Kolhapur Institute of Technology's

College of Engineering (Autonomous), Kolhapur

Structure and Syllabus

M. Tech

Electronics & Telecommunication Engineering

(Post Graduate Program)

Department of Electronics and Telecommunication Engineering

With effect from

Academic Year 2022-2023

Department of Electronics and Telecommunication Engineering

Teaching and Evaluation scheme for

M.Tech. Program in Electronics & Telecommunication Engineering

Semester-I

Sr. No.	Curriculum Component	Course Code	Course	Teaching Scheme				Examination Scheme			
				L	T	P	Credits	Scheme	Weightage		
									Max	Min	Min
1	ES	PETC0101	Engineering Linear Algebra	3	1	-	4	ISE I	10	20	40
								MSE	30		
								ISE II	10		
								ESE	50	20	
2	PC	PETC0102	Mobile Security	3	-	-	3	ISE I	10	20	40
								MSE	30		
								ISE II	10		
								ESE	50	20	
3	PC	PETC0103	Cloud Computing IOT Programming	4	-	-	4	ISE I	10	20	40
								MSE	30		
								ISE II	10		
								ESE	50	20	
4	PE	PETC01**	Program Elective-I	3	1	-	4	ISE I	10	20	40
								MSE	30		
								ISE II	10		
								ESE	50	20	
5	PE	PETC01**	Program Elective-II	3	1	-	4	ISE I	10	20	40
								MSE	30		
								ISE II	10		
								ESE	50	20	
6	BS	PETC0161	Research Methodology	2	-	-	-	ESE	100	40	
7	PC	PETC0131	Mobile Security Lab	-	-	2	1	ISE	50		20
								ESE (OE)	50		20
8	PC	PETC0132	Cloud Computing IOT Programming Lab	-	-	2	1	ISE	50		20
								ESE (OE)	50		20
9	PC	PETC0141	Seminar	-	-	2	1	ISE	50		40
			Total	**18**	**3**	**6**	**22**	**Total**	**850**		

Total Contact Hours/Week: 27 Hrs

Note:
ESE : End Semester Examination,
MSE : Mid Semester Examination,
ISE : In Semester Evaluation.

Department of Electronics and Telecommunication Engineering

Teaching and Evaluation scheme for

M.Tech. Program in Electronics & Telecommunication Engineering

Semester-II

Sr. No.	Curriculum Component	Course Code	Course	Teaching Scheme				Examination Scheme			
				L	T	P	Credits	Scheme	Weightage		
									Max	Min	Min
1	PC	PETC0204	RF and Microwave Circuit design	3	1	-	4	ISE I	10	20	40
								MSE	30		
								ISE II	10		
								ESE	50	20	
2	PC	PETC0205	Communication Standards and protocols	3	-	-	3	ISE I	10	20	40
								MSE	30		
								ISE II	10		
								ESE	50	20	
3	PC	PETC0206	Design of Digital Signal Processing Systems	3	1	-	4	ISE I	10	20	40
								MSE	30		
								ISE II	10		
								ESE	50	20	
4	PE	PETC02**	Program Elective-III	3	1	-	4	ISE I	10	20	40
								MSE	30		
								ISE II	10		
								ESE	50	20	
5	PE	PETC02**	Program Elective-IV	3	1	-	4	ISE I	10	20	40
								MSE	30		
								ISE II	10		
								ESE	50	20	
6		PETC0262	Web Technology	2	-	-	-	ESE	100		40
7	PC	PETC0233	RF and Microwave Circuit design Lab	-	-	2	1	ISE	50		20
								ESE (OE)	50		20
8	PC	PETC0234	Communication Standards and protocols Lab	-	-	2	1	ISE	50		20
								ESE (OE)	50		20
9	PW	PETC0242	Mini Project	-	-	2	1	ISE	50		40
			Total	**17**	**4**	**6**	**22**	**Total**	**850**		

Total Contact Hours/Week: 27 Hrs

Teaching and Evaluation scheme for

M.Tech. Program in Electronics & Telecommunication Engineering

Semester-III

Sr. No.	Curriculum Component	Course Code	Course	Teaching Scheme				Evaluation Scheme		
								Scheme	Weightage	
				L	T	P	Credits		Max	Min
1	PW	PETC0343	Internship **	-	-	4	2	ISE	50	20
2	PC	PETC0344	MOOCS/ NPTEL/COURSERA Exam Certificate **	-	-	-	2	ISE	50	20
3	PW	PETC0351	Dissertation Phase I	-	-	8	4	ISE I	50	20
								ISE II	50	20
4	PW	PETC0352	Dissertation Phase II	-	-	8	4	ESE (OE)	100	40
			Total	**-**	**-**	**20**	**12**	**Total**	**300**	

**Note:
Internship : ISE marks should be given after submission of Internship Certification
MOOCS/ NPTEL/ COURSERA : Students have to enroll to the courses(4 weeks duration) identified by Department. ISE marks should be given after submission of Assignments and Exam Certificate

Semester-IV

Sr. No.	Curriculum Component	Course Code	Course	Teaching Scheme				Evaluation Scheme		
								Scheme	Weightage	
				L	T	P	Credits		Max	Min
1	PW	PETC0453	Dissertation Phase III	-	-	8	4	ISE I	50	20
								ISE II	50	20
2	PW	PETC0454	Dissertation Phase IV	-	-	16	8	ESE(OE)	100	40
			Total	**-**	**-**	**24**	**12**	**Total**	**200**	

Program Elective Courses

PE I	PE II	PE III	PE IV
PETC0121 Cortex ARM Architecture &Programming	**PETC0124** Automotive embedded system design	**PETC0221** Embedded Linux Programming	**PETC0224** AI and Machine learning
PETC0122 Optical Communication & Networks	**PETC0125** Wireless Sensor Network	**PETC0222** Advance Network Security	**PETC0225** Software Defined Radio
PETC0123 Digital Image and Video Processing	**PETC0126** Random Signal Processing	**PETC0223** Adaptive Signal Processing	**PETC0226** Digital Audio Processing

Dr. M. R. Dixit
PG Coordinator (E&TC)

Dr. N. B. Sambre
H.O.D (E&TC)

Dr. A. S. Patil
Dean (Academics)

Semester -I

Title of the Course: ENGINEERING LINEAR ALGEBRA Course Code: PETC0101	L	T	P	Credit
	3	1	0	4

Course Pre-Requisite: Engineering Mathematics, MATLAB, Matrix Algebra

Course Description: To impart the necessary linear algebra concepts to aid the analytical capabilities of the students.

COURSE OBJECTIVES

1	To understand several important concepts in linear algebra.
2	To understand the concept of mathematical theorems.
3	To Evaluate Orthogonality and Eigen values.
4	To Evaluate Engineering problems using Algebraic Theorems.

Course Learning Outcomes:

CO: After the completion of the course the student should be able to

CO1	Understand the algebraic structures and Linear Transformation.
CO2	Illustrate the concept of Vector space.
CO3	Interpret use of Eigen Values and Eigen Vectors
CO4	Perform applications to Image Processing and Statistics.

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	1	2	-
CO2	-	2	-
CO3	-	2	-
CO4	-	-	2

.**Assessments:**

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Unit 1:- Linear Equations In Linear Algebra And Matrix Algebra Solutions and Elementary Operations, Gaussian Elimination, Homogeneous Equations, Matrix Addition, Scalar Multiplication, and Transposition, Equations, Matrices, and Transformations, Matrix Multiplication, Matrix Inverses, Elementary Matrices, Linear Transformations, Matrix (LU) Factorization, subspaces of R^n , Dimensions and rank, Applications on above topic.	6Hrs
Unit 2:--- : Vector Spaces Definition and properties, Algebra of Subspaces, Linear dependence and independence, Basis and dimensions – Homomorphism of vector spaces or Linear transformation, Isomorphism of vector space, Quotient spaces, Direct sum subspaces, Disjoint subspaces, complementary subspaces. Change of basis – Row space and Column space.	6 **Hrs.**
Unit 3:- Linear Transformations Elementary properties, Kernel and Image of a linear transformation, Sum, product and inverse of Linear Transformations, Rank-nullity theorem, Invertible linear transformation, Singular and non singular transformation, Definition – Matrix representations, similarity, Determinant of linear transformation, Trace of matrix and linear transformation.	6 **Hrs.**
Unit 4:- Eigen Values and Eigen Vectors Eigen values and Eigenvectors, Systems of Linear differential equations, Diagonalization, Eigen vectors and linear transformations, Complex Eigen values, discrete dynamical systems, Applications to differential equations, Iterative estimations for Eigen values.	6 **Hrs.**
Unit 5:- Orthogonality and Least Squares Inner product, length and orthogonality, Orthogonal sets, Orthogonal projections, The Gram-Schmidt process, Least square problems, Applications to linear Models, Inner product spaces, Applications of Inner product spaces.	6 **Hrs.**
Unit 6:- Symmetric Matrices and Quadratic Forms Diagonalization of symmetric matrices, Quadratic forms, constrained optimization, The singular value decomposition, Applications to image processing and statistics.	5 **Hrs.**
Textbooks: **1.** David C. Lay ”Linear Algebra and its Applications”,Third Edition,Pearson Education. **2.** W.KeithNicholson, ”Linear Algebra with Application”, Seventh Edition, Mc Graw Hill Ryerson **3.** J.N.Sharma and A.R.Vasishtha,”Linear algebra”,KRISHNA Prakashan Media,Meerut.	
References: 1. Gilbert Strang (2009),” Introduction to Linear algebra*”*, Fourth edition, WesleyCambridge Press, MA,USA. 2. KeithMathews(1998*), “*ElementaryLinearalgebra*”*,UniversityofQueensland,Australia. 3. JimHefferon(2001*), ”*Linearalgebra*”*,SaintMichael’scollege,Vermont,USA. 4.Steven J. Leon (2009): “Linear algebra and its applications,” Eighth edition, Prentice Hall Inc., NY,USA. 5. Hoffman Kenneth and Kunze Ray, ‘LinearAlgebra*’,* Prentice Hall of India	

6. G.F.Simmons, 'Topology and Modern Analysis' ,McGrawHill
7. Frazier, Michael W. 'An Introduction to Wavelets through Linear Algebra',Springer Publications.
8. JinHoKwak&SungpyoHong,'LinearAlgebra',SpringerInternational,2004
9. Erwin Kreyzig, 'Introductory Functional Analysis with Applications', JohnWiley, 2006.

Unit wise Measurable students Learning Outcomes:

Unit1

UO1: Students will able to understand Algebraic Structures

Unit2

UO2: Students will able to work on Vector Spaces and Linear Transformations

Unit3

UO3: Students will understand Metric Space And Hilbert Space

Unit4

UO4: Student will understand the concept of Orthogonality and Eigen values

Unit5

UO5: Student will know the Numerical Linear Algebra

Unit6

UO6: Student will able to understand Iterative Methods And Canonical Forms

Title of the Course: Mobile Security **Course Code: PETC0102**	**L**	**T**	**P**	**Credit**
	3	**-**	**-**	**3**

Course Pre-Requisite: GSM, Mobile frequency, Handoff

Course Description: To introduce the students to concepts of various issues in security of mobile. Introduces security issues with respect operating system such as android,IOS etc.

Course Objectives:

1. To learn security issues
2. To discuss android security
3. To discuss IOS security
4. To Know windows mobile security

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive level	Descriptor
CO1	**Describe** the basics of Mobile security	II	**Describe**
CO2	**Classify** the different mobile OS	I	**Classify**
CO3	**Apply** the basic knowledge of security.	III	**Apply**
CO4	**Compare** the various Mobile OS	IV	**Compare**

CO-PO Mapping:

CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
CO1	3	2	-											
CO2	3	1	-											
CO3	2	2	2		1								2	2
CO4	2	1	-		1								2	2

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:-- Security issues Physical security, Secure data storage, strong authentication, Multiple user support with security, safe browsing environment, secure operating system, application isolation, Cross site request forgery(CSRF), Location privacy, Insecure device driver	**8 Hrs.**
Unit 2: Android security Development and debugging on android, Android IPC mechanism, Android security model, Android permission review, manifest permission, Intents, Broadcasts, Services, content providers, Android security tools.	**7 Hrs.**
Unit 3: Apple IOS security Breaking out, Breaking In, Security testing, Application format, Permissions and user control, Local data storage, Networking, Push notification, copy/paste and other IPC	**7 Hrs.**
Unit 4: Windows mobile security Introduction, Kernel architecture, Security testing, Permissions and user control, Local data storage, networking	**6 Hrs.**
Unit 5: WAP and Mobile android security Basics, Authentication on WAP/Mobile HTML sites, Encryption, Application attacks, Browser weakness.	**8 Hrs.**
Unit 6: Mobile Geo location Geo location methods, Geo location Implementation, Risks Geo location Services.	**8 Hrs.**

Textbooks:

1. John M Senior, Optical Fiber Communications, Principles and Practice, 3 Edition, Pearson Education, 20i0, ISBN:978-8i-3i7-3266-3.
2. Rajeev Ramaswamy and Kumar N Sivarajan, "Optical Networks: A Practical Perspective", 2nd Ed., 2004, Elsevier Morgan Kaufmann Publishers (An imprint of Elsevier).

