Chapter – 2
Semester-Wise Structure of Curriculum

Mandatory Induction Program

3 Weeks Duration
• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent people • Visit to local areas • Familiarization of Dept./Branch Innovations

ENGINEERING FIRST YEAR: SEMESTER-1					
SLNO	**CATEGORY**	**COURSE CODE**	**SUBJECT NAME**	**L-T-P**	**Credits**
1	BSC	20MA1101	Differential Equations and Multivariable calculus	3-1-0	4
2	BSC	20PY1101	Engineering Physics	3-1-0	4
3	BSC	20PY1181	Engineering Physics Lab	0-0-3	1.5
4	PCC	20EC1203	Signals and Systems	3-1-0	4
5	ESC	20EE1110	Electrical Technology	3-1-0	4
6	ESC	20EE1180	Electrical Technology Lab	0-0-3	1.5
7	ESC	20EC1102	Introduction to Latest Technical Advancements	1-0-0	1
8	ESC	20CS1108	Programming & Data Structures	3-0-0	3
9	ESC	20CS1188	Programming & Data Structures Lab	0-0-3	1.5
				Total Credits	**24.5**
Total contact hours : 29 hours					

ENGINEERING FIRST YEAR: SEMESTER-2					
SLNO	**CATEGORY**	**COURSE CODE**	**SUBJECT NAME**	**L-T-P**	**Credits**
1	BSC	20MA1201	Mathematical Methods	3-1-0	4
2	ESC	20CS1209	Object Oriented Programming	2-0-0	2
3	ESC	20CS1289	Object Oriented Programming Laboratory	0-0-3	1.5
4	ESC	20EC1285	Computational Lab	0-0-3	1.5
5	HSC	20EG1281	English-Language Communication skills Lab-1	1-0-3	2.5
6	PCC	20EC1201	Electronic Devices and Circuits	3-1-0	4
7	PCC	20EC1281	Electronic Devices and Circuits Lab	0-0-3	1.5
8	PCC	20EE1211	Network Theory	3-1-0	4
9	ESC	20CE1114	Engineering Graphics and Design	1-0-3	2.5
				Total Credits	**23.5**
Total contact hours : 31 hours					

ENGINEERING SECOND YEAR: SEMESTER-1					
SLNO	**CATEGORY**	**COURSE CODE**	**SUBJECT NAME**	**L-T-P**	**Credits**
1	BSC	20MA2101	Probability & Random Variables	2-1-0	3
2	ESC	20EC2185	Internet of Things Lab	0-0-3	1.5
3	PCC	20EC2101	Analog Electronic Circuits	3-1-0	4
4	PCC	20EC2181	Analog Electronic Circuits Lab	0-0-3	1.5
5	PCC	20EC2102	Digital Logic Design	3-1-0	4
6	PCC	20EC2182	Digital Logic Design Lab	0-0-3	1.5
7	PCC	20EC2103	Digital Signal Processing	3-1-0	4
8	PCC	20EC2183	Digital Signal Processing Lab	0-0-3	1.5
9	PCC	20EE21XX	Control Systems	3-0-0	3
Total Credits					**24**
Total contact hours: 30 hours					

ENGINEERING SECOND YEAR: SEMESTER-2					
SLNO	**CATEGORY**	**COURSE CODE**	**SUBJECT NAME**	**L-T-P**	**Credits**
1	ESC	20EC2285	Robotics Laboratory	1-0-3	2.5
2	PCC	20EC2201	Communication Systems-1	3-1-0	4
3	PCC	20EC2281	Communication Systems-1 Lab	0-0-3	1.5
4	PCC	20EC2202	Digital System Design	3-1-0	4
5	PCC	20EC2282	Digital System Design Lab	0-0-3	1.5
6	PCC	20EC2203	Linear Integrated Circuits	3-1-0	4
7	PCC	20EC2283	Linear Integrated Circuits Lab	0-0-3	1.5
8	PCC	20EC2204	Electromagnetic Waves & Guided Media	3-1-0	4
Total Credits					**23**
Total contact hours : 29 hours					

ENGINEERING THIRD YEAR: SEMESTER-1					
SLNO	**CATEGORY**	**COURSE CODE**	**SUBJECT NAME**	**L-T-P**	**Credits**
1	ESC	20EC3102	Computer Networks	3-0-0	3
2	ESC	20EC3103	Computer Organization & Architecture	3-1-0	4
3	HSC	20EG3182	English-Language Communication skills Lab-2	0-0-3	1.5
4	PCC	20EC3101	Communication Systems- 2	3-1-0	4
5	PCC	20EC3181	Communication Systems -2 Lab	0-0-3	1.5
6	PCC	20EC3182	Microprocessors, Microcontrollers & Computer Networks Lab	0-0-3	1.5
7	PCC	20EC3185	Radio Frequency & Microwave Engg. Lab	1-0-3	2.5
8	PROJ	20EC3190	Mini-Project-I (Socially Relevant Project)	0-0-2	1
Total Credits					**19**
MC		20HS3101	Indian Constitution	2-0-0	0
Total contact hours: 25 hours *Mini Project-1 workload not included in above workload calculation					

ENGINEERING THIRD YEAR: SEMESTER-2					
SLNO	**CATEGORY**	**COURSE CODE**	**SUBJECT NAME**	**L-T-P**	**Credits**
1	HSC	20EG3283	English-Language Communication skills Lab-3	0-0-3	1.5
2	HSC	20BMXY01	Product Design & Innovation	1-0-0	1
3	PEC	20EC32XX	Elective-1	3-0-0	3
4	PEC	20EC32XX	Elective-2	3-0-0	3
5	OEC	20XX32XX	Open Elective-1	3-0-0	3
6	OEC	20XX32XX	Open Elective-2	3-0-0	3
7	PROJ	20EC3291	Mini Project-II	0-0-3	1.5
Total Credits					**16**
MC		20MC3201	Career Development Course	2-0-0	0
Total contact hours : 18 hours *Mini Project-2 work load not included in above calculation					

ENGINEERING FOURTH YEAR: SEMESTER-1					
SLNO	**CATEGORY**	**COURSE CODE**	**SUBJECT NAME**	**L-T-P**	**Credits**
1	PEC	20EC41XX	Elective-3	3-0-0	3
2	PEC	20EC41XX	Elective-4	3-0-0	3
3	OEC	20XX41XX	Open Elective-3	3-0-0	3
4	PROJ	20EC4192	Summer Internship Project	0-0-6	3
5	PROJ	20EC4193	Project I	0-0-8	4
Total Credits					**16**
MC		20BE4101	Environmental Science	2-0-0	0
Total contact hours : 11 hours *Project-1 work load not included in above calculation *Summer Internship Project will be after completion of Engineering Third Year Semester-2					

ENGINEERING FOURTH YEAR: SEMESTER -2					
SLNO	**CATEGORY**	**COURSE CODE**	**SUBJECT NAME**	**L-T-P**	**Credits**
1	HSC	20HS4299	Community Service	0-0-4	2
3	PEC	20EC42XX	Elective-5	3-0-0	3
5	OEC	20XX42XX	Open Elective-4	3-0-0	3
6	PROJ	20EC4294	Project-II & Dissertation	0-0-12	6
Total Credits					**14**
Total contact hours : 6 hours *Project-2 and Community Service work load not included in above calculation					

