syntax: Variable Types, Basic Operators, Reading Input from User – Arrays/List, Dictionary and Set – Conditional Statements – Control Flow and loop control statements

UNIT II PYTHON FUNCTIONS AND PACKAGES 9

File Handling: Reading and Writing Data – Errors and Exceptions Handling – Functions & Modules – Package Handling in Python – Pip Installation & Exploring Functions in python package – Installing the Numpy Library and exploring various operations on Arrays: Indexing, Slicing, Multi-Dimensional Arrays, Joining Numpy Arrays, Array intersection and Difference, Saving and Loading Numpy Arrays – Introduction to SciPy Package & its functions - Introduction to Object Oriented Programming with Python

UNIT III IMPLEMENTATION OF MACHINE LEARNING USING PYTHON 9

Description of Standard Datasets: Coco, ImageNet, MNIST (Handwritten Digits) Dataset, Boston Housing Dataset – Introducing the concepts of Regression – Linear, Polynomial & Logistic Regression with analytical understanding - Introduction to SciPy Package & its functions – Python Application of Linear Regression and Polynomial Regression using SciPy – Interpolation, Overfitting and Underfitting concepts & examples using SciPy

UNIT IV CLASSIFICATION AND CLUSTERING CONCEPTS OF ML 9

Introduction to ML Concepts of Clustering and Classification – Types of Classification Algorithms – Support Vector Machines (SVM) - Decision Tree - Random Forest – Introduction to ML using scikit-learn – Using scikit-learn, Loading a sample dataset, Learning & prediction, interpolation & fitting, Multiclass fitting - Implementation of SVM using Blood Cancer Dataset, Decision Tree using data from csv.

Types of Clustering Algorithms & Techniques – K-means Algorithm, Mean Shift Algorithm & Hierarchical Clustering Algorithm – Introduction to Python Visualization using Matplotlib: Plotting 2-dimensional, 3-dimensional graphs; formatting axis values; plotting multiple rows of data in same graph – Implementation of K-means Algorithm and Mean Shift Algorithm using Python

UNIT V INTRODUCTION TO NEURAL NETWORKS AND EMBEDDED MACHINE LEARNING 9

Introduction to Neural Networks & Significance – Neural Network Architecture – Single Layer Perceptron & Multi-Layer Perceptron (MLP) – Commonly Used Activation Functions - Forward Propagation, Back Propagation, and Epochs – Gradient Descent – Introduction to Tensorflow and Keras ML Python packages – Implementation of MLP Neural Network on Iris Dataset – Introduction to Convolution Neural Networks – Implementation of Digit Classification using MNIST Dataset

ML for Embedded Systems: Comparison with conventional ML – Challenges & Methods for Overcoming – TinyML and Tensorflow Lite for Microcontrollers – on-Board AI – ML Edge Devices: Arduino Nano BLE Sense, Google Edge TPU and Intel Movidius

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Develop skill in system administration and network programming by learning Python.

CO2: Demonstrating understanding in concepts of Machine Learning and its implementation using Python

CO3: Relate to use Python's highly powerful processing capabilities for primitives, modelling etc

CO4: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

CO5: Apply the concepts acquired over the advanced research/employability skills

CO	PO					
	1	2	3	4	5	6
1	-	-	2	3	3	-
2	3	1	3	-	3	1
3	2	1	2	-	3	3
4	3	2	3	3	3	3
5	-	-	-		3	-
AVg.	2.66	1.33	2.5	3	3	2.33

REFERENCES:

1. Mark Lutz,"LearningPython,Powerful OOPs,O'reilly,2011
2. Zelle, John "M. Python Programming: An Introduction to Computer Science.", Franklin Beedle& Associates, 2003
3. Andreas C. Müller, Sarah Guido, "Introduction to Machine Learning with Python", O'Reilly,2016
4. Sebastian Raschka , VahidMirjalili, "Python Machine Learning - Third Edition", Packt, December 2019

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.

MAPPING O CO'S WITH PO'S

CO	PO					
	1	2	3	4	5	6
1	3	2	-	2	2	2
2	3	-	2	2	-	2
3	2	-	1	-	-	-
4	1	-	-	3	3	1
5	-	2	2	2	2	3
AVG	2.25	2	1.66	2.25	2.3	2

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

COURSE OBJECTIVES

1. Teach how to improve writing skills and level of readability
2. Tell about what to write in each section
3. Summarize the skills needed when writing a Title
4. Infer the skills needed when writing the Conclusion
5. 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.

