



RSET
RAJAGIRI SCHOOL OF
ENGINEERING & TECHNOLOGY

COURSE HAND-OUT

B.TECH. - SEMESTER VI

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
(EC), RSET**

VISION

TO EVOLVE INTO A CENTRE OF EXCELLENCE IN ELECTRONICS AND COMMUNICATION ENGINEERING, MOULDING PROFESSIONALS HAVING INQUISITIVE, INNOVATIVE AND CREATIVE MINDS WITH SOUND PRACTICAL SKILLS WHO CAN STRIVE FOR THE BETTERMENT OF MANKIND

MISSION

TO IMPART STATE-OF-THE-ART KNOWLEDGE TO STUDENTS IN ELECTRONICS AND COMMUNICATION ENGINEERING AND TO INCULCATE IN THEM A HIGH DEGREE OF SOCIAL CONSCIOUSNESS AND A SENSE OF HUMAN VALUES, THEREBY ENABLING THEM TO FACE CHALLENGES WITH COURAGE AND CONVICTION

B.TECH PROGRAMME

Program Outcomes (POs)

Engineering students will be able to

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, Engineering fundamentals, and Electronics and Communication Engineering to the solution of complex Engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and Engineering sciences.
3. **Design/development of solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.
6. **The Engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional Engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional Engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex Engineering activities with the Engineering Community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life -long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

Program-Specific Outcomes (PSOs)

Engineering students will be able to:

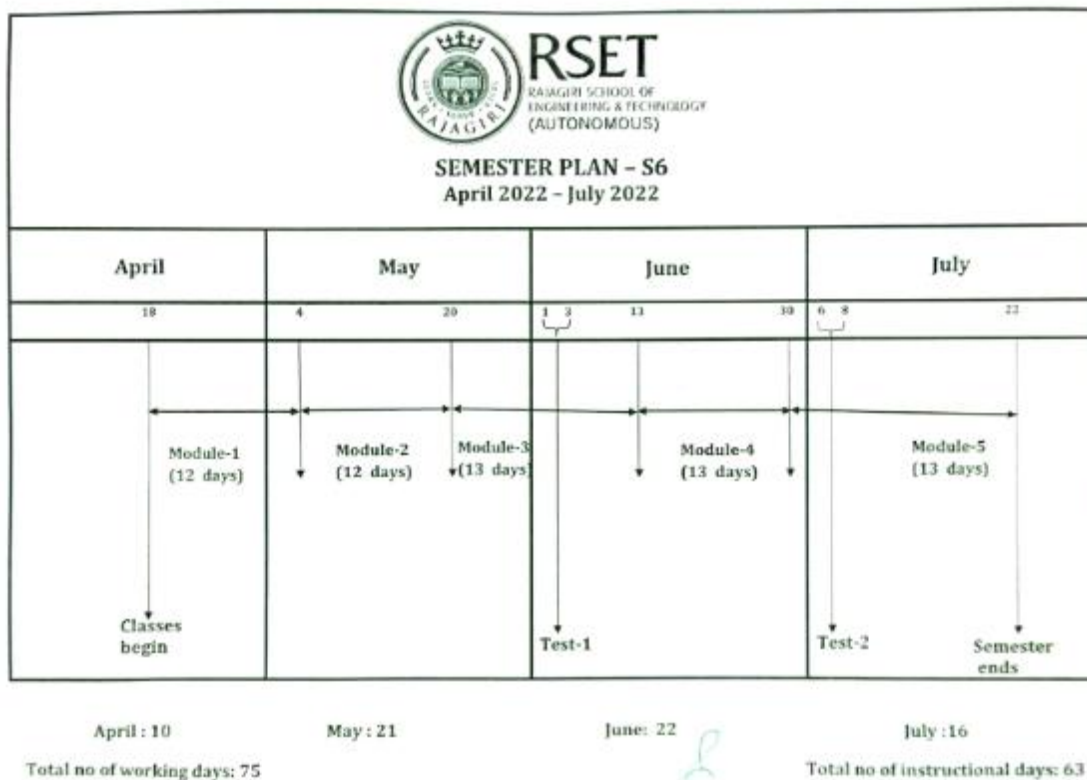
1. Demonstrate their skills in designing, implementing and testing analogue and digital electronic circuits, including microprocessor systems, for signal processing, communication, networking, VLSI and embedded systems applications;
2. Apply their knowledge and skills to conduct experiments and develop applications using electronic design automation (EDA) tools;
3. Demonstrate a sense of professional ethics, recognize the importance of continued learning, and be able to carry out their professional and entrepreneurial responsibilities in electronics engineering field giving due consideration to environment protection and sustainability.

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SEMESTER PLAN



SCHEME: B.TECH 6th SEMESTER

(Electronics & Communication Engineering)
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
 REVISED SCHEME FOR B TECH SYLLABUS REVISION 2019

SLOT	Code	Subject	Hours/Week			Credits
			L	T	P	
A	ECT 302	ELECTROMAGNETICS	3	1	0	4
B	ECT 304	VLSI CIRCUIT DESIGN	3	1	0	4
C	ECT 306	INFORMATION THEORY AND CODING	3	1	0	4
D	ECT XXX	PROGRAM ELECTIVE 1	2	1	0	3
E	HUT310	MANAGEMENT FOR ENGINEERS	3	0	0	3
F	ECT 308	COMPREHENSIVE COURSE WORK	1	0	0	1
S	ECL 332	COMMUNICATION LAB	0	0	3	2
T	ECD 334	MINIPROJECT	0	0	3	2

ECT 302

ELECTROMAGNETICS

COURSE INFORMATION SHEET

PROGRAMME: U.G.	DEGREE: BTECH
COURSE: ELECTROMAGNETICS	SEMESTER: S6 CREDITS: 4
COURSE CODE: ECT302 REGULATION: 2019	COURSE TYPE: CORE
COURSE AREA/DOMAIN: COMMUNICATION	CONTACT HOURS: 4 hours/week.
CORRESPONDING LAB COURSE CODE (IF ANY): ECL411	LAB COURSE NAME: ELECTROMAGNETICS LAB

SYLLABUS:

No	Topic	No. of Lectures
1	Module 1	
1.1	Introduction to Electromagnetic Theory. Review of vector calculus- curl, divergence gradient.	3
1.2	Rectangular, cylindrical and spherical coordinate systems. Expression of curl divergence and Laplacian in cartesian , cylindrical and spherical coordinate system.	3
1.3	Electric field and magnetic field. Review of Coulomb's law , Gauss law and Amperes current law.	2
1.4	Poisson and Laplace equations, Determination of E and V using Laplace equation.	2
2	Module 2	
2.1	Derivation of capacitance and inductance of two wire transmission line and coaxial cable.	2
2.2	Energy stored in Electric and Magnetic field.	1
2.3	Displacement current density, continuity equation. Magnetic vector potential. Relation between scalar potential and vector potential.	3
2.4	Maxwell's equation from fundamental laws.	2
	Boundary condition of electric field and magnetic field from Maxwell's equations.	1
2.5	Solution of wave equation	1
3	Module 3	
3.1	Propagation of plane EM wave in perfect dielectric, lossy medium, good conductor, media-attenuation, phase velocity, group velocity, skin depth.	4
3.2	Reflection and refraction of plane electromagnetic waves at boundaries for normal & oblique incidence (parallel and perpendicular polarization), Snell's law of refraction, Brewster angle.	4
4	Module 4	
4.1	Power density of EM wave, Poynting vector theorem.	2
4.2	Polarization of electromagnetic wave – linear, circular and elliptical polarisation.	2
4.3	Uniform lossless transmission line - line parameters. Transmission line equations	3

4.4	Voltage and Current distribution of a line terminated with load. Reflection coefficient and VSWR. Derivation of input impedance of transmission line.	3
5	Module 5	
5.1	Transmission line as circuit elements (L and C)	1
5.2	Development of Smith chart - calculation of line impedance and VSWR using smith chart.	3
5.3	The hollow rectangular wave guide — modes of propagation of wave-dominant mode, group velocity and phase velocity -derivation and simple problems only	4

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T	Mathew N O Sadiku, Elements of Electromagnetics, Oxford University Press, 6/e, 2014.
T	William, H. Hayt, and John A. Buck. Engineering Electromagnetics. McGraw-Hill, 8/e McGraw-Hill, 2014.
T	John D. Kraus, Electromagnetics, 5/e, TMH, 2010.
R	Joseph A Edminister , Electromagnetics, Schaum's Outline Series McGraw Hill, 4/e, 1995
R	Nannapaneni Narayana Rao, Elements of Engineering Electromagnetics, Pearson, 6/e, 2006.
R	Umran S. Inan and Aziz S. Inan, Engineering Electromagnetics, Pearson, 2010.
R	Martin A Plonus, Applied Electromagnetics, McGraw Hill, 2/e,1978.
R	Jordan and Balmain , Electromagnetic waves and Radiating Systems, PHI, 2/e,2013

COURSE PRE-REQUISITES:

COURSE CODE	COURSE NAME
MAT102	Vector Calculus

COURSE OBJECTIVES:

1	To introduce basic mathematical concepts related to electromagnetic vector fields.
2	To impart knowledge on the basic concepts of Maxwell's equations related to electric and magnetic fields
3	To develop a solid foundation in the analysis and application of electromagnetic fields, Maxwell's equations and Poynting theorem.
4	To understand, analyse and evaluate the propagation of EM waves in Transmission lines
5	To understand, analyse and evaluate the propagation of EM waves in Wave guides

COURSE OUTCOMES:

Sl No.	DESCRIPTION
1	To summarize the basic mathematical concepts related to electromagnetic vector fields.
2	Analyse Maxwell's equation in different forms and apply them to diverse engineering problems.
3	To analyse electromagnetic wave propagation and wave polarization

4	To analyse the characteristics of transmission lines and solve the transmission line problems using Smith chart.
5	To analyse and evaluate the propagation of EM waves in Wave guides.

CO-PO-PSO MAPPING AND JUSTIFICATION:

CO No.	Programme Outcomes (POs)												Programme-specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	1	1	-	-	-	-	-	-	-	2	1	-	-
2	3	3	1	1	-	-	-	-	-	-	-	2	1	-	-
3	3	3	1	1	-	-	-	-	-	-	-	2	1	1	-
4	3	3	1	1	-	-	-	-	-	-	-	2	1	1	-
5	3	3	1	1	-	-	-	-	-	-	-	2	1	1	-
ECT302	3	3	1	1	-	-	-	-	-	-	-	2	1	1	-

	PO1	PO2	PO3	PO4	PO12	PSO1	PSO2
CO1	Students will acquire the knowledge of vector calculus and apply this knowledge to understand electric fields and solve problems	Solving problems using vector calculus	Develop an idea about solving problems of vector calculus in different coordinate systems	Analysis and interpretation of problems in vector calculus	Ability to use the knowledge of vector calculus for further study of antennas	Demonstrate their skills in designing, implementing EM field based applications	
CO2	Students will acquire the knowledge of Maxwell's equations and apply this knowledge to solve problems	Solving problems using Maxwell's equations in different media	Develop the Maxwell's equations for static and time varying fields.	Analysis and interpretation of Maxwell's equation in different media and also for static and time varying conditions	Ability to use the concept of Maxwell's equations for further study in advanced subjects	Demonstrate their skills in designing, implementing EM field based applications	
CO3	Students will acquire the basic knowledge of Maxwell's equations and apply this knowledge to understand electromagnetic wave propagation and to solve problems	Solving problems related to electromagnetic wave propagation in different media	Develop the solutions of Maxwell's equations to study electromagnetic wave propagation	Conduct investigation on electromagnetic wave propagation in different media.	Ability to use the concept of electromagnetic wave propagation for study in advanced subjects	Demonstrate their skills in designing, implementing EM field based applications	Apply their knowledge and skills to conduct experiments and develop applications using software tools

CO4	Students will use the knowledge of electromagnetics and apply this to understand electromagnetic wave propagation in transmission lines and solve problems	Solving problems on electromagnetic wave propagation in transmission lines and also using Smith Chart	Develop solution involving EM wave propagation in transmission lines	Conduct investigation of problems involving transmission of electromagnetic waves through transmission lines	Ability to use the concept of transmission lines for design and projects	Demonstrate their skills in designing, implementing EM field based applications	Apply their knowledge and skills to conduct experiments and develop applications using software tools
CO5	Students will use the knowledge of electromagnetics and apply this knowledge to understand electromagnetic wave propagation in waveguides and to solve problems	Solving problems on electromagnetic wave propagation in waveguides	Develop solution involving EM wave propagation in waveguides	Conduct investigation of problems involving transmission of electromagnetic waves through waveguides	Ability to use the concept of waveguides for various applications in microwave field/	Demonstrate their skills in designing, implementing EM field based applications	Apply their knowledge and skills to conduct experiments and develop applications using software tools

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

Sl No.	Description	Proposed Actions	PO-PSO Mapping
1	Analysis of wave propagation parallel plate waveguide	Lecture	PO1, PO2, PO3, PO4, PO12, PSO1, PSO2

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

Sl No.	Description	Proposed Actions	PO-PSO Mapping
1	Single stub matching analysis using smith chart	Tutorial/ Group assignment	PO1, PO2, PO3, PO4, PO12, PSO1, PSO2

WEB SOURCE REFERENCES:

1	http://nptel.ac.in/courses/115101005/
2	http://www.scribd.com/collections/3218090/electromagnetics
3	http://ocw.mit.edu/resources/res-6-001-electromagnetic-fields-and-energy-spring-2008/
4	http://www.transmission-line.net/search/label/Electromagnetics

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

<input type="checkbox"/> CHALK & TALK	<input type="checkbox"/> STUD. ASSIGNMENT	<input type="checkbox"/> WEB RESOURCES
<input type="checkbox"/> LCD/SMART BOARDS	<input type="checkbox"/> STUD. SEMINARS	<input type="checkbox"/> ADD-ON COURSES

ASSESSMENT METHODOLOGIES-DIRECT

<input type="checkbox"/> ASSIGNMENTS	<input type="checkbox"/> STUD. SEMINARS	<input type="checkbox"/> TESTS/MODEL EXAMS	<input type="checkbox"/> UNIV. EXAMINATION
<input type="checkbox"/> STUD. LAB PRACTICES	<input type="checkbox"/> STUD. VIVA	<input type="checkbox"/> MINI/MAJOR PROJECTS	<input type="checkbox"/> CERTIFICATIONS
<input type="checkbox"/> ADD-ON COURSES	<input type="checkbox"/> QUIZ		

ASSESSMENT METHODOLOGIES-INDIRECT

<input type="checkbox"/> ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	<input type="checkbox"/> STUDENT FEEDBACK ON FACULTY (TWICE)
<input type="checkbox"/> ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	<input type="checkbox"/> OTHERS

**Prepared
by**

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(Faculty in charges)**

Approved By

**Dr. Rithu James
(HOD)**

COURSE PLAN

No	Topic	No. of Lectures
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3.1	Propagation of plane EM wave in perfect dielectric, lossy medium, good conductor, media-attenuation, phase velocity, group velocity, skin depth.	4
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4.2	Polarization of electromagnetic wave – linear, circular and elliptical polarisation.	2
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5.2	Development of Smith chart - calculation of line impedance and VSWR using smith chart.	3

5.3	The hollow rectangular wave guide — modes of propagation of wave- dominant mode, group velocity and phase velocity -derivation and simple problems only	4
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SAMPLE QUESTION

MODULE – 1

- State Coulomb's law.
- State Gauss's law.
- State and derive Gauss's law in point form.
- Define electric field intensity or electric field.
- Write the Poisson's and Laplace equation with applications
- Define potential and potential difference.
- Give the relationship between potential gradient and electric field.
- State and prove Ampere's law.
- Derive the expression for energy stored in a magnetic field.
- Derive the expression for inductance of two wire transmission line.
- Derive the expression for inductance of coaxial cable.
- Derive Maxwell's first and second equations from fundamental laws.
- State and explain Maxwell's equations in integral and differential form.
- Explain scalar and vector magnetic potential.
- List all Maxwell's equations in integral form.
- Consider 2 concentric cylinders where $V = 0$ at $\rho = 1$ mm and $V = 150$ at $\rho = 20$ mm. Determine potential and electric field intensity in the region between them.

$$[V=50.1 \ln \rho + 345.9; E=-50.1 \rho a_\rho] \quad \mathbf{V=50.1 \ln \rho + 345.9; E=-50.1 \rho a_\rho}$$

- In spherical coordinates, $V = 0$ for $r = 0.1$ m and $V = 100$ for $r = 2$ m. Assume free space between concentric spherical shells, find electric field intensity and electric flux density. Also, find charge densities on both the conductors.

MODULE – 2

- Derive the expression for capacitance of coaxial cable.
- Derive the expression for capacitance of two-wire transmission line.
- Derive an expression for energy density in electrostatic fields.
- Derive and explain the two Maxwell's equations for electrostatic fields.
- State and derive continuity equation.
- Derive the solution for uniform plane wave in lossy dielectric medium.
- For a plane wave propagating in a lossy dielectric, derive the expression for propagation constant.
- Starting from Maxwell's equations, derive the wave equation for a conducting medium.
- State and derive the boundary conditions at the interface between two perfect dielectrics.
- Derive the boundary conditions for magnetic fields at the interface of two medium with different permeabilities.
- State and prove boundary conditions for E and H in accordance with Maxwell's equations.
- Write the general wave equation for a conductive medium and explain each term.