List of Program Electives Courses/ Open Elective Courses

Program Elective Courses
Communication Stream
20ECXY01:Advanced Digital Communications
20ECXY02:Antenna and Radio wave propagation
20ECXY03:Cooperative Communications
20ECXY04:Design of Microwave systems
20ECXY05:Detection and Estimation Theory
20ECXY06:Error Correcting Codes
20ECXY07:Information Theory and Coding
20ECXY08:Millimeter wave Technology
20ECXY09:Optical Communications
20ECXY10:Principles of RADAR
20ECXY11:Radio Frequency and Microwave Engineering
20ECXY12:Satellite Communications
20ECXY13:Wireless Communications
Signal Processing Stream
20ECXY14:Advanced Digital Signal Processing
20ECXY15:Artificial Neural Networks
20ECXY16:Biomedical Signal Processing
20ECXY17:Digital Image Processing
20ECXY18:Digital Voice and Picture Communication

20ECXY19:Estimation of Signals and Systems
20ECXY20:Medical Image Analysis
20ECXY21:Pattern Recognition and applications
20ECXY55: Adapative Signal Processing
20ECXY56: Introduction to Deep Learning
VLSI and Embedded systems Stream
20ECXY22:Analog IC Design
20ECXY23:Digital IC Design
20ECXY24:Digital VLSI System Design
20ECXY25:Electronic System Packaging
20ECXY26:Embedded Systems
20ECXY27:Embedded System Software Testing
20ECXY28:FPGA based System Design
20ECXY29:Low Power Circuits and Systems
20ECXY30:MEMS and Microsystems
20ECXY31:RF IC Design
20ECXY32:Systemverilog
20ECXY33:VLSI DSP
20ECXY34:VLSI Physical Design
20ECXY35:VLSI Testing and Verification
OpenElectiveCourses (Offered to other departments)
20ECXY50:Artificial Intelligence
20ECXY51:Computational science and Engineering using Python

20ECXY52:Linux Programming and Scripting
20ECXY53:Machine Learning
20ECXY54:Robotics Operating System: Drones
20ECXY57: Electronic Measurements and Instrumentation

COURSES BEING OFFERED TO OTHER DEPARTMENTS

COURSE CODE	SUBJECT NAME	L-T-P	CREDITS	BRANCHES
20ECXX10	Digital Logic Design	3-0-0	3	CSE
20ECXX80	Digital Logic Design Laboratory	0-0-3	1.5	CSE

CSE: Department of Computer Science and Engineering

CHAPTER 2

DETAILED 4-YEAR CURRICULUM CONTENTS

SEMESTER-WISE

ENGINEERING FIRST YEAR: SEMESTER-I

20MA1101	**Differential Equations and Multivariable calculus**	**BSC**	**3L:1T:0P**	**4 credits**

Course Learning Objectives: The objective of this course is to

1. Discuss the Solutions of first order differential equations
2. Discuss the Solutions of higher order linear differential equations
3. Understand the converge of infinite series with different tests.
4. Learn power series representation of functions and its validity
5. Understand Continuity and differentiability of multi-variable functions and its applications to discuss maximum and minimum
6. Discuss the convergence Improper integrals and apply Leibnitz rule

Course Content:

Unit – I **(10 Contact hours)**

Differential equations of first order and first degree:

Basic concepts, Variable Separable method, homogeneous differential equations, Exact differential equations, Integrating factor, Differentiable equations Reducible to exact, Linear differential equations, Bernoulli differential equations.

Unit - II **(11 Contact hours)**

Linear differential equations of higher order:

Homogenous differentiable equations, Non-homogeneous linear equations of higher order with constant coefficients with RHS term of the type $e^{ax}, sinax, cosax,$ polynomials in $x, e^{ax}\,V(x), xV(x),$ Methods of Undetermined Coefficients, Method of variation of parameters, Euler Cauchy equation.

Unit - III **(12 Contact hours)**

Sequences and Series

Definition of Sequences and convergence, Convergence of series, Comparison test, Ratio test, Root test, Absolute and Conditional convergence, Alternating series, Power series, Taylor's and Maclaurin's series.

Unit - IV **(12 Contact hours)**

Functions of several variables:

Limit, Continuity and Differentiability of functions of several variables, Partial derivatives and their geometrical interpretation, Differentials, Derivatives of Composite and Implicit functions, Chain rule, Jacobians, Derivatives of higher order, Homogeneous functions, Euler's theorem, and Harmonic functions.

Unit – V Applications of Functions of several Variable: (8 Contact hours)

Taylor's expansion of functions of several variables, Maxima and Minima of functions of several variables - Lagrange's method of multipliers.

Unit – VI (6 Contact hours)

Beta and Gamma Function:
Beta and Gamma functions - elementary properties, Relation between Beta and gamma functions, Evaluation of Definite integral using Beta and Gamma functions, differentiation under integral sign, and differentiation of integrals with variable limits - Leibnitz rule.

Learning resources

Text book:

1. ERWIN KREYSZIG, '*Advanced Engineering Mathematics'*, Wiley-India, 9th Edition

Reference Books:

1. TOM M. APOSTAL,*' Calculus, Volume II'*, Wiley-India, Second Edition,
2. R. K. JAIN AND S. R. K. IYENGAR,' *Advanced Engineering Mathematics'*, Narosa Publishers, 3rd Edition.
3. B.S.GREWAL, '*Higher Engineering Mathematics'*, Khanna Publishers, 42nd Edition.

Web resources:

1. NPTEL, IIT- Madras, 08-June-2017, Introduction to ordinary differential equations URL: https://nptel.ac.in/courses/111106100/12
2. NPTEL, IIT- Kanpur, 15-March-2016, Differential Calculus of Several Variables URL: https://nptel.ac.in/courses/111104092/11
3. NPTEL, IIT- Roorkee, 22-December-2017, Multivariable Calculus URL:https://nptel.ac.in/courses/111107108/
4. MatheMagician, 24–April-2017, Calculus - sequences and series, URL: https://www.youtube.com/playlist?list=PLJMXXdEk8kMAeBLj14HX0fhe_LypRc4aW
5. RGUKT Course Content

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

CO 1	Solve first order differential equations.
CO 2	Solve higher order linear differential equations.

CO 3	Check the convergence of infinite series with different methods
CO 4	Discuss the power series representation of a function at various points.
CO 5	Explain limits and continuity, differentiability and partial derivatives of functions of multivariable and solve the extremum problems subjected to constraints.
CO 6	Apply Leibnitz rule and beta gamma functions to evaluate improper integrals.

For Theory courses only:

Course Nature		**Theory**		
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

ENGINEERING FIRST YEAR: SEMESTER-I

20PY1101	**Engineering Physics**	**BSC**	**3L: 1T: 0P**	**4 credits**

Course Learning Objectives:

1. To impart basic knowledge on the concept of vector and scalar fields as well its physical significance in all 3D coordinate systems. To integrate knowledge on vector calculus and its applications to transform 1, 2 and 3 dimensions.