References:

1. Harold Kolimbris, "Fiber Optic Communication", 2nd Ed, 2004, PEI
2. Uyless Black, "Optical Networks: Third Generation Transport Systems", 2nd Ed, 2009, PEI
3. Govind Agarwal, "Optical Fiber Communications", 2nd Ed, 2004, TMH.

Unit wise Measurable students Learning Outcomes:

1. To learn security issues
2. To discuss android security
3. To discuss IOS security
4. To Know windows mobile security

Title of the Course: Cloud Computing &Internet of Things Programming Course Code: PTC0103	L	T	P	Credit
	4	-	-	4

Course Pre-Requisite:

- **Fundamentals of Computer Networks**
- **Fundamentals of Embedded Systems**
- **Basic knowledge of programming language**

Course Description: The course is designed to learn the importance of IoT in society, the current components of typical IoT devices, IoT design considerations, constraints and interfacing between the physical world and your device. Students will also learn how to connect their device to the Internet.

Course Learning Objectives:

1.To understand the fundamentals and essentials of Cloud Computing
2. To understand the concepts and protocols related to Internet of Things.
3. To study and develop applications of the Internet of Things.

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Explain the core concepts of the cloud computing paradigm	2	Understanding
CO2	Illustrate the use of virtualization in enabling the cloud Computing system model.	2	Understanding
CO3	Explain the concept of Internet of Things	2	Understanding
CO4	Apply key technologies, protocols and standards in Internet of Things.	3	Applying
CO5	Design a simple IoT system comprising sensors, edge devices and wireless network connections involving prototyping, programming and data analysis.	6	Creating

CO-PO Mapping:

CO	PO1	PO2	PO 3
CO1		2	
CO2		2	
CO3	2		1
CO4	3		2
CO5	3		2

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on Online objective test and quiz.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Introduction to Cloud Getting to know the Cloud, Cloud and other similar configurations, Components of Cloud Computing, Cloud Types and Models: Private Cloud, Community Cloud, Public Cloud, Hybrid Clouds	**5Hrs**
Unit 2:Virtualization Introduction and benefits, Implementation Levels of Virtualization, Virtualization at the OS Level, Virtualization Structure, Virtualization Mechanism, Open Source Virtualization Technology, Xen Virtualization Architecture, Binary Translation with Full Virtualization, Paravirtualization, Virtualization of CPU, Memory and I/O Devices	**6Hrs**
Unit 3:Cloud Computing Services and Data Security in Cloud Infrastructure as a Service, Platform as a Service, Software as a Service, Database as a Service , Specialized Cloud Services, Challenges with Cloud Data, Challenges with Data Security, Data Confidentiality and Encryption, Data availability, Data Integrity, Cloud Storage Gateways	**8Hrs**
Unit 4: IoT Definitions, History, Applications & development boards Introduction, History of IoT, About objects/things in IoT, The identifier in the IoT, Enabling technologies of IoT, Examples of Applications, IPv6 Role, IoT Definitions, Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, BeagleBone Black, Electric Imp, Other Notable Platforms	**7 Hrs.**
Unit 5:---RFID, Wireless Sensor Networks and other Evolving Standards Introduction, Principles of RFID, Components of RFID systems. Wireless Sensor Networks: History and context, The Node, Connecting nodes, Networking nodes Overview and Approaches, IETF IPv6 Routing Protocol for RPL Roll , Constrained Application Protocol (CoAP) , Representational State Transfer (REST) , ETSI M2M , IETF IPv6 Over Low power WPAN (6LoWPAN) , ZigBee IP (ZIP)	**8 Hrs.**
Unit 6:--- Wireless Technologies for the IoT Basics of WPAN Technologies for IoT/M2M :Zigbee/IEEE 802.15.4, Radio Frequency for Consumer Electronics (RF4CE), Bluetooth and its Low-Energy profile, IEEE 802.15.6 WBANs, NFC. Introduction and Developing an IoT Applications on Arduino &Rasberry PI	**8 Hrs.**

platforms.	

Textbooks:

1) Cloud Computing Black Book- Jayaswal, Kallakurchi, Houde, Shah, Dreamtech Press
2) Cloud Computing: Principles and Paradigms – Buyya, Broburg, Goscinski.
3) The Internet of Things – Connecting Objects to the Web, Edited by HakimaChaouchi – Wiley Publications. { for UNIT-4 (1.1 to 1.5), UNIT-5 (2.1 to 2.3 and 3.1 to 3.4) }
4) Building the Internet of Things with IPv6 AND MIPv6 by DANIEL MINOLI Published by John Wiley & Sons, Inc., Hoboken, New Jersey. { for UNIT-4 (1.2, 1.3, 2.1), UNIT-5 (5.1 to 5.5, 5.8, 5.9), UNIT-6 (6.1.1 to 6.1.4, 6.1.7) }
5) Designing the Internet of Things by Adrian McEwen and Hakim Cassimally Published by John Wiley & Sons { for UNIT-1 (Chapter 5) }
6) Refer user manuals of Arduino & Raspberry PI boards for programming.

References:

1) Cloud Computing for Dummies – Judith Hurwitz
2) Getting Started with the Internet of Things by CunoPfister Published by O'Reilly Media, Inc.
3) Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things" Key Applications and Protocols, ISBN 978-1-119-99435-0, Wiley Publications.

Title of the Course: Research Methodology Course Code: PETC0161	L	T	P	Credit
	2	-	-	0
Course: There are no Pre-Requisite for this course				

Course Description: This course will provide an opportunity for participants to establish or advance their understanding of research through critical exploration of research language, ethics, and approaches.

Course Objectives:

1. Judging the reliability and validity of experiments
2. Perform exploratory data analysis
3. Draw conclusions from categorical data
4. Using computer-intensive methods for data analysis
5. Compare statistical models

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	defend the use of Research Methodology	Affective	Defend
CO2	Judge the reliability and validity of experiments	Psychomotor	Judge
CO3	perform exploratory data and statistical data analysis techniques	Psychomotor	Analysis
CO4	draw conclusions from categorical data	Psychomotor	conclude

CO	PO1	PO2	PO3
CO1		2	
CO2		2	
CO3	1		
CO4			1

Assessments :

Teacher Assessment:

Assessment	Marks
ISE 1	-
MSE	-
ISE 2	-
ESE	100

ESE: Assessment is based on 100% course content

Unit I: Introduction to Research An Introduction, Meaning of Research ,Objectives of Research, Motivation in Research, Types of Research, Research Approaches ,Significance of Research ,Research Methods versus Methodology Research and Scientific Method ,Importance of Knowing How Research is Done ,Research Process Criteria of Good Research, Problems Encountered by Researchers	**5 Hrs.**
Unit II Research Design Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs	**4 Hrs.**
Unit III: Sampling Design	**4 Hrs.**

Need for sampling, Population, Sample, Normal distribution, Steps in sampling, Systematic bias and Sampling error, Characteristics of good sample design, Probability sampling and Random sampling, Determination of sample size	
Unit IV: Results and Analysis Importance and scientific methodology in recording results, importance of negative results, Different ways of recording, industrial requirement, artifacts versus true results, types of analysis (analytical, objective, subjective) and cross verification, correlation with published results, discussion, outcome as new idea, hypothesis, concept, theory, model etc	**4 Hrs.**
Unit V : Measurement and Scaling Techniques Introduction, Concept of measurement - Measurement of scale, Developing measurement scale, Criteria of good measurement tools, Error measurement. Concept of Scaling, Classification, Approaches of scale construction, Types of scales - Rating scale, Ranking scale, Arbitrary scale, Differential scale, Summated scale, Cumulative scale, Factor scale.	**3 Hrs.**
Unit VI: Data Collection and Analysis of Data Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Data Processing Operations, Problems in Processing, Elements/Types of Analysis	**4 Hrs.**
Textbooks: 1.Books: C. R. Kothari, "Research Methodology", New Age international, 2004. 2.Deepak Chopra and Neena Sondhi, "Research Methodology : Concepts and cases", Vikas Publishing House, New Delhi, 2008. 3.Ranjit Kumar, "Research Methodology: A Step by Step Guide for Beginners", 2nd Edition, Sage Publisher, 2011.	
Unit wise Measurable students Learning Outcomes: 1. Recall research terminology 2. Be aware of the ethical principles of research, ethical challenges and approval processes 3. Describe quantitative, qualitative and mixed methods approaches to research 4. Identify the components of a literature review process 5. Critically analyze published research 6. Discuss Research Methodology	

Title of the Course: Mobile Security Lab	**L**	**T**	**P**	**Credit**
Course Code: PETC0131	**-**	**-**	**2**	**1**

Course Pre-Requisite: GSM, Mobile frequency, Handoff

Course Description: To introduce the students to concepts of various issues in security of mobile. Introduces security issues with respect operating system such as android,IOS etc.

Course Objectives:

5. To learn security issues
6. To discuss android security
7. To discuss IOS security
8. To Know windows mobile security

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	**Bloom's Cognitive**	
		level	**Descriptor**
CO1	Describe the basics of Mobile security	II	Describe
CO2	Classify the different mobile OS	I	Classify
CO3	Apply the basic knowledge of security.	III	Apply
CO4	Compare the various Mobile OS	IV	Compare

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CO1	3	2	-											
CO2	3	1	-											
CO3	2	2	2		1								2	2
CO4	2	1	-		1								2	2

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: To study RedLegg Cybersecurity	8 Hrs.
Unit 2: To Study Burp Suite	7 Hrs.
Unit 3: To study Zed Attack Proxy	7 Hrs.
Unit 4: To study microfocus	6 Hrs.
Unit 5: To study quick android review kit	8 Hrs.
Unit 6: To study android debug Bridge	8 Hrs.

Textbooks:

3. Himanshu Dwivedi, Chris Clark, David Thiel “Mobile Application security” Tata Mcgraw Hill
4. Sandeep Singhal, Thomas Bridgman, Lalita Suryanarayan “The Wireless application Protocol” Pearson Education

References:

1. Android Security Internals: An In-Depth Guide to Android's Security Architecture 1st Edition, Kindle Edition by Nikolay Elenk
2. Mobile Device Security: A Comprehensive Guide to Securing Your Information in a

Moving World 1st Edition by Stephen Fried
Unit wise Measurable students Learning Outcomes: 5. To learn security issues 6. To discuss android security 7. To discuss IOS security 8. To Know windows mobile security

Title of the Course: Cloud Computing & IOT programming Lab Course Code: PTCC0132	L	T	P	Credit
	0	0	2	1

Course Pre-Requisite:

- Fundamentals of Computer Networks
- Fundamentals of Embedded Systems
- Basic knowledge of programming language

Course Description: The course is designed to learn the importance of IoT in society, the current components of typical IoT devices, IoT design considerations, constraints and Interfacing between the physical world and your device. Students will also learn how to Connect their device to the Internet.

Course Objectives:

1. To understand the fundamentals and essentials of Cloud Computing
2. To understand the concepts and protocols related to Internet of Things.
3. To study and develop applications of the Internet of Things..

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Develop various applications using Cloud Services	6	Develop
CO2	Apply key technologies, protocols and standards in Internet of Things..	3	Apply
CO3	Develop applications of the Internet of Things..	3	Apply

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	1		
CO2		2	
CO3			1

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) (OE).