MODULE – 3

- State Poynting theorem. Derive the equation of Poynting vector.
- Derive the expression for net outward power flow associated with an electromagnetic wave from a surface.
- What is polarization? Explain the different types of Polarization?
- Differentiate circular and elliptical polarization.
- Derive the expression for the ratio of reflected to incident electric field strength for an insulator with oblique incidence. (If parallel/perpendicular is not mentioned, you can write anyone)
- What is Snell's law?
- Derive the expression for reflection coefficient for a wave of perpendicular polarization, travelling from one medium to another at oblique incidence.
- Explain wave polarization.
- Explain polarization and different types of polarization with examples.
- Derive the expression for reflection coefficient for a wave of parallel polarization, travelling from one medium to another at oblique incidence.
- Show that Brewster's angle does not exist for a non-magnetic medium for perpendicular polarization.
- Derive the expression for Brewster's angle for parallel polarized wave.
- Derive the equation for transmission and reflection coefficients of an electromagnetic wave incident normally on the boundary between two different regions.
- Determine the type of polarization for the following waves:

MODULE-4

- Derive standard transmission line equations.
- What are distributed elements?
- Differentiate between lumped and distributed elements.
- Derive an expression for characteristic impedance of a transmission line and show that it is resistive at radio frequencies.
- Derive the expression of input impedance due to a transmission line terminated by a load. Also find the expression for SWR.
- Derive the expression for characteristic impedance of a transmission line.
- Derive the expression for reflection coefficient and VSWR for a transmission line. Also, derive the relationship between reflection coefficient and VSWR.
- Derive the current and voltage equation of a transmission line.
- Explain lossless and distortionless transmission line.
- A lossless transmission line has primary constant $L = 0.01 \mu\text{H/m}$, $C = 100 \text{pF/m}$. Find the characteristic impedance of the line.
- A Derive the expression for input impedance of a transmission line. For a shorted section of 75 ohm transmission line, $l = \lambda/4$, Find the input impedance assuming $\alpha = 0$.

MODULE – 5

- Derive the expressions for r- and x-circles in Smith Chart.
- Differentiate between open circuited and short-circuited transmission lines.
- What are half wave and quarter wave transmission lines?

- Briefly explain the importance of Quarter wave transformer.
- Explain how transmission line acts as circuit elements (inductor and capacitor).
- Write short notes on transmission line parameters.
- A load of $100 + j 150 \Omega$ is connected to a 75Ω lossless line. Find (Use Smith chart)
 - Reflection coefficient, (b) Standing wave ratio, (c) Load admittance, (d) Input impedance at 0.4λ from load, (e) Location of maxima and minima with respect to load if the transmission line is 0.6λ long and (f) Input impedance at the generator.
- A RF transmission line is terminated with a purely resistive load. The characteristic impedance of line is 1200Ω and reflection coefficient was observed as 0.2. Calculate the terminating load which is less than Z_0 .
- At a frequency of 80MHz, a lossless transmission line has a characteristic impedance of 300Ω and a wavelength of 2.5m. Find (a.) L, (b.) C and (c.) if the line is terminated with a parallel combination of 200Ω and 5pF, determine reflection coefficient and SWR.
- A lossless line is terminated with a load of $50+j25 \Omega$. Calculate reflection coefficient and SWR.
- A transmission line of length 0.2λ and characteristic impedance 100Ω is terminated with a load impedance of $50+200j$. Find input impedance, reflection coefficient at load end, reflection coefficient at the input end and VSWR.

ECT 304

VLSI CIRCUIT DESIGN

COURSE INFORMATION SHEET

PROGRAMME: ELECTRONICS & COMMUNICATION ENGINEERING	DEGREE: BTECH
COURSE: VLSI Circuit Design	SEMESTER: 6 CREDITS: 3-1-0-4
COURSE CODE: ECT 304 REGULATION: 2019	COURSE TYPE: Core
COURSE AREA/DOMAIN: VLSI & Embedded System	CONTACT HOURS: 4
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	LAB COURSE NAME:

SYLLABUS:

Module 1: VLSI Design Methodologies.

Introduction: Moore's law, ASIC design, Full custom ASICs, Standard cell-based ASICs, Gate array-based ASICs, SoCs, FPGA devices, ASIC and FPGA Design flows, Top-Down and Bottom-Up design methodologies. Logical and Physical design. Speed power and area considerations in VLSI design

Module 2: Static CMOS Logic Design

MOSFET Logic Design - NMOS Inverter (Static analysis only), basic logic gates, CMOS logic, Static and transient analysis of CMOS inverter, Switching power dissipation and delays. Realization of logic functions with static CMOS logic, Pass transistor logic, and transmission gate logic

Module 3: Dynamic Logic Design and Storage Cells

Dynamic Logic Design-Pre-charge- Evaluate logic, Domino Logic, NP domino logic. Read Only Memory-4x4 MOS ROM Cell Arrays (OR, NOR, NAND) Random Access Memory – SRAM-Six transistor CMOS SRAM cell, DRAM –Three transistor and One transistor Dynamic Memory Cell.

Module 4: Arithmetic circuits

Adders: Static adder, Carry-Bypass adder, Linear Carry- Select adder, Square- root carry-select adder. Multipliers: Array multiplier.

Module 5: Fabrication techniques and MOSFET physical Design Material Preparation

Purification and Crystal growth (CZ process), wafer preparation Thermal Oxidation- Growth mechanisms, Dry and Wet oxidation. Diffusion and ion implantation techniques. Epitaxy: molecular beam epitaxy. Lithography- Photo lithographic sequence, Electron Beam Lithography, Etching and metal deposition techniques. MOSFET Fabrication techniques Twin-Tub fabrication sequence, Fabrication process flow. Layout Design and Design rules, Stick Diagram and Design rules-micron rules and Lambda rules. (Definitions only). the layout of CMOS Inverter, two input NAND and NOR gates.

Text Books:

1. Sung –Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits- Analysis & Design, McGraw-Hill, Third Ed., 2003

2. S.M. SZE, VLSI Technology, 2/e, Indian Edition, McGraw-Hill, 2003
3. Wayne Wolf, Modern VLSI design, Third Edition, Pearson Education, 2002.

References:

1. Michael John Sebastian Smith, Application Specific Integrated Circuits, Pearson Education, 2001.
2. Neil H.E. Weste, Kamran Eshraghian, Principles of CMOS VLSI Design- A Systems Perspective, Second Edition. Pearson Publication, 2005.
3. Jan M. Rabaey, Digital Integrated Circuits- A Design Perspective, Prentice Hall, Second Edition, 2005.
4. Razavi - Design of Analog CMOS Integrated Circuits, 1e, McGraw Hill Education India Education, New Delhi, 2003.

Preamble: This course aims to impart knowledge of VLSI design methodologies and Digital VLSI circuit design.

Prerequisite:

1. ECT201 Solid State Devices
2. ECT202 Analog Circuits
3. ECT 203 Logic Circuit Design

Course Outcomes: After the completion of the course the student will be able to

CO1: Explain the various methodologies in ASIC and FPGA design.

CO2: Design VLSI Logic circuits with various MOSFET logic families.

CO3: Compare different types of memory elements.

CO4: Design and analyze data path elements such as Adders and multipliers.

CO5: Explain MOSFET fabrication techniques and layout design rules.

CO-PO-PSO MAPPING:

CO No.	Programme Outcomes (POs)												Programme-specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3		3									2	2	2	
2	3	2	3									2		3	
3	3	2	3									2	1		
4	3	2	3									2	2	1	
5	3		2									2			
ECT 304															

JUSTIFICATION

Mapping	Level	Justification
ECT 304.1 – PO1	3	Knowledge of various methodologies in ASIC and FPGA design to solve complex engineering problems

ECT 304.2 –PO1	3	Apply the knowledge of VLSI circuit design to help in solving problems
ECT 304.3 –PO1	3	Apply the knowledge of memory system design for solving computational problems
ECT 304.4–PO1	3	Apply the knowledge of computational blocks
ECT 304.5–PO1	3	Apply the knowledge of MOSFET fabrication techniques and layout design
ECT 304.2–PO2	2	Analysis of complex engineering problems & providing solution with VLSI circuit with various MOSFET logic families
ECT 304.3-PO2	2	Solving memory bottle neck of computational systems
ECT 304.4-PO2	2	Analysis of performance of computational blocks and proposed improvements
ECT 304.1-PO3	3	Design and development of engineering systems with ASIC & FPGA
ECT 304.2-PO3	3	Design and development of MOSFET based computational circuits
ECT 304.3-PO3	3	Design and development of energy efficient memory systems
ECT 304.4-PO3	3	Design and development of energy efficient & high-performance computational blocks
ECT 304.5-PO3	2	Applying MOSFET fabrication techniques for developing high-performance computational systems
ECT 304.1-PO12	2	Study and use of EDA tools for ASIC & FPGA design
ECT 304.2-PO12	2	Apply the VLSI logic circuit design for low power VLSI design
ECT 304.3-PO12	2	Design memory elements for low power high performing embedded systems
ECT 304.4-PO12	2	Design computational blocks for low power high performing embedded systems
ECT 304.5-PO12	2	Use industry relevant EDA tools for MOSFET fabrication & layout design

PSO MAPPING

MAPPING	LEVEL	JUSTIFICATION
ECT304.1-PSO1	2	Demonstrate FPGA & ASIC design skills for embedded system applications
ECT304.3-PSO1	1	Demonstrate several types of memory design for embedded applications
ECT304.4-PSO1	2	Demonstrate diverse types of adder multiplier design for embedded applications
ECT304.1-PSO2	2	Design ASIC using EDA tools
ECT304.2-PSO2	3	Simulate & synthesis VLSI circuits on FPGA

ECT304.4-PSO2	1	Simulate adder & multiplier using verilog
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GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SNO	DESCRIPTION	PROPOSED ACTIONS	PO PSO MAPPING
1	LAB BASED LEARNING	Assignments using Industrial EDA tools	PO9, PSO3, PO5, PSO2

WEB SOURCE REFERENCES:

Sl. No.	DESCRIPTION
1	https://www.tutorialspoint.com/vlsi_design/vlsi_design_digital_system.htm
2	http://ece-research.unm.edu/jimp/vlsi/slides/c1_intro.html

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

• <input type="checkbox"/> CHALK & TALKII	• <input type="checkbox"/> STUD. ASSIGNMENTII	• <input type="checkbox"/> WEB RESOURCES	<input type="checkbox"/> LCD/SMART BOARDS
<input type="checkbox"/> STUD. SEMINARS	<input type="checkbox"/> ADD-ON COURSES		

Assessment Pattern

Bloom's Category	CT1	CT2	End Sem Exam
Remember	10	10	20
Understand	20	20	40
Apply	20	20	40
Analyze			
Evaluate			
Create			

Mark Distribution:

Total Marks	CIE	ESE	Duration
150	50	100	3 Hrs

Continuous Internal Evaluation Pattern:

Attendance: 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignments: 15 marks.

End Semester Examination Pattern**Maximum Marks: 100 Time: 3 Hrs**

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module which students should answer any one. Each question can have a maximum of 2 sub-divisions and carry 14 marks. Mark patterns are as per the syllabus with 75% for theory and 25% for logical/numerical problems

ASSESSMENT METHODOLOGIES-DIRECT

• <input type="checkbox"/> ASSIGNMENTS II	• <input type="checkbox"/> STUD. SEMINARS	• <input type="checkbox"/> TESTS/MODEL EXAMS II	• <input type="checkbox"/> UNIV. EXAMINATION II
<input type="checkbox"/> STUD. LAB PRACTICES	<input type="checkbox"/> STUD. VIVA	<input type="checkbox"/> MINI/MAJOR PROJECTS	<input type="checkbox"/> CERTIFICATIONS
<input type="checkbox"/> ADD-ON COURSES	<input type="checkbox"/> OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

• <input type="checkbox"/> ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE) II	• <input type="checkbox"/> STUDENT FEEDBACK ON FACULTY (TWICE) II
• <input type="checkbox"/> ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	<input type="checkbox"/> OTHERS

Prepared by

Dr. Simi Zerín Sreeba
Abhishek Viswakumar
Nitheesh Kurian

Approved by

Dr. Rithu James
HoD

COURSE PLAN

SL No	SYLLABUS:
1	Module 1: VLSI Design Methodologies. Introduction: Moore's law. ASIC design, Full custom ASICs, Standard cell-based ASICs, Gate array-based ASICs, SoCs, FPGA devices, ASIC and FPGA Design flows, Top-Down and Bottom-Up design methodologies. Logical and Physical design. Speed power and area considerations in VLSI design
2	Module 2: Static CMOS Logic Design MOSFET Logic Design - NMOS Inverter (Static analysis only), basic logic gates, CMOS logic, Static and transient analysis of CMOS inverter, Switching power dissipation and delays. Realization of logic functions with static CMOS logic, Pass transistor logic, and transmission gate logic
3	Module 3: Dynamic logic Design and Storage Cells Dynamic Logic Design-Pre-charge- Evaluate logic, Domino Logic, NP domino logic. Read Only Memory-4x4 MOS ROM Cell Arrays (OR, NOR, NAND) Random Access Memory –SRAM-Six transistor CMOS SRAM cell, DRAM – Three transistor and One transistor Dynamic Memory Cell.
4	Module 4: Arithmetic circuits Adders: Static adder, Carry-Bypass adder, Linear Carry- Select adder, Square- root carry- select adder. Multipliers: Array multiplier.
5	Module 5: Fabrication techniques and MOSFET physical Design Material Preparation Purification and Crystal growth (CZ process), wafer preparation Thermal Oxidation- Growth mechanisms, Dry and Wet oxidation. Diffusion and ion implantation techniques. Epitaxy: molecular beam epitaxy. Lithography- Photo lithographic sequence, Electron Beam Lithography, Etching and metal deposition techniques. MOSFET Fabrication techniques Twin-Tub fabrication sequence, Fabrication process flow. Layout Design and Design rules, Stick Diagram and Design rules-micron rules and Lambda rules. (Definitions only). the layout of CMOS Inverter, two input NAND and NOR gates.

SAMPLE QUESTION

Module 1

1. Differentiate between full custom and semi-custom ASIC.
2. With a neat flow chart, explain ASIC design flow.
3. Describe Gate array-based ASIC with neat diagram.
4. What are the processes involved in Soc design

Module 2

1. With a neat diagram explain static and transient analysis of CMOS inverter
2. Realize the given logic function using static CMOS logic and transmission gate logic.
3. Compare the advantages and disadvantages of static and dynamic circuits.

Module 3

1. Compare different ROM structures.
2. Compare static and dynamic RAM structures.
3. Compare the advantages of three transistors and one transistor DRAM cell.

Module 4

1. Design a full adder with static CMOS logic
2. Compare the delay of Carry-Bypass adder, Linear Carry- Select adder, Square- root carry- select adder.

Module 5

1. Explain how electronic grade silicon (EGS) is developed.
2. Explain the necessity of single crystalline silicon in VLSI fabrication and how single crystal silicon is made.
3. Explain diffusion and ion implantation techniques.
4. Explain the advantages of SiO₂ and the oxidation techniques.

ECT 306
INFORMATION THEORY AND CODING

COURSE INFORMATION SHEET

PROGRAMME: U.G.	DEGREE: BTECH
COURSE: INFORMATION THEORY AND CODING	SEMESTER: SIX CREDITS: 4
COURSE CODE: ECT 306 REGULATION: 2019	COURSE TYPE: CORE
COURSE AREA/DOMAIN: Digital Communication	CONTACT HOURS: 4hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY):	LAB COURSE NAME:

SYLLABUS:

UNIT	DETAILS	HOURS
I	<p>Module 1 – Entropy, Sources and Source Coding</p> <p>Entropy, Properties of Entropy, Joint and Conditional Entropy, Mutual Information, Properties of Mutual Information.</p> <p>Discrete memoryless sources, Source code, Average length of source code, Bounds on averagelength, Uniquely decodable and prefix-free source codes. Kraft Inequality (with proof), Huffman code. Shannon's source coding theorem (both achievability and converse) and operational meaning of entropy.</p>	10
II	<p>Module 2 – Channels and Channel Coding</p> <p>Discrete memoryless channels. Capacity of discrete memoryless channels. Binary symmetric channels (BSC), Binary Erasure channels (BEC). Capacity of BSC and BEC. Channel code. Rate of channel code. Shannon's channel coding theorem (both achievability and converse without proof) and operational meaning of channel capacity.</p> <p>Modeling of Additive White Gaussian channels. Continuous-input channels with average power constraint. Differential entropy. Differential Entropy of Gaussian random variable. Relation between differential entropy and entropy. Shannon-Hartley theorem (with proof – mathematical subtleties regarding power constraint may be overlooked).</p> <p>Inferences from Shannon Hartley theorem – spectral efficiency versus SNR per bit, power-limited and bandwidth-limited regions, Shannon limit, Ultimate Shannon limit.</p>	11
III	<p>Module 3 – Introduction to Linear Block Codes</p> <p>Overview of Groups, Rings, Finite Fields, Construction of Finite Fields from</p>	11

	<p>Polynomial rings, Vector spaces.</p> <p>Block codes and parameters. Error detecting and correcting capability. Linear block codes. Two simple examples -- Repetition code and single parity-check code. Generator and parity-check matrix. Systematic form.</p> <p>Maximum likelihood decoding of linear block codes. Bounded distance decoding. Syndrome. Standard array decoding.</p>	
IV	<p>Module 4 – A Few Important Classes of Algebraic codes</p> <p>Cyclic codes. Polynomial and matrix description. Interrelation between polynomial and matrix viewpoint. Systematic encoding. Decoding of cyclic codes.</p>	7
V	<p>Module 5 – Convolutional and LDPC Codes</p> <p>Convolutional Codes. State diagram. Trellis diagram. Maximum likelihood decoding. Viterbi algorithm.</p> <p>Low-density parity check (LDPC) codes. Tanner graph representation. Message-passing decoding for transmission over binary erasure channel.</p>	5
TOTAL HOURS		44

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
1	<ol style="list-style-type: none"> 1. “Elements of Information Theory”, Joy A Thomas, Thomas M Cover, Wiley-Interscience. 2. “Information Theory, Inference and Learning Algorithms”, David JC McKay, Cambridge University Press 3. “Principles of digital communication”, RG Gallager, Cambridge University Press 4. “Digital Communication Systems”, Simon Haykin, Wiley. 5. “Introduction to Coding Theory”, Ron M Roth, Cambridge University Press 6. Shu Lin & Daniel J. Costello. Jr., Error Control Coding : Fundamentals and Applications, 2nd Edition. 7. Modern Coding Theory, Rüdiger Urbanke and TJ Richardson, Cambridge University Press.

