GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI

DEPARTMENT OF ELECTRONICS ENGINEERING

Curriculum for Second Year

B. Tech. (Electronics and Telecommunication)

2020-2021

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Specialization: Electronics and Telecommunication

PROGRAM OBJECTIVES

PO1: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PO12: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Member Secretary	Chairman, BoS	Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)	(Prof. A.M.Mahalle)

(B) PROGRAM SPECIFIC OUTCOMES (PSOs)

A Graduate of the Electronics and Telecommunication program will be able to:

PSO1: Apply the concepts of Analog and Digital Electronics, Microprocessors, Signal processing and communication engineering in design and implementation of Engineering Systems.

PSO2: Solve complex problems in the field of Electronics and telecommunication using latest hardware and software tools along with analytical and managerial skills

PSO3: Acquire the social and environmental awareness with ethical responsibility to have successful carrier

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI.
Department of Electronics Engineering.
Scheme for B. Tech. (Electronics and Telecommunication)
Semester I

Teaching Scheme							Evaluation Scheme						
Category	**Course Code**	**Course Title**	**Theory**	**Tutorial**	**Practical**		**Theory**			**Practical**		**Total**	**Credits**
			Hrs/week	**Hrs/week**	**Hrs/week**	**Total**	**MSE**	**TA**	**ESE**	**ICA**	**ESE**		
MC	SHU100	Induction Program	Two weeks mandatory audit course										0
BSC	SHU121	Physics	3	1	---	4	30	10	60	---	---	100	4
BSC	SHU122	Calculus and Linear Algebra	3	1	---	4	30	10	60	---	---	100	4
ESC	EEU121	Basic Electrical Engineering	3	---	---	3	30	10	60	---	---	100	3
ESC	CEU121	Engineering Mechanics	3	---	---	3	30	10	60	---	---	100	3
HSMC	SHU123	English	2	---	---	2	---	---	60	---	---	60	2
BSC/LC	SHU124	Physics Lab	---	---	2	2	---	---	---	50	---	50	1
ESC/LC	EEU122	Basic Electrical Engg Lab	---	---	2	2	---	---	---	50	---	50	1
ESC/LC	CEU122	Engineering Mechanics Lab	---	---	2	2	---	---	---	50	---	50	1
HSMC/LC	SHU125	English Lab	---	---	2	2	---	---	---	50	---	50	1
ESC/LC	MEU121	Workshop Practice I	---	---	2	2	---	---	---	50	---	50	1
		Total	14	2	10	26	120	40	300	250	0	710	21

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Semester II

Teaching Scheme							Evaluation Scheme						
Category	**Course Code**	**Course Title**	**Theory**	**Tutorial**	**Practical**		**Theory**			**Practical**		**Total**	**Credits**
			Hrs/week	**Hrs/week**	**Hrs/week**	**Total**	**MSE**	**TA**	**ESE**	**ICA**	**ESE**		
BSC	SHU221	Chemistry	4	--	---	4	30	10	60	---	---	100	4
BSC	SHU222	Integral calculus and differential equations	3	1	---	4	30	10	60	---	---	100	4
ESC	CSU221	Programming for Problem solving	3	---	---	3	30	10	60	---	---	100	3
ESC	MEU221	Engineering Graphics	2	---	---	2	30	10	60	---	---	100	2
ESC	MEU222/ ETU221	Basic Mechanical Engineering/ Basic Electronics Engineering	2	---	---	2	30	10	60	---	---	100	2
BSC/LC	SHU223	Chemistry Lab	---	---	2	2	---	---	---	50	---	50	1
ESC/LC	CSU222	Programming for Problem solving Lab	---	---	4	4	---	---	---	50	---	50	2
ESC/LC	MEU223	Engineering Graphics Lab	---	---	4	4	---	---	---	50	---	50	2
ESC/LC	MEU224	Workshop Practice II	---	---	2	2	---	---	---	50	---	50	1
		Total	14	1	12	27	150	50	300	200	0	700	21

TA: Teacher Assessment **MSE: Mid Semester Examination** **ESE: End Semester Examination** **ICA: Internal Continuous Assessment**

MSE Duration: 1.30 Hrs all courses

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Important Note:

MEU222 for only Electrical, Electronics & TC, Computer Science, Information Technology and Instrumentation Engineering branch

ETU221 for only Civil and Mechanical Engineering branch

In Semester I, the students of Civil, Mechanical, Electrical & Instrumentation Engineering shall be offered group A courses, and that of Electronics & TC, Computer Science and Information Technology shall be offered group B courses. In Semester II, vice versa.

In addition following courses are offered

SHU122 and MEU121 for all students in Semester I. SHU222 and MEU224 for all students in Semester II.

MEU222 shall be offered in Semester I for Electronics & TC, Computer Science, Information Technology branch. And it shall be offered in Semester II for Electrical and Instrumentation Engineering branch

ETU221 shall be offered in Semester II for Civil and Mechanical Engineering branch.

There should be direct correspondence of group A and group B courses.

Sr. No.	Group A Courses		Group B Courses	
	Course Code	**Title of Course**	**Course Code**	**Title of Course**
1	SHU121	Physics	SHU221	Chemistry
2	EEU121	Basic Electrical Engineering	CSU221	Programming for Problem solving
3	CEU121	Engineering Mechanics	MEU221	Engineering Graphics
4	SHU123	English	SHU223	Chemistry Lab
5	SHU124	Physics Lab	CSU222	Programming for Problem solving Lab
6	EEU122	Basic Electrical Engineering Lab	MEU223	Engineering Graphics Lab
7	CEU122	Engineering Mechanics Lab		
8	SHU125	English Lab		

Category of Course	Definition	Credits
BSC	Basic Science Courses	**18**
ESC	Engineering Science Courses	**21**

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Government College of Engineering Amravati

Principal
(Prof. A.M.Mahalle)

HSMC	Humanities and Social Sciences including Management Courses	**3**
	Total Credits	**42**

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

SEMESTER-III

Category	Course Code	Name of the Course	Teaching Scheme					Evaluation Scheme					Credit
								Theory		Practical		Total	
			Theory Hrs/week	Tutorial Hrs/week	Practical Hrs/week	Total	TA	MSE	ESE	ICA	ESE		
BSC	SHU321C *SHU322C	Transform And Statistical Methods *Integral Calculus And Probability	3	1	0	4	10	30	60	---	---	100	4
PCC	ETU321	Electronic Devices and Circuits	3	1	0	4	10	30	60	---	---	100	4
PCC	ETU322	Signals and Systems	3	0	0	3	10	30	60	---	---	100	3
PCC	ETU323	Digital Electronics	3	0	0	3	10	30	60	---	---	100	3
PCC	ETU324	Network Theory	3	1	0	4	10	30	60	---	---	100	4
MC	SHU323	Introduction to Constitution of India	1	--	--	1	20	30	---	---	---	50	--
PCC	ETU325	Electronics Devices and Circuits Lab.	0	0	2	2	---	---	---	25	25	50	1
PCC	ETU326	Signal and Systems Lab.	0	0	2	2	---	---	---	25	25	50	1
PCC	ETU327	Digital Electronics Lab.	0	0	2	2	---	---	---	25	25	50	1
PCC	ETU328	Computer Programming Lab.	0	0	2	2	---	---	---	25	25	50	1
	Total		**16**	**3**	**8**	**27**	**70**	**180**	**300**	**100**	**100**	**750**	**22**

TA: Teacher Assessment MSE: Mid Semester Examination ESE: End Semester Examination ICA: Internal Continuous Assessment

ESE Duration for Theory: 2.30Hrs.

*For direct second year admitted students

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

SEMESTER-IV

Category	Course Code	Name of the Course	Teaching Scheme					Evaluation Scheme					Credit
								Theory		Practical		Total	
			Theory Hrs/week	Tutorial Hrs/week	Practical Hrs/week	Total	TA	MSE	ESE	ICA	ESE		
PCC	ETU421	Probability Theory and Stochastic Processes	3	0	0	3	10	30	60	---	---	100	3
PCC	ETU422	Analog Communication	3	0	0	3	10	30	60	---	---	100	3
PCC	ETU423	Analog Circuits	3	0	0	3	10	30	60	---	---	100	3
PCC	ETU424	Microprocessors and Microcontrollers	3	1	0	4	10	30	60	---	---	100	4
PCC	ETU425	Digital System Design	3	1	0	4	10	30	60	---	---	100	4
MC	*SHU422	Environmental Studies	1	0	0	1	20	30	---	---	---	50	---
PCC	ETU426	Analog Communication Lab.	0	0	2	2	---	---	---	25	25	50	1
PCC	ETU427	Analog Circuits Lab.	0	0	2	2	---	---	---	25	25	50	1
PCC	ETU428	Microprocessors and Microcontrollers Lab.	0	0	2	2	---	---	---	25	25	50	1
	Total		**16**	**2**	**6**	**24**	**70**	**180**	**300**	**75**	**75**	**700**	**20**

TA: Teacher Assessment MSE: Mid Semester Examination ESE: End Semester Examination ICA: Internal Continuous Assessment
ESE Duration for Theory: 2.30Hrs. * ESE Duration for Theory: 1.30Hrs

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

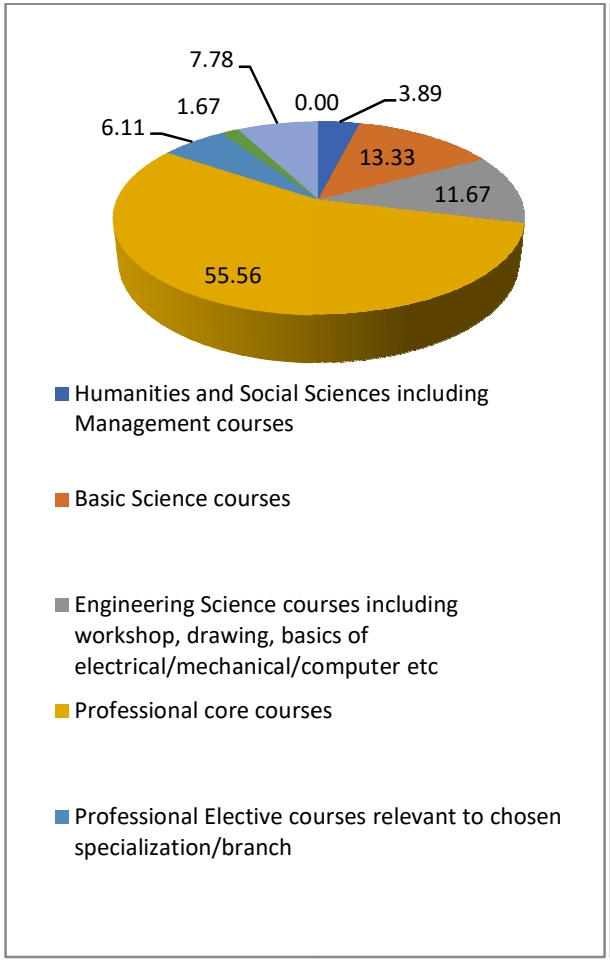
Credit Distribution of Electronics and Telecommunication (Existing and Proposed)

S. No.		Credit Breakup for E & TC (Proposed)	Credit Breakup for E & TC (Existing)	Credit Breakup for E & TC in % (Proposed)	Credit Breakup for E & TC in % (Existing)
1.	Humanities and Social Sciences including Management courses	10	7	6.10	3.89
2.	Basic Science courses	22	24	13.41	13.33
3.	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc	21	21	12.80	11.67
4.	Professional core courses	71	100	43.29	55.56
5.	Professional Elective courses relevant to chosen specialization/branch	18	11	10.98	6.11
6.	Open subjects – Electives from other technical and /or emerging subjects	6	3	3.66	1.67
7.	Project work, seminar and internship in industry or elsewhere	16	14	9.76	7.78
8.	Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Traditional Knowledge]	(non-credit)	(non-credit)	(non-credit)	(non-credit)
9.	Total	164	180	100.00	100.00

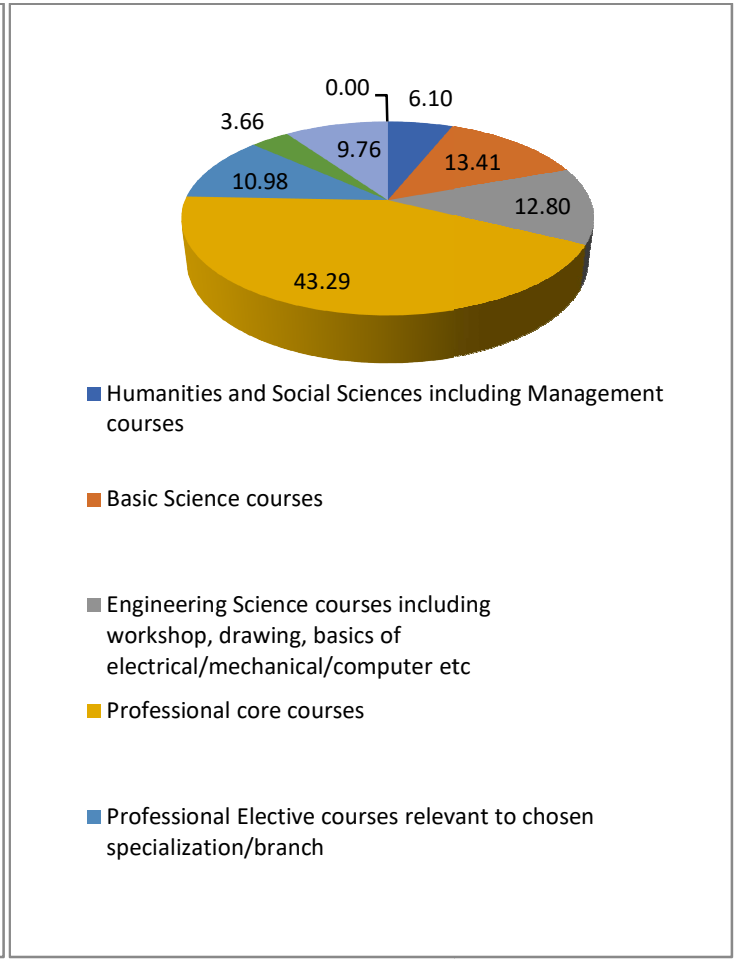
Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)



Credit Distribution Chart (Proposed)



Credit Distribution Chart (Existing)

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Department of Electronics EngineeringEquivalence Scheme

Programme Name: -Electronics and Telecommunication

Sr. No.	Course code with Name of course(old) with total 184 credits		Credit	Course code with Name of course(new)with total 164 credits		Credit
1	SHU 302	Engineering Mathematics - III	3	SHU321C	Transform And Statistical Methods	4
2	ETU303	Electronics Devices and Circuits	4	ETU321	Electronic Devices and Circuits	4
3	ETU 401	Signals and Systems	4	ETU322	Signals and Systems	3
4	ETU 304	Digital Electronics	3	ETU323	Digital Electronics	3
5	ETU301	Network analysis	3	ETU324	Network Theory	4
6	SHU 205	General Proficiency I	2	No Equivalence Provided		--
7	No Equivalence Provided		--	SHU323	Introduction to Constitution of India	--
8	ETU307	Electronics Devices and Circuits Lab	1	ETU325	Electronics Devices and Circuits Lab	1
9	ETU 406	Signals and Systems Lab	1	ETU326	Signal and Systems Lab	1
10	ETU 308	Digital Electronics Lab	1	ETU327	Digital Electronics Lab	1
11	ETU302	Component Devices and instrument Technology	4	No Equivalence Provided		---
12	No Equivalence Provided		-	ETU328	Computer Programming Lab	1

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

13	ETU306	Component Devices and instrument Technology Lab	1	No Equivalence Provided		-
14	No Equivalence Provided		-	ETU421	Probability Theory and Stochastic Processes	3
15	ETU 404	Control System Engineering	3	No Equivalence Provided		-
16	No Equivalence Provided		-	ETU422	Analog Communication	3
17	ETU 402	Analog Circuits	4	ETU423	Analog Circuits	3
18	ETU 403	Microprocessor and its Interfacing	3	ETU424	Microprocessors and Microcontrollers	4
19	No Equivalence Provided		-	ETU425	Digital System Design	4
20	ETU 405	Object Oriented Programming Lab	2	No Equivalence Provided		-
21	No Equivalence Provided		-	SHU422	Environmental Studies	-
22	ETU 409	Control System Engineering Lab	1	No Equivalence Provided		-
23	No Equivalence Provided		-	ETU426	Analog Communication Lab.	1
24	ETU 407	Analog Circuits Lab	1	ETU427	Analog Circuits Lab.	1
25	ETU 408	Microprocessor and its Interfacing Lab	1	No Equivalence Provided		-
26	No Equivalence Provided		-	ETU428	Microprocessors and Microcontrollers Lab.	1

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

- All students promoted to third year with some backlog courses shall remain in old scheme (184 Credits) with old curriculum.
- All students who failed in second year (DC Students) shall be transferred to new same scheme (164 Credits) but with new curriculum.
- Important notes for * courses

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

i) All courses of old curriculum shall be offered during the academic year (2020-2021) for back logger students.
ii) In the academic year 2021-22and onward all students shall register for courses as revised curriculum

Equivalence Scheme for online courses

Sr. No.	Course code with Name of course(old/new)		Credit	Course code with Name of course (online)	Name of Online platform	Credit
1.	ETU321	Electronic Devices and Circuits	4	**1.** NPTEL course on **Semiconductor Devices and Circuits** **2.** NPTEL course on **Fundamental of Semiconductor Devices**	NPTEL	
2.	ETU322	Signals and Systems	3	**1.** NPTEL course on **Principles of Signals and Systems** **2.** NPTEL course on **Signals and Systems**	NPTEL	
3.	ETU323	Digital Electronics	3	**1.** NPTEL course on **Digital Circuitsand Systems** **2.** NPTEL course on **Digital Electronic Circuits** **3.** NPTEL course on **Digital Circuits**	NPTEL	
4.	ETU324	Network Theory	4	**1.1** NPTEL course on **Network Analysis** **1.2** NPTEL course on **Networks and Systems** **(These two courses have covered 100**	NPTEL	

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

5.	ETU501	Linear Integrated Circuits and Applications	3	**1.** NPTEL course on **OP-AMP Practical Applications: Design, Simulation and Implementation** **2.** NPTEL course on **Integrated Circuits, MOSFETs, Op-Amps and their Applications** **3.** NPTEL course on **Electronic Modules For Industrial Applications Using Op-Amps**	NPTEL	
6.	ETU502	Analog Communication	3	1. NPTEL course on **Principle of Communication Systems-Part1** 2*. NPTEL course on **Communication Engineering** **3.** NPTEL course on **Analog Communication**	NPTEL	
7.	ETU503	Power Electronics	3	**1.** NPTEL course on **Power Electronics** **2.** NPTEL course on **Advanced Power Electronics and Control** **3.** NPTEL course on **Fundamental of Power Electronics**	NPTEL	
8.	ETU504	Microcontroller and Its Applications	3	1. NPTEL course on **Microprocessors and Microcontrollers**	NPTEL	

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Sr. No.	Course code with Name of course(old/new)		Credit	Course code with Name of course (online)	Name of Online platform	Credit
9.	ETU505	Humanities and Economics	3	Same course contents are not available in NPTEL/NOC but some topics are approx 30% align	NPTEL	
10.	ETU701	Digital System Design	3	**1.** NPTEL course on **Digital Electronic Circuits** **2.** NPTEL course on **Digital Circuits and Systems**	NPTEL	
11.	ETU702	Digital Communications	3	1. NPTEL course on **Principles of Digital Communications** (IITB) **2.** NPTEL course on **Modern Digital Communication Techniques**	NPTEL	
12.	ETU703-I(A)	Fiber Optic Communications	3	**1.** NPTEL course on **Fiber Optic Communication Technology** **2.** NPTEL course on **Fiber Optic Communication Systems and Techniques** **3.** NPTEL course on **Optical Communications**	NPTEL	

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

13.	ETU703-I(B)	Embedded Systems	3	1*. NPTEL course on **Embedded Systems** **2.** NPTEL course on **Embedded System Design** **3.** NPTEL course on **Embedded**	NPTEL	
14.	ETU703-I(D)	Artificial Intelligence	3	1. NPTEL course on **Fuzzy Logic Neural Networks**	NPTEL	
15.	ETU704-II(B)	Industrial Electronics	3	1. NPTEL course on **Power Electronics**	NPTEL	

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

SHU321C TRANSFORM AND STATISTICAL METHODS

Teaching Scheme:03L+01T **Total: 04** **Credit:04**

Evaluation Scheme:30 MSE + 10 TA + 60 ESE **Total marks:100**

ESE duration:2 Hrs 30 min

Course Objectives:

I. To study method solution of partial differential equations and apply it to solve wave and heat equations.
II. To learn Laplace transform and its properties. Apply it to solve differential equation and to calculate stability of LTI system.
III. To equip students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science.

Partial differential equations: (10 hours)

Definition, order, degree, classification, formation of partial differential equation, method of separation of variables, first and second order one dimensional wave equation, heat equation and two dimensional Laplace equation.

Laplace Transform: (10 hours)

Laplace Transform, Properties of Laplace Transform, Laplace transform of causal periodic signals, Analysis and Characterization of LTI systems using the Laplace Transform, The transfer function and differential equation, Impulse response and Step response, Causality, Stability, Stability of a causal LTI system

Random variables and Probability Distributions: (10 hours)

Basic concepts of probability and its properties; Conditional probability and independent events; Random variables, discrete and continuous random variables, Mean and variance of Binomial, Poisson and Normal distributions and applications**.**

Sampling Distributions and Interval of Estimation: (08 hours)

Sampling Distributions: t-distribution, Chi-square distribution, Interval of estimation.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Text books:

1. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers,2020, 44th edition.
2. Advanced Engineering Mathematics, H.K.Das, S.Chand & Company Pvt.Ltd,2014.
3. A text book of Engineering Mathematics,N.P. Bali and Manish Goyal, Laxmi Publications, Reprint, 2010.

Reference books:

1. Advanced Engineering Mathematics,Erwin Kreyszig, 9th Edition, John Wiley & Sons, 2006.
2. Higher Engineering Mathematics, B.V,Ramana,Tata Mc Graw Hill Publishing company Ltd.,New Delhi,2008, 6th edition.
3. A First Course in Probability, S. Ross, 6th Ed., Pearson Education India, 2002.
4. An Introduction to Probability and Statistics,V. K. Rohatgi and A.K. Md. Ehsanes Saleh, 2nd Edition.
5. Applied Statistics and Probability for Engineers, D. C. Montgomery and G.C. Runger, 5th edition, John Wiley & Sons, (2009).
6. Introductory Statistics, P. S. Mann, Wiley Publications, 7th edition (2013).
7. I. N. Sneddon, Elements of Partial Differential Equations, Dover Publications, Inc. Mineola New York.

Course Outcomes:

After the successfully completion of the course the student will able to

SHU321(C).1 To solve partial differential equations and also to solve wave and heatequations.
SHU321(C).2 To use knowledge of Laplace Transform and to solve differential equationand to calculate stability of LTI system.
SHU321(C).3 Tackle problems related to continuous and discrete probabilitydistributions.

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

ELPO/EXTC//INSTRU **(DSY)**

SHU322C INTEGRAL CALCULUS AND PROBABILITY

Teaching Scheme:03L+01T **Total: 04** **Credit:04**

Evaluation Scheme:30 MSE + 10 TA + 60 ESE **Total marks:100**

ESE duration:2 Hrs 30 min

Course Objectives:

I. To study method solution of partial differential equations and apply it to solve wave and heat equations.
II. To learn Laplace transform and its properties. Apply it to solve differential equation and to calculate stability of LTI system.
III. To equip students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science.

Ordinary differential equations of higher orders: (08hours)

Linear differential equation with constant coefficient, complementary function, particular integral, complete solution; method of variation of parameters.

Integral Calculus: (08 hours)

Beta and Gamma functions and their properties; Evaluation of double integrals (Cartesian & polar), change of order of integration.

Partial differential equations: (08 hours)

Definition, order, degree, classification, formation of partial differential equation, method of separation of variables, first and second order one dimensional wave equation, heat equation

Laplace Transform:(08 hours)

Laplace Transform, Properties of Laplace Transform, Laplace transform of causal periodicsignals, Analysis and Characterization of LTI systems using the Laplace Transform, The transfer function and differential equation, Impulse response and Step response,

Random variables and Probability Distributions: (08 hours)

Basic concepts of probability and its properties; Conditional probability and independent events; Random variables, discrete and continuous random variables, Mean and variance of Binomial, Poisson and Normal distributions and applications.

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

Text books:

1. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, 2020, 44th edition.
2. Advanced Engineering Mathematics, H.K.Das, S.Chand & Company Pvt.Ltd, 2014.
3. A text book of Engineering Mathematics, N.P. Bali and Manish Goyal, Laxmi Publications, Reprint, 2010.

Reference books:

1. Advanced Engineering Mathematics,Erwin Kreyszig, 9th Edition, John Wiley & Sons, 2006.
2. Higher Engineering Mathematics, B.V,Ramana,Tata Mc Graw Hill Publishing company Ltd.,New Delhi,2008, 6th edition.
3. A First Course in Probability, S. Ross, 6th Ed., Pearson Education India, 2002.
4. An Introduction to Probability and Statistics,V. K. Rohatgi and A.K. Md. Ehsanes Saleh, 2nd Edition.
5. Applied Statistics and Probability for Engineers , D. C. Montgomery and G.C. Runger, 5th edition, John Wiley & Sons, (2009).
6. Introductory Statistics, P. S. Mann, Wiley Publications, 7th edition (2013).
7. I. N. Sneddon, Elements of Partial Differential Equations, Dover Publications, Inc. Mineola New York.

Course Outcomes:

After the successfully completion of the course the student will able to

SHU322(C).1	To solve partial differential equations and also to solve wave and heat equations.
SHU322(C).2	To use knowledge of Laplace Transform and to solve differential equationand to calculate stability of LTI system.
SHU322(C).3	Tackle problems related to continuous and discrete probability distributions.

Member Secretary (Dr. S.S. Thakare)	Chairman, BoS (Dr. P.R.Deshmukh)	Government College of Engineering Amravati	Principal (Prof. A.M.Mahalle)

ETU 321 ELECTRONIC DEVICES AND CIRCUITS

Teaching Scheme:03L+01T **Total: 04** **Credit:04**

Evaluation Scheme:30 MSE + 10 TA + 60 ESE **Total marks:100**

ESE duration: 2 Hrs 30 min

Course Objectives:

I. To introduce semiconductor devices and their properties.
II. To understand the behavior of semiconductor devices under the application of DC and AC signals.
III. To study MOSFET and BJT amplifier design process
IV. To introduce MOS Technology and related circuits.

Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equation

P-N junction characteristics, I-V characteristics and small signal equivalent circuits of diodes,simple diode circuits: clipping, clamping and rectifiers, Zener diode

Bipolar transistors: Bipolar Junction Transistor, I-V characteristics and Ebers-Moll model; LED, photodiode and solar cell

Field Effect Devices: JFET/HFET, JFET characteristics, MIS structures, concept of accumulation, depletion and inversion, MOSFET operation, I-V characteristics, C-V characteristics, MOS capacitor and small signal models

Amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., low frequency analysis of multistage amplifiers

Text Books:

1. J. Millman, C. Halkias and Satyabrata jit, "Electronic Devices and Circuits," 2nd edition, Tata McGraw Hill, 2008.
2. D. R. Cheruku and B. T. Krushna, "Electronic Devices and Circuits," 2nd edition, Pearson Education, 2008.

Reference Books:

1. G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson,2014.

Member Secretary (Dr. S.S. Thakare) | Chairman, BoS (Dr. P.R.Deshmukh) | Principal (Prof. A.M.Mahalle)

2. N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4th Edition, Pearson Education India, 2011
3. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ.Press, 2011.

Course Outcomes: At the end of this course students will demonstrate the ability toETU

321.1	Understand the principles of semiconductor Physics
ETU 321.2	Be familiar with electronic devices, and their applications to circuits
ETU 321.3	Be able to link knowledge of biasing and other characteristics with circuit operation
ETU 321.4	Realize simple amplifier circuits using BJT and FET.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU 322 SIGNALS AND SYSTEMS

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2 Hrs 30 min

Course Objectives: Students undergoing this course are expected to

I. Know types of signals, their representations for signal processing
II. Know type of systems required for communication and control system.
III. Know Fourier representation and Fourier transform of continuous and discrete time periodic signals
IV. Understand concept of region of convergence(ROC) of Laplace transform and Z-Transform
V. Know the significance of sampling theorem.

Introduction to signals and system: Continuous and discrete time signals, transformation ofsignals, unit impulse and unit step functions. System - continuous & discrete time system, continuous and discrete LTI system, properties of LTI system. Causal LTI system described by differential and difference equation.

