Electronics & Telecommunication Engineering Department

Curriculum: BE(E&TC) w.e.f 2015-16

Approved in 12th Academic Council held on 18/04/2015

Electronics & Telecommunication Engineering Department

Program Educational Objective(s)	
After graduation and few years of graduation, the Electronics & Telecommunication Engineering graduates would	
PEO 1	Core Competency: Graduates will provide engineering solutions with strong base of science and mathematics, subject domain knowledge for challenging problems in Electronics and allied disciplines.
PEO 2	Career Building: Graduates will fulfill professional responsibilities effectively by synergizing theoretical and practical skills.
PEO 3	Technical Proficiency: Graduates will practice analytical, creative, innovative skills for higher education, research, industrial development.
PEO 4	Managerial Skills: Graduates will perform cohesively in group using moral, ethical practice, managerial, entrepreneurial skills for welfare of society with global outlook.

Electronics & Telecommunication Engineering Department

Programme Outcomes (POS)

Programme Outcomes describe what students are expected to know or be able to do by the time of graduation from the programme. The POs for Under Graduate Course in Electronics and Telecommunication Engineering are able to

1. Apply knowledge of mathematics, science and technical fundamentals for solutions of domain problems
2. Identify, formulate, review the literature, analyze the complex engineering problems
3. Design and implement the systems' components and processes serving the needs of safety, environment and society
4. Perform experiment, analyze and interpret results
5. Use modern tools and technical skills necessary for electronic system development
6. Understand the impact of electronics in modern era
7. Explore the needs of society for sustainable development and human values
8. Understand professional, ethical and legal responsibilities
9. Work effectively in diverse and multidisciplinary tasks, to accomplish common goal
10. Communicate effectively
11. Engage in continuing educational / professional, entrepreneurship development
12. Apply electronics engineering and management principles / skills, as a member and leader in a team to solve social and industrial problems

Mapping of PEOs and POs

Program Educational Objective(s)		Mapped Programme Outcomes
PEO 1	Core Competency: Graduates will provide engineering solutions with strong base of science and mathematics, subject domain knowledge for challenging problems in Electronics and allied disciplines.	1,2,3,4,5,6
PEO 2	Career Building: Graduates will fulfill professional responsibilities effectively by synergizing theoretical and practical skills.	6,7,8,9,10,11,12
PEO 3	Technical Proficiency: Graduates will practice analytical, creative, innovative skills for higher education, research, industrial development.	1,2,3,4,5,6,9,11
PEO 4	Managerial Skills: Graduates will perform cohesively in group using moral, ethical practice, managerial, entrepreneurial skills for welfare of society with global outlook.	7,8,9,10,11,12

GOVERNMENT COLLEGE OF ENGINEERING, AURANGABAD
(An Autonomous Institute of Government of Maharashtra)

Department of Electronics & Telecommunication Engineering

Teaching and Evaluation Scheme
BE (Full-Time) in Electronics & Telecommunication Engineering
SEMESTER-I
Proposed structure for BE (E&TC) to be implemented from 2015-2016

S. No.	Course Code	Subject	Programme Outcome	Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)					
				L	T	P		Theory			Term Work	Practical /Vivavoce	Total
								Test	TA	ESE			
	THEORY COURSES												
1	ET441	Power Electronics	1,2,3,4,5,6,7,8, 9,10,11,12	3	-	-	3	20	20	60	-	-	100
2	ET442	Embedded Systems	1,2,3,4,5,12	4	-	-	4	20	20	60	-	-	100
3	ET443	Microwave Engineering	1,2,3,4,6,12	3	1	-	4	20	20	60	-	-	100
4	ET444	Computer Network	2,3,4,5,8,11, 12	3	-	-	3	20	20	60	-	-	100
5	ET445 - ET447	Elective II											
	ET445	Digital Image Processing	1,2,3,10,11,12	3	1	-	4	20	20	60	-	-	100
	ET446	Information Theory & Coding	1,2,3,7,10	3	1	-	4	20	20	60	-	-	100
	ET447	Radar & Satellite Communication	1,2,6,10	3	1	-	4	20	20	60	-	-	100
	LABORATORY COURSES												
1	ET448	Lab Power Electronics	2,3,5,6,7,8, 11,12	-	-	2	1	-	-	-	25	25	50
2	ET449	Lab Embedded Systems	1,3,4,5,12	-	-	2	1	-	-	-	25	25	50
3	ET450	Lab Microwave Engineering	1,2,3,4,5,6, 10,12	-	-	2	1	-	-	-	25	-	25
4	ET451	Lab Computer Network	3,4,5,8,11,12	-	-	2	1	-	-	-	25	-	25
5	ET452 - ET454	Lab Elective II											
	ET452	Lab Digital Image Processing	4,5,11,12	-	-	2	1	-	-	-	25	25	50
	ET453	Lab Information Theory & Coding	1,2,3,4,5,7,9, 10	-	-	2	1	-	-	-	25	25	50
	ET454	Lab Radar & Satellite Communication	1,4,5	-	-	2	1	-	-	-	25	25	50
6	ET455	Project Part I	2,3,5,6,7,9,10, 11,12	-	-	2	1				50	-	50
				16	**2**	**12**	**24**	**100**	**100**	**300**	**175**	**75**	**750**

L-Lectures, T-Tutorials, P-Practical, TA-Teacher Assessment, ESE-End-Semester Examination

Elective II: ET445 (i) Digital Image Processing ET446 (ii) Information Theory & Coding ET447 (iii) Radar & Satellite Communication

GOVERNMENT COLLEGE OF ENGINEERING, AURANGABAD
(An Autonomous Institute of Government of Maharashtra)

Department of Electronics & Telecommunication Engineering

Teaching and Evaluation Scheme
BE (Full-Time) in Electronics & Telecommunication Engineering
SEMESTER-II
Proposed structure for BE (E&TC) to be implemented from 2015-2016 SEMESTER-II

THEORY COURSES													
S. No.	**Course Code**	**Subject**	**Programme Outcome**	**Scheme of Teaching (Hrs/Week)**			**Total Credits**	**Scheme of Evaluation (Marks)**					
								Theory			**Term Work**	**Practical /Vivavoce**	**Total**
				L	**T**	**P**		**Test**	**TA**	**ESE**			
1	ET456	Wireless Communication	1,2,3,4,5,6, 10	4	-	-	4	20	20	60	-	-	100
2	ET457	Industrial Automation	2,3,5,12	4	-	-	4	20	20	60	-	-	100
3	ET458	Optical Fiber Communication	1,2,3,5,10,11	3	1	-	4	20	20	60	-	-	100
4	ET459	Android Applications Development	1,3,4,5,7,11	2	-	-	2	25	25	-	-	-	50
5	ET460 - ET462	Elective III											
	ET460	Cloud Computing	1,2,5,10	3	1	-	4	20	20	60	-	-	100
	ET461	Antenna & Wave Propagation	1,2,3,10,11	3	1	-	4	20	20	60	-	-	100
	ET462	Micro Electro Mechanical Systems	1,2,3,4,5,6,8, 9,10	3	1	-	4	20	20	60	-	-	100
LABORATORY COURSES													
1	ET463	Lab Wireless Communication	1,4,5,6,8,9, 11,12	-	-	2	1	-	-	-	25	25	50
2	ET464	Lab Industrial Automation	2,3,4,5,6,10, 11,12	-	-	2	1	-	-	-	25	-	25
3	ET465	Lab Optical Fiber Communication	3,4,5	-	-	2	1	-	-	-	25	-	25
4	ET466 - ET468	Lab Elective III											
	ET466	Lab Cloud Computing		-	-	2	1	-	-	-	25	25	50
	ET467	Lab Antenna & Wave Propagation	4,5,10	-	-	2	1	-	-	-	25	25	50
	ET468	Lab Micro Electro Mechanical Systems	2,3,5,6,7,8, 11,12	-	-	2	1	-	-	-	25	25	50
5	ET469	Lab Project Part II	2,3,4,5,6,7,9, 10,11,12	-	-	4	2	-	-	-	50	100	150
				16	**2**	**12**	**24**	**105**	**105**	**240**	**150**	**150**	**750**

L-Lectures, T-Tutorials, P-Practical, TA-Teacher Assessment, ESE-End-Semester Examination

Elective III: ET460 (i) Cloud Computing ET461 (ii) Antenna & Wave Propagation ET462 (iii) Micro Electro Mechanical Systems

GOVERNMENT COLLEGE OF ENGINEERING, AURANGABAD

(An Autonomous Institute of Government of Maharashtra)

Department of Electronics & Telecommunication Engineering

Teaching and Evaluation Scheme

BE(Part-Time) in Electronics & Telecommunication Engineering

Sr No.	Course Code	Subject	Programme Outcome	Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)					
				L	T	P		Theory			Term Work	Practical/Viva-voce	Total
								Test	TA	ESE			
THEORY COURSES													
Semester I													
1	ET441	Power Electronics	1,2,3,4,5,6,7,8,9,10,11,12	3	-	-	3	20	20	60	-	-	100
2	ET442	Embedded Systems	1,2,3,4,5,12	4	-	-	4	20	20	60	-	-	100
3	ET443	Microwave Engineering	1,2,3,4,6,12	3	1	-	4	20	20	60	-	-	100
	Laboratory Courses												
4	ET448	Lab- Power Electronics	2,3,5,6,7,8, 11,12	-	-	2	1	-	-	-	25	25	50
5	ET449	Lab-Embedded Systems	1,3,4,5,12	-	-	2	1	-	-	-	25	25	50
6	ET450	Lab- Microwave Engineering	1,2,3,4,5,6, 10,12	-	-	2	1	-	-	-	25	-	25
		Total for Sem I		**10**	**01**	**06**	**14**	**60**	**60**	**180**	**75**	**50**	**425**
Semester II													
1	ET444	Computer Network	2,3,4,5,8,11, 12	3	-	-	3	20	20	60	-	-	100
2	ET445 - ET447	Elective II											
	ET445	Digital Image Processing	1,2,3,10,11,12	3	1	-	4	20	20	60	-	-	100
	ET446	Information Theory & Coding	1,2,3,7,10	3	1	-	4	20	20	60	-	-	100
	ET447	Radar & Satellite Communication	1,2,6,10	3	1	-	4	20	20	60	-	-	100
3	ET456	Wireless Communication	1,2,3,4,5,6, 10	4	-	-	4	20	20	60	-	-	100
4	ET459	Android Applications Development	1,3,4,5,7,11	2	-	-	2	25	25	-	-	-	50
	Laboratory Courses												
5	ET451	Lab- Computer Network	3,4,5,8,11,12	-	-	2	1	-	-	-	25	-	25
6	ET452-ET454	Lab- Elective II											
	ET452	Lab Digital Image Processing	4,5,11,12	-	-	2	1	-	-	-	25	25	50
	ET453	Lab Information Theory & Coding	1,2,3,4,5,7,9, 10	-	-	2	1	-	-	-	25	25	50
	ET454	Lab Radar & Satellite Communication	1,4,5	-	-	2	1	-	-	-	25	25	50
7	ET463	Lab- Wireless Communication	1,4,5,6,8,9, 11,12	-	-	2	1	-	-	-	25	25	50