AX4092 **DISASTER MANAGEMENT** **L T P C**
2 0 0 0

COURSE OBJECTIVES

1. Summarize basics of disaster
2. Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
3. Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
4. Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
5. 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.

AX4093 CONSTITUTION OF INDIA L T P C
2 0 0 0

COURSE OBJECTIVES

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
3. Role and entitlement to civil and economic rights as well as the emergencenation hood in the early years of Indian nationalism.
4. 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 6

History, Drafting Committee, (Composition &Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION 6

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES 6

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 6

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 6

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

UNIT VI ELECTION COMMISSION 6

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.Ambedkarframing 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.

AX4094	நற்றமிழ்இலக்கியம்	LT P C 2 0 0 0

UNIT I சங்கஇலக்கியம் 6

1. தமிழின்துவக்கநூல்தொல்காப்பியம்

   – எழுத்து, சொல், பொருள்

2. அகநானூறு (82)

   - இயற்கைஇன்னிசைஅரங்கம்

3. குறிஞ்சிப்பாட்டின்மலர்க்காட்சி

4. புறநானூறு (95,195)

   - போரைநிறுத்தியஔவையார்

UNIT II அறநெறித்தமிழ் 6

1. அறநெறிவகுத்ததிருவள்ளுவர்

   - அறம்வலியுறுத்தல், அன்புடைமை, ஒப்புரவறிதல், ஈகை, புகழ்

2. பிறஅறநூல்கள்- இலக்கியமருந்து

– ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை (தூய்மையைவலியுறுத்தும்நூல்)

UNIT III **இரட்டைக்காப்பியங்கள்** **6**

1.கண்ணகியின்புரட்சி

- சிலப்பதிகார வழக்குரைகாதை

2. சமூகசேவை இலக்கியம் மணிமேகலை

- சிறைக்கோட்டம்அறக்கோட்டமாகியகாதை

UNIT IV **அருள்நெறித்தமிழ்** **6**

1. சிறுபாணாற்றுப்படை

- பாரிமுல்லைக்குத் தேர் கொடுத்தது, பேகன் மயிலுக்குப்போர்வை கொடுத்தது, அதியமான் ஔவைக்கு நெல்லிக்கனி கொடுத்தது, அரசர்பண்புகள்

2. நற்றிணை

- அன்னைக்குரியபுன்னைசிறப்பு

3. திருமந்திரம் (617, 618)

- இயமம்நியமம்விதிகள்

4. தர்மச்சாலையைநிறுவிய வள்ளலார்

5. புறநானூறு

- சிறுவனேவள்ளலானான்

6. அகநானூறு (4) - வண்டு

நற்றிணை (11) - நண்டு

கலித்தொகை (11) - யானை, புறா

ஐந்திணை 50 (27) - மான்

ஆகியவை பற்றிய செய்திகள்

UNIT V நவீனதமிழ்இலக்கியம் 6

1. உரைநடைத்தமிழ்,
   - தமிழின்முதல்புதினம்,
   - தமிழின்முதல்சிறுகதை,
   - கட்டுரைஇலக்கியம்,
   - பயணஇலக்கியம்,
   - நாடகம்,
2. நாட்டு விடுதலை போராட்டமும் தமிழ் இலக்கியமும்,
3. சமுதாய விடுதலையும் தமிழ் இலக்கியமும்,
4. பெண்விடுதலையும்விளிம்புநிலையினரின்மேம்பாட்டில்தமிழ்இலக்கியமும்,
5. அறிவியல்தமிழ்,
6. இணையத்தில்தமிழ்,
7. சுற்றுச்சூழல்மேம்பாட்டில்தமிழ்இலக்கியம்.