Fourier series representation: Fourier Series Representation of Periodic Signal, properties of Continuous and Discrete -Time Fourier Series. Parseval's Relation of Periodic Signal.

Fourier Transform: continuous-time and discrete time Fourier Transform for Periodic Signals, Properties of the Fourier Transform. Discrete time Fourier transform (DTFT),Magnitude and Phase response, properties of DTFT such as convolution, multiplication and duality.

Review of Laplace and Z- transform: Introduction to Laplace and Z-transforms, properties of Laplace and Z-Transform. The Inverse Laplace and Z-Transform, Pole- zero plot, , Analysis and Characterization of LTI Systems, System function algebra and block diagram representation.

Sampling: The sampling theorem, sampling of continuous time signals, digitization and reconstruction of a signal, ideal interpolator, effect of under sampling: aliasing, discrete time processing of continuous time signals.

Text Books:

1. Oppenheim, A.V.,Willsky, A.S. and Nawab, S.H., "Signals & Systems", 2nd1997Ed., Prentice-Hall of India.
2. Haykin, S. and Van Been, B., "Signals and Systems" 2nd 2003Ed., John Wiley & Sons.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Reference books:

1. Roberts, M.J., “Fundamentals of Signals & Systems”, Tata McGraw-Hill.2007
2. Ziemer, R.E., Tranter, W.H. and Fannin, D.R., “Signals and Systems: Continuous and Discrete”, 4th2001Ed., Pearson Educat4.Lath
3. Lathi, B. P., “Linear Systems and Signals”, 2nd2006 Ed., Oxford University press.

Course Outcomes:

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

ETU 322.1	Analyze different types of signals
ETU 322.2	Represent continuous and discrete systems in time and frequencydomain using different transforms.
ETU 322.3	Investigate whether the system is stable
ETU 322.4	Analyze signals in terms of Z and Laplace transform.
ETU 322.5	Sampling and reconstruction of a signal

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU323 DIGITAL ELECTRONICS

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE +10 TA + 60 ESE **Total Marks: 100**

ESE duration:2 Hrs 30 min

Course Objectives:

I. To acquire the basic knowledge of digital logic circuit components which is the back bone for digital computers
II. To implement minimization techniques and Boolean algebra for circuit minimization
III. To understand, analyze and design combinational logic circuits using gates and MSIs
IV. To study various components and design sequential circuits and study semiconductor memories

Number system and codes: Positional number system – Binary, octal, decimal, hexadecimal, general conversions, arithmetic operations on unsigned and signed numbers, 1's, 2's, 9's, 10's complement method, negative number representation, BCD codes, gray codes, ASCII codes, error detection and correction codes. Overview and comparison of various logic families

Boolean algebra and logic circuits: Logic gates – basic, derived and universal gates, theorems and properties of Boolean algebra, DeMorgan's theorem, canonical and standard SOP and POS forms, simplification and synthesis of Boolean functions using gates, Boolean theorems, K-Map ,don't care condition (up to four variables) and Quine McCluskey method (up to 6 variables), Implementation of Boolean expressions using universal gates.

Combinational logic circuit design- adders, subtractors, BCD adder, ripple carry look aheadadders, parity generator, decoders, encoders, multiplexers, demultiplexers, Realization of Boolean expressions- using decoders-and multiplexers.

Sequential circuits – latches, flip flops, edge triggering, asynchronous inputs. Shift registers, Universal shift register, applications. Binary counters – Synchronous and asynchronous up/down counters, mod-N counter, Counters for random sequence.

Semiconductor memories: RAM, ROM, PROM, EPROM, CCD and flash memories. Introduction to PLDs, PLA and FPGA.

Text Books:

1. Digital Design by Morris Mano, Pearson education, 2018
2. Digital Principles And Logic Design By A. Saha N. Manna By Infinity Science Press LLC, 2007

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

Reference Books:

1. T. L. Floyd ”Digital Fundamentals”, 11th ed., Pearson Education, 2018.
2. Wakerly J F, “Digital Design: Principles and Practices, Prentice-Hall”, 5th Ed., 2018.
3. Roth C.H., “Fundamentals of Logic Design”, Jaico Publishers. V Ed., 2009.

Course outcomes

At the end of the course student will be able

ETU323.1 Optimize the digital circuits by applying the applying the Boolean algebraand other minimization techniques

ETU323.2 Examine and design the combinational circuits using gates and MSIs ETU323.3 Realize the sequential circuits suing flip-flops counters and shift registers.ETU323.4 Design and realize the digital logic circuits using SSI and MSIs.

Member Secretary (Dr. S.S. Thakare)	Chairman, BoS (Dr. P.R.Deshmukh)	Government College of Engineering Amravati	Principal (Prof. A.M.Mahalle)

ETU324 NETWORK THEORY

Teaching Scheme: 03L+01T **Total: 04** **Credits: 04**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks:**

100ESE duration: 2.30hrs

Course Objectives:

To make the student able

I. To understand the basics electrical circuits.
II. To apply electrical network theorems and to solve related numerical.
III. To apply Laplace Transform for steady state and transient analysis.
IV. To determine different network functions.

Node and Mesh Analysis: Node and mesh equation, Matrix approach of network containing voltage and current sources, Source transformation and Duality.
Network theorems: Superposition, Reciprocity, Thevenin's, Norton's, Maximum power Transfer, Compensation and Tallegen's theorem as applied to ac circuits.

Steady state response of a network to non-sinusoidal periodic inputs, Introduction to A.C circuits, Power factor, power calculations, Introduction to three phase a.c. circuit and power calculation.

Laplace transforms and properties: Partial fractions, Singularity functions, Waveform synthesis, Analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms, evaluation of initial conditions.

Transient behavior, Concept of complex frequency, driving points and transfer functions, Concept of poles and zeros, their properties, Sinusoidal response from pole-zero locations, Convolution theorem. Behaviors of series and parallel resonant circuits.

Text Books:

1. Network analysis: Van Valkenburg, 3rd edition, Prentice Hall of India, 2000
2. Networks and Systems: D Roy Choudhury, 1st edition, New Age International (P) Limited,1998, reprint 2005

Reference Books:

1. Circuits and Networks: Sudhakar, A., Shyammohan S. P., 3rdedition,Tata McGraw-Hill, New Delhi, 2007
2. Engineering Circuit Analysis: William Hayt, 8th edition, McGraw-Hill Education, 2013

Member Secretary (Dr. S.S. Thakare) | Chairman, BoS (Dr. P.R.Deshmukh) | Principal (Prof. A.M.Mahalle)

Course Outcomes:

After completing this course, students will demonstrate the ability to:

ETU324.1	Understand basics electrical circuits with nodal and mesh analysis.
ETU324.2	Appreciate electrical network theorems.
ETU324.3	Apply Laplace Transform for steady state and transient analysis.
ETU324.4	Determine different network functions.
ETU324.5	Appreciate the frequency domain techniques.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

SHU 323 INTRODUCTIONS TO CONSTITUTION OF INDIA

Teaching Scheme: 1 Th **Credit: 00**

Evaluation scheme: 20TA+30MSE **Total Marks: 50**

Course Objectives:

To acquaint students about constitution of India, Fundamental rights, fundamental duties, electoral process and role of central, state, and local government and its administration.

Course Content

Unit I: Introduction to Constitution of India
Salient features of the Constitution of India, Preamble of the Constitution, fundamental rights and fundamental duties, Directive Principles of State Policy, and relevance of directive principles. Parliamentary Form of Government in India- President, Vice-President, Prime Minister along with council of Minister, Parliament, Supreme court, Electoral process in India. Amendment Procedure.

Unit II: State executives Governor, chief minister, state legislature, high courts of state,

Unit III: Role and functions of local self government- Municipalities in India, with special reference to 73rd amendment. Panchayat Raj in India with special reference to 74th amendment.

Course outcomes:

On the successful completion of this course, Students shall be able to-

1. Understand and remember the knowledge of basic information about Indian Constitution.
2. Apply the knowledge of fundamental rights and fundamental duties.

Reference Books: -

1. An Introduction to Constitution of India, M.V. Pylee, Vikas Publishing, 2002
2. Constitution of India, Dr. B. R. Ambedkar, Government of India Publication
3. Latest Publications of Indian Institute of Human Rights, New Delhi

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

ETU325 ELECTRONICS DEVICES AND CIRCUITS LAB

Teaching Scheme: 02 **Total: 02** **Credits: 01**

Evaluation Scheme: 25Internal + 25 External **Total Marks:50**

Course Objectives:

I. To understand operation of semiconductor devices

II. To understand input, output characteristics and application of semiconductor diodes and transistors

III. To understand the devices in detail to use this devices for various application

IV. To verify the theoretical concepts through circuit simulation package

The instructor may choose experiments as per his/her requirements, so as to coverentire course contents of ETU321. Minimum 8 experiments should be performed.

The list given below is just a guideline.

1. Simple diode circuits: clipping, clamping and rectifiers
2. Zener diode Characteristics and Zener diode as Voltage Regulator
3. Input and output Characteristics of BJT in CE configuration (find h parameters from the characteristics)
4. Single stage BJT CE amplifier (Find performance parameters - Av, Ri and Ro)
5. Comparison of CE, CC, CB configurations for Av, Ri, and Ro
6. Transfer and drain characteristics of JFET. (find gm, rd and μ from characteristics.)
7. Simulate frequency response of single stage BJT CE / FET CS amplifier. (effect of coupling and bypass capacitors)
8. Output and transfer characteristic of n-channel MOSFET
9. Output and transfer characteristic of p-channel MOSFET

Course Outcomes:

ETU325.1 Plot the characteristics of semiconductor diodes and transistors to understand their behavior

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU325.2 Understanding the input and output characteristics and application of thesedevices.

ETU325.3 To study and understand the devices in detail to use this devices for various application.

ETU325.4 Simulate a few of the circuit applications using appropriate Circuit Simulation package.

Note :

- ICA – The Internal Continues Assessment shall be based on practical record and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.

- ESE – The End Semester Exam for practical shall be based on performance in one of the experiments and followed by sample questions.

Member Secretary (Dr. S.S. Thakare)	Chairman, BoS (Dr. P.R.Deshmukh)	Government College of Engineering	Principal (Prof. A.M.Mahalle)

ETU326 SIGNALS AND SYSTEMS LAB

Teaching Scheme: 02P **Credits : 01** **Evaluation Scheme : 25 ICA+25 ESE**
Total Marks: 50 **ESE Duration: 3.00 Hrs**

The term work shall include minimum 10 experiments based on theory syllabus signal and systems as per sample list given below, using MATLAB or equivalent MATHCAD, LAB VIEW etc application software packages.

Course Objectives:

The objectives of this course are to

I. Provide learning practical implementation of the basic principles of signals
II. Acquire knowledge regarding types of system and their properties
III. Verify the concept of DFT, Z- transform and Laplace transform in the laboratory.
IV. Verify the concepts and applications of sampling and aliasing in the laboratory.
V. Provide practical exposure to random variables and processes.

Sample list is given below but any experiment related to signals and systems can be included

List of Experiments

1. To demonstrate generation of various types of signal representation.

2. To explore the effect of transformation of signal parameters (amplitude-scaling, and time shifting).

3. To verify different properties of a given system as linear or non-linear, causal or non-causal, stable or unstable etc.

4. Verification of Parseval's theorem associated with Fourier series analysis for a periodic square wave sampled using appropriate sampling frequency.

5. To study Fourier Transform and inverse Fourier Transform.

6. Verification of Multiplication property associated with Fourier series analysis for a periodic triangular wave sampled using appropriate sampling frequency.

7. Verification of shifting property associated with Fourier series analysis for a periodic square wave sampled using appropriate sampling frequency.

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

8 .To study Laplace transform and inverse Laplace Transform.

9. To study Z transform and inverse Z transform.

10. To study sampling, aliasing of discrete and continuous signals.

Course Outcomes: Student shall be able to

ETU326.1 Remember basic concepts of signals and systems.
ETU326.2 Analyzing signal and systems in time and frequency domain.
ETU326.3 Apply discrete Fourier transformation of signals.
ETU326.4 Understand need and concept of Z transform
ETU326.5 Evaluate energy and power spectral density of random variables andprocesses.

Note :

- ICA – The Internal Continues Assessment shall be based on practical record and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.

- ESE – The End Semester Exam for practical shall be based on performance in one of the experiments and followed by sample questions.

Member Secretary (Dr. S.S. Thakare)	Chairman, BoS (Dr. P.R.Deshmukh)	Government College of Engineering	Principal (Prof. A.M.Mahalle)

ETU327 DIGITAL ELECTRONICS LAB

Teaching Scheme: 02 **Total: 02** **Credits: 01**

Evaluation Scheme: 25Internal + 25 External **Total Marks:50**

Course Objectives:

I. To acquire the hands-on experience of digital component, circuit realization using bread board
II. To realize combinational logic circuits using gates and MSIs
III. To realize sequential circuits using gates and MSIs

The instructor may choose experiments as per his/her choice, so as to cover entire course contents of ETU323. Minimum 8 experiments should be performed.

Following list of laboratory experiments is indicative but not limited to following topics

1. Combinational Logic design using basic gates (Code Converters, Comparators, etc).
2. Combinational Logic design using decoders and MUXs.
3. Arithmetic circuits - Half and full address and subtractors.
4. Arithmetic circuits – design using adder ICs, BCD adder.
5. Flip flop circuit (RS latch, JK & master slave) using basic gates.
6. Asynchronous Counters
7. Synchronous counters, Johnson & Ring counters.
8. Sequential Circuit designs (sequence detector circuit).

Course Outcomes:

ETU327.1 To apply concepts and methods of digital system design techniques introduced in ETU323 through experimentation.

ETU327.2 To design, analyze, synthesize and realize combinational circuits using components and ICs

ETU327.3 To design and realize sequential circuits.

ETU327.4 To write clear and concise lab journal and reports.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Note :

- ICA – The Internal Continues Assessment shall be based on practical record and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.

- ESE – The End Semester Exam for practical shall be based on performance in one of the experiments and followed by sample questions.

Member Secretary (Dr. S.S. Thakare)	Chairman, BoS (Dr. P.R.Deshmukh)		Principal (Prof. A.M.Mahalle)

ETU328 COMPUTER PROGRAMMING LAB

Teaching Scheme: 02 **Total: 02** **Credits: 01**

Evaluation Scheme: 25Internal + 25 External **Total Marks: 50**

Course Objectives:

Students will be able to

I. Comprehend the difference between MATLAB and PYTHON
II. Study MATLAB as a scientific computing language with powerful computational built in functions and dynamic variable arrays with unbounded dimensions
III. Study Python as a Open source and huge community developed high level language with available various packages, useful for current era of big-data, cloud computing, web designing, natural language processing and data analytics
IV. Choose the suitable programming language for solving specific problems.

Lab contents: Minimum eight experiments shall be performed to cover entire curriculum of course out of following representative list.

1. Compare MATLAB and Python Programming Languages on the basis of their key features.
2. Write a MATLAB program for matrix manipulations like addition, substation, multiplication of two matrices, a matrix and a scalar variable.
3. Write a MATLAB program to read images, perform basic operations like changing brightness, adding, subtracting them and writing them. Use the imtool image viewer to perform the same operations on image.
4. Write a MATLAB program to perform logical operations; Create user defined functions to do the same logical operations.
5. Use Signal Generator block of MATLAB Simulink to produce Sine, square, triangle and random signals.
6. Write a Python program for calculating sum, average, mean, mode, median, standard deviation of elements in an array.
7. Write a Python program that will find minimum and maximum numbers in a List, compute average of these two and find the sum of differences of all the elements in the list from this average.
8. Write a Python program used to find all the words (substrings separated by a space) which are greater than given length k in a given String.
9. Write a Python program to find grades of the students. The test grade is an average of the respective marks scored in assignments, tests and lab-works using Dictionaries.
10. Write a Python program to sort the list of tuples by the second item of each tuple.
11. Write a python program to read contents of a file and copy only the content of odd lines into new file.

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

Course Outcomes:

ETU328.1	Understand the concept of MATLAB and PYTHON programming
ETU328.2	Acquire programming skills for MATLAB and PYTHON ETU328.3
	Applying MATLAB for interactive computations
ETU328.4	Develop ability to use PYTHON as a scripting language and write database applications

Note :

- ICA – The Internal Continues Assessment shall be based on practical record and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.
- ESE – The End Semester Exam for practical shall be based on performance in one of the experiments and followed by sample questions.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU421 PROBABILITY THEORY AND STOCHASTIC PROCESSES

Teaching Scheme: 03L+00T **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks:**

100ESE duration:2 Hrs 30 min

Course Objectives:

To make the student able

I. To understand the fundamentals of probability.
II. To understand the concepts of random variables.
III. To understand the concept of sequence and series of random variables.
IV. To understand theorems in random process, stochastic processes and its applications, its spectral representation and its spectrum estimation.
V. To understand Markov chains, Markov processes, Power spectral density and random variable in linear systems.

Set, sample sets, operation with sets, various relation, indicator; Probability theory, experiments, sample spaces and events; Axiom of probability; Assigning probability; Joints and Conditional probability; Bayes theorem; Independence.

Discrete random variables, cumulative distributed function; probability density function; Gaussian random variable and introduction to other important random variables; Conditional distribution and density ; reliability and failure rates;

Expected value of a random variable; expected value of function of a random variable; moments; central moments; conditional expected value; transformations of random variables; characteristic functions; ,probability generating functions; moment generating functions; evaluating tail probabilities, Markov's inequality, Chebyshev's inequality, Chernoff bound.

Random sequences and series; independent and identically distributed random variables; convergence modes of random sequences; law of large numbers; central limit theorem; confidence interval; random sum of random variables.

Random process its definition and classification of processes; mathematical tools for studying random processes; stationary and Ergodic random processes; properties of the autocorrelation function; Gaussian random processes; Poisson processes.

Definition and examples of Markov processes; calculating transition and state probabilities inMarkov chain; characterization of Markov chain; continuous time Markov processes; Definition of power spectral density; Wiener-Khintchine-Einstein theorem; bandwidth of random process; spectral estimation; thermal noise ; introduction to random process in linear system.

Text Books:

1. Henry Stark and John W. Woods, "Probability and Random Processes with Applications

Member Secretary (Dr. S.S. Thakare) | Chairman, BoS (Dr. P.R.Deshmukh) | Principal (Prof. A.M.Mahalle)

to Signal Processing", 3rd edition, 2001, Pearson Education.
2. Athanasios Papoulis and S. Unnikrishna Pillai, "Probability, Random Variables and Stochastic Processes", 4th edition, 2002, McGraw Hill.

Reference Books:

1. Kai Lai Chung and Farid AitSahlia, "Elementary Probability Theory", 4th edition, 2007, Springer.
2. Simon Haykin, "Communication Systems", 4th edition, 2000, John Wiley & Sons.
3. Uwe Hassler, " Stochastic Processes and calculus", 1st edition, 2016, Springer.
4. Achim Klenke, " Probability Theory", 2nd edition, 2014, Springer.

Course Outcomes:

After completing this course, Students shall be able to learn: ETU421.1 Representation of probability and random variables.

ETU421.2 Investigate characteristics of probability, random variables.

ETU421.3 Investigate the random sequence and series.

ETU421.4 Make use of theorems related to random variables, stochastic processes, its applications, its spectral representation and its spectrum estimation.

ETU421.5 Markov chains, Markov processes, Power spectral density and randomvariables in linear system.

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

ETU422 ANALOG COMMUNICATION

Teaching Scheme: 03L + 0T Total: 03 Credits: 03

Evaluation Scheme: 30MSE + 10 TA + 60 ESE Total Marks: 100

ESE duration: 2.30hrs

Course Objective:

The course aims to provide the students with

I. The concepts of analogue communication systems.
II. The various issues related to analogue communication such as modulation, demodulation, transmitters and receivers and noise performance.
III. The techniques for generating and demodulating narrow-band and wide-band frequency and phase modulated signals
IV. Various radio receivers with their parameters.
V. Basic introduction to antennas, their principal of operation also introduce to wave propagation.

Introduction to communication systems: The communication process, Sources of information, Communication networks, communication channels, Electromagnetic frequency spectrum, communication systems, need of modulation and its types, bandwidth requirement.

Noise: Sources of noise and its types signal to noise ratio, noise factor, noise figure, definition of noise figure, calculation of noise figure, noise figure from equivalent noise resistance, noise temperature and noise equivalent temperature.

Amplitude (Linear)Modulation and Demodulation: Amplitude modulation (AM), double side band (DSB), double side band suppressed carrier (DSB-SC), single side band (SSB), vestigial side band modulation (VSB): generation, demodulation; independent side band (ISB) transmission, modulation index, frequency spectrum, power requirement of these systems, super heterodyne radio receiver. Noise in AM receivers using coherent detection and envelop detection. Signal-to-noise ratio (SNR) calculations for amplitude modulation (AM) for low noise conditions

Angle (Exponential) Modulation and Demodulation: Generalized concept and features of angle modulation; Frequency modulation (FM): modulation index, power requirement, frequency spectrum, bandwidth, phasor comparison of narrowband FM and AM waves, generation of FM, demodulation, interference in FM system, pre-emphasis and de-emphasis techniques, FM receiver, noise in FM receiver. Signal-to-noise ratio (SNR) calculations for frequency modulation (FM) for low noise conditions

Phase modulation (PM): modulation index, power requirement, frequency spectrum, bandwidth analysis of narrow band FM, wide band FM and PM, interference in angle modulated system.

Signal-to-noise ratio (SNR) calculations for amplitude modulation (AM) and frequency modulation (FM) for low noise conditions

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

Antenna and Wave propagation:

Antenna: Introduction, Basic Antenna system, Antenna parameters, Yagi Uda antenna, Dishantenna
Wave propagation: Fundamentals of electromagnetic waves, Ground wave propagation, skywave, space wave, tropospheric scatter, Extraterrestrial propagation.
Ionosphere: Structure, layers of Ionosphere, critical frequency, MUF, skip distance andvirtual height.

Text Books:

1. Modern Digital and Analog Communication Systems, B. P. Lathi, 4rd edition, Oxford University press, 2009
2. Electronic communication systems, G. Kennedy and B. Davis, 5th edition, Tata McGraw Hill, 2012.

Reference Books:

1. Communication System, S. Haykin, 5th edition, John Wiley and sons, 2009.
2. Electronic communications, R. Dennis and J. Coolen, 4th edition, Prentice Hall
3. Communication Electronics Principles and Application, "Frenzel", Tata McGraw Hill, 3rd Edition

Course Outcome:

ETU422.1 Interpret the basic concept of communication systems and gain the knowledge of components of analogue communication system.
ETU422.2 Understand the analog modulation transmission and reception and achieve Knowledge in various methods of analog and digital communication, including amplitude Modulation (AM), Frequency Modulation (FM) and Phase Modulation (PM)
ETU422.3 Illustrate how the mathematical concepts bend the analog communication process.
ETU422.4 Analyze the effect of noise on various transmission systems and learn wave propagation.
ETU422.5 Illustrate techniques for antenna parameter measurements.

Member Secretary	Chairman, BoS	Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)	(Prof. A.M.Mahalle)

ETU423 ANALOG CIRCUITS

Teaching Scheme: 03L+00T **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2 Hrs.30Min

Course Objectives:

To make the student able to

I. Study negative feedback and power amplifier circuits
II. Study various Oscillators circuits
III. Develop the skill to build, test, diagnose and rectify the OP-AMP based electronic circuits.
IV. Study various active filters

Feedback Amplifier : Classification of amplifier, concept of feedback, types of feedback (positive and negative feedback), general characteristics of negative feedback amplifier - transfer gain, input resistance and output resistance, negative feedback amplifier - analysis of voltage series, current series, voltage shunt and current shunt negative feedback amplifier

Large Signal Amplifier : High frequency transistor models, frequency response of single stage and multistage amplifiers, cascode amplifier. Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues.

Oscillators : Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators. Multivibrator : astable, bistable and monostable multivibrator.

OPAMP, inverting, non-inverting, differential amplifier configurations, Input offset voltage, input bias and offset current, Thermal drift, CMRR, PSRR.

OP-AMP applications: review of inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications. Active filters: Low pass, high pass, band pass and band stop, design guidelines.

Text Books:

1.Millman's Electronic Devices and Circuits, J. Millman, C. C. Halkias, S. Jit, 3rd edition, McGraw-Hill Education (India) Private Limited, 2010 .

2. Tobey, Graeme ,Huelsman , Operational amplifiers, Design and applications, McGraw Hills, Edition

Reference Books:

Member Secretary (Dr. S.S. Thakare) | Chairman, BoS (Dr. P.R.Deshmukh) | Principal (Prof. A.M.Mahalle)

1. Adel S. Sedra and K. C. Smith, “Microelectronic Circuits,” 6th Ed. Oxford University Press India, 2010

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

2. Electronics Devices and Circuits, S. Salivahanan, N. Sureshkumar, 3rd edition, McGrew Hill Education (India) Private Limited, 2012

3. Ramakant A Gayakwad, "Op-Amps and Linear Integrated Circuits", PHI, 4th edition

4. D.Roy Choudhary, Shail Jain, "Linear Integrated Circuits", New Age Int.

Course Outcomes:

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

ETU423.1 Analyze negative feedback amplifier and power amplifiers

ETU423.2 Understand various oscillator circuits

ETU423.3 Understand the functioning of OP-AMP and design OP-AMP based circuits

ETU423.4 Troubleshoot various linear applications of OP-AMP

ETU423.5 Helps students to know about active filter design

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU424 MICROPROCESSORS AND MICROCONTROLLERS

Teaching Scheme: 03L+01T **Total: 04** **Credits: 04**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100ESE duration: 2Hrs.30Min.**

Course Objectives:

To make the student able

I. To learn the fundamentals of microprocessors and microcontrollers
II. To understand the concepts of Assembly Language Programming
III. To understand the basic hardware interfacing
IV. To develop application based systems using microprocessors and microcontrollers with efficient programming

8-bit Microprocessors: Block diagram and operation of microcomputer system, Introduction to Intel's 8085 Architecture and its description along with functional pin diagram, organization of Memory in microcomputer system. Flag structure, Addressing Modes & Instruction set of 8085.

Assembly Language Programming: Assembly language Programming and timing diagram of instructions; Concept of Interrupts and its structure and programming in 8085 & Interrupt service routines, timer/counter; Serial communication basics in 8085.

Microcontrollers: Introduction to MCS51 family, microprocessor and microcontroller comparison, architecture of 8051, pin configuration and description, register organization, input/output port structure, timer structure and their modes, interrupts and serial port modes, Addressing modes, instruction set, bit and byte level logical operations, programming of serial and parallel ports, timer/counters, and interrupts..

Interfacing with 8051: Interfacing of LED, Seven segment, LCD, ADC, DAC, memory, DC and Stepper motor.

Introduction to Advanced Microcontrollers: ARM and PIC

Text Books:

1. Microprocessor, Architecture, Programming and Applications with 8085, Ramesh S. Gaonkar, 5th edition, Penram International Publication, 2004.
2. The 8051 microcontroller, Kenneth Ayala, 3rd edition, Delmar Cengage Learning, 2005.
3. 8051 Microcontroller and Embedded System, Muhammad Ali Mazidi, 2nd edition, Prentice Hall, 2000

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

Reference books:

1. 0000 to 8085 – Introduction to Microprocessor for Engineers and Scientists, P. R. Sridhar and P. K. Ghosh, 2nd edition, Prentice Hall India Ltd, 2005.
2. Introduction to Microprocessor, Aditya P. Mathur, 3rd edition, Tata McGraw-Hill,2004.
3. Advanced microprocessors and Peripherals, A.K.Ray and K.M.Bhurchandi, 2nd edition, Tata McGraw Hill, 2008
4. Design with PIC microcontrollers, John B. Peatman, 1st edition, PHI, 1998

Course Outcomes:

After completing this course, Students shall be able to:

ETU424.1 Understand Microprocessor and Microcontrollers basics ETU424.2 Develop and implement Assembly language programs ETU424.3 Understand the hardware interfaces required to develop a simple microcomputer system

ETU424.4 Develop simple application based projects.

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

ETU425 DIGITAL SYSTEM DESIGN

Teaching Scheme: 03L+01T **Total: 04** **Credits: 04**

Evaluation Scheme: 30MSE + 10 TA + 60 ESE **Total Marks: 100ESE duration: 2 hrs 30 min.**

Course Objectives:

Student shall be

I. Able to perform the analysis and design of various digital electronic circuits.

II. Able to design and analyze a given combinational and sequential circuit.

II. Able to understand the logic design of programmable devices, including SPLDs, CPLDs and FPGAs.

III. Able to synthesize and simulate with hardware description language (VHDL)

Recapitulation of digital logic and minimization techniques.