2. To enable the student in detailed knowledge on Gauss's Law in electrostatics and it'sapplications how to calculate electric field associated by different symmetrical charge distributions. And also impart basic fundamentals on dielectric materials and induced polarizations associated by the presence of external electric field on dielectrics.

3. To impart basic idea on solving problems by using Poisson's and Laplace equations of different electrical charged bodies and also create knowledge on boundary conditions of electric fields and potentials.

4. To enhance in detail knowledge on magnetic force due to current carrying charged bodies and Amphere's law as well its applications. To integrate in detail knowledge on magnetic materials and its properties as well applications.

5. To get physical ideas contained in Maxwell's equations, and how the symmetry between changing electric andchanging magnetic fields explains Maxwell's prediction of electromagnetic waves in different medium.

6. To gain fundamentals on band theory of solids, semiconductors materials its classification by Fermi energy level and band gap. To get basic knowledge on electronic devices fabricated with semiconductors, i.e. P-N diode, LED's, Photo diodes and solar cells and its working principle as well characteristics.

Course Content:

UNIT - I: Introduction (09 Hours)

Coordinate system: Cartesian, cylindrical and spherical coordinate system transformations, Differential Calculus: Gradient, Divergence, Curl and their physical significance, Integral Calculus: Line, Surface, and Volume Integrals, Integral theorem: Gauss and stokes theorems, Curvilinear Coordinates, second derivatives: Laplacian.

UNIT-II: Electrostatics -1 (09 Hours)

Gauss's Law and applications, electric Potential, Gradient relationship between E and V, Electric Dipole, Energy Density in Electrostatic Fields, Fields inside Perfect Conductors, Polarization Dielectrics, Dielectric Constant, capacitance, Dielectric break down.

UNIT-III: Electrostatics -2 **(09 Hours)**

Current density, Ohm's law, Poisson's and Laplace equations. Boundary conditions of electric field and electrostatic potential, method of images (with one example), energy of a charge distribution and its expression in terms of electric field.

UNIT-IV: Magnetostatics **(10 Hours)**

Magnetic Forces, Biot-Savart's Law, Steady currents, Ampere's Law, Magnetic Vector Potentials, Magnetization, Permeability, Para , Dia, Ferro-Magnetic material properties, Magnetic Energy, boundary conditions, Scalar & vector fields.

UNIT-V: Time varying fields **(9 Hours)**

Faraday's Law, Lenz's law, EMF, Displacement current, Maxwell's equation in vacuum and non-conducting medium and conducting medium, Energy in an electromagnetic field; Flow of energy, Poynting's theorems and conservation Laws.

UNIT-VI: Semiconductor physics **(14 Hours)**

Introduction to Quantum Mechanics: De Brogliematter waves, Uncertainty Principle, Wave function& it's probability interpretation, Postulates of quantum mechanics, Time independent Schrodinger Equation and its Applications, Particle in a box (1-D and 3-D)

*Semiconductor:*Electron in periodic structures, Band theory of solids, Density of states, Fermi level, Band theory of semiconductors, effective mass, Direct and indirect band gap, carriers in intrinsic and extrinsic semiconductors, Charge densities in intrinsic and extrinsic semiconductor, Law of mass action, Hall Effect, Generation and Recombination of charges, Diffusion, the continuity equation, Injected minority carrier charge, Potential Variation within a graded semiconductor, P-N diode, LED's, Photo diodes and solar cells.

Learning resources

Text book:

1. David J. Griffiths '*Introduction to Electrodynamics'* HPI Publications, 3rd edition
2. Elements of electromagnetics by Mathews N.O. Sadiku , 3rd Edition

Reference Books:

1. S.L. Kakani, Subhadra Kakani '*Engineering Physics'*, CBS Publications, 2nd edition
2. Arunkumar *'Introduction to solid state physics'* HPI Publications, (30 January 2010)
3. Iswar Singh Tyagi *'Principles of quantum mechanics'* Pearson Publications; 1st edition (25 September 2012)
4. Donald Neamen *'Semiconductor devices'* McGraw Hill Education; 3ed edition (25 August 2006)

Web resources:

1. Prof V. Ravi Shakar, NPTEL-IIT Kanpur, '*Engineering Physics-II*'
URL: https://nptel.ac.in/courses/122104016/
2. Prof. D. K. Ghosh, NPTEL-IIT Bombay, '*Engineering Physics-II'*
URL: https://nptel.ac.in/courses/122101002/

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

CO 1	The student will have capacity to integrate knowledge on vector and scalar fields using mathematical del operators, and also solve the problems in integral calculus.
CO 2	Student will have capacity to describe the electric field and potentials associated various symmetric charged bodies by using Gauss Law. And also understand the applications of dielectric materials in real life.
CO 3	Student will be able understand different electrical charged body fields, potentials, energy density and boundary conditions by solving Poisson's and Laplace equations.
CO 4	Student will have capacity to distinguish different magnetic materials such as Dia, para and ferro (Ferri) materials and its applications.
CO 5	Student will have capacity to describe Maxwell's equation in vacuum and conducting and non-conducting media.
CO 6	Student will have capacity to describe classification of solid state materials in band theory, semiconducting materials and its significance in basic electronic devices.

Course Nature		**Theory**		
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING FIRST YEAR: SEMESTER-I

20PY 1181	**Engineering Physics Laboratory**	**BSC**	**0L:0 T:3P**	**1.5 credits**

Course Learning Objectives:

1. Hall Effect: To determine the hall coefficient, carrier density and carrier mobility of a given semiconducting materials.
2. Frank Hertz: To verify the postulates of Bohr's theory and discrete (quantized) energy levels in atoms.
3. Photo electric Effect: To understand phenomenon of the photoelectric effect and Determine the value of Plank's constant.
4. Energy gap of Semiconductor: Determine the energy gap of a given semiconducting material by four probe method.
5. Susceptibility of Para Magnetic Materials: To determine the susceptibility of a given paramagnetic by Gouy's method.
6. Magnetic hysteresis curve tracer: Determine the Coercivity, Saturation magnetization and retentivity of a given Ferro magnetic material using a Hysteresis loop tracer.
7. Dielectric Constant measurement: Determine the Dielectric constant of a given dielectric material.
8. Viscosity of water Measurement: Determine the co-efficient of viscosity of given oil by falling sphere method.
9. Zener Diode experiment: Verification of I-V characteristics of Zener Diode and Determination break down voltage of Zener Diode.
10. Transition characteristic experiment: Determine different input and output parameters in common emitter configuration of both p-n-p and n-p-n Transistor.
11. Solar cell experiment: Determine the efficiency of a given Solar cell.

Experiments list

Exp-1: Hall Effect
Exp-2: Frank Hertz
Exp-3: Photo electric Effect
Exp-4: Energy gap of Semiconductor
Exp-5: Susceptibility of Para Magnetic Materials
Exp-6: Magnetic hysteresis curve tracer
Exp-7: Dielectric Constant measurement
Exp-8**:** Viscosity of water Measurement
Exp-9: Verification of I-V characteristics of Zener Junction Diode and Determination break down voltage of Zener Diode.