<u>தமிழ்இலக்கியவெளியீடுகள் / புத்தகங்கள்</u>

1. தமிழ்இணையகல்விக்கழகம் (Tamil Virtual University)
   - www.tamilvu.org

2. தமிழ்விக்கிப்பீடியா (Tamil Wikipedia)

-https://ta.wikipedia.org

3. தர்மபுர ஆதீன வெளியீடு

4. வாழ்வியல்களஞ்சியம்
   - தமிழ்ப்பல்கலைக்கழகம், தஞ்சாவூர்

5. தமிழ்கலைக்களஞ்சியம்

- தமிழ்வளர்ச்சித்துறை (thamilvalarchithurai.com)

6. அறிவியல்களஞ்சியம்

- தமிழ்ப்பல்கலைக்கழகம், தஞ்சாவூர்

TOTAL: 30 PERIODS

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).

PROGRESS THROUGH KNOWLEDGE

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.

PROGRESS THROUGH KNOWLEDGE

OME432 ENERGY CONSERVATION AND MANAGEMENT IN DOMESTIC SECTORS

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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

PROGRESS THROUGH KNOWLEDGE

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

PROGRESS THROUGH KNOWLEDGE

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.

UNIT V 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.

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 Guidell, 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

DS4015 BIG DATA ANALYTICS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the basics of big data analytics
- To understand the search methods and visualization
- To learn mining data streams
- To learn frameworks
- To gain knowledge on R language

UNIT I INTRODUCTION TO BIG DATA 9

Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis Vs Reporting - Modern Data Analytic Tools- Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error.

UNIT II SEARCH METHODS AND VISUALIZATION 9

Search by simulated Annealing – Stochastic, Adaptive search by Evaluation – Evaluation Strategies – Genetic Algorithm – Genetic Programming – Visualization – Classification of Visual Data Analysis Techniques – Data Types – Visualization Techniques – Interaction techniques – Specific Visual data analysis Techniques

UNIT III MINING DATA STREAMS 9

Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions

UNIT IV FRAMEWORKS 9

MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Case Study- Preventing Private Information Inference Attacks on Social Networks- Grand Challenge: Applying Regulatory Science and Big Data to Improve Medical Device Innovation

UNIT V R LANGUAGE 9

Overview, Programming structures: Control statements -Operators -Functions -Environment and scope issues -Recursion -Replacement functions, R data structures: Vectors -Matrices and arrays -Lists -Data frames -Classes, Input/output, String manipulations

COURSE OUTCOMES:

CO1:understand the basics of big data analytics
CO2: Ability to use Hadoop, Map Reduce Framework.
CO3: Ability to identify the areas for applying big data analytics for increasing the business outcome.
CO4: gain knowledge on R language
CO5: Contextually integrate and correlate large amounts of information to gain faster insights.

TOTAL:45 PERIODS

REFERENCE:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 3rd edition 2020.
3. Norman Matloff, The Art of R Programming: A Tour of Statistical Software Design, No Starch Press, USA, 2011.
4. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, John Wiley & sons, 2012.
5. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007.

NC4201 INTERNET OF THINGS AND CLOUD L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

UNIT I FUNDAMENTALS OF IoT 9

Introduction to IoT – IoT definition – Characteristics – IoT Complete Architectural Stack – IoT enabling Technologies – IoT Challenges. Sensors and Hardware for IoT – Hardware Platforms – Arduino, Raspberry Pi, Node MCU. A Case study with any one of the boards and data acquisition from sensors.

UNIT II PROTOCOLS FOR IoT 9

Infrastructure protocol (IPV4/V6/RPL), Identification (URIs), Transport (Wifi, Lifi, BLE), Discovery, Data Protocols, Device Management Protocols. – A Case Study with MQTT/CoAP usage-IoT privacy, security and vulnerability solutions.

UNIT III CASE STUDIES/INDUSTRIAL APPLICATIONS 9

Case studies with architectural analysis: IoT applications – Smart City – Smart Water – Smart Agriculture – Smart Energy – Smart Healthcare – Smart Transportation – Smart Retail – Smart waste management.

UNIT IV CLOUD COMPUTING INTRODUCTION 9

Introduction to Cloud Computing - Service Model – Deployment Model- Virtualization Concepts – Cloud Platforms – Amazon AWS – Microsoft Azure – Google APIs.