Introduction to VHDL, design units, data objects, data types, concurrent and sequential statements.

Subprograms: Function, Procedures, attributes, generic, generate, package, IEEE std logic library, file I/O, test bench, component declaration, instantiation, configuration

Combinational logic circuit design and its VHDL implementation: Multiplexers, De-multiplexer, Encoders, Decoders, Comparators, Code converters, Priority encoders, Parity generator/checker.

Read only memory (ROM), Programmable Logic Array (PLA), Programmable array logic (PAL), Complex Programmable Logic Devices (CPLD) and field programmable gate array (FPGA).

Synchronous Sequential Circuit Design and its VHDL implementation: Design of shift registers and counters, analysis of clocked sequential networks, Finite state machines, Mealy and Moore, derivation of state graph and tables, state assignments.

Asynchronous sequential circuit design – primitive flow table, concept of race, critical race and hazards, design issues like metastability, synchronizers, clock skew and timing considerations. Introduction to place & route process.

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

Text Books:

1. Roth C.H., "Fundamentals of Logic Design", Jaico Publishers. V Ed., 2009.
2. Digital Circuit and Logic Design, S.C. Lee, 3rd edition, Prentice Hall of India Pvt. Ltd, 2002
3. M. M. Mano, "Digital Design", 6th ed., Pearson Education, Delhi, 2018.
4. VHDL: Analysis and Modeling of Digital Systems, Z. Navabi, McGraw Hill International Ed. 1998
5. A VHDL Primer, J. Bhasker, 1st Edition, PTR Prentice Hall, Englewood Cliffs, New Jersey, 1991

Reference Books :

1. Modern Digital Electronics, R. P. Jain , 4th edition, TMH Publication, 2009
2. T. L. Floyd "Digital Fundamentals", 11th ed., Pearson Education, 2018.
3. Wakerly J F, "Digital Design: Principles and Practices, Prentice-Hall", 5th Ed., 2018.
4. D. D. Givone, "Digital Principles and Design", Tata Mc-Graw Hill, New Delhi, 2003.
5. S.Brown and Z.Vranesic, "Fundamentals of Digital Logic with VHDL Design", Tata Mc-Graw Hill, 2013.
6. VHDL – 3rd Edition – Douglas Perry – TMH

Course Outcomes:

At the end of the course student shall be able to

ETU425.1 Design and Analysis of Combinational Logic circuits.

ETU425.2 Design and Analysis of Modular Combinational Logic circuits usingMUX/DEMUX, Encoder/Decoder, PLDS.

ETU425.3 Design and Analysis of Sequential Logic circuits..

ETU425.4 Write a VHDL code to implement a particular design/block.

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

SHU422 ENVIRONMENTAL STUDIES

Teaching Scheme: Th-01 **Credit: 00**

Evaluation scheme: 20TA + 30 MSE **Total Marks: 50**

Course objectives: The objectives of offering this course are to-

I. Be aware of various environmental factors and there preservation.
II. Teach them how to protect Environment and natural resources.
III. How to make equitable use of energy resources.

Course Content

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness.

Social issues and Environment: From Unsustainable to sustainable development, urban problems related to energy, Water conservation, rainwater harvesting, and watershed management Resettlement and rehabilitation of people, problems.
Environmental ethics: Issues and possible solution, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Wasteland reclamation. Consumerism and Waste products, Environment protection act, Air (prevention & control) act, Water (prevention and control) act, Wildlife protection act, Forest conservation act, Issues involved in enforcement of environmental legislation.
Human population and environment: Environment and human health, Human rights, Role of Information Technology in Environment and human health, Public awareness.

Natural Recourses: Conventional energy resources: definition, classification, composition, energy content types: coal, petroleum, natural gases, hydrogeothermal, nuclear, environmental implication of energy uses. Non conventional energy resources: solar energy, wind energy, tidal energy, geothermal energy, hydropowers and biogas.

Ecosystem and Biodiversity: Concept of ecosystem, Structure and function of ecosystem, Producer, consumer, decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of following ecosystem: Forest ecosystem, Grass land ecosystem, Desert ecosystem Aquatic ecosystem (Rivers and ocean).
Introduction- definition: genetics, species and ecosystem, diversity.
Biogeographically classification of India. Conservation of biodiversity- In-situ and Ex-situ conservation of Biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts. Endangered and endemic species of India. Value of biodiversity: consumptive use,

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

productive use, social, ethical, aesthetic and option values. Biodiversity at global, national and local level. India as mega diversity nation. Hot spot of biodiversity.

Environmental Pollution: Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste, Management, Causes effects and control measures, Role of individual in prevention of pollution, Hazardous waste management, Biomedical waste management, Disaster management: floods, earthquake, cyclone and landslides.

Course outcomes: After studying the course, the students will be able to:-

SHU422.1 Convey the Environmental awareness among peoples.

SHU422.2 Apply Conservation of various natural resources and environmental factors.

SHU422.3 Aware about social and environmental issues.

Recommended Books:

1) The Biodiversity of India, Bharucha Erach ,Marin Publishing Pvt. Ltd., Ahmedabad
2) Brunner R.C., 1989,Hazardous Waste Incineration, McGraw Hill Inc.
3) Marine pollution, Clark R.S., Clanderson Press Oxford (TB)
4) Environmental Chemistry, De A.K. Wiley Estern Lmt.
5) Environmental Chemistry, Sharma B.K., 2001 Goel Publ., House, Meerat.
6) Environmental Management, Wagner K.D., 1998, W.B. Saunders Co., Philadel phia, USA
7) Environmental Studies, Benny Joseph, 1st edition,2005,Tata Mcgraw-Hill Publ

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

ETU426 ANALOG COMMUNICATION LAB

Teaching Scheme: 02 **Total: 02** **Credits: 01**

Evaluation Scheme: 25Internal + 25 External **Total Marks: 50**

Course Objective:

I. Familiarize the students with basic analog communication systems.
II. Integrate theory with experiments so that the students appreciate the knowledge gained from the theory course, e.g., amplitude and frequency modulation, pulse modulation.
III. Understand Modulation and demodulation techniques of AM, FM.
IV. Know Characteristics of AM and FM receivers.

Minimum eight experiments shall be performed to cover entire curriculum of courseETU422.
The list is just a guide line.

List

1. To Study Noise Spectral density.
2. AM modulation: Calculation of Modulation Index.
3. FM modulation: Calculation of Modulation Index.
4. Pre-emphasis and De-emphasis.
5. FM Modulation using PLL.
6. Demodulation of AM and FM.
7. Effect of noise on AM and FM
8. Pulse Amplitude Modulation and Demodulation.
9. Generation of double side band suppressed carrier.
10. To study SSB modulation and de-modulation.
11. Observe and plot radiation pattern of Omni-directional and directional antenna.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Course Outcomes:

ETU426.1	To develop practical knowledge about theories of analog communication.
ETU426.2	Evaluate analog modulated waveform in time /frequency domain and also find modulation index.
ETU426.3	Develop understanding about performance of analog communication systems.
ETU426.4	Analyze performance of noise on AM and FM.
ETU426.5	Illustrate techniques for antenna parameter measurements and analyze the performance of radiation pattern.

Note :

- ICA – The Internal Continues Assessment shall be based on practical record and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.

- ESE – The End Semester Exam for practical shall be based on performance in one of the experiments and followed by sample questions.

Member Secretary (Dr. S.S. Thakare)	Chairman, BoS (Dr. P.R.Deshmukh)	Government College of Engineering	Principal (Prof. A.M.Mahalle)

ETU427ANALOG CIRCUITS LAB

Teaching Scheme: 02 **Total: 02** **Credits: 01**

Evaluation Scheme: 25Internal + 25 External **Total Marks:50**

The instructor may choose experiments as per his/her requirements, so as to cover entire course contents of ETU423.Minimum 10 experiments should be performed.

At the end of the laboratory work, students will demonstrate the ability to:

I. Design, build, test and analyze performance of various amplifier circuits.
II. Analyze and design various applications of OP-AMP
III. Simulate a few of the circuit applications using appropriate Circuit Simulation package.

Design Experiments

1. Single stage BJT CE amplifier.
   (Find performance parameters - Av, Ri, Ro & Bandwidth for BJT CE amplifier.)
2. Voltage series feedback amplifier
3. Voltage shunt feedback amplifier
4. Class A power amplifier with resistive load
5. Multivibrator - astable, monostable bistable
6. OP-AMPapplications- Integrator, Differentiators.
7. OP-AMP applications- Schmitt trigger.
8. filter Design.

Simulation Based Experiments

1. Simulate frequency response of single stage BJT CE / FET CS amplifier.

(Effect of coupling and bypass capacitors.)

2. Design and simulate LC and RC oscillators.
   (Compare practical and theoretical oscillation frequency.)
3. Design and simulate active filters

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

Note :

- ICA – The Internal Continues Assessment shall be based on practical record and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.

- ESE – The End Semester Exam for practical shall be based on performance in one of the experiments and followed by sample questions.

Member Secretary (Dr. S.S. Thakare)	Chairman, BoS (Dr. P.R.Deshmukh)		Principal (Prof. A.M.Mahalle)

ETU428 MICROPROCESSORS AND MICROCONTROLLERS LAB

Teaching Scheme: 02P **Total: 02** **Credits: 02**

Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**

ESE duration: 3.00hrs

Course Objectives:

To make student able

I. To learn the instruction set of microprocessor and microcontroller
II. To understand the concept of Assembly Language Programming
III. To understand the interfacing of peripheral devices and their programming
IV. To develop application based programs

Minimum eight experiments shall be performed to cover entire curriculum of courseETU424. The list given below is just a guideline.

List:

1. To write Assembly Language Program (ALP) using 8085 and 8051
2. To develop programs on data transfer operations such as block move, exchange, sorting
3. To implement arithmetic operations (8-bit and 16-bit) like addition, subtraction, multiplication, division, square, cube using look-up tables, multi byte arithmetic operations
4. To implement logical operations such as Boolean & logical instructions bit manipulations.
5. To find largest/smallest element in an array,
6. To arrange the array elements in ascending/descending order using bubble sorting.
7. To understand the concept of Stack and Subroutine.
8. To understand the concept of serial communication.
9. To write delay subroutines using timer/counter.
10. Interfacing of
    a. Relays for controlling operations,
    b. Generation of various types of waveforms using ADC/DAC,
    c. Interfacing basic output devices like LED, LCD, keyboard, 7-segment display, DIP switches, Push button switches
    d. Implementation of stepper and DC motor control.
11. To implement a simple microcontroller based application system like temperature control etc.

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

Course Outcomes:

After completing this course, Students shall be able to:

ETU424.1 Understand Microprocessor and Microcontrollers basics
ETU424.2 Develop Assembly language programs
ETU424.3 Learn the hardware interfaces required to develop a simple microcomputersystem
ETU424.4 Develop simple application based projects

Note :

- ICA – The Internal Continues Assessment shall be based on practical record and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.

- ESE – The End Semester Exam for practical shall be based on performance in one of the experiments and followed by sample questions.

Member Secretary (Dr. S.S. Thakare)	Chairman, BoS (Dr. P.R.Deshmukh)		Principal (Prof. A.M.Mahalle)

ETU331C ANALOG ELECTRONIC CIRCUITS

Teaching Scheme	**: 03 L Total: 03**	**Credit: 03**
Evaluation Scheme	**: 15 CT1 + 15 CT2 +10 TA+ 60 ESE**	**Total Marks: 100**
Duration of ESE	**: 2 Hrs.30 min.**	

Module 1: Diode circuits (4 Hours)

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Module 2: BJT circuits (8 Hours)

Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

Module 3: MOSFET circuits (8 Hours)

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Module 4: Differential, multi-stage and operational amplifiers (8 Hours)

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Module 5: Linear applications of op-amp (8 Hours)

Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift).Analog to Digital Conversion.

Module 6: Nonlinear applications of op-amp (6 Hours)

Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.

Member Secretary (Dr. S.S. Thakare)	Chairman, BoS (Dr. P.R.Deshmukh)	Government College of Engineering	Principal (Prof. A.M.Mahalle)

Text/References:

1. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press,1998.
2. J.V.Wait, L.P. Huelsman and G.A.Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.
4. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
5. P. R. Gray, R. G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits"John Wiley & Sons, 2001.

Course Outcomes:

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

ETU331(C).1	Understand the characteristics of transistors.
ETU331(C).2	Design and analyze various rectifier and amplifier circuits.
ETU331(C).3	Design sinusoidal and non-sinusoidal oscillators.
ETU331(C).4	Understand the functioning of OP-AMP and design OP-AMP based circuits

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU332C ANALOG ELECTRONIC CIRCUITS LAB

Teaching Scheme	**: 02 P**	**Total: 02**	**Credit: 01**
Evaluation Scheme	**: 50 ICA**		**Total Marks: 50**

Minimum eight hands-on experiments related to the course contents of ETU331C Analog Electronic Circuits **shall be performed.**

The representative list of experiment is as follows.

1. To study and compare V-I characteristics of PN- junction diode and Zener diode.
2. To Study of diode as clipper and clamper.
3. To study half wave & full wave rectifier without filter and to calculate its ripple factor
4. To study bridge full wave rectifier without filter and to calculate its ripple factor.
5. To study half wave & full wave rectifier with filter and to calculate its ripple factor
6. To study bridge full wave rectifier with filter and to calculate its ripple factor.
7. To study the input and output characteristics of a given transistor in CE configuration.
8. To Study of CE amplifier- current & power gains and input, output impedances.
9. To study biasing of transistor by following method:

a. Fixed bias. b. Voltage divider bias.

10. To study the frequency response of RC coupled amplifier.
11. Measurement and study of output characteristics of JFET.
12. Measurement and study of output characteristics of MOSFET.
13. To study Hartley oscillator.
14. To study the different types of negative feedback in two stage amplifier and to observe its effects upon the amplifier parameters.
15To study biasing of transistor by following method:

a. Fixed bias. b. Voltage divider bias.

Course Outcomes:

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

ETU332(C).1	Set up a bias point in a transistor.
ETU332(C).2	Verify the working of diodes, transistors and their applications.
ETU332(C).3	Build a common emitter/base/collector amplifier and measure its voltagegain.
ETU332(C).4	Explore the operation and advantages of feedback amplifiers.
ETU332(C).5	Learn to design different types of filters and apply the same to oscillatorsand amplifiers.

ICA - Internal Continuous Assessment shall be based on the practical record and knowledge /skills acquired. The performance shall assess experiment wise by using continuous assessment formats, A and B.

Member Secretary (Dr. S.S. Thakare)	Chairman, BoS (Dr. P.R.Deshmukh)		Principal (Prof. A.M.Mahalle)

ETU431C DIGITAL ELECTRONICS

Teaching Scheme : 03 L Total: 03 **Credit: 03**

Evaluation Scheme : 15 CT1 + 15 CT2 +10 TA+ 60 ESE **Total Marks: 100**

Duration of ESE : 2 Hrs.30 min.

Module 1:Fundamentals of Digital Systems and logic families (7Hours)

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive- OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-statelogic.

Module 2: Combinational Digital Circuits (7Hours)

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, seria ladder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Module 3: Sequential circuits and systems (7Hours)

A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K- TandD-types flipflops, applications of flipflops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

Module 4: A/D and D/A Converters (7Hours)

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs,sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs

Module 5: Semiconductor memories and Programmable logic devices. (7Hours)

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

Text/References:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

Course Outcomes:

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

ETU431(C).1	Understand working of logic families and logic gates.
ETU431(C).2	Design and implement Combinational and Sequential logic circuits.
ETU431(C).3	Understand the process of Analog to Digital conversion and Digital to Analog conversion.
ETU431(C).4	Be able to use PLDs to implement the given logical problem.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU432C DIGITAL ELECTRONICS LAB

Teaching Scheme : 02 P **Total: 02** **Credit: 01**

Evaluation Scheme : 25 ICA + 25 ESE **Total Marks: 50**

Minimum Eight hands-on experiments related to the course contents of ETU 431C Digital Electronics to be performed. Representative list is as follows:

1. To verify truth table of different logic gates.
2. NOR gate as universal gate: Realization of AND/ OR/ NAND/ NOT/ EX-OR gates usingNOR gates only
3. NAND gate as universal gate: Realization of AND/ OR/ NOR / NOT/ EX-OR gates usingNAND gates only
4. Realization of half adder using gates
5. Realization of half subtractor using gates
6. Implementation of full Adder circuit using gates
7. To study Flip-Flops (Realization of RS/ T/ D/ JKMS flip-flops using logic gates)
8. To study counters: Up counter/ down counter/ up-down counter/ decade counter
9. To study shift registers: Left shift/ right shift register
10. To study analog to digital converter
11. To study digital to analog converter

Course Outcomes:

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

ETU432(C).1 Analyze and design simple logic circuits using gates

ETU432(C).2 Construct the circuits for experiments and take readings/ observations

ETU432(C).3 Derive conclusions on the basis of the readings/ observations in context of digital electronics

ETU432(C).4 Explain the working principle of various combinational and sequential logiccircuits

ETU432(C).5 Explain the working principle of ADC and DAC

Note:

ICA - Internal Continuous Assessment shall be based on the practical record and knowledge /skills acquired. The performance shall assess experiment wise by using continuousassessment formats, A and B.

ESE - The End Semester Exam for practical shall be based on performance in one of experiments andmay be followed by sample questions.

Member Secretary Chairman, BoS Principal

GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI

DEPARTMENT OF ELECTRONICS ENGINEERING

Curriculum for Third Year
B. Tech. (Electronics and Telecommunication)

2021-2022

Member Secretary | Chairman, BoS | Principal

Government College Of Engineering, Amravati
Department of Electronics Engineering.
Scheme for B. Tech. (Electronics and Telecommunication)

SEMESTER-V

Category	Course Code	Name of the Course	Teaching Scheme					Evaluation Scheme					Credit
								Theory		Practical		Total	
			Theory Hrs/week	Tutorial Hrs/week	Practical Hrs/week	Total	TA	MSE	ESE	ICA	ESE		
PCC	ETU521	Electromagnetic Waves	3	1	0	4	10	30	60	---	---	100	4
PCC	ETU522	Computer Architecture	3	0	0	3	10	30	60	---	---	100	3
PCC	ETU523	Digital Communication	3	1	0	4	10	30	60	---	---	100	4
PCC	ETU524	Digital Signal Processing	3	1	0	4	10	30	60	---	---	100	4
BSC	SHU523*	Human Values and Ethics	1	0	0	1	20	30	--	---	---	50	--
HSMC	ETU525	Operational Research and Optimization	3	1	0	4	10	30	60	---	---	100	4
PCC	ETU526	Electromagnetic Waves Lab.	0	0	2	2	---	---	---	25	25	50	1
PCC	ETU 527	Computer Architecture Lab.	0	0	2	2	---	---	---	25	25	50	1
PCC	ETU528	Digital Communication Lab.	0	0	2	2	---	---	---	25	25	50	1
PCC	ETU529	Digital Signal Processing Lab.	0	0	2	2	---	---	---	25	25	50	1
	Total		**16**	**4**	**8**	**28**	**70**	**180**	**300**	**100**	**100**	**750**	**23**

TA: Teacher Assessment MSE: Mid Semester Examination ESE: End Semester Examination ICA: Internal Continuous Assessment
ESE Duration for Theory: 2.30Hrs. * ESE Duration for Theory: 1.30Hrs

SEMESTER-VI

Category	Course Code	Name of the Course	Teaching Scheme					Evaluation Scheme					Credit
								Theory		Practical		Total	
			Theory Hrs/week	Tutorial Hrs/week	Practical Hrs/week	Total	TA	MSE	ESE	ICA	ESE		
PCC	ETU621	Control Systems	3	0	0	3	10	30	60	---	---	100	3
PCC	ETU622	Communication Networks	3	0	0	3	10	30	60	---	---	100	3
PEC	ETU623	Program Elective – I	3	0	0	3	10	30	60	---	---	100	3
OEC	ETU624	Open Elective-I	3	0	0	3	10	30	60	---	---	100	3
PEC	ETU625	Program Elective –II	3	0	0	3	10	30	60	---	---	100	3
HSMC	ETU626	Human resource and Economics	3	0	0	3	10	30	60	---	---	100	3
PROJ	ETU627	Minor Project	0	0	4	4	---	---	---	25	25	50	2
PCC	ETU628	Communication Networks Lab.	0	0	2	2	---	---	---	25	25	50	1
PCC	ETU629	Electronic Measurement Lab.	0	0	2	2	---	---	---	25	25	50	1
	Total		**18**	**0**	**8**	**26**	**60**	**180**	**360**	**75**	**75**	**750**	**22**

TA: Teacher Assessment MSE: Mid Semester Examination ESE: End Semester Examination ICA: Internal Continuous Assessment
ESE Duration for Theory: 2.30Hrs.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Department of Electronics Engineering

Equivalence Scheme

Programme Name: -Electronics and Telecommunication

Sr. No.	Course code with Name of course(old) with total 184 credits		Credit	Course code with Name of course(new)with total 122 credits		Credit
1	ETU501	Linear Integrated Circuits	3	No Equivalence Provided		
2	ETU502	Analog Communication	3	No Equivalence Provided		
3	ETU503	Power Electronics	3	No Equivalence Provided		
4	ETU504	Microcontroller and its application	3	No Equivalence Provided		
5	ETU601	Electromagnetic Fields	3	ETU521	Electromagnetic Waves	4
6	No Equivalence Provided			ETU522	Computer Architecture	3
7	ETU702	Digital Communication	4	ETU523	Digital Communication	4
8	ETU604	Digital Signal Processing	3	ETU524	Digital Signal Processing	4
9	ETU505	Humanities and Economics	3	SHU525*	Human Values and Ethics	--

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

10	ETU605	Industrial Management and Operational Research	3	ETU525	Operational Research and Optimization	4
11	ETU506	Linear Integrated Circuits Lab	1	No Equivalence Provided		
12	ETU507	Analog Communication Lab	1	No Equivalence Provided		
13	ETU508	Power Electronics Lab	1	No Equivalence Provided		
14	No Equivalence Provided			ETU526	Electromagnetic Waves Lab.	1
15	ETU509	Microcontroller and Its Applications Lab	1	No Equivalence Provided		
16	No Equivalence Provided			ETU527	Computer Architecture Lab.	1
17	ETU510	Data Structure Lab	2	No Equivalence Provided		
18	ETU706	Digital Communication Lab.	1	ETU528	Digital Communication Lab.	1
19	ETU511	Self Study – I	2	No Equivalence Provided		
20	ETU608	Digital Signal Processing Lab	1	ETU529	Digital Signal Processing	1

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Government College of Engineering Amravati

Principal
(Prof. A.M.Mahalle)

					Lab.	
21	ETU602	Audio Video Engineering	3	No Equivalence Provided		
22	ETU603	Electronics Measurement	3	No Equivalence Provided		
23	No Equivalence Provided			ETU621	Control Systems	3
24	ETU801	Computer Networks and Communications	3	ETU622	Communication Networks	3
25	No Equivalence Provided			ETU623	Program Elective –I A)Information theory & coding	3
26	No Equivalence Provided			ETU623	B) Scientific Computing	3
27	ETU804	B)Electronic Design Techniques	3	ETU623	C) Electronic Design Techniques with HDL	3
28	ETU703	D)Artificial Intelligence	3	ETU623	D) Machine learning	3
29	No Equivalence Provided			ETU633	Open Elective-I A) Consumer Electronics	3
30	ETU704	B) Industrial Electronics	3	ETU633	B) Industrial Electronics	3
31	ETU802	Microwave Engineering	3	ETU625	Program Elective –II	3

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Government College of Engineering Amravati

Principal
(Prof. A.M.Mahalle)

					A) Microwave Engineering	
32	No Equivalence Provided			ETU625	B) Wavelets and other Engineering Transforms	3
33	No Equivalence Provided			ETU625	C) Micro-Electro-Mechanical Systems	3
34	ETU803	D) Fuzzy Logic and Neura Networks	3	ETU625	D) Fuzzy Logic	3
35	No Equivalence Provided			ETU626	Human resource and Economics	3
36	ETU610	Mini Project	2	ETU627	Minor Project	2
37	ETU606	Audio & Video Engineering Lab	1	No Equivalence Provided		
38	ETU805	Computer Networks and Communications Lab.	3	ETU628	Communication Networks Lab.	1
39	ETU607	Electronics Measurement Lab	1	ETU629	Electronic Measurement Lab.	1

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

40	ETU609	Circuit Simulation Lab	2	No Equivalence Provided
41	ETU611	Self Study – II	2	No Equivalence Provided
42	ETU612	Industrial Lecture – I	-	No Equivalence Provided

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU521 ELECTROMAGNETIC WAVES

Teaching Scheme: 03L+01T **Total: 04** **Credits: 04**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
ESE duration: 2.30hrs

Course Objectives:
To make the student able

I. To introduce students with different coordinate systems.
II. To familiarize the students with the different concepts of electrostatic, magneto static and time varying electromagnetic systems.
III. To expose the students to the ideas of electromagnetic waves
IV. To identify, formulate and solve fields and electromagnetic waves propagation problems

Vector Analysis: Review of Scalars and Vectors, Vector Algebra. The Coordinate System: Rectangular, Cylindrical and Spherical. Scalar and Vector Fields, Differential Elements of Length, Surface and Volume.

Electrostatics: Introduction to Coulomb's Law, Electric Field Intensity, Flux Density, Field of Line Charges, Field of Surface Charges, Gauss's Law, Divergence, Divergence Theorem, Maxwell's First Equation, Electric Potential and Potential Gradient.

Magneto statics: Current and Current Density, Continuity Equation, Biot-Savart Law, Ampere's Circuital Law and Applications, Curl, Stokes's Theorem, Magnetic Flux and Flux Density, Scalar and Vector Magnetic Potentials. Maxwell's Equations: Steady Field, Boundary Conditions, Time Varying Fields, Electric and Magnetic Boundary Conditions.

Electromagnetic Waves: Electromagnetic Wave Equation, Wave Propagation in Free Space, in a Perfect Dielectric, and Perfect Conductor, Skin Effect, Poynting Vector and Poynting Theorem, Reflection and Refraction of Uniform Plane Wave at Normal Incidence Plane, Reflection at Oblique Incident Angle.

Waveguides: Introduction, Wave Equation in Cartesian Coordinates, Rectangular Waveguide, Transverse Electric (TE), Transverse Magnetic (TM), Transverse Electromagnetic (TEM) Waves in Rectangular Guides, Wave Impedance, Impedance Discontinuities and Standing Waves, Loses in Wave Guide, Introduction to Circular Waveguide.

Radiation: Retarded Potential, Electric and Magnetic Fields Due to Oscillating Dipole (Alternating Current Element), Power Radiated and Radiation Resistance, Application to Short Monopole and Dipole, Basic Antenna Principles.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Text Books:

1. Engineering Electromagnetic, W. H. Hayt. and J. A. Buck, 7th edition, Tata McGraw Hill, 2006.
2. Electromagnetic Waves and Radiating System, E. C. Jordan and K. C. Balamin, 2nd edition, Prentice Hall of India Private Limited, 1985.
3. Elements of Engineering Electromagnetic, Nannapaneni Narayana Rao, 6th edition, Pearson Education, 2006.

Reference Books:

1. Field and Wave Electromagnetic, David K. Cheng, 2nd Edition, Prentice Hall
2. Electromagnetic, J. D. Krauss, 3rd edition, Mc-Graw Hill, 1984.

Course Outcomes:

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

ETU521.1 Apply the knowledge of Engineering Mathematics to solve the numerical, analyse and evaluate various scalar and vectors quantities of electrostatics, magneto statics.

ETU521.2 Understand the concept of electrostatics, magneto statics behavior and wave propagation.

ETU521.3 Describe, select and apply various laws and theorems to evaluate electrostatics and magneto statics quantities.

ETU521.4 Analyze and evaluate EM wave propagation parameters in different media

ETU521.5 Understand principle of radiation and radiation characteristics of an antenna

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU521.1	3	2	0	0	0	1	1	1	3	2	1	1	1	2	1
ETU521.2	2	3	1	1	1	2	2	0	3	2	2	2	1	2	1
ETU521.3	3	2	1	0	1	0	1	1	3	2	2	2	1	2	1
ETU521.4	3	2	2	1	0	1	1	1	3	2	1	2	2	3	1
ETU521.5	3	3	2	0	1	1	2	1	3	2	2	2	2	3	1

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU522 COMPUTER ARCHITECTURE

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2Hrs.30Min.

Course Objectives:

To make the student able

I. To describe the fundamental architecture and organization of basic computer

II. To understand the structure, function and characteristics of the computer functional units

III. To learn the concept of memory organization

IV. To acquire knowledge of micro programming, pipelining and parallelism

Introduction: Types of computers, functional units, operational concepts, computer components – top level view, bus interconnection structure, performance equation, CISC Vs RISC, types of instructions, instruction sequencing, stack, queues and subroutine.