8	ET455	Project Part I	2,3,5,6,7,9,10, 11,12	-	-	2	1	-	-	-	50	-	50
		Total for Sem II		**12**	**01**	**08**	**17**	**85**	**85**	**180**	**125**	**50**	**525**
		Semester III											
1	ET457	Industrial Automation	2,3,5,12	4	-	-	4	20	20	60	-	-	100
2	ET458	Optical Fiber Communication	1,2,3,5,10,11	3	1	-	4	20	20	60	-	-	100
3	ET460 to ET462	Elective III											
	ET460	Cloud Computing	1,2,5,10	3	1	-	4	20	20	60	-	-	100
	ET461	Antenna & Wave Propagation	1,2,3,10,11	3	1	-	4	20	20	60	-	-	100
	ET462	Micro Electro Mechanical Systems	1,2,3,4,5,6,8,9 , 10	3	1	-	4	20	20	60	-	-	100
	Laboratory Courses												
4	ET464	Lab- Industrial Automation	2,3,4,5,6,10,1 1,12	-	-	2	1	-	-	-	25	-	25
5	ET465	Lab- Optical Fiber Communication	3,4,5	-	-	2	1	-	-	-	25	-	25
6	ET466 to ET468	Lab- Elective III											
	ET466	Lab Cloud Computing		-	-	2	1	-	-	-	25	25	50
	ET467	Lab Antenna & Wave Propagation	4,5,10	-	-	2	1	-	-	-	25	25	50
	ET468	Lab Micro Electro Mechanical Systems	2,3,5,6,7,8, 11,12	-	-	2	1	-	-	-	25	25	50
7	ET469	Lab-Project Part II	2,3,4,5,6,7,9, 10,11,12	-	-	4	2	-	-	-	50	100	150
		Total for Sem III		**10**	**02**	**10**	**17**	**60**	**60**	**180**	**125**	**150**	**550**

L-Lectures, T-Tutorials, P-Practical, TA-Teacher Assessment, ESE-End-Semester Examination

Elective II:(i) ET445 Digital Image Processing (ii) ET446 Information Theory & Coding (iii) ET447 Radar & Satellite Communication

Elective III: (i) ET460 Cloud Computing (ii) ET461 Antenna & Wave Propagation (iii) ET462 MEMs

ET441: Power Electronics	
Teaching Scheme **Lectures: 3Hrs/Week**	**Examination Scheme** **Test : 20 Marks** **Teachers Assessment: 20 Marks** **End Semester Exam: 60 Marks**

Prerequisites: Knowledge of Circuit Analysis, fundamental electronics circuits, differential equations and Calculus

Course description: Power electronics deals with the application of solid-state electronics for the control and conversion of electric power. The course is an introduction to power converters and its application. It provides a basic knowledge of circuitry for the control and conversion of electrical power with high efficiency. These converters can change and regulate the voltage, current, or power

Course Objectives:

To enable students to gain knowledge and understanding in the following aspects:

1. To enhance knowledge and understanding of power electronic devices and their application in power electronic converters and selection of components for different applications
2. The concepts and operating principles of power electronics circuits.
3. Design procedures and techniques of power electronics systems & Design of power electronics circuits such as DC/DC, AC/DC, DC/AC and AC/AC converters
4. To enhance the knowledge and understanding of power electronic converters and their application in power electronic systems
5. To provide students with the skills and techniques necessary to analyze and synthesize power electronic circuits utilizing modern power electronic devices.

Course Outcomes

After completing the course, students will able to:

CO1	Understand the fundamental principles and applications of power electronics circuits
CO2	Solve problems and design of device and convertors according to specifications or Ability to analyze and design ac-to-dc circuit/ design dc-to-dc converters/ dc-to-ac inverters.
CO3	Use computer skills (e.g., PSPICE and MATLAB)for the design of power converter circuits
CO4	Appreciate the latest developments in power electronics.
CO5	Communicate effectively.
CO6	Think critically and creatively.
CO7	Assimilate new technological and development in related field.

Detailed Syllabus:

Unit 1	**Power Semiconductor Devices**: Power diodes, Power transistors, Thyristors, IGBT, GTO,TRIAC,DIAC, UJT,PUT and other Member of Thyristor Family: Their principles, Characteristics, and Ratings and specifications, SCR Firing, Gate triggering circuits. Commutation circuit, Gate drive circuit, Protection circuits.
Unit 2	**Phase Controlled Rectifiers**: Phase angle control, phase cntrolled rectifiers, 1-phase/3-Phase, half wave, full wave , half controlled full controlled , Half controlled bridge rectifier, Three pulse, six pulse three phase converters
Unit 3	**Cycloconverter:** Single phase to single phase cycloconverter, Three phase half wave cycloconverters, cycloconverter circuits for three phase outputs. Dual Converters, A.C. Regulaters
Unit 4	**Chopper and Inverter:** Basic chopper classification, Basic chopper operation, Control strategies, Chopper configuration, Thyristor chopper circuit, Source filter. Classification of inverter, Single Phase: Half bridge voltage source inverters, Full bridge inverter, Performance parameter of inverter, Voltage control of inverter, PWM inverter, Three phase inverter, Classification of Resonant Converter : Series resonant inverters, Parallel inverter, Current source Inverter ,Harmonic reduction
Unit 5	**Power Electronics Application:** Battery charging regulator, Flasher circuits, Protective SCR circuits, Time delay circuits, Static relay, Emergency lightening system, Single phase preventor, Servo controlled voltage stabilizer, Temp Controller, Static circuit breaker, AC/DC drive control circuits

Text and Reference Books

1. P.C. Sen , " Power Electronics ", Tata McGraw Hill
2. M.H. Rashid , " Power Electronics " , John Wiley & Sons
3. General Electric, " SCR manual "
4. G. K. Dubey, S. R Doradle, " Thyristorised Power Controller "
5. J. M. Jalnekar and N. B. Pasalkar, " Power Electronics " Technical Publication
6. Ned Mohan, T.M. Undeland and W.P. Robbins, " Power Electronics: Converters, Applications and Design", John Wiley, Singapore, 1994
7. M D Singh and K. B Khanchandani, " Power Electronics ", Tata McGraw Hill
8. B.K.Bose, "Power Electronics & A.C. Drives", Prentice Hall, 1986.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2		1							
CO2		2	2		1							
CO3				2	1	3						
CO4			2			3	3					
CO5								3	3	3		
CO6												
CO7											1	2

1 – High2 – Medium3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Simulation
2) Application development
3) Power point presentation of case studies
4) Question & answer / Numerical solution
5) Study of Industry processes and its presentation
6) Design Project
7) Quizzes
8) Laboratory Work
9) Tutorials

Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	05	00	15
K2	Understand	10	05	20
K3	Apply	05	10	15
K4	Analyze	00	05	10
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K4	K3	K2	K3	K2
	CO1	CO2	CO3	CO4	CO5	CO6	CO7
Class Test (20 Marks)	04	04	04	04	00	04	00
Teachers Assessment (20 Marks)	05	05	00	00	05	05	00
ESE Assessment (60 Marks)	15	10	10	15	00	10	10

Special Instructions if any: Nil

Designed by
1.R.P.Chaudhari
2.N.R.Kolhare

ET442: Embedded Systems	
Teaching Scheme **Lectures: 4 Hrs/Week**	**Examination Scheme** **Test : 20 Marks** **Teachers Assessment : 20 Marks** **End Semester Exam : 60 Marks**

Prerequisites: Basic knowledge of microcontroller and processor

Course description: After completing this course, students will have a broad and fundamental understanding of Embedded System. Topics range from an overview of Basics of Embedded System, ARM processor's introduction, programs based on ARM processor using Embedded C, Overview of Real Time Embedded System.

Course Objectives:

- To provide a clear view on Embedded System
- To accustom with ARM Processor architecture and Embedded C Programming for industrial applications
- To familiarize with Real Time Operating System

Course Outcomes
After completing the course, students will able to:

CO1	Express the evolution of Embedded Systems and associated device and their development
CO2	Illustrate simple programs in 'Embedded C'
CO3	IllustrateARM processor architecture and its applications
CO4	Develop programming using ARM processor for interface of various peripherals for engineering solutions
CO5	Explain the RTOS and implement embedded based applications for industrial automation

Detailed Syllabus:

Unit 1	**Introduction To Embedded Systems** Definition and Classification: Overview of Processors and hardware units in an embedded system – Software embedded into the system, Processor and memory organization, Structural units in processor, Processor selection, Embedded system project design and management, Design issues in system development process, Design cycle in development phase.
Unit 2	**Devices and Buses for Device Network** I/O Devices, Timer and counting devices, Serial communication, Synchronous and asynchronous communications, I^2C, USB, CAN, Advanced I/O Serial High Speed Buses : ISA, PCI, PCIX
Unit 3	**ARM Architecture** ARM Design Philosophy, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table, Architecture Revision, ARM Processor Families.

Unit 4	**ARM Programming Model** Simple C Programs using Function Calls, Pointers, Structures, Integer and Floating Point Arithmetic, Assembly Code using Instruction Scheduling, Register Allocation, Conditional Execution and Loops, Case studies of embedded system development using ARM and programming with real time operating systems for industrial applications
Unit 5	**Real Time Operating Systems** Operating system services, I/O subsystems, Network operating systems, Real-time and embedded system operating system,, Interrupt routines and interrupt handling in RTOS, Task scheduling models, Performance metric in scheduling models, OS security issues

Text and Reference Books:

1. Raj Kamal, Embedded Systems, Architecture, Programming and Design, TATAMcGrawHill.
2.Steve Heath, Embedded Systems Design, Second Edition, 2003, Newness.
3.David E. Simon, An Embedded Software Primer, Pearson Education Asia.
4. Andrew Sloss, ARM System Developers Guide, second Edition, Morgan Kaufmann publication

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		1			3							
CO2				1	2							
CO3	1											
CO4			1									
CO5					1							2

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Simulation
2) Application development
3) Power point presentation of case studies
4) Question & answer / Numerical solution
5) Study of Industry processes and its presentation
6) Mini projects

Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	00	00	00
K2	Understand	15	05	25
K3	Apply	05	05	30
K4	Analyze	00	10	05
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	**K2**	**K2**	**K3**	**K4**	**K2**
	CO1	**CO2**	**CO3**	**CO4**	**CO5**
Class Test (20 Marks)	10	10	00	00	00
Teachers Assessment (20 Marks)	00	05	05	10	00
ESE Assessment (60 Marks)	05	10	30	05	10

Designed by

1. Prof. S.R. Hirekhan
2. Prof. R.P. Chaudhari
3. Prof. S.R. Kulkarni

ET443: Microwave Engineering	
Teaching Scheme **Lectures: 3 Hrs/Week** **Tutorials: 1 Hr/Week**	**Examination Scheme** **Test : 20 Marks** **Teachers Assessment : 20 Marks** **End Semester Exam : 60 Marks**

Prerequisites: ET354 Electromagnetic Engineering& ET251 Network & lines

Course description: After completing this course, students will have a fundamental understanding of microwave generation & applications. Learning this course students develop ability to simulate electrical characteristics of waveguide.
They also gain knowledge to analyze various parameters of microwave devices and develop ability of mathematical modeling using S-parameters.

Course Objectives:

- To develop conceptual understanding of microwave generation using tubes & solid state devices.
- To analyze microwave components and system behavior in terms of scattering parameters.
- To impart fundamental knowledge of microwave measurements & antenna.
- To provide hands-on training on engineering tools such as HFSS and RF instruments.