UNIT V IoT AND CLOUD 9

IoT and the Cloud - Role of Cloud Computing in IoT - AWS Components - S3 – Lambda - AWS IoT Core -Connecting a web application to AWS IoT using MQTT- AWS IoT Examples. Security Concerns, Risk Issues, and Legal Aspects of Cloud Computing- Cloud Data Security

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the various concept of the IoT and their technologies..
CO2: Develop IoT application using different hardware platforms
CO3: Implement the various IoT Protocols
CO4: Understand the basic principles of cloud computing.
CO5: Develop and deploy the IoT application into cloud environment

REFERENCES

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman ,CRC Press, 2017
2. Adrian McEwen, Designing the Internet of Things, Wiley,2013.
3. EMC Education Services, “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, Wiley publishers, 2015.
4. Simon Walkowiak, “Big Data Analytics with R” PackT Publishers, 2016
5. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, Wiley Publishers, 2015.

MX4073 MEDICAL ROBOTICS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To explain the basic concepts of robots and types of robots
- To discuss the designing procedure of manipulators, actuators and grippers
- To impart knowledge on various types of sensors and power sources
- To explore various applications of Robots in Medicine
- To impart knowledge on wearable robots

UNIT I INTRODUCTION TO ROBOTICS 9

Introduction to Robotics, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Dynamic Stabilization

Sensors and Actuators

Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, PD and PID feedback actuator models

UNIT II MANIPULATORS & BASIC KINEMATICS 9

Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse Kinematic problems

Navigation and Treatment Planning

Variable speed arrangements, Path determination – Machinery vision, Ranging – Laser – Acoustic, Magnetic, fiber optic and Tactile sensor

UNIT III SURGICAL ROBOTS 9

Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump, CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric and General Surgery, Gynecologic Surgery, General Surgery and Nanorobotics. Case Study

UNIT IV REHABILITATION AND ASSISTIVE ROBOTS 9

Pediatric Rehabilitation, Robotic Therapy for the Upper Extremity and Walking, Clinical-Based Gait Rehabilitation Robots, Motion Correlation and Tracking, Motion Prediction, Motion Replication. Portable Robot for Tele rehabilitation, Robotic Exoskeletons – Design considerations, Hybrid assistive limb. Case Study

UNIT V WEARABLE ROBOTS 9

Augmented Reality, Kinematics and Dynamics for Wearable Robots, Wearable Robot technology, Sensors, Actuators, Portable Energy Storage, Human–robot cognitive interaction (cHRI), Human–robot physical interaction (pHRI), Wearable Robotic Communication - case study

TOTAL:45 PERIODS

COURSE OUTCOMES:

CO1: Describe the configuration, applications of robots and the concept of grippers and actuators
CO2: Explain the functions of manipulators and basic kinematics
CO3: Describe the application of robots in various surgeries
CO4: Design and analyze the robotic systems for rehabilitation
CO5: Design the wearable robots

REFERENCES

1. Nagrath and Mittal, “Robotics and Control”, Tata McGraw Hill, First edition, 2003
2. Spong and Vidhyasagar, “Robot Dynamics and Control”, John Wiley and Sons, First edition, 2008
3. Fu.K.S, Gonzalez. R.C., Lee, C.S.G, “Robotics, control”, sensing, Vision and Intelligence, Tata McGraw Hill International, First edition, 2008
4. Bruno Siciliano, Oussama Khatib, Springer Handbook of Robotics, 1st Edition, Springer, 2008
5. Shane (S.Q.) Xie, Advanced Robotics for Medical Rehabilitation - Current State of the Art and Recent Advances, Springer, 2016
6. Sashi S Kommu, Rehabilitation Robotics, I-Tech Education and Publishing, 2007
7. Jose L. Pons, Wearable Robots: Biomechatronic Exoskeletons, John Wiley & Sons Ltd, England, 2008
8. Howie Choset, Kevin Lynch, Seth Hutchinson, “Principles of Robot Motion: Theory, Algorithms, and Implementations”, Prentice Hall of India, First edition, 2005
9. Philippe Coiffet, Michel Chirouze, “An Introduction to Robot Technology”, Tata McGraw Hill, First Edition, 1983
10. Jacob Rosen, Blake Hannaford & Richard M Satava, “Surgical Robotics: System Applications & Visions”, Springer 2011
11. Jocelyn Troccaz, Medical Robotics, Wiley, 2012
12. Achim Schweikard, Floris Ernst, Medical Robotics, Springer, 2015

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.

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

PROGRESS THROUGH KNOWLEDGE

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
3 0 0 3

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 Veprįek (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.

PROGRESS THROUGH KNOWLEDGE

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.