Arithmetic and Logic Unit: Data representation, computer arithmetic, addition / subtraction logic unit, fast adder design, multiplication, Booth algorithm, division, simple ALU design.

Input/output Organization: Accessing I/O devices, Direct Memory Access, interrupts, buses, multi-level bus architecture, interface circuits – parallel and serial ports, standard I/O interfaces – PCI and USB.

Memory Organization: Internal memory organization, system memory, cache memory, performance considerations of cache, virtual memory, memory management, external memory.

Processing unit: Fundamental concept, instruction execution cycle, hardwired control, micro programmed control.

Pipelining and Parallel processing: Introduction to Pipelining, hazards, data path control considerations, performance considerations. Architecture of 8086 microprocessor, concurrent operation of EU and BIU, introduction to parallelism, on-chip parallelism, case study of Pentium 4 processor.

Text Books:

1. Computer Organization, Carl Hamacher, ZvonkoVrenesic, SafwatZaky, 5th edition, McGraw Hill Education, 2002.
2. Computer Organization and Architecture – Designing for Performance, William Stalling, 7th edition, Prentice Hall, 2009.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Reference books:

1. Structured Computer Organization, Andrew S. Tanenbaum, Todd Austin, 6th edition, Pearson India.
2. Computer Architecture and Organization, John P. Hayes, 3rd edition, McGraw Hill Education, 1998.
3. Computer System Architecture, Morris M. Mano, Peter Abel, 5th edition, Pearson Education Ltd., 2005

Course Outcomes:

After completing this course, Students shall be able to:

ETU522.1 Understand the working of the computer components and analyze the performance

ETU522.2 Illustrate the system memory hierarchy and memory management hardware

ETU522.3 Discuss the pipelining and parallelism in computer system

ETU522.4 Apply the knowledge of combinational and sequential logic circuits to design simple ALU

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU522.1	3	1	1	2	1	1	2	2	2	1	2	2	3	1	0
ETU522.2	2	0	0	1	2	0	2	1	2	1	2	2	3	1	0
ETU522.3	3	0	0	1	2	0	2	1	2	1	3	2	3	1	0
ETU522.4	2	0	0	1	2	1	2	1	2	1	2	2	3	1	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU523 DIGITAL COMMUNICATION

Teaching Scheme: 03L+01T **Total: 04** **Credit: 04**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total marks: 100**

ESE duration: 02 Hrs 30 min.

Course Objectives:

The course aims to provide the students

I. Understanding the key modules of digital communication systems with emphasis on digital modulation techniques.
II. To get introduced to the concept and basics of information theory, source and channel coding/decoding
III. Learn about theoretical bounds on the rates of digital communication system and represent a digital signal using several modulation methods.
IV. Draw signal space diagrams, compute spectra of modulated signals and apply redundancy for reliable communication.

Pulse Modulation Techniques: Sampling theory, uniform and non-uniform quantization in pulse code modulation PCM, μ-law and A-law PCM, DPCM, DM/ADM, bandwidth requirement of PAM, PPM, PWM, PCM, TDM, FDM and CDMA.

Digital Communication System: Introduction, elements of digital communication system, importance of digital system.

Information Theory and Channel Capacity: Measure of information, encoding of the source output, Shannon's encoding algorithm, Huffman encoding algorithm, discrete communication channel and its capacity, Shannon's theorem on channel capacity.

Baseband Data Transmission: Baseband binary PAM system, inter symbol interference, Nyquist's criteria for distortion less baseband binary transmission, correlative coding, duobinary signaling, modified duobinary technique, equalization, eye diagram, synchronization.

Digital Carrier Modulation and Demodulation Schemes: Coherent and noncoherent: binary ASK, PSK, FSK, probability of errors, comparison of digital modulation schemes, basics of DPSK and QPSK, M-ary signaling schemes and synchronization method.

Error Control Coding: Introduction, methods, types, linear block codes, error- detecting and correcting capability, cyclic code, convolutional codes and viterbi decoding algorithm.

Spread Spectrum Techniques: Direct Sequence Spread Spectrum modulation, Frequency-hop Spread Spectrum modulation - Processing gain and jamming margin.

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

Text Books:

1. Digital and Analog Communication Systems, K. S. Shanmugam, 2nd edition, John Wiley and Sons, 1996
2. Digital Communication, S. Haykin, 4th edition, John Wiley and Sons, reprint 2009

Reference Books:

1. Digital Communication, J. K. Proakis, 5nd edition, Mc-Graw Hill Book Co., New York, 2008
2. Principles of Communication Systems, H. Taub, D. L. Schilling, G. Saha, 3rd edition, Mc-Graw Hill Publication Co. Ltd., 2008
3. Digital Communications Fundamentals and Applications, B. Sklar, 2nd edition, Pearson Education, 2006

Course Outcomes:

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

ETU523.1 Understand the principles of digital communications systems.

ETU523.2 Apply the knowledge of signals and system and evaluate the performance of digital communication system in the presence of noise.

ETU523.3 Analyze the performance of advance modulation techniques.

ETU523.4 Explain importance and use of channel coding in digital communication.

ETU523.5 Analyze the performance of spread spectrum communication system.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU523.1	3	1	2	0	1	0	2	1	3	2	2	3	3	2	1
ETU523.2	3	2	2	0	2	1	3	2	2	1	2	3	3	2	1
ETU523.3	2	2	2	1	2	1	2	1	2	1	1	3	3	2	1
ETU523.4	3	1	2	0	1	0	2	1	2	2	2	2	3	2	1
ETU523.5	2	2	2	1	2	1	2	1	2	1	1	3	3	2	1

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU524 DIGITAL SIGNAL PROCESSING

Teaching scheme: 03 L + 01T **Total: 04** **Credit: 04**

Marking scheme: 30 MSE + 10TA + 60 ESE **Total Marks: 100**

Duration of ESE: 2Hrs.30 Min

Course Objectives:

The objectives of offering this course are

I. To make strong foundation of discrete time signals and discrete systems.
II. To strengthen ability of students to analyze discrete time signals and Discrete Time systems.
III. To provide a study, implementation, and applications of DSP algorithms.
IV. To make familiar with design of digital filters and its implementation on DSP processor.
V. To understand working of different processors and apply them in system design.

Discrete Fourier transform: DTFT and DFT relationship and their inverses, Properties, Fast Fourier transform (FFT), Decimation in time and frequency, Computation of the DFT of real sequences, Linear and Circular convolution using DFT.

Implementation of Discrete Time Systems: Structures for FIR systems, Structures for IIR systems, Representation of numbers, Errors resulting from Rounding and Truncation.

Design of Digital Filters: Design of linear-phase FIR filter using windows (rectangular, Blackman, Bartlett, Hamming, etc.), frequency sampling method, pole zero placements, IIR filter design techniques: approximation of derivatives, impulse invariant, Bilinear transformation, Characteristics of commonly used analog filters.

Introduction to Multirate Digital Signal Processing: Decimation and interpolation, sampling rate conversion, applications of multirate signal processing, digital filter banks.

DSP Processors and Applications: Study of DSP chip architecture and its features, comparison with similar digital signal processors.

Text Books:

1. Digital Signal Processing, J. G. Proakis and D. G. Monolakis, 4rth edition, Pearson Education, 2006

2. Digital Signal Processing, A. V. Oppenheim, R. W. Schafer, 3rd edition, McGraw

Hill International, 2006

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Reference Books:

1. Digital Signal Processing, S. K. Mitra, 3rdedition, Tata McGraw Hill, 1998
2. Digital Signal Processing- A practical approach, E. C. Ifeachor, B. W. Jarvis, 2nd edition, Prentice Hall, 2002
3. Digital Signal Processor: Architecture, Programming and Applications, B. Venkatramani and M. Bhaskar, 2nd edition Tata McGraw Hill, 2011
4. Digital Signal Processing, S. Salivahanan and C. Gnanapriya, 2nd edition, Tata McGraw Hill, reprint 2011

Course Outcomes:

On the successful completion of this course; student shall be able

ETU524.1 To represent and analyze discrete systems in time domain.
ETU524.2 To analyze discrete signals and systems in frequency domain using DTFT, DFT.
ETU524.3 To design FIR and IIR filters and realize them in direct form, cascade form and parallel form.
ETU524.4 To implement architecture of DSP processor in various applications.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU524.1	2	1	2	2	3	1	1	1	1	2	2	2	3	3	1
ETU524.2	2	0	2	2	3	0	1	1	1	2	1	2	3	2	0
ETU524.3	2	1	2	2	3	0	1	0	1	2	1	2	3	2	0
ETU524.4	3	1	2	2	3	1	1	2	2	2	2	3	3	3	1

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

SHU525 HUMAN VALUES AND ETHICS

Teaching Scheme: 01Th **Total Credits: 00**

Evaluation Scheme: 20 TA + 50 MSE **Total Marks: 50**

Course Objectives:

I. To develop the importance of moral virtue through spiritual and yoga activities which leads to professional experience of students

II. To understand the dimension of professional ethics.

III. To learn engineering ethics through theories which develop moral judgment among technical students.

IV. To understand the global ethical issues and its dimension this leads to moral leadership

Human Values

Morals, values and Ethics, Integrity, Work ethic, Service learning, Civic virtue, Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Character, Spirituality, Introduction to yoga and meditation for professional excellence and stress management.

Professional Ethics

Definition of Ethics, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Profession, Professionalism, Professional Responsibility, Professional Ethics; Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistle blowing, protected disclosures.

Engineering Ethics

Senses of 'Engineering Ethics', Variety of moral issues, Types of inquiry, Moral dilemmas, Moral Autonomy, Kohlberg's theory, Gilligan's theory, Consensus and Controversy, Models of professional roles, Theories about right action, Self-interest, Customs and Religion, Uses of Ethical Theories

Global Issues

Multinational Corporations, Environmental Ethics, Computer Ethics, Weapons Development, Engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisors, Moral Leadership, Code of Conduct, Corporate Social Responsibility

Member Secretary Chairman, BoS Principal

Text books:

1. “Ethics in Engineering”, Mike W. Martin and Roland Schinzinger, Tata McGraw Hill, New Delhi, 2003.
2. “Engineering Ethics”, Govindarajan M, Natarajan S, Senthil Kumar V. S, Prentice Hall of India, New Delhi, 2004.

Reference books:

1. “Engineering Ethics”, Charles B. Fleddermann, Pearson Prentice Hall, New Jersey,

   2004.

3. “Engineering Ethics – Concepts and Cases”, Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, Cengage Learning, 2009
4. “Ethics and the Conduct of Business”, John R Boatright, Pearson Education, New

   Delhi,2003

5. “Fundametals of Ethics for Scientists and Engineers”, Edmund G Seebauer and Robert L Barry, Oxford University Press, Oxford, 2001
6. “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Laura P. Hartman and Joe Desjardins, Mc Graw Hill education, India Pvt. Ltd.,New Delhi

   2013.

7. "Value Education", World Community Service Centre, Vethathiri publications, Erode, 2011

Course Outcomes:

After the successful completion of the course the student shall be able to

SHU525.1 Make work life balance and found himself or herself with sound mindset at workplace.

SHU525.2 Incorporate professional ethics at work place.

SHU525.3 Manage moral dilemmas and conflicts at workplace.

SHU525.4 Develop global perspective for ethical issues.

CO-PO-PSO Mapping:

Member Secretary (Dr. S.S. Thakare)	Chairman, BoS (Dr. P.R.Deshmukh)	Principal (Prof. A.M.Mahalle)

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU525.1	3	0	0	1	1	2	3	2	3	2	2	3	3	3	3
ETU525.2	3	0	1	1	2	2	3	2	3	3	3	3	3	3	3
ETU525.3	2	1	1	2	1	2	2	2	3	3	2	3	3	3	3
ETU525.4	1	1	1	2	2	2	2	2	3	3	2	3	3	3	3

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU525 OPERATIONAL RESEARCH AND OPTIMIZATION

Teaching Scheme: 03L+01T **Total: 04** **Credit: 04**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

Duration of ESE: 2 Hrs.30 min.

Course Objectives:

The objectives of offering this course are

I. Introduction to operation research and optimization techniques using both linear and non-linear programming.
II. The focus of the course for optimization though various techniques using dynamic programming etc.
III. To design operation research problem in various area of resource minimization,
IV. Students will learn to frame engineering minima maxima problems in the framework of optimization problems

Operation Research (OR) modeling approach (Problem identification, modeling, finding solution, testing etc.), scope and limitations of OR. Introduction to optimization, Statement, Classification of an Optimization Problem with Historical Development and application to Engineering

Linear Programming (LP): Assumption and formulation of LP model, solution by graphical method, simplex and two-phase simplex method, dual simplex method and sensitivity analysis, Transportation problem with IBFS and MODI method.

Non-Linear Programming: Introduction, types, constrained and unconstrained. Optimization method, one variable and multivariable, Indirect Search (Descent) Methods steepest descent, conjugate gradient and Newton's method.

Dynamic Programming: Introduction and characteristics, recursion in dynamic programming, investment problem, production scheduling problem, and stage coach problem, equipment replacement.

Machine Sequencing Problems: n jobs through two machines, n jobs through three machines, n jobs through machines, two jobs through m machines sequencing problem.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Project Management: CPM and PERT, finding critical path, time-cost trade off, resource smoothing and resource leveling

Text Books :

1. Introduction to Operation Research (1st edition), by B. E. Gillet, McGraw-Hill,

2. Introduction to Optimization (3rd edition), by S. S. Rao, Prentice Hall of India

Reference Books :

1. Introduction to Operation Research, by H. A. Taha, Prentice Hall of India.
2. Operation Research (1st edition), by Tiwari and Shandilya, Prentice Hall of India.
3. Computer Aided Project Management (2nd edition), by P. B. Mahapatra Prentice Hall of India
4. Operation Research (8th edition), by Natrajan, Balsubramani, Pearson Education
5. Introduction to Operation Research, Concepts and Cases (8th edition, 2004), by Hillier and Liberman, McGraw-Hill.

Course Outcomes:

By the end of the course, students should be able to

ETU525.1	Cast engineering minima/maxima problems into optimization framework.
ETU525.2	Learn efficient computational procedures to solve constrained and unconstrained optimization
ETU525.3	Solve operation research problems in field of machine sequencing and project development
ETU525.4	Program in Matlab/Python to implement important optimization methods.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU525.1	3	2	1	1	1	0	1	1	1	2	1	3	3	2	1
ETU525.2	3	2	1	1	2	1	1	1	1	1	0	2	2	1	0
ETU525.3	3	2	1	1	2	1	1	0	1	1	0	2	2	2	0
ETU525.4	2	1	1	0	1	0	0	0	0	1	0	1	3	1	1

0-Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU526 ELECTROMAGNETIC WAVES LAB

Teaching Scheme: 02 **Total: 02** **Credits: 01**

Evaluation Scheme: 25 ICA+25 ESE **Total Marks: 50**

Course Objectives:

To make the student able

I. To understand and verify various laws of Electric Field and Magnetic field.
II. To demonstrate or to visualize the propagation of EM waves within the waveguides.
III. To fabricate printed antenna and analyze its performance using Network Analyzer.
IV. To simulate and analyze the antenna using antenna designing software.

Minimum eight experiments shall be performed to achieve course outcomes.

It is a representative list of practical/exercises. The instructor may choose experiments to fulfill the course outcomes.

List of Experiments

1. To study and verify Gauss's law.
2. To study and verify Biot-Savart law.
3. To study and verify Ampere Circuital law.
4. Verify the relationship between wavelength of an EM wave in air and inside a rectangular waveguide.
5. Visualize and study various mode of rectangular waveguide.
6. Measurement of Transmission line parameters.
7. Make any printed antenna using FeCl3 and tape on a substrate and then test it (using a Network Analyzer).
8. Make any antenna using CAD-FEKO software and test it.

Course Outcomes:

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

ETU526.1	Demonstrate various laws of Electric Field and Magnetic field.
ETU526.2	Understand the propagation of EM waves within the waveguides.
ETU526.3	Fabricate printed antenna and analyze its performance using Network Analyzer.
ETU526.4	Design, simulate and analyze the antenna using antenna designing software.

Note:

Member Secretary (Dr. S.S. Thakare)	Chairman, BoS (Dr. P.R.Deshmukh)	Government College of Engineering Amravati	Principal (Prof. A.M.Mahalle)

ICA – The Internal Continuous Assessment shall be based on practical record and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.

ESE – The End Semester Exam for practical shall be based on performance in one of the experiments and followed by sample questions.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU526.1	2	2	2	3	0	2	1	1	2	1	2	2	1	2	0
ETU526.2	2	1	1	2	1	2	1	1	2	2	1	2	1	2	0
ETU526.3	2	1	1	3	0	1	1	1	2	1	1	2	1	2	0
ETU526.4	2	2	3	3	1	2	2	1	2	2	1	2	1	2	0

0-Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU527 COMPUTER ARCHITECTURE LAB

Teaching Scheme: 02P **Total: 02** **Credits: 01**

Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**

Course Objectives:

To make student able

I. To learn the functional units of ALU
II. To understand the design concept arithmetic circuits
III. To understand concept of memory design
IV. To develop ALU for small computer system

Minimum eight experiments shall be performed to achieve course outcomes.

It is a representative list of practical/exercises. The instructor may choose experiments to fulfill the course outcomes.

List of Experiments :

To simulate

1. Ripple carry adder
2. Carry-look-ahead adder
3. Flip-flops
4. Registers and counters
5. Combinational multipliers
6. Booth's multiplier
7. ALU
8. Memory design
9. Associative cache design
10. CPU design

Course Outcomes:

After completing this course, Students shall be able to:

ETU527.1 Learn the different circuits of ALU
ETU527.2 Implement circuits to form processing unit
ETU527.3 Design memory for a computer system
ETU527.4 Simulate small microcomputer system

ICA – The Internal Continuous Assessment shall be based on practical record and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ESE – The End Semester Exam for practical shall be based on performance in one of the experiments and followed by sample questions.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU527.1	3	1	3	2	1	1	2	2	2	1	2	2	3	1	0
ETU527.2	2	0	2	1	2	0	2	1	2	1	2	2	3	1	0
ETU527.3	3	0	3	0	2	0	2	1	2	1	3	2	3	1	0
ETU527.4	2	0	2	1	2	1	2	1	2	1	2	2	3	1	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU528 DIGITAL COMMUNICATION LAB

Teaching Scheme: 02 **Total: 02** **Credits: 01**
Evaluation Scheme: 25Internal + 25 External **Total Marks: 50**

Course Objective:

I. Knowledge in digital communication systems at the practical level and familiarize the students with basic digital communication systems.
II. Integrate theory with experiments so that the students appreciate the knowledge gained from the theory course, e.g., ASK, FSK, PSK…
III. Identify and measure factors which hamper communication systems.
IV. Understand fundamental concepts on TDM, source coding techniques and Error-control coding techniques.
V. Identify and measure factors which hamper communication systems.

Minimum eight experiments shall be performed to achieve course outcomes.

It is a representative list of practical/exercises. The instructor may choose experiments to fulfill the course outcomes.

List of Experiments

1. Verify sampling theorem
2. Verify different pulse modulation techniques
3. Verify time division multiplexing and de-multiplexing
4. Analyze pulse code modulation (PCM) for uniform and non-uniform quantization
5. Measure signal to noise ratio for pulse code modulation (PCM) system with uniform quantization
6. Compare delta modulation and adaptive delta modulation systems
7. Generate phase shift keying and its spectral analysis
8. Spectral analysis of line codes
9. Generation and detection of direct spread spectrum (DS-SS) binary shift keying (BPSK)
10. Simulation of any digital communication system using MATLAB
11. Implementing Convolution Encoder/Decoder using MATLAB.
12. Implementing Viterbi Algorithm using MATLAB.

Course Outcomes:

On completion of this lab course the students shall be able to:

ETU528.1 Able to understand basic theories of digital communication system in practical.
ETU528.2 Able to design and implement different modulation and demodulation techniques.
ETU528.3 Able to analyze digital modulation techniques by using MATLAB tools.
ETU528.4 Able to identify and describe different techniques in modern digital communications, in particular in source coding using MATLAB tools.

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

ETU528.5 Able to demonstrate the error detection and error correction in linear convolution codes.

ICA – The Internal Continuous Assessment shall be based on practical record and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.

ESE – The End Semester Exam for practical shall be based on performance in one of the experiments and followed by sample questions.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU528.1	3	1	2	0	1	0	2	1	3	2	2	3	3	2	1
ETU528.2	3	2	2	0	2	0	3	2	2	1	2	3	3	2	1
ETU528.3	2	2	2	1	2	0	2	1	2	1	1	3	3	2	1
ETU528.4	3	1	2	0	1	0	2	1	2	2	2	2	3	2	1
ETU528.5	2	2	2	1	2	0	2	1	2	1	1	3	3	2	1

0-Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU529 DIGITAL SIGNAL PROCESSING LAB

Teaching Scheme: 02P **Total: 02** **Credit: 01**

Evaluation Scheme: 50 ICA **Total Marks: 50**

Course Objectives:

The objectives of offering this course are

I. To make strong foundation of discrete time signals and discrete systems
II. To strengthen ability of students to analyze discrete time signals and discrete time linear time invariant (DTLTI) systems in time domain and frequency domain
III. To make students familiar with design of digital filters
IV. To strengthen ability of students in digital filters implementation on DSP processor .

Minimum eight experiments shall be performed to achieve course outcomes.

It is a representative list of practical/exercises. The instructor may choose experiments to fulfill the course outcomes.

List of Experiments

1. Prove the Nyquist criteria with the help of Fourier transform. Also suggest the practical sampling rate for undistorted signals using Mentor DSP Software Tool.
2. To study Convolution sum /correlation.
3. To study Discrete Fourier transform and its properties.
4. To design Pole zero plot of a transfer function.
5. To solve the difference equation and find the system response using Z transform (for non-relaxed LTI system).
6. To design FIR filter using window and frequency sampling method.
7. To design IIR filter (Butterworth and Chebyshev Approximation).
8. To study Effect of coefficient quantization on the impulse response of the filter using direct form I and II realization and cascade realization (theory assignment) .
9. To study Interfacing DSP processor.
10. To Verify FIR filter on DSP processor.
11. To verify IIR filter on DSP processor.
12. With the help of Fourier series, to make a square wave from sine and cosine waves. using Mentor DSP Software Tool.
13. To verify different windowing techniques using Mentor DSP Software Tool (Rectangular, Blackman and Hamming) for square wave as an input. Which window will give good results?

Course Outcomes:

On the successful completion of this course; student shall be able to

ETU529.1 Analyze discrete systems in time domain.
ETU529.2 Analyze discrete systems in frequency domain using DFT.
ETU529.3 Design FIR / IIR filters and implement on software platform.
ETU529.4 Implement FIR / IIR filters on digital signal processor.

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

ICA – The Internal Continuous Assessment shall be based on practical record and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.

ESE – The End Semester Exam for practical shall be based on performance in one of the experiments and followed by sample questions.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU529.1	2	1	2	2	3	1	1	1	1	2	2	2	3	3	1
ETU529.2	2	0	2	2	3	0	1	1	1	2	1	2	3	2	0
ETU529.3	2	1	2	2	3	0	1	0	1	2	1	2	3	2	0
ETU529.4	3	1	2	2	3	1	1	2	2	2	2	3	3	3	1

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU 621 CONTROL SYSTEMS

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2 Hrs 30 Min

Course Objectives:

To make student able

I. To learn modeling of a physical system
II. To understand the concept of stability of system
III. To understand the systems in time and frequency domain
IV. To understand the state space modeling and its analysis

Introduction to control problem: Industrial Control examples, Transfer function, System with dead time, System response, Control hardware and their models: potentiometers, synchros, LVDT, dc and ac servomotors, tacho-generators, electro hydraulic valves, hydraulic servomotors, electro pneumatic valves, and pneumatic actuators. Closed-loop systems, Block diagram and signal flow graph analysis.

Feedback control systems: Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness, proportional, integral and derivative systems, Feed-forward and multi-loop control configurations, stability concept, relative stability, Routh stability criterion. Time-response of second order systems, steady-state errors and error constants, Performance specifications in time domain, Root locus method of design, Lead and lag compensation.

Frequency-response analysis: Polar plots, Bode plot, stability in frequency domain, Nyquist plots, Nyquist stability criterion, Performance specifications in frequency-domain, Frequency-domain methods of design, Compensation and their realization in time and frequency domain, Lead and Lag compensation, Op-amp based and digital implementation of compensators, Tuning of process controllers, State variable formulation and solution.

State variable Analysis: Concepts of state, state variable, state model, state models for linear continuous time functions, diagonalization of transfer function, solution of state equations, concept of controllability and observability. Introduction to optimal control and nonlinear control, optimal control problem, regulator problem, output regulator, trekking problem, nonlinear system: Basic concept & analysis.

Text Book:

1. Gopal. M., "Control Systems: Principles and Design", Tata McGraw-Hill, 1997.

Reference Books:

1. Kuo, B.C., "Automatic Control System", Prentice Hall, sixth edition, 1993.
2. Ogata, K., "Modern Control Engineering", Prentice Hall, second edition, 1991.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

3. Nagrath & Gopal, “Modern Control Engineering”, New Age International, New Delhi

Course Outcomes:

ETU621.1 Model a physical system by means of block diagrams, mathematical model and transfer functions
ETU621.2 Investigate stability of a system using different tests
ETU621.3 Analyse the systems in time and frequency domain
ETU621.4 Model and analyse the control systems using state space analysis

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU621.1	3	2	3	2	1	1	0	1	2	2	2	3	3	2	1
ETU621.2	3	2	2	3	1	1	1	0	2	1	2	2	3	2	1
ETU621.3	2	2	2	3	2	1	1	1	2	2	2	2	3	2	1
ETU621.4	2	2	3	3	2	1	0	1	2	2	2	3	3	2	1

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU622 COMMUNICATION NETWORKS

Teaching Scheme	**: 03 L Total: 03**	**Credit: 03**
Evaluation Scheme	**: 30 MSE +10 TA+ 60 ESE**	**Total Marks: 100**
Duration of ESE	**: 2 Hrs.30 min.**	

Course Objectives:

To make student able to

I. Describe the general principles of data communication.
II. Describe how computer networks are organized with the concept of layered approach.
III. Describe how signals are used to transfer data between nodes.
IV. Implement a simple LAN with hubs, bridges and switches.

Introduction to Data Communication and Networking: Uses of Computer Networks, Network Hardware, Network Software Internet Reference Models (OSI and TCP/IP), Switching.

Physical Layer: Basis for Data Communication, Guided Transmission Media, Wireless Transmission Medium

Data Link Layer and its Protocols: Piggybacking, multiple access protocol: channel allocation, random access methods: Additive Links On-line Hawaii (ALOHA), slotted ALOHA, carrier sense multiple access (CSMA), CSMA with collision detection (CSMA/CD), controlled access methods: polling, token bus and token ring

TCP/IP Protocols: Overview of transfer control protocol (TCP) / internet protocol (IP), user datagram protocol (UDP), IP addressing and related issues, IP address resolution techniques, IP datagram and forwarding.

Networking Devices and Routing algorithms: Hubs, repeaters, bridges, routers, gateways, switches, routing algorithms: Distance Vector, Link State, Dijkstra's algorithm.

Applications: X.25, Frame Relay, Asynchronous Transfer Mode (ATM), Integrated Services Digital Network (ISDN)

Text Books:

1. B. A. Forouzan, "Data Communications and Networking", Tata McGraw Hill, 4th Edition
2. J.F. Kurose and K. W. Ross, "Computer Networking – A top down approach featuring the Internet", Pearson Education, 5th Edition

Reference Books:

1. L. Peterson and B. Davie, "Computer Networks – A Systems Approach" Elsevier

Member Secretary (Dr. S.S. Thakare)	Chairman, BoS (Dr. P.R.Deshmukh)	Government College of Engineering Amravati	Principal (Prof. A.M.Mahalle)

Morgan Kaufmann Publisher, 5th Edition.
2. T. Viswanathan, "Telecommunication Switching System and Networks", Prentice Hall
3. Andrew Tanenbaum, "Computer networks", Prentice Hall,4th Edition
4. D. Comer, "Computer Networks and Internet/TCP-IP", Prentice Hall ,3rd Edition
5. William Stallings, "Data and computer communications", Prentice Hall

Course Outcomes:

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

ETU622.1 Describe the components and infrastructure that form the basis for most computer networks

ETU622.2 Describe the technical aspects of data communications on the Internet

ETU622.3 Design the network by using the concepts of layered architecture

ETU622.4 Understand the concepts of networking thoroughly.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU622.1	1	1	3	0	2	1	1	1	2	2	2	3	3	2	1
ETU622.2	1	1	2	0	2	1	1	1	3	2	3	3	3	2	1
ETU622.3	2	1	2	1	2	2	1	1	3	2	3	3	3	2	0
ETU622.4	2	1	3	1	2	1	1	1	3	2	3	3	3	2	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

PROGRAM ELECTIVE-I
ETU623A INFORMATION THEORY AND CODING

Teaching Scheme	**: 03 L Total: 03**	**Credit: 03**
Evaluation Scheme	**: 30 MSE +10 TA+ 60 ESE**	**Total Marks: 100**
Duration of ESE	**: 2 Hrs.30 min.**	

Course Objectives:
To make students able to

I. Define and apply the basic concepts of information theory (entropy, channel capacity etc.)
II. Learn the principles and applications of information theory in communication systems
III. Study various data compression methods and describe the most common such methods
IV. Understand the theoretical framework upon which error-control codes are built

Prerequisite for this course: ETU523 Digital Communication.