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
MAT 201	Linear Algebra & Calculus	Linear Algebra & Complex Analysis	3

MAT204	Probability random process and numerical methods	Probability distributions, Transforms and Numerical Methods	4
ECT 204	Signals and System	Analyze Digital Communication System	4
ECT 305	Analog & Digital Communication	Analyze Digital Communication System	5

COURSE OBJECTIVES:

1. To introduce the concept of information
2. To understand the limits of error free representation of information signals and the transmission of such signals over a noisy channel
3. To design and analyse data compression techniques with varying efficiencies as per requirements
4. To understand the concept of various theorems proposed by Shannon for efficient data compression and reliable transmission
5. To give idea on different coding techniques for reliable data transmission
6. To design an optimum decoder for various coding schemes used.

COURSE OUTCOMES:

CO 1	Explain measures of information – entropy, conditional entropy, mutual information
CO 2	Apply Shannon's source coding theorem for data compression.
CO 3	Apply the concept of channel capacity for characterize limits of error-free transmission.
CO 4	Apply linear block codes for error detection and correction
CO 5	Apply algebraic codes with reduced structural complexity for error correction
CO 6	Understand encoding and decoding of convolutional and LDPC codes

CO-PO-PSO MAPPING:

CO No.	Programme Outcomes (POs)												Programme-specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3											3	2	
2	3	3	2	3	3								3	2	
3	3	3	2	3	3	2						2	3	2	
4	3	3	2	3	3	2						2	3	2	
5	3	3	2	3	3	2						2	3	2	
6	3	3	2	3	3	2						2	2	2	
EC 401	3	3	2	3	3	2						2	2.83	2	

JUSTIFICATION FOR THE CORRELATION LEVEL ASSIGNED IN EACH CELL OF THE TABLE ABOVE.

CO1	PO1	Information concept and mathematical formulation of information
	PO2	Probability requirements for information analysis
	PSO1	Sampling ,shannons theorem ,Probability aspects
	PSO2	FCC broad band allocation
CO2	PO1	Basic concept of source coding & lossless transmission
	PO2	Mathematical formulation of noiseless coding
	PO3	Limiting case of noiseless coding and complex channels
	PO4	Investigation of on operational meaning of entropy
	PO5	Mathematical modeling for different source encoders
	PSO1	Communication and signal processing background for different encoders
	PSO2	MatLab code for source coding
CO3	PO1	Differential Entropy
	PO2	SNR Trade off & Channel capacity calculations
	PO3	Application of Shannon Hartley theorem & Shannon's limit
	PO4	Investigation on hannel noise models
	PO5	Mathematical modeling for channels
	PO6	Optimum bandwidth concept
	PO12	Complex analysis of noise due to heavy traffic
	PSO1	Communication and signal processing background for Noise analysis
	PSO2	MatLab code for noise modelling
CO4	PO1	Study of rings, groups & fields.
	PO2	Algebra background for coding
	PO3	Application oriented coding techniques
	PO4	Analysis of error correcting code

	PO5	MatLab for coding
	PO6	Effect of Correct reception
	PO12	Study of linear block codes for error correction
	PSO1	Signal processing and communication aspects of coding
	PSO2	Setting lab experiments for understanding coding
CO5	PO1	Basic concept of error correction & detection.
	PO2	Algebra background for coding
	PO3	Application oriented coding techniques
	PO4	Analysis of error correcting code
	PO5	MatLab code for error correction & detection.
	PO6	Effect of Correct reception
	PO12	Study of cyclic codes for error correction
	PSO1	Signal processing and communication aspects of error correction techniques.
	PSO2	MatLab codes for error correction & detection.

CO6	PO1	Time & frequency domain approaches for convolutional codes.
	PO2	Algebra background for coding
	PO3	Application of maximum likelihood decoding
	PO4	Analysis of decoders
	PO5	MatLab code for encoding & decoding of convolutional codes
	PO6	Efficient decoder implementation
	PO12	Study of convolutional codes – encoding & decoding.
	PSO1	Signal processing and communication aspects of error correction techniques.
	PSO2	MatLab codes for sequential decoding

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

Sl. No.	DESCRIPTION	PROPOSED ACTIONS	PO MAPPING
1	Decoding techniques of various source encoder	ASSIGNMENT	1,2,3,5,12
2			

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS:

Sl. No.	DESCRIPTION	PO MAPPING
1	Probability, and Random Process advanced theory	1,2,3,12
2	Digital Communication Techniques advanced topics	1,2,3,12

DESIGN AND ANALYSIS TOPICS:

Sl. No.	DESCRIPTION	PO MAPPING
1	Analysis of various coding schemes	1,2,3,12

WEB SOURCE REFERENCES:

1	http:// nptel.iitm.ac.in/courses.php?disciplineId=117, http://www.nptel.iitm.ac.in/courses/117101053/
2	http://www.slideshare.net/rogerpitiot/information-theory
3	http://www.edutalks.org/beta/downloads/INFORMATION_%20THEORY.pdf
4	http://www.scribd.com/collections/3855510/Information-theory

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

<input type="checkbox"/> CHALK & TALK	<input type="checkbox"/> STUD. ASSIGNMENT	<input type="checkbox"/> WEB RESOURCES	
<input type="checkbox"/> LCD/SMART BOARDS	<input type="checkbox"/> STUD. SEMINARS	<input type="checkbox"/> ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT [Append details of assessment methodologies actually employed (including design and analysis assessment) in spreadsheet format after the completion of each semester]

<input type="checkbox"/> ASSIGNMENTS	<input type="checkbox"/> STUD. SEMINARS	<input type="checkbox"/> TESTS/MODEL EXAMS	<input type="checkbox"/> UNIV. EXAMINATION
<input type="checkbox"/> STUD. LAB PRACTICES	<input type="checkbox"/> STUD. VIVA	<input type="checkbox"/> MINI/MAJOR PROJECTS	<input type="checkbox"/> CERTIFICATIONS
<input type="checkbox"/> ADD-ON COURSES	<input type="checkbox"/> OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

<input type="checkbox"/> ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	<input type="checkbox"/> STUDENT FEEDBACK ON FACULTY (TWICE)
<input type="checkbox"/> ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	<input type="checkbox"/> OTHERS

Prepared by

Dr. Jisa David
Mr. Jaison Jacob

Approved by**Dr. Rithu James**

COURSE PLAN

UNIT	DETAILS	HOURS
I	<p>Module 1 – Entropy, Sources and Source Coding</p> <p>Entropy, Properties of Entropy, Joint and Conditional Entropy, Mutual Information, Properties of Mutual Information.</p> <p>Discrete memoryless sources, Source code, Average length of source code, Bounds on averagelength, Uniquely decodable and prefix-free source codes. Kraft Inequality (with proof), Huffman code. Shannon's source coding theorem (both achievability and converse) and operational meaning of entropy.</p>	10
II	<p>Module 2 – Channels and Channel Coding</p> <p>Discrete memoryless channels. Capacity of discrete memoryless channels. Binary symmetric channels (BSC), Binary Erasure channels (BEC). Capacity of BSC and BEC. Channel code. Rate of channel code. Shannon's channel coding theorem (both achievability and converse without proof) and operational meaning of channel capacity.</p> <p>Modeling of Additive White Gaussian channels. Continuous-input channels with average power constraint. Differential entropy. Differential Entropy of Gaussian random variable. Relation between differential entropy and entropy. Shannon-Hartley theorem (with proof – mathematical subtleties regarding power constraint may be overlooked).</p> <p>Inferences from Shannon Hartley theorem – spectral efficiency versus SNR per bit, power-limited and bandwidth-limited regions, Shannon limit, Ultimate Shannon limit.</p>	11
III	<p>Module 3 – Introduction to Linear Block Codes</p> <p>Overview of Groups, Rings, Finite Fields, Construction of Finite Fields from Polynomial rings, Vector spaces.</p> <p>Block codes and parameters. Error detecting and correcting capability. Linear block codes. Two simple examples -- Repetition code and single parity-check code. Generator and parity-check matrix. Systematic form.</p> <p>Maximum likelihood decoding of linear block codes. Bounded distance decoding. Syndrome. Standard array decoding.</p>	11

IV	Module 4 – A Few Important Classes of Algebraic codes Cyclic codes. Polynomial and matrix description. Interrelation between polynomial and matrix viewpoint. Systematic encoding. Decoding of cyclic codes.	7
V	Module 5 – Convolutional and LDPC Codes Convolutional Codes. State diagram. Trellis diagram. Maximum likelihood decoding. Viterbi algorithm. Low-density parity check (LDPC) codes. Tanner graph representation. Message-passing decoding for transmission over binary erasure channel.	5
TOTAL HOURS		44

SAMPLE QUESTIONS

MODULE 1

- A binary channel transmitting at the bit rate of $R = 40000$ bps is used for transmitting PCM voice signal. What will be the appropriate sampling rate f_s , quantizing level L , and the binary digit number if the maximum frequency in the signal is 3.6 kHz?
- A memoryless source emits n symbols each with probability p . Which among the following would be the entropy of the source as a function of n ?
 - increases as $\log(n)$
 - decreases as $\log(1/n)$
 - increases as n
 - increases as $n \log(n)$
- Five possible messages m_i , $i = 1, 2, \dots, 5$ have probabilities $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{16}$, and $\frac{1}{16}$, respectively.
- Find the entropy. Six possible messages m_i , $i = 1, 2, \dots, 6$ have probabilities $\frac{1}{8}, \frac{1}{8}, \frac{2}{8}, \frac{2}{8}, \frac{1}{8}$, and $\frac{1}{8}$, respectively.
- Find the entropy. Four messages m_i , $i = 1, 2, \dots, 4$ have probabilities $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}$, and $\frac{1}{8}$:
 - Calculate entropy H .
 - If $r = 1$ message per second, find rate of information transfer R .
- Four messages m_i , $i = 1, 2, \dots, 4$ have probabilities $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}$, and $\frac{1}{8}$:
 - Find the rate at which the binary digits will be transmitted if the signal is encoded as 00, 01, 10, and 11.
 - Find the rate at which the binary digits will be transmitted if the signal is encoded as 0, 01, 10, 110, and 111.
- Six messages m_i , $i = 1, 2, \dots, 6$, have probabilities $\frac{1}{8}, \frac{1}{8}, \frac{1}{4}, \frac{1}{4}, \frac{1}{8}$, and $\frac{1}{8}$, respectively. Find the entropy.
- M messages have probabilities p_i , $i = 1, 2, \dots, M$. If $M = 3$, write down an expression for H using the result $p_1 + p_2 + p_3 = 1$.
- A code is composed of dots and dashes. One dash = 3 dots. Probability of occurrence of dash is $\frac{1}{3}$ the probability of dot. Find the information content of a dot.
- State and prove the properties of mutual information.
- Explain the concept of information associated with message. Why the information is a measure used for measuring the amount of information?
- A source has two symbols whose probability of occurrences respectively are $p(i) = \frac{1}{8}$, $p(j) = \frac{7}{8}$. Determine entropy of the source?
- Define self information, entropy, information rate and memory less source in the case of information theory?

- Write the condition for Kraft inequality?

MODULE 2

- Encode the following messages with their respective probability using basic Huffman algorithm.
calculate the efficiency of coding and comment on the result M1 M2 M3 M4 M5 M6 M7 M8
 $\frac{1}{2}$ $\frac{1}{8}$ $\frac{1}{8}$ $\frac{1}{16}$ $\frac{1}{16}$ $\frac{1}{16}$ $\frac{1}{32}$ $\frac{1}{32}$
- Compute the Huffman code for this source, moving the composite symbol as high as possible.
- Explain why the computed source code has an efficiency of 100%.
- A discrete memory less source with 3 symbols X1,X2 and X3, having probabilities 0.3,0.4 and 0.3 respectively is to be encoded in binary form
 - a) Huffman coding scheme without extension.
 - b) Huffman coding scheme with 2nd extension.
 - c) Huffman coding scheme with 3rd extension.
 - Use Shannon-Fano algorithm to develop an efficient code and calculate the average number of bits/message thereof for a set of five messages with probabilities $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, and $\frac{1}{16}$.
 - A Gaussian channel has bandwidth of 1 MHz and signal-to-noise power spectral density of 105 Hz. Calculate the channel capacity and maximum transfer rate R of information.
 - What is optimum Huffman coding?
 - Differentiate between Huffman and optimum Huffman coding

MODULE 3

- Find the channel matrix of the resultant channel. Find $P(z_1)$ if $P(x_1) = 0.6$ and $P(x_2) = 0.4$
15000 samples are transmitted per second.
- I. Find the rate of information transmitted in the system.
- II. Find the max channel capacity of the system.
 - A voice graded channel of the telephone network has a bandwidth of 3.4 kHz.
 - Calculate the information capacity of the telephone channel for a signal to noise ratio of 30dB.
 - Calculate the minimum signal to noise ratio required to support information transmission through the telephone channel at the rate of 9600b/s.
 - Alphanumeric data are entered into a computer from a remote terminal through a voice graded telephone channel. The channel has a bandwidth of 3.4 kHz and output signal to noise ratio of 20 dB. The terminal has a total of 128 symbols. Assume that the symbols are equiprobable and successive transmissions are statically independent.
 - Calculate the information capacity of the channel.
 - Calculate the maximum symbol rate for which error free transmission over the channel is possible.

- A black and white television picture may be viewed as consisting of approximately 3×10^5 elements, each of which may occupy one of the 10 distinct brightness levels with equal probability.
- Assume that the rate of transmission is 30 picture frames per second, and the signal to noise ratio is 30 dB.
- Using the information capacity theorem, calculate the minimum bandwidth required to support the transmission of the resulting video signal.
- State and explain Shannon's 1st, 2nd and 3rd theorems.
- Compute the channel capacity for the channel matrix shown and compute $p(x_i)$ and check if they are realizable.
- Explain mutual information and prove that the mutual information of a channel is symmetric.

MODULE 4

- Give the concepts of groups and fields.
- What is binary field arithmetic?
- Explain the construction of Galois field.
- Consider the (7, 4) Hamming code defined by the generator polynomial $g(x) = 1+x+x^3$. The codeword 1000101 is sent over a noisy channel, producing the received word 0000101 that has a single error. Determine the syndrome polynomial $s(x)$ for this received word. Find its corresponding message vector m and express m in polynomial $m(x)$.
- Explain the advantages of cyclic codes over linear block codes?
- What is parity check matrix of a linear block codes?
- Discuss on the error detection and error correction capabilities of linear block codes?
- Differentiate systematic and Unsystematic codes?
- Prove that the minimum distance of a linear block code is equal to minimum Hamming weight of a nonzero code vector.
- Explain the process of encoding for a (n,k) cyclic code using shift registers.
- Explain the general form of decoder for cyclic codes.
- For a systematic (6,3) linear block code, the parity check matrix 'P' is given as Find all possible code vectors.
- Given a generator matrix $G = [1, 1, 1, 1]$ construct a (5,1) code. How many errors can this code correct? Find the code word for the data vector $d=0$ and $d=1$?
- Find a generator matrix G for a (15, 11) single error correcting linear block code. Find the code word for the data vector 10111010101.

MODULE 5

- Consider a (7, 4) cyclic code with generator polynomial $g(x) = 1+x+x^3$. Let data $d = (1010)$. Find the corresponding systematic code word.
- Determine the encoded message for the following 8-bit data codes using the CRC generating polynomial $g(x) = x^4+x^3+x$. (a) 11001100 (b) 01011111.
- Construct a convolutional encoder for the following specifications: rate efficiency $\frac{1}{2}$, constraint length 3, the connections from the shift register to modulo-2 adders are described by the following equations, $g_1(x) = 1+x+x^2$, $g_2(x) = 1+x^2$. Determine the output codeword for the message [10011].
- Explain the Turbo Decoding in detail.
- A convolution encoder has a single shift register with 2 stages, 3 mod-2 adders and an output Mux. The generator sequence of the encoder as follows: $g(1)=(1,0,1)$, $g(2)=(1,1,0)$ $g(3)=(1,1,1)$.
- Draw the block diagram and encode the message sequence (1110) and also draw the state diagram.
- Explain the advantages of cyclic codes over linear block codes?
 - Explain systematic Encoding of (n,k) cyclic codes using n-k shift registers.
 - Draw the syndrome computation circuit for a single error correcting (7, 4) BCH code and explain its operation?
- Explain the decoding procedure for BCH codes. Draw the syndrome computation circuit for a single correcting (7,4) BCH codes and explain the operation.
- Prove that the minimum distance of a linear block code is equal to minimum Hamming weight of a nonzero code vector. (ii) Explain the process of encoding for a (n,k) cyclic code using shift registers.
- Explain the general form of decoder for cyclic codes.
- Explain briefly the syndrome calculation circuit for (n,k) cyclic codes?

ECT 352
DIGITAL IMAGE PROCESSING

COURSE INFORMATION SHEET

PROGRAMME: UG PROGRAMME IN ELECTRONICS & COMMUNICATION ENGINEERING	DEGREE: B. TECH. UNIVERSITY: APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
COURSE: DIGITAL IMAGE PROCESSING	SEMESTER: S6 CREDITS: 3
COURSE CODE: EC 352 REGULATION: 2019	COURSE TYPE: ELECTIVE
COURSE AREA/DOMAIN: 2D- signal processing	CONTACT HOURS: 3(2L+1T)hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	LAB COURSE NAME:

SYLLABUS:

UNIT	DETAILS	HOURS
I	Digital Image Fundamentals: Image representation, basic relationship between pixels, elements of DIP system, elements of visual perception-simple image formation model. Vidicon and Digital Camera working principles. Brightness, contrast, hue, saturation, mach band effect, Colour image fundamentals:- RGB, CMY, HIS models. 2D sampling, quantization	7
II	Review of matrix theory: row and column ordering- Toeplitz, Circulant and block matrix, 2D Image transforms : DFT, its properties, Walsh transform, Hadamard transform, Haar transform. DCT, KL transform and Singular Value Decomposition Image Compression: Need for compression, Basics of lossless compression – bit plane coding, run length encoding and predictive coding, Basics of lossy compression – uniform and non-uniform quantization techniques used in image compression, Concept of transform coding, JPEG Image compression standard	10
III	Image Enhancement: Spatial domain methods: point processing- intensity transformations, histogram processing, image subtraction, image averaging , Spatial filtering- smoothing filters, sharpening filters , Frequency domain methods: low pass filtering, high pass filtering, homomorphic filter.	5
IV	Image Restoration: Degradation model, Unconstraint restoration- Lagrange multiplier and constraint restoration , Inverse filtering- removal of blur caused by uniform linear motion, Weiner filtering, Geometric transformations-spatial transformations	6
V	Image segmentation: Classification of Image segmentation techniques, region approach, clustering techniques ,Segmentation based on thresholding,	7

	edge based segmentation, Classification of edges, edge detection, Hough transform, active contour.	
TOTAL HOURS		35

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
1	Gonzalez Rafael C, Digital Image Processing, Pearson Education, 2009
2	S Jayaraman, S Esakkirajan, T Veerakumar, Digital image processing, Tata Mc Graw Hill, 2015
3	Jain Anil K , Fundamentals of digital image processing: , PHI,1988
4	Kenneth R Castleman , Digital image processing:, Pearson Education,2/e,2003
5	Pratt William K , Digital Image Processing: , John Wiley,4/e,2007

COURSE PRE-REQUISITES:

COURSE CODE	COURSE NAME	DESCRIPTION	SEM
ECT 303	Digital Signal Processing	Background knowledge on digital signal representation and operations	5

COURSE OBJECTIVES:

Sl. No.	DESCRIPTION
1	This course aims to develop the skills for methods of various transformation and analysis of image enhancement, image reconstruction, image compression, image segmentation and image representation.