Course Outcomes
After completing the course, students will able to:

CO1	Understand generation of microwaves
CO2	Explain working of microwave passive devices
CO3	Formulate mathematical references of wave propagation in a waveguide
CO4	Explain various microwave measurements
CO5	Examine properties of all Tee junctions & ferrite devices using s-parameters

Detailed Syllabus:

Unit 1	**Introduction to Microwaves & waveguide:** Microwave band designations, Advantages and applications of Microwaves, Propagation of microwave in rectangular waveguides, TE and TM modes, Waveguide Cutoff Frequency, Guide wavelength, Group & Phase Velocity, **,** flexible waveguide.
Unit 2	**Microwave Passive Devices:** Terminators, Attenuators, Microwave filter, Scattering Parameters Tee junctions, Faraday's rotation, Circulators, Isolators, Directional couplers, Cavity Resonators, Impedance matching elements.
Unit 3	**Microwave Tubes & solid state devices**: Klystron, Reflex Klystron, TWT, Magnetron, PIN diode, Varactor diode, BJT, FET, IMPATT, TRAPATT, and GUNN diode, Gun Effect, Resonant Tunnel diode (RTDs).
Unit 4	**Microwave Measurements:** VSWR, Power, Cavity-Q, Antenna gain, Noise measurements, Microwave Integrated Circuits: Materials, Hybrid and monolithic MICS, Micro strip lines.
Unit 5	**Microwave Antenna:** Horn antenna, Slot antenna, Parabolic reflector, Cassegrain feed, Lens antennas, Broad side, End fire arrays.

Text and Reference Books

1. Samuel Y Liao, Microwave Devices and Circuits, PHI 3rd edition.
2. David M Pozar, Microwave Engineering, Wiley Publication 3rd Edition
3. Peter A Rizzi, Microwave Engineering, Passive circuits, PHI EEE
4. Annapurna Das Sisir K. Das Microwave Engineering, TATA Mc GRAW HILL
5. G.P. Srivastava and V.L. Gupta, Microwave Devices and Circuit Design, PHI, 1st Edition
6 K. C. Gupta, Microwave Engineering, New Age International Publisher

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1					1						
CO2				1		2						
CO3	1	2		1								
CO4						3						2
CO5	1		3	1								

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Quiz
2) Surprise Test
3) Power point presentation of advanced topic in detail
4) Question & answer / Numerical solution

Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	00	00	00
K2	Understand	10	15	35
K3	Apply	10	05	25
K4	Analyze	00	00	00
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K2	K2	K3	K2	K3
	CO1	CO2	CO3	CO4	CO5
Class Test (20 Marks)	00	10	10	00	00
Teachers Assessment (20 Marks)	05	05	00	05	05
ESE Assessment (60 Marks)	20	10	10	05	10

Special Instructions if any: Nil

Designed by

1. **Prof. M.R.Joshi**
2. **Dr.V.R. Ratnaparkhe**
3. **Dr. A.S. Bhalchandra**

ET444: Computer Network	
Teaching Scheme **Lectures: 3 Hrs/Week**	**Examination Scheme** **Test : 20 Marks** **Teachers Assessment : 20 Marks** **End Semester Exam : 60 Marks**

Prerequisites: You should have basic knowledge of digital communication systems and computers as a data terminal.

Course description: This course introduces the elements and architecture of computer and data communication networks, demonstrates the fundamental principles of computer networking, and provides experience in the practical use of current networking technology. Topics ranges from data communications architecture and protocols and network topologies, internetworking, routing and switching strategies and emerging high speed networks. You will also learn what careers may be available to you within this field.

Course Objectives:

To understand the various error controlling techniques in data communication networks
To learn the functions of different protocols
To understand TCP/IP & Application layer protocols and its uses in modern communication
To identify different components of data communication network

Course Outcomes

As an outcome of completing the course, students will able to:

CO1	Identify the issues and challenges in the architecture of a computer network and recognize security issues in a network.
CO2	Understand the ISO/OSI seven layers in a network.
CO3	Realize protocols at different layers of a network hierarchy.
CO4	Chose the require protocol and the communication modes for the given system
CO5	Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies
CO6	Analyze, specify and design the topological and routing strategies for an IP based networking infrastructure

Detailed Syllabus:

Unit 1	Data Communication, Networks, Protocols and Standards, Topology, Categories of Networks, OSI & TCP/IP Protocol suites Guided media, Unguided media
Unit 2	Data Link Layer Design Issues : Framing, Error control, Flow control, practical data link protocols, Medium Access Technique : Ethernet ,CSMA /CD protocol High speed LAN's like FDDI, Ethernet
Unit 3	Network Layer & Design Issues: Routing & congestion control algorithms, IP addressing ARP,RARP, OSPF & BGP, CIDR & IPV6 Transport Layer: Transport Protocols, Addressing, Establishing & releasing a connection Transport protocol for Internet TCP & UDP
Unit 4	Application Layer: DHCP, DNS, TELNET, FTP, SMTP, HTTP, WWW, VoIP, Introduction to Network security, Privacy, Digital Signature
Unit 5	A simple client-server implementation, A simple web server implementation, Networking simulation and modeling techniques. Case studies

Recommended Books:

1. BEHROUZ A. FOROUZAN, Data Communications and Networking, 2nd Edition, Tata McGraw-Hill, New Delhi, 2003
2. ANDREW S. TANENBAUM, Computer Networks, 4th Edition, Prentice-Hall of India, New Delhi, 2000.
3. WILLIAM STALLINGS, Data and Computer Communication, 6th Edition, Prentice Hall of India, New Delhi, 1999.
4. DOUGLAS E COMER, Computer Networks and Internet, Pearson Education Asia, 2000.
5. LARRY L. PETERSON AND BRUCE S. DAVIE, Computer Networks: A Systems Approach, 3rd edition (2003), Morgan Kaufmann Publishers.

List of Reference Sources for Classes and Assignments:

Request for Comments, Network Standards, available from http://www.rfceditor.org/rfcsearch.html;
IEEE Communications Magazine (technical journal)
IEEE Journal on Selected Areas in Communications (technical journal)
IEEE Network (technical journal)
IEEE Spectrum (technical journal)
IEEE Transactions on Communications (technical journal)
Resources available on e-learning site http://www.e-gecaect.com
Computer Networks and ISDN Systems (technical journal)
Cisco Systems Technical Journal

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					2			3				1
CO2		3										2
CO3												1
CO4			2		3							
CO5				1	3							1
CO6											2	1

1 – High 2 – Medium 3 – Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Simulation
2) Application development
3) Power point presentation of case studies
4) Question & answer / Numerical solution
5) Study of Industry processes and its presentation
6) Mini projects

Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	00	10
K2	Understand	10	05	20
K3	Apply	05	10	25
K4	Analyze	00	05	05
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K3	K3	K3	K4
	CO1	CO2	CO3	CO4	CO5	CO6
Class Test (20 Marks)	05	10	05	00	00	00
Teachers Assessment (20 Marks)	00	05	00	05	05	05
ESE Assessment (60 Marks)	10	20	10	10	05	05

Special Instructions if any: Nil

Designed by
1. Dr. A.R. Karwankar
2. Dr. S.D. Bharkad

ET445 : Digital Image Processing	
Teaching Scheme **Lectures: 03 Hrs/Week** **Tutorial: 01 Hr/Week**	**Examination Scheme** **Test : 20 Marks** **Teachers Assessment : 20 Marks** **End Semester Exam : 60 Marks**

Prerequisites: Knowledge of Digital Signal Processing

Course description: This course covers representation of image in matrix form. There are various operations carried out on image to boost the quality of image or to compress the image. Algorithms based on morphology, segmentation lead to important applications. Course covers all the spatial and frequency domain techniques for image enhancement. This also exposes to representation and classification of images.

Course Objectives:

To explain image matrix formation
To impart knowledge mechanisms spatial and frequency domain image enhancement techniques
To elaborate various morphological processes
To expose to segmentation techniques
To introduce applications of image processing

Course Outcomes:

After completing the course, students will able to:

CO1	Understand digital representation of image
CO2	Learn the signal processing algorithms for image enhancement and restoration
CO3	Appreciate image processing techniques and their applications to real world problem
CO4	Conduct independent study and analysis of image processing problems and techniques

Detailed Syllabus:

Unit 1	Fundamental of Image Processing: Image Sensing and Acquisition, Image Sampling and Quantization, Digital Image Representation, Basic Relationship between Pixels, Linear and Nonlinear Operations, Color Image Processing, Image formats Image Enhancement in Spatial Domain and Frequency Domain Filtering
Unit 2	Image Restoration: Models of Image Degradation /Restoration Process, Noise Models, Restoration in presence of Noise, Periodic Noise Reduction by Frequency Domain Filtering , Linear Position Invariant Degradation, Estimating Degradation Function , Inverse Filtering, Wiener Filtering, Constrained Least Square Filtering, Geometric Mean Filtering, Geometric Transformations
Unit 3	Image Compression: Fundamentals, Compression Models, Error Free Compression, Lossy Compression, Image Compression Standards
Unit 4	Morphology: Dilation, Erosion, Opening and Closing, Basic Morphological Algorithms, Gray Scale Morphology
Unit 5	Image Segmentation and Description: Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region Based Segmentation, Use of Motion in Segmentation, Representation and Description: Representation Schemes, Boundary Descriptors, Regional Descriptions, Relational Descriptors

Text and Reference Books

1. Rafel Gonzales and Richard Woods,Digital Image Processing, Third Edition, Pearson Education
2. A. K. Jain ,Fundamentals of Digital Image Processing, PHI
3. Aurthr Weeks,Fundamentals of Electronic Image Processing, PHI
4. Rafel Gonzales and Richard Woods, Digital Image Processing with MATLAB, Pearson Education

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2										
CO2		2	2									
CO3			2							1	1	1
CO4		3	2								1	1

1 – High2 – Medium3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Block Simulation
2) Application development
3) Case study on role of Image Processing in Industry processes, medical application etc. and its presentation

Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	10	00	12
K2	Understand	10	00	30
K3	Apply	00	10	12
K4	Analyze	00	10	06
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K2	K2	K3	K4
	CO1	CO2	CO3	CO4
Class Test (20 Marks)	10	10	00	00
Teachers Assessment (20 Marks)	00	00	10	10
ESE Assessment (60 Marks)	20	16	18	06

Special Instructions if any: Nil

Designed by
1. Dr.V.R.Ratnaparkhe
2. Dr.S.D.Bharkad
3. Dr.A.S. Bhalchandra

ET446 : Information Theory and Coding	
Teaching Scheme **Lectures: 3Hrs/Week** **Tutorials: 1 Hr/Week**	**Examination Scheme** **Test : 20 Marks** **Teachers Assessment : 20 Marks** **End Semester Exam : 60 Marks**

Prerequisites: Digital Communication, Mathematics IV

Course description: This course covers need of need of source coding, Channel coding. It also discusses about types of coding.

Course Objectives:

1. To give exposure to students about concepts of information, entropy ,coding efficiency
2. To explain need of data compression
3. To give mathematical foundation of compression, error control and security of information.
4. To give exposure to students about various source coding and channel coding

Course Outcomes
After completing the course, students will able to:

CO1	Describe fundamental concepts of information theory and source coding
CO2	Explain the need of Channel Coding
CO3	Design various types of Source coding and Channel Coding and decoding
CO4	Apply theoretical concepts to derive various codes for real world signal

Detailed Syllabus:

Unit 1	Information Theory, Entropy, Source coding theorem, Channel models, capacity and coding, Information capacity theorem, Shannon's Limit
Unit 2	Linear Block Coding/Decoding , Matrix description of Linear block codes, Hamming codes, optimal linear codes, Maximum Distance Separable codes
Unit 3	Cyclic Codes, Polynomials, Generation of Cyclic codes, matrix description of cyclic codes, Burst Error Correction, Fire Codes, Golay Codes, Cyclic Redundancy Check
Unit 4	BCH Coding /Decoding , Primitive elements, Minimal Polynomials, Generator Polynomials, Reed Solomon codes, Nested Codes
Unit 5	Convolutional Code, Tree Codes and trellis codes, Polynomial description of Convolutional Codes, Distance Notion, Generating function, Matrix description, Viterbi coding , Distance Bound , Performance bound, Turbo Coding/Decoding

Text and Reference Books

- Ranjan Bose, "Information Theory coding and Cryptography", McGraw-Hill Publication, 2nd Edition
- R. Avudaiammal, , Information Coding Techniques" Second Edition. Tata McGrawHill
- J C Moreira, P G Farrell, "Essentials of Error-Control Coding", Wiley Student Edition.
- Simon Haykin, "Communication Systems", John Wiley & Sons, Fourth Edition.