Assessment	Marks
ISE	50
ESE (OE)	50

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

ESE: Assessment is based on Oral Examination

Course Contents:	
Course Contents:	
Experiment No. 1: Creating Your First Cloud App with Salesforce.com	**02 Hrs.**
Experiment No. 2: Implementation of Para-Virtualization using VM Ware's Workstation/ Oracle's Virtual Box and Guest O.S.	**02Hrs.**
Experiment No. 3: Creating an Application in SalesForce.com using Apex programming Language.	**02Hrs.**
Experiment No. 4: Case Study: Amazon Web Services	**02Hrs.**
Experiment No. 5: **Basic Setup of Raspberry Pi** : To understand Raspberry Pi Configuration, Raspberry Pi OS setup and understanding all the I/O Ports of Raspberry Pi.	**02 Hrs**
Experiment No. 6: Creating an application for blinking an LED with Buttons. (Demonstration of output and input pins) on Raspberry Pi Board.	**02 Hrs**
Experiment No. 7: **Basic Setup of Arduino Board :** To understand Arduino Configuration, Setup and understanding all the I/O Ports of Arduino.	**02 Hrs**
Experiment No. 8: Creating an application for blinking an LED with Buttons. (Demonstration of output and input pins) on Arduono Board.	**02 Hrs**
Experminet No. 9 : Creating an IoT application for sensing data and uploading on the Cloud for analyzing, triggering and action (Actuation).	**02 Hrs**

Textbooks:

7) Cloud Computing Black Book- Jayaswal, Kallakurchi, Houde, Shah, Dreamtech Press
8) Cloud Computing: Principles and Paradigms – Buyya, Broburg, Goscinski.
9) The Internet of Things – Connecting Objects to the Web, Edited by HakimaChaouchi – Wiley Publications. { for UNIT-4 (1.1 to 1.5), UNIT-5 (2.1 to 2.3 and 3.1 to 3.4) }
10) Building the Internet of Things with IPv6 AND MIPv6 by DANIEL MINOLI Published by John Wiley & Sons, Inc., Hoboken, New Jersey. { for UNIT-4 (1.2, 1.3, 2.1), UNIT-5 (5.1 to 5.5, 5.8, 5.9), UNIT-6 (6.1.1 to 6.1.4, 6.1.7) }
11) Designing the Internet of Things by Adrian McEwen and Hakim Cassimally Published by John Wiley & Sons { for UNIT-1 (Chapter 5) }
12) Refer user manuals of Arduino & Raspberry PI boards for programming.

References:

4) Cloud Computing for Dummies – Judith Hurwitz
5) Getting Started with the Internet of Things by CunoPfister Published by O'Reilly Media, Inc.
6) Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things" Key Applications and Protocols, ISBN 978-1-119-99435-0, Wiley Publications.

Title of the Course: Seminar	L	T	P	Credit
Course Code: PETC0141	--	--	02	01

Course Pre-Requisite: Communication skill etc.

Course Description:

Oral presentation is an important aspect of engineering education. The objective of the seminar is to prepare the student for systematic independent study of state of the art topics in broad area of his/her specialization.

Seminar topics can be chosen by the students with the advice from the faculty members.

To assess the debating capability of the student to present a technical topic. Also to impart training to students to face audience and present their ideas and thus creating in them self-esteem and courage that are essential for engineers

Individual students are required to choose a topic of their interest from Embedded Systems related topics preferably from outside the M. Tech syllabus and give a seminar on that topic about 30 minutes. A committee consisting of at least three faculty members assesses the presentation of the seminar and gives marks to the students.

Each student shall submit two copies of a write up of his/her seminar topic. One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, content organization, question/answers, quality of the report and communication skill.

Course Objectives:

- To apply engineering knowledge in practical problem solving
- To foster innovation in design of products, processes or systems
- To develop creative thinking in finding viable solutions to engineering problems

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Apply the skill of presentation and communication techniques **Identify**, **formulate**, **review** research ideas, research question	**III**	**Applying**
CO2	**Design** and **demonstrate** appropriate research idea / topic for a complex engineering problem	**II**	**Understanding**
CO3	**Explain** confidently and constructively the selected topic/idea.	**V**	**Evaluating**
CO4	**Elaborate** the knowledge and understanding of complex research problem in terms of final presentation	**VI**	**Creating**

Assessments :

Teacher Assessment:

In Semester Evaluation (ISE),.

Assessment	Marks
ISE	100

Semester –II

Title of the Course: RF and Microwave Circuit Design	**L**	**T**	**P**	**Credit**
Course Code: PETC0204	3	1	-	4

Course Pre-Requisite:
Basics of Microwave engineering and transmission lines

Course Description: This course aims to introduce design strategies for various microwave circuit like microwave filters, amplifiers and oscillators and Mixers.

Course Objectives:

1. To understand the basic concepts of microwave waveguides and transmission lines.
2. To Design the microwave active filters
3. To Design microwave active amplifiers
4. To Design microwave oscillators and Mixers

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive level	
CO1	**Understand** the basic concepts of microwave waveguides and transmission lines.		
CO2	**Design** the microwave active filters		
CO3	**Design** microwave active amplifiers		
CO4	**Design** microwave oscillators and Mixers		

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**
CO1	-	-	2
CO2	-	-	3
CO3	-	-	3
CO4	-	-	3

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:--- Introduction to transmission lines and waveguides : Solutions for TEM waves, rectangular waveguide, circular waveguide, co-axial line, stripline, microstrip, impedance and equivalent voltage and currents, the S- matrix, ABCD matrix, SFG, discontinuities and model analysis, waveguide excitation, introduction to smith chart, single and double stub matching, quarter wave transformer, binomial and chebyshev multi-section matching transformer, Bode-fano criterion	8 **Hrs.**
Unit 2:--- Microwave Resonators, power dividers and directional couplers: Series and parallel resonant circuits, transmission line resonator, rectangular waveguide cavities, circular waveguide cavities, di-electric resonators, excitation of resonators, concept of power dividers and couplers, T-junction power divider, Wilkinson power divider, directional coupler, quadrature hybrid, Lange coupler, 180 degree hybrid	8 **Hrs**
Unit 3:--- Microwave Filters: Periodic structures, filter design by image parameter method and insertion loss methods, filter transformations, filter implementation, stepped impedance LPF, coupled line filters, filters using coupled resonators	8 **Hrs**
Unit 4:---. Noise and Active RF components: Noise in microwave circuits, dynamic range and inter-modulation distortion, RF diode and transistor characteristics, MMIC.	8 **Hrs**
Unit 5:--- Microwave amplifier design: Two port power gain, stability, single stage and broadband transistor amplifier design, Power amplifiers.	8 **Hrs**
Unit 6:--- Design of microwave oscillators and mixers: RF oscillators, microwave oscillators, oscillator phase noise, frequency multipliers, different microwave sources, mixer design.	8 **Hrs**

Textbooks:

1. Microwave Engineering, David M Pozar, wiley publication, 3rd edition

References:

1. RF circuit design theory and applications, reinhold Ludwig, gene bogdanov, pearson publication 2nd edition
2. Microwave Circuit Design: A Practical Approach Using ADS, Kyung-Whan Yeom, PHI publication
3. Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design By Matthew M. Radmanesh, Authorhouse publication
4. Passive RF and Microwave Integrated Circuits, Leo Maloratsky, Elsevier publication

Unit wise Measurable students Learning Outcomes:

Students will be able to understand the fundamental concepts of transmission lines and waveguides
Students will be able to understand the operations Microwave Resonators, power dividers and directional couplers
Students will be able to Design Microwave Filters
Students will be able to calculate Noise in Active RF components
Students will be able to design Microwave amplifier design
Students will be able to design microwave oscillators and mixers

Title of the Course: Communication Standards & Protocols **Course Code: PETC0205**	**L**	**T**	**P**	**Credit**
	3	**-**	**-**	**3**

Course Pre-Requisite: GSM, Mobile frequency, Handoff

Course Description: To introduce the students to concepts of various issues in security of mobile. Introduces security issues with respect operating system such as android,IOS etc.

Course Objectives:

9. To learn security issues
10. To discuss android security
11. To discuss IOS security
12. To Know windows mobile security

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive level	Descriptor
CO1	**Describe** the basics of Mobile security	II	**Describe**
CO2	**Classify** the different mobile OS	I	**Classify**
CO3	**Apply** the basic knowledge of security.	III	**Apply**
CO4	**Compare** the various Mobile OS	IV	**Compare**

CO-PO Mapping:

CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
CO1	3	2	-											
CO2	3	1	-											
CO3	2	2	2		1								2	2
CO4	2	1	-		1								2	2

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Basics of Network Security Network security: Introduction to Cryptography, Basics of Security attacks, Private and public key algorithm, Message integrity and authentication, Digital signature.	**8 Hrs.**
Unit 2: WLAN 802.11 WLAN in AP, WLAN in Adhoc node, Security attacks in WLAN, Security in 802.11	**7 Hrs.**
Unit 3: Wireless Personal Area network (WPAN 802.15) PAN, Bluetooth network security, IEEE 802.15.4: Zigbee security, UWB security	**7 Hrs.**
Unit 4: Wireless Security Protocol Encryption and Decryption WEP, Security Vulnerabilities, Common attacks in WEP, WPA	**6 Hrs.**
. **Unit 5: WPA 2** WPA2 Authentication, WPA2 Key generation, WPA2 Encryption, WPA2 Decryption , Benefits of WPA2	**8 Hrs.**
Unit 6: Worldwide Interoperability for Microwave Access (WiMAX 802.16) OFDM Basic Terms, 802.16 Key parameters, Frequency Bands, Sub channelization, Frame structure, 802.16 – 2004 OFMA	**8 Hrs.**

Textbooks:

5. John M Senior, Optical Fiber Communications, Principles and Practice, 3 Edition, Pearson Education, 20i0, ISBN:978-8i-3i7-3266-3.
6. Rajeev Ramaswamy and Kumar N Sivarajan, "Optical Networks: A Practical Perspective", 2nd Ed., 2004, Elsevier Morgan Kaufmann Publishers (An imprint of Elsevier).

References:

4. Harold Kolimbris, "Fiber Optic Communication", 2nd Ed, 2004, PEI
5. Uyless Black, "Optical Networks: Third Generation Transport Systems", 2nd Ed, 2009, PEI
6. Govind Agarwal, "Optical Fiber Communications", 2nd Ed, 2004, TMH.

Unit wise Measurable students Learning Outcomes:

9. **To learn security issues**
10. **To discuss android security**
11. **To discuss IOS security**
12. **To Know windows mobile security**

Title of the Course: Design of digital signal processing systems	L	T	P	Credit
Course Code: PESC0206	3	-	-	3

Course Pre-Requisite: Digital Signal Processing, Properties of Random Variables , ARM programming

Course Description: This Course aims to develop the applications of DSP using ARM Processors

Course Objectives:

- Interfacing audio codec with ARM processor
- implementing FIR,IIR filters using ARM Processor
- Implementing Adaptive filters with ARM Processor

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Illustrate interfacing audio Codec, DAC with processors	2	Understanding
CO2	Apply FIR/IIR filters	3	Applying
CO3	Explain Adaptive Filter implementation	5	Evaluating
CO4	Evaluate performance of Wiener ,Kalman filters	5	Evaluating

CO-PO Mapping:

CO	PO1	PO 2	PO 3
CO1	2		
CO2		2	2
CO3		2	
CO4		1	

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) andone End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% Weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Unit 1:--- Introduction Interfacing the audio hub codec and stereo codec for audio Inputs and Outputs with ARM Cortex M4. Real time waveform generation. Identifying frequency response of DAC for Pseudorandom noise and using Adaptive filter. Aliasing effect. Case Study using Arm Cortex-4	**Hrs-6**
Unit 2:--- FIR and IIR filters Low pass, High pass, Band pass, Band stop filters. Programming examples. IIR filter structures, Impulse Invariance, Bilinear Transformation, Programming examples. Case Study using Arm Cortex-4	**Hrs. 6**
Unit 3:-- FFT Development of FFT Algorithm, Decimation in frequency FFT algorithm with Radix 2, Radix 4. Decimation in time FFT algorithm with Radix 2. Frame or Block based FFT. Application of fast convolution. Programming examples. Case Study using Arm Cortex-4	**Hrs. 6**
Unit 4:--- Adaptive Filters Introduction, Adaptive filters configurations, Performance function. Lease mean square adaptive filters. Programming examples. Case Study using Arm Cortex-4	**Hrs. 6**
Unit 5:--- Wiener Filters Linear optimum filtering, principal of Orthogonality, minimum mean square error, Linear prediction, forward and backward, Method of steepest decent algorithm Programming examples, Case Study using Arm Cortex-4	**Hrs. 6**
Unit 6:--- Kalman Filters Statement of kalman filters problem, the innovation process estimation, filtering, initial conditions. Square root adaptive filters. Order –recursive Adaptive filter Programming examples. Case Study using Arm Cortex-4	**Hrs. 6**

Textbooks:

1. "Digital Signal Processing principles, algorithms and applications" Manolakis , John G. Proakis 4th Edition Pearson Publication
2. "Adaptive filter Theory" Simon Haykin Fourth Edition Pearson publication
3. " Digital Signal Processing using CORTEX ARM M4" Donald S. Raey Wiley publication

References:

1. "Adaptive Signal Processing" Bernard Widrow, Samual Stearns Pearson publication
2. "Theory and Design of Adaptive Filters" John R.Treichler et.al PHI private Publication.
3. "Digital Signal Processing using Arm Cortex M based Microcontrollers

Theory and Practice" ISBN 978-1-911531-16-6 by arm Education Media

Unit wise Measurable students Learning Outcomes:

UO1: Explain audio codec interfacing with arm cortex 4 .
UO2: Design FIR and IIR Filters by using arm cortex 4
UO3: Implement FFT algorithms by using arm cortex 4
UO4: Explain Least mean-square Adaptive Filter by using arm cortex 4
UO5: Demonstrate concept of Wiener Filter. by using arm cortex 4
UO6: Explain Kalman Filters by using arm cortex 4

Title of the Course: Web Technologies	L	T	P	Credit
Course Code: PETC0262	2	-	-	-

Course Pre-Requisite:
Fundamentals of Programming and Networking

Course Description:
The wide spread use of the Internet and WWW by common people has made it compulsion to provide web based interface for the applications to access the application from anywhere, anytime, anyone. The subject covers the wide range of web technologies both client side and server side to provide the exposure to the students to develop Rich Internet Applications using them. It covers the basics WWW, client side technologies like HTML, CSS and DHTML including JavaScript, server side scripting with PHP and database connectivity using PHP and related technologies.