COURSE OUTCOMES:

Sl. No.	DESCRIPTION
1	They will <u>understand</u> Image representation and will be able to <u>experiment with</u> color coordinates of images.
2	They will <u>understand</u> Image transforms and its application in Image compression
3	They will <u>understand</u> Image enhancement and will be able to <u>experiment with</u> image enhancement
4	They will <u>understand</u> Image restoration.
5	They will <u>understand</u> Image segmentation.

CO MAPPING WITH PO, PSO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	P O 8	PO 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2		2				2			2	3	2	1
CO 2	3	3	3		2				2			2	3	2	1
CO 3	3	3	2		2				2			2	3	2	1
CO 4	3	3	2									2	3		1
CO 5	3	3	3									2	3		1
EC 352	3	3	2.4		1.2				1.2			2	3	1.2	1

JUSTIFICATION FOR CO-PO-PSO MAPPING

MAPPING	LEVEL Low(1)/ Medium(2)/ High(3)	JUSTIFICATION
EC352.1-PO1, PO2,PO3, PO12 PSO1,PSO3	3, 3,2,2 3,1	Students will learn Image representation, & color fundamentals. It will help their future leaning.
EC352.1-PO5, PO9,PSO2	2, 2,2	Students will do simulation of colour coordinate modification using Matlab. They will be doing it in small teams.
EC352.2- PO1, PO2,PO3, PO12 PSO1,PSO3	3, 3,3, 2 3,1	Students will learn Image Transforms and image compression techniques. It will help their future leaning.
EC352.2-PO5, PO9,PSO2	2, 2,2	Students will do simulation of image transforms using Matlab. They will be doing it in small teams.
EC352.3-PO1, PO2,PO3, PO12 PSO1,PSO3	3, 3,2,2 3,1	Students will learn Image Enhancement. It will help their future leaning.
EC352.3-PO5, PO9,PSO2	2, 2,2	Students will do simulation of image enhancement using Matlab. They will be doing it in small teams.
EC352.4- PO1, PO2,PO3, PO12 PSO1,PSO3	3, 3,2, 2 3,1	Students will learn Image restoration. It will help their future leaning.

EC352.5- PO1, PO2,PO3, PO12 PSO1,PSO3	3, 3,3, 2 3,1	Students will learn Image segmentation. It will help their future leaning.
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GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

Sl. No.	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Practical Implementation of image processing methods	Included in the course as demonstration and hands on experiment	5,9	1,2

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS:

Sl. No.	DESCRIPTION	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Introduction and hands on to basic Matlab programming in Image processing	5,9	1,2
2	Implementation of image restoration and segmentation using Matlab	1,5,9	1,2

DESIGN AND ANALYSIS TOPICS:

Sl. No.	DESCRIPTION	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	2D transforms	1,5	1,2
2	Histogram manipulation	1,5	1,2
3	Spatial & Frequency domain filters	1,5	1,2
4	Image encoding	1	1

WEB SOURCE REFERENCES:

Sl. No.	DESCRIPTION
1	http://mathworld.wolfram.com/
2	http://www.imageprocessingplace.com
3	http://www.mathworks.in/academia/student_center/tutorials/launchpad.html
4	http://www.mit.edu/people/abbe/matlab/lec1.html
5	http://www.yorku.ca/eye/
6	http://www.mathworks.in/products/image/examples.html

7	http://www.imageprocessingbasics.com/
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DELIVERY/INSTRUCTIONAL METHODOLOGIES:

<input checked="" type="checkbox"/> CHALK & TALK	<input checked="" type="checkbox"/> STUD. ASSIGNMENTS	<input checked="" type="checkbox"/> WEB RESOURCES	<input checked="" type="checkbox"/> ONLINE CLASSES
<input checked="" type="checkbox"/> LCD/SMART BOARDS	<input type="checkbox"/> STUD. SEMINARS	<input type="checkbox"/> ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

<input checked="" type="checkbox"/> ASSIGNMENTS	<input type="checkbox"/> STUD. SEMINARS	<input checked="" type="checkbox"/> TESTS/MODEL EXAMS	<input checked="" type="checkbox"/> UNIV. EXAMINATION
<input checked="" type="checkbox"/> STUD. LAB PRACTICES	<input type="checkbox"/> STUD. VIVA	<input type="checkbox"/> MINI/MAJOR PROJECTS	<input type="checkbox"/> CERTIFICATIONS
<input type="checkbox"/> ADD-ON COURSES	<input type="checkbox"/> OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

<input checked="" type="checkbox"/> ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	<input checked="" type="checkbox"/> STUDENT FEEDBACK ON FACULTY (TWICE)
<input type="checkbox"/> ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	<input type="checkbox"/> OTHERS

Prepared by
Jaison Jacob
 (Course In-charge)

Approved by

HOD-ECE

COURSE PLAN

UNIT	DETAILS	HOURS
I	Digital Image Fundamentals: Image representation, basic relationship between pixels, elements of DIP system, elements of visual perception-simple image formation model. Vidicon and Digital Camera working principles. Brightness, contrast, hue, saturation, mach band effect, Colour image fundamentals:- RGB, CMY, HIS models. 2D sampling, quantization	7
II	Review of matrix theory: row and column ordering- Toeplitz, Circulant and block matrix, 2D Image transforms : DFT, its properties, Walsh transform, Hadamard transform, Haar transform. DCT, KL transform and Singular Value Decomposition Image Compression: Need for compression, Basics of lossless compression – bit plane coding, run length encoding and predictive coding, Basics of lossy compression – uniform and non-uniform quantization techniques used in image compression, Concept of transform coding, JPEG Image compression standard	10
III	Image Enhancement: Spatial domain methods: point processing- intensity transformations, histogram processing, image subtraction, image averaging , Spatial filtering- smoothing filters, sharpening filters , Frequency domain methods: low pass filtering, high pass filtering, homomorphic filter.	5
IV	Image Restoration: Degradation model, Unconstraint restoration- Lagrange multiplier and constraint restoration , Inverse filtering- removal of blur caused by uniform linear motion, Weiner filtering, Geometric transformations-spatial transformations	6
V	Image segmentation: Classification of Image segmentation techniques, region approach, clustering techniques ,Segmentation based on thresholding, edge based segmentation, Classification of edges, edge detection, Hough transform, active contour.	7
TOTAL HOURS		35

SAMPLE QUESTIONS

Moduel-1

- Distinguish between a raster and a vector image.
- Define what is “Weber ratio” and discuss what is meant by brightness adaptation in human visual system.
- What is brightness discrimination?
- Give the practical limitations in sampling and reconstruction of images.
- Discuss about image file formats.
- Define 2-D Sampling theorem and discuss what is meant by fold over frequencies.
- Differentiate between Vidicon and Digital Camera.
- Explain Differentiate between brightness and contrast.
- Mach band effect.
- Explain the following relationship between pixels. (a) Adjacency (b) Connectivity
- Explain simultaneous contrast.
- How a digital image is represented?
- What are called 4-neighbors of a pixel?
- What are diagonal neighbors of a pixel?
- Define 4-connectivity.
- Define 8-connectivity.
- Define m-connectivity.
- Explain in detail the elements of Digital Image Processing systems.
- Explain (a) Image formation in the eye.
- (b) Brightness adaptation and discrimination.
- Write notes on the following (a)Luminance, Brightness and contrast
- (b) Image quantization.
- Explain the HSI colour model
- Explain the RGB and CMYK colour models.
- Define a two dimensional bandlimited image.
- Define Nyquist rate for an Image.
- What is aliasing? Explain it with image spectrum?
- What are called fold over frequencies?
- Briefly explain
 - How do you determine the ability of the eye to discriminate between changes in light intensity?
 - The two phenomena which clearly demonstrate that perceived brightness is not a simple function of intensity

Module-2

- What do you understand form Toeplitz matrix, Circulant matrix, and block matrix ?
- Define 2D-convolution.
- Generate Hadamard transform $HN=8$ form $HN=2$
- Define Haar transform and list its properties .
- Show that the DFT matrices are orthogonal in nature.
- Give an account of convolution and correlation in digital Image processing .
- What is meant by redundancy in an image?
- Define the efficiency of an encoding scheme with necessary explanations.
- Discuss the transform coding technique used for Image compression.
- Explain in detail JPEG still picture compression standard.

Module-3

- Explain any two spatial filtering techniques used for image enhancement.
- Explain the frequency domain filtering techniques used for image enhancement.
- How will you differentiate between the quality of an image on the basis of histogram.
- Explain the Homomorphic filtering for images

Module -4

- Discuss pseudo inverse filtering.
- How do you classify the image restoration techniques?
- Differentiate between point spread function(PSF), optical transfer function(OTF) and modulation transfer function(MTF).
- What is inverse filtering ? what is its drawback? How it is overcome?
- Derive transfer function of Wiener restoration filter. Also explain it's practical implementation methods.
- Explain constrained least squares restoration.
- Give the block diagram of the image observation model and explain it.
- What is speckle noise? Discuss the methods used to restore an image from speckle noise.
- What is meant by geometric transformation of images? Explain the techniques used for it.
- What is meant by spatial transformation of Images? Explain the techniques used for it.

Module-5

- What is meant by Image segmentation?
- What is meant by active contour? What is its use?
- Briefly explain the region based and cluster based approaches for image segmentation.
- What is edge linking? Explain the edge linking techniques used for boundary detection.
- What is “edge” of an image? Give its classification. Explain the methods employed to obtain the edge of an image.
- Briefly explain segmentation based on region growing.
- Briefly explain segmentation techniques based on thresholding,

- Briefly explain segmentation techniques based on clustering.
- Explain the K-means clustering and Fuzzy clustering.
- Explain the Edge based segmentation.
- Give the details of Canny Edge detector.
- Explain Second derivative methods of detecting edges in an image (Laplacian, LoG, DoG).

ECT 362
INTRODUCTION TO MEMS

COURSE INFORMATION SHEET

PROGRAMME: Electronics & Communications Engineering	DEGREE: BTECH
COURSE: Introduction to MEMS	SEMESTER: S6 CREDITS: 3
COURSE CODE: ECT362 REGULATION: 2019	COURSE TYPE: CORE /ELECTIVE
COURSE AREA/DOMAIN: ELECTRONICS	CONTACT HOURS: 3 hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY):	LAB COURSE NAME:

SYLLABUS:

UNIT	DETAILS	HOURS
This course introduces students to the rapidly emerging, multi-disciplinary, and exciting field of Micro Electro Mechanical Systems.		
I	MEMS and Microsystems: Applications – multidisciplinary nature of MEMS – principles and examples of Micro sensors and micro actuators – micro accelerometer – comb drives - Micro grippers – micro motors, micro valves, micro pumps, Shape Memory Alloys. Actuation and Sensing techniques: Thermal sensors and actuators, Electrostatic sensors and actuators, Piezoelectric sensors and actuators, magnetic actuators.	8
II	Review of Mechanical concepts: Stress, Strain, Modulus of Elasticity, yield strength, ultimate strength – General stress strain relations – compliance matrix. Overview of commonly used mechanical structures in MEMS - Beams, Cantilevers, Plates, Diaphragms – Typical applications. Flexural beams: Types of Beams, longitudinal strain under pure bending – Deflection of beams – Spring constant of cantilever – Intrinsic stresses	6
III	Scaling laws in miniaturization - scaling in geometry, scaling in rigid body dynamics, Trimmer force scaling vector, scaling in electrostatic and electromagnetic forces, scaling in electricity and fluidic dynamics, scaling in heat conducting and heat convection. Materials for MEMS – Silicon – Silicon compounds – Silicon Nitride, Silicon Dioxide, Silicon carbide, Poly Silicon, GaAs, Silicon Piezo resistors. Polymers in MEMS – SU-8, PMMA, PDMS, Langmuir – Blodgett Films.	10
IV	Micro System fabrication – Photolithography – Ion implantation-Diffusion – Oxidation – Chemical vapour deposition – Etching. Overview of Micro manufacturing – Bulk micro manufacturing, Surface micro machining, LIGA process – Microstereo lithography	8
V	Micro system Packaging: general considerations in packaging design – Levels of Micro system packaging. Bonding techniques for MEMS:	6

Surface bonding, Anodic bonding, Silicon - on - Insulator, wire bonding, Sealing – Assembly of micro systems.	
Overview of MEMS areas : RF MEMS, BioMEMS, MOEMS, NEMS	
Total	38

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T	Chang Liu, Foundations of MEMS, Pearson 2012
T	Tai-Ran Hsu, MEMS and Microsystems Design and Manufacture, TMH, 2002
R	Chang C Y and Sze S. M., VLSI Technology, McGraw-Hill, New York, 2000
R	Julian W Gardner, Microsensors: Principles and Applications, John Wiley & Sons, 1994
R	Mark Madou, Fundamentals of Micro fabrication, CRC Press, New York, 1997
R	Stephen D. Senturia, Microsystem design, Springer (India), 2006
R	Thomas B. Jones, Electromechanics and MEMS, Cambridge University Press, 2001
R	Gregory T.A. Kovacs, Micromachined Transducers Sourcebook, McGraw Hill, 1998

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
EST130	-Basics of Electrical and Electronics Engineering,		2
EST 100	Engineering Mechanics		1

COURSE OBJECTIVES:

1	To understand the operation of major classes of MEMS devices/systems
2	To give the fundamentals of standard micro fabrication techniques and processes
3	To understand the unique demands, environments and applications of MEMS devices

COURSE OUTCOMES:

Sl No.	DESCRIPTION
1	Describe the working principles of micro sensors and actuators
2	Identify commonly used mechanical structures in MEMS
3	Explain the application of scaling laws in the design of micro systems
4	Identify the typical materials used for fabrication of micro systems
5	Explain the principles of standard micro fabrication techniques
6	Describe the challenges in the design and fabrication of Micro systems

CO MAPPING WITH PO, PSO

CO No.	Programme Outcomes (POs)												Programme-Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3											2		
2	3	3											2		
3	3	3											2		
4	3	3	2										2		
5	3	3											2		

6	3	3											2		
ECT362	3	3	0.33										2		

JUSTIFICATION FOR CO-PO MAPPING

MAPPING	LEVEL	JUSTIFICATION
ECT362.1-PO1	3	Working principles of micro sensors and actuators enhances engineering knowledge
ECT362.1-PO2	3	Understanding working principles of micro sensors and actuators enables students to analyze a problem effectively
ECT362.2-PO1	3	Understating the mechanical structures in MEMS enhances the engineering knowledge
ECT362.2-PO2	3	Understanding in various mechanical structures helps to analyze a MEMS design problem effectively
ECT362.3-PO1	3	Application of scaling laws enhances engineering knowledge
ECT362.3-PO2	3	Scaling laws will help to perform proper problem analysis
ECT362.4-PO1	3	Awareness of typical materials used for fabrication enhances engineering knowledge
ECT362.4-PO2	3	Awareness of typical materials used for fabrication could help in problem analysis
ECT362.4-PO3	2	Awareness of typical materials used for fabrication could help in designing solutions for complex Engineering problems
ECT362.5-PO1	3	Knowledge about the standard micro fabrication techniques helps in enhancing engineering knowledge
ECT362.5-PO2	3	Awareness about the principles of standard micro fabrication techniques
ECT362.6-PO1	3	Knowledge about the challenges in the design and fabrication helps in enhancing engineering knowledge
ECT362.6-PO2	3	Knowledge about the challenges in the design and fabrication helps out in analyzing a problem

JUSTIFICATION FOR CO-PSO MAPPING

MAPPING	LEVEL	JUSTIFICATION
ECT362.1-PSO1	2	Knowledge on working principles of micro sensors and actuators enables students to design and implement MEMS devices and applications
ECT362.2-PSO1	2	Understating the mechanical structures in MEMS enables students to design and implement MEMS devices
ECT362.3-PSO1	2	Knowledge of scaling laws enables students to design and implement MEMS devices
ECT362.4-PSO1	2	Knowledge about typical materials used for fabrication helps the student to think about the possibility of design and implement his/her application
ECT362.5-PSO1	2	Understanding principles of standard micro fabrication helps to design and implement MEMS devices
ECT362.6-PSO1	2	Appreciating the challenges in the design and fabrication will create a venue to demonstrate the students skill in design and implementation

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SNO	DESCRIPTION	PROPOSED ACTIONS	PO PSO MAPPING
1	Understanding MEMS device applications in day-to-day activities - Case study	Class Seminars	PO1, PO3, PO6, PSO1, PSO2

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURE/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

S No:	DESCRIPTION	PO PSO MAPPING
1	Identifying MEMS applications - Case study	PO1, PO3, PO6, PSO1, PSO2

WEB SOURCE REFERENCES:

1.	http://nptel.ac.in/courses/117105082/
2.	https://www.mepits.com/tutorial/255/vlsi/mems
3.	https://www.engr.sjsu.edu/trhsu/

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

<input checked="" type="checkbox"/> CHALK & TALK	<input checked="" type="checkbox"/> STUD. ASSIGNMENT	<input type="checkbox"/> WEB RESOURCES	
<input checked="" type="checkbox"/> LCD/SMART BOARDS	<input type="checkbox"/> STUD. SEMINARS	<input type="checkbox"/> ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