Information Theory: Introduction, Uncertainty and Information, Average Mutual Information and Entropy, Information Measures for continuous random variables.

Channel Capacity and Coding: Channel Models, Channel Capacity, Channel Coding, Channel Capacity Using the Noise Matrix, Shannon Capacity, Memory Sources (Markov Sources) ,Finite and Homogeneous Markov Chains.

Source Coding: Types of Codes, Prefix Codes, Source Coding Theorem, Binary Codes Used in Data Transmission, Storage or computing, Coding Efficiency: Compression Ratio, Lossless Compression Algorithms, Run Length Coding (RLC),Dictionary Techniques, Lempel-Ziv Type Algorithms, Arithmetic Coding, Lossy Compression in Differential Coding.

Cryptography Basics, Cryptosystems: Role and Classification, Cryptanalytic Attacks and Algorithms Security, Modern Symmetric (Conventional) Cryptography , Block Ciphers, DES (Data Encryption Standard) , Public Key Cryptography.

Error Control Coding: The Hamming Codes, Burst Error Correcting Codes: Burst Errors, Interleaved Codes, and BCH Codes.

Text Books:

1. R. Bose, Information Theory, Coding and Cryptography, Second Edition, Tata McGraw Hill, Reprint 2012.
2. Monika Borada, Fundamentals in Information theory and coding, Springer, Scientific Publishing Services Pvt. Ltd., Chennai, India.2011.

Reference Books:

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

1. R. Togneri, C.J.S deSilva, Fundamentals of Information Theory and Coding Design, Taylor and Francis.2011
2. T. M. Cover, J. A. Thomas, Elements of Information Theory, Wiley.
3. N. Abramson, Information and Coding, McGraw Hill, 1963.
4. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.
5. R.B. Ash, Information Theory, Prentice Hall, 1970.

Course Outcomes:

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

ETU623A.1 Quantify the notion of information in a mathematically sound way.

ETU623A.2 **C**alculate entropy and channel capacity of a system.

ETU623A.3 Differentiate between lossy and lossless compression techniques.

ETU623A.4 Apply coding techniques.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU623A.1	3	2	2	1	1	2	2	1	2	2	1	2	2	2	1
ETU623A.2	3	2	2	1	2	0	2	2	2	2	2	2	2	1	0
ETU623A.3	2	2	1	0	1	1	2	1	2	2	2	2	2	2	1
ETU623A.4	3	2	2	1	2	1	2	3	3	2	2	3	3	3	2

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU623B SCIENTIFIC COMPUTING

Teaching Scheme	**: 03 L Total: 03**	**Credit: 03**
Evaluation Scheme	**: 30 MSE +10 TA+ 60 ESE**	**Total Marks: 100**
Duration of ESE	**: 2 Hrs.30 min.**	

Course Objectives:
Students will

I. Learn the necessary mathematical concepts of linear and non-linear equation.
II. Understand the scientific techniques of data analysis using Interpolation and Numerical Integration.
III. Comprehend fundamental concepts of scientific programming using suitable computing platform viz. Matlab, Python, R programming etc..
IV. To solve initial and boundary value problems.

System of liner equations: Linear Systems, Solving Linear Systems, Gaussian elimination, Pivoting, Gauss-Jordan, Norms and Condition Numbers, Symmetric Positive Definite Systems and Indefinite System, Iterative Methods for Linear Systems.

Linear least squares: Data Fitting, Linear Least Squares, Normal Equations Method, Orthogonalization Methods, QR factorization, Rank Deficiency, and Column Pivoting.

Nonlinear equations: Fixed Point Iteration, Newton's Method, and Inverse Interpolation Method.
Optimization: One-Dimensional Optimization, Multidimensional Unconstrained Optimization, and Nonlinear Least Squares.

Interpolation: Purpose for Interpolation, Choice of Interpolating, Function, Polynomial Interpolation, Piecewise Polynomial Interpolation.

Numerical Integration and Differentiation: Quadrature Rule, Newton-Cotes Rule, Gaussian Quadrature Rule, Finite Difference Approximation.

Initial Value Problems for ODEs: Euler's Method, Taylor Series Method, Runga-Kutta Method, Extrapolation Methods, Boundary Value Problems For ODEs, Finite Difference Methods, Finite Element Method.

Text Books:
1. Heath Michael T., "Scientific Computing: An Introductory Survey", McGraw-Hill, 2nd Ed., 2002

Reference Books:
1. Press William H., Saul A. Teukolsky, Vetterling William T and Brian P. Flannery, "Numerical Recipes: The Art of Scientific Computing", Cambridge University Press, 3rd Ed., 2007

Member Secretary (Dr. S.S. Thakare)	Chairman, BoS (Dr. P.R.Deshmukh)	Government College of Engineering Amravati	Principal (Prof. A.M.Mahalle)

2. Xin-she Yang (Ed.)., "Introduction To Computational Mathematics", World Scientific Publishing Co., 2nd Ed., 2008
3. Kiryanov D. and Kiryanova E., "Computational Science", Infinity Science Press, 1st Ed., 2006
4. Quarteroni, Alfio, Saleri, Fausto, Gervasio and Paola, "Scientific Computing With MATLAB And Octave", Springer, 3rd Ed., 2010

Course Outcomes:

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

ETU623B.1 Understand the significance of computing methods, their strengths and application areas.
ETU623B.2 Perform the computations on various data using appropriate computation tools.
ETU623B.3 Apply these methods to academic and simple practical instances.
ETU623B.4 Modeling and solving real time application using ODE.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU623B.1	3	2	3	0	2	2	2	1	3	3	2	2	3	3	3
ETU623B.2	3	2	3	3	2	2	2	1	3	3	2	0	3	3	0
ETU623B.3	2	2	3	3	2	3	2	1	0	3	2	2	0	3	3
ETU623B.4	3	2	3	3	2	3	0	1	3	3	2	2	3	3	3

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU 623C ELECTRONIC DESIGN TECHNIQUES WITH HDL

Teaching Scheme: 03L **Total:03** **Credits:03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2 Hrs 30 Min

Course Objectives: Students will

I. To design combinational and sequential circuits using Verilog HDL
II. To understand behavioral and RTL modeling of digital circuits
III. To simulate and synthesize the program on a development board
IV. To make the students exposed to Front end VLSI CAD tools

Introduction to Verilog HDL, Structural, Dataflow and behavioral modeling of combinational and sequential logic circuits.

Hardware modeling with the verilog HDL. Encapsulation, modeling primitives, different types of description.

Logic system, data types and operators for modeling in verilog HDL. Verilog Models of propagation delay and net delay, path delays and simulation, inertial delay effects and pulse rejection.

HDL-based synthesis - technology-independent design, styles for synthesis of combinational and sequential logic, synthesis of finite state machines, synthesis of gated clocks, design partitions and hierarchical structures.

System Verilog- Introduction, Design hierarchy, Data types, Operators and language constructs. Functional coverage, Assertions, Interfaces and test bench structures.

Text Books:

1. S. Palnitkar, "Verilog HDL – A Guide to Digital Design and Synthesis", Pearson, 2003
2. J Bhaskar, "A Verilog HDL Primer", 3 rd Edition, Kluwer, 2005.

Reference books:

1. S.Brown and Z.Vranesic, "Fundamentals of Digital Logic with Verilog Design", Tata Mc-Graw Hill, 2008
2. M.D.Ciletti, "Modeling, Synthesis and Rapid Prototyping with the Verilog HDL", PHI, 1999.
3. S.Sutherland, S. Davidmann, P. Flake, "System Verilog for Design", (2/e), Springer, 2006.

Course Outcomes:

At the end of the course student will be able to

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU623C.1 Simulate the basic concepts of verilog HDL
ETU623C.2 Model digital systems in verilog HDL at different levels of abstraction
ETU623C.3 Analyze the design flow from simulation to synthesizable version
ETU623C.4 Execute the special features of VLSI front end CAD tools.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU623C.1	1	0	2	3	2	1	0	2	2	1	0	3	3	2	2
ETU623C.2	2	0	2	3	2	1	0	2	2	2	1	3	3	2	2
ETU623C.3	1	2	1	3	2	1	1	2	2	2	1	3	3	2	2
ETU623C.4	1	1	1	3	2	1	0	2	2	1	0	3	3	2	2

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU623D MACHINE LEARNING

Teaching Scheme: 03L+00T **Total: 03** **Credits: 03**

Evaluation Scheme: 30MSE + 10TA+ 60ESE **Total Marks: 100**

ESE duration: 2Hrs 30min

Course Objectives:
To make the student able

I. To understand the fundamentals of Supervised and Unsupervised learning.
II. To compare and contrast the concepts of Bayesian Decision Theory and Parametric Methods.
III. To interpret and explain the concept of Multivariate Methods, Dimensionality Reduction, Clustering and Nonparametric Methods.
IV. To illustrate usage of Decision Trees, Linear Discrimination, Multilayer Perceptron's, and Local Models.

Introduction to: Linear Algebra, Linear Algebra and Machine Learning, Examples of Linear Algebra in Machine Learning;
Introduction to Probability axioms, probability distributions, probability moments, Bayes theorem, joint, marginal and conditional probability; Introduction to Machine Learning

Examples of Machine Learning Applications: Learning Associations, Classification, Regression, Unsupervised Learning, Reinforcement Learning, Supervised Learning.

Bayesian Decision Theory: Introduction, Classification, Losses and Risks, Discriminate Function, Association Rules, Parametric Methods: Introduction, Maximum Likelihood Estimation, Evaluating an Estimator: Bias and Variance.

Multivariate Methods: Multivariate Data, Parameter Estimation, Estimation of Missing Values, Multivariate Normal Distribution, Multivariate Classification, Tuning Complexity, Discrete Features, Multivariate Regression, Dimensionality Reduction: Introduction, Subset Selection, Principal Component Analysis.

Clustering: Introduction, Mixture Densities, k-Means Clustering, Expectation-Maximization Algorithm, Mixtures of Latent Variable Models, Supervised Learning after Clustering, Spectral Clustering, Hierarchical Clustering, Choosing the Number of Clusters; Introduction to Nonparametric Methods.

Decision Trees: Introduction, Univariate Trees, Pruning, Rule Extraction for Trees, Learning Rule from Data, Multivariate Trees, Gradient Descent, Logistic Discrimination, Discrimination by Regression, Learning to Rank.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Multilayer Perceptron: Introduction, Training, Learning Boolean Functions, MLP as a Universal Approximator, Back propagation Algorithm; Introduction to Competitive Learning and Radial Basis Functions.

Text Book:

1.Ethem Alpaydin, "Introduction to Machine Learning", 3rdedition, 2014, MIT Press

Reference Book:

1. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning", 1stedition, 2014, CambridgeUniversity Press.
2. Jason Bell, "Machine Learning", 4th edition,2015, John Wiley& Sons.
3. Subramanian Chandramouli, Saikat Dutt and Amit Kumar Das, "Machine Learning", 1st edition,2018, Pearson India Education Services Pvt. Ltd.
4. Kevin P. Murphy, "Machine Learning A Probabilistic Perspective", 1st edition, 2012, MIT Press.
5. Jason Brownlee, "Basics of Linear Algebra for Machine Learning", 1st edition, 2018, Machine Learning Mastery.

Course Outcomes:

After completing this course, Students shall be able:

ETU623D.1 To differentiate between Supervised and Unsupervised learning and able to select model and perform generalization.

ETU623D.2 To investigate and apply Bayesian Decision Theory to calculate the probabilities of classes and different Parametric Methods for estimation of probabilities.

ETU623D.3 To comprehend and apply the concept of Multivariate Methods, Dimensionality Reduction, Clustering and Nonparametric Methods.

ETU623D.4 To implement usage of Decision Trees, Linear Discrimination, Multilayer Perceptron's, and Local Models both for classification and regression.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU623D.1	2	3	2	2	3	1	1	1	0	0	2	2	1	2	1
ETU623D.2	3	3	2	2	3	1	1	1	0	0	2	2	3	2	1
ETU623D.3	3	3	3	2	3	1	1	1	0	0	2	2	3	2	1
ETU623D.4	3	3	2	2	3	1	1	1	0	0	2	3	3	2	1

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

OPEN ELECTIVE - I
ETU633A CONSUMER ELECTRONICS

Teaching Scheme: 03L+00T **Total: 03** **Credit:03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total marks:100**
ESE duration: 02 Hrs 30 min.

Course Objectives:
The course aims to provide the students with

I. Knowledge of audio amplifiers, microphones and speakers.
II. Knowledge of public address system.
III. Television (TV) fundamentals and TV transmitter and receiver.
IV. Identify the need of preventive maintenance in various electronic appliances.
V. To understand working principle of various home appliances.

Audio System: Microphone, loudspeaker, acoustics, mono, stereo, quad, binaural and dichotic, amplifying system, equalizers and mixers synthesizers, theater sound system.

Video Systems and Displays: Video system standards, display devices, smart TV, Direct-To Home (DTH- Set Top Box), video telephone and video conferencing.

Sensors and Actuators: Introduction to IOT sensors and actuators, its software platform and application in IOT systems.

Smart Domestic and Consumer Appliances: Washing machines, microwave ovens, air-conditioners and refrigerators, mobile radio system, solar system, power supplies SMPS/UPS and remote controls, bar codes, RFID. Case studies: Case studies on introduction to evolution in technology of consumer electronics products. For example e- learning initiatives, Mobile phone industry

Product Compliance: Product safety and liability issues; standards related to electrical safety and fire hazards.

Text Books:

1. Consumer Electronics, S. P. Bali 1st edition, Pearson Education, 2005
2. The Electronics Hand Book, J. C. Whitaker, IEEE Press 3. Multimedia Communications, F. Halsal, Pearson Education

Reference Books:

1. Modern Television Practice, R. R. Gulati, 3rd edition New Age International Publishers, 2006
2. Sensors and Actuators, Clarence W. de Silva, 2nd edition, CRC Press, 2015

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

3. Consumer Electronics; J.S. Chitode; Technical Publications, Pune

Course Outcomes:

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

ETU633A.1 Troubleshoot different types of microphones and speakers.
ETU633A.2 Maintain audio systems.
ETU633A.3 Troubleshoot smart TV receivers
ETU633A.4 Maintain various consumer/home electronics appliances
ETU633A.5 Understand product safety, compliance standards and techniques associated with electronic products

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU633A.1	2	1	1	1	2	2	0	1	3	0	2	3	3	3	3
ETU633A.2	1	0	0	1	1	2	2	1	3	1	2	2	1	2	2
ETU633A.3	2	1	1	1	2	2	1	1	3	0	2	3	3	3	3
ETU633A.4	1	0	0	1	1	2	2	1	3	1	2	2	3	2	2
ETU633A.5	2	0	0	1	2	3	2	1	3	2	2	2	2	3	3

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU633B INDUSTRIAL ELECTRONICS

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2Hrs.30Min.

Course Objectives:
To make the student able

a. To learn the switching characteristics of power switching devices
b. To understand the working principle of various converter circuits
c. To acquire basic knowledge of programmable logic controllers
d. To learn the motor speed control methods using choppers

Power switching Devices: SCR, UJT, MOSFET, IGBT, GTO - principle of working, VI characteristics, switching characteristics and applications.

Power supplies: Power supply and its performance parameters**;** Phase controlled converters**,** four quadrant operation**,** regulated power supply**,** SMPS.

Amplifiers and Timers: Differential amplifier, current mirror circuit, linear and non-linear applications of operational amplifiers, IC555: timer, multivibrator and its applications.

Introduction to Inverters, Choppers, dual converter, cyclo converter, and AC to DC converters

Programmable Logic Controller: Introduction, advantages over relay logic, block diagram of PLC, basics of PLC Programming Languages, basic arithmetic and logic operations.
Speed control of industrial motors using choppers.

Text books:

1. Industrial Electronics, Biswanath Paul, Prentice Hall India, 3rd edition, 2014
2. Power Electronics, M.D.Singh, K.B.Khanchandani, 2nd edition (3rd reprint), McGraw Hill Education, 2008
3. Programmable Logic Controllers, Frank D. Petruzela, Tata McGraw Hill, 3rd edition, 2010

Reference books:

1. In Operational Amplifiers and Linear Integrated circuits, Ramakant A. Gaykwad, Prentice Hall, New Delhi, 3rd edition, 2007
2. Programmable Logic Controllers, W. Bolton, Elsevier Ltd., 6th edition, 2015
3. Power Electronics, Converter, Application and Design, N. Mohan, T. M. Undeland and W. P. Robbins, 3rd edition, John Willey and Sons, 2004

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

4. Power Electronics, circuits, Devices and Applications, M. H. Rashid, Pearson, 2002.

Course Outcomes:

After completing this course, students shall be able to:

ETU633B.1 Analyze the performance of power supplies

ETU633B.2 Implement the control circuits using power switching devices for industrial applications

ETU633B.3 Implement timer and control circuits using operational amplifiers

ETU633B.4 Program PLC for basic arithmetic and logical operations

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU633B.1	0	2	1	2	1	2	0	2	2	2	3	3	3	2	2
ETU633B.2	1	2	0	0	2	2	1	2	2	2	2	3	3	3	2
ETU633B.3	1	2	0	0	2	2	1	2	2	2	2	3	3	3	2
ETU633B.4	2	2	0	1	1	2	0	2	2	2	3	3	3	2	2

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

PROGRAM ELECTIVE-II

ETU625A MICROWAVE ENGINEERING

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2.30hrs

Course Objectives:
To make the student able

I. To know about microwave frequency bands.
II. To Analysis the Transmission lines and waveguides at microwave frequencies
III. To understand the behavior of various microwaves tubes.
IV. To analysis and study characteristics of microwave semiconductor devices and passive devices.
V. To learn designing methods for microwave resonators and filters

Introduction to Microwaves: History of Microwaves, Microwave Frequency Bands, Applications of Microwaves.

Transmission Lines and Waveguides: Concept of modes, General solutions for TEM, TE, TM waves, Concept of modes, Rectangular Waveguides, Circular Waveguides, Coaxial Lines, Stripline, Microstrip Line, and Losses associated with Microwave transmission

Microwave Tubes: Limitations of conventional tubes at microwave frequencies. Two Cavity Klystrons, Reflex Klystrons, Helix Travelling Wave Tubes, Magnetron.

Microwave Semiconductor Devices: Microwave BJT, Tunnel Diodes, Gunn diode, Read Diode, IMPATT diode, TRAPATT diode.

Microwave Passive Devices: Attenuator, Phase Changer, Directional Coupler, Hybrid Junctions, Devices employing Faraday rotation: Isolator, Circulator, scattering matrix.

Microwave Resonators and filter: Series and parallel RLC resonators, Transmission line Resonators, Waveguide Resonators. RF filter design: Image Impedance method, Insertion Loss method, Filter Transformation, Filter Implementation.

Text Books:
1. Microwave Engineering, D. M. Pozar, 3rd edition, John Willey and Sons, 2007
2. Microwave Devices and Circuits, S. Y. Liao, 3rd edition, PHI, 2003

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

References Books:

1. Foundations for Microwave Engineering, R.E. Collin, 2nd edition, John Wiley, 2007
2. Microwave Engineering Passive Circuits, P. A. Rizzi, 1st edition, PHI, reprint 2009

Course Outcomes:

After completing this course, students will demonstrate the ability to:

ETU625A.1	Understand and analyze various components of Microwave System.
ETU625A.2	Evaluate the performance parameters of microwave Transmission lines and waveguides
ETU625A.3	Understand structure and working of microwave tubes, various microwave active and passive components.
ETU625A.4	Design and implement resonators and filters at microwave frequencies.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU625A.1	2	2	1	3	2	2	3	1	2	2	3	2	3	2	2
ETU625A.2	3	3	2	3	2	2	1	2	3	2	3	3	3	3	2
ETU625A.3	2	3	2	1	2	2	3	1	2	2	3	2	3	2	2
ETU625A.4	2	3	3	2	2	2	2	3	3	2	3	3	3	3	2

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU625 B WAVELETS AND OTHER ENGINEERING TRANSFORMS

Teaching scheme: 03 L + 0T **Total: 03** **Credit: 03**

Marking scheme: 30 MSE+ 10TA + 60 ESE **Total Marks:100**

Duration of ESE: 2Hrs.30 Min

Course Objective:
To make the student able

I. To motivate students for studying different types of transform.
II. To expose the students to the basics of wavelet theory.
III. To illustrate the use of wavelet transform for image, speech and other processing.
IV. To apply the concept of wavelets to solve practical problems.

Introduction to wavelet: Wavelets and Other Reality Transforms , History of Wavelet from Morlet to Daubechies, Different Communities and families of Wavelets, Vector Space , Functions and Function Spaces.

Continuous Wavelet and Short Time Fourier Transform: Continuous Time-Frequency Representation of Signals, The Windowed Fourier Transform (Short Time Fourier Transform) The Uncertainty Principle and Time Frequency Tiling , Properties of Wavelets Used in Continuous Wavelet Transform , Continuous Versus Discrete Wavelet Transform .

Discrete Wavelet Transform: Introduction, Haar Scaling Functions and Function Spaces, Nested Spaces, Haar Wavelet function, Orthogonality, Normalization of Haar Bases at Different Scales, Support of a Wavelet System, introduction to Daubechies Wavelets.

Orthogonal wavelet systems: Restrictions on Filter Coefficients, Designing Daubechies Orthogonal Wavelet System Coefficients, Design of Coiflet wavelets. Discrete WaveIet Transform and Relation to Filter Banks: signal decomposition (analysis) and reconstruction. Perfect Matching Filters, Computing Initial Coefficients.

Biorthogonal Wavelets: Biorthogonality in Vector Space, Biorthogonal Wavelet Systems, Signal Representation Using Biorthogonal Wavelet System, Biorthogonal Analysis, Biorthogonal Synthesis-From Coarse Scale to Fine Scale , Construction of Biorthogonal Wavelet System.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Designing Wavelets-Frequency Domain Approach: Introduction, Basic, properties of Filter Coefficients, Choice of Wavelet Function Coefficients, Vanishing Moment Conditions in Fourier Domain, Derivation of Daubechies Wavelets.

Text Books

1. K.P.Soman ,K.I.Ramchandran,N.G.Resmi Insight into wavelets,from theory to practice , 3rd edition 2010 , PHI Private Limited,New Dehli.

Reference Books

1. C. Sidney Burrus, Ramesh A. Gopinath, and ,Haitao Guo Introduction to Wavelets and Wavelet Transforms, 2015 by Prentice-Hall, Inc.
2. PatrikJ. Van Fleet University of St. Thomas Discrete Wavelets transformations, An Elementary Approach with Applications ,2007a John Wiley & Sons, Inc., Publication.
3. A.Teolis, Computational Signal Processing with Wavelets, Birkhauser, 1998.
4. J.C. Goswami & A.K. Chan, Fundamentals of Wavelets, John Wiley, 1999.
5. Alexander D.Poularikar ,Transforms and Applications Handbook, Third Edition, CRC Press
6. L.Prasad&S.S.Iyengar, Wavelet Analysis with Applications to Image Processing, CRC Press, 1997.

Course outcomes:

At the end of the course student will be able

ETU625B1 To observe windowed Fourier transform and difference between windowed Fourier transform and wavelet transform.

ETU625B2 To design wavelet basis and characterize continuous and discrete wavelet transform.

ETU625B3 To verify multi resolution analysis and identify various wavelets and evaluate their time frequency resolution properties.

ETU625B4 To implement discrete wavelet transforms with multirate digital filters.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU625B.1	1	0	2	3	2	3	3	2	3	2	1	1	3	2	2
ETU635B.2	2	2	3	3	1	3	2	2	3	2	2	3	3	2	2
ETU625B.3	2	1	2	3	2	2	2	2	2	2	2	3	3	2	2
ETU625B.4	2	2	2	3	2	2	3	2	3	2	3	3	3	2	2

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU625C MICRO-ELECTROMECHANICAL SYSTEMS

Teaching Scheme	**: 03 L Total: 03**	**Credit: 03**
Evaluation Scheme	**: 30 MSE +10 TA+ 60 ESE**	**Total Marks: 100**
Duration of ESE	**: 2 Hrs.30 min.**	

Course Objectives:
Students will be able to

I. Introduce the technology for development of micro electromechanical systems.
II. Learn principles of Microsystems.
III. Exposed to micro system fabrication process and manufacturing.
IV. Trained with MATLAB environment for simulation and modelling of MEMS.

Introduction and Historical Background, Scaling Effects: Need of Miniaturization, Microsystems versus MEMS, Need of Microfabrication, Smart Materials, Structures and Systems, Integrated Microsystems, Applications of Smart Materials and Microsystems.

Micro/Nano Sensors, Actuators and Systems overview: Case studies: Silicon Capacitive Accelerometer, Piezoresistive Pressure Sensor, Conduct metric Gas Sensor, An Electrostatic Comb-Drive, A Magnetic Microrelay, Portable Blood Analyzer, Piezoelectric Inkjet Print Head, Micromirror Array for Video Projection, Smart Materials and Systems.

Review of Basic MEMS fabrication modules: Oxidation, Deposition Techniques, Lithography (LIGA), Etching, Silicon as a Material for Micromachining, Specialized Materials for Microsystems, Advanced Processes for Microfabrication.

Micromachining: Surface Micromachining, sacrificial layer processes, Stiction; Bulk Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding.

Mechanics of solids in MEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending; Energy methods, Overview of Finite Element Method, Modelling of Coupled Electromechanical Systems.

Modelling of Micro-Scale Electromechanical Systems and Devices: Introduction to Modelling, Analysis, and Simulation, Basic Electromagnetics with Applications to MEMS, Model Developments of Micro-actuators Using Electromagnetics, Classical Mechanics and Its Application to MEMS, Simulation of MEMS in the MATLAB Environment with Examples, Induction Micromachines, Synchronous Micromachines, Permanent-Magnet Stepper Micromotors, Piezo-transducers.

Text Books:

Member Secretary (Dr. S.S. Thakare)	Chairman, BoS (Dr. P.R.Deshmukh)	Government College of Engineering Amravati	Principal (Prof. A.M.Mahalle)

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.
2. S. E. Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering, Vol. 8. CRC press, 2005.

Reference Books:

1. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
2. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.
3. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
4. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.

Course Outcomes:

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

ETU625C.1 Review MEMS technology, micro sensors, micro-actuators, their types and applications.
ETU625C.2 Interpret the fabrication process of MEMS.
ETU625C.3 Estimation of forces, displacements and other mechanical concepts is paramount when fabricating MEMS devices.
ETU625C.4 Model and simulate the MEM systems.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU625C.1	1	0	0	3	1	3	3	2	3	2	1	1	3	2	2
ETU635C.2	2	3	3	3	1	3	2	2	3	2	2	3	3	2	2
ETU625C.3	2	1	2	3	2	2	2	2	2	2	2	3	3	2	2
ETU625C.4	2	3	3	3	2	2	3	2	3	2	3	3	3	2	2

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU625D FUZZY LOGIC

Teaching Scheme: 03L+00T **Total: 03** **Credits: 03**
Evaluation Scheme: 30MSE + 10TA+ 60ESE **Total Marks: 100**
ESE duration: 2Hrs 30min

Course Objectives:
To make the students able

I. To understand the fundamentals of classical Relation and Fuzzy Relation their properties, Fuzzification and Defuzzification.
II. To understand the concept of automated Methods and simulation of Fuzzy Systems.
III. To understand the concepts of Bayesian Decision Theory and Fuzzy Classification.
IV. To understand the application of Fuzzy logic and usage of Matlab in implementing Fuzzy Logic.

Fuzzy System: Introduction, imprecision, uncertainty, limitation, fuzzy sets and membership, chance versus fuzziness, sets as a point in hypercube.