- Todd Moon, "Error Correction Coding : Mathematical Methods and Algorithms", Wiley Publication

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2									3		
CO2		2										
CO3	1	2	3				2					
CO4	1	2	3									

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

- Question & answer / Numerical solution
- Simulation
- Power point presentation of special topics
- Case study of real world application of 1-D and 2-D signal

Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	05	00	12
K2	Understand	15	10	36
K3	Apply	05	10	12
K4	Analyze	00	00	00
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K2	K3
	CO1	CO2	CO3	CO4
Class Test (20 Marks)	05	15	00	00
Teachers Assessment (20 Marks)	00	05	05	15
ESE Assessment (60 Marks)	06	12	30	12

Special Instructions if any: Nil

Designed by

1. Dr. Smt. A.S. Bhalchandra
2. Prof. N.R. Kolhare

ET447: Radar & Satellite Communication	
Teaching Scheme **Lectures: 3 Hrs/Week** **Tutorial: 1 Hr/Week**	**Examination Scheme** **Test : 20 Marks** **Teachers Assessment : 20 Marks** **End Semester Exam : 60 Marks**

Prerequisites: Knowledge of Analog and Digital Communication

Course description: This course covers fundamental principles of Radar. Block diagram representation of CW and Pulse Radar are dealt in second chapter. Exposure to Satellite communication, basic terms related to satellite, transponder, up link and down link accessing methods are exposed in remaining chapters.

Course Objectives:
To explain principle of Radar and its types
To expose components involved in CW & Pulse Radar
To impart knowledge of satellite and related terms
To explain transponder and various techniques for up linking and down linking

Course Outcomes:
After completing the course, students will able to:

CO1	Understand principles of Radar
CO2	Explain blocks involved in Radar system and transponder
CO3	Define basic terms related to satellite communication
CO4	Understand multiple access techniques in satellite communication
CO5	Understand role of electronics in modern era through radar applications

Detailed Syllabus:

Unit 1	Radar frequencies, Radar principle, Pulse Radar: Operation, Range equation, Displays, Minimum detectable signal, Receiver noise, Transmitter power, PRF
Unit 2	CW Radar: Doppler effect principle, Receivers, Bank of filters, Sign of radial velocity, Applications , FM-CW Radar, Altimeter, Multiple frequency CW radar, MTI radar, Delay line canceller, Blind speed, Non-coherent MTI & Pulse Doppler radar, AMTI, Search radar, Tracking radar, Types of tracking radar, Radar antenna
Unit 3	Communication satellites, Orbits, Frequency bands, Analog modulation, Digital encoding & decoding, Error correction, Digital throughput, Links, Propagation loss, Polarization, Antennae, Atmospheric losses, Receiver noise, Carrier to noise ratio, Satellite link analysis
Unit 4	DTH, Satellite cross links, Frequency reuse, Satellite transponder & their details, signal processing, Limitations, Nonlinear satellite amplifiers, AM/AM conversion, AM/PM conversion, Effect of nonlinear amplification on digital carriers
Unit 5	FDMA, FDMA carriers, Spectrum, Soft limiting amplifiers, FDMA channelization, TDMA system, Guard time, Bit timing, Network synchronization, CDMA system, synchronized-non synchronized CDMA, Orthogonal & non orthogonal CDMA, Frequency hopped CDMA

Text and Reference Books

1. Merrill I. Skolnik, Introduction to Radar Systems, McGraw-Hill International
2. Robert M. Gagliardi, Satellite Communication, CBS Publishers & Distributors

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2									2		
CO2	2	3								2		
CO3	3									3		
CO4	2									2		
CO5						1						

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on

1) Case Study of real world application of Radar shall be presented by the student. This exercise will help in attainment of PO6.

&

One of the / or combination of few of following

1) Simulation
2) Power point presentation of modern techniques in subject
4) Question & answer / Numerical solution

Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	05	00	06
K2	Understand	15	20	54
K3	Apply	00	00	00
K4	Analyze	00	00	00
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K2	K2	K3	K3	K4
	CO1	CO2	CO3	CO4	CO5
Class Test (20 Marks)	05	10	05	00	00
Teachers Assessment (20 Marks)	00	05	00	05	10
ESE Assessment (60 Marks)	12	24	06	18	00

Special Instructions if any: Nil

Designed by

1. Dr.V.R.Ratnaparkhe
2. Prof.M.R.Joshi
3. Dr.A. S. Bhalchandra

ET448: Lab Power Electronics	
Teaching Scheme **Practical: 2Hrs/Week**	**Examination Scheme** **Term Work: 25 Marks** **Practical Examination** **& Viva Voce: 25 Marks**

Laboratory Course Outcomes

CO1	Learn the principles of operation, simulation and design procedures of ac-dc , dc-dc converter, dc-ac inverters
CO2	Learn the principles of operation, simulation and characteristic of power devices, method of turn on and turn off of SCR
CO3	Ability to design, set up, and test power electronic circuits in the laboratory
CO4	Communicate effectively both verbally and in written form through the preparation of journal report and practical presentation.
CO5	Become proficient with computer skills (e.g., PSPICE and MATLAB) for the simulated analysis and design of power electronic circuits

List of Experiments

Sr. No.	Details
1	Power Devices such as Thyristor /IGBT/GTO their V/I characteristics & Measurement of holding current ,
2	Firing circuit of SCR and design of snubber circuit
3	Performance of SCR commutating circuits.
4	TRIAC and DIAC characteristics
5	Single phase/Three phase , Thyristor –Bridge converter with R/RL load
6	Series inverter
7	Performance of Parallel inverter using two thyristors
8	SCR application(Any one)
9	Performance of Chopper circuit is using SCR (DC chopper)
10	Study of Cycloconverter circuit using thyristors.

Relationship of course learning outcomes to ECE program outcomes:

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		1	1			2						
CO2		1	1			2						
CO3		1	1		1	2	3	2			2	3
CO4					1		3	2			2	3
CO5					1		3	2			2	3

1 – High 2 – Medium 3 - Low

Assessment Table

Assessment Tool	S1	S2	S3	S3	S2
	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	04	04	08	06	03
Practical Examination & Viva Voce (25 Marks)	05	10	05	05	00

Recommended Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	04	05
S2	Manipulation	07	10
S3	Precision	14	10
S4	Articulation	00	00
55	Naturalization	00	00
Total		25	25

Preparation (S1)	04	05
Conduct of Experiment (S2)	04	07
Observation and Analysis of Results (S3)	08	05
Record (S2)	03	03
Mini-Project / Presentation/ Viva-Voce (S3)	06	05
Total	**25**	**25**

Designed by
1. R.P.Chaudhari
2. N.R.Kolhare

ET449: Lab Embedded Systems	
Teaching Scheme **Practical:2Hrs/Week**	**Examination Scheme** **Term Work: 25 Marks** **Practical Examination & Viva Voce: 25 Marks**

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	Program the basic interfacing of ARM processor with peripherals using Embedded C
CO2	Demonstrate the data communication using SPI, I2C, etc with ARM processor
CO3	Implement Industrial application using the data conversion techniques using ARM processor
CO4	Implement multitasking with two separate LED blinking tasks, priority scheduling and OS time delay functions by writing 3 diff. UART based on µC/OS – II RTOS

List of Experiments

Sr. No.	Details
1.	**Experiments based on ARM& (LPC 2148)** 1. Write a program for Digital Output, Digital Input, Buzzer Interface, Relay, Stepper Motor, 16x2 Text LCD, 4*4 Matrix Keypad 2. Write a program for Serial Communication using UART0, I2C, SPI, etc. 3. Implement the ARM processor based application based on following aspect • On-chip Analog to Digital Conversion • Sensor Interface • On-chip DAC • External Interrupt • 128x64 Graphics LCD Interface
2.	**Experiments based on µC/OS-II RTOS** 1. Implement Multitasking with Two separate LED blinking tasks 2. Implement Priority Scheduling and OS Time Delay Functions by writing 3 different UART

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1				2							
CO2				2	3							
CO3			3	1								2
CO4				3	2							

1 – High 2 – Medium 3 - Low

Assessment Table

Assessment Tool	S1	S2	S3	S2
	CO1	CO2	CO3	CO4
Term Work (25 Marks)	05	05	10	05
Practical Examination & Viva Voce (25 Marks)	10	05	05	05

Recommended Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	05	10
S2	Manipulation	10	10
S3	Precision	10	05
S4	Articulation	00	00
55	Naturalization	00	00
Total		25	25

Preparation (S1)	05	10
Conduct of Experiment (S2)	10	10
Observation and Analysis of Results (S3)	05	05
Mini-Project / Presentation/ Viva-Voce (S3)	05	00
Total	**25**	**25**

Designed by

1. Prof. S.R. Hirekhan
2. Prof. R.P. Chaudhari
3. Prof. S.R. Kulkarni

ET450: Lab Microwave Engineering	
Teaching Scheme **Practical: 2Hrs/Week**	**Examination Scheme** **Term Work : 25 Marks**

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	Demonstrate working of basic microwave bench
CO2	Execute the performance of passive waveguide components &ferrite devices
CO3	Implement microwave devices practically with software tools.
CO4	Communicate effectively both verbally and in written form through the preparation of journal report and practical presentation
CO5	Organize different microwave devices to setup transmission reception link

List of Experiments

Sr. No.	Details
1	Study of microwave components
2	Study of X –band Microwave Bench.
3	To determine the guide wavelength of a RF signal
4	To verify the properties of E-plane Tee
5	To verify the properties of H-plane Tee
6	To verify the properties of Magic Tee
7	Study of circulator
8	To determine a coupling factor of directional coupler

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			3			2						
CO2	1	3	2			2						
CO3				1	1	3						
CO4			2		3					1		
CO5												1

1 – High 2 – Medium 3 - Low

Assessment Table

Assessment Tool	S3	S2	S2	S3	S1
	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	05	05	05	07	03

Recommended Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**
S1	Imitation	03
S2	Manipulation	10
S3	Precision	12
S4	Articulation	00
55	Naturalization	00
Total		25

Preparation (S1)	05
Conduct of Experiment (S2)	05
Observation and Analysis of Results (S3)	05
Record (S2)	03
Mini-Project / Presentation/ Viva-Voce (S3)	07
Total	**25**

Designed by:

1. **Prof. M.R. Joshi**
2. **Dr. V.R.Ratnaparkhe**
3. **Dr. A.S. Bhalchandra**

ET451: Lab Computer Network	
Teaching Scheme **Practical: 2 Hrs/Week**	**Examination Scheme** **Term Work : 25 Marks**

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	Identify and describe the functions of common networking devices.
CO2	Configure and construct a local area network (LAN),WLAN
CO3	Design and implementation of a simple client/server model and running application using sockets and TCP/IP
CO4	Perform various network security algorithms (e.g. firewall, cryptography)

List of Experiments

Preform any six experiments.