Course Objectives:
1. To impart the design, development and implementation of Dynamic Web Pages.
2. To develop programs for Web using Scripting Languages.
3. To give an introduction to Data Interchange formats in Web.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Prepare interactive Web pages using HTML/XHTML.	III	Prepare
CO2	Demonstrate a professional document using Cascaded Style Sheets.	III	Demonstrate
CO3	Develop Web applications using PHP.	VI	Develop
CO4	Understand different scripting languages and Know the different information interchange formats like XML and JSON.	II	Understand

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	-	-	3
CO2	-	-	2
CO3	-	-	3
CO4	-	-	2

Assessments :
Teacher Assessment:
ESE: Assessment is based on 100% course content.

Assessment	Marks
ESE	100

Course Contents:

Unit 1:--- Introduction to HTML/XHTML : Origins and Evolution of HTML and XHTML, Basic Syntax of HTML, Standard HTML Document Structure, Basic Text Markup, Images, Hypertext Links, Lists, Tables, Forms, HTML5, Syntactic Differences between HTML and XHTML.	6 **Hrs.**

Unit 2:--- Introduction to Styles sheets and Frameworks **Cascading Style Sheets:** Levels of Style Sheets – Style Specification Formats, Selector Forms, Property-Value Forms, Font Properties, List Properties, Alignment of Text, Color, The Box Model, Background Images, The span and div Tags. **Frameworks:** Overview and Basics of Responsive CSS Frameworks - Bootstrap.	8 **Hrs**
Unit 3:--- Introduction to Data Interchange Formats **XML:** The Syntax of XML, XML Document Structure, Namespaces, XML Schemas, Displaying Raw XML Documents, Displaying XML Documents with CSS, XSLT Style Sheets, XML Applications. **JSON** (Basics Only): Overview, Syntax, Datatypes, Objects, Schematic, Comparison with XML.	8 **Hrs**
Unit 4:--- Introduction to PHP: Origins and Uses of PHP, Overview of PHP - General Syntactic Characteristics - Primitives, Operations, and Expressions - Control Statements, Arrays, Functions, Pattern Matching, Form Handling, Cookies, Session Tracking.	8 **Hrs**
Unit 5:--- PHP and MySQL : Basic commands with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP myadmin and database bugs	8**Hrs**
Unit 6:--- Advanced Scripting language Lua: overview, environment, basic syntax, variables, data types, operators, loops, decision making, functions, strings, arrays, iterators, tables, modules, metatables, Coroutines, file I/O, error handling.	6 **Hrs**
Textbooks: 1. P. J. Deitel, H.M. Deitel, Internet &World Wide Web How To Program, 4/e, Pearson International Edition 2010. 2. Robert W Sebesta, Programming the World Wide Web, 7/e, Pearson Education Inc., 2014.	
References: 1. Steven Holzner,"HTML Black Book", Dremtech press. 2. Web Technologies, Black Book, Dreamtech Press 3. Web Applications : Concepts and Real World Design, Knuckles, Wiley-India 4. Developing Web Applications, Ralph Moseley and M. T. Savaliya, Wiley-India 5. Web Design, Joel Sklar, Cengage Learning 6. Developing Web Applications in PHP and AJAX, Harwani, McGrawHill	
Unit wise Measurable students Learning Outcomes: Students will be able to understand the fundamental concepts of web design. Students will be able to understand the HTML and XHTML. Students will be able to design web pages, servers etc. Students will be able to understand the advanced scripting languages used in embedded servers.	

Title of the Course: RF & Microwave Circuit Design Lab	L	T	P	Credit
Course Code: PETC0233	0	0	2	1

Course Pre-Requisite: MATLAB, Electromagnetic Engineering, Microwave Engineering.

Course Description: This Laboratory course helps students to develop understanding and apply the concept of Microwave Engineering

Course Objectives:

1. Students should understand basic concepts of Microwave Engineering
2. Students should Design Microwave Circuits.
3. Students should able to perform Experimentation on apply Microwave Circuits.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	**Understand** concepts of Microwave Circuits	Comprehension	Cognitive
CO2	**Apply** theory to **design** Microwave Circuits	Applying	Psychomotor
CO3	**Analyze** the designed Microwave circuits	Analysis	Cognitive

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	1		3
CO2	1		3
CO3	1		3

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

Assessment	Marks
ISE	50
ESE	50

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

ESE: Assessment is based on oral examination

Course Contents:

Experiment No. 1:--- Overview of Microwave Engineering It is Expected to Perform Following Experiments as a Overview Using Virtual Lab Lab of IIT Kanpur (Separate List Enclosed) **Aim and Objectives:** Overview of Microwave Engineering **Outcomes:** **Theoretical Background:** **Experimentation:** **Results and Discussions:** **Conclusion:**	-2- **Hrs.**
Experiment No. 2:--- Microwave Resonators, Power Dividers and Directional Couplers	-2- **Hrs.**

Aim and Objectives: To Study of Microwave Resonators, Power Dividers and Directional Couplers **Outcomes:** **Theoretical Background:** **Experimentation:** **Results and Discussions:** **Conclusion:**	
Experiment No. 3:---Microwave Filters. **Aim and Objectives:** Design of Microwave Filters (Using CAD Tool) **Outcomes:** **Theoretical Background:** **Experimentation:** **Results and Discussions:** **Conclusion:**	-2- **Hrs.**
Experiment No. 4:--- Characteristics of Active Components. **Aim and Objectives: To** Study of characteristics of Active Components **Outcomes:** **Theoretical Background:** **Experimentation:** **Results and Discussions:** **Conclusion:**	-2- **Hrs.**
Experiment No. 5:--- Microwave Amplifier **Aim and Objectives:** Design of Single stage Microwave Amplifier **Outcomes:** **Theoretical Background:** **Experimentation:** **Results and Discussions:** **Conclusion:**	-2- **Hrs.**
Experiment No. 6:--- Broadband Transistor Amplifier **Aim and Objectives: To** Design of Broadband Transistor Amplifier **Outcomes:** **Theoretical Background:** **Experimentation:** **Results and Discussions:** **Conclusion:**	-2- **Hrs.**
Experiment No. 7:--- Power Amplifier **Aim and Objectives:** To Design of Power Amplifier **Outcomes:** **Theoretical Background:** **Experimentation:** **Results and Discussions:** **Conclusion:**	-2- **Hrs.**
Experiment No. 8:--- Microwave Oscillators **Aim and Objectives:** To Design of Microwave Oscillators **Outcomes:** **Theoretical Background:** **Experimentation:**	-2- **Hrs.**

Results and Discussions: **Conclusion:**	
Experiment No. 9:--- Structures of Adaptive Filter **Aim and Objectives:** To Design of Microwave Mixers **Outcomes:** **Theoretical Background:** **Experimentation:** **Results and Discussions:** **Conclusion**	-2- **Hrs.**

Textbooks:

1. Microwave Engineering, David M Pozar, wiley publication, 3rd edition

References:

1. RF circuit design theory and applications, reinhold Ludwig, gene bogdanov, pearson publication 2nd edition
2. Microwave Circuit Design: A Practical Approach Using ADS, Kyung-Whan Yeom, PHI publication
3. Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design By Matthew M. Radmanesh, Authorhouse publication
4. Passive RF and Microwave Integrated Circuits, Leo Maloratsky, Elsevier publication

Title of the Course: Communication Standards LAB Course Code: PETC0234	L	T	P	Credit
	-	-	2	1

Course Pre-Requisite: OSI Layer, Networking protocols, IEEE standard

Course Description: To introduce students with different IEEE wireless standards, wireless protocols and security aspects.

Course Objectives:

13. To learn security issues
14. To discuss Wireless standards
15. To discuss Wireless protocol
16. To know Wimax

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	**Describe** the basics of wireless security	II	**Describe**
CO2	**Classify** the different wireless standards	I	**Classify**
CO3	**Apply** the basic knowledge of wireless protocol	III	**Apply**
CO4	**Compare** the various wireless standard	IV	**Compare**

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CO1	3	2	-											
CO2	3	1	-											
CO3	2	2	2		1								2	2
CO4	2	1	-		1								2	2

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Unit 1: To study Non-roaming architecture for 5G Core Network with non-3GPP access	**4 Hrs.**
Unit 2: To study A Queuing Network Model of Short-Lived TCP Flows with Mixed Wired and Wireless Access Links	**4 Hrs.**
Unit 3: To study An integrated system based on Web and/or WAP framework for remote monitoring and control of industrial processes	**4 Hrs.**
Unit 4: To Set up a Wireless Network using a Wireless Access Point (WAP)	**4 Hrs.**
Unit 5: To configure WLAN	**2 Hrs.**
Unit 6: To configure wireless Router and client	**2 Hrs.**

Textbooks:

1. Sandeep Singhal, Thomas Bridgman, Lalita Suryanarayan "The Wireless application Protocol" Pearson Education
2. The Wireless Application Protocol (WAP): A Wiley Tech Brief (Technology Briefs Series)

References:

1. Wireless Application Protocol Programming, by hamad rashid
2. Programming Applications with the Wireless Application Protocol: The Complete Developer′s Guide: 3 (WAP) by Steve Mann

Unit wise Measurable students Learning Outcomes:

1. To learn security issues
2. To discuss Wireless standards
3. To discuss Wireless protocol
4. To know Wimax

Title of the Course: Mini Project Course Code: PETC0142	L	T	P	Credit
	--	--	02	01

Course Pre-Requisite: Communication skill etc.

Course Description:

Oral presentation is an important aspect of engineering education. The objective of the seminar is to prepare the student for systematic independent study of state of the art topics in broad area of his/her specialization.

Seminar topics can be chosen by the students with the advice from the faculty members.

To assess the debating capability of the student to present a technical topic. Also to impart training to students to face audience and present their ideas and thus creating in them self-esteem and courage that are essential for engineers

Individual students are required to choose a topic of their interest from Embedded Systems related topics preferably from outside the M. Tech syllabus and give a seminar on that topic about 30 minutes. A committee consisting of at least three faculty members assesses the presentation of the seminar and gives marks to the students.

Each student shall submit two copies of a write up of his/her seminar topic. One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, content organization, question/answers, quality of the report and communication skill.

Course Objectives:

- To apply engineering knowledge in practical problem solving
- To foster innovation in design of products, processes or systems
- To develop creative thinking in finding viable solutions to engineering problems

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Apply the skill of presentation and communication techniques **Identify**, **formulate**, **review** research ideas, research question	**III**	**Applying**
CO2	**Design** and **demonstrate** appropriate research idea / topic for a complex engineering problem	**II**	**Understanding**
CO3	**Explain** confidently and constructively the selected topic/idea.	**V**	**Evaluating**
CO4	**Elaborate** the knowledge and understanding of complex research problem in terms of final presentation	**VI**	**Creating**

Assessments :

Teacher Assessment:

In Semester Evaluation (ISE),.