Classical Sets and Fuzzy Sets: operations, properties, mapping and alternative operation. Classical Relation and Fuzzy Relation: Cartesian Product, Crisp Relations, Fuzzy Relations, Tolerance and Equivalence Relations, Fuzzy Tolerance and Equivalence Relations, Value Assignments, Other Forms of the Composition Operation.

Properties of Membership Functions, Fuzzification, and Defuzzification: Features of the Membership Function, Various Forms, Fuzzification, Defuzzification to Crisp Sets, λ-Cuts for Fuzzy Relations, Defuzzification to Scalars.

Logic and Fuzzy Systems: Classical Logic, Proof, Fuzzy Logic, Approximate Reasoning, Other Forms of the Implication Operation; Natural Language, Linguistic Hedges, Fuzzy (Rule-Based) Systems, Graphical Techniques of Inference

Development of Membership Functions: Membership Value Assignments (Intuition, Inference, Rank Ordering, Neural Networks, Genetic Algorithms, Inductive Reasoning).

Automated Methods for Fuzzy Systems: Definitions, Batch Least Squares Algorithm, Recursive Least Squares Algorithm, Gradient Method, Clustering Method, etc.; Introduction to Fuzzy Systems Simulation with examples

Decision Making with Fuzzy Information: Decision Making Under Fuzzy States and Fuzzy Actions; Fuzzy Classification: Classification by different methods mostly used.

Applications of Fuzzy Logic: Fuzzy logic application in various areas; Fuzzy Logic Projects with Matlab

Member Secretary	Chairman, BoS	Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)	(Prof. A.M.Mahalle)

Textbook :

1. Timothy J. Ross, "Fuzzy Logic with Engineering Application",3rd edition, 2010, Wiley.
2. S.N. Sivanandam, S. Sumathi and S.N. Deepa, "Introduction to Fuzzy Logic using MATLAB", 1stedition,2007, Springer.

Reference Book :

1. George J. Klir and Bo Yuan,"Fuzzy Sets & Fuzzy Logic",1stIndianedition,2015,Pearson India Education Services Pvt. Ltd.
2. Gaunrong Chen and Trung Tat Pham, "Fuzzy Sets, Fuzzy Logic and Fuzzy Control System",1st edition, 2001,CRC Press.

Course Outcome:

After completing this course, Students shall be able:

ETU625D.1	To differentiate between Classical Relation and Fuzzy Relation.
ETU625D.2	To investigate automated Methods and simulation of Fuzzy Systems.
ETU625D.3	To comprehend the concept of Bayesian Decision Theory and Fuzzy Classification.
ETU625D.4	To identify usage of Fuzzy logic and usage of Matlab in implementing Fuzzy Logic in different applications.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU625D.1	2	3	2	2	3	1	1	1	0	0	2	3	3	2	1
ETU635D.2	2	3	2	2	3	1	1	1	0	0	2	3	3	2	1
ETU625D.3	2	3	2	2	3	1	1	1	0	0	2	3	3	2	1
ETU625D.4	2	3	2	2	3	1	1	1	0	0	2	3	3	2	1

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

ETU626 HUMAN RESOURCE AND ECONOMICS

Teaching Scheme: 03L + 0T **Total: 03** **Credits: 03**

Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**

ESE Duration: 2 Hrs. 30 min.

Course Objectives:

To make the students able

I. Understand principles for balancing social, economic and environmental dimensions of development.
II. To learn to establish link between HRD practice and organizational strategy.
III. To acquaint Microeconomics, Production planning and control in manufacturing and services to take business decisions
IV. To know functioning of banking, its products and Investment science.

Sustainable development: sustainability, Factors, governing determinants, and future of sustainable development

Behavioral science: Importance of science and technology in culture of civilization, Industrial Psychology, consumer behavior, social responsibility of business.

Human needs: Motivation, MASLAW's need hierarchy theory, importance of humanities to engineer, Constitution of India rights and duties

Human Resource Development: HRD-Concept & Goals, Assessing HRD Needs, Meaning and necessity of Benchmarking, Performance Management System.

Organization Development: Organization change and development, manpower planning, man power development, career management.

Economics: Importance, Demand Analysis, elasticity of demand, Laws of supply and Supply analysis, laws of return.

Production: Nature, scope and operations management, planning & Control, factor, Cost, break even analysis, cost benefit analysis of Production

Banking and taxations: Banking System in India, its function and roles in development, type of taxation, GST and other taxes.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Investment Science: Meaning, Objectives and Significance & Mechanism of Investments, Investment Markets and Intermediaries, Money Market, Stock Market,

Globalization: Economics and globalization, foreign collaboration, joint ventures, impact of globalization on small-scale industries.

Text Book:

1. Koontz, H and Wechrich,H., Essentials of Management - An International, Innovation and Leadership Perspective – 11 Edition, Chennai, McGraw Hill Education (India) Pvt. Ltd. 2020.
2. Gordon-Natrajan, Banking Theory, Law and Practice, Himalaya Publishing House

Reference Books:

1. Mujumdar Ramanuj, Consumer Behaviour – Insights from Indian Market, Bew Delhi, PHI Learning Pvt. Ltd., 2010
2. Maheshwari, B L. & Sinha, Dharni P. Management of Change Through HRD. New Delhi, Tata McGraw Hill, 1991.
3. Preeti Singh, Investment Management, Himalaya Publishing House.

Course Outcomes:

After completing this course, student shall be able to:

ETU626.1 Apply the sustainable development principles during the planning and development of various engineering activities.
ETU626.2 Develop the understanding of the concept of human resource management, their needs & relevance in organizations.
ETU626.3 To manage with Economics, production in today's market structures
ETU626.4 To implement taxation system in India along with globalization.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU626.1	3	0	0	1	1	2	3	2	3	2	2	3	3	3	3
ETU626.2	3	0	1	1	2	2	3	2	3	3	3	3	3	3	3
ETU626.3	2	1	1	2	1	2	2	2	3	3	2	3	3	3	3
ETU626.4	1	1	1	2	2	2	2	2	3	3	2	3	3	3	3

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU627 MINOR PROJECT

Teaching Scheme	**: 02P**	**Total: 02**	**Credit: 02**
Evaluation Scheme	**: 25 ICA+25 ESE**		**Total Marks: 50**
Duration of ESE	**: 3 Hrs.**		

Course Objectives:

I. To provide students for knowledge of Electronics Components and soldering techniques and its package information for electronics circuit design.
II. Knowledge for the assembling of electronics circuit with components on PCB (Printed Circuit Board) of circuit design.
III. Design and development of Small electronic project based on hardware and software for electronics systems.

The Minor project is undertaken by single students.

Students are expected to complete work pertaining to following aspects:

1. The selected problem by the student should have at least 20 to 25 components.
2. The Student should understand testing of various components.
3. Soldering of components should be carried out by the student.
4. The Student should develop a necessary PCB for the circuit.
5. The Student should see that final circuit submitted by them is in working condition.
6. The report on this work is to be submitted.
7. Single student can be permitted to work on a single minor project.
8. The minor project must have hardware part. The software part is optional.
9. The Course Coordinator may arrange demonstration with poster presentation of all minor projects developed by the students at the end of semester.

Course Outcomes:

ETU627.1 Students will be able to practice acquired knowledge within the chosen area of technology for project development.
ETU627.2 Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
ETU627.3 Work as an individual with implementation of overall knowledge acquired in a program in development of technical projects.
ETU627.4 Communicate and report effectively project related activities.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ICA – The Internal Continuous Assessment shall be based on practical record and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.

ESE – The End Semester Exam for practical shall be based on performance in one of the experiments and followed by sample questions.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU627.1	3	3	3	3	3	2	3	2	3	3	3	3	3	3	2
ETU627.2	3	3	3	3	3	2	2	2	2	3	3	3	3	3	2
ETU627.3	2	3	2	2	3	2	2	2	3	3	3	3	3	3	2
ETU627.4	2	3	2	1	3	2	2	3	2	3	3	3	3	3	2

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU628 COMMUNICATION NETWORKS LAB

Teaching Scheme	**: 02P**	**Total: 02**	**Credit: 01**
Evaluation Scheme	**: 25 ICA+25 ESE**		**Total Marks: 50**
Duration of ESE	**: 3 Hrs.**		

Course Objectives:
To make students able to

I. Understand the working principle of various communication protocols.
II. Analyze the various routing algorithms.
III. Know the concept of data transfer between nodes.

Minimum eight experiments shall be performed to achieve course outcomes.

It is a representative list of practical/exercises. The instructor may choose experiments to fulfill the course outcomes.

List
1. Build a local area network (LAN) using any one topology
2. Build wireless LAN and troubleshoot the connectivity and file sharing
3. Socket programming for client/server application
4. Set up a dial up connection (wired phones and mobile) for internet access
5. Set up a broad band connection using wired / wireless fidelity (Wi-Fi) modem
6. Build LAN and configure TCP/IP protocol suite
7. Build LAN using sub netted IP address
8. Build LAN using classless inter domain routine (CIDR) and CIDR IP addresses
9. Install dynamic host configuration protocol (DHCP) server in an active directory domain of windows operating system (configure DHCP service and troubleshooting)
10. Write a program for frame sorting technique used in buffer
11. Write a program for implementation of Shortest Path algorithm

Course Outcomes:
After completion of the course, the students will be able to

ETU628.1	Understand fundamental underlying principles of computer networking
ETU628.2	Understand details and functionality of layered network architecture.
ETU628.3	Analyze performance of various communication protocols.
ETU628.4	Compare routing algorithms

Member Secretary (Dr. S.S. Thakare)	Chairman, BoS (Dr. P.R.Deshmukh)	Principal (Prof. A.M.Mahalle)

ICA – The Internal Continuous Assessment shall be based on practical record and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.

ESE – The End Semester Exam for practical shall be based on performance in one of the experiments and followed by sample questions.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU628.1	3	2	3	2	2	1	2	2	2	2	2	3	3	2	2
ETU628.2	2	3	2	2	2	1	1	2	3	2	3	3	3	2	2
ETU628.3	2	3	2	2	2	2	2	2	3	2	3	3	3	2	2
ETU628.4	2	2	3	1	2	1	1	2	3	2	3	3	3	2	2

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU629 ELECTRONIC MEASUREMENTS LAB.

Teaching Scheme: 02 **Total: 02** **Credits: 01**

Evaluation Scheme: 25 Internal + 25 External **Total Marks: 50**

Course Objectives:

To make students able to

I. Design DC and AC bridges
II. Understand dynamic response and the calibration of few instruments
III. Study various measurement devices, their characteristics, operation and limitations
IV. Study statistical data analysis

Minimum eight experiments shall be performed to achieve course outcomes.

It is a representative list of practical/exercises. The instructor may choose experiments to fulfill the course outcomes.

1. Designing DC bridge for Resistance Measurement (Quarter, Half and Full bridge)
2. Designing AC bridge Circuit for capacitance measurement
3. Designing signal Conditioning circuit for Pressure Measurement
4. Designing signal Conditioning circuit for Temperature Measurement
5. Designing signal Conditioning circuit for Torque Measurement
6. Designing signal Conditioning circuit for Strain Measurement
7. Experimental study for the characteristics of ADC and DAC
8. Error compensation study using Numerical analysis using MATLAB (regression)
9. Characterize the temperature sensor (RTD, Thermocouple)
10. Simulate the performance of Biosensor
11. Characterize the strain gauge sensor
12. Characterize of LVDT

Course Outcomes:

ETU629.1 Design and validate DC and AC bridges
ETU629.2 Analyze the dynamic response and the calibration of few instruments
ETU629.3 Classify various measurement devices, their characteristics, operation and limitations
ETU629.4 Analyze statistical data analysis

Member Secretary	Chairman, BoS	Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)	(Prof. A.M.Mahalle)

ICA – The Internal Continuous Assessment shall be based on practical record and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.

ESE – The End Semester Exam for practical shall be based on performance in one of the experiments and followed by sample questions.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU629.1	3	2	3	1	2	3	2	1	3	3	2	2	3	2	2
ETU629.2	3	2	3	3	2	2	2	1	3	3	2	2	3	2	2
ETU629.3	2	2	3	3	2	3	2	1	2	3	2	2	1	2	2
ETU629.4	3	1	3	3	2	3	0	1	3	3	2	2	3	2	2

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ELECTRICAL ENGINEERING DEPARTMENT
ETU631ELECTRONIC DESIGN LABORATORY

Teaching Scheme: 02 **Total: 02** **Credits: 01**

Evaluation Scheme: 25 Internal + 25 External **Total Marks: 50**

Course Objectives:
To make students able

I. To study various measurement devices, their characteristics, operation and limitations

II. To simulate and synthesize the program on a hardware development board

III. To study statistical data analysis

Minimum eight experiments shall be performed to achieve course outcomes.

It is a representative list of practical/exercises. The instructor may choose experiments to fulfill the course outcomes.

1. To study biasing of transistor by following method:
   a. Fixed bias. b. Voltage divider bias.
2. Measurement and study of output characteristics of JFET.
3. Measurement and study of output characteristics of MOSFET
4. Simulate frequency response of single stage BJT CE / FET CS amplifier.
   (Effect of coupling and bypass capacitors.)
5. Design and simulate LC and RC oscillators.
   (Compare practical and theoretical oscillation frequency.)
6. Design and simulate active filters
7. Experimental study for the characteristics of ADC and DAC
8. FPGA implementation of any combinational digital logic design
9. FPGA implementation of any sequential digital logic design
10. Stepper motor control using microcontroller
11. Temperature control using microcontroller
12. Serial communication between microcontroller and PC

Course Outcomes:
After completion of the course, the students will be able to
ETU 631.1 Learn about various measurement devices, their characteristics, operation and limitations

ETU 631.2 Understand the implementation on hardware development board

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

ETU 631.3 Understand statistical data analysis

ICA – The Internal Continuous Assessment shall be based on practical record and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.

ESE – The End Semester Exam for practical shall be based on performance in one of the experiments and followed by sample questions.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU631.1	3	2	3	0	2	2	0	2	3	3	2	2	3	3	2
ETU631.2	3	2	3	1	2	2	1	2	3	3	2	2	3	3	2
ETU631.3	2	1	3	3	2	2	1	1	1	3	2	2	2	3	2
ETU631.4	3	2	3	1	2	2	1	2	3	3	2	2	3	3	2

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI

DEPARTMENT OF ELECTRONICS ENGINEERING

Curriculum for Final Year
B. Tech. (Electronics and Telecommunication)

2022-2023

Member Secretary | Chairman, BoS | Principal

Department of Electronics Engineering.
Scheme for B. Tech. (Electronics and Telecommunication)
SEMESTER-VII

Category	Course Code	Name of the Course	Teaching Scheme					Evaluation Scheme					Credit
								Theory		Practical		Total	
			Theory Hrs/week	Tutorial Hrs/week	Practical Hrs/week	Total	TA	MSE	ESE	ICA	ESE		
PEC	ETU721	Program Elective –III	3	0	0	3	10	30	60	---	---	100	3
PEC	ETU722	Program Elective –IV	3	0	0	3	10	30	60	---	---	100	3
OEC	ETU723	Open Elective-II	3	0	0	3	10	30	60	---	---	100	3
PEC	ETU724	Program Elective –V	3	0	0	3	10	30	60	---	---	100	3
PCC	ETU725	VLSI Design	3	0	0	3	10	30	60	--	--	100	3
PCC	ETU726	Optical Communication	3	0	0	3	10	30	60	---	---	100	3
PROJ	ETU727	Seminar	0	0	2	2	---	---	---	50	---	50	1
	Total		**18**	**0**	**02**	**20**	**60**	**180**	**360**	**50**	**---**	**650**	**19**

TA: Teacher Assessment MSE: Mid Semester Examination ESE: End Semester Examination ICA: Internal Continuous Assessment
ESE Duration for Theory: 2.30Hrs.

SEMESTER-VIII

Category	Course Code	Name of the Course	Teaching Scheme					Evaluation Scheme					Credit
								Theory		Practical		Total	
			Theory Hrs/week	Tutorial Hrs/week	Practical Hrs/week	Total	TA	MSE	ESE	ICA	ESE		
PEC	ETU821	*Program Elective –VI	3	0	0	3	10	30	60	---	---	100	3
PROJ	ETU822	A. Project **OR** **B.** Industry Internship Project	0	0	26	26	--	--	--	200	200	400	13
	Total		**3**	**0**	**26**	**29**	**10**	**30**	**60**	**200**	**200**	**500**	**16**

TA: Teacher Assessment MSE: Mid Semester Examination ESE: End Semester Examination ICA: Internal Continuous Assessment
ESE Duration for Theory: 2.30Hrs.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

***Students not present for regular classes have to complete the said course through online platform MOOCs, if available. If not then, students shall prepare with self-study mode and will appear for ESE only. (Total internal marks (MSE+TA) will be awarded proportional to marks scored in ESE), the department will provide the list of equivalent MOOC courses.**

Elective Courses:

ETU624 Open Elective-I	**ETU723 Open Elective-II**	**ETU623 Program Elective-I**	**ETU625 Program Elective-II**	**ETU721 Program Elective-III**	**ETU722 Program Elective-IV**	**ETU724 Program Elective-V**	**ETU821 Program Elective-VI**
A) Consumer Electronics	A) Mechatronics	A)Information theory & coding	A) Microwave Engineering	A) Antennas & Wave propagation	A) Wireless Communication	A) Satellite Communication	A) Mobile Communication
B) Industrial Electronics	B) Bioengineering	B) Scientific Computing	B) Wavelets and other Engineering Transforms	B) Multirate DSP	B) Adaptive Signal Processing	B) Image and Video processing	B) Speech Processing
		C) Electronic Design Techniques with HDL	C) Micro-Electro-Mechanical Systems	C) CMOS Design	C) Mixed Signal Design	C) Nanotechnology	C) MEMS Technology
		D) Machine learning	D) Fuzzy Logic	D) Artificial Neural Network	D) Soft Computing tools	D) Pattern Recognition	D) Artificial Intelligence

Abbreviations:

BSC Basic Science Courses

ESC Engineering Science Courses

HSMC Humanities and Social Sciences including Management courses

PCC Professional core courses

PEC Professional Elective courses

OEC Open Elective courses

LC Laboratory course

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Government College of Engineering Amravati

Principal
(Prof. A.M.Mahalle)

MC Mandatory courses

SI Summer Industry Internship

PROJ Project

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Department of Electronics Engineering

Change in Course Code and Percentage Change in syllabus

Programme Name: -Electronics and Telecommunication

Sr	Course Code and Name (As per New curriculum)		Credit (New)	Equivalent Course Code and Name (As per Old curriculum)		Credit (Old)	Percentage Change in syllabus
1	ETU721A	Antennas & Wave propagation	3	ETU804	Antenna and Radar	03	50
2	ETU721B	Multirate DSP	3	Newly added		--	--
3	ETU721C	CMOS Design	3	Newly added		--	--
4	ETU721D	Artificial Neural Network	3	ETU703D ETU803D	Artificial Intelligence Fuzzy Logic and Neural Network	03 03	45 50
5	ETU722A	Wireless Communication	3	ETU803A	Wireless Communication	03	25
6	ETU722B	Adaptive Signal Processing	3	Newly added		--	--
7	ETU722C	Mixed Signal Design	3	Newly added		--	--
8	ETU722D	Soft Computing tool	3	Newly added		--	--
9	ETU723A	Mechatronics	3	Newly added		--	--
10	ETU723B	Bioengineering	3	Newly added		--	--
11	ETU724A	Satellite Communication	3	ETU804A	Satellite Communication Systems	03	10
12	ETU724B	Image and Video processing	3	ETU804D	Digital Image Processing	03	25
13	ETU724C	Nanotechnology	3	Newly added		--	--

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

14	ETU724D	Pattern Recognition	3	ETU703D ETU803D	Artificial Intelligence Fuzzy Logic and Neural Network	03 03	15 10
15	ETU725	VLSI Design	3	ETU803B	VLSI Design	03	20
16	ETU726	Optical Communication	3	ETU703A	Fibre Optic Communication	03	20
17	ETU727	Seminar	1	ETU709	Seminar	02	No Change
18	ETU821A	Mobile Communication	3	Newly added		--	--
19	ETU821B	Speech Processing	3	Newly added		--	--
20	ETU821C	MEMS Technology	3	Newly added		--	--
21	ETU821D	Artificial Intelligence	3	ETU703D	Artificial Intelligence	03	40
22	ETU822	A. Project **OR** **B.** Industry Internship Project	13	ETU808	Project	06	No Change

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Department of Electronics Engineering

Equivalence Scheme

Programme Name: -Electronics and Telecommunication

Sr. No.	Course code with Name of course (old)		Credit	Course code with Name of course (new)		Credit
1	ETU701	Digital System Design	03	ETU425	Digital System Design	04
2	ETU702	Digital Communication	03	ETU523	Digital Communication	04
3	ETU703A	Fibre optic communication	03	ETU726	Optical Communication	03
4	ETU703B	Embedded system	03	No Equivalence Provided		--
5	ETU703C	System Software	03	No Equivalence Provided		--
6	ETU703D	Artificial Intelligence	03	ETU821D	Artificial Intelligence	03
7	ETU703E	Biomedical Engineering	03	No Equivalence Provided		--
8	ETU704A	Electronics Instruments and Applications	03	No Equivalence Provided		--
9	ETU704B	Industrial Electronics	03	ETU624B	Industrial Electronics	03
10	ETU705	Digital System Design Lab	01	No Equivalence Provided		--
11	ETU706	Digital Communication Lab	01	ETU528	Digital Communication Lab	01
12	ETU707A	Fiber optic communication Lab	01	No Equivalence Provided		--
13	ETU707B	Embedded system Lab	01			
14	ETU707C	System Software Lab	01			
15	ETU707D	Artificial Intelligence Lab	01			
16	ETU707E	Biomedical Engineering Lab	01			
17	ETU708	Project Phase-I	02	ETU822	A. Project **OR** **B.** Industry Internship Project	13
18	ETU709	Seminar	02	ETU727	Seminar	01
19	ETU710	Industrial Training and Visit	01	No Equivalence provided		--

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

20	ETU711	Industrial Lecture	01	No Equivalence provided		--
21	ETU712	Self Study III	02	No Equivalence provided		--
22	ETU801	Computer Network and Communication	03	ETU622	Communication Networks	03
23	ETU802	Microwave Engineering	03	ETU625A	Microwave Engineering	03
24	ETU803A	Wireless Communication	03	ETU722A	Wireless Communication	03
25	ETU803B	VLSI Design	03	ETU725	VLSI Design	03
26	ETU803C	Open Source Operating System	03	No Equivalence Provided		--
27	ETU803D	Fuzzy logic and Neural Network	03	ETU724D	Pattern Recognition	03
28	ETU803E	Bio Informatics	03	No Equivalence Provided		--
29	ETU804A	Satellite Communications systems	03	ETU724A	Satellite Communication	03
30	ETU804B	Modern Electronics Design Technique	03	No Equivalence Provided		--
31	ETU804C	Antenna and Radar	03	ETU721A	Antennas & Wave propagation	03
32	ETU804D	Digital Image Processing	03	ETU724B	Image and Video processing	03
33	ETU804E	Industrial Automation	03	No Equivalence Provided		--
34	ETU805	Computer Network and Communication Lab	01	ETU628	Communication Networks Lab.	03
35	ETU806	Microwave Engineering Lab	01	No Equivalence Provided		--
36	ETU807	Elective-II and Elective-III Lab	01	No Equivalence Provided		--
37	ETU808	Project	06	ETU822	A. Project **OR** **B.** Industry Internship Project	13
38	ETU809	Self Study-IV	02	No Equivalence Provided		--

- All students promoted to Final year with some backlog courses shall remain in old scheme (184 Credits) with old curriculum.
- All students who failed in second year (DC Students) shall be transferred to new same scheme (164 Credits) but with new curriculum.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU721 – PROGRAM ELECTIVE – III

ETU721 (A) ANTENNAS AND WAVE PROPAGATION

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2.30hrs

Course Objectives:

Students should be able to

I. Understand the fundamental terms related to antenna.
II. Familiarize with the working principles of various types of antenna
III. Apply knowledge of antenna for wave propagation.

Fundamental Concepts: Physical concept of radiation, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.

Radiation from Wires and Loops: Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.

Aperture and Reflector Antennas: Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas.

Broadband Antennas: Log-periodic and Yagi-Uda antennas, frequency independent antennas, broadcast antennas.

Micro strip Antennas: Basic characteristics of micro strip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

Antenna Arrays: Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays, synthesis of antenna arrays using Schelkunoff polynomial method, Woodward-Lawson method.

Basic Concepts of Smart Antennas: Concept and benefits of smart antennas, fixed weight beam forming basics, Adaptive beam forming.

Different modes of Radio Wave propagation used in current practice.

Text Books:

1. Antennas, . J. D. Kraus, McGraw Hill, 1988.

2. Antenna Theory - Analysis and Design, C. A. Balanis, John Wiley, 1982.

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Reference Books:

1. Antennas and Radio Wave Propagation, R. E. Collin, McGraw Hill, 1985.

2. Antenna Engineering Handbook, R. C. Johnson and H. Jasik, McGraw ill, 1984.

3. Micro Strip Antennas, I. J. Bahl and P. Bhartia, Artech House, 1980.

4. Electromagnetic Waves, R. K. Shevgaonkar,Tata McGraw Hill, 2005

5. Adaptive Antennas, R. E. Crompton, John Wiley

Course Outcomes:

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

ETU721(A).1 Understand the properties and various types of antennas.
ETU721(A).2 Analyze the properties of different types of antennas and their design.
ETU721(A).3 Operate antenna design software tools and come up with the design of the antenna of required specifications.

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU721(A).1	2	2	1	1	0	1	1	1	2	1	1	1	1	1	1
ETU721(A).2	3	3	2	3	1	2	2	1	2	1	1	1	3	2	1
ETU721(A).3	2	1	3	2	3	1	2	1	2	1	1	1	2	1	1

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU721(B) MULTIRATE SIGNAL PROCESSING

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2.30hrs

Course Objectives

I. Understanding of sampling, reconstruction, sampling rate conversion using multirate
II. Applications of multirate DSP – Filter design, Filterbanks
III. Mathematical framework for Reconstruction Filterbanks
IV. Introduction to Wavelets and Multichannel filter banks
V. To codify multirate DSP concepts and applications.

Introduction, Overview of Sampling and Reconstruction, Review Discrete-Time Systems, digital filters Oversampling techniques, DT processing of continuous time signals Fundamentals of Multi-rate Systems, Basic building blocks – Up sampling, down sampling, aliasing, Mathematical framework

Sampling rate change and filtering, fractional sampling rate change Interconnection of multirate DSP blocks, Multiplexer and Demultiplexer functionality, Polyphase decomposition, Noble Identities, efficient implementation of sampling rate conversion

Applications of Multirate DSP - DFT-based Filterbanks, Interpolated FIR filter design, Cascaded-Integrator-Comb (CIC) filters, Transmultiplexer,

Filterbank interpretation of Spectral analysis using DFT Two channel maximally decimated filter bank, Signal impairments - Aliasing, Magnitude distortion, Phase distortion, Aliasing cancellation

Allpass filters, properties, application in two channel filterbanks, Half-band filters, Power complementary filter pairs, Introduction to wavelets and M-channel perfect reconstruction filterbanks.

Text Books



1. Multirate Systems and Filterbanks, P. P. Vaidyanathan, Pearson, 2004, ISBN 81-297-0685-73.

2. Multirate digital signal processing: multirate systems, filterbanks, wavelets,Norbert Fliege, Wiley, 1994, ISBN 978-04719397645.

Reference Books

1. Discrete-Time Signal Processing by Alan V. Oppenheim, Ronald W. Schafer, 3rd edition, 2016, Pearson, ISBN 978-93-325-3503-92.

2. Filter Bank Transceivers for OFDM and DMT Systems, Lin,hoong & Vaidyanathan, Cambridge University Press, 2011, ISBN 978-1-107-00273-94.