Sr. No.	Details
1	Identification of various networks components - connections, BNC, RJ-45, I/O box - Cables, Co-axial, twisted pair, UTP - NIC (network interface card) - Switches
2	Demonstrate wiring diagrams of network cabling considering a computer lab of 20 systems
3	Use of protocols in establishing LAN
4	Installation of networks (Peer to Peer Networking client server interconnection)
5	Use/installation of proxy server
6	Designing a network system for an organization using TCP/IP Network using a. Class A address b. Class B address c. Class C address d Telnet e. FTP f. Ping
7	Installation of server operating system
8	Create a Virtual Private Network (VPN) over WAN Evaluate application response time in the presence and absence of a firewall.
9	Perform various network security algorithms

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			3	3								3
CO2			1								2	3
CO3			1								2	3
CO4			1	2	2			2			1	2

1 – High 2 – Medium 3 - Low

Assessment Table

Assessment Tool	S1	S3	S4	S2
	CO1	CO2	CO3	CO4
Term Work (25 Marks)	05	05	10	05

Recommended Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**
S1	Imitation	05
S2	Manipulation	05
S3	Precision	05
S4	Articulation	10
55	Naturalization	00
Total		25

Designed by
1. Dr. A.R. Karwankar
2. Dr.S.D.Bharkad

ET452: Lab Digital Image Processing	
Teaching Scheme **Practical: 2Hrs/Week**	**Examination Scheme** **Term Work : 25 Marks** **Practical Examination & Viva Voce: 25 Marks**

Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	Demonstrate image information
CO2	Manipulate various image operations
CO3	Manipulate image using various filters
CO4	Differentiate between spatial and frequency domain operation

List of Experiments

Sr. No.	Details
1	Study image information and various image formats
2	Write a program to perform arithmetic and logical operations on image
3	Write a program to perform geometric operations
4	image enhancement algorithms
5	Implement various spatial domain filters on images
6	Implement various frequency domain filters on images
7	Perform various morphological operations on image
8	Implement image segmentation using edge detection
9	Implement image segmentation using thresholding
10	Implement region based image segmentation

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				2								
CO2					2						2	3
CO3					2						2	1
CO4					1						1	

1 – High 2 – Medium 3 - Low

Assessment Table

Assessment Tool	S1	S2	S2	S3
	CO1	CO2	CO3	CO4
Term Work (25 Marks)	03	12	06	04
Practical Examination & Viva Voce (25 Marks)	05	10	05	05

Recommended Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	03	05
S2	Manipulation	18	15
S3	Precision	04	05
S4	Articulation	00	00
55	Naturalization	00	00
Total		**25**	**25**

Preparation (S1)	03	05
Conduct of Experiment & Record(S2)	12	10
Observation and Analysis of Results (S3)	04	05
Mini-Project / Presentation/ Viva-Voce (S3)	06	05
Total	**25**	**25**

Designed by:

1. **Dr. V.R.Ratnaparkhe**
2. **Dr. S.D. Bharkad**
3. **Dr. A.S. Bhalchandra**

ET453: Lab Information Theory and Coding	
Teaching Scheme **Practical: 2 Hrs/Week**	**Examination Scheme** **Term Work : 25 Marks** **Practical Examination & Viva Voce: : 25 Marks**

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	Recognize /calculate entropy, mutual information of given signal
CO2	Implement programs to generate various codes
CO3	Apply modern tools to code the real world signal
CO4	Demonstrate to compare the performance of coded with uncoded signals

List of Experiments

Sr. No.	Details
1	Write a program to find out , entropies and mutual information of given signals for given channel. Test various types of channel such as a) Noise free channel. b) Error free channel c) Binary symmetric channel d) Noisy channel Compare channel capacity of above channels.
2	Write a program for generation and evaluation of source coding a) Shannon – Fano coding and decoding b) Huffman Coding and decoding c) Lempel Ziv Coding and decoding
3	Write a Program for coding & decoding of Linear block codes.
4	Write a Program for coding & decoding of Cyclic codes.
5	Write a program for coding and decoding of BCH and RS codes.
6	Write a program for coding and decoding of convolutional codes
7	Write a program to study performance of a coded and uncoded communication
8	Implementation of any one of the coding technique for real world 1-D or 2-D signals

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2			3								
CO2		2	3									
CO3					2		3		3			
CO4			2	2						2		

1 – High 2 – Medium 3 - Low

Assessment Table

Assessment Tool	S1	S2	S3	S3
	CO1	CO2	CO3	CO4
Term Work (25 Marks)	04	07	08	06
Practical Examination & Viva Voce (25 Marks)	04	07	08	06

Recommended Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	04	04
S2	Manipulation	07	07
S3	Precision	14	14
S4	Articulation	00	00
55	Naturalization	00	00
Total		25	25

Preparation (S1)	04	04
Conduct of Experiment (S2)	04	04
Observation and Analysis of Results (S3)	08	08
Record (S2)	03	03
Mini-Project / Presentation/ Viva-Voce (S3)	06	06
Total	**25**	**25**

Designed by

1. Dr. Smt. A.S. Bhalchandra
2. Prof. N.R. Kolhare

ET454: Lab Radar & Satellite Communication	
Teaching Scheme **Practical: 2Hrs/Week**	**Examination Scheme** **Term Work : 25 Marks** **Practical Examination & Viva Voce: 25 Marks**

Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	Arrange Radar set up for object detection
CO2	Measure Radar parameters
CO3	Understand satellite communication frequency bands and modulation techniques
CO4	Explain transponder characteristics
CO5	Simulation of Radar characteristics

List of Experiments

Sr. No.	Details
1	Measurement of range of pulse radar
2	Measurement of Doppler frequency shift of CW radar
3	Measurement of blind speed of MTI radar
4	Measurement of characteristics of tracking radar
5	Study Communication satellite frequency bands and orbits
6	Study Analog modulations used in communication satellites
7	Simulate Characteristics of digital encoding and decoding
8	Simulate Characteristics of DMA and TDMA concerned to satellites
9	Study the characteristics of transponder
10	Study of DTH systems and satellite cross links

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3								
CO2	0			2								
CO3	3			3								
CO4	3			3								
CO5	2			2	2							

1 – High 2 – Medium 3 - Low

Assessment Table

Assessment Tool	S1	S2	S1	S1	S2
	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	05	05	05	05	05
Practical Examination & Viva Voce (25 Marks)	05	05	05	05	05

Recommended Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	15	15
S2	Manipulation	10	10
S3	Precision	00	00
S4	Articulation	00	00
55	Naturalization	00	00
Total		25	25

Preparation (S1)	15	15
Conduct of Experiment (S2)	05	05
Observation and Analysis of Results (S3)	00	00
Record (S2)	05	05
Mini-Project / Presentation/ Viva-Voce (S3)	00	00
Total	**25**	**25**

Designed by
1. Dr.V.R.Ratnaparkhe
2. Prof.M.R.Joshi
3. Dr.A. S. Bhalchandra

ET455: Project Part I

Teaching Scheme			**Evaluation Scheme**	
Practicals	02Hrs/Week		Term Work	50 Marks

Course Description: The project work will be carried out by a batch of at the most 4 students (Preferably 3 students) working on topic related to the Electronics, Telecommunications and allied fields. It is also allowed to have a multi-disciplinary work by forming a project group of students from different programmes. The batch will select the topic, by consulting the guide. They have to design and fabricate the system, which will be submitted at the end of second term of current academic year.
Students shall carry field survey and review of literature on selected topic. They shall finalize the methodology and plan implementation stages of project.

Term Work Assessment: The batch has to prepare typed report of not less than 25 pages, in prescribed format, which shall include:

- Summary of field survey
- Literature review
- Technical details
- Design
- Related data

Every candidate has to give a talk on the selected topic in presence of staff members and students.

The Head of the department will appoint two internal examiners to assess the term work; guide shall be one of the examiners.

Course Outcomes

CO1	Identify, formulate and review the literature and frame problem statement
CO2	Plan methodologies and implementation stages
CO3	Write technical report and deliver presentation

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		1				1	1		2		2	1
CO2			3		2					2		2
CO3										1		2

1 – High 2 – Medium 3 - Low

Assessment Table

Assessment Tool	K4	K2	A3
	CO1	CO2	CO3
Term Work (25 Marks)	20	20	10

Recommended Assessment Pattern

Assessment Pattern Level No.	**Cognitive/ Skill /Affective domain Level**	**Term Work**
K2	Understand	20
K4	Analyze	20
A3	Valuing	10
Total		50

Designed by
All faculty members

ET456: Wireless Communication	
Teaching Scheme **Lectures: 4 Hrs/Week**	**Examination Scheme** **Test : 20 Marks** **Teachers Assessment : 20 Marks** **End Semester Exam : 60 Marks**

Course Description:
To expose the students to the most recent technological developments in Mobile communication systems.

Course Objectives:

- To deals with the fundamental cellular radio concepts
- To accustom with various multiple access Techniques.
- To know about mobile technologies like GSM and CDMA.
- To identify the trends andlatest development of the technologiesin the area

Course Outcomes
After completing the course, students will able to:

CO1	Describe the basic concepts and principles in mobile communication.
CO2	Setup and configure cellularsystems.
CO3	Understand GSM and CDMA Cellular architecture.
CO4	To explore the characteristics ofdifferent types of mobile networks.
CO5	Understand emerging technologies required for future generation mobile systems.

Detailed Syllabus:

Unit 1	Introduction to Cellular Communications, Frequency reuse, channel assignment strategies,handoffStrategies, Interference and system capacity, tracking and grade off service, improving coverage and capacity Cellular Processes -Call Setup, Handover etc.
Unit 2	Introduction to Multiple Access,FDMA, TDMA, Spread Spectrum multiple Access, space division multiple access, packet ratio, capacity of acellular systems
Unit 3	Mobile Services, System architectures, radio interfaces, protocols architecture, localization and calling, handover, security, new data services.
Unit 4	Frequency and channel specifications of IS-95, forward and reverse CDMA channel, packet and frame formats, mobility and radio resource management.
Unit 5	3G and 4G Wireless Standards: Wireless LAN, Bluetooth, GPRS, HSCSD, EDGE, WCDMA, LTE, WiMAX, ultra wideband technology, WAP

Text and Reference Books

3. Andrea Goldsmith, Wireless Communications, Cambridge University Press.
4. Simon Haykin, Modern Wireless Communications, Pearson Edition.
5. Theodore Rappaport, Wireless Communications: Principles and Practice,Prentice Hall.
6. John Schiller, Mobile Communications, Pearson Education
7. William C.Y.Lee, Mobile Cellular Telecommunications Analog and Digital Systems, II Ed. TMH.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2								3		
CO2			2		1	1				3		
CO3	3	1		2	2	2						
CO4		2	2							1		
CO5		1	2			2				1		

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Simulation
2) Application development
3) Power point presentation of case studies
4) Question & answer / Numerical solution
5) Study of Industry processes and its presentation

Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	05	00	15
K2	Understand	10	05	25
K3	Apply	05	10	20
K4	Analyze	00	05	00
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	20

Assessment table

Assessment Tool	K1	K2	K3	K3	K2
	CO1	CO2	CO3	CO4	CO5
Class Test (20 Marks)	05	10	05	00	00
Teachers Assessment (20 Marks)	00	00	05	10	05
ESE Assessment (60 Marks)	15	15	10	10	10

Special Instructions if any: Nil

Designed by
1. Prof. N.R. Kolhare
2. Prof. P.H. Bhagat
3. Prof. M.R. Joshi

ET457: Industrial Automation	
Teaching Scheme **Lectures: 4 Hrs/Week**	**Examination Scheme** **Test : 20 Marks** **Teachers Assessment : 20 Marks** **End Semester Exam : 60 Marks**

Prerequisites: ET341 Instrumentation &Measurement

Course description:After completing this course, students will have a broad and fundamental understanding of industrial automation. Topics range from an overview of common automation industries to an introduction of basic automated system components, such as controllers, I/O, drives, and HMI (Human Machine Interface). In addition, students will learn common automation terminology, tools used in industrial automation, and career options available within this field

Course Objectives:

To provide a clear view on Programmable Logic Controllers (PLC), SCADA and DCS
To accustom with various methods involved in automatic control and monitoring
To impart knowledge about robotics, fuzzy Neuro controllers used in automation
To familiarize with industrial communication protocols