Exp-10: ***p-n-p*** and ***n-p-n*** Transistor parameters in common emitter configuration
EXP-11: Calculating the efficiency of Solar cell

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

CO 1	Student will have capacity to measure hall coefficient of given semiconductor. Further, students can calculate carrier density and carrier mobility of a given semiconductor.
CO 2	Student will have capacity to describe discrete (Quantized) energy levels of atoms.
CO 3	Student will able to understand the photoelectric effect phenomena and then calculate Plank's constant value by using photoelectric equation.
CO 4	Student will have ability to describe the relation between conductivity and temperature in semiconductor materials and then calculate the energy gap of material.
CO 5	Student will have capable to calculate magnetic susceptibility of a given paramagnetic solution by Quinck's tube method.
CO 6	Student will able to differentiate between hard and soft ferromagnetic materials by observing B-H loops and then calculate M_s, M_r and H_c of a given ferromagnetic materials.
CO 7	Student will able to differentiate different type of dielectric mediums by calculate the dielectric constant.
CO 8	Student will have capable to calculate the co-efficient of viscosity of given oil by falling sphere method
CO 9	Student will able to understand (nonohmic) nature of I-V characteristic of Zener diode. And then calculate breakdown voltage.
CO 10	Student will able to calculate input resistance, output resistance, out the values of current and voltage gain parameters for given transistor. And also Identify the active, Saturation and cutoff regions of a given Transistors by drawing I-V characteristics.
CO11	Student will able to calculate the efficiency of solar cell.

Course Nature		**Practical**		
Assessment Method				
Assessment Tool	Experiments	Record	Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	5%	10%	40 %

End Semester Examination weightage (%)	60 %

Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING FIRST YEAR: SEMESTER-II

20CE1114	**Engineering Graphics and Design**	**ESC**	**1L: 0T: 3P**	**2.5 credits**

Course Learning Objective

1. To know about emergence of Engineering Graphics as a refined communication tool and to be aware of International and national standards of practice for uniform presentation of drawings.
2. To adopt the projection of three dimensional object orthogonally on a set of vertical and horizontal planes and obtain the views of the frontal and the top surfaces.
3. To describe the position of a point and position of the line with respect to all the planes of projection and obtain itsviews.
4. To learn orthographic projections of various simple plane surfaces in simple and inclined positions.
5. To know about orthographic projections of right and regular solids in simple positions, when their axes are perpendicular to one reference plane and parallel to theother.
6. To learn about types of cutting planes and to obtain views of simplesolids.
7. To learn about different methodologies to be used for obtaining the two dimensional layout of the lateral surfaces of uncutsolids.
8. To learn about computer aided drafting techniques and to be familiarize with one of the mostpo werful software 'AutoCAD'.

Course content

Unit-I **(7 hours)**

Introduction to Engineering Drawing

Introduction toEngineeringdrawing – Tools and Standards, Geometric Constructions, Scales, Conics and Special Curves - ellipse, parabola, hyperbola, cycloids,Involutes.

Unit-II **(6 hours)**

Orthographic projections

Introduction to Orthographic Projections, Projections of Points, Projection of Lines.

Unit-III **(8 hours)**

Projection of Solids

Projection of Planes, Projections of Solids cube, prism, pyramid, cylinder, cone and sphere.

Unit-IV **(8 hours)**

Section of solids

Sections of Solids - cube, prism, pyramid, cylinder, cone and sphere. Development of Surfaces – Parallel line method and Radial linemethod.

Unit-V **(8hours)**

Introduction to AutoCAD

ComputerAidedDesign – Introduction to AutoCAD, Co-ordinate System (UCS) and their Commands, Basic Commands of Drawing and Editing, Dimensioning andText.

Unit-VI **(8 hours)**

Computer Graphics

Drawing practice with AutoCAD Creating 2D Drawings of Objects from Isometric views, Creating Isometric views form Orthographic views and Introductions to 3D drawings.

Learning Resources

Textbooks

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), *'Engineering Drawing'*, Charotar Publishing House.

Reference books

1. Shah, M.B. &Rana B.C. (2008), *'Engineering Drawing and Computer Graphics'*, PearsonEducation.
2. Agrawal B. & Agrawal C. M. (2012), *'Engineering Graphics'*, TMHPublication.

Web resources

1. Prof Anupam Saxena, NPTEL-IIT Kanpur, 'Engineering Drawing'. URL:https://nptel.ac.in/courses/112104172/
2. Prof Anupam Saxena, NPTEL-IIT Kanpur, 'Computer Aided Engineering Design'. URL:https://nptel.ac.in/syllabus/112104031/

Course outcome: After the completion of this course, the student will be able to

CO 1	Student will be aware of International and national standards of practice.
CO 2	Student willbefamiliarwith obtaining the views ofthefrontalandthe top

	surfaces of an object.
CO 3	Student will be aware of orthographic projections of right and regular solids in simple positions, when their axes are perpendicular to one reference plane and parallel to the other.
CO 4	Student will know about computer aided drafting techniques and will be familiar with one of the most powerful software 'AutoCAD'

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING FIRST YEAR: SEMESTER-I

20EC1101	**Electrical Technology**	**ESC**	**3L: 1T: 0P**	**4 credits**

Course Learning Objectives

1. To make understand the concept of discrete electronic & electric components and fundamental laws associated with it along with circuitlaws.
2. To make understand the concept of the DC circuits usingtheorems
3. To make understand the concept of Single Phase and Three phasecircuits
4. To make understand the concept of DCmachines

Course Content

Unit-I **(12 hours)**

Circuit Concepts, R,L,C Parameters & Elements, Voltage and Current Sources, Independent and Dependent Sources, Kirchhoff's Laws, Network Reduction Techniques – Series, Parallel, Series Parallel, Star to-Delta or Delta-to-Star Transformations, Nodal Analysis, Mesh Analysis, Super node and Super mesh for DC Excitations. (Only with Independentsources)

Unit-II **(8 hours)**

Tellegen's Theorem, Source Transformations, Super Position Theorem, Thevenins, Norton and Maximum Power transfer Theorem.

Unit-III **(12 hours)**

Introduction to AC, calculation of R.M.S and average values. Steady State Analysis of R, L, C elements (in Series, Parallel, Series-Parallel Combinations) with sinusoidal excitation. Concept of Reactance, Impedance, Susceptance and Admittance. Phase and Phase difference. Concept of Power Factor, Real and Reactive powers. Complex and Polar forms of representation, Complexpower.

Unit-IV **(8 hours)**

Series Resonance.-Phase Sequence- Star and Delta connection-Relation between Line and Phase Voltages and Currents in Balanced Systems-analysis of Balanced Three Phase Circuits Phasor Diagrams-Measurement of active and reactive Power in Balanced Three Phase Systems.

Unit-V **(12hours)**

Two Wattmeter Method of Measurement of Three Phase Power. Construction and Principle of Operation of Single Phase Transformers Types- EMF Equation Principle of Operation of DC Machines, DC Motors, Types of Motors, Characteristic-Losses and Efficiency.

Unit-VI **(8 hours)**

Speed Control of DC Shunt Motor, Flux and Armature Voltage Control Methods. Applications of DC motors. Block level analysis of DC-DC (buck and boost) converters.