<input checked="" type="checkbox"/> ASSIGNMENTS	<input checked="" type="checkbox"/> STUD. SEMINARS	<input checked="" type="checkbox"/> TESTS/MODEL EXAMS	<input type="checkbox"/> UNIV. EXAMINATION
<input type="checkbox"/> STUD. LAB PRACTICES	<input type="checkbox"/> STUD. VIVA	<input type="checkbox"/> MINI/MAJOR PROJECTS	<input type="checkbox"/> CERTIFICATIONS
<input type="checkbox"/> ADD-ON COURSES	<input type="checkbox"/> OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

<input checked="" type="checkbox"/> ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	<input checked="" type="checkbox"/> STUDENT FEEDBACK ON FACULTY (TWICE)
<input type="checkbox"/> ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	<input type="checkbox"/> OTHERS

Prepared by

Rony Antony P

Approved by

Dr. Rithu James

COURSE PLAN

UNIT	DETAILS	HOURS
This course introduces students to the rapidly emerging, multi-disciplinary, and exciting field of Micro Electro Mechanical Systems.		
I	MEMS and Microsystems: Applications – multidisciplinary nature of MEMS – principles and examples of Micro sensors and micro actuators – micro accelerometer –comb drives - Micro grippers – micro motors, micro valves, micro pumps, Shape Memory Alloys. Actuation and Sensing techniques: Thermal sensors and actuators, Electrostatic sensors and actuators, Piezoelectric sensors and actuators, magnetic actuators.	8
II	Review of Mechanical concepts: Stress, Strain, Modulus of Elasticity, yield strength, ultimate strength – General stress strain relations – compliance matrix. Overview of commonly used mechanical structures in MEMS - Beams, Cantilevers, Plates, Diaphragms – Typical applications. Flexural beams: Types of Beams, longitudinal strain under pure bending – Deflection of beams – Spring constant of cantilever – Intrinsic stresses	6
III	Scaling laws in miniaturization - scaling in geometry, scaling in rigid body dynamics, Trimmer force scaling vector, scaling in electrostatic and electromagnetic forces, scaling in electricity and fluidic dynamics, scaling in heat conducting and heat convection. Materials for MEMS – Silicon – Silicon compounds – Silicon Nitride, Silicon Dioxide, Silicon carbide, Poly Silicon, GaAs , Silicon Piezo resistors. Polymers in MEMS – SU-8, PMMA, PDMS, Langmuir – Blodgett Films.	10
IV	Micro System fabrication – Photolithography – Ion implantation-Diffusion – Oxidation – Chemical vapour deposition – Etching. Overview of Micro manufacturing – Bulk micro manufacturing, Surface micro machining , LIGA process –Microstereo lithography	8
V	Micro system Packaging: general considerations in packaging design – Levels of Micro system packaging. Bonding techniques for MEMS: Surface bonding, Anodic bonding, Silicon - on - Insulator, wire bonding, Sealing – Assembly of micro systems. Overview of MEMS areas : RF MEMS, BioMEMS, MOEMS, NEMS	6
Total		38

SAMPLE QUESTIONS

Module 1

- Explain the different engineering fields involved in the development and design of MEMS.
- Give one application of MEMS in biomedical field. Illustrate its working with neat sketches.
- Explain the operating principle of two types of micro motors with suitable schematics.
- Explain the operating principle of micro valves and micro pumps with suitable schematics.
- Explain the working principle of micro accelerometer.
- Explain any four actuation techniques for MEMS devices.
- Discuss the actuation using shape memory alloys.
- Design an efficient air bag system using MEMS devices.
- What are the main components and applications of microfluidic system? Describe the principle and operation of an actuator that can be used in such systems.
- Explain the working principle of magnetic actuation with necessary diagrams.
- Explain the multidisciplinary nature of MEMS.
- Mention the characteristics of sensors and actuators. Explain about the working of acoustic wave sensor.
- Explain about electrostatic and electromagnetic sensing and actuating principles. Why electrostatic actuation is preferred over electromagnetic actuation in micro motors?
- Explain the principle of operation of different types of optical and chemical sensors.

Module 2:

- Explain about different types of beams encountered in MEMS research and their boundary conditions
- A cylindrical silicon rod is pulled on both ends with a force of 10 mN. The rod is 1mm long and 100 μ m in diameter. Find the stress and strain in the longitudinal direction of the rod
- Explain the stress-strain relation using stress-strain diagram.
- Discuss about different types of stress and strain.
- Distinguish the concepts of stress and strain with neat diagrams. How the stress and strain can be related? What is the significance of Young's modulus?
- State the reasons for intrinsic stress in thin film materials under room temperature and zero loading conditions. Mention the strategies for minimizing undesirable intrinsic bending
- Explain the deflection of beams under simple loading condition. Discuss on the procedure to find the spring constant of end-loaded cantilever.

Module 3

- Describe the effect of scaling in heat conducting and heat convection.
- Why electrostatic actuation is preferred over electromagnetic actuation in micro motors?

- State three relevant properties of poly silicon and GaAs for use in Microsystems.
- What are the advantages of use of polymers in micro systems? Give two examples of Polymers (full chemical/commercial names).
- Derive equations for acceleration a , time t and power density P/V based on the Trimmer Force Scaling Vector? What information does the force scaling vector provide to the MEMS designer?
- Illustrate the SU – 8 Photoresists development process with relevant figures. What are the applications of SU – 8 Photoresists?
- Why silicon is considered as an ideal substrate material for MEMS? Explain the method to produce single-crystal silicon.
- Explain the role of Silicon compounds and Gallium Arsenide in the development of MEMS sensors and actuators.
- Discuss on the crystalline structure of silicon using Miller indices. Compare the characteristics of silicon by principal planes.

Module 4

- Describe the etching process used to create deep trenches with high aspect ratio.
- Explain the oxide growth process in Silicon with relevant figures.
- Compare different types of chemical vapour deposition processes in terms of temperature, pressure, deposition rates, advantages, disadvantages and applications.
- Compare the dopant profiles of ion implantation and diffusion. Which process is used for controlled doping?
- What is the role of photoresist in photolithography? Mention the different types of photoresist with examples. What type of photoresist is used for more clear edge definitions?
- Give five relevant points of comparison between bulk and surface micromachining.
- Discuss on the methods to control wet etching process.
- What are the requirements for substrate and photoresist materials in the LIGA process?
- Explain the process of chemical vapour deposition (CVD) and the rate of CVD build-up. What are the different methods to enhance the rate of CVD process?
- Illustrate the Surface Micromachining process with necessary diagrams. What are the problems associated with this process?
- Illustrate the fabrication of a square tube using LIGA process.
- A silicon substrate is doped with boron ions at 100 KeV. Assume the maximum concentration after the doping is $30 \times 10^{18}/\text{cm}^3$. Find: (a) the dose, Q , (b) the dopant concentration at the depth $0.15 \mu\text{m}$, (c) the depth at which the dopant concentration is at 0.1% of the maximum value. (Given: $R_p = 307 \text{ nm} = 307 \times 10^{-7} \text{ cm}$ and $\Delta R_p = 69 \times 10^{-7} \text{ cm}$ at 100 KeV energy level).
- Perform a comparison between different micromachining techniques.
- Explain the three dry etching techniques. Perform the comparison between dry and wet etching on any six parameters.
- Discuss on the bulk micro-manufacturing techniques. What are the problems associated with this process?
- Explain the technique of photolithography using both positive and negative photoresists. What are the different light sources used for photolithography?

Module 5

- Compare MEMS and NEMS.
- Describe bio-MEMS. Analyze the technical issues and interface requirements of such micro-systems.
- Discuss about the different sealing techniques used in micro-system packaging.

- What are the issues involved in MEMS packaging?
- What are the major technical issues in Bio-MEMS products?
- Mention the difference between biomedical sensors and biosensors.
- Discuss about bio-MEMS. Explain the working principle of biotesting and analytical systems.
- Mention the objectives and general considerations of microsystems packaging. Explain about different interfaces in microsystems packaging.
- What are the four techniques available for surface bonding in MEMS? Explain the techniques with suitable diagrams.

ECT 332
DATA ANALYSIS

COURSE INFORMATION SHEET

PROGRAMME: ELECTRONICS & COMMUNICATION ENGINEERING	DEGREE: BTECH
COURSE: DATA ANALYSIS	SEMESTER: 6 CREDITS: 2-1-0-3
COURSE CODE: ECT 332 REGULATION: 2016	COURSE TYPE: ELECTIVE
COURSE AREA/DOMAIN: Electronics and Communication	CONTACT HOURS:
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	LAB COURSE NAME:

SYLLABUS:

Module 1: Overview of Data Analysis and Python

Numpy and Scipy Python modules for data analysis. Reading and processing spreadsheets and csv files with Python using xlrd, xlwt and openpyxl. Data visualization with Matplotlib. Two dimensional charts and plots. Scatter plots with matplotlib. Three dimensional visualization using Mayavi module. Reading data from sql and mongodb databases with Python.

Module 2: Big Data Arrays with Pandas

Familiarization of the python pandas. Reading and writing pandas dataframes. Reading rows and columns from pandas dataframe. Handling NaN values. Reading and writing .txt, .csv, .pdf, .html and json files with pandas. Merging, concatenating and grouping of data frames. Use of pivot tables. Pickling of data frames in Python

Module 3: PCA and Cluster Analysis

Singular value decomposition of a matrix/array. Eigen values and eigen vectors. Principal component analysis of a data frame. Scree plot. Dimensionality reduction with PCA. Loadings for principal components. Case study with Python. Cluster analysis. Hierarchical and K-means clustering. Interpretation of dendrograms.

Module 4: Statistical Data Analysis

Hypothesis testing. Bayesian analysis. Meaning of prior, posterior and likelihood functions. Use of pymc3 module to compute the posterior probability. MAP Estimation. Credible interval, conjugate distributions. Contingency table and chi square test. Kernel density estimation.

Module 5: Machine Learning

Supervised and unsupervised learning. Use of scikit-learn. Regression using scikit-learn. Deep learning with convolutional neural networks. Structure of CNN. Use of Keras and Tensorflow. Machine learning with pytorch. Reading and writing images with openCV. Case study of character recognition with MNIST dataset. High performance computing for machine learning. Use of numba, jit and numexpr for faster Python code. Use of Ipython-parallel.

Text Books and References

1. "Python Data Analytics", Fabio Nelli, Apress.

2. “Data Analysis from Scratch with Python”, Peters Morgan, AI Sciences.
3. “Python for Data Analysis”, Wes McKinny, O’Reilly.
4. “Ipython Interactive Computing and Visualization Cookbook”, Cyrille Rossant , PACKT Open Source Publishing
5. “Deep Learning with Python”, Francois Chollet, Manning

Preamble: This course aims to set the foundation for students to develop new-age skills pertaining to analysis of large-scale data using modern tools.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to

CO1:Read and write data to and fro spreadsheets and databases

CO2:Work with large data as pandas data frames

CO 3 Perform PCA and cluster analysis on data frames

CO 4 Perform Bayesian analysis on data frames.

CO 5 Apply machine learning in data analysis problems

CO 6 Apply methods in high performance computing for data analysis

CO-PO-PSO MAPPING:

CO-PO-PSO MAPPING:

CO No.	Programme Outcomes (POs)												Programme-specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3			3							2	1		
2	3	3	2	3	3										
3	3	3	2	3	3	2						2			
4	3	3	2	3	3	2						2			
5	3	3	2	3	3	2						2		2	
6	3	3	2	3	3	2						2		2	
ECT 332															

JUSTIFICATION

Mapping	Level	Justification
ECT 332.1 – PO1	3	Knowledge of various data analytic approaches involves solving complex engineering problems
ECT 332.2 –PO1	3	Comparative study of different dimensionality reduction techniques involves solving complex engineering problems
ECT 332.3 –PO1	3	Knowledge of theoretical foundations of association rule mining involves solving complex engineering problems
ECT 332. 4–PO1	3	Knowledge of the fundamental concepts of Big Data management and analytics helps in solving complex engineering problems
ECT 332. 5–PO1	3	Exploratory data analysis can be used to design and conduct experiments to provide valid conclusions
ECT 332. 6–PO1	3	Knowledge of high performance computing involves solving complex engineering problems
ECT 332.2-PO3	2	In the Design and development of solutions we have to Work with large data as pandas data frames is analysis
ECT 332.3-PO3	2	Perform PCA and cluster analysis on data frames is involved in the design process
ECT 332.4-PO3	2	Perform Bayesian analysis on data frames is involved in the design process
ECT 332.5-PO3	2	Machine learning in data analysis problems is involved in the design process
ECT 332.6-PO3	2	High performance computing for data analysis is involved in the design process
ECT 332.2-PO4	3	Pandas data frames Is used in the design of experiments and analysis

ECT 332.3-PO4	3	Performing PCA and cluster analysis on data frames is research based investigation
ECT 332.4-PO4	3	Performing Bayesian analysis on data frames is research based investigation
ECT 332.-PO4	3	Machine learning in data analysis problems is now a days an essential part of investigation
ECT 332.6-PO4	3	high performance computing for data analysis is used in the research investigation
ECT 332.1-PO5	3	Read and write data to and fro spreadsheets and databases is required in Problem analysis
ECT 332.2-PO5	3	Work with large data as pandas data frames requires modern tools
ECT 332.3-PO5	3	Perform PCA and cluster analysis on data frames requires modern tools
ECT 332.4-PO5	3	Perform Bayesian analysis on data frames requires modern tools
ECT 332.-PO5	3	Apply machine learning in data analysis problems requires modern tools
ECT 332.6-PO5	3	Apply methods in high performance computing for data analysis
ECT 332.3-PO6	2	Perform PCA and cluster analysis on data frames process should think about responsibilities relevant to the professional engineering practice.
ECT 332.4-PO6	2	Perform Bayesian analysis on data frames should follow professional engineering practice.
ECT 332.-PO6	2	Apply machine learning in data analysis problems professional engineering practice.
ECT 332.6-PO6	2	Apply methods in high performance computing for data analysis should think

		about responsibilities relevant to the professional engineering practice.
ECT 332.1-PO12	2	Read and write data to and fro spreadsheets and databases is required in the life long learning process
ECT 332.3-PO12	2	Perform PCA and cluster analysis on data frames is required in the continues learning
ECT 332.4-PO12	2	Bayesian analysis on data frames is required in the continues learning
ECT 332.-PO12	2	machine learning in data analysis problems is required in the continues learning
ECT 332.6-PO12	2	High performance computing for data analysis is required in the continues learning

PSO MAPPING

MAPPING	LEVEL	JUSTIFICATION
ECT 332.1-PSO1	1	Demonstrate their skills in designing, implementing and testing
ECT 332.5-PSO2	2	Apply their knowledge for the analysis
ECT 332.6-PSO2	2	Apply their knowledge and skills to conduct experiments

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

Sl. No.	DESCRIPTION	PROPOSEDACTIONS
1	Nil	

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SNO	DESCRIPTION	PROPOSED ACTIONS	PO PSO MAPPING
1	LAB BASED LEARNING	After each modules projects will be given	PO9,PSO3

WEB SOURCE REFERENCES:

Sl. No.	DESCRIPTION
1	https://www.tutorialspoint.com/python/index.htm
2	https://www.simplilearn.com/tutorials/data-analytics-tutorial/data-analytics-with-python

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

<input checked="" type="checkbox"/> <input type="checkbox"/> CHALK & TALK <input type="checkbox"/>	<input checked="" type="checkbox"/> <input type="checkbox"/> STUD. ASSIGNMENT <input type="checkbox"/>	<input checked="" type="checkbox"/> <input type="checkbox"/> WEB RESOURCES	<input type="checkbox"/> LCD/SMART BOARDS
<input type="checkbox"/> STUD. SEMINARS	<input type="checkbox"/> ADD-ON COURSES		

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	20
Understand	30	30	60
Apply	10	10	20
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions**Course Outcome 1 (CO1): Read and write data to and fro spreadsheets and databases**

1. Write Python code to read an .xls file using xlrd module. Save it as a different .xlsx file using openpyxl.
2. Write Python code to read mongodb data base.

Course Outcome 2 (CO2): Work with pandas dataframes

1. Write Python code read a table in a pdf file as a pandas dataframe.
2. Write Python code to create a pandas dataframe. Pickle this data and store it. Write another Python code to retrieve the data from the pickle.

Course Outcome 3 (CO3): PCA and Cluster Analysis

1. Write Python code to perform PCA on a pandas dataframe. Write code to create a scree plot.
2. Write Python code to do K-means clustering.

Course Outcome 4 (CO4): Bayesian Analysis on Dataframes

1. Write Python code to compute the posterior probability of a data set with Pymc3
2. Write a python code to evaluate the statistical correlation between variables in 5X5 random data set.

Course Outcome 5 (CO5): Machine learning in Data Analysis

1. Write python code to use Keras for training a CNN
2. Write Python code to read an RGB image and convert to gray scale and write the grayscale image in .jpg format.

Course Outcome 6 (CO6): High Performance Computing Methods in Data analysis

1. Write Python code to use numexpr for faster parallel computation
2. Write Python code with Ipython-parallel to perform parallel computing with 4 cores.