Course Outcomes
After completing the course, students will able to:

CO1	Develop the PLC program for various timing and sequencing operations.
CO2	Identify the necessity of using Supervisory Control and Data Acquisition (SCADA) for Complex projects.
CO3	Analyze the requirements for a given industrial process and select the most appropriate automation architecture and technologies
CO4	Understand the interfacing methods and industrial communication protocols.
CO5	Specify the strategies for utilizing robots in industrial environment

Detailed Syllabus:

Unit 1	Signal Conditioning Systems Data Acquisition systems, Data Loggers, Industrial case studies
Unit 2	Programmable logic controllers (PLC), Programming techniques, SCADA, Distributed Control Systems (DCS). Human Machine Interface, Case studies
Unit 3	Introduction to industrial communication protocols- TCP/IP protocol- HART communicator protocol Wireless communication(Ip56, Ip58) LAN – PROFI bus – Mod bus – CAN bus- field bus architecture
Unit 4	Process Control system principles, Basic concepts, ON/OFF, P,PI,PD,PID controllers case studies
Unit 5	Introduction to Robotics, Computer vision. Fuzzy Neuro Controllers Development of automation systems to industrial processes. Case studies

Text and Reference Books

1. Bela G. Liptak, Instrumentation Engineer ‟s Hand Book,CRC Press
2. H.S.Kalsi, Electronic Instrumentation, TMH
3. I.J.Nagrath&M.Gopal,Control System Engineering, Third edition, New Age International Publication
4. Rangan and Sarma, Instrumentation Systems, TMH
5. Helfric A.D & Cooper W.D, Modern Electronic Instrumentation &Measurement Techniques, Pearson Education
6. Curtis D Johnson, Process Control; Instrumentation Technology, Pearson Education, 2008
7. PLC manuals from Siemens
8. G.C.Goodwin, S.R.Graebe, M.E. Salgado, Control System Design, Pearson Education

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					2							1
CO2		3										2
CO3												1
CO4			2		3							
CO5					3							1

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Simulation
2) Application development
3) Power point presentation of case studies
4) Question & answer / Numerical solution
5) Study of Industry processes and its presentation
6) Mini projects

Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	05	00	15
K2	Understand	10	05	20
K3	Apply	05	10	15
K4	Analyze	00	05	10
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K4	K3	K2
	CO1	CO2	CO3	CO4	CO5
Class Test (20 Marks)	05	10	00	05	00
Teachers Assessment (20 Marks)	00	00	05	10	05
ESE Assessment (60 Marks)	15	20	10	15	00

Special Instructions if any: Nil

Designed by

1. **Dr. A.R. Karwankar**
2. **Prof. R.P. Chaudhari**
3. **Prof. S.R. Kulkarni**

ET458 : Optical Fiber Communication	
Teaching Scheme **Lectures: 3Hrs/Week** **Tutorials: 1 Hr/week**	**Examination Scheme** **Test : 20 Marks** **Teachers Assessment : 20 Marks** **End Semester Exam : 60 Marks**

Prerequisites: Knowledge of Engineering Chemistry and Electromagnetic Engineering

Course description: This course covers basics of light propagation in optical fiber, types and structure of optical fiber. It deals with manufacturing process as well. Signal degradation which includes attenuation and dispersion are discussed in detail. Measurements related to optical fiber are covered. Optical networks are dealt appropriately.

Course Objectives:

5. To give exposure to students about components of optical fiber communication link
6. To explain propagation of light through optical fibers
7. To make students understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors
8. To give exposure to students about various optical networks
9. To explain various measurements of optical fiber

Course Outcomes

After completing the course, students will able to:

CO1	Define basic optical laws required for propagation of light waves in Optical fiber
CO2	Illustrate operation of optical fiber communication components , their integration and related measurements
CO3	Formulate mathematical representation for propagation of light in fiber
CO4	Understand the significance of dispersion and attenuation in optical fiber communications
CO5	Design Optical Fiber link power and time budget considering attenuation and dispersion
CO6	Express operations of and trends in, optical networks

Detailed Syllabus:

Unit 1	Optical fiber communication link, fiber types and structure, manufacturing technique, fiber connections, signal degradation in optical fiber wave guide : attenuation and dispersion
Unit 2	Optical Sources: Light emitting diode, LASER diode, Optical detectors : PIN diodes, Avalanche photo diode, Optical Amplifiers
Unit 3	Optical Receiver Performance Considerations: Fundamental receiver operation, Receiver noise, Receiver structures, Preamplifiers, High performance amplifiers.
Unit 4	Digital Transmission System: Point to point links, Digital system planning considerations, Analog systems, Distribution Systems, Advanced multiplexing strategies
Unit 5	Measurements: Test equipment, Attenuation measurements, Dispersion measurement, Refractive index profile, Numerical aperture, fiber cut off wavelength measurements , Field measurements OTDR, optical networks

Text and Reference Books

- G. Keiser, Optical Fiber Communications (4/e), TMH, 2008.
- Optical Fiber Communications Principles and Practices (4/e) PHI John M. Senior 2010
- J. Gowar, Optical Communication Systems, (2/e), PHI, 2001.
- Ghatak& K. Thygarajan, Introduction to Fiber Optics, Cambridge, 1999.
- G.P. Agrawal, Fiber Optic Communication Systems, (3/e), Wiley, 2002.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2			2		3							
CO3	1	2										
CO4		2	2									
CO5		2	1								2	
CO6										2	2	

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

- Question & answer / Numerical solution
- Simulation
- Power point presentation of advanced topics
- Visit to manufacturing processes plants and BSNL
- Mini projects
- Survey

Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	05	00	12
K2	Understand	15	10	36
K3	Apply	05	10	12
K4	Analyze	00	00	00
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K3	K2	K32	K2
	CO1	CO2	CO3	CO4	CO5	CO6
Class Test (20 Marks)	05	15	00	00	00	00
Teachers Assessment (20 Marks)		05	00	05	05	05
ESE Assessment (60 Marks)	12	36	00	15	10	05

Special Instructions if any: Nil

Designed by
1. Dr. Smt. A.S. Bhalchandra
2. Prof. P.H. Bhagat

ET459: Android Applications Development	
Teaching Scheme **Lectures: 2Hrs/Week**	**Examination Scheme** **Test : 25 Marks** **Teachers Assessment : 25 Marks**

Prerequisites: Strong knowledge of any programming language preferably JAVA

Course Objectives:

To get familiar with Android Development Environment
To worked with screen configurations and multiple screen sizes
To worked with the all-important Activity Class and its lifecycle
To develop running multiple activities with the Fragment Class
To create user interfaces

Course Outcome

As an outcome of completing the course, students will able to:

CO1	Design applications that run on multiple, differently-sized devices
CO2	Understand the components comprising the Android Platform
CO3	Recognize the four fundamental components of Android applications
CO4	Create a simple Android application

Detailed Syllabus:

Unit 1	Android Platform and the Android Development Environment, logistics of how to get started as an Android application developer.
Unit 2	Basic components from which all Android applications are created, the Activity class (main class responsible for displaying an application's user interface)
Unit 3	Intent class and Permissions, Fragment class (key class responsible for displaying an application's user interface).
Unit 4	Demonstration of Android provides for creating user interfaces

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				2	1							
CO2	2										3	
CO3	1				2							
CO4			1		2		3					

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 25 marks is based on one of the / or combination of few of following

1) Simulation
2) Application development
3) Power point presentation of case studies
4) Quizzes
5) Lab Exercises
6) Mini projects

Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**
K1	Remember	00	00
K2	Understand	15	10
K3	Apply	10	15
K4	Analyze	00	00
K5	Evaluate	00	00
K6	Create	00	00
Total Marks 100		25	25

Assessment table

Assessment Tool	**K3**	**K2**	**K2**	**K3**
	CO1	CO2	CO3	CO4
Class Test (25 Marks)	05	10	05	05
Teachers Assessment (25 Marks)	05	05	05	10

Designed by:

1. P. H. Bhagat
2. S. R. Kulkarni
3. M. R. Joshi

ET460: Cloud Computing

Teaching Scheme			**Evaluation Scheme**	
Lectures	3 Hrs/Week		Test	20 Marks
Tutorials	1 Hrs/Week		Teacher Assessment	20 Marks
			End-Semester Examination	60 Marks

Pre-requisite:

Operating System, Computer Networks, Network Security.

Course Outcomes Expected:

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

1. Identify the appropriate cloud services for a given application.
2. Assess the comparative advantages and disadvantages of Virtualization technology.
3. Analyze authentication, confidentiality and privacy issues in cloud computing.
4. Awareness of security implications in cloud computing.
5. Discuss the importance of protocols and standards in management for cloud services.

Detailed Syllabus

UNIT 1	**Introduction to Cloud Computing** Defining Cloud computing, Characteristics, Components, deployment model, service model, Applications, Benefits of cloud computing, Limitations of cloud computing. Grid Computing, Grid vs Cloud Computing.
UNIT 2	**Cloud architecture, Services and Applications** Exploring cloud computing stack – Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols, Applications, Defining Infrastructure as a Service (IaaS), Defining Software as a Service (SaaS), Defining Platform as a Service (PaaS), Defining Identity as a Service (IDaaS), Defining Compliance as a Service (CaaS).
UNIT 3	**Cloud Infrastructure and Virtualization** Hardware and Infrastructure – Clients, Security, Network and Services., use of Virtualization technology, Load Balancing and Virtualization, virtualization benefits, Hypervisors, porting application, Defining cloud capacity by defining baselines and Metrics.
UNIT 4	**Exploring cloud services** Software as a Service – Overview, advantages, limits, virtualization benefits, examples. Platform as a Service – overview, advantages and functionalities, PaaS application frameworks – Drupal, Long Jump. Case study – Google Apps and Web Services.
UNIT 5	**Cloud Administration and Security Management** Management responsibilities, lifecycle management, cloud management products, Cloud management standards. Cloud security, data security, Identity and presence protocol standards, Availability management in SaaS, IaaS, PaaS, Access Control, Security Vulnerability, Patch and Configuration Management, Security as a Service of cloud, Future of Security in Cloud computing.

TEXT BOOKS

1. Barrie Sosinsky, "Cloud Computing Bible", Wiley India Edition.
2. Anthony Velte, Toby Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach", Tata McGraw-Hill Edition.

REFERENCE BOOKS

1. John W. Rittinghouse, James F. Ransome, "cloud computing: implementation management and security" CRC Press.
2. Gautam Shroff, "Enterprise Cloud Computing: Technology, Architecture, Applications", Cambridge University Press.
3. Christian Baun, Marcel Kunze, Jens Nimis, Stefan Tai, "Cloud Computing: Web-Based Dynamic IT Services", Springer.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1				2					2		
CO2		1			2							
CO3		1			3					3		
CO4					1							
CO5	1											

1 – High 2 – Medium 3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Power point presentation of case studies
2) Question & answer
3) Study of Industry processes and its presentation

Assessment table which includes mapping of various course OUTCOMES and assessment tools

Sample Assessment Table (Terminology as per Blooms Taxonomy)

Assessment Tool	K2(understand)	K3(Apply)	K4(analyze)
	CO1, CO4, CO5	CO2	CO3
Class Test 20 Marks	20		
Teachers Assessment 20 Marks		10	10
ESE Assessment 60 Marks	40	10	10

Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level (According to Blooms Revised Taxonomy)	Test (20)	Assignment	Case Study	Presentation	End Semester Examination (60)
K2	Understand	20				40
K3	Apply		5		5	10
K4	Analyze			10		10
Total		20	20			60

ET461: Antenna & Wave Propagation	
Teaching Scheme **Lectures: 03 Hrs/Week** **Tutorial: 01 Hr/Week**	**Examination Scheme** **Test : 20 Marks** **Teachers Assessment : 20 Marks** **End Semester Exam : 60 Marks**

Prerequisites: Knowledge of Electromagnetic fields andwaves

Course description: This course covers fundamental things of wireless communication such as interaction of waves with atmosphere and radiating and capturing devices. Antenna parameters, structures, classification, applications and operating frequencies are discussed in this course. Course also covers antenna parameter measurement techniques.