Learning Resources

Text Books

1. Charles Alexander and Matthew Sadiku, *'Fundamentals of ElectricCircuits'*, McGraw-Hill Education; 5th edition ,2012
2. WH Hayt JE Kemmerly and S M Durbin, *'Engineering circuit analysis'*, McGraw-Hill Book Company Inc, (8th Edition),2013.

Reference Books

1. DP Kothari and I.J Nagrath, *'Basic Electrical Engineering'*, McGraw-Hill Education (3rd edition)2010.
2. Vincent Del Toro, *'Electrical Engineering Fundamentals'*, Pearson2nd Edition.
3. Hughes, *'Electrical and Electronic Technology'*, Pearson 10/E2011.

Web resources

1. Prof U Umanand, IISC Bangalore, *'Basic Electrical Technology'*.
   URL:http://nptel.ac.in/courses/108108076/
2. Prof S Aniruddhan, IIT Madras, *'Basic Electrical Circuits'*.
   URL:https://onlinecourses.nptel.ac.in/noc16_ee03
3. Prof Anant Agarwal, Masuchussets Institute of Technology, *'Circuits and Electronics'*.
   URL: https://6002x.mitx.mit.edu/courseware/6.002_Spring_2012/
4. Prof N C Jagan, RGUKT Video content, 'ElectricalTechnology'.

Course Outcomes

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

CO 1	Useohmslaws, Kirchhoff's laws on passiveelements
CO 2	Analyze circuitsmade up of linear lumped elements. Specifically, analyze circuits containing resistors and independent sources using techniques such as

	the node method, superposition andtheThevenin ’s method
CO 3	Analyze the Single phase AC circuits
CO 4	Analyze the Three phase AC circuits
CO 5	Analyze DC and AC machines and
CO 6	To understand speed control techniques and power electronic applications.

Assessment Method

Assessment Tool	Weekly tests/Assignments (in a semester)	Monthly tests (in a semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING FIRST YEAR: SEMESTER-I

20EC1181	**Electrical Technology Laboratory**	**ESC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective

To get a hands-on experience on the concepts in Electrical Technology theory course and thereby developing practical knowledge in analysis of electrical equipments like motors, generators etc.

List of Experiments

1. Familiarization with supply panel (AC & DC), all measuring instruments, auto transformers(1- φ and 3- φ), Name plate specifications of all machines.
2. Verification of KVL and KCL.
3. Verification of network theorems. (Super position and Thevenin's Theorem)
4. Calibration of Single Phase EnergyMeter.
5. Study the Characteristics of Fluorescent and IncandescentLamp.
6. Study the behaviors of series RLCcircuit.
7. Three phase power iby two Wattmetermethod.
8. Speed control of D.C Shunt Motor using Field and Armaturecontrol.

Course outcome

After the completion of this laboratory course, the student will be able to

CO1	Understand the AC and DC power supplies and their measurementpractices
CO2	Analyze the circuits using Kirchoff's voltage and current laws
CO3	Understand the working of Energy Meter, Power measurement techniques
CO4	Analyze the working principles of motors and generators
CO5	Understanding the concept of loadline by experimental analysis
CO6	Able to understand and analyze the real-time problems of Electrical Technology Applications

Assessment Method

Assessment Tool	Experiments	Record	Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	5%	10%	40%
End Semester Examination weightage (%)				60%

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ENGINEERING FIRST YEAR: SEMESTER-I

20EC1102	**Introduction to latest technological advancements**	**ESC**	**1L: 0T: 0P**	**1 credit**

Course Learning Objective

1. To know the emerging technology trends related in the Electronics and Communication Engineeringdomain.
2. To know the other interdisciplinary domains connected with Electronics and CommunicationEngineering.
3. To gain knowledge on the recent Industrialadvancements.

Course content

Exercise-I: ICT in Engineering Education (MOOCs), Interactive Education tools, Social networking for Education, ICT for societal development.

Exercise-II: Understanding the latest Mobile Phone Hardware system: Study of sensors, display, memory, processor functionality other features.

Exercise-III: Introduction to Internet of Things (IoT), Emphasis on Electronics and Communication field in IoT, challenges and applications.

Exercise-IV: Introduction to Artificial Intelligence, Machine learning applications and challenges.

Exercise-V: Advancements in telecommunications, 5G networks and challenges.

Exercise-VI: Advancements in RADAR and Space communications - NASA, Indian Space (ISRO), DRDOothers.

Exercise-VII: Recent advancements in VLSI and Signal Processing domains, others.

Learning Resources

Magazines

1. Electrobits magazine.
2. DRDO/ISRO/NASA Newsletters andmagazines.
3. Industry newsletters andmagazines.

Web resources

1. NPTEL/SWAYAM/Coursera/Udemy/
2. Flipboard apps/TED app/ Educational appsetc
3. https://spectrum.ieee.org/
4. https://www.eetimes.com/
5. https://www.digit.in/
6. https://www.ecnmag.com/
7. https://www.techdesignforums.com/

Course outcome: After the completion of this course, the student will be able to

CO 1	Understand the scope of Electronics and Communication Engineering in real-time applications
CO2	Understand the various available resources so as to get updated with the current technology trends
CO3	Understand the current technology trends across different domains – Government sectors and Industries

Assessment Method

Assessment tool	Monthly Seminar	Report submission (End Semester)	Total
Weightage (%)	75%	25%	100%

*Note:

1. The topics in the course may vary as per the recent technical trends of the Industry. However,thechangesaresubjectedtotheapprovaloftheInstitutecompetentauthorities.
2. Industry personnel/People from ISRO/DRDO/Research Center are recommended to engage in thiscourse.
3. In Assessment Method, among one of the monthly seminars, the student is supposed to submit video recording of seminar and the same should be played in theclassroom.

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ENGINEERING FIRST YEAR: SEMESTER-I

20CS1109	**Programming and Data Structures**	**ESC**	**3L: 0T: 0P**	**3 credits**

Course Learning Objectives

1. To deduce adequate knowledge in programming language and problem-solving techniques.
2. To develop programming skills using the fundamentals of CLanguage.
3. To recognize the effective usage of arrays, structures, functions,pointers.
4. To implement the memory managementconcepts.
5. To illustrate the usage of pointers and dynamic memoryallocation.
6. Explore Data Structures and itsapplications.

Course Content

Unit-I **(5hours)**

Introduction

Computer

Hardware, Bits and Bytes, History of Programming Languages, Character Set, Variables and Identifiers, Built-in Data Types. Operators and Expressions, Constants and Literals, Simple Assignment Statement, Basic Input/output Statement, Simple 'C' Program, Conditional Statements andLoops.

Unit – II **(6 hours)**

Arrays

One Dimensional Arrays, Array Manipulation, Searching, Insertion, Deletion of An Element from An Array; Finding the Largest/Smallest Element in An Array; Two Dimensional Arrays, Addition/Multiplication of Two Matrices, Transpose of square Matrix, Inverse of Matrix, Character Arrays, Multi-dimensionalarrays.

Unit – III **(8hours)**

Functions

Function Declaration, Function Definition, Function Call, Call by Value, Call byReference, Recursion, String Fundamentals, String HandlingFunctions.

Unit -IV **(8 hours)**

Structure & Union

Structure Variables, Initialization, Structure Assignment, Nested Structure, Structures and Functions, Structures and Arrays: Arrays of Structures, Structures Containing Arrays, Unions.