3. Multirate Signal Processing for Communication Systems,Frederic Harris, Prentice Hall, 2004, ISBN 978-0131465114.

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

ETU721(B).1	Realize sampling, reconstruction, sampling rate conversion using multirate building blocks
ETU721(B).2	Analyze framework for Reconstruction Filter banks
ETU721(B).3	Apply multirate DSP in Filter design, Filterbanks, etc
ETU721(B).4	Analyze Wavelets and Multichannel filter banks
ETU721(B).5	Write code/program using MATLAB or similar software tool for multirate DSP principles and applications

Equivalent NPTEL course: Multirate DSP **By Prof. R. David Koilpillai | IIT Madras**
Multirate DSP - Course (nptel.ac.in) **https://onlinecourses.nptel.ac.in/noc21_ee36/preview**

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU721(B).1	2	2	0	1	0	0	0	0	0	0	0	0	1	0	0
ETU721(B).2	3	3	1	2	0	0	0	0	0	0	0	0	2	0	0
ETU721(B).3	2	0	2	0	0	0	2	0	0	2	0	3	2	2	0
ETU721(B).4	0	0	3	0	2	0	3	0	0	2	0	2	3	3	0

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU721(B)..5	0	0	3	0	3	0	0	0	0	2	0	3	0	3	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU721C CMOS DESIGN

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2.30hrs

Course Objectives:

I. To understand fabrication processes
II. To study and analyze different current mirrors used to bias IC amplifiers
III. To understand the frequency response of amplifier designed in integrated circuits

Course Content:

VLSI Technology- NMOS, CMOS, BiCMOS, Introduction to CMOS Circuits CMOS Design Introduction: Flow of circuit design, fabrication process steps, Layout Design rules

CMOS Digital circuits: Inverter, static logic gates, Transmission Gates, Flip flop, Dynamic logic Gates, Memory circuits

BiCMOS Logic gates: Layout of Junction Isolated BJT, Modeling the NPN. BiCMOS Inverter, other BiCMOS logic gates, CMOS and ECL Conversion using BiCMOS

CMOS Analog Circuits: MOS Analog models, Current sources and sinks, References, Amplifier, Differential Amplifier, Operational amplifier

Text Books:

1. CMOS Circuit Design, Layout and Simulation, R. Jacob Baker, Harry W,Li, David E. Boyce, Prentice Hall, 2005
2. CMOS VLSI Design, Neil H. E. Weste, David Harris, Ayan Banerjee,Pearson Education, 2011

Reference Books:



1. Digital Integrated circuits: A Design Jan Rabaey, Anatha Chandrakkasan, Borivoje Nikolic,Perspective, Pearson Education, 2009
2. Modern VLSI Design, Wayne Wolf, Prentice Hall,4th edition 2009
3. Design of Analog CMOS Integrated Circuits, B. Razavi, McGraw Hill, 2011.
4. FPGA Based system Design, Wayne Wolf, Pearson, First Edition 2009

Course Outcomes:

At the end of this course students will be able to

ETU721(C).1	To know fundamental principal of VLSI circuit design flow
ETU721(C).2	Realize CMOS Fabrication Process flow
ETU721(C).3	Analyze and design differential amplifiers using CMOS
ETU721(C).4	Analyze and design active and passive current mirrors using CMOS
ETU721(C).5	Design performance parameters related to operational amplifiers

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU721 (C).1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ETU721 (C).2	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0
ETU721 (C).3	0	0	3	0	0	0	0	0	0	0	0	0	2	0	0
ETU721 (C).4	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0
ETU721 (C).5	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU721(D) ARTIFICIAL NEURAL NETWORKS

Teaching Scheme: 03L+00T **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2 hrs 30 min.

Course Objectives:

I. To understand the fundamental theory and concepts of Artificial Intelligence.
II. To provide knowledge of artificial neural network modelling, several artificial neural network paradigms, its applications and recent trends.
III. To analyze feed forward and feedback artificial neural networks.
IV. To apply auto associative and recurrent neural networks for pattern storage and retrieve
V. To analyze self-organizing maps

Basics of Artificial Neural Networks: Introduction to biological neural network, artificial model of neuron: Mc-Culloch – Pitts model, Mathematical Preliminaries, Neural Networks and Architectures, characteristics of artificial neural networks, mathematical models of neurons.

Backpropagation networks: Architecture of feed forward network, single layer perceptron, multilayer perceptron, back propagation learning, input - hidden and output layer computation, backpropagation algorithm, applications, selection of tuning parameters in BPN, Numbers of hidden nodes, learning.

Fast learning methods: Conjugate gradient method. Auto associative neural networks, Pattern storage and retrieval, Hopfield model, Radial basis function networks: Regularization theory, RBF networks for function approximation, RBF networks for pattern classification.

Self-organizing maps and recent trends: Pattern clustering, Topological mapping, Kohonen's self-organizing maps, introduction to deep neural networks: convolutional neural networks, recurrent neural networks, long short term memory.

Applications of ANN: Pattern classification, Recognition of printed Characters, Recognition of handwritten characters, English text to speech. Recognition of consonant vowel (CV) segments, texture classification and segmentation.



Text Books:

1. A Classroom Approach, Satish Kumar, Neural Networks,Tata McGraw-Hill, 2003
2. Neural Networks, A Comprehensive Foundation, S.Haykin,Prentice Hall, 1998.
3. Introduction to Artificial Neural Networks, Jacek Zurada, Jaico Publishing House, 1997.

Reference Books:

1. Pattern Recognition and Machine Learning, C.M.Bishop, Springer, 2006.
2. Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville MIT Press, 2016

Course Outcomes

On successful completion of the course the students will be able to:

ETU721(D).1 know the basic ANN architectures, algorithms, and their limitations.
ETU721(D).2 understand the Various Learning methodologies.
ETU721(D).3 get expertise in the use of different ANN structures and algorithm.
ETU721(D).4 develop ANN based models.

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU721(D).1	2	2	1	1	3	1	0	0	0	0	0	0	1	1	1
ETU721(D).2	2	2	1	1	2	1	1	0	0	0	0	0	2	1	1
ETU721(D).3	3	3	2	2	2	1	1	1	0	0	0	0	3	2	1
ETU721(D).4	2	1	3	3	2	1	1	1	0	0	0	0	3	3	1

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU722 – PROGRAM ELECTIVE – IV

(A)WIRELESS COMMUNICATION

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2Hrs.30Min.

Course Objectives:

The students shall be able

V. To get introduced to the wireless communication systems
VI. To study the multiple access techniques used in wireless communication
VII. To study the various system standards used in wireless communication
VIII. To study the cordless system and other wireless systems

Introduction: Evolution of Wireless Communication, advantages and disadvantages, Different types of Wireless Systems, Evolution to Next-Generation Wireless Networks, and Applications.

Multiple Access Technique: Frequency division multiple access (FDMA), time division multiple access (TDMA), frequency hop multiple access (FHMA), space division multiple access (SDMA).

Wireless Systems and Standards: Global system for mobile (GSM), system architecture, radio subsystem, channel types, frame structure, signal processing in GSM, code division multiple access CDMA (IS-95), frequency and channel specifications, forward and reverse CDMA channel.

Cordless Systems and WLL: Introduction to cordless systems, cordless telephony standard (CT2) and digital enhanced cordless telecommunication (DECT): standards, architecture, frame format and radio link, operation; IEEE802.16, role of wireless local loop (WLL), propagation considerations for WLL, local multipoint distribution services (LMDS) and multichannel multipoint distribution services (MMDS).

Wireless LAN: Overview, technologies; types: infrared, spread-spectrum, narrow band microwave LAN, mobile data networks, cellular digital packet data (CDPD), global packet for radio service (GPRS), wireless application protocol (WAP), introduction to Bluetooth technology

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Text Books

1. Wireless Communications Principles and Practice, T. S. Rappaport, 2nd edition, Pearson Education, 2010
2. Wireless Communications, T.L.Singhal, 4th reprint, Tata McGraw Hill, 2012

Reference Books

1. Mobile Cellular Telecommunications, W. C.Y. Lee, 2nd edition, MGH, 2006
2. Wireless Communications and Networks, W. Stallings, 2nd edition, Pearson Education, 2009
3. Mobile Cellular Communication, G.S.Rao, 1st edition, Pearson Education, 2013

Course Outcomes:

After completing this course, Students shall be able to:

ETU722(A).1 Understand the functioning of wireless communication systems, and their evolution
ETU722(A).2 Demonstrate ability to explain various multiple access techniques for Wireless communication
ETU722(A).3 Compare the various wireless system standards
ETU722(A).4 Understand cordless and wireless local loop concepts
ETU722(A).5 Understand the concept of different wireless networks and Bluetooth technology

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU722(A).1	2	1	1	1	2	-	-	-	-	-	-	-	2	1	1
ETU722(A).2	2	2	3	2	2	-	-	-	-	-	-	-	3	2	1
ETU722(A).3	3	3	2	3	2	-	-	-	-	-	-	-	3	2	1
ETU722(A).4	3	3	2	3	2	-	-	-	-	-	-	-	3	2	1
ETU722(A).5	3	3	2	3	2	-	-	-	-	-	-	-	3	2	1

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU722(B) ADAPTIVE SIGNAL PROCESSING

Teaching Scheme: 03L+00T **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2.30hrs

Course Objectives:

The students shall be able to

I. Understand the need of Adaptive signal processing
II. Study to know the components of ASP
III. Study and use various algorithm for error minimization
IV. Realize importance of orthgonalizaion, linear prediction and autoregressive modelling
V. Encode and simulate the algorithm, processes and applications

Adaptive Signal Processing (ASP), Introduction to Adaptive Filters Introduction to Stochastic Processes, Stochastic Processes, Correlation Structure, FIR Wiener Filter

Steepest Descent Technique, LMS Algorithm, Convergence Analysis, Convergence Analysis (Mean Square), Convergence Analysis (Mean Square), Misadjustment and Excess MSE

Sign LMS Algorithm, Block LMS Algorithm, Fast Implementation of Block LMS Algorithm, Vector Space Treatment to Random Variables

Orthogonalization and Orthogonal Projection, Orthogonal Decomposition of Signal Subspaces, Introduction to Linear Prediction, Lattice Filter, Lattice Recursions, Lattice as Optimal Filter

Linear Prediction and Autoregressive Modeling, Gradient Adaptive Lattice, Gradient Adaptive Lattice, Introduction to Recursive Least Squares, RLS Approach to Adaptive Filters, ,

Text Books



1.Bernard Widrow and Samuel D. Stearns, ―Adaptive Signal Processing‖, Person Education, 1985.

Reference Books:

1. Simon Haykin, ―Adaptive Filter Theory‖, Pearson Education, 2003.

2. John R. Treichler, C. Richard Johnson, Michael G. Larimore, ―Theory and Design of Adaptive Filters‖, Prentice-Hall of India, 2002.

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

ETU722(B).1 Elaborate the importance of signal processing in non-stationary environment.

ETU722(B).2 Interpret and justify various components of Adaptiver signal processing

ETU722(B).3 Explain and compare and the role of adaptive signal processing in communications

ETU722(B).4 Apply the various mathematical models to adaptive signal processing. and minimum error

ETU722(B).5 Write Code and use simulation tools related to the concepts of ASP and applications

Equivalent NPTEL course:

Adaptive Signal Processing Video course in Electronics & Communication Engineering by Prof. Mrityunjoy ChakrabortyIIT Kharagpur--
Url: https://nptel.ac.in/courses/117/105/117105075/#
Link: NPTEL :: Electronics & Communication Engineering - Adaptive Signal Processing

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU722(B).1	2	1	0	1	0	0	0	0	0	0	0	0	1	0	0
ETU722(B).2	2	2	2	2	0	0	0	0	0	0	0	0	2	0	0
ETU722(B).3	2	3	2	3	0	0	2	0	0	2	0	2	3	2	0
ETU722(B).4	3	0	3	0	2	0	2	0	0	2	0	2	3	3	0
ETU722(B).5	0	0	3	0	3	0	0	0	0	3	0	3	0	3	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU722(C) MIXED SIGNAL DESIGN

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2.30hrs

Course Objectives:

I. To understand basics of analog and digital signal VLSI design

II. To understand the inter-conversions between signals

III. To describe mixed signal design using ADC and DAC

IV. To study analog and digital PLL

Analog and discrete-time signal processing, introduction to sampling theory; Analog continuous-time filters: passive and active filters; Basics of analog discrete-time filters.

Switched-capacitor filters: Nonidealities in switched-capacitor filters; Switched-capacitor filter architectures; Switched-capacitor filter applications.

Basics of data converters; Successive approximation ADCs, Dual slope ADCs, Flash ADCs, Pipeline ADCs, Hybrid ADC structures, High-resolution ADCs, DACs.

Mixed-signal layout, Interconnects and data transmission; Voltage-mode signaling and data transmission; Current-mode signaling and data transmission.

Introduction to frequency synthesizers and synchronization; Basics of PLL, Analog PLLs; Digital PLLs; DLLs.

Text Books:

1. CMOS mixed-signal circuit design, R. Jacob Baker, Wiley India, IEEE press, reprint 2008.

Reference books:

1. CMOS circuit design, layout and simulation, R. Jacob Baker, Revised second edition, IEEE press, 2008.

2. Design of analog CMOS integrated circuits, Behzad Razavi, McGraw-Hill, 2003.

Course Outcomes:

At the end of the course, student will demonstrate the ability to

ETU722(C).1	Understand the practical situations where mixed signal analysis is required.
ETU722(C).2	Analyze and handle the inter-conversions between signals.
ETU722(C).3	Analyze the mixed signal design using ADC and DAC
ETU722(C).4	Understand analog and digital PLL.
ETU722(C).5	Design systems involving mixed signals

CO-PO-PSO Mapping

CO	PO/PSO														
	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU722(C).1	1	2	1	1	1	0	1	0	0	0	1	1	1	1	0
ETU722(C).2	2	3	2	2	3	1	2	1	1	1	2	2	3	3	1
ETU722(C).3	2	3	2	2	3	1	2	1	1	1	2	2	3	3	1
ETU722(C).4	1	3	1	1	3	0	1	0	0	0	1	1	1	1	0
ETU722(C).5	2	2	3	3	2	1	3	2	2	2	2	3	3	3	1

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU722(D) SOFT COMPUTING TOOLS

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2.30hrs

Course Objectives:

The students shall be able

I. To provide an introduction to the basic principles, techniques, and applications of Soft Computing.
II. To understand the basic areas of Soft Computing including Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms.
III. To provide the mathematical background for carrying out the optimization associated with Soft Computing.
IV. To develop some complex methods in Soft Computing by working on design project.

Introduction to Soft Computing**:** Soft Computing vs. Hard Computing, various types of Soft Computing Techniques, Fuzzy Computing, Neural Computing, Genetic Algorithms, Applications of Soft Computing.

Fundamentals of Artificial Neural Network : Introduction, Model of Artificial Neuron, Architectures, Learning Methods, Deep learning, Taxonomy of ANN Systems, Single Layer ANN System, Supervised Learning Neural Networks, Perceptrons, Adaline, Backpropagation, Mutilayer Perceptrons, Applications of ANN.

Fuzzy Set Theory & Fuzzy Systems : Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, introduction & features of membership functions, Extension Principle, Fuzzy If-Then Rules, Fuzzification, Defuzzification, Applications.

Genetic Algorithms and Hybrid Systems: Fundamentals of Genetic Algorithms, basic concepts, working principle, encoding, fitness function, reproduction, Genetic Modeling, Research orientation of Soft Computing techniques.

R programming for Data Science: History and Overview of R, Basic features of R, Design of the R system, Limitations of R, Arithmetic Operators, Logical Operations, Functions, variables and data types, Creating Variables, Numeric, Character and Logical Data, Vectors, Data Frames ,Factors ,Sorting Numeric, Character, and Factor Vectors , Special Value.

Text Books:

4. Soft Computing, D. K. Pratihar, Narosa, 2008 .
5. Neural Networks, Fuzzy Logis and Genetic Algorithms: Synthesis, and Applications, S. Rajasekaran, and G. A. Vijayalakshmi Pai, Prentice Hall of India, 2007
6. R Programming for Data Science, Roger D. Peny

Member Secretary	Chairman, BoS		Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)		(Prof. A.M.Mahalle)

Reference Books:

1. Neuro-Fuzzy and soft Computing, J.-S. R. Jang, C.-T. Sun, and E. Mizutani, PHI Learning, 2009.

2. Genetic Algorithms in Search, Optimization And Machine Learning, David E. Goldberg,

Pearson Education, 2002

3 Data Science, Wickham, H. & Grolemund, G.,O'Reilly: New York. 2018. Available for free at http://r4ds.had.co.nz

4. R Fundamentals, Sosulski, K, Bookdown: New York.. (2018).

Available at: http:// becomingvisual.com/rfundamentals

Required software:

1. R: http://www.r-project.org/ (FREE)
2. R Studio (additional libraries required): http://www.rstudio.com/ (FREE)

Course Outcomes:

At the end of this course students will be able to

Understand and apply the concept of human intelligence and Artificial Intelligence.

ETU722(D).1 Understand the genetic algorithms and other random search procedures and apply it to find out global optimum solutions in self-learning situations.

ETU722(D).2 Understand the fundamental syntax of R through readings, practice exercises, demonstrations, and writing R code.

ETU722(D).3 Apply critical programming language concepts such as data types, iteration, functions and Boolean operators by writing R programs and through examples.

ETU722(D).4 Solve the complex problems and methods in Engineering using Soft Computing Techniques.

CO-PO-PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU722(D).1	1	1	0	0	3	0	0	0	0	0	0	0	1	0	0
ETU722(D).2	1	2	0	3	2	0	0	0	0	0	0	0	1	2	0
ETU722(D).3	2	2	2	2	3	2	0	0	0	0	0	0	2	1	0

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU722(D).4	1	2	0	2	2	0	0	0	0	0	0	0	1	2	0
ETU722(D).5	3	3	1	3	2	3	0	0	0	0	0	0	3	3	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU723 – OPEN ELECTIVE – II

ETU723(A) MECHATRONICS

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2.30hrs

Course Objectives:

The students shall be able

I. To understand the Mechatronics system and its components.
II. To familiarize with the working principles of various sub-systems
III. To apply knowledge of engineering to make a blended system.

Introduction to Mechatronics: Introduction, The Design Process, System Components, Examples of Mechatronic systems.

Sensors and Transducers: Performance Terminology of Sensors, Displacement, Position & Proximity Sensors, Velocity and Motion, Vibration and Acceleration, Force, Fluid Pressure, Liquid Flow Sensors, Temperature, Light sensor.

Signal Conditioning: Introduction to Signal Conditioning, Analog Signal Conditioning, Analog to Digital Converter, Digital to Analog Converter, Multiplexers, Data Acquisition, Controller, Serial and Parallel Data Communication, Communication Interfaces, Fault findings: common hardware faults

Actuators and Mechanisms: Overview of Mechanical Actuation System, Hydraulic & Pneumatic Actuation System, Electrical Actuation System, Data Presentation Systems

Closed Loop Controllers: Proportional control, Integral control, PID Controllers, Digital Controllers

Modeling and System Response: Mechanical System, Electrical System, Fluid System Building Blocks, Dynamic Response of Systems, Transfer Function and Frequency Response.

Design and Mechatronics: Hard Disc Drive system, Myoelectrically Controlled Robotic Arm, Mechatronic Design of a Robotic Walking Machine.

Text Books:

1. Mechatronics: Electronic Control systems in Mechanical and Electrical Engineering, W. Bolton, Pearson Education Limited, 6th edition, 2015

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

2. Introduction to Mechatronics and Measurement Systems: David G. Alciatore, Michael B. Histand, Tata Mc Graw Hill, 4th edition

References:

1. Mechatronic System Design: Devdas Shetty, Dedas, Richard A. Kolk, Cengage Learning, 2nd edition, 2011
2. The Mechatronic Handbook: Robert H. Bishop; CRC press, 2nd edition, 2008
3. Intelligent Mechatronic Systems: Modeling, Control and Diagnosis, Rochdi Merzouki, Arun Kumar Samantaray, Pushparaj Mani Pathak, Belkacem Ould Bouamama, Springer, London, 1st edition, 2013

NPTEL course on 'Mechatronics' by Prof. Pushpraj Mani Pathak, IIT Roorkee

Course Outcomes:

After completing this course, students will be able to:

ETU723(A).1 Realize the mechatronics systems components.
ETU723(A).2 Understand and Apply the working principle of sensors and transducers.
ETU723(A).3 Understand various signal conditioning, processing and actuator mechanisms.
ETU723(A).4 Demonstrate the working of controllers.
ETU723(A).5 Identify and Select the system components to model and design a mechatronics system.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU723(A).1	2	2	1	1	0	1	1	0	3	1	1	1	2	1	1
ETU723(A)..2	3	3	2	1	1	1	2	0	3	1	1	1	3	1	1
ETU723(A).3	2	2	2	1	1	1	2	0	3	1	1	1	2	1	1
ETU723(A).4	2	2	2	1	1	1	2	0	2	1	1	1	3	1	1
ETU723(A)..5	3	3	3	1	2	2	3	1	3	1	2	3	3	2	2

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU723 – OPEN ELECTIVE – II

ETU723(B) BIOENGINEERING

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2Hrs.30Min.

Course Objectives:

The students shall be

I Aware about the conjunction of Biology with Engineering
II Able to get acquainted with multi-disciplinary application fields in bioengineering
III Able to understand the basic concepts of bioinformatics and biosensors
IV Able to acquire basic knowledge about the biomedical engineering

Introduction to Bioinformatics, goal, scope, applications.

Database and its types, biological databases, pitfalls in biological databases, information retrieval from biological database, unique requirements for database searching, Heuristic database searching, Basic Local Alignment Search Tool (BLAST), FastAll (FASTA).

Introduction to Biosensors, basic principle, components of biosensors, types of biosensors – electrochemical, optical.

Brief introduction to human physiology, Biomedical transducers: displacement, velocity, force,

acceleration, flow, temperature, potential, dissolved ions and gases, Bio-electrodes and biopotential amplifiers for ECG, EMG, EEG.

Basic X-ray components and circuits, types of X-ray machines biological effects of X-rays and precautions, computerized axial tomography (CAT), ultrasonic and MRI Techniques: Foetus monitoring, introduction to T-rays.

Text Books

1. Essential Bioinformatics, Jin Xiong, 1st edition, Cambridge University Press, 2006
2. Biosensors: Fundamentals and Applications, Bansidhar Malhotra and Chandra Mouli Pandey, 1st edition, Smithers Rapra Technology Limited, 2017

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

Reference Books

1. Biomedical Instrumentation and Measurements, L. Cromwell, F.J. Weibell, E.A.Pfeiffer, 2nd edition, PHI Learning, 2011

2. Biomedical Instrumentation, R. S. Khandpur, 6th edition, TMH, 2004

3. Biosensors and Bioelectronics: Chandran Karunakaran, Kalpana Bhargava, Robson Benjamin, 1st edition, Elsevier Publications, 2015

Course Outcomes:

After completing this course, Students will be able to:

ETU723(B).1 Identify the multidisciplinary applications of bioengineering
ETU723(B).2 Understand the basic concepts of application of principles of biology and engineering tools
ETU723(B).3 Understand the technical aspects of existing technologies capable of addressing the biological and medical challenges faced by mankind
ETU723(B).4 Apply the knowledge information extraction databases useful in computer modeling
ETU723(B).5 Apply acquired knowledge to identify usable and cost efficient solutions in bioengineering

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU723(B).1	2	3	1	1	0	0	0	0	0	0	0	0	3	1	2
ETU723(B).2	3	3	2	2	0	0	0	0	0	0	0	0	3	1	2
ETU723(B).3	3	3	2	1	1	3	2	0	0	1	2	1	3	3	2
ETU723(B).4	3	3	2	2	2	1	1	0	0	0	0	0	3	3	1
ETU723(B).5	3	3	2	2	2	2	3	0	0	2	2	1	3	3	1

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU724 – PROGRAM ELECTIVE – V

ETU724(A)SATELLITE COMMUNICATION

Teaching Scheme: 03L **Total: 03** **Credit: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total marks: 100**

ESE duration: 02 Hrs 30 min.

Course Objective:

Students will be able to

I Enable the student to become familiar with satellites and satellite services.

II Study of satellite orbits and launching.

III Gain the knowledge about earth segment and space segment components

IV Learn about the science behind the orbiting satellites, various multiplexing schemes and earth station parameters used for satellite communication

Overview of Satellite Systems: Satellite frequency bands, satellite types, orbit, modulation, transmission and multiplexing, launching and positioning methods, Kepler's law, orbital aspects of satellite communication, orbital period and velocity, effects of orbital inclination, azimuth and elevation, coverage angle and slant range, orbit determination, orbit perturbations, orbital spacing and capacity.

Satellite Construction (Space Segment): Introduction; attitude and orbit control system; telemetry, tracking and command; power systems, communication subsystems, antenna subsystem, equipment reliability and space qualification

Physical Media and Link Components: Microwave bands for satellite communication, Satellite microwave link calculations: general link design equation, system noise temperature, uplink design, downlink design, complete link design, effects of rain, antennas, gain temperature (G/T) ratio.

Modulation Schemes used in Satellite Links: FDMA, TDMA and packet switched systems; spread spectrum techniques and CDMA systems, Satellite systems.

Application of Satellite Communication: Earth station technology and satellite services, earth station design, tracking, equipment for earth station, domestic satellite systems using small earth stations, VSAT, Global positioning system, satellite navigation, direct broadcast satellite television and radio, satellite services and the internet.



Text Books

1. Satellite Communication, D. Roddy, 4 th edition, Tata McGraw Hill, 2008

2. Satellite Communication, P. Timothy, B. W. Charles and J. Allnutt, 2nd edition, Willey International Publication, 2006

Reference Books

1. Satellite communication , Timothy Pratt, Charles Bostian, Jeremy Allnut, John Willey and Sons Inc. Second edition
2. Satellite Communication, R. M. Gagliardi, 1 st edition, CBS publications and Distributors, 2004.
3. Satellite Communication systems engineering, W. L. Pritchard, H. G. Suyderhoud, R. A. Nelson, 2 nd edition, Pearson Education, 2003

Course Outcome:

At the end of the course students will be able to

ETU724(A).1 Apply knowledge about the Satellite communications Principles properties.
ETU724(A).2 Analyze the effects of various parameters on Satellite System performance.
ETU724(A).3 Discuss and understand how analog and digital technologies are used for satellite communication networks.
ETU724(A).4 Design Satellite Earth station antennas and link power budget for satellites.
ETU724(A).5 Understands the applications of Satellite Communication.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU724(A).1	3	1	1	1	3	0	0	0	0	1	1	2	3	1	1
ETU724(A).2	2	1	0	0	1	0	0	0	0	1	1	1	3	2	1
ETU724(A).3	3	2	1	1	1	0	0	0	0	1	2	1	1	1	1
ETU724(A).4	3	1	3	2	1	0	0	0	0	0	0	0	1	2	0
ETU724(A).5	2	2	3	2	2	0	0	0	0	0	1	1	2	0	1

0-Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU724(B) DIGITAL IMAGE AND VIDEO PROCESSING

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2.30hrs

Course Objectives:

The student shall be able

I. To understand the fundamentals of digital image and video processing and algorithms for most of the work currently underway in this field.

II. To get a clear impression of the breadth and practical scope of digital image and video processing

III. To develop conceptual understanding which will enable them to undertake further study, research and/or implementation work in this area.

Digital Image Fundamentals: Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationships between Pixels – Neighbourhood, Adjacency, Connectivity, Distance Measures. Color image fundamentals-RGB-HSI models

Two Dimensional Transforms: Discrete Fourier Transform, Discrete Cosine Transform, Walsh and Hadamard Transform, Haar Transform, Discrete Wavelet Transform, and its applications.

Image Enhancement Spatial Domain: Point Processing, Digital Negative, Contrast Stretching, Thresholding, Gray Level Slicing, Bit Plane Slicing, Log Transform and Power Law Transform, Histogram Equalization and Specification, Neighbourhood Processing: Averaging Filters, Order Statistics Filters, High Pass Filters and High Boost Filters, Frequency Domain Filtering.

Image Compression-Redundancy–inter-pixel and psycho-visual; Lossless compression – predictive, entropy; Lossy compression- predictive and transform coding. Image compression standards, Application in various fields

Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding – Global and Adaptive, Region-Based Segmentation.

Fundamentals of Video Coding, Motion Estimation Techniques, Full Search, Fast Search Strategies, Forward And Backward Motion Prediction

Video Processing: display enhancement, video mixing, video scaling, scan rate conversion, representation of digital video, Spatio-temporal sampling, video compression-motion

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

estimation, intra and interframe prediction, perceptual coding,Elements of a Video Encoder and Decoder; Video Coding Standards – MPEG And H.26X.

Text Books:

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education, 3rd edition ,2008.
2. Thomas B. Moeslund, Introduction to Video and Image Processing (Building Real Systems and Applications), Springer London Dordrecht Heidelberg New York2012.

Reference Books:

1. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004
2. Murat Tekalp , Digital Video Processing, Prentice Hall, 2nd edition 2015
3. John W. Woods, "Multidimensional Signal, Image and Video Processing", booksite.elsevier.com, 2nd edition 2011.

Course Outcomes:

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

ETU724(B).1 Mathematically represent the various types of images and analyze them.
ETU724(B).2 Explain the need of spatial and frequency domain techniques for image compression.
ETU724(B).3 Process these images for the enhancement of certain properties or for optimized use of the resources.
ETU724(B).4 Understand the colour image processing
ETU724(B).5 Study the fundamentals of video processing and understand the video encoding and decoding.