Course Objectives:

To explain radiation mechanism
To impart knowledge mechanisms of atmospheric effects on radio wave propagation
To elaborate antenna types, basic parameters and structures
To expose parameter measuring techniques
To calculate fields from antennas

Course Outcomes:
After completing the course, students will able to:

CO1	Explain variety of principles of propagation of waves
CO2	Classify and compare different types of antennas with their basic parameters
CO3	Prove Reciprocity theorem and its applications
CO4	Illustrate methods to calculate antenna parameters
CO5	Analyze simple arrays by varying linear, angular positions, distances and excitation phase

Detailed Syllabus:

Unit 1	Propagation: Radio waves, Propagation in free space, Modes of propagation, Ground Wave propagation, Sky Wave Propagation, Space Wave Propagation, Maximum usable frequency, Skip distance, Sunspot number and sunspot cycle, Fading, Multi-hop propagation, Virtual height-Critical frequency, Duct propagation
Unit 2	Antenna basic terms: Radiation mechanism, Radiating source, Short electric dipole, Current distribution, Induction and radiation field, Isotropic radiator, Half wave dipole, Field intensity, Radiation pattern, Power density, Power gain, Directivity, Efficiency, Effective length, Effective area, Reciprocity theorem, Antenna impedance, Front to back ratio, Antenna band width, Antenna beam efficiency, Antenna temperature, Equivalent noise temperature
Unit 3	Antenna Arrays: Broadside array, End fire array, Collinear arrays, Arrays of point sources, Linear arrays with 'n' Isotropic point sources, Multiplication of patterns, Tapering of arrays, Chebychev arrays, Continuous arrays, Rectangular array, Super directivity, Rhombic antenna, Traveling wave antenna, Loop antenna: Direction finding, Errors, Radiation resistance, Directivity, Ferrite rod antenna, Adcock antenna, Crossed loop direction finder
Unit 4	Receiving Antenna: Simple vertical antenna, Yagi-Uda antenna, Biconical antenna, Corner reflector antenna, Helical antenna, Notch antenna, Turnstile antenna, Super Turnstile antenna, Discone antenna, Log Periodic antenna
Unit 5	Antenna Measurements: Impedance, Radiation pattern, Beam width, Gain, Phase, Radiation resistance, Antenna efficiency, Directivity, Polarization, Noise figure and noise temperature

Text and Reference Books

1. C.A.Balanis , Antenna Theory: Analysis & Design, John Wiley & Sons
2. F.E.Terman, Electronics and Radio Engineering, McGraw Hill Publicaitons
3. K.D.Prasad, Antenna and Wave Propagation, Satya Prakashan, New Delhi

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			3							2	2	
CO2		3	3							2		
CO3	1	2										
CO4	1	2								1		
CO5	1										1	

1 – High2 – Medium3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Simulation of specific antenna for given frequency
2) Application development (Transmitter – Antenna – Receiver)
3) Power point presentation of modern antennas or case studies
4) Question & answer / Numerical solution
5) Mini projects (Designing and Model Making)

Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	05	00	12
K2	Understand	10	10	24
K3	Apply	05	00	18
K4	Analyze	00	10	06
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K2	K2	K3	K3	K4
	CO1	CO2	CO3	CO4	CO5
Class Test (20 Marks)	10	05	05	00	00
Teachers Assessment (20 Marks)	00	10	00	00	10
ESE Assessment (60 Marks)	10	20	10	10	10

Special Instructions if any: Nil

Designed by
1. Dr.V.R.Ratnaparkhe
2.Dr.A. S. Bhalchandra

ET462: MICROELECTROMECHANICAL SYSTEMS (MEMS)	
Teaching Scheme **Lectures: 3 Hrs/Week** **Tutorial: 1 Hr/week**	**Examination Scheme** **Test : 20 Marks** **Teachers Assessment : 20 Marks** **End Semester Exam : 60 Marks**

Course Prerequisites: You are expected to know standard processes for cleanroom fabrication of micro- and nanostructures (otherwise self-study). You are expected to have a background in basic electromagnetism and mathematics/differential equations.

Course description: The goal of this course is introduce the subject of micro-electromechnical devices and systems (MEMS). MEMS devices include pressure sensors, accelerometers, opto-mechanical assemblies and displays, and microfluidic bioanalytical systems, and require knowledge of a broad range of disciplinces, from microfabrication to mechanics to electromagnetism. Lectures will cover microfabrication technologies and process flow development, material properties, structural behavior, actuation and sensing. This requires an awareness of design, fabrication, and materials issues involved in micro/nanosystems. The course will cover fabrication technologies, material properties, structural mechanics, basic sensing and actuation principles, packaging, and MEMS markets and applications.

Course Objectives:

During this course, students will be provided with information to better able them to:

1. Converse in the subject of MEMS with physical and real-world applications
2. Understand the basics of MEMS processing, including lithography, etching, deposition, oxidation and sputtering.
3. Describe current applications and opportunities in the industry and understand the potential offered by MEMS, and understand how MEMS will impact manufacturing, processing and design in all industries. Understand the design constraints and modeling steps required for classic MEMS devices.
4. To learn and to realize fundamentals of MEMS fabrication technology
5. To understand the applications of micro electronic technology

Course Outcomes

After completing the course, students will able to:

CO1	Ability to evaluate and analyze concepts in fundamental fabrication of MEMS & Microsystem processes and their relevance to current industry/scientific needs
CO2	Develop experience on micro/nanosystems for photonics , optical,Bio-Medical,RF power and energy applications
CO3	To discuss the limitations and challenges in the design and fabrication of micro-sensors, sensing modalities to build the desired microsystem
CO4	Ability to evaluate and analyze concepts in micro-fabricated miniaturized components and actuators

Detailed Syllabus:

Unit 1	**Micro-fabrication**: MEMS Roadmaps, Benefits of Miniaturization, Benefits of ScalingFabrication Process Modules : oxidation, film deposition, lithography, etching, ion implantation, diffusion, Glimpses of Microsystems; scaling effects, Smart materials and systems: an overview, Micro-sensors, Micro-actuators,Microsystems. Examples of smart systems: structural health monitoring and vibration control
Unit 2	**Micromachining :** Structure of silicon and other materials,Polymers in MEMS Silicon wafer processing; Thin-film deposition, Lithography, wet etching and dry etching, Bulk micromachining and Surface micromachining, Wafer-bonding; LIGA and other molding techniques, Soft lithography and polymer processing, Thick-film processing; Low temperature co-fired ceramic processing, Smart material processing **Bulk Micromachining** – wet etching , dry etching , wet etch-based, dissolved wafer process, SOI MEMS, Scream, Hexsil MEMS, sealed cavity deep RIE **Surface Micromachining** : basic process flow, release, stiction, material choices, residual stress, stringers and planarization, MUMPS, Summit, electroplating, 3D out-of-plane LIGA and electroplating
Unit 3	**Actuation and Sensing :** Electrostatic actuation (parallel plate) ,Electrostatic actuation (comb drive) ,Electrostatic sensing Piezoelectric actuation, Piezoelectric sensing, Thermoelectric sensing and actuation
Unit 4	**Design and Modeling :** Design considerations,Scaling in miniaturization ,Finite Element analysis Examples Packaging & Assembly, wire bonding and encapsulation, surface bonding and 3D packaging, Wafer level packaging, Signal integrity, MEMS characterization , characterization techniques **MEMS Testing and Reliabilities** Nano technologies Principles, applications and challenges
Unit 5	**Structures and Devices :** Mechanical Sensors ,Mechanical Actuators ,Microfluidic Devices, Optical/Photonic Microsystems ,Biological Transducers **Applications and case studies** Acoustic MEMS: Microphones ,Optical MEMS: micro mirrors,Micro fluidics,Inkjet head,MEMS for Biomedical Applications (Bio-MEMS) , Piezoelectric energy harvester,Micro-machined Micro-accelerometers for MEMS,MEMS Accelerometers for Avionics , Piezoresistive Accelerometer Technology , MEMS Capacitive Accelerometer, MEMS Capacitive Accelerometer Process, MEMS Gyro Sensor, MEMS for Space Application , Polymer MEMS & Carbon Nano Tubes CNT ,MEMS Micro-sensors Thermal ,Micro-machined Micro-sensors Mechanical, MEMS Pressure and Flow sensor, Micro-machined Flow Sensors MEMS Inertial Sensors , Power MEMS (micro-engines, etc.) , MEMS-based microwave circuit and system

Text and Reference Books

1. S.D. Senturia, Microsustem Design, Kluwer Academic Publishers, 2001.
2. Tai-Ran Hsu, MEMS & Microsystems Design and Manufacture, McGraw Hill, 2002.
3. V.K. Varadan, K.J. Vinoy, and S. Gopalakrishnan, Smart Material Systems and MEMS: Design and Development Methodologies, Wiley, 2006.
4. G. Rebeiz, "RF MEMS: theory, design, and technology," Wiley Interscience, 2003 (ISBN: 0471201693)
5. G.T.A. Kovacs, Micromachined Transducers Sourcebook, WCB McGraw-Hill, 1998.
6. J.W. Gardner, Microsensors: principles and applications, John Wiley & Sons, 1994.
7. M. Madou, Principles of Microfabrication, CRC Press, 1998.
8. About MEMS and Nanotechnology: http://www.memsnet.org/mems/
9. Analog Devices: http://www.analog.com/en/mems-andsensors/products/index.html
10. Microsystem Design: http://web.mit.edu/microsystem-design/www/
11. W. Trimmer, Editor, Micromechanics and MEMS, IEEE Press, 1997.
12. R. S. Muller, et. al., Editors, Microsensors, IEEE Press, 1991.
13. J. Micro-electromechanical Systems (IEEE/ASME).
14. J. Micromechanics and Microengineering (IEEE) (available on line).
15. Sensors and Actuators (Elsvier).
16. Sensors and Materials (MY, Japan – in English).