Assessment	Marks
ISE	100

Professional Elective - I

Title of the Course: Cortex -ARM Architecture & Programming	**L**	**T**	**P**	**Credit**
Course Code: PETC0121	**3**	**1**	**-**	**4**

Course Pre-Requisites:
Study of ARM7TDMI architecture and assembly language programing, Basics of C programming, Programming resources of microcontroller like Timer, ADC, DAC, PWM, Serial buses etc.

Course Description:
This course focuses on programmer's view of the ARMv7 Architecture, with a specific focus on Cortex-A, Cortex-R, Cortex-M profiles,. This course is aimed at embedded systems and software developments using ARM technology and software tools with a bias toward application processors and real-time processors.

Course Objectives: The objective is to impart the concepts and architecture of Cortex A/ R/ M and to make the students capable of designing Advance Embedded systems. To achieve this, the architecture and programming of Industry popular 32-bit architecture,, Cortex A/ R/ M is covered in detail.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Illustrate facts and innovative ideas of Industry standard 32-bit ARM Cortex architecture	2	Understanding
CO2	examine ARM ISA: Thumb/2 by Solving engineering computational problems	3	Applying
CO3	Analyze methods of memory management and protection	3	Analyzing
CO4	Practice philosophy of environment friendly embedded systems design	5	Evaluating
CO5	Optimize Software of Embedded system applications	5	Evaluating

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**
CO1			1
CO2	2		
CO3		2	
CO4		2	
CO5			1

Assessments :

Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules) ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.	
Course Contents:	
Unit 1:- ARM Processor Architectures ARM architecture evolution (v5, v6, v7 and v8) as well as the architecture profiles (-A, -R and -M), high-level overview of the instruction sets supported and privilege levels and exception levels, Integer Registers- Discusses the integer registers of the ARM architecture, the purpose and behavior of register banking and the Program Status Register Instructions - Thumb/2, Jazelle, VZP and Neon - differences between ARM and Thumb/Thumb2 instructions and then goes through several examples of conditional execution in Thumb (If/Then/Else); Jazelle, Vector Floating Point and Neon instructions	8 **Hrs.**
Unit 2:--- : Privilege, Modes, State, Trust Zone and Exceptions and Interrupts Privilege Levels, the basic processor modes, provides an overview of Trust Zone, the implemented virtualization extensions, and the concept of coprocessors the behavior of exceptions and interrupts including some info on common interrupt controllers	6 **Hrs.**
Unit 3:- Memory Management, Protection and Paging The memory management behavior typical in the -M profile as well as the memory protection scheme commonly used in the -R profile, Introduction to managing and protecting memory using paging (typical in -A profile), includes a discussion of TLBs and their management v7 LPAE and Hardware Virtualization: implementation of large physical addresses in the v7 architecture as well as the affects of hardware virtualization on paging Caches: The basics of caching, including cache line states, coherency and cache policies; Then shows Cortex-A9 caches as an example	8 **Hrs.**
Unit 4:- Discusses the feature set and instruction pipelines of the Cortex-M3/-M4 , Cortex-R4 and Cortex-R5 Cortex-A8, Cortex-A9,	6 **Hrs.**
Unit 5:- AMBA - The Buses - brief discussion on AMBA 3, AMBA 4 as well as AXI and the coherency extensions added to this interconnect Power Management and Booting - an introduction to power management on ARM-based systems as well as a generic boot process	6 **Hrs.**
Unit 6:- Software Development and Optimization An overview of the software development process which includes a discussion of the purposes of the compiler and linker as well as object files, libraries (static v/s dynamic) and the ARM ABI (Application Binary Interface) Code optimization: pointer aliasing, loop termination, parameter passing, compiler options, inline examples, variable types, data layout and packing of structures, base pointer optimization and more. Introduction to profiling tools and its applications.	6 **Hrs.**
Textbooks: 1. ARM® Cortex™-A Series, Version: 4.0, Programmer's Guide 2. ARM® Cortex®-R Series, Version: 1.0, Programmer's Guide	

3. ARMv7-M Architecture Application Level Reference Manual
4. AMBA Specification
5. The Definitive Guide to the ARM Cortex-M3, Joseph Yiu, Second Edition, Elsevier Inc. 2010.
6. Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide – 2. Designing and Optimizing System Software", 2006, Elsevier.

References:

1. Cortex-R series-ARM Reference Manual
2. Cortex-M series-ARM Reference Manual
3. Cortex-M3 Technical Reference Manual (TRM)
4. David Seal "ARM Architecture Reference Manual", 2001 Addison Wesley, England; Morgan Kaufmann Publishers
5. ARM Application Note 179: Cortex-M3 Embedded Software Development

Unit wise Measurable students Learning Outcomes:

Unit1: Ability to develop ARM ISA/ Thumb/2 codes to solve engineering problem
Unit2: Ability to discuss Privilege, Modes, State, Trust Zone and Exceptions and Interrupts
Unit3: Ability to discuss Memory Management, Protection and Paging of Cortex architecture
Unit4: Ability Discusses the feature set and instruction pipelines of the Cortex architecture
Unit5: Ability to discuss AMBA buses and power management
Unit6: Develop optimized software for embedded system applications

Title of the Course: Optical Communication and Networks **Course Code: PETC0122**	**L**	**T**	**P**	**Credit**
	3	**1**	**-**	**4**

Course Pre-Requisite: Semiconductor Physics, Fundamentals of Electromagnetic theory, Principles of Communication Systems

Course Description: To introduce the students to various optical fiber modes, configurations and various signal degradation factors associated with optical fiber and to study about various optical sources and optical detectors, optical amplifiers, SONET/SDH, WDM / DWDM and their use in the optical communication system. Fiber optical communication enables telecommunications networks to provide high bandwidth high speed data connections across countries and the globe. This type of communication can transmit voice, video and telemetry through local area networks, computer networks across long distance. Optical fiber also offers low power loss, lost cost, lower attenuation, and greater security.

Course Objectives:

1.To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures

2. To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors

3. To learn the various optical source materials, LED structures, Laser diodes

4. To learn the fiber optical receivers, noise performance in photo detector, receiver operation and configuration

5. To learn the fiber optical network components, variety of networking aspects, SONET/SDH and operational principles of WDM/DWDM.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive level	Descriptor
CO1	**Describe** the basics of optical fiber and its Mode Characteristics.	II	**Describe**
CO2	**Classify** the construction and characteristics of optical sources and detectors.	I	**Classify**
CO3	**Apply** the basic knowledge of optical fibers to get the design aspect of optical amplifiers	III	**Apply**
CO4	**Compare** the various optical source materials, LED / Laser diodes, photo-detector structures, optical amplifiers and SONET/ SDH.	IV	**Compare**

CO-PO Mapping:

CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
CO1	3	2	-											
CO2	3	1	-											
CO3	2	2	2		1								2	2
CO4	2	1	-		1								2	2

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:-- Optical fibers Light Propagation in Fibers, Optical Fiber Modes, Variations of Fiber Types, Single-Mode Fibers, Optical Fiber Attenuation, Fiber Information Capacity, Optical Fiber Standards, Erbium-Doped Fiber	**8 Hrs.**
Unit 2:-- Optical sources Light emitting diodes (LED's), Laser diodes, line coding, light source linearity, Reliability considerations, power launching and coupling.	**7 Hrs.**
Unit 3:-- Optical detectors Physical principles of photodiodes, pin photo diode, Avalanche photo diodes, photo-detector noise, detector response time, Avalanche noise, structures for InGaAs APDs, temperature effects, comparison	**7 Hrs.**
Unit 4:-- Optical Amplifiers Basic applications and types, amplification mechanism, Stimulated Emission, Spontaneous Emission, semiconductor optical amplifiers, Erbium Doped Fiber amplifiers, Raman amplifier, wideband optical amplifiers, analog and digital links. Link budget.	**6 Hrs.**
Unit 5:-- SONET and SDH How SONET and SDH Came into Being, Reasons for Success of SONET/SDH, The SONET Multiplexing Hierarchy, SONET and SDH Multiplexing Structure, The SONET/SDH Frame Structure, Overhead and User Areas in the Envelope, SONET and SDH Functional Components, SONET and SDH Problem Detection, Locating and Adjusting Payload with Pointers, Virtual Tributaries, Virtual Tributaries and Virtual Containers, The Overhead Bytes, SONET and SDH Concatenation.	**8 Hrs.**
Unit 6:-- Wavelength Division Multiplexing (WDM) Network concepts, The WDM Operation, Dense Wave Division Multiplexing (DWDM), TDM and WDM Topologies, Relationship of WDM to SONET/SDH, Erbium-doped Fiber (EDF), WDM Amplifiers, Gain Flatness, Add-Drop Multiplexers, WADM Input and Output Ports, WDM Cross-connects, Wavelength Continuity Property, Example of DWDM Wavelength Plan , Average Versus Maximum Span Loss and Chromatic Dispersion, Higher Dispersion for DWDM, Tunable DWDM Lasers	**8 Hrs.**

Textbooks:

7. Gerd Keiser, Optical Fiber Communication, 5thEdition, McGraw Hill Education(India) Private Limited, 20i5. ISBN:i-25-900687-5.
8. John M Senior, Optical Fiber Communications, Principles and Practice, 3 Edition, Pearson Education, 20i0, ISBN:978-8i-3i7-3266-3.
9. Rajeev Ramaswamy and Kumar N Sivarajan, "Optical Networks: A Practical Perspective", 2nd Ed., 2004, Elsevier Morgan Kaufmann Publishers (An imprint of Elsevier).

References:

7. Harold Kolimbris, "Fiber Optic Communication", 2nd Ed, 2004, PEI
8. Uyless Black, "Optical Networks: Third Generation Transport Systems", 2nd Ed, 2009, PEI
9. Govind Agarwal, "Optical Fiber Communications", 2nd Ed, 2004, TMH.
10. S. C. Gupta, "Optical Fiber Communications and its Applications", 2004, PHI
11. P.E Green, "Optical Networks" Prentice Hall.
12. C.S.Murthy & M. Gurusamy, "WDM Optical Networks", Prentice Hall (India).

Unit wise Measurable students Learning Outcomes:

13. To understand the basics of fiber optics and signal degradation.
14. Classify the optical transmitters and detectors
15. Discuss the operation and design of optical amplifiers
16. To learn the fiber optical network components, SONET/SDH and operational principles of WDM/DWDM.

Title of the Course: Digital Image and Video Processing **Course Code: PETC0123**	**L**	**T**	**P**	**Credit**
	3	**1**	**-**	**4**

Course Pre-Requisite: Engineering Mathematics III, Digital Signal Processing, Digital Image Processing

Course Description: This course aims to focus on applications of Image and Video Processing. It includes the concepts based upon Image enhancement, moving object detection , video compression etc.