ASSESSMENT METHODOLOGIES-DIRECT

✓ <input type="checkbox"/> ASSIGNMENTS	✓ <input type="checkbox"/> STUD. SEMINARS	✓ <input type="checkbox"/> TESTS/MODEL EXAMS	✓ <input type="checkbox"/> UNIV. EXAMINATION
<input type="checkbox"/> STUD. LAB PRACTICES	<input type="checkbox"/> STUD. VIVA	<input type="checkbox"/> MINI/MAJOR PROJECTS	<input type="checkbox"/> CERTIFICATIONS
<input type="checkbox"/> ADD-ON COURSES	<input type="checkbox"/> OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

✓ <input type="checkbox"/> ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE) <input type="checkbox"/>	✓ <input type="checkbox"/> STUDENT FEEDBACK ON FACULTY (TWICE) <input type="checkbox"/>
✓ <input type="checkbox"/> ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	<input type="checkbox"/> OTHERS

Prepared by

Tressa Michael

Approved by

Dr.Rithu James

COURSE PLAN

UNIT	SYLLABUS
	Module 1: Overview of Data Analysis and Python Numpy and Scipy Python modules for data analysis. Reading and processing spreadsheets and csv files with Python using xlrd, xlwt and openpyxl. Data visualization with Matplotlib. Two dimensional charts and plots. Scatter plots with matplotlib. Three dimensional visualization using Mayavi module. Reading data from sql and mongodb databases with Python.
	Module 2: Big Data Arrays with Pandas Familiarization of the python pandas. Reading and writing pandas dataframes. Reading rows and columns from pandas dataframe. Handling NaN values. Reading and writing .txt, .csv, .pdf, .html and json files with pandas. Merging, concatenating and grouping of data frames. Use of pivot tables. Pickling of data frames in Python
	Module 3: PCA and Cluster Analysis Singular value decomposition of a matrix/array. Eigen values and eigen vectors. Principal component analysis of a data frame. Scree plot. Dimensionality reduction with PCA. Loadings for principal components. Case study with Python. Cluster analysis. Hierarchical and K-means clustering. Interpretation of dendrograms.
	Module 4: Statistical Data Analysis Hypothesis testing. Bayesian analysis. Meaning of prior, posterior and likelihood functions. Use of pymc3 module to compute the posterior probability. MAP Estimation. Credible interval, conjugate distributions. Contingency table and chi square test. Kernel density estimation.
	Module 5: Machine Learning Supervised and unsupervised learning. Use of scikit-learn. Regression using scikit-learn. Deep learning with convolutional neural networks. Structure of CNN. Use of Keras and Tensorflow. Machine learning with pytorch. Reading and writing images with openCV. Case study of character recognition with MNIST dataset. High performance computing for machine learning. Use of numba, jit and numexpr for faster Python code. Use of Ipython-parallel.

SAMPLE QUESTIONS

Module 1

1. Write Python code to read an .xls file using xlrd module. Save it as a different .xlsx file using openpyxl.
2. Write Python code to read mongodb data base.
3. Create a two dimensional array of real numbers using numpy.
4. Write Python code to pickle this data.
5. Write Python code to read a spreadsheet in .xls format a text file in .csv format and put these data into numpy arrays. In both cases, plot the second column against the first column using matplotlib
6. Write code to read files in .xlsx format using openpyxl

Module 2

1. Write Python code to import mayavi module and perform 3-D visualization of $x^2 + y^2 + z^2 = 1$
2. Write Python code read a table in a pdf file as a pandas dataframe.
3. Write Python code to generate a 5×5 pandas data frame of random numbers. Add a header to this dataframe.
4. Write Python code to concatenate two dataframes of same number of columns.
5. Write Python code to create a pandas dataframe. Pickle this data and store it.
6. Explain the term pivot table. Create a pivot table from the above dataframe
7. Write Python code to import a table in .xls format into a data frame. Remove all NaN values.
8. Write Python code to generate 10 data frames of size 5×5 of random numbers and use a for loop to concatenate them.
9. Pickle the concatenated dataframe and store it. Write another code to retrieve the dataframe from the pickle

Module 3

1. Write another Python code to retrieve the data from the pickle.
2. Write Python code to perform PCA on a pandas dataframe.
3. Write the expression for the singular value decomposition of a matrix A
4. Explain how principal components are isolated using scree plot.
5. Write code to create a screen plot.
6. Write Python code to read in table in .xls format, perform PCA analysis on it and produce the scree plot and loadings for the principal components
7. Write Python code to perform hierarchical cluster analysis on a pandas dataframe. Explain how dendrograms can be used to classify data

Module 4

1. State Bayes theorem and explain the significance of the terms prior, likelihood and posterior.
2. Write Python code with pymc3 to realize a Bernoulli trial with $p(\text{head}) = 0.2$

3. Write Python code to do K-means clustering.
4. Write Python code to compute the posterior probability of a data set with Pymc3
5. Write a python code to find the Bayesian credible interval in the above question. How is it different from confidence interval.

Module 5

1. Write a python code to evaluate the statistical correlation between variables in 5X5 random data set.
2. Write python code to use Keras for training a CNN
3. Write Python code to read an RGB image and convert to gray scale and write the grayscale image in .jpg format.
4. Write Python code to use numexpr for faster parallel computation
5. Write Python code with Ipython-parallel to perform parallel computing with 4 cores
6. Give the structure a convolutional neural network
7. Compare supervised and unsupervised learning

ECT 342
EMBEDDED SYSTEM

COURSE INFORMATION SHEET

PROGRAMME: ELECTRONICS &COMMUNICATION ENGINEERING	DEGREE: BTECH
COURSE: EMBEDDED SYSTEMS	SEMESTER: 6 CREDITS: 4
COURSE CODE: ECT 381 REGULATION: 2019	COURSE TYPE: ELECTIVE
COURSEAREA/DOMAIN: EMBEDDED SYSTEM	CONTACT HOURS: 3+1 (Tutorial) Hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	LAB COURSE NAME:

SYLLABUS:

UNIT	DETAILS	HOURS
I	<p style="text-align: center;">Introduction to Embedded Systems</p> <p>Complex Systems and Microprocessors-Embedding Computers, Characteristics of Embedded Computing Applications, Application of Microprocessors, The Physics of Software, Challenges in Embedded Computing System, Characteristics and quality attributes of an embedded system, Performance in Embedded Computing. The Embedded System Design Process-Requirements, Specification, Architecture Design, Designing Hardware and Software Components and System Integration. Formalisms for System Design-Structural Description, Behavioral Description, An embedded system design example. Embedded product development cycle (EDLC)-Different phases of EDLC and DLC Models</p>	8
II	<p style="text-align: center;">Embedded system interfacing and peripherals</p> <p>Communication devices:-Serial Communication Standards and Devices - UART, HDLC and SPI. Serial Bus Protocols - I2C Bus, CAN Bus and USB Bus, Parallel communication standards-ISA, PCI and PCI-X Bus. Memory:-Memory devices and systems :- ROM-Flash, EEPROM: RAM-SRAM, DRAM, Cache memory, memory mapping and addresses, memory management unit- DMA I/O Device:-Interrupts:-Interrupt sources, recognizing an interrupt, ISR – Device drivers for handling ISR, Shared data problem, Interrupt latency.</p>	9
III	<p style="text-align: center;">ARM Processor fundamentals</p> <p>ARM Processor architecture:-The Acorn RISC Machine- Architectural inheritance, The ARM programmer's model, ARM development tools. ARM Assembly Language Programming:-Data processing instructions, Data</p>	7

	transfer instructions, Control flow instructions, writing simple assembly language programs. ARM Organization and Implementation:- 3 stage pipeline ARM organization, 5-stage pipeline ARM organization, ARM instruction execution, ARM implementation, The ARM coprocessor interface.	
IV	<p style="text-align: center;">ARM Programming</p> <p>Architectural Support for High Level Languages:-Abstraction in software design, Data types, Floating-point data types, The ARM floating-point architecture, Expressions, Conditional statements, Loops, Functions and procedures, Use of memory, Run-time environment. The Thumb Instruction Set :-The Thumb bit in the CPSR, The Thumb programmer's model, Thumb branch instructions, Thumb software interrupt instruction, Thumb data processing instructions, Thumb single register data transfer instructions, Thumb multiple register data transfer instructions, Thumb breakpoint instruction, Thumb implementation, Thumb applications. Architectural Support for System Development:- The ARM memory interface, The Advanced Microcontroller Bus Architecture (AMBA).</p>	10
V	<p style="text-align: center;">Real Time Operating Systems</p> <p>Operating system basics:- Kernel, types of operating systems. Real time operating systems:- Tasks, process, threads, multiprocessing and multi-tasking, task scheduling, types, threads and process scheduling, task communication, task synchronization, device drivers, choosing an RTOS.</p>	7
TOTAL HOURS		36

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	Rajkamal, Embedded Systems Architecture, Programming and Design, TMH, 2003
T2	K.V. Shibu, Introduction to Embedded Systems, 2e, McGraw Hill Education India, 2016.
T3	Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers - Elsevier 3ed, 2008.
T4	Steve Furber, ARM system-on-chip architecture, Addison Wesley, Second Edition, 2000
R1	David E. Simon, An Embedded Software Primer, Pearson Education Asia, First Indian Reprint 2000.
R2	Steve Heath, Embedded Systems Design, Newnes – Elsevier 2ed, 2002
R3	Andrew N. Sloss, Dominic Symes, Chris Wright, ARM System Developer's Guide Designing and Optimizing Systems Software, Morgan Kaufmann Publishers 2004.

R4	Frank Vahid and Tony Givargis, Embedded Systems Design – A Unified Hardware / Software Introduction, John Wiley, 2002.
R5	Tammy Noergaard, Embedded Systems Architecture, A Comprehensive Guide for Engineers and Programmers, Newnes – Elsevier 2ed, 2012.
R6	Iyer - Embedded Real time Systems, 1e, McGraw Hill Education New Delhi, 2003.
R7	Lyla B. Das, Embedded Systems: An Integrated Approach, 1/e , Lyla B. Das, Embedded Systems, 2012.

COURSE PRE-REQUISITES:

Sl.No	COURSE NAME	DESCRIPTION	SEM
1	ECT 206 Computer Architecture & Microcontrollers	Basic knowledge of preliminary subjects.	S4
2	ECT 203 Logic Circuit Design	Basic knowledge of preliminary subjects.	S3
3	ECT 202 Analog Circuits	Basic knowledge of preliminary subjects.	S3

COURSE OBJECTIVES:

1	To have a thorough understanding of the Embedded System fundamentals and system design.
2	To gain architecture level knowledge about the system and hence to program an embedded system.
3	To apply the knowledge for solving the real life problems with the help of an embedded system.

COURSE OUTCOMES:

Sl. No.	DESCRIPTION
ECT381.1	Ability to understand basics of embedded system fundamentals and system design.
EC308.2	Ability to understand the different standards and protocols used for communication with I/O devices and their interfacing with the processor.
EC308.3	Ability to gain ARM Processor architectural level and pipeline processor organization knowledge.
EC308.4	Ability to write programs in assembly and high level languages for ARM Processor.
EC308.5	Ability to understand real time operating systems and their use in embedded systems.

CO-PO-PSO MAPPING:

CO No.	Programme Outcomes (POs)												Programme-specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	3	2		1	1						2		1
2	3	3	1	2		1							3		1
3	1	3	3	3									3	2	
4	3	1	2	3	3				2			2	3	3	1
5		3	3	3	2								3	3	
ECT 381															

CO-PO,PSO Justification

Mapping	Justification
ECT381.1-PO1	Since embedded systems have lots of inbuilt components the basic knowledge of engineering fundamentals will be gained.
ECT381.1-PO2	The subject provides student with the required skills to analyze engineering problems
ECT381.1-PO3	Design of embedded systems will help students in improving their designing skills
ECT381.1-PO4	Embedded system design involves investigation of complex problems.
ECT381.1-PO6	Embedded system design needs to consider legal and societal issues.
ECT381.1-PO7	Design of embedded system will have to consider environmental aspects.
ECT381.2-PO1	Protocol study will improve the basic mathematical and engineering knowledge of the students.
ECT381.2-PO2	This course will help the students to study research papers and analyze Engineering problems in the field of Embedded systems
ECT381.2-PO3	Interfacing of I/O devices has to be based on environmental considerations

ECT381.2-PO4	Timing diagram analysis is a key tool in investigating complex engineering problems
ECT381.2-PO6	Protocols are used based on legal/societal issues as well.
ECT381.3-PO1	Processor fundamentals will aid students to solve complex engineering problems
ECT381.3-PO2	Knowledge of processor fundamentals will help students to analyze complex engineering problems
ECT381.3-PO3	ARM processor architecture and pipeline processor organization knowledge is essential in designing solutions for complex engineering problems.
ECT381.3-PO4	Design and analysis of engineering experiments require good knowledge of ARM processor architecture and pipeline processor organization.
ECT381.3-PO4	The outcome of a systems reflects the professional ethics and responsibilities of the Engineer
ECT381.4-PO1	Programming skills will help students develop their engineering fundamental knowledge to solve complex engineering problems
ECT381.4-PO2	Basic programming skills will aid in formulating complex engineering problems.
ECT381.4-PO3	Programming ability will aid in developing solutions that meet specified needs.
ECT381.4-PO4	Programming skills will surely aid analysis and interpretation of data.
ECT381.4-PO5	High Level languages for ARM Processors are executed using modern tools
ECT381.4-PO9	Programming solutions through discussions will help in improving students ability to work in a team.
ECT381.4-PO12	Programming skill will help the student in adapting to technological changes and thus improving his life-long learning ability.
ECT381.5-PO2	Knowledge about RTOS will help students to formulate and analyze complex engineering problems
ECT381.5-PO3	RTOS fundamentals will help students to design solutions for complex engineering problems.
ECT381.5-PO4	Knowledge of RTOS helps in analyzing and interpreting data efficiently.
ECT381.5-PO5	RTOS knowledge helps in the usage and understanding of modern IT tools.
ECT381.1-PSO1	The student acquires fundamental knowledge to design embedded systems applications

ECT381.1-PSO3	Knowledge of embedded system design is required for entrepreneurial and professional responsibilities in electronics engineering field.
ECT381.2-PSO1	Interfacing and peripheral device knowledge will help in implementing applications.
ECT381.2-PSO3	Interfacing and peripheral device knowledge will aid in sound engineering decision making.
ECT381.3-PSO1	ARM processor architecture and pipeline processor organization knowledge is essential in designing, implementing and testing embedded systems applications.
ECT381.3-PSO2	ARM processor architecture and pipeline processor organization knowledge aids the skills to conduct experiments and develop applications using EDA tools
ECT381.4-PSO1	Programming skills are required for designing, implementing and testing embedded systems applications.
ECT381.4-PSO2	Programming skills are required to conduct experiments and develop applications using EDA tools
ECT381.4-PSO3	Knowledge about low level and high level programming will aid in making sound engineering decision.
ECT381.5-PSO1	RTOS knowledge is required for designing, implementing and testing embedded systems applications.
ECT381.5-PSO2	Basic knowledge about RTOS is useful to conduct experiments and develop applications using EDA tools.

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

Sl. No.	DESCRIPTION	PROPOSED ACTIONS	PO PSO Mapping
1	Latest Embedded product development models	Tutorial	PO1,PO2,PO3,PSO3
2	CISC Philosophy	Tutorial	PO1,PO2,PO3,PSO3

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SNO	DESCRIPTION	PROPOSED ACTIONS	PO, PSO Mapping
2	Processor Design	Group Assignment	PO1,PO2,PO3,PO11,PO12,PO10,PO9, PSO2

4	Skills required for an embedded designer	Talk – Industry Expert	P012, P06,P07,P08, PS03
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WEB SOURCE REFERENCES:

Sl. No.	DESCRIPTION
1	http://www.brainkart.com/subject/Embedded-and-Real-Time-Systems_186/
2	http://www.dauniv.ac.in/downloads/EmbsysRevEd_PPTs/
3	https://www.techopedia.com/definition/2273/real-time-clock-rtc

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

<input type="checkbox"/> CHALK & TALK✓	<input type="checkbox"/> STUD. ASSIGNMENT✓	<input type="checkbox"/> WEB RESOURCES	<input type="checkbox"/> LCD/SMART BOARDS
<input type="checkbox"/> STUD. SEMINARS✓	<input type="checkbox"/> ADD-ON COURSES		

ASSESSMENT METHODOLOGIES-DIRECT

<input type="checkbox"/> ASSIGNMENTS✓	<input type="checkbox"/> STUD. SEMINARS✓	<input type="checkbox"/> TESTS/MODEL EXAMS✓	<input type="checkbox"/> UNIV. EXAMINATION✓
<input type="checkbox"/> STUD. LAB PRACTICES	<input type="checkbox"/> STUD. VIVA	<input type="checkbox"/> MINI/MAJOR PROJECTS✓	<input type="checkbox"/> CERTIFICATIONS
<input type="checkbox"/> ADD-ON COURSES	<input type="checkbox"/> OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

<input type="checkbox"/> ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)✓	<input type="checkbox"/> STUDENT FEEDBACK ON FACULTY (TWICE)✓
<input type="checkbox"/> ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS✓	<input type="checkbox"/> OTHERS

Prepared by**Anoop Thomas
(Faculty)****Approved by****Dr. Rithu James
(HOD)**

COURSE PLAN

UNIT	DETAILS	HOURS
I	<p style="text-align: center;">Introduction to Embedded Systems</p> <p>Complex Systems and Microprocessors-Embedding Computers, Characteristics of Embedded Computing Applications, Application of Microprocessors, The Physics of Software, Challenges in Embedded Computing System, Characteristics and quality attributes of an embedded system, Performance in Embedded Computing. The Embedded System Design Process-Requirements, Specification, Architecture Design, Designing Hardware and Software Components and System Integration. Formalisms for System Design-Structural Description, Behavioral Description, An embedded system design example. Embedded product development cycle (EDLC)-Different phases of EDLC and DLC Models</p>	8
II	<p style="text-align: center;">Embedded system interfacing and peripherals</p> <p>Communication devices:-Serial Communication Standards and Devices - UART, HDLC and SPI. Serial Bus Protocols - I2C Bus, CAN Bus and USB Bus, Parallel communication standards-ISA, PCI and PCI-X Bus. Memory:-Memory devices and systems :- ROM-Flash, EEPROM: RAM-SRAM, DRAM, Cache memory, memory mapping and addresses, memory management unit- DMA I/O Device:-Interrupts:-Interrupt sources, recognizing an interrupt, ISR – Device drivers for handling ISR, Shared data problem, Interrupt latency.</p>	9
III	<p style="text-align: center;">ARM Processor fundamentals</p> <p>ARM Processor architecture:-The Acorn RISC Machine- Architectural inheritance, The ARM programmer's model, ARM development tools. ARM Assembly Language Programming:-Data processing instructions, Data transfer instructions, Control flow instructions, writing simple assembly language programs. ARM Organization and Implementation:-3 stage pipeline ARM organization, 5-stage pipeline ARM organization, ARM instruction execution, ARM implementation, The ARM coprocessor interface.</p>	7
IV	<p style="text-align: center;">ARM Programming</p> <p>Architectural Support for High Level Languages:-Abstraction in software design, Data types, Floating-point data types, The ARM floating-point architecture, Expressions, Conditional statements, Loops, Functions and procedures, Use of memory, Run-time environment. The Thumb Instruction Set :-The Thumb bit in the CPSR, The Thumb programmer's</p>	10

	model, Thumb branch instructions, Thumb software interrupt instruction, Thumb data processing instructions, Thumb single register data transfer instructions, Thumb multiple register data transfer instructions, Thumb breakpoint instruction, Thumb implementation, Thumb applications. Architectural Support for System Development:- The ARM memory interface, The Advanced Microcontroller Bus Architecture (AMBA).	
V	<p style="text-align: center;">Real Time Operating Systems</p> <p>Operating system basics:- Kernel, types of operating systems. Real time operating systems:- Tasks, process, threads, multiprocessing and multi-tasking, task scheduling, types, threads and process scheduling, task communication, task synchronization, device drivers, choosing an RTOS.</p>	7
TOTAL HOURS		36

SAMPLE QUESTIONS

Module 1

- Explain the feature of Embedded Systems.
- What are the Components of embedded system?
- Explain the hardware–Software embedded into the system.
- Which are the different types of Embedded Processors?
- Explain the software embedded systems.
- Differentiate between embedded systems and general computing systems.
- Explain Von-Neumann and Harvard architecture.
- What is the requirement of the firmware for embedded systems? Explain the process of embedded firmware development.
- Explain CPU architecture of ARM processor (ARM9)
- What are the various classifications of embedded systems?