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2		1				2			
CO2	1	2	2		1			2	2			
CO3	1	2		2	1	3		2	2			
CO4	1	2	2			3		2	2			
CO5								2	3	3		

1 – High2 – Medium3 - Low

Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1) Simulation
2) Application development
3) Power point presentation of case studies
4) Question & answer / Numerical solution
5) Study of Industry processes and its presentation
6) Design Project
7) Quizzes
8) Laboratory Work
9) Tutorials

Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	05	00	15
K2	Understand	10	05	20
K3	Apply	05	10	15
K4	Analyze	00	05	10
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1	K2	K4	K3	K2	K3	K2
	CO1	CO2	CO3	CO4	CO5	CO6	CO7
Class Test (20 Marks)	04	04	04	04	00	04	00
Teachers Assessment (20 Marks)	05	05	00	00	05	05	00
ESE Assessment (60 Marks)	15	10	10	15	00	10	10

Special Instructions if any: Nil

Designed by
1. N.R.Kolhare

ET463: Lab Wireless Communication	
Teaching Scheme **Practical: 2Hrs/Week**	**Examination Scheme** **Term Work : 25 Marks** **Practical Examination & Viva Voce: : 25 Marks**

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	Acquire knowledge of GSM AT commands for different applications
CO2	Build awareness of current and future mobile technology.
CO3	Demonstrate DSSS technique by knowing different types of PN codes, chip rate, process gain
CO4	Implement CDMA Technique effectively & analyze problems

List of Experiments

Sr. No.	Details
1	To study and analyze different modulation techniques in time and frequency domain.
2	To study various GSM- AT Commands
3	Study of direct sequence spread spectrum (DSSS) technique for CDMA.
4	Study of GSM handset for various signaling and fault insertion techniques
5	Study of GSM Technology
6	Study of CDMA Technology

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				1		1			3			
CO2						1					3	3
CO3	1				2							
CO4								1	2			1

1 – High 2 – Medium 3 - Low

Assessment Table

Assessment Tool	S2	S2	S3	S2
	CO1	CO2	CO3	CO4
Term Work (25 Marks)	08	04	08	05
Practical Examination & Viva Voce (25 Marks)	10	02	08	05

Recommended Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	04	05
S2	Manipulation	07	10
S3	Precision	14	10
S4	Articulation	00	00
55	Naturalization	00	00
Total		25	25

Preparation (S1)	04	05
Conduct of Experiment (S2)	04	07
Observation and Analysis of Results (S3)	08	05
Record (S2)	03	03
Mini-Project / Presentation/ Viva-Voce (S3)	06	05
Total	**25**	**25**

Designed by
1. Prof. N.R. Kolhare
2. Prof. P.H. Bhagat
3. Prof. M.R. Joshi

ET464- Lab Industrial Automation	
Teaching Scheme **Practical: 2Hrs/Week**	**Examination Scheme** **Term Work : 25 Marks**

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	Explore PLC's, SCADA, DCS, controllers, motors, actuators, encoders, sensors, and PID loops in automation systems.
CO2	Characterize performance of automation equipment.
CO3	Participate in a group atmosphere for the defining, planning, and execution of an open ended Automation problem.
CO4	Communicate effectively both verbally and in written form through the preparation of journal report and practical presentation.
CO5	Develop an understanding of economic issues related to industrial Robotic and automation systems.

List of Experiments

Sr. No.	Details
1	To Study PLC, SCADA and write a PLC program for a defined timing and sequence operation
2	Visit an industry where SCADA/ DCS is implemented write a report on visit.
3	Study of various types of practical sensor and its interfacing with systems.
4	Implementation/ Simulation of application of automation to any manual system
5	Perform elementary operation in developing a tiny robotic system
6	Study of computer vision systems

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				1	2	3						1
CO2		3		1	1							2
CO3				1							2	3
CO4			2		3					1		
CO5												1

1 – High 2 – Medium 3 - Low

Assessment Table

Assessment Tool	S1	S2	S3	S3	S2
	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	04	04	08	06	03

Recommended Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**
S1	Imitation	04
S2	Manipulation	07
S3	Precision	14
S4	Articulation	00
55	Naturalization	00
Total		25

Preparation (S1)	04
Conduct of Experiment (S2)	04
Observation and Analysis of Results (S3)	08
Record (S2)	03
Mini-Project / Presentation/ Viva-Voce (S3)	06
Total	**25**

Designed by

1. **Dr. A.R. Karwankar**
2. **Prof. R.P. Chaudhari**
3. **Prof. S.R. Kulkarni**

ET465: Lab Optical Fiber Communication	
Teaching Scheme **Practical: 2 Hrs/Week**	**Examination Scheme** **Term Work : 25 Marks**

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	Plot the characteristics of optical devices
CO2	Organize various components of optical fiber communication and establish /set up transmission-reception link
CO3	Use modern tools to perform optical fiber communication related measurements

List of Experiments

Sr. No.	Details
1	To study optical fiber communication link
2	To draw the characteristics of optical sources and detectors
3	To Examine /measure attenuation
4	To Examine /Measure Numerical Apertures
5	To Measure power using OTDR
6	Demonstrate use of connectors ,splicers
7	To Measure bit rate
8	To Measure pulse spreading

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				2								
CO2			3	3								
CO3					1							

1 – High 2 – Medium 3 - Low

Assessment Table

Assessment Tool	S1	S2	S3
	CO1	CO2	CO3
Term Work (25 Marks)	5	10	10

Recommended Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**
S1	Imitation	5
S2	Manipulation	10
S3	Precision	10
S4	Articulation	00
55	Naturalization	00
Total		25

Preparation (S1)	5
Conduct of Experiment (S2)	5
Observation and Analysis of Results (S3)	5
Record (S2)	5
Mini-Project / Presentation/ Viva-Voce (S3)	5
Total	**25**

Designed by

1. Dr. Smt. A.S. Bhalchandra
2. Prof. P.H. Bhagat

ET466: Lab Cloud Computing

Teaching Scheme			**Examination Scheme :**	
Practical :	2 hrs/week		Practical Exam. :	25
Credit:	1		Term Work:	25

Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

1. Understand virtualization concept.
2. Use cloud services provided by Amazon AWS.
3. Understand Cloud Services SaaS, PaaS and IaaS.
4. Use and administrate Openstack services**.**

Suggestive List of Laboratory Practical:

1. Installing Ubuntu (server edition) using virtual box, and study virtualization.
2. Setting up and using an instance on public IaaS cloud, using Amazon AWS.
3. Exploring GitHub to learn features such as
    a. How to create repositories on GitHub.
    b. How source code can be uploaded/downloaded from repositories.
    c. Making code commits in repositories.
    d. GitHub issue tracking features.
4. Writing Sample Applications on Cloud using Google App Engine.
5. Understanding Software as a Service: Sales Force
6. Understanding Private Clouds: OpenStack, Eucalyptus.
7. Installing Openstack cloud: Creating sand box environment using Virtual Box.
8. Installing and Administrating OpenStack Compute packages.
9. Installing Openstack Identity and storage services.
10. Installing Openstack Image services.

ET467: Lab- Antenna & Wave Propagation	
Teaching Scheme **Practical: 2Hrs/Week**	**Examination Scheme** **Term Work : 25 Marks** **Practical Examination & Viva Voce: 25 Marks**

Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	Manipulate antennas to obtain outputs with respect to changes in linear and angular positions
CO2	Interpret the effect of obstructions on propagation
CO3	Obtain impedance matching precisely
CO4	Demonstrate use of software tool for modeling antenna
CO5	Write correct algorithm for simulating antenna arrays

List of Experiments

Sr. No.	Details
1	Plot radiation pattern of different antennas
2	Plot the curves of output versus linear distance between the transmitter and receiver
3	Measure the parameters of antenna beam width, current at various points
4	Add different obstacles by way of reflection in propagation path and interpret the result
5	Obtain impedance matching using stubs
6	Demonstrate the use of IE3D/FEKO/Ansys /RF Tool Box/Antenna Magus/Any other similar software for antenna modeling
7	Write a program to plot radiation pattern of various antenna arrays
8	Write a program to plot radiation pattern of antenna array and observe the effect by changing number of elements, distance between elements and excitation phase

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				3						2		
CO2				2						1		
CO3				2						1		
CO4					3					3		
CO5					1							

1 – High 2 – Medium 3 - Low

Assessment Table

Assessment Tool	S1	S2	S3	S3	S2
	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	05	05	05	05	05
Practical Examination & Viva Voce (25 Marks)	05	05	05	05	05

Recommended Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	05	05
S2	Manipulation	10	10
S3	Precision	10	10
S4	Articulation	00	00
55	Naturalization	00	00
Total		25	25

Preparation (S1)	05	05
Conduct of Experiment (S2)	05	05
Observation and Analysis of Results (S3)	05	05
Record (S2)	05	05
Mini-Project / Presentation/ Viva-Voce (S3)	05	05
Total	**25**	**25**

Designed by
1. Dr.V.R.Ratnaparkhe
2.Dr.A.S. Bhalchandra

ET468: Lab Micro Electro Mechanical Systems	
Teaching Scheme **Practical: 2Hrs/Week**	**Examination Scheme** **Term Work : 25 Marks** **Practical Examination: 25 Marks**

Laboratory Course Outcomes

Students should leave the course with the ability to:

CO1	Demonstrate a basic understanding of silicon electronic device and MEMS device fabrication processes
CO2	Demonstrate good laboratory procedures and laboratory notebook maintenance
CO3	Demonstrate hands on experience and working knowledge of microelectronics or MEMS processing steps and process modules
CO4	Demonstrate hand on experience and working knowledge of electronic or MEMS device testing and characterization
CO5	Become proficient with computer skills (e.g., coventorware, Intellisuit and COMSOL) for the simulated analysis and design of MEMS device

List of Experiments

Sr. No.	Details
1	Coventor-Ware: build a 3D model
2	Coventor-Ware: model and stress analysis using MemMech, Spring MM, meshing study
3	Electrical analysis of comb drives
4	Coupled Electro-thermal-mechanical analysis: Thermal actuator
5	Micromirror design
6	Piezoelectric frequency sensor design
7	MEMS testing
8	MEMS switch as logic gates
9	Project assignment – RF MEMS
10	Lab on a chip demo/project

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		1	1			2						
CO2		1	1			2						
CO3		1	1		1	2	3	2			2	3
CO4					1		3	2			2	3
CO5					1		3	2			2	3

1 – High 2 – Medium 3 - Low

Assessment Table

Assessment Tool	S1	S2	S3	S3	S2
	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	04	04	08	06	03
Practical Examination & Viva Voce (25 Marks)	05	10	05	05	00

Recommended Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	04	05
S2	Manipulation	07	10
S3	Precision	14	10
S4	Articulation	00	00
55	Naturalization	00	00
Total		25	25

Preparation (S1)	04	05
Conduct of Experiment (S2)	04	07
Observation and Analysis of Results (S3)	08	05
Record (S2)	03	03
Mini-Project / Presentation/ Viva-Voce (S3)	06	05
Total	**25**	**25**

Designed by
Prof. N.R. Kolhare

ET469: Project Part II

Teaching Scheme			**Evaluation Scheme**	
Practical	04Hrs/Week		Term Work	50 Marks
			Practical / Viva voce Examination	100 Marks

Course Description:

Project Part-II, is in continuation of Project Part-I undertaken by the candidates in first term. The group of students shall complete the work assigned to them in the first term with faculty guidance. Group of students shall implement hardware and / or software for planned project. They shall carry module wise testing / debugging, analysis. They shall integrate and validate the specifications under faculty guidance. It is mandatory for students to report weekly progress to guide.

Term Work Assessment

The term work shall consist of a typed report of about 70 pages or more, on the work carried out by the batch of students in respect of the project assigned, during first term and second term. It should be in the prescribed format.

Practical Examination

It shall consist of demonstration of designed, fabricated project and viva voce based on it. The said examination will be conducted by a panel of two examiners; one of them will be a guide and another will be an external examiner. The external examiner will be either from the allied industry or a senior faculty member from other institute.

Course Outcomes

CO1	Identify, formulate and review the literature and frame problem statement
CO2	Implement hardware and/or software techniques for identified problems
CO3	Test and analyze the modules of planned project
CO4	Write technical report and deliver presentation
CO5	Apply engineering and management principles to achieve project goal

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		1				1	1		2		2	1
CO2			2		1							1
CO3				1		1						1
CO4										1		1
CO5		1	2	1								1

1 – High 2 – Medium 3 - Low

Assessment Table

Assessment Tool	K4	K4 & S3	K4 & S3	A3	A4
	CO1	CO2	CO3	CO4	CO5
Term Work (50 Marks)	10	10	15	10	05
Practical Examination & Viva Voce (100 Marks)	20	20	30	20	10

Assessment Pattern

Assessment Pattern Level No.	**Cognitive/ Skill /Affective domain Level**	**Term Work**	**Practical Examination & viva voce**
K4	Analyze	10	20
K4 & S3	Analyze & Precision	25	50
A3	Valuing	10	20
A4	Organizing	05	10
Total		50	100

Designed by:
All faculty members