Course Objectives:

1. Study Image Enhancement techniques
2. Study Face detection/recognition techniques
3. Understand object detection techniques
4. Study image/video processing using processors

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive level	Descriptor
CO1	**apply** Image Enhancement techniques	**3**	**Applying**
CO2	**apply** Face detection/recognition techniques	**3**	**Applying**
CO3	**analyze** object detection techniques	**4**	**Analyzing**
CO4	**perform** image/video processing	**3**	**Applying**

CO-PO Mapping:

CO	**1**	**2**	**3**
CO1	3	2	-
CO2	3	-	1
CO3	2	2	2
CO4	2	1	-

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:-- Image Enhancements Filtering. Spatial filtering Denoising. Contrast Enhancement. Blurring: Gaussian Blur, Motion Blur, Blur kernels	**6Hrs.**

Unit 2:-- Image Segmentation and Feature Analysis Detection of Discontinuities, Edge operators , Edge linking and Boundary Detection Thresholding. Image Segmentation Background subtraction. Environment mating: basic concepts. Region based segmentation - Morphological Watersheds ,use of Motion for Segmentation	**6 Hrs.**
Unit 3:-- Face Detection and Recognition. SVD. PCA, Eigen Faces, Haar Wavelets, Hadamard Transform, . Viola-Jones framework for object detection. Filters for detecting parts of faces. Cascaded Architecture, Advanced Image Processing. Morphological operations: Erosion. Dilation. Compound operations: opening, closing. Hit and Miss transformation.	**6 Hrs.**
Unit 4:-- Object Recognition Introduction – Pattern and Pattern Class – Selection Measurement Parameters – Approaches – Types of Classification – Bayes, Template matching, Non parametric density estimation, Neural Network approach – Applications	**6 Hrs.**
Unit 5:-- Image Compression **Image Compression:-** Data redundancies Variable-length coding, Quantizers, Predictive coding, Transform coding, Image compression models, Source encoder and decoder, Error free compression, Lossy Compression, JPEG 2000 Standard Stereoscopic vision : Depth perception from stereo	**8 Hrs.**
Unit 6:-- Video Processing Basics of video processing, Motion analysis, **Video compression:** Analog Video , Composite and Components Video , Digital Video , MPEG ,MPEG-4 , H.261standards video compression standards Case studies: Watermarking, Biometrics, Document analysis, Moving object detection	**6 Hrs.**

Textbooks:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson , 4rd Edition
2. Anit K. Jain, Fundamentals of Digital Image Processing, Prentice Hall.
3. Digital Video Processing by A. Murat Tekalp, first edition, Prentice Hall Gerd Keiser,

References:

1.“Computer Vision A Modern Approach” David Forsyth, Jean Ponce , Pearson Publication

2. Image Processing, Analysis and Machine Vision Sonka, Milan, Hlavac, Vaclav, Boyle, Roger, Springer Publication

3. Computer Vision A Modern Approach David Forsyth, Jean Ponce , Pearson Publication

Unit wise Measurable students Learning Outcomes:

1. Ability to differentiate between different kernels used in Image Enhancement
2. Ability to apply image segmentation techniques to solve problems
3. Ability to perform face detection
4. Ability to apply object detection techniques.
5. Ability to understand video processing,
6. Ability to perform motion analysis

Professional Elective - II

Title of the Course: Automotive embedded system design	**L**	**T**	**P**	**Credit**
Course Code: PETC0124	**3**	**1**	**-**	**4**

Course Pre-Requisites: Microprocessor architecture and programming, Understanding of 4 stroke engine and diesel engine, Basics of model based design, Concepts from operating system,

Course Description: This course gives comprehensive overview about automotive electronic systems. The distinctive features of the automotive industry in terms of requirements, technologies, implementation methods are presented in the following areas: In-vehicle architectures, Software engineering methods , Embedded communications , Safety and dependability assessment: validation, verification, and testing

Course Objectives: Make students aware about technologies and industry practices of
1. Functional domain in vehicle, their requirements and microprocessor review to handle those requirements with suitable case study.
2. Automotive industry popular RTOS.
3. Model based automotive embedded system design.
4. Automotive software testing methods.
5. automotive communication standard and case studies

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Select Industry standard microcontroller architecture for automotive functional domain	2	Understanding
CO2	Develop automotive system software using small footprint RTOS	3	Applying
CO3	Develop control algorithm using MBD	3	Analyzing
CO4	Test automotive embedded software	5	Evaluating
CO5	Analyze and test automotive communication system	5	Evaluating

CO-PO Mapping:

CO	**1**	**2**	**3**
CO1			
CO2			
CO3			
CO4			
CO5			

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:- Microcontrollers/Microprocessors in Automotive domain: Critical review of automotive grade processors ex: Free scale, Renesas, Quorivva, Infineon: microprocessor, microcontroller and digital signal processor: overview of development within the automotive context, Case study of Reference Design: MPC563xM Engine Control Unit, 4-Cylinder Hardware Design	8 **Hrs.**
Unit 2:- : RTOS for Automotive Embedded System OSEK/VDX: Introduction, Different standards defined in OSEK/VDX, Tasks in OSEK/VDX OS, Scheduling policies in OSEK/VDX OS, Interrupts in OSEK , Event processing, Alarm mechanism, Message communications, Resource management OS services, system modeling and OIL (8Hrs)	6 **Hrs.**
Unit 3:- Model based software development: Product lines in automotive electronics, MBD for Automotive Embedded Systems, Context, Concerns, and Requirements, MBD Technology, Guidelines for Adopting MBD, Development of control algorithm for different automotive subsystems Look-up tables and maps, Need of maps, Procedure to generate maps, Fuel maps/tables, Ignition maps/tables, Engine calibration, Torque table, Dynamometer testing	8 **Hrs.**
Unit 4:-Testing Automotive Control Software: Test Activities and Testing Techniques, Testing in the Development Process Test Planning Testing and Monitoring of FlexRay Based Applications , Objectives for Testing and Monitoring, Monitoring and Testing Approaches, Discussion of Approaches	6 **Hrs.**
Unit 5:- Automotive communication system: characteristics and constrains, In-car embedded networks review, Middleware, AUTOSAR, Issues for automotive communication system, Study of automotive communication standards: CAN, FlexRay, review of LIN bus	6 **Hrs.**
Unit 6:- Timing Analysis of CAN-Based Automotive Communication Systems: CAN Schedulers, Scheduling Model, Response Time Analysis, Timing Analysis Incorporating Error Impacts, Holistic Analysis, middle wares and Frame Packing	6 **Hrs.**

Textbooks:

1. Internal combustion engine fundamentals by John B.LHeywood McGrawHill Inc.
2. Automotive embedded systems Handbook edited by Nicolas Navet Pub: CRC press
3. OSEK/VDX specification, OSEK/VDX Operating System Version 2.2.3
4. OSEK/VDX specification, OSEK/VDX System Generation Version 2.5
5. AN4156: MPC563xM Engine Control Unit Reference Design 4-Cylinder Hardware Design by: Randy Dees,

References:

1. Understanding Automotive Electronics, by Williams Ribbens Pub:Elsevier
2. Automotive Electronics Handbook by Ronald K. Jurgen Pub: McGrawHill Inc
3. BOSCH CAN specifications version 2.

4. FlexRay and its applications by Dominique Pret Pub: Wiley

Unit wise Measurable students Learning Outcomes:
Unit1: Ability to select microprocessor/ microcontroller for functional domain of automobile
Unit2: Ability to develop application using industry standard RTOS
Unit3: Ability to develop control algorithm using MBD
Unit4: Ability to plan test and testing automotive system software
Unit5: Ability to discuss automotive standard buses
Unit6: Through analysis of CAN bus as case study

Title of the Course: WIRELESS SENSOR NETWORKS Course Code: PETC0125	L	T	P	Credit
	3	-	-	3

Course Pre-Requisite: Basic knowledge of Data Communication Networks.

Course Objectives:

- 1 To make students understand the basics of Wireless sensor Networks.
- To familiarize with learning of the Architecture of WSN.
- To understand the concepts of Networking and Networking in WSN.
- To study the design consideration of topology control and solution to the various problems.
- To introduce the hardware and software platforms and tool in WSN.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Understand challenges and technologies for wireless networks	I	**Understand**
CO2	Understand architecture and sensors	II	**Describe**
CO3	Describe the communication, energy efficiency, computing, storage and transmission	II	**Describe**
CO4	Establishing infrastructure, simulations and programming the in WSN environment	III	**Apply**

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CO1	3	2	-											
CO2	3	1	-											
CO3	2	2	2		1								2	2
CO4	2	1	-		1								2	2

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:-- OVERVIEW OF WIRELESS SENSOR NETWORKS SingleNode Architecture, Hardware Components , Network Characteristics, unique constraints and challenges, Enabling Technologies for Wireless Sensor Networks , Types of wireless sensor networks.	**8 Hrs.**
Unit 2:-- ARCHITECTURES Network Architecture, Sensor Networks- Scenarios - Design Principle, Physical Layer and Transceiver Design Considerations, Optimization Goals and Figures of Merit, Gateway Concepts, Operating Systems and Execution Environments introduction to Tiny OS and nesC Internet to WSN Communication.	**8 Hrs.**
Unit 3:-- NETWORKING SENSORS MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts – SMAC, BMAC Protocol, IEEE 802.15.4 standard and ZigBee, the Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols Energy Efficient Routing, Geographic Routing.	**10 Hrs.**
Unit 4:-- INFRASTRUCTURE ESTABLISHMENT Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.	**8 Hrs.**
Unit 5:-- SENSOR NETWORK PLATFORMS AND TOOLS Sensor Node Hardware – Berkeley Motes, Programming Challenges, Nodelevel software platforms, Node level Simulators, Statecentric programming.	**8Hrs.**
Textbooks: 1. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005. 2. Feng Zhao & Leonidas J.Guibas, “Wireless Sensor Networks An Information Processing Approach", Elsevier, 2007. 3. Waltenegus Dargie , Christian Poellabauer, “Fundamentals of Wireless Sensor Networks Theory and Practice”, John Wiley & Sons Publications, 2011	
References: 1. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor NetworksTechnology, Protocols, and Applications”, John Wiley, 2007. 2. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003	

Title of the Course: Random Signal Processing **Course Code:** PETC0126	**L**	**T**	**P**	**Credit**
	3	**1**	**-**	**4**

Course Pre-Requisites:
MATLAB, Digital Signal Processing .

Course Description:
This course helps students to develop understanding and apply the concept of Probability Discrete Random Variable, Continuous Random Variable. The student will be able to evaluate Moments of Random Variable and understand types of Random Processes. The student will be able to apply Markov chains technique with continuous state space. The student will be able to apply Queuing Theory with single or Multi server system to solve everyday problems.

Course Objectives: Students should develop the logical concepts of probability theory. Students should understand basic concepts of Random variables & Random Processes. Students should be able to apply concepts of Markov Chains ,state-space analysis and Queuing Theory.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Apply Probability concepts and statistical measures to solve Problems	2	Applying
CO2	**Classify** Continuous and Discrete Random Variables	3	Applying
CO3	**Differentiate** between various Random Processes	3	Analyzing
CO4	**apply** Markov Chain & Queuing Theory to solve problems	5	Evaluating

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**
CO1			1
CO2	2		
CO3		2	
CO4		2	
CO5			1

Assessments :
Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Unit 1:--- Probability Theory: The concept of Probability; the axioms of Probability; sample space and events;	-6- Hrs.
Conditional probability and Baye's theorem, Independence of events, Bernoulli trails.	
Unit 2:--- Random variables: Introduction to Random Variables, Discrete Random Variable, Continuous Random Variable, Expectation of Random Variable, Moments of Random Variable(mean, mode variance, skewness, Kurtosis)	-7- Hrs.
Unit 3:--- Multiple Random Variables: cumulative distribution function and probability density function of single and multiple Random Variables, statistical properties, Jointly distributed Gaussian random variables, Conditional probability density, properties of sum of random variables, Central limit theorem, Estimate of population means, Expected value and variance and covariance.	-8- Hrs.
Unit 4:--- Random Processes: Classification of Processes; Properties, Auto correlation and cross correlation function; Estimate of auto correlation function. Spectral Density: Definition, Properties, white noise, Estimation of auto-correlation function using frequency domain technique, Estimate of spectral density, cross spectral density and its estimation, coherence.	-7- Hrs.
Unit 5:--- Markov Chains: Chapman Kolmogorov equation, Classification of states, Limiting probabilities, Stability of Markov system, Reducible chains, Markov chains with continuous state space	-6- Hrs.
Unit 6:--- Queuing Theory: Elements of Queuing System Little's Formula, M/M/1 Queue, single, Multi server system	-6- Hrs.

Textbooks:

Textbooks:

1. Introduction to probability Models,(Third edition) - Sheldon M. Ross.
2. Random Signal Processing, Prof.G.V.Kumbhojkar, C.Jamanadas &Company

References:

1 Probability and Random Processes for Electrical Engg.-Alberto Lean-Garcia (Pearson Edu.)
2. Probability, Random Variables and Stochastic Processes by Athanasios Papoulis and S. Unnikrishna Pillai, PHI, 4th Edition, 2002
3. Stochastic Processes – J. Medhi , (New Age International.)

Textbooks:

1. Introduction to probability Models,(Third edition) - Sheldon M. Ross
2. Random Signal Processing, Prof.G.V.Kumbhojkar, C.Jamanadas & Co.
3. Probability and Random Processes for Electrical Engg.-Alberto Lean-Garcia (Pearson Edu.)

References:

1. Probability, Random Variables and Stochastic Processes by Athanasios Papoulis and S. Unnikrishna Pillai, PHI, 4th Edition, 2002
2. Stochastic Processes – J. Medhi , (New Age International.)

Unit wise Measurable students Learning Outcomes:

Unit1: Student should be able to understand basic concepts of Probability **,** Baye's theorem and Bernoulli trails.

Unit2: Student should be able to understand types of Random Variable and Moments of RV.