Module 2

- Write short note on Serial Communication Standards and Devices - UART, HDLC, SCI and SPI.
- Write short note on Serial Bus Protocols - I2C Bus, CAN Bus and USB Bus.
- Write short note on Parallel communication standards ISA, PCI and PCI-X Bus.
- Explain the signal using a transfer of byte when using the I2C bus and also the format of bits at the I2C bus with diagram.
- What is EDLC? What are the Objectives of the EDLC?
- Explain High level language to machine language conversion process.

Module 3

- Write short note on Memory devices and systems
- What is memory map?
- Write short note on DMA
- Explain the various forms of memory and the functions assigned to them.
- Write short note on I/O Devices
- Write short note on Interrupts
- What is ISR?
- What are the classifications of I/O devices?

- What are some of the factors that should be considered when designing a memory map for an embedded system?
- Explain the basic concepts of cache memory.

Module 4

- Explain the Programming concepts of embedded programming
- What are Features of Embedded C++?
- Explain Interrupt Handling and Time Management performed by RTOS.
- What are the advantages of Assembly language?
- What are advantages of high level languages?
- Mention the elements of C program.
- Explain the Embedded programming in C++ and Java.
- How C/C++ is useful in embedded system programming. Also mention the advantages of high level programming for embedded system.
- How is Software Implementation done?

Module 5

- What is Inter Process Communication?
- Explain the Synchronization Process.
- Differentiate process, tasks and threads.
- Explain Shared data problem.
- Define Semaphore.
- Explain interprocess communication and synchronization.
- Explain how thread and process are used in embedded system.
- Explain process management and memory management in embedded system.
- Write short note on : Signals, Semaphore, Message, Queues, Mailboxes, Pipes, Sockets Remote Procedure Calls

HUT 310
MANAGEMENT FOR ENGINEERS

COURSE INFORMATION SHEET

PROGRAMME: ELECTRONICS AND COMMUNICATION ENGINEERING	DEGREE: B.TECH
COURSE: MANAGEMENT FOR ENGINEERS	SEMESTER: S4 CREDITS: 3
COURSE CODE: HUT 310 REGULATION: 2020	COURSE TYPE: Common
COURSE AREA/DOMAIN: Management	CONTACT HOURS: 3 hours/week
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	LAB COURSE NAME: NA

SYLLABUS:

Sl. No	Topic	No of Lectures
1	Module 1 (Introduction to management Theory) Introduction to management theory, Management Defined, Characteristic of Management, Management as an art-profession, System approaches to Management, Task and Responsibilities of a professional Manager, Levels of Manager and Skill required.	7
2	Module 2 Management and organization Management Process, Planning types , Mission, Goals, Strategy, Programmes, Procedures, Organising, Principles of Organisation, Delegation, Span of Control, Organisation Structures, Directing, Leadership, Motivation, Controlling..	5
3	Module 3 Productivity and decision making Concept of productivity and its measurement; Competitiveness; Decision making process; decision making under certainty, risk and uncertainty; Decision trees; Models of decision making.	7
4	Module 4 Project management Project Management, Network construction, Arrow diagram, Redundancy. CPM and PERT Networks, Scheduling computations, PERT time estimates, Probability of completion of project, Introduction to crashing.	8
5	Module 5 (functional areas of management)	8

	Introduction to functional areas of management, Operations management, Human resources management, Marketing management, Financial management, Entrepreneurship, Business plans, Corporate social responsibility, Patents and Intellectual property rights.	
TOTAL HOURS		35

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
1	H. Koontz, and H. Weihrich, Essentials of Management: An International Perspective. 8th ed., McGraw-Hill, 2009.
2	P C Tripathi and P N Reddy, Principles of management, TMH, 4 th edition, 2008
3	P. Kotler, K. L. Keller, A. Koshy, and M. Jha, Marketing Management: A South Asian Perspective. 14th ed., Pearson, 2012.
4	M. Y. Khan, and P. K. Jain, Financial Management, Tata-McGraw Hill, 2008
5	R. D. Hisrich, and M. P. Peters, Entrepreneurship: Strategy, Developing, and Managing a New Enterprise, 4th ed., McGraw-Hill Education, 1997
6	D. J. Sumanth, Productivity Engineering and Management, McGraw-Hill Education, 1985
7	K.Ashwathappa, 'Human Resources and Personnel Management', TMH, 3 rd edition, 2005
8	R. B. Chase, Ravi Shankar and F. R. Jacobs, Operations and Supply Chain Management, 14th ed. McGraw Hill Education (India), 2015

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
NIL	NIL	NA	-

COURSE OBJECTIVES:

1	To learn the basic concepts and functions of management and its role in the performance of an organization
2	To understand various decision-making approaches available for managers to achieve excellence
3	Students will have a broad view of different functional areas of management like operations, human resource, finance and marketing.

COURSE OUTCOMES:

SL. NO.	DESCRIPTION	Blooms' Taxonomy Level
C01	Explain the characteristics of management in the contemporary context	Understand
C0 2	Describe the functions of management	Understand

C0 3	Demonstrate ability in decision making process and productivity analysis	Understand
C0 4	Illustrate project management technique and develop a project schedule	Apply
C05	Summarize the functional areas of management	Understand
C06	Comprehend the concept of entrepreneurship and create business plans	Understand

CO-PO MAPPING

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

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SL NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Functions of management	Lecture	6,8,9,11	-

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SL NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Case study	Provide reference materials	6,8,9,11	-

WEB SOURCE REFERENCES:

1	
2	
3	
4	

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

<input checked="" type="checkbox"/> CHALK & TALK	<input checked="" type="checkbox"/> STUD. ASSIGNMENTS	<input type="checkbox"/> WEB RESOURCES	<input checked="" type="checkbox"/> ONLINE CLASSES
<input checked="" type="checkbox"/> LCD/SMART BOARDS	<input type="checkbox"/> STUD. SEMINARS	<input type="checkbox"/> ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

<input type="checkbox"/> ASSIGNMENTS	<input type="checkbox"/> STUD. SEMINARS	<input checked="" type="checkbox"/> TESTS/MODEL EXAMS	<input checked="" type="checkbox"/> UNIV. EXAMINATION
<input type="checkbox"/> ADD-ON COURSES	<input type="checkbox"/> OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

<input checked="" type="checkbox"/> ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	<input checked="" type="checkbox"/> STUDENT FEEDBACK ON FACULTY (TWICE)
<input type="checkbox"/> ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	<input type="checkbox"/> OTHERS

Prepared by**Approved by**

Ms. Rinju Mariam Rolly
 Ms. Mariya Vincent
 Mr. Karunakara P. Menon
 Mr. Vimal kumar V

Dr. Rithu James

COURSE PLAN

Sl. No	Topic	No of Lectures
1	Module 1 (Introduction to management Theory) Introduction to management theory, Management Defined, Characteristic of Management, Management as an art-profession, System approaches to Management, Task and Responsibilities of a professional Manager, Levels of Manager and Skill required.	7
2	Module 2 Management and organization Management Process, Planning types , Mission, Goals, Strategy, Programmes, Procedures, Organising, Principles of Organisation, Delegation, Span of Control, Organisation Structures, Directing, Leadership, Motivation, Controlling..	5
3	Module 3 Productivity and decision making Concept of productivity and its measurement; Competitiveness; Decision making process; decision making under certainty, risk and uncertainty; Decision trees; Models of decision making.	7
4	Module 4 Project management Project Management, Network construction, Arrow diagram, Redundancy. CPM and PERT Networks, Scheduling computations, PERT time estimates, Probability of completion of project, Introduction to crashing.	8
5	Module 5 (functional areas of management) Introduction to functional areas of management, Operations management, Human resources management, Marketing management, Financial management, Entrepreneurship, Business plans, Corporate social responsibility, Patents and Intellectual property rights.	8
TOTAL HOURS		35

SAMPLE QUESTIONS

Module 1

- Define management.
- Explain the five managerial functions.
- Is management a profession or art or both?
- How do you view management in global, innovative and entrepreneurial perspective?
- Define scientific management.
- Explain any four techniques in scientific management.
- b) Explain the postulates of Ouchi's theory and comment on its application in Indian conditions.
- Explain the various steps involved in planning process.
- Define planning and discuss levels of planning.
- Why planning and controlling are said to be inseparable- the Siamese twins of management.
- Define organizing.
- Explain organisation levels in terms of narrow and wide spans with sketches and discuss its merits and demerits.
- What is meant by decision making and rationality in decision making.
- Explain the three approaches to select an alternative in decision making such as experience, experimentation, research and analysis.

Module 2

- What is meant by staffing? Discuss the systems approach to staffing
- Define delegation of authority and discuss advantages of delegation.
- Explain the steps in selection process of a candidate from receiving application to final selection.
- Define leadership
- Explain trait theory of leadership and discuss its advantages and limitations.
- Define controlling.
- Differentiate and discuss feedforward and feedback control systems
- Name and explain any four control techniques.
- Explain the principle of preventive control and also discuss its assumptions and advantages.

Module 3

- What is MBO? How is it different from conventional planning process?
- Explain the types of Plans with examples.
- What is the importance of span of control in management?
- Explain the line and staff approach in management.
- What is meant by the term Departmentation?
- Explain the strategies adopted in Departmentation process with example

Module 4

- What is the significance of organisational culture in management?
- What are the sources of organisational culture? Explain them.
- Explain the process of Job Analysis
- What are the processes involved in Job Design?
- Give an account on the leadership qualities.
- Differentiate Transactional and Transformational leadership.
- Explain Managerial Grid with suitable example.
- Explain the basic Control process.

Module 5

- Define the terms: Plan, Objective, Goal, Policy and Rule
- Differentiate between Strategic, Administrative and Routine type planning
- Describe the stages involved in the planning process
- With a block diagram, outline the structure of Management by Objectives MBO
- Distinguish between line and staff functions with the aid of examples
- Define the term – Span of Control
- What is an organization chart? What are its merits and demerits?
- Illustrate the difference between programmed and non programmed decisions by highlighting suitable examples
- Describe the following stages in creative process: Unconscious scanning, Intuition, developing insights and logical evaluation

ECT 308
COMPREHENSIVE COURSE WORK

COURSE INFORMATION SHEET

PROGRAMME: ELECTRONICS & COMMUNICATION ENGINEERING	DEGREE: BTECH
COURSE: COMPREHENSIVE COURSE WORK	SEMESTER: 6 CREDITS: 1-0-0-1
COURSE CODE: ECT308 REGULATION: 2019	COURSE TYPE: Core
COURSEAREA/DOMAIN:	CONTACT HOURS: 2
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	LAB COURSE NAME:

SYLLABUS:

No	Topic	No. of Lectures
1	Analog Circuits	
1.1	Mock Test on Module 1 and Module 2	1
1.2	Mock Test on Module 3, Module 4 and Module 5	1
1.3	Feedback and Remedial	1
2	Logic Circuit design	
2.1	Mock Test on Module 1, Module 2 and Module 3	1
2.2	Mock Test on Module 4 and Module 5	1
2.3	Feedback and Remedial	1
3	Linear IC	
3.1	Mock Test on Module 1 and Module 2	1
3.2	Mock Test on Module 3, Module 4 and Module 5	1
3.3	Feedback and Remedial	1
4	Digital Signal Processing	
4.1	Mock Test on Module 1, Module 2 and Module 3	1
4.2	Mock Test on Module 4 and Module 5	1
4.3	Feedback and Remedial	1
5	Analog and Digital Communication	
5.1	Mock Test on Module 1, Module 2 and Module 3	1
5.2	Mock Test on Module 4 and Module 5	1
5.3	Feedback and Remedial	1

Preamble: The objective of this Course work is to ensure the comprehensive knowledge of each student in the most fundamental Program core courses in the curriculum. Five core courses credited from Semesters 3, 4 and 5 are chosen for the detailed study in this course work. This course has an End Semester Objective Test conducted by the University for 50 marks. One

hour is assigned per week for this course for conducting mock tests of objective nature in all the listed five courses.

Prerequisite:

Sl. No.	Subjects	Semester
1.	ECT202 Analog Circuits	4
2.	ECT203 Logic Circuit Design	3
3.	ECT301 Linear Integrated Circuits	5
4.	ECT303 Digital Signal processing	5
5.	ECT305 Analog and Digital communication	5

Course Outcomes: After the completion of the course the student will be able to

CO1	Apply the knowledge of circuit theorems and solid-state physics to solve the problems in electronic circuits.
CO2	Design a logic circuit for a specific application.
CO3	Design linear IC circuits for linear and non-linear circuit applications.
CO4	Explain basic signal processing operations and Filter designs.
CO5	Explain existent analog and digital communication systems.

CO-PO-PSO MAPPING:

CO No.	Programme Outcomes (POs)												Programme-specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	1									2			
2	3	3	1									2			
3	3	3	1									2			
4	3	2										2			
5	3	2	1									2			
ECT308															

JUSTIFICATION

Mapping	Level	Justification
ECT308.1 – PO1	3	Apply the knowledge and fundamentals of circuit theorems and solve the problems in electronic circuits.
ECT308.2 – PO1	3	Apply the knowledge and fundamentals in combinational and sequential logic circuits.
ECT308.3 – PO1	3	Apply the knowledge of operational amplifiers and other linear ICs for various applications.

ECT308.4 – PO1	3	Apply the knowledge understanding of the principles, algorithms and applications of DSP.
ECT308.5 – PO1	3	Apply the knowledge to develop analog and digital communication systems.
ECT308.1 – PO2	3	Analyse and design of different types of analog circuits using discrete electronic components.
ECT308.2 – PO2	3	Apply the knowledge and fundamentals in logic circuits
ECT308.3 – PO2	3	It help the students to reinforce the core fundamentals of electronics and communication which helps in solving complex engineering problems.
ECT308.4 – PO2	2	Students will get the knowledge to analyse problems using signal processing and filter design concepts
ECT308.5 – PO2	2	Students can design complex communication systems by improving the technical aspects for engineering give valid results.
ECT308.1 – PO3	1	Design system components for basic amplifiers using BJT and MOSFET and for oscillator
ECT308.2 – PO3	1	Design a sequential logic circuit using the basic building blocks like flip-flops.
ECT308.3 – PO3	1	Exposure to designing linear IC circuits for linear and non-linear circuit applications and enable students to solve complex solutions
ECT308.5 – PO3	1	Knowledge to existent analog and digital communication systems and enable the students to solve complex communication systems
ECT308.1 – PO12	2	Design of systems changes according to the technological developments.
ECT308.2 – PO12	2	Design of systems changes according to the technological developments.
ECT308.3 – PO12	2	Design of systems changes according to the technological developments.
ECT308.4 – PO12	2	Design of systems changes according to the technological developments.
ECT308.5 – PO12	2	Design of systems changes according to the technological developments.

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

Sl. No.	DESCRIPTION	PROPOSEDACTIONS
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1	Verilog design of advanced VLSI Circuit	Additional projects/lab can be included
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PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SNO	DESCRIPTION	PROPOSED ACTIONS	PO PSO MAPPING
1	LAB BASED LEARNING	Assignments using Industrial EDA tools	PO9, PSO3, PO5, PSO2

WEB SOURCE REFERENCES:

Sl. No.	DESCRIPTION
1	https://www.tutorialspoint.com/vlsi_design/vlsi_design_digital_system.htm
2	http://ece-research.unm.edu/jimp/vlsi/slides/c1_intro.html

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

<ul style="list-style-type: none"> <input type="checkbox"/> CHALK & TALK 	<ul style="list-style-type: none"> <input type="checkbox"/> STUD. ASSIGNMENT 	<ul style="list-style-type: none"> <input type="checkbox"/> WEB RESOURCES 	<input type="checkbox"/> LCD/SMART BOARDS
<input type="checkbox"/> STUD. SEMINARS	<input type="checkbox"/> ADD-ON COURSES		

Assessment Pattern

Bloom's Category	End Sem Exam
Remember	10
Understand	20
Apply	20
Analyze	
Evaluate	
Create	

Mark Distribution:

Total Marks	CIE	ESE	Duration
50	0	50	1 Hrs

Continuous Internal Evaluation Pattern:

Attendance: 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignments: 15 marks.

End Semester Examination Pattern

Objective Questions with multiple choice (Four). Question paper include Fifty Questions of One mark each covering the five identified courses.