Unit -V **(8hours)**

Pointers

Pointer Type Declaration, Pointer Assignment, Pointer Initialization, Pointer Arithmetic, Functions and Pointers, Arrays and Pointers, Pointer to Pointers, Dangling Memory, Dynamic Memory Allocations, Storage Classes.

Unit – VI **(10hours)**

Data Structures

Linked List, Double Linked Lists, Stack, Stack Implementation Using Arrays, Stack Implementation Using Linked List, Queues, tree traversals.

Learning Resources

Text book

1. ReemaThareja, *'Data Structures using C'*, Oxford Higher Education,2nd Edition.

Reference Books

1. W. Kernighan, DennisM. Ritchie, *'C ProgrammingLanguage'*, Prentice Hall India Learning Private Limited, 2nd Edition.
2. Balagurusamy, *'Programming in ANSI C'*, McGraw Hill Education India Private Limited; 7th Edition.
3. YashavantKanetkar, *'Let us C'*, BPB Publications,14th Edition

Web resources

1. Prof Satyadev Nandakumar, NPTEL-IIT Kanpur, *'Introduction to Programming in C'*, URL:https://nptel.ac.in/syllabus/106104128/
2. Dr P P Chakraborty, NPTEL-IIT Kharagpur, *'Programming and DataStructures'* URL: https://nptel.ac.in/courses/106105085/4
3. URL:https://www.tutorialspoint.com/cprogramming/

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

CO 1	Illustrate the flowchart and design an algorithm for a given problem and to develop one C program using Operators.
CO 2	Develop conditional and iterative statements to write C Programs.
CO 3	Describe C Programs that use the arrays and its usage.
CO 4	Exercise user defined functions to solve real time problems.
CO 5	Describe C Programs using pointers and to allocate memory using dynamic memory management functions.

CO 6	Explore different data structures and understand.

Assessment Method

Assessment Tool	Weekly tests/Assignments (in semester)	Monthly tests (in semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING FIRST YEAR: SEMESTER-I

20CS1189	**Programming and Data Structures Laboratory**	**ESC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective

1. Understand the basic concept of C Programming and Data Structures, its different modules that include conditional and looping expressions, Arrays, Strings, Functions, Structures, Files, Stacks andQueues.
2. Acquire knowledge about the basic concept of writing aprogram.
3. Purpose of programming language and its application in problemsolving.

List of Experiments

Exercise-1: Introduction to C, Conditional Statements and Loops

1. C Program to calculate the sum of Naturalnumbers.
2. C Program to generate multiplication table of a givennumber.
3. C Program to display Fibonacci sequence (Up to givennumber).
4. C Program to Check whether a given number is prime ornot.
5. C Program to make a simple Calculator using switchcase.
6. C Program to check whether a number is palindrome ornot.
7. C Program to display factors of a givennumber.
8. C Program to print Pyramids, Triangles and various patters usingloops.

Exercise-2: Arrays and Sorting

1. C Program to find second largest Element of anArray.
2. C Program to add two matrix using multi-dimensionalarrays.
3. C Program to multiply two matrix using multi-dimensionalarrays.
4. C Program to find transpose of amatrix.
5. C Program to Sort Elements of an Array using Bubblesort.
6. Using Insertion Sort, SelectionSort.
7. Using Counting Sort, Bucket Sort 8. Check whether two strings are anagram of each other ornot.

Exercise 3: Functions and Recursion

1. C Program to check whether given number is prime or not using user-defined function.
2. C Program to swap two integer values using call by value and call byreference.
3. C Program to find the factorial of a given number usingrecursion.

4. C Program to calculate length of string without using strlen()function.
5. C Program to print all permutations of a string (abc, acb, bac, bca, cab,cba).
6. C Program to sort elements in Lexicographical order (Dictionary order) using in built stringfunctions.
7. Sorting using MergeSort.
8. Sorting using QuickSort.

Exercise-4: Structues and Unions

1. C Program using structures to read and display the information about astudent.
2. C Program to read, display, add and subtract two complexnumbers.
3. C Program to read and display the information of a student using nestedstructure
4. C Program, using an array of pointers to a structure, to read and display the data of students.
5. C Program to demonstrate arrays of Unionvariables.
6. C Program using structures to maintain a book library (Book is a structure) which has following operations print various types of books along with their count, author details, search a book by author name or book name orpublisher.

Exercise-5: Pointers and File Handling

1. C Program to demonstrate, handling of pointers inC.
2. C Program to access array elements usingpointers.
3. C Program to find the sum of n numbers with arrays andpointers.
4. C Program to swap two numbers using pointers andfunction
5. C Program to find sum of n elements entered by user. To perform this allocate memory dynamically using malloc()function.
6. C Program to read and write afile.
7. C Program to count number of lines andwords.
8. Write a c program to copy a data of file to otherfile.

Exercise-6: Introduction to Data Structures

1. Write a program to create a linked list and perform insertions and deletions of all cases. Write functions to sort and finally delete the entire list atonce.
2. Write a program to create a doubly linked list and perform insertions and deletions in allcases.
3. Write a program to perform push, pop and peek operations on astack.
4. Write a program to implement a linkedstack.
5. Write a program to implement a linkedqueue.
6. Write a program to implement binary search treeinsertion.

7. Write a program to implement binary search tree traversals (pre-order, post-order, in-order).

Course outcome: After the completion of this Laboratory course, the student will be able to

CO 1	Apply and practice logical ability to solve the problems
CO 2	Understand C programming development environment, compiling, debugging, executing a program using the development environment
CO 3	Analyzing the complexity of problems, modularize the problems into small modules and then convert them into programs
CO 4	Understand and apply the in-built functions and customized functions for solving the problems
CO 5	Understand and apply the pointers, memory allocation techniques and use of files for dealing with variety of problems
CO 6	Understand and apply the structures and unions concept and solving problems on the same
CO 7	Understand the basic concepts of stacks, queues and applying the same for basic problems

Assessment Method

Assessment Tool	Experiments	Record	Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	5%	10%	40%
End Semester Examination weightage (%)				60%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING FIRST YEAR: SEMESTER-II

20MA1201	**Mathematical Methods**	**BSC**	**3L: 1T: 0P**	**4 credits**

Course Learning Objectives: The objective of this course is to
1. Introduce vector spaces and linear transformation.
2. Discuss Eigen values and Eigen vectors of a matrix and various properties.
3. Setup double and triple integrals to find volume and surface area.
4. Discuss directional derivatives and application of Green's, Stokes and Gauss theorems.
5. Discuss numerical methods to find the roots of transcendental equations and Interpolation.
6. Evaluate integrals by using numerical methods and solving IVP.

Course Content:

Unit – I: Linear Algebra: (12 hours)
Vector Spaces, Linear Combinations of Vectors, Linear dependence and Independence, Basis and Dimension, Linear Transformations, Matrix Representations of Linear transformation.

Unit – II: Eigen values and Eigen vectors: (8 hours)
Solving system of Homogeneous and Non-Homogeneous equations by using Gauss elimination method. Characteristic roots and Characteristic Vectors of a matrix - Cayley-Hamilton Theorem (without proof); Finding inverse and power of a matrix by Cayley-Hamilton Theorem.