SWAYAM/NPTEL Course on Digital video and Image processing (IIT KHARAGPUR)
https://nptel.ac.in/courses/117/105/117105079

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU724(B).1	2	3	0	0	0	0	0	0	0	0	0	3	3	0	0
ETU724(B).2	2	2	0	0	0	0	0	0	0	0	0	0	1	3	0
ETU724(B..3	3	2	0	0	0	0	0	0	0	0	0	3	2	3	0
ETU724(B).4	2	3	0	0	0	0	0	0	0	0	0	0	2	3	0
ETU724(B).5	1	2	3	0	0	0	0	0	0	0	0	0	2	0	0

0-Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU724(C) NANOTECHNOLOGY

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2.30hrs

Course Objectives:

I To study various aspects of nanotechnology
II To explain various aspects of nanotechnology and the processes involved in making nano components and material
III To describe advantages of the nano materials and appropriate use in solving practical problems
IV To study the advancements of semiconductor materials for future electronics

Introduction to nanotechnology, meso structures, Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box concepts, Degeneracy. Band theory of solids. Kronig-Penny Model. Brillouin Zones.

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.),

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotube electronics, Band structure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

Text Books:

1. Introduction to Nanotechnology, C.P. Poole, F. J. Owens, Wiley, 2003

2. Fundamentals of Nanoelectronics, G.W. Hanson, Pearson, 2009

Reference books:

1. Nanoelectronics and Information Technology (Advanced Electronic Material and Novel Devices), W. Ranier, Wiley, 2003.

Course Outcomes:

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



ETU724(C).1 Understand various aspects of nanotechnology for making nano components and material.

ETU724(C).2 Study the processes involved in making nano components and material.

ETU724(C).3 Leverage advantages of the nano materials.

ETU724(C).4 Study appropriate use of the nano materials in solving practical problems.

ETU724(C).5 Understand the requirement of futuristic of semiconductor material

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU724(C).1	3	3	1	1	1	0	0	0	0	0	0	0	0	0	0
ETU724(C).2	3	3	2	0	0	0	0	0	0	0	0	0	0	0	0
ETU724(C).3	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0
ETU724(C).4	3	2	2	0	1	0	1	0	0	0	1	0	0	1	0
ETU724(C).5	3	2	1	2	2	1	1	0	0	0	1	0	0	1	0

0-Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU724(D)PATTERN RECOGNITION

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2.30hrs

Course Objectives:

Students shall be able to

I. understand basic concepts in pattern recognition.
II. gain knowledge about state-of-the-art algorithms used in pattern recognition research.
III. understand pattern recognition theories, such as Bayes classifier, linear discriminate Analysis etc.
IV. apply pattern recognition techniques in practical problems.

Basics of Pattern Recognition: Pattern recognition system, decision boundary and classifier, components of pattern recognition system, design principles, structural approach, Feature of pattern recognition process, phases and activities.

Review of Probability, Random Processes and Linear Algebra: Probability, conditional and joint probability, Bayes theorem Random Processes: Stationary and non-stationary processes, Expectation, Autocorrelation, Cross-Correlation, inner product, outer product, inverses, Eigen values, Eigen vectors, singular values, singular vectors.

Bayes Decision Theory: Minimum-error-rate classification. Classifiers, Discriminant functions, Decision surfaces. Normal density and discriminant functions. Discrete features.

Parameter Estimation Methods: Maximum-Likelihood estimation: Gaussian case. Maximum a Posteriori estimation. Bayesian estimation: Gaussian case.

Unsupervised Learning and Clustering: Unsupervised Learning and its applications in clustering using k-means, computational hurdles in clustering algorithms and implementation of clustering algorithms, Hidden Markov Models (HMMs), Nonparametric techniques for density estimation. Parzen-window method. K-Nearest Neighbour method.

Dimensionality Reduction: Principal component analysis - its relationship to Eigen analysis. Fisher discriminant analysis - Generalised Eigen analysis. Eigen vectors/Singular vectors as dictionaries. Factor Analysis, Total variability space - a dictionary learning methods. Nonnegative matrix factorisation - a dictionary learning method.



Non-metric methods and applications of pattern classification: Non-numeric data or nominal data. Decision trees: Classification and Regression Trees (CART), Applications of pattern classifiers in image pattern recognition, speech pattern detection, visual pattern recognition and logical synthesis.

Text Books:

1. Pattern Classification,R.O.Duda, P.E.Hart and D.G.Stork, John Wiley, 2001
2. Pattern Recognition, S.Theodoridis and K.Koutroumbas, 4th Ed., Academic Press, 2009
3. Pattern Recognition and Machine Learning, C.M.Bishop, Springer, 2006

Reference Books:

1. Essentials of pattern recognition : an accessible approach, Jianxin Wu, Cambridge university press, 2020
2. Pattern Recognition: Introduction, Features, Classifiers and Principles, B. Jurgen, R. Matthias, N. Matthias,De Gruyter, 2017
3. Applied Pattern Recognition, H. Bunke, A. Kandel, M. Last, Springer India, 2010
4. Markov Models for Pattern Recognition: from Theory to Application, G.A. Fink, 2nd Ed., Springer, 2014.
5. Pattern Recognition Technologies and Applications: Recent Advances, B. Verma, M. Blumenstein, Scopus, 2008

Course Outcomes

On successful completion of the course the students will be able to:

ETU724(D).1 understand the fundamentals of pattern recognition and its application.
ETU724(D).2 revise the concepts of probability and linear algebra and review them from the viewpoint of ways and means for pattern understanding.
ETU724(D).3 analyze the unsupervised algorithms suitable for pattern Classification.
ETU724(D).4 understand the role of pattern classification in various machine intelligence applications.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU724(D).1	2	2	1	1	1	1	0	0	0	0	0	0	1	1	1
ETU724(D).2	3	2	1	1	2	1	1	0	0	0	0	0	2	1	1
ETU724(D).3	3	3	2	2	2	1	1	0	0	0	0	0	3	2	1
ETU724(D).4	1	1	3	3	2	1	1	0	0	0	0	0	3	3	1

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU725 VLSI DESIGN

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2.30hrs

Course Objectives:

I. To learn basic CMOS Circuits.
II. To Learn CMOS device parameters and characteristics.
III. To Learn physical design of logic gates.
IV. To Study Testing and Verification Process.

Introduction to CMOS CIRCUITS: MOS Transistor, CMOS Combinational logic Gates, Multiplexer, Latches, Flip Flops, CMOS Fabrication and Layout, VLSI Design Flow

MOS Transistor theory, ideal I-V and C-V Characteristics, Non-ideal I-V effects, DC transfer Characteristics, switch level RC-delay Model

CMOS technologies, Layout design rules, CMOS process enhancement, Technology related CAD issues

Circuit characterization and Performance estimation, Delay estimation, Logical efforts and Transistor sizing, Power Dissipation, Interconnect, Design margin, Reliability, Scaling.

Testing and Verification: Logic Verification Principals, Manufacturing Test Principals, Design for Testability, Boundary Scan

Test Book:



1. CMOS VLSI Design: a Circuit and System Perspective, Neil H. E. Weste, David Harris, Ayan Banerjee, Pearson Education, 2011

Reference Books:

1. Essentials of VLSI circuits and Systems, Kamran Eshraghian, Douglas A. Pucknell, Sholeh Eshraghian, Prentice Hall, 2005
2. VLSI Design, M. Michael Vai, CRC Press,2017
3. FPGA Based system Design, Wayne Wolf, Perason, First Edition 2009

Course Outcome:

ETU725.1 Realize VLSI Design Flow

ETU725.2 Analyze CMOS Logic

ETU725.3 Implementation Different Combinational logic circuits

ETU725.4 Design layout for CMOS various circuits.

ETU725.5 Analyze testing, Verification.

SWAYAM/NPTEL Course on VLSI Design: Combinational Circuit Simulation
https://nptel.ac.in/courses/108/107/108107129/

IPS Academy, Institute of Engineering & Science, Indore

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU725.1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ETU725.2	0	2	0	0	0	0	0	0	0	0	0	0	2	3	0
ETU725.3	0	0	3	0	0	2	0	0	0	0	0	0	0	0	0
ETU725.4	0	0	0	2	0	0	2	0	0	0	2	0	0	0	0
ETU725.5	0	0	0	0	3	0	0	0	0	0	0	0	0	2	0

0-Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU726 OPTICAL COMMUNICATION

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2.30hrs

Course Objective:

The course aims to provide the students to

I Learn about various components used in optical communication.
II Understand the different kind of losses, signal distortion, SM fibers.
III Gain the knowledge of the various optical sources, materials and fiber splicing.
IV Learn the optical receivers and noise performance in photo detector.
V Understand the link budget, WDM, and SONET/SDH network.

Introduction to Optical Communication: Basic opticprinciples, Snell's law, different manufacturing and splicing techniques, and connectors.

Optical Properties: Theory of circular wave guide, modes of optical fibers, numerical aperture (NA), power flow, attenuation, losses, dispersion, nonlinear effects, introduction to Soliton propagation.

Optical Sources and Detectors: Optical sources - LEDs and Lasers, Photo-detectors - pin-detectors, detector responsivity, detector noise characteristics, optical receivers

Principles of Optical Communication: Analog and digital transmission, digital coding, bandwidth occupancy, noise and bit error rate.

Optical Transmitters, Receivers, Fiber Optic Test and Measurement: Optical transmitter, receiver, digital system planning consideration, power penalty, optical link design, power budgeting coherent and non coherent system, modulation and demodulation scheme, multiplexing and demultiplexing, optical switches, measure fiber output power, use of OTDR.



Optical Amplifiers and Networks: Optical fiber amplifier, Semiconductor optical amplifiers, wavelength conversion, optical switches, photonic switching, SONET/SDH, fiber channel, optical interfaces. Introduction to WDM and DWDM systems.

Text Books

1. Optical Fiber Communication and Application, J.M. Senior, 3rd edition, PHI, 2009

2. Optical Fiber Communication, G. Keiser, 4th edition, TMH, 2008

Reference Books

1. Optical Communication System, J. Gowar, 3rd edition, PHI, 2000

2. Fiber optic communication technology, D. F. Mynbaev and L. Scheiner, 6 th Impression, Pearson Education, 2001

3. Fiber Optics Communication, H. Kolimbiris, 2nd edition, Pearson Education, 2004

4. Fiber-Optic Communications Systems, G. P. Agrawal, 3rd, John Wiley and Sons, 2002

Course Outcomes:

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

ETU726.1 Apply the knowledge with basic concepts of Optical Communication.
ETU726.2 Ability to demonstrate optical communication components, assemble them and solve problems on Optical Communication system.
ETU726.3 Ability to design, implements, analyzes and maintains optical communication system.
ETU726.4 Acquaintance of different source of light as well as receiver and their comparative study
ETU726.5 Assess the different techniques to improve the capacity of the system and solve problems on Optical Communication system.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU726.1	3	2	1	2	1	0	0	0	0	0	0	1	3	0	1
ETU726.2	2	2	1	1	2	0	1	0	0	0	1	0	2	1	1
ETU726.3	1	1	3	1	2	0	0	0	0	0	3	0	3	2	0
ETU726.4	2	2	1	1	2	0	0	0	0	0	0	2	2	0	1
ETU726.5	2	2	2	1	1	0	0	0	0	0	0	1	2	0	1

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU727 SEMINAR

Teaching Scheme: 02 P **Total: 02** **Credits: 01**

Evaluation Scheme: 50 ICA **Total Marks: 50**

ESE duration: ----

Course Objectives:

To make the student able to

I. Establish motivation for any topic of interest not covered in curriculum and develop a thought process for technical presentation.
II. Organize a detailed literature survey and build a document with respect to technical publications.
III. Learn effective presentation and improve soft skills.
IV. Make use of new and recent technology for creating technical reports.

The seminar is to be undertaken by single student

1. Student shall select a topic for seminar which is **not covered in curriculum**
2. Topics shall be registered within a month after beginning of VII Semester and shall be approved by the concerned guide and Program Head
3. Students should know the functional and technical details of selected topic after carrying out the conceptual study.
4. Before the end of semester, student shall deliver a seminar and submit the seminar report in following format:
   - Introduction
   - Literature Survey
   - Concept
   - Functional and Technical Details
   - Future scope
   - Applications

Course Outcomes:

After completing this course, Students shall be able:

ETU727.1 To study research papers for understanding of a new field, in the absence of a textbook , to summaries and review them.
ETU727.2 To identify promising new directions of various cutting edge technologies
ETU727.3 To impart skills in preparing detailed report describing the topic and results

Member Secretary	Chairman, BoS	Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)	(Prof. A.M.Mahalle)

ETU727.4 To effectively communicate by making an oral presentation before an evaluation committee

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU727.1	2	3	3	3	1	1	2	3	1	2	2	3	3	3	1
ETU727.2	1	2	1	2	2	2	3	3	1	2	2	3	3	3	1
ETU727.3	1	1	2	2	2	1	1	3	2	1	1	1	0	1	1
ETU727.4	1	1	2	2	2	1	1	3	2	1	1	1	3	1	1

0-Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU821– PROGRAM ELECTIVE – VI

ETU821(A) MOBILE COMMUNICATION

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2.30hrs

Course Objective:

The course aims to provide the students to

I understanding the basic principles of mobile communication systems
II study the recent trends adopted in cellular systems
III analysis of mobile communications with the interpretation of the call prints
IV understanding the operation of mobile communications systems and their generation divisions

Cellular Concept: Cell structure, frequency reuse, frequency and channel assignment, handoff, interface, capacity, power control, teletraffic theory, multiple access technologies; overview of 2G to 7G and future mobile technologies.

Signal Propagation: Signal propagation mechanism, large scale signal propagation and lognormal shadowing. Path loss modelling and signal coverage. Fading in mobile systems.

Antennas: The gain and pattern relationship, Antennas at cell site, Mobile Antennas.

Receiver Structure- Diversity receivers - selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity: Altamonte scheme.

MIMO and Space Time signal processing, spatial multiplexing, diversity/multiplexing tradeoff.

Performance Measures and system examples: Outage, average SNR, average symbol/bit error rate; GSM, GPRS, CDMA 2000 and WCDMA

Text Book:

1. Mobile Cellular Telecommunications, W. C.Y. Lee, 2nd edition, MGH, 2006.
2. Mobile Wireless Communications, Mischa Schwartz -Cambridge University Press.

Reference Book:

1. Mobile Communications, J. Schiller, 2nd edition, Pearson Education, 2008



2. Introduction to Space-Time Wireless Communication, A. Paulraj, R. Nabar and D. Gore, Cambridge University Press, 2003.
3. Digital Communication over Fading Channels, M. Simon and M. Alouini, 2nd edition, John Wiley and Sons, 2005.
4. Mobile Wireless Communications, Mischa Schwartz-Cambridge University Press.

Course Outcome:

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

Apply the basic principles of mobile communication system

ETU821(A).1 Identify and describe the development and implementation of mobile communication systems
ETU821(A).2 Analyze the Mobile radio propagation, fading, diversity concepts and the channel modeling.
ETU821(A).3 Discuss the cellular system design and technical challenges.
ETU821(A).4 Test mobile communication equipment for the technical functionality.

NPTL Course on Mobile Communication https://nptel.ac.in/courses/117/104/117104099/

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU821(A).1	3	2	1	1	1	0	0	0	0	0	1	1	3	1	1
ETU821(A).2	3	3	1	1	1	0	0	0	0	0	1	1	3	1	1
ETU821(A).3	1	2	3	0	1	0	0	0	0	0	0	1	1	2	1
ETU821(A).4	2	2	2	1	0	0	0	0	0	0	0	0	2	1	1
ETU821(A).5	0	0	1	0	1	0	0	0	0	0	0	1	1	0	0

0-Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU821(B)SPEECH PROCESSING

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2.30hrs

Course Objectives:

To make the student able

I. To provide an introduction to speech processing oriented to human computer interaction.
II. To understand the basic principles of sound and speech production and perception.
III. To understand the basic principles of speech recognition, synthesis and dialogue systems.
IV. To obtain an introductory overview in the field.

Introduction to speech processing, Digitization and Recording of speech signal, Review of Digital Signal Processing Concepts.

Speech production and modeling : Human Auditory System, General structure of speech coders, Acoustic Phonetics and Articulatory Phonetics, Different categories speech sounds and Location of sounds in the acoustic waveform and spectrograms

Classification of speech coding techniques: Parametric, Waveform and Hybrid, Requirements of speech codecs: quality, coding delays, robustness, Speech Signal Processing, Pitch-period estimation, all-pole and all-zero filters, convolution, Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

Linear Prediction Coding: Block diagram of Simplified Model for Speech Production. Basic Principles of Linear Predictive Analysis- The Auto Correlation Method. The Prediction Error Signal. Digital Speech Processing for Man-Machine Communication by voice. Speaker Recognition Systems- Speaker verification and Speaker Identification Systems. Audio Deep Learning: Automatic Speech Recognition (ASR).

Text Books:

1. "Digital Speech" by A.M.Kondoz, Second Edition (Wiley Students Edition), 2004.
2. Lawrence R Rabiner and Ronald W Schafer, Introduction to Digital Speech Processing (Foundations and Trends in Signal Processing).2007.

Reference Books:

1. "Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", W.C. Chu, WileyInter science, 2003.

Member Secretary (Dr. S.S. Thakare) | Chairman, BoS (Dr. P.R.Deshmukh) | Principal (Prof. A.M.Mahalle)

2. "Digital Speech Processing: Synthesis, and recognition", Sadaoki Furui, Second Edition

Course Outcomes:

At the end of this course students will be able to

ETU821(B).1 Mathematically model the speech signal.
ETU821(B).2 Analyze the quality and properties of speech signal.
ETU821(B).3 Modify and enhance the speech and audio signals.
ETU821(B).4 Design and implement the methods and systems for efficient quantization coding of speech signals.
ETU821(B).5 Solve the problems regarding various methods in speech processing.

SWAYAM/NPTEL course on Digital Speech Processing (IIT Kharagpur): PEC-AI-508 Speech Processing https://nptel.ac.in/courses/117/105/117105145

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU821(B).1	1	1	0	1	2	0	0	3	0	0	0	0	1	2	3
ETU821(B).2	3	1	3	3	0	3	0	0	0	0	0	3	1	3	3
ETU821(B).3	0	1	2	3	3	0	0	0	0	0	0	0	2	2	0
ETU821(B).4	3	2	1	0	3	0	0	0	0	0	0	0	1	2	0
ETU821(B).5	2	2	2	3	0	0	0	0	0	0	0	0	2	1	0

0-Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU821(C) MEMS TECHNOLOGY

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2.30hrs

Course Objectives:

To make the student able

I To review the MEM systems and smart materials
II To familiarize with the various MEMS application areas
III To apply the knowledge of MEMS principle and smart materials to make a specialized system

Review of Micro-Electromechanical systems: Need of Miniaturization, Smart Materials, Structures and Systems, Applications of Smart Materials and Microsystems. Micro/Nano Sensors, Actuators and Systems.

MEM Structures and Systems in Industrial and Automotive Applications: General Design Methodology, Techniques for Sensing and Actuation, Passive Micromachined Mechanical Structures, Sensors and Analysis Systems, Actuators and Actuated Microsystems.

MEM Structures and Systems in Photonic Applications: Imaging and Displays, Fiber-Optic Communication Devices.

MEMS Applications in Life Sciences: Microfluidics for Biological Applications, DNA Analysis, Microelectrode Arrays, Advances in Application for Health.

MEM Structures and Systems in RF Applications: Signal Integrity in RF MEMS, Passive Electrical Components, Microelectromechanical Resonators, Switches.

Text Books:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, 'Micro and Smart Systems', Wiley India, 2012.
2. Nadim Maluf, Kirt Williams, 'An Introduction to Microelectromechanical Systems Engineering', 2nd edition, Artech House Inc.

Reference Books:

1. Vikas Choudhary, Krzysztof Iniewski, 'MEMS: Fundamental Technology and Applications', CRC pres.
2. Stephen D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
3. Laurent A. Francis, Krzysztof Iniewski, 'Noval Advances in Microsystems Technologies and their Applications', CRC press, 2014

Member Secretary	Chairman, BoS	Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)	(Prof. A.M.Mahalle)

Course Outcomes:

After completing this course, students will:

ETU821(C)1 Realise the importance of MEM system and smart materials.
ETU821(C)2 Apply the principle of MEM structures in various application fields.
ETU821(C)3 Understand the working of MEM application systems
ETU821(C)4 Demonstrate the principles of MEM to model applications.

SWAYAM/NPTEL or any other platform course on Micro and nano fabrication – MEMS https://www.edx.org/course/micro-and-nanofabrication-mems

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU821(C).1	2	2	1	1	0	1	1	1	3	1	1	1	2	1	1
ETU821(C).2	3	3	2	1	1	1	2	1	3	1	1	1	3	1	1
ETU821(C).3	2	2	2	1	1	1	2	1	3	1	1	1	2	1	1
ETU821(C).4	3	3	3	1	2	2	3	1	3	1	2	3	3	2	2

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU821(D) ARTIFICIAL INTELLIGENCE

Teaching Scheme: 03L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

ESE duration: 2.30hrs

Course Objectives: The students shall be able to

I. familiar with basic principles of AI
II. capable of using heuristic searches
III. aware of knowledge-based systems

Fundamentals of Artificial Intelligence: Introduction, A.I. Representation, Non-AI & AI Techniques, Representation of Knowledge, Knowledge Base Systems, State Space Search, Production Systems, Problem Characteristics, types of production systems, Intelligent Agents and Environments, concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation

Uninformed Search Strategies: Formulation of real-world problems, Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening Depth First Search, Bidirectional Search, Comparison of Uninformed search Strategies, Searching with partial information, Sensor-less problems, Contingency problems.

Informed Search Strategies: Generate & test, Hill Climbing, Best First Search, A* and AO* Algorithm, Constraint satisfaction, Game playing: Minimax Search, Alpha-Beta Cut-offs, Waiting for Quiescence

Knowledge Representation: Knowledge based agents, Wumpus world. Propositional Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining. First order Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining.

Uncertain Knowledge and Reasoning: Uncertainty, probability, Bayesian networks, probabilistic reasoning, dynamic Bayesian networks, concepts of probabilistic programming, probabilistic logic.

Applications of Artificial Intelligence: Smart transportation & smart vehicles using ai, smart grid computing & technologies, geographical information system, smart city, security and intrusion detection, future communications and computing.

Text Books:

1. Elaine Rich and Kevin Knight: "Artificial Intelligence." Tata McGraw Hill
2. Stuart Russell & Peter Norvig : "Artificial Intelligence : A Modern Approach", Pearson Education, 2nd Edition.



Reference Books:

1. Eugene, Charniak, Drew Mcdermott: "Introduction to Artificial Intelligence.", Addison Wesley
2. Patterson: Introduction to AI and Expert Systems, PHI
3. Nilsson: Principles of Artificial Intelligence, Morgan Kaufmann.
4. S. Kanimozhi Suguna, M. Dhivya, Sara Paiva, Artificial Intelligence (AI) Recent Trends and Applications, CRC Press, 1st Edition, 2021

Course Outcomes:

On successful completion of the course the students will be able to:

ETU724(D).1 Identify appropriate AI methods to solve given problems.
ETU724(D).2 formulation of real-world problems using search strategies.
ETU724(D).3 Acquire skills on knowledge representation, natural deduction, and dealing with uncertainty.
ETU724(D).4 Implement basic AI algorithms and identify their scale which the state of art AI applications are using.

SWAYAM/NPTEL or any other platform on An Introduction to Artificial Intelligence, IITD https://onlinecourses.nptel.ac.in/noc22_cs56/preview

CO- PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU724(D).1	2	2	1	1	1	1	1	0	0	0	0	0	1	1	1
ETU724(D).2	2	3	2	3	2	1	2	1	0	0	0	0	2	1	1
ETU724(D).3	3	3	2	2	2	3	2	1	0	0	0	0	3	2	1
ETU724(D).4	1	1	3	3	2	1	2	1	0	0	0	0	3	3	1

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)

ETU822A). PROJECT OR B). INDUSTRY INTERNSHIP PROJECT

Teaching Scheme: 26P **Total: 26** **Credits: 13**

Evaluation Scheme: 200 ICA + 200 ESE **Total Marks: 400**

ESE duration: ----

Course Objectives:

- **I.** To encourage the students to make a meaningful intellectual commitment to an engineering problem.
- **II.** To help in the development of one of the most important attributes of an engineer - self-discipline.
- **III.** To emphasis the use of fundamental concepts, and use of texts and references.
- **IV.** To emphasis the presentation of technical material by informal summary reports, drawings, formal reports and presentations.
- **V.** To help the students to critically evaluate their own work

Students are expected to complete work pertaining to following aspects:

A) Project

1. In general, a group of 3-6 students should be allowed to complete the project on Approved topic.

2. Preferably more than 25 % projects shall be Industry / Research based / oriented.

3. Exhaustive survey of literature based on a clear definition of the scope and focus of the topic should be carried out by the students.

4. Students should finalize the topic for the project after literature survey in consultation with the Guide.

5. The Synopsis/Abstract on the selected topic should be submitted to the Program Head for approval.

6. On approval of the topic, students should initiate the topic based work.

7. Students should complete implementation of ideas given in synopsis, so that project work should be completed before end of semester.

8. Students shall submit the final project report in proper format as per guidelines given on the college website.

9. For uniform and continuous evaluation, evaluation committee for each group shall be formed by Program Head in which guide must be a member. Internal marks should be awarded by committee at the end of semester based on continuous evaluation.

Member Secretary (Dr. S.S. Thakare)	Chairman, BoS (Dr. P.R.Deshmukh)	Government College of Engineering Amravati	Principal (Prof. A.M.Mahalle)

10. Final examination of project shall include demonstration, presentation of complete work and oral examination based on the project work.

B) Industry Internship Project

1. The aim of Industry Internship Project is to provide the impactful strategy for creating a future talent pool for the industry .This gives a student an opportunity to solve the real industrial problems with innovative solutions
2. The students can work in group / individually decided by the department as per availability of the industry project. Each student / Group of student will have a Industry Mentor in the industry and Faculty guide in the institute.
3. Students /Group select the industry which is ready to provide Industry Internship Project through communication with industry through proper channel or through AICTE internship portal. The student/Group need to submit acceptance letter from Industry stating the approved topic of the project from Industry & Institute. Also students need to accept the institute internship policy if any with proper procedure before joining the internship.
4. Students will not get any financial assistance from the institute but can accept the stipend provided by the industry if given.
5. The meeting with Project guide is once within week/two week at Institute. These meetings typically include assistance in finding solutions recent problems in the projects, technical support on applied software packages, and support with writing the final report.
6. Industry Internship Project includes seminars/presentation to share the experience and knowledge to a larger audience. The Project monitoring will be done by Institute Guide & Industry guide to know whether learning objective is achieved or not.
7. Students undergone the Industry Internship Project will have to submit following documents on the successful completion of Industry Institute Project
   i. Authenticated attendance record from Industry internship project mentor/supervisor/Guide
   ii. Industry internship project signed by Industry Mentor/Guide
   iii. Industry internship project Completion Letter by Industry Mentor/ Guide
   iv. Project evaluation report signed by Industry Mentor/ Guide

Note:

ICA: The Internal Continuous Assessment shall be based on the active participation of the students in the Project work and knowledge / skill acquired. Oral examination shall be conducted on the Project report, by the panel of examiners consisting of Project Guide, Course Coordinator and Expert appointed by Program Head

ESE: The End Semester Examination for Project shall consist of demonstration if any, presentation and oral examinations based on the project report.

Member Secretary	Chairman, BoS	Principal
(Dr. S.S. Thakare)	(Dr. P.R.Deshmukh)	(Prof. A.M.Mahalle)

Course Outcomes:

On successful completion of the course students will be able to:

ETU822.1 Demonstrate a sound technical knowledge of their selected project topic.
ETU822.2 Undertake problem identification, formulation and solution.
ETU822.3 Design engineering solutions to complex problems utilising a systems approach.
ETU822.4 Conduct an engineering project.
ETU822.5 Demonstrate the knowledge, skills and attitudes of a professional engineer.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETU822.1	2	2	1	1	1	1	1	1	3	1	1	1	2	1	1
ETU822.2	3	3	2	1	1	1	2	1	3	1	1	1	3	1	1
ETU822.3	2	2	2	1	1	1	2	1	3	1	1	1	2	1	1
ETU822.4	2	2	2	1	1	1	2	1	2	1	1	1	3	1	1
ETU822.5	3	3	3	1	2	2	3	1	3	1	2	3	3	2	2

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3-Strongly Correlated

Member Secretary
(Dr. S.S. Thakare)

Chairman, BoS
(Dr. P.R.Deshmukh)

Principal
(Prof. A.M.Mahalle)