ASSESSMENT METHODOLOGIES-DIRECT

<ul style="list-style-type: none"> <input type="checkbox"/> ASSIGNMENTS 	<ul style="list-style-type: none"> <input type="checkbox"/> STUD. SEMINARS 	<ul style="list-style-type: none"> <input type="checkbox"/> TESTS/MODEL EXAMS 	<ul style="list-style-type: none"> <input type="checkbox"/> UNIV. EXAMINATION
<input type="checkbox"/> STUD. LAB PRACTICES	<input type="checkbox"/> STUD. VIVA	<input type="checkbox"/> MINI/MAJOR PROJECTS	<input type="checkbox"/> CERTIFICATIONS
<input type="checkbox"/> ADD-ON COURSES	<input type="checkbox"/> OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

<ul style="list-style-type: none"> <input type="checkbox"/> ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE) 	<ul style="list-style-type: none"> <input type="checkbox"/> STUDENT FEEDBACK ON FACULTY (TWICE)
<ul style="list-style-type: none"> <input type="checkbox"/> ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS 	<input type="checkbox"/> OTHERS

Prepared by

Abhishek Viswakumar
Mariya Vincent
Jasmin Sebastin

Approved by

Dr. Rithu James
HoD

COURSE PLAN

No	Topic	No. of Lectures
1	Analog Circuits	
1.1	Mock Test on Module 1 and Module 2	1
1.2	Mock Test on Module 3, Module 4 and Module 5	1
1.3	Feedback and Remedial	1
2	Logic Circuit design	
2.1	Mock Test on Module 1, Module 2 and Module 3	1
2.2	Mock Test on Module 4 and Module 5	1
2.3	Feedback and Remedial	1
3	Linear IC	
3.1	Mock Test on Module 1 and Module 2	1
3.2	Mock Test on Module 3, Module 4 and Module 5	1
3.3	Feedback and Remedial	1
4	Digital Signal Processing	
4.1	Mock Test on Module 1, Module 2 and Module 3	1
4.2	Mock Test on Module 4 and Module 5	1
4.3	Feedback and Remedial	1
5	Analog and Digital Communication	
5.1	Mock Test on Module 1, Module 2 and Module 3	1
5.2	Mock Test on Module 4 and Module 5	1
5.3	Feedback and Remedial	1

ECL 332
COMMUNICATION LAB

COURSE INFORMATION SHEET

PROGRAMME: ELECTRONICS & COMMUNICATION ENGINEERING	DEGREE: BTECH
COURSE: Communication Lab	SEMESTER: 6 CREDITS: 0-0-3-2
COURSE CODE: ECL332 REGULATION: 2019	COURSE TYPE: Lab
COURSE AREA/DOMAIN: Communication	CONTACT HOURS: 3
CORRESPONDING LAB COURSE CODE (IF ANY):	LAB COURSE NAME:

SYLLABUS:

Exp. No.	Title
PART A	
1	FM generation and demodulation using PLL
2	Generation and Detection of PCM signals
3	Generation and Detection of Delta modulated signals
4	Generation and Detection of BPSK
5	Generation and Detection of 16-QPSK
PART B	
6	Performance of Waveform Coding Using PCM
7	Pulse Shaping and Matched Filtering
8	Eye Diagram
9	Error Performance of BPSK
10	Error Performance of QPSK
PART C	
11	Familiarization with Software Defined Radio (Hardware and Control Software)
12	FM Reception
13	FM Transmission

Prerequisite:

1. ECT303 Digital Signal Processing
2. ECT305 Analog and Digital Communication

Course Outcomes: After the completion of the course the student will be able to
 CO1: Set up simple prototype circuits for waveform coding and digital modulation techniques working in a team.

CO2: Simulate the error performance of a digital communication system using standard binary and M-ary modulation schemes.

CO3: Develop hands on skills to emulate a communication system with software designed radio working in a team.

CO-PO-PSO MAPPING:

CO No.	Programme Outcomes (POs)												Programme-specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	2	3				3	2		1	2	2	
2	3	3	3	2	3				0	0		1	3		
3	3	3	3	3	3				3	2		3	3	3	2
ECL 332	3	3	3	2.33	3				2	1.33		1.66	2.66	1.66	2

JUSTIFICATION

Mapping	Level	Justification
ECL 332.1-PO1	3	The knowledge of mathematics, science, Engineering fundamentals, and Electronics and Communication Engineering are essential to study the various analog and digital modulation schemes.
ECL 332.2-PO1	3	Applying concept of Analog and digital modulation schemes for simulation.
ECL 332.3-PO1	3	Learning basics of SDR and applying the same for FM transmission and reception.
ECL 332.1-PO2	3	Students analyse and evaluate the various waveform coding techniques and modulation techniques in terms of their performance
ECL 332.2-PO2	3	Students analyse and evaluate the various modulation techniques, concept of pulse shaping in the transmitter and matched filter in the receiver using MATLAB in terms of their performance
ECL 332.3-PO2	2	Students analyse and evaluate a communication system using basics of SDR.
ECL 332.1-PO3	2	Students learn to design the transmitters and receivers for the waveform coding & modulation techniques
ECL 332.2-PO3	2	Students learn to design a communication system using MATLAB simulations.
ECL 332.3-PO3	3	Students learn to design a communication system using SDR and Labview.
ECL 332.1-PO4	2	The knowledge of basic waveform coding techniques & modulation schemes can be

		used to design and analyse more complex methods
ECL 332.2-PO4	2	The knowledge of simulation using Matlab can be used to design and analyse more complex communication systems.
ECL 332.3-PO4	3	The knowledge of simulation using SDR & Labview can be used to design and analyse more complex communication systems.
ECL 332.1-PO5	3	Students can use modern IT tools like MATLAB & simulink to design and investigate the waveform coding & modulation techniques
ECL 332.2-PO5	3	Students can use modern IT tools like to design and investigate a communication system
ECL 332.3-PO5	3	Students can investigate modern tools like SDR together with Labview for transmitter and receiver designs.
ECL 332.1-PO9	3	Work in teams for circuit design and setup.
ECL 332.3-PO9	3	Work in teams for setting up the SDR and simulation using Labview.
ECL 332.1-PO10	2	Communicate the inferences of each experiment and record the results and observations for further analysis.
ECL 332.3-PO10	2	Record the setup of SDR as a transceiver and communicate the inferences of each experiment and record the results and observations for further analysis.
ECL 332.1-PO12	1	Students can use their understanding of basic modulation techniques to understand, analyse and design new modulation techniques to meet the communication requirements of the future
ECL 332.2-PO12	1	Students can use their understanding of basic modulation techniques, eye diagrams, waveform coding, etc and devise software simulations for future projects.
ECL 332.3-PO12	3	Students can use their understanding of basics of SDR & Labview and make use of its application for future requirements.

PSO MAPPING

MAPPING	LEVEL	JUSTIFICATION
ECL 332.1-PSO1	2	Digital system requires devices which can handle both analog and digital information

ECL 332.1-PSO2	2	Digital systems needs the usage of tools like Simulink etc
ECL 332.2-PSO1	3	Provide a platform to demonstrate their programming skills
ECL 332.3-PSO1	3	Design and implementation of MW receiver using parameter measurements
ECL 332.3-PSO2	3	Conduct experiment such as various measurements using bench set up
ECL 332.3-PSO3	2	Implementation of social relevant projects using the basics of measurement concepts

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

Sl. No.	DESCRIPTION	PROPOSEDACTIONS
1	Simulation of Analog Modulation Schemes.	Additional experiments can be included

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SNO	DESCRIPTION	PROPOSED ACTIONS	PO PSO MAPPING
1	LAB BASED LEARNING	Assignments using Industrial EDA tools	PO9, PSO3, PO5, PSO2

WEB SOURCE REFERENCES:

Sl. No.	DESCRIPTION
1	www.matworks.com
2	www.nptel.iit.a.c.in

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

<input checked="" type="checkbox"/> CHALK & TALK	<input type="checkbox"/> STUD. ASSIGNMENT	<input checked="" type="checkbox"/> WEB RESOURCES	<input type="checkbox"/> LCD/SMART BOARDS
<input type="checkbox"/> STUD. SEMINARS	<input type="checkbox"/> ADD-ON COURSES		

Mark Distribution:

Total Marks	CIE	ESE
150	75	75

Continuous Internal Evaluation Pattern:

Attendance: 15 marks

Continuous Assessment: 30 marks

Internal Test: 30 marks.

End Semester Examination Pattern**ASSESSMENT METHODOLOGIES-DIRECT**

<input type="checkbox"/> ASSIGNMENTS	<input type="checkbox"/> STUD. SEMINARS	<input checked="" type="checkbox"/> TESTS/MODEL EXAMS	<input checked="" type="checkbox"/> UNIV. EXAMINATION
<input checked="" type="checkbox"/> STUD. LAB PRACTICES	<input checked="" type="checkbox"/> STUD. VIVA	<input type="checkbox"/> MINI/MAJOR PROJECTS	<input type="checkbox"/> CERTIFICATIONS
<input type="checkbox"/> ADD-ON COURSES	<input type="checkbox"/> OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

<input checked="" type="checkbox"/> ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	<input checked="" type="checkbox"/> STUDENT FEEDBACK ON FACULTY (TWICE)
<input type="checkbox"/> ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	<input type="checkbox"/> OTHERS

Prepared by

Dr. Rithu James
Neethu Radha Gopan
Mariya Vincent

Approved by

HoD

COURSE PLAN

Exp. No.	Title
PART A	
1	FM generation and demodulation using PLL
2	Generation and Detection of PCM signals
3	Generation and Detection of Delta modulated signals
4	Generation and Detection of BPSK
5	Generation and Detection of 16-QPSK
PART B	
6	Performance of Waveform Coding Using PCM
7	Pulse Shaping and Matched Filtering
8	Eye Diagram
9	Error Performance of BPSK
10	Error Performance of QPSK
PART C	
11	Familiarization with Software Defined Radio (Hardware and Control Software)
12	FM Reception
13	FM Transmission

ECD 334
MINI PROJECT

COURSE INFORMATION SHEET

PROGRAMME: Electronics and Communication Engineering	DEGREE: B.Tech
COURSE: MINI PROJECT	SEMESTER: 6 CREDITS: 2
COURSE CODE: ECD 334 REGULATION: 2019	COURSE TYPE: PRACTICAL
COURSE AREA/DOMAIN: Electronics & Communication	CONTACT HOURS: 3 hours /Week.
CORRESPONDING LAB COURSE CODE (IF ANY):	LAB COURSE NAME:

SYLLABUS:

Preamble: The course aims

- To estimate the ability of the students in transforming the theoretical knowledge studied in to a working model of an electronic system
- For enabling the students to gain experience in organisation and implementation of small projects.
- Design and development of Small electronic project based on hardware or a combination of hardware and software for electronics systems.

Course Plan

In this course, each group consisting of three/four members is expected to design and develop a moderately complex electronic system with practical applications, this should be a working model. The basic concept of product design may be taken into consideration.

Students should identify a topic of interest in consultation with Faculty/Advisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carry out the design/fabrication or develop codes/programs to achieve the objectives. Demonstrate the novelty of the project through the results and outputs. The progress of the mini project is evaluated based on a minimum of two reviews.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The product has to be demonstrated for

its full design specifications. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due weight.

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
1.	Roy D. C. and S. B. Jain, Linear Integrated Circuits, New Age International, 3/e, 2010
2.	Franco S., Design with Operational Amplifiers and Analog Integrated Circuits, 3/e, Tata McGraw Hill, 2008
3.	Pulse, Digital and Switching waveforms by Milman and Taub

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
		Circuit designing and debugging skill	
		Programming skill viz. C as well as Assembly level Programming	
		PCB designing and soldering skill is good provided known.	

COURSE OUTCOMES:

No.	DESCRIPTION	BLOOM'S TAXONOMY LEVEL
CO1	Students will be able to practice acquired knowledge within the selected area of technology for project development.	Apply (3)
CO2	Students will be able to Identify, discuss and justify the technical aspects and design aspects of the project with a systematic approach.	Analyze (4)
CO3	Students will be able to Reproduce, improve and refine technical aspects for engineering projects.	Analyze (4) & Apply(3)
CO4	Work as a team in development of technical projects.	Understand (2)

CO5	Communicate and report effectively project related activities and findings.	Understand (2)
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Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	2		3						2
CO 2	3	3	3	2		3					3	2
CO 3	3	3	3	2		3					3	2
CO 4								3		3	3	2
CO 5								3	3	3		2

CO-PSO MAPPING:

	Programme-specific Outcomes (PSOs)		
	1	2	3
CO 1	2	1	
CO 2	3	2	
CO 3	3	2	
CO 4	2	1	1
CO 5	2	1	1

JUSTIFICATION FOR CO-PO MAPPING

MAPPING	LEVEL	JUSTIFICATION
CO1-PO1	3	Students can able to practice acquired knowledge of mathematics ,science, engineering fundamentals and electronics and communication engineering within the selected area of technology for project development.
CO1-PO2	3	From the basics of engineering fundamentals and various analysis, student can identify and formulate complex engineering problems in the area of Electronics and communication which changes according to the technological developments.
CO1-PO3	3	Design of various electronic projects to meet the specified needs with appropriate consideration to the public health and safety can be achieved from the detailed study of electronic components

CO1-PO4	2	Using the acquired knowledge within the selected area of technology and various electronic components, students can conduct design experiments and give valid results.
CO1-PO6	3	Socially relevant projects can be designed, implemented and presented in front of audience of students and teachers.
CO1-PO12	2	Design of systems changes according to the technological developments
CO2-PO1	3	From the basics of engineering fundamentals and various analysis, student can identify, discuss and justify the technical aspects and design aspects of the project with a systematic approach.
CO2-PO2	3	Identify, formulate, review research literature, and analyze various technical aspects and design aspects of the project are presented in front of audience of students and teachers.
CO2-PO3	3	Design of various electronic projects to meet the specified needs with appropriate consideration to the public health and safety can be achieved from the detailed study of electronic components
CO2-PO4	2	Using technical aspects and design aspects of the project, students can conduct design experiments and give valid results.
CO2-PO6	3	Socially relevant projects can be designed, implemented and presented in front of audience of students and teachers
CO2-PO11	3	Students should learn how to manage projects and finance status by acting as a member or a leader in a team in multi-disciplinary environments
CO2-PO12	2	Design of systems changes according to the technological developments.
CO3-PO1	3	From the basics of engineering fundamentals and various analysis, Students can reproduce, improve and refine technical aspects for engineering projects.
CO3-PO2	3	From the analysis of electronic system design, student can identify and formulate complex engineering problems in the area of electronics and communication which changes according to the technological developments.
CO3-PO3	3	Design of various electronic projects to meet the specified needs with appropriate consideration to the public health and

		safety can be achieved from the detailed study of electronic components.
CO3-PO4	2	Students can conduct design experiments by improving the technical aspects for engineering projects and give valid results.
CO3-PO6	3	Socially relevant projects can be designed, implemented and presented in front of audience of students and teachers
CO3-PO11	3	Students should learn how to manage projects and finance status by acting as a member or a leader in a team in multi-disciplinary environments
CO3-PO12	2	Design of systems changes according to the technological developments
CO4-PO8	3	For proper planning and work in a team, team members should apply professional ethics and responsibilities.
CO4-PO10	3	The presentation in front of teachers and students help them to communicate effectively about their project ideas with the engineering community and with the society.
CO4-PO11	3	Students should learn how to manage projects and finance status by acting as a member or a leader in a team in multi-disciplinary environments
CO4-PO12	2	Design of systems changes according to the technological developments.
CO5-PO8	3	To Communicate and report effectively project related activities and findings, team members should apply professional ethics and responsibilities.
CO5-PO9	3	Function effectively as an individual and as a member or leader in diverse teams for designing and testing electronic projects.
CO5-PO10	3	The presentation in front of teachers and students help them to communicate effectively about their project ideas with the engineering community and with the society.
CO5-PO12	2	Design of systems changes according to the technological developments

JUSTIFICATION FOR CO-PSO MAPPING

MAPPING	LEVEL	JUSTIFICATION
CO1-PSO1	2	Student can learn to demonstrate their skills in designing, communication systems, and applications from the practical knowledge acquired within the selected area of technology for project development.
CO1-PSO2	1	From the practical knowledge acquired within the selected area of technology, students can able to conduct experiments and develop applications using modern tools.
CO2-PSO1	3	Students can able to demonstrate their skills in designing, communication systems, and applications through their project presentations in front of teachers and students
CO2-PSO2	2	During their presentations, student should represent their knowledge and skills to conduct experiments and develop applications using modern tools.
CO3-PSO1	3	The student can learn to demonstrate their skills in designing, testing electronic systems, and applications
CO3-PSO2	2	Modern tools are used to design and test electronic system
CO4-PSO1	2	Team of students is able to plan and design socially relevant projects.
CO4-PSO2	1	Modern tools are used to design systems in student groups
CO4-PSO3	1	Systems design shows the sense of professional ethics of student group.
CO5-PSO1	2	Student can use PCB design techniques to demonstrate their skills in designing, electronic systems, and applications
CO5-PSO2	1	Modern tools are used to design PCB layout
CO5-PSO3	1	Communicate and report effectively project related activities and findings shows the sense of professional ethics of student.

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SINo	DESCRIPTION	PROPOSED ACTIONS	PO MAPPING	PSO Mapping
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1	PCB designing Course	Short term course	1,2	1,2
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PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SINo	DESCRIPTION	PROPOSED ACTIONS	PO MAPPING	PSO Mapping
1	LateX software based documentation	Short term course	1,2	2

WEB SOURCE REFERENCES:

1	http://www.electronicsforu.com
2	http://www.labcenter.com

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

<input type="checkbox"/> CHALK & TALK	<input type="checkbox"/> STUD. ASSIGNMENT	<input type="checkbox"/> WEB RESOURCES	
<input type="checkbox"/> LCD/SMART BOARDS	<input type="checkbox"/> STUD. SEMINARS	<input type="checkbox"/> ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

<input type="checkbox"/> ASSIGNMENTS	<input type="checkbox"/> STUD. SEMINARS	<input type="checkbox"/> TESTS/MODEL EXAMS	<input type="checkbox"/> UNIV. EXAMINATION
<input type="checkbox"/> STUD. LAB PRACTICES	<input type="checkbox"/> STUD. VIVA	<input type="checkbox"/> MINI/MAJOR PROJECTS	<input type="checkbox"/> CERTIFICATIONS
<input type="checkbox"/> ADD-ON COURSES	<input type="checkbox"/> OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

<input type="checkbox"/> ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	<input type="checkbox"/> STUDENT FEEDBACK ON FACULTY (TWICE)
<input type="checkbox"/> ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	<input type="checkbox"/> OTHERS

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Approved

(HOD)

COURSE PLAN

Course Plan

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