Unit-III: Multiple integrals: (10 hours)
Double and triple integrals, computations of surface and volumes, Jacobeans of transformations, change of variables in double integrals, Change of Order of double integrals, integrals dependant on parameters - applications.

Unit–IV: Vector calculus: (12 hours)
Scalar and vector fields, level surfaces, directional derivative, Gradient, Curl, Divergence, Laplacian, line, surface integrals and Volume integrals, Green, Gauss and Stokes theorems (without Proof) and problems.

Unit – V: Root finding Methods and Interpolation: (10 hours)
Roots of polynomial and transcendental equations – bisection method, Regula-falsi method and Newton-Raphson method, Finite differences, Newton's forward and backward interpolation formulae.

Unit – VI: Numerical integration and numerical solution of IVP: (8 hours)
Trapezoidal rule, Simpson's $1/3^{rd}$ rule and $3/8^{th}$ rule for numerical integration, Solution of IVP by Euler and Runga-Kutta method.

Learning resources

Text book:
1. ERWIN KREYSZIG**, '***Advanced Engineering Mathematics',* Wiley-India, 9^{th} Edition.

Reference Books:
1. R. K. Jain and S. R. K. Iyengar**,** '*Advanced Engineering Mathematics',* Narosa Publishing House, New

Delhi, 3rd Edition.
2. B.S.Grewal, '*A Text Book of Higher Engineering Mathematics'*, Khanna Publishers, 43rd Edition.
3. Gilbert Strang , 'Linear Algebra and its Applications', CENGAGE Learning 4th Edition.

Web resources:

1. https://onlinecourses.nptel.ac.in/noc20_ma54/preview
2. https://onlinecourses.nptel.ac.in/noc21_ma11/preview
3. RGUKT content

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

CO 1	Write Matrix representation for transformations.
CO 2	Find Eigen values and Eigen vector for a Matrix.
CO 3	Setup and evaluating double and triple integrals.
CO 4	Apply Green's Stokes and Gauss Divergence Theorems.
CO 5	Approximate the roots of polynomial and transcendental equations.
CO 6	Approximate the Integral value by numerical methods and solve IVP using numerical methods.

For Theory courses only:

Course Nature		**Theory**		
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING FIRST YEAR: SEMESTER-II

20CS1209	**Object Oriented Programming**	**ESC**	**2L: 0T: 0P**	**2 credits**

Course Learning Objectives

1. Gain knowledge about basic C++ language syntax and semantics to write C++ programs and use concepts such as variables, conditional and iterative execution methods etc.,
2. Understanding the fundamentals of object-oriented programming inC++, including defining classes, objects, invoking methods etc. and exception handling mechanisms.
3. Understand the principles of inheritance, packages andinterfaces.
4. Understand the principles of Multithreading and Appletprogramming

Course content

Unit-1: Review of C: strings, arrays, pointers, Programming in C++ : Build and execute a C program in C++, Write equivalent programs in C++, C++ as Better C : Procedural Extensions of C

Unit-2: OOP in C++: Classes and basic Object-Oriented features (encapsulation), Overview of OOP in C++: More OO features, overloading, namespace and using struct and union

Unit-3: Inheritance : Generalization / Specialization of Object Modeling in C++, Polymorphism : Static and Dynamic Binding.

Unit-4: Type Casting &Exceptions : C++ cast operators; C++ Exceptions & standard exception

Unit-5: Classes Templates& STL - Function and Class templates and using STL like containers, algorithms.

Unit-6: File handling, streams, Interfaces and Multithreaded Programming.

References:

1. C++ Primer, Stanley Lippman, 5th edition.
2. Object-Oriented Programming with C++, E.Balagurusamy, McGraw-Hill Education (India)

Web resources:

1. PROF. PARTHA PRATIM DAS, IIT Kharagpur, NPTEL," PROGRAMMING IN C++" NPTEL :: Computer Science and Engineering - NOC:Programming in C++
1. Object Oriented Programming in C++ - GeeksforGeeks

Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING FIRST YEAR: SEMESTER-II

20CS1289	**Object Oriented Programming Laboratory**	**ESC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective

1. To build software development skills using C++ programming for real-world applications.
2. To understand and apply the concepts of classes, packages, interfaces, arraylist, User defined Linked List, File Handling, exception handling andMulti-threading.

List of Experiments

Lab No 1: Basic Programs in C++.
Lab No 2: Programming Assignments on Arrays and Strings.
Lab No 3: Programming Assignments on Classes, Objects and Encapsulation.
Lab No 4: Implementing the concepts of Inheritance and Array Objects.
Lab No 5: Implementing the OOPS Concepts of Abstract, Interfaces and Polymorphism.
Lab No 6: Programming Assignments on File Handling.
Lab No 7: Programming Exercises on Exception Handling.
Lab No 8: Working with List Operations.
Lab No 9: Implementing the concepts of Multi-Threading.

Course Outcomes

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

CO 1	Understanding the control structures and conditional statements in C++
CO 2	Understanding the arrays and String handling in C++
CO 3	Understanding the difference between class and object and providing security for objects
CO 4	Understanding the reusability of objects and working with multiple objects
CO 5	Understanding about hiding the data, getting multiple inheritance through Interfaces
CO 6	Understanding the data processing from files
CO 7	Understanding about handling run time abnormal program executions
CO 8	Understanding about creating user defined linked list and dynamic objects
CO 9	Understanding the multi-threaded programming and inter thread Communication

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab Project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING SECOND YEAR: SEMESTER-I

20EC1285	**Computational Laboratory**	**ESC**	**0L: 1T: 3P**	**2.5 credits**

Course Learning Objective

List of Experiments

Exercise 1: Python as a tool for computation
Exercise 2: Python for signal processing
Exercise 3: Introduction and familiarization with MATLAB tool
Exercise 4: MATLAB for signal processing and other applications
Exercise 5: Utilisation of Scilab

Learning Resources

Textbooks

1. J.MichaelFitzpatrickandAkosLedeczi,*'ComputerProgrammingwithMATLAB'*, Wordpress
2. Hanspeterlangtangen,'PythonscriptingforComputationalScience',Springer publications

Reference books

1. MiszaKalechman, *'Practical MATLAB-Basics for Engineers'*, CRC Press.
2. Burkhard A.Meier, 'Python GUI Programming cookbook'. PACKT publications

Web Resources

1. J. Michael Fitzpatrick and AkosLedeczi, *'Introduction to Programming with MATLAB'*. URL:https://www.coursera.org/learn/matlab
2. Dr Sudarshan Iyengar, NTEL-IIT Ropar, *'Joy of Computing using Python'*. URL:https://www.nptel.ac.in/courses/106106182/
3. https://www.mathworks.com/academia/educators.html

Course outcome After the completion of this Laboratory course, the student will be able to

CO 1	To learn the MATLAB environment, python scripting and its programming Fundamentals
CO 2	Ability to write Programs using commands and functions
CO 3	Able to handle polynomials, and use 2D Graphic commands

CO 4	Able to understand perform operations on applications related todifferent Fields
CO 5	Able to perform simulation of a simple prototype design project in Electronics and communication and relevant fileds