Unit3: Student should be able to understand basic concepts of cumulative distribution function and probability density function of single and multiple Random Variables and statistical properties

Unit4: Student should be able to estimate Auto correlation and cross correlation function and spectral density of Random Processes

Unit5: Student should be able to understand basic concepts of Markov chains with continuous state space and apply it

Unit6: Student should be able to understand basic concepts of single and Multiple server Queuing system

Professional Elective - III

Title of the Course: Embedded Linux Programming	**L**	**T**	**P**	**Credit**
Course Code: PETC0221	**3**	**-**	**-**	**3**

Course Pre-Requisite: Embedded System Programming

Course Description: This Course aims to develop the basic concepts of Super loop programming, RTOS programming, programming on Embedded Linux platform and develop application on embedded Linux.

Course Objectives: To develop understanding for selecting platform for embedded system programming specific to application in design.
To develop understanding of Embedded Linux architecture, file system and boot sequence of Embedded Linux
To develop understanding of board support package of embedded Linux.
To develop understanding of embedded storage system using MTD
To develop understanding of Drivers for embedded Linux
To study Beagle Bone Black and Raspberry Pi as platform and develop applications on the same

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive level	Descriptor
CO1	Select suitable embedded system development models	3	Applying
CO2	Understand Linux BSP for a hardware platform.	2	Understand
CO3	Understand drivers in embedded Linux	2	Understand
CO4	Develop and debug applications in embedded Linux	3	Applying

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**
CO1	2		
CO2		2	2
CO3			2
CO4		2	

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% Weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Unit 1:--- I Review of super loop and RTOS programming, Need of embedded Linux, Embedded Linux Versus Desktop Linux, Embedded Linux Distributions and porting	**Hrs. 6**
Unit 2:--- Architecture of Embedded Linux, Linux Kernel Architecture: HAL, Memory manager, Scheduler, File System, I/O and Networking subsystem, IPC, User space, Linux Start-Up Sequence	**Hrs. 6**
Unit 3:-- Board Support Package: Inserting BSP in Kernel Build Procedure, The Boot Loader Interface, Memory Map, Interrupt Management, Timers, UATRS, Power management	**Hrs. 6**
Unit 4:--- Embedded Storage: MTD, Architecture, Drivers, Embedded File System	**Hrs. 6**
Unit 5:--- Embedded Drivers: Serial, Ethernet, I2C, USB, Timer, Kernel Modules Porting Applications	**Hrs. 6**
Unit 6:--- Introduction to Beagle Bone hardware platform, Introduction to Raspberry PI hardware platform, Programming hardware resources of any of above boards using programming languages	**Hrs. 6**
Textbooks: 1. P Raghvan, Amol Lad, Sriram Neelakandan, "Embedded Linux System Design and Development", Auerbach Publications 2. Derek Molloy, "Exploring BeagleBone: Tools and Techniques for Building with Embedded Linux", Wiley, 1st Edition, 2014	
References: 1. 1. Karim Yaghmour, "Building Embededd Linux Systems", O'Reilly & Associates 2. Christopher Hallinan, "Embedded Linux Primer: A Practical Real World Approach", Prentice Hall, 2nd Edition, 2010. 3. Chris Simmonds "Mastering Embedded Linux Programming" Packt Publication..	
Unit wise Learning Outcomes 1. Differentiate methods of embedded system programming and state features of embedded Linux distributions 2. State architectural aspects of Embedded Linux 3. Able to understand Board support package 4. State different file systems used in Embedded Linux 5. Understand Embedded Linux drives 6. Able to develop applications on Beagle Bone/ Raspberry Pi platform	

Title of the Course: **Advance Network Security** **Course Code: PETC0222**	**L**	**T**	**P**	**Credit**
	3	**-**	**-**	**3**

Course Pre-Requisite: Semiconductor Physics, Fundamentals of Electromagnetic theory, Principles of Communication Systems

Course Description: To introduce the students to various optical fiber modes, configurations and various signal degradation factors associated with optical fiber and to study about various optical sources and optical detectors, optical amplifiers, SONET/SDH, WDM / DWDM and their use in the optical communication system. Fiber optical communication enables telecommunications networks to provide high bandwidth high speed data connections across countries and the globe. This type of communication can transmit voice, video and telemetry through local area networks, computer networks across long distance. Optical fiber also offers low power loss, lost cost, lower attenuation, and greater security.

Course Objectives:

The objective of this course is to expose students to advanced topics in network security. Topics covered will include network security issues like authentication, anonymity, traceback, denial of service, encryption, forensics etc At the conclusion of the course, students will be expected to get a clear and in-depth understanding of state of the art in network security attacks and defenses.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive level	Descriptor
CO1	**Describe** Overview of network security and cryptography	II	**Describe**
CO2	**Classify** encryption techniques.	I	**Classify**
CO3	**Compare** Public Key Cryptography for Message Authentication and Hash Algorithms	III	**Compare**
CO4	**Apply** Network Security for Different Apllications	IV	**Apply**

CO-PO Mapping:

CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
CO1	3	2	-											
CO2	3	1	-											
CO3	2	2	2		1								2	2
CO4	2	1	-		1								2	2

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30

ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:-- **Introduction:** Principles of security, Overview of network security and cryptography, OSI Security architecture, model for network security, classification of attacks (Reply, Reflection, Man – in – the – middle), Virus, Worm, Trojan Horse, Spam etc.	**7 Hrs.**
Unit 2:-- **Symmetric ciphers:** Algorithm types and modes, classical encryption techniques, block ciphers and Data Encryption Standard (DES), Advanced Encryption Standard (AES), Contemporary Symmetric Ciphers, and confidentiality using symmetric encryption.	**7 Hrs.**
Unit 3:-- **Public Key Cryptography:** Public key Infrastructure (PKI), RSA, key management, Diffe-Hellman key exchange, elliptic curve arithmetic, elliptic curve cryptography. Message Authentication,Authentication requirements, authentication functions, message authentication codes.	**7Hrs.**
Unit 4:-- **Hash Functions and Hash Algorithms**: Hash functions, security of Hash functions and MACs,MD5 Message Digest Algorithm, Secure Hash Algorithm, Digital Signature Algorithm, Digital Signature Standard.	**7 Hrs.**
Unit 5:-- **Network Security Applications:** Authentication Applications (Kerberos), Electronic Mail Security (SMIME), IP Security (IPSec), Web Security (SSL and TLS), E – cash and Secure Electronic Transaction (SET), System security using Firewalls and VPNs.	**7 Hrs.**
Unit 6:-- **Advance Applications of Network Security**: Smart cards and security, Enterprise Application Security, Biometric Authentication, Database Access Control, Security and Privacy Issues in RFIDs.	**6 Hrs.**

Textbooks:

1. William Stallings, Cryptography and Network Security—Principles and Applications, Pearson Edu.
2. Atul Kahate, Cryptography and Network Security, Tata McGraw Hill.
3. Trappe & Washington, Introduction to Cryptography with Coding theory, Pearson Education.

References:

1. William Stallings, Network Security Essentials, Pearson Education.
2. Kaufman, Perlman & Speciner, Network Security, Pearson Education.
3. Behrouz A. Forouzan, , Cryptography and Network Security, McGraw – Hill Education.

Title of the Course: Adaptive Signal Processing Course Code: PETC0223	L 3	T 1	P --	Credit 4

Course Pre-Requisite: Signals and Systems, Digital Signal Processing, Linear algebra and Random signal processing theory

Course Description: This course aims to introduce Adaptive Signal Processing.
It is concerned with processing of signals where the processing parameters are adjusted continuously to suit time varying signal environmental conditions. It consists of adaptive linear combiner, often called adaptive filter where the combiner filter coefficients are trained continuously. The course consists of development of various adaptation algorithms and assessing them in terms of convergence rate, computational complexity, robustness against noisy data, hardware complexity, numerical stability etc.

Course Objectives:

1. To Understand Concept of Adaption.
2. To Demonstrate concepts of Wiener Filter.
3. To Explain Least mean-square Adaptive Filter
4. To Design Kalman Filter

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive Level	Bloom's Cognitive Descriptor
CO1	Understand Concept of Adaption	**1**	Understand
CO2	Demonstrate concepts of Wiener Filter.	**2**	Demonstrate
CO3	Explain Least mean-square Adaptive Filter	**3**	Apply
CO4	Design Kalman Filter	**3**	Apply

CO-PO Mapping:

CO	a	b	c
CO1		2	
CO2	2		3
CO3	1		
CO4	2	2	
CO5		2	

Assessments :
Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules) **ESE: Assessment is based on 100% course content with60-70% weight age for course content (normally last three modules) covered after MSE.**	
Course Contents:	
Unit 1: Introduction Adaptive systems, areas of application, general properties, open and closed loop adaption, Application of closed loop adaption, Examples of Adaptive systems. Adaptive linear combiner.	**6 Hrs**
Unit 2: Wiener Filters Linear optimum filtering, principal of Orthogonality, minimum mean square error, Linear prediction, forward and backward, Method of steepest decent.	**6 Hrs**
Unit 3:--- Least mean-square Adaptive Filtering Overview of structure and operation statistical LMS Theory, normalized least mean – square Adaptive filters, Frequency domain and sub band Adaptive filters, Methods of squares, Recursive least squares Adaptive filters.	6 **Hrs.**
Unit 4:--- Kalman Filters Statement of kalman filter problem, the innovation process estimation, filtering, initial conditions variants extended kalman filters. Square root adaptive filters. Order – recursive Adaptive filter.	**6 Hrs**
Unit 5:- Finite precision Effects Quantization errors, least mean-square Algorithm, Recursive least square Algorithm, Square root Adaptive filters, Order recursive filters, Fast Transversal Filters. Tracking of Time varying systems	6- **Hrs.**
Unit 6:--- Adaptive Filters using Infinite-Duration Impulse Response structure IIR Adaptive filters-Output Error Method, Equation Error Method. Some Practical Considerations, Laguerre Transversal Filters, Adaptive Laguerre Latice Filters.	**6- Hrs.**
Textbooks*:* 1. Adaptive filter Theory Simon Haykin Fourth Edition Pearson publication	
References: 1. Adaptive Signal Processing Bernard Widrow, Samual Stearns Pearson publication 2. Theory and Design of Adaptive Filters John R.Treichler et.al PHI private Publication.	
Unit wise Measurable students Learning Outcomes: **Unit1:** Explain Adaptive systems **Unit 2:** Design Wiener Filters **Unit 3:** Explain Least mean-square Adaptive Filtering **Unit 4:** Demonstrate concept of Kalman Filter. **Unit 5:** Explain Finite precision Effects **Unit 6:** Understand Concepts of Adaptive Filters using Infinite-Duration Impulse Response structure.	

Professional Elective - IV

Title of the Course: Artificial Intelligence and Machine Learning **Course Code: PETC0224**	**L** **3**	**T** **1**	**P** **--**	**Credit** **4**

Course Pre-Requisite: Data Structures, Mathematics

Course Description: This Course aims to develop the basic concepts of Artificial Intelligence & Machine Learning with having concepts learnt of data mining. With the usage of Internet and World Wide Web increasing day by day, the field of AI and ML and its techniques are being used in many areas which directly affect human life. This course covers basic concepts of data mining, AI & ML, and methodologies used in AI & ML

Course Objectives:

5. To learn basic concepts of Data mining, Data Preprocessing, Data Cleaning & Reduction
6. Understand basic concepts of AI ,Machine Learning and Knowledge Representation Issues
7. To study various case studies used in Neural Networks, Decision Tree, Random Forest
8. Understand problems solved with Machine Learning

Course Learning Outcomes:

- Understand Data mining ,
- Understand ML based algorithms and AI based various search methods
- Use various knowledge representation methods
- Apply Machine Learning techniques to solve real life problems using case studies
- Use Symbolic Reasoning and Statistical Reasoning

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive Level	Bloom's Cognitive Descriptor
CO1	Understand AI based various search methods	**1**	Understand
CO2	Understand ML based algorithms and AI based various search methods	**1**	Understand
CO3	Use various knowledge representation methods	**3**	Applying
CO4	Apply Machine Learning techniques to solve real life problems using case studies	**3**	Applying

CO-PO Mapping:

CO	**a**	**b**	**c**
CO1		2	
CO2	2		3
CO3	1		
CO4	2	2	

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weight age for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Introduction to Data Mining and Data Pre-processing : Introduction, Data Mining Process, Basic Data Types, Data Objects and Attribute Types , Basic Statistical Descriptions of Data, Data Pre-processing: An Overview , Data Cleaning , Data Integration, Data Reduction, Mining Frequent Patterns, Associations, and Correlations, Basic Concepts , Frequent Item set Mining Methods, Pattern Evaluation Methods	**6 Hrs**
Unit 2: Classification: Basic Concepts, Decision Tree Induction- Attribute Selection Measures, Tree Pruning , Bayes Classification Methods, Rule-Based Classification , Advanced Methods - Classification Using Frequent Patterns, k-Nearest Neighbor Classifiers	**6 Hrs**
Unit 3:--- Introduction to Machine Learning: Definition, Terminology, Types of learning, Machine Learning Problem categories, Machine learning architecture, process, Life cycle, Performance measures, tools and framework, data visualization **Introduction to AI :** The AI Problems, The Underlying Assumption, AI techniques, the Level of the Model, Criteria for Success **Knowledge Representation Issues :** Representations and Mappings, Approaches to Knowledge Representation **Representing Knowledge Using Rules :** Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning	8 **Hrs.**
Unit 4:--- Regression: Simple regression – hypothesis, cost function, parameter learning with gradient descent, learning rate, Gradient Descent for linear regression, examples, Multivariate Linear Regression – multiple features, hypothesis functions, Gradient Descent for multiple variables, Feature scaling, polynomial regression, Logistic Regression, decision boundary, cost function, gradient descent for logistic regression. multiclass classification, Regularization - Over fitting & Under fitting , cost function	**6 Hrs**

Unit 5:- Problems, State Space Search & Heuristic Search Techniques : Defining The Problems as a State Space Search, Issues in the Design of Search Programs, additional problems. Generate-and-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction. **Using Predicate Logic :** Representation of simple Facts in Logic, Representing Instance and Relationships Computable Functions And Predicates, Resolution	6- **Hrs.**
Unit 6:--- Neural Networks & Decision Trees- Neuron representation and model, Hypothesis for neuron, cost function, solution of a problem using single neuron. Gradient descent for a neuron. Neural network, Multiclass classification with neural network. Learning in neural network-back propagation algorithm **Classification**- Decision trees and Naïve Bayes Decision trees: constructing and understanding. Decision trees, Decision tree algorithms, random forest, examples. Conditional probability and Naïve Bayes Classifier Instance-based classifier – K- Nearest Neighbor Classifier, Unsupervised learning: Clustering, K Means clustering, Hierarchical clustering, **Case studies**: Decision tree, Random forest ,KNN	**-8- Hrs.**

Textbooks*:*

1. Jiawei Han, Micheline Kamber, Jian Pei: Data Mining -Concepts and Techniques, 3rd Edition, Morgan Kaufmann Publisher, 2012.
2.Margaret H. Dunham: DATA MINING Introductory and Advanced Topics, Pearson Education, Prentice Hall, 2002.
3. J. M. Zurada, "Introduction to Artificial Neural systems", Jaico Publishing House Delhi, VIth Edition, 2003.
4.Artificial Intelligence-By Elaine Rich And Kevin Knight (2nd Edition) Tata Mcgraw-Hill
5. Artificial Intelligence: A Modern Approach, Stuart Russel, Peter Norvig, PHI
6."Artificial Intelligence" –By Mr.Saroj Kaushik ,Cengage Learning
7 . Machine Learning with Python- an approach to applied ML - by Abhishek Vijayvargia, BPB publications
8. Practical Machine Learning by Sunila Gollapudi Packt Publishing Ltd

References:

1. Machine Learning by Tom M. Mitchell, McGraw Hill Education; First edition Machine Learning for dummies John Paul Muller, Willey Publication
2. Ethem Alpaydin : Introduction to Machine Learning, PHI 2nd Edition-2013

List of Open Source Software/learning website:

1. http://www.journals.elsevier.com/artificial-intelligence/
2. https://www.technologyreview.com/s/534871/our-fear-of-artificial-intelligence/
3. http://www.sanfoundry.com/artificial-intelligence-mcqs-inductive-logic-unification-lifting-1/
4. http://neuralnetworksanddeeplearning.com/

Unit wise Measurable students Learning Outcomes:

Unit1

UO1.1: Student should be able to understand Data Mining and Data Pre-processing .
UO 1.2 : Students should be able to understand basic concepts of AI Problems **.**

Unit 2

UO2.1: Student should be able to understand Classification related concepts ,
UO2.2: Students should be able to understand concepts of Bayes Classification.

Unit 3

UO3: Student should be able to apply concepts related to Machine Learning algorithms , Artificial

Intelligence

Unit 4 : Student should be able to understand Problems, State Space Search & Heuristic Search Techniques

Unit 5

UO5.1: Student should be able to develop symbolic Reasoning Techniques

UO5.2: Student should be able to understand statistical reasoning Techniques

Unit 6 : Student should be able to understand Neural Networks & Decision Trees, classification and various case studies

Title of the Course: Software Defined Radio Course Code: PETC0225	L	T	P	Credit
	3	1	-	4

Course Pre-Requisite:
Basics of communication engineering

Course Description: This course aims to introduce design strategies for software defined radio and cognitive radio.

Course Objectives:

1. To understand reconfigurable Modern Radio Communication System
2. To understand the concept of Cognitive Radio and Spectrum sharing
3. To understand how SDR allows access to both PHY and MAC layer
4. To understand GNU Radio

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Understand fundamental concepts required for SDR.	I	Understand
CO2	Simulate modern wireless system based on OFDM, MIMO & Smart Antenna	V	Simulate
CO3	Understand PHY and MAC layers	II	Understand
CO4	Understand fundamental concepts required for CR.	I	Understand

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	-	-	3
CO2	-	-	2
CO3	-	-	2
CO4	-	-	3

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:--- Software Defined Radio Fundamentals Introduction to SDR, Need of SDR, Principles of SDR, Basic Principle and difference in	8 **Hrs.**

Analog radio and SDR , SDR characteristics, required hardware specifications, Software/Hardware platform, GNU radio -What is GNU radio, GNU Radio Architecture, Hardware Block of GNU, GNU software , MATLAB in SDR , **Lab Tutorials** : AM/FM/BPSK/QPSK/OFDM Simulation in Matlab	
Unit 2:--- RF Front End Radio Frequency Implementation issues, Purpose of RF front End, Dynamic Range ,RF receiver Front End topologies, Flexibility of RF chain with software radio, Duplexer ,Diplexer ,RF filter ,LNA ,Image reject filters , IF filters , RF Mixers Local Oscillator , AGC, Transmitter Architecture and their issues, Sampling theorem in ADC, Noise and distortion in RF chain, Pre-distortion	8 **Hrs**
Unit 3:--- SDR Architecture Architecture of SDR-Open Architecture, Software Communication Architecture, ADC, DAC, DAC/ADC Noise, Budget, ADC and DAC Distortion **LAB Tutorials**: JTRS –Goals of SCA ,Architectural details ,SDR forum Architecture	8 **Hrs**
Unit 4:--- Digital Hardware for SDR Key hardware elements, DSP processors, Role of FPGA/CPU/GPU in SDR, Applications of FPGA in SDR, Design Principles using FPGA, Trade –offs in using DSP, FPGA and ASIC, Power Management Issues in DSP, ASIC, FPGA	8 **Hrs**
Unit 5:--- Cognitive Radio Cognitive Radio Architecture, Dynamic Access Spectrum, Spectrum Efficiency, Spectrum Efficiency gain in SDR and CR ,Spectrum Usage, SDR as a platform for CR, OFDM as PHY layer ,OFDM Modulator, OFDM Demodulator, OFDM Bandwidth, Benefits of OFDM in CR, Spectrum Sensing in CR, CR Network	8 **Hrs**
Unit 6:--- Applications of SDR Application of SDR in Advance Communication System-Case Study, Challenges and Issues, Implementation, Parameter Estimation –Environment, Location, other factors, Vertical Handoff, Network Interoperability. **LAB Tutorials**: 1)CR for Public Safety –PSCR , Modes of PSCR, Architecture of PSCR OR 2)Beagle board based SDR 3)Embedded PCSR using GNU radio	8 **Hrs**
Textbooks: 1. Jeffrey.H.Reed ,Software Radio : A Modern Approach to Radio Engineering , Pearson , LPE	
References: 1. Markus Dillinger ,KambizMadani ,Nancy Alonistioti, Software Defined Radio : Architectures , Systems and Functions ,Wiley 2. Tony .J. Rouphael , RF and DSP for SDR, Elsevier Newness Press ,2008 3. Dr.TajStruman ,Evaluation of SDR –Main Document 4. SDR –Handbook , 8th Edition , PENTEK 5. Bruce a. Fette , Cognitive Radio Technology, Newness, Elsevier	
Unit wise Measurable students Learning Outcomes: Students will be able to understand the fundamental concepts of software defined radio. Students will be able to understand the operations software defined radio Students will be able to design software defined radio Students will be able to calculate smart antenna design parameters Students will be able to understand the operation of cognitive radio	

Title of the Course: Digital Audio Processing **Course Code: PETC0226**	**L**	**T**	**P**	**Credit**
	3	**1**	**-**	**4**

Course Pre-Requisite: Digital Signal Processing, Speech Processing

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive level	Descriptor
CO1	**Describe** characteristics of audio signals.	II	**Describe**
CO2	**Describe** speech analysis and synthesis systems	II	**Describe**
CO3	**Apply** speech processing algorithms	III	**Apply**
CO4	**Compare** applications of speech processing	IV	**Compare**

CO-PO Mapping:

CO	**1**	**2**	**3**
CO1	3	-	-
CO2	-	1	-
CO3	2	-	2
CO4	2	1	-

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:-- Introduction Audio Signal Characteristics, Production model, Hearing and Auditory model, Acoustic characteristic of speech, Speech production models, Linear Separable equivalent circuit model, Vocal Tract and Vocal Cord Model	**6 Hrs.**
Unit 2:-- Audio signal acquisition Representation and Modeling, Enhancement of audio signals: Spectral Subtraction, Weiner based filtering, Neural networks	**6 Hrs.**
Unit 3:-- Audio/ Speech Analysis and Synthesis Systems Digitization, Sampling, Quantization and coding, Spectral Analysis, Spectral structure of speech, Autocorrelation and STFT of speech signal, Window function, Sound Spectrogram, Mel frequency Cepstral Coefficients, Filter bank and Zero Crossing Analysis, Analysis –by-Synthesis, Pitch Extraction., Linear Predictive Coding Analysis	**8 Hrs.**

Unit 4:-- Acoustics Psychoacoustics, Multi-microphone audio processing: Room acoustics, Array beam forming. Acoustic sound source localization and tracking.	**6 Hrs.**
Unit 5:-- Audio Compression Sound, Digital Audio , The Human Auditory System , µ-Law and A-Law Companding , ADPCM Audio Compression , MLP Audio , Speech Compression , Shorten MPEG-1 Audio Layers	**6 Hrs.**
Unit 6:-- Applications Principles of Automatic Speech Recognition (ASR),Theory and implementation of Hidden Markov Model (HMM) for ASR, Speaker Recognition, Evolution of Speech APIs, Natural Language Processing, Sound source separation model	**8 Hrs.**

Textbooks:

1. Rabiner and Schafer, "Digital Processing of Speech Signals", Pearson Education
2. Sen, Soumya, Dutta, Anjan Dey, Nilanjan, Audio Processing and Speech Recognition,1st edition, 2019, Springer
3. Gold, B.; Morgan, N.; Ellis, D. Speech and audio signal processing: processing and perception of speech and music. 2nd rev. ed. Wiley-Blackwell, 2011.
4. Speech and audio processing by Dr. Shaila D. Apte Springer 2016

References:

1. Sadaoki Furui, "Digital Speech Processing, Synthesis and Recognition"
2. D. O'Shaughnessy, "Speech Communications: Human and Machine," Universities Press, 2001
3. L. R. Rabiner and B. Juang, "Fundamentals of Speech Recognition," Pearson Education (Asia) Pte. Ltd., 2004
4. Z. Li and M.S. Drew, "Fundamentals of Multimedia," Pearson Education (Asia) Pvt. Ltd., 2004

Unit wise Measurable students Learning Outcomes:

Unit 1:-- Students should be able to describe Speech production models
Unit 2:-- Students should be able to apply Speech Analysis and Synthesis Systems
Unit 3:-- Students should be able to understand Cepstral Coefficients
Unit 4:-- Students should be able to apply acoustic theory
Unit 5:-- Students should be able to perform audio signal compression techniques
Unit 6:-- Students should be able to apply speech/speaker recognition systems