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab Project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

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20EG1281	**English-I Laboratory**	**HSC**	**0L : 1T : 3P**	**2.5 credits**

Course objectives:

1. To facilitate computer-aided multi-media instruction enabling individualized and independent language learning
2. To sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm
3. To provide opportunities for practice in using English in day to day situations
4. To improve the fluency in spoken English and neutralize mother tongue influence
5. To train students to use language appropriately for debate, group discussion and public speaking

Course Content

UNIT-I: **(06 Contact Hours)**

Theory: An Ideal Family by Katherine Mansfield

Spoken Skills: Situational Dialogues – Role-play – Expressions in various situations – Self Introduction – Introducing others – Greetings – Apologies – Requests – Giving directions

UNIT-II: **(06 Contact Hours)**

Theory: Energy -Alternative sources of Energy

Panel Debate on "On-grid & off-grid support to public participation in the production of solar energy in India", Reading the Wikipedia content on "The Green New Deal". Reflective session on the prospects of "The Green New Deal in India"

Writing Skills: Letter Writing (Formal & Informal) and Hands on Session on Letter Writing

UNIT-III: **(06 Contact Hours)**

Theory: Transport - Problems & solutions

Group Discussion on "The Future of Bullet Trains in India"

PPT on "The Dedicated Freight Corridors & the Future of Indian Economy" – Introduction to Speech

Spoken Skills: Sounds – Vowels, Consonants and Diphthongs – Pronunciation Exercises (Basic Level)

UNIT-IV: **(06 Contact Hours)**

Theory: Technology - Evaluating technology

PPT on "3R: Reduce, Recycle, Reuse" - Solo Debate on "Can Block Chain Technology Mitigate the Issue of Cyber Crimes and Hacking?"

Presentation Skills: JAM –Description of Pictures, Photographs, Process, Talking about wishes, Information Transfer

UNIT-V: **(06 Contact Hours)**

Theory: Environment - Ecology versus Development

Listening Skills: Listening Activity on YouTube video on "Greening the Deserts" - Students' seminar on "Waste to Wealth: Examples from around the Globe".

UNIT-VI: **(06 Contact Hours)**

Theory: Industry - Selling products

Reading Skills: Reading the material on "4Ps: Product, Price, Place, and Promotion" Role play on "How to sell your product and services"

References:

1. Non – Detailed Text Book: Panorama – A Course on Reading published by Oxford University Press, India
2. English for engineers and technologists by Orient Black Swan
3. A Textbook of English Phonetics for Indian Students 2nd Ed T. Balasubramanian. (Macmillan), 2012.
4. Speaking English Effectively, 2nd Edition Krishna Mohan & NP Singh, 2011. (Macmillan).
5. A Hand book for English Laboratories, E.Suresh Kumar, P.Sreehari, Foundation Books,2011
6. English Pronunciation in Use. Intermediate & Advanced, Hancock, M. 2009. CUP
7. Basics of Communication in English, Soundararaj, Francis. 2012.. *New Delhi: Macmillan*
8. English Pronouncing Dictionary, Daniel Jones Current Edition with CD.Cambridge, 17th edition, 2011.

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

CO 1	Understand the issues affecting the economy and environment in India and across the globe
CO 2	Develop the instinct for problem solution
CO 3	Develop the ability to collect materials on various socio-economic-technological issues and prepare PPT for presentation
CO 4	Improving listening skills
CO 5	Inculcate speaking as a behaviour by repeated practice and exposure

Assessment Method:

Course Nature: THEORY + LABORATORY

Internal Assessment (40 Marks)	**External Assessment (**60 Marks)
Record Writing – 10 Marks	Reading Comprehension – 15 Marks
Attendance – 10 Marks	Writing – 30 Marks
Continuous Assessment (Listening – 10 Marks + Oral Presentations – 10 Marks)	Speaking (Viva-Voce) – 15 Marks

ENGINEERING FIRST YEAR: SEMESTER-II

20EC1201	Basic Electronics	PCC	3L: 1T: 0P	4 credits

Course Learning Objectives

1. To make the students understand the fundamentals of Electronic Devices and Circuits.
2. To design simple Electronic circuits understanding the concept of design specification and designrequirements.

Course Content

Unit-I **(6 hours)**

Introduction

Intrinsic and Extrinsic semiconductors, Fermi Level in Intrinsic and Extrinsic semiconductors. Mobility and conductivity, Diffusion currents and drift currents, Injected minority carrier charge, contact potential, currents in forward and reverse biased junction.

Unit-II **(10 hours)**

Diodes

The open circuited p-n Junction, Current components in a p-n diode, Volt-Ampere characteristics (Forward Bias and Reverse Bias and temperature dependence of the V/I characteristic, Diode Resistance (Static and Dynamic), Diode as a circuit element ,diode models, Load line concept, Small signal analysis of diode, Transition capacitance and Diffusion capacitance, Junction diode switching times; Zener diodes, Zener breakdown and Avalanche breakdown, Zener voltage regulator and itslimitations.

Unit-III **(10hours)**

PN Diode Applications

Half Wave, Full wave and Bridge rectifiers (their operation, performance calculations), with Filters (RC, LC, RLC), Ripple factor calculations, Clippers (two level) Transfer characteristics, clampers; Diode as a switch; Diode as a analog gate, Voltage Multipliers (Doubler andTripler).

Unit-IV **(18 hours)**

MOSFETs

MOS capacitor, MOSFET construction, Types of MOSFET (Enhancement type and Depletion type), derivation of current equation, Regions of operation, second order effects

(Channel-length modulation, body effect), MOSFET characteristics and operating point including load line analysis, MOSFET as a switch (inverter). Biasing of a MOSFET.

Unit-V **(8 hours)**

BJT Characteristics

BJT construction, Transistor Junction formation (Collector-Base, Base-Emitter Junctions), Current components; Modes of Transistor operations; Early Effect, BJT input and output characteristics in different configurations, BJT as an inverter.

Unit-VI **(8 hours)**

Transistor Biasing and Stabilization-BJT

Biasing techniques-different types of biasing , Transistor as an amplifier, Thermal runaway, heat sinks, Thermal stabilization, Operating point stabilization against temperature and device variations, Stability factors, Bias stabilization and compensation techniques.

Learning resources

Text book

1. Jacob Milliman, Christos C. Halkias,and Satyabratajit, *'Electronic Devices and Circuits'* McGraw Hill, 3rd Edition,2012.
2. David A.Bell, *'Electronic Devices and Circuits'*, Oxford University Press, 5th edition,2008.

Reference Books

1. Ben G.StreetMan, Sanjay Kumar Benerjee, *'Solid State Electronic Devices'*,6th edition.

Web Resources

1. Prof K Radhakrishna Rao, NPTEL-IIT Madras, *'Electronics for Analog Signal Processing-I'*. URL:https://nptel.ac.in/courses/117106087/
2. Dr. Mahesh B Patil, NPTEL-IIT Bombay, *'BasicElectronics'*. URL: https://nptel.ac.in/courses/108101091/
3. Dr. ChitralekhaMahanta,NPTEL - IIT Guwahati, *'BasicElectronics'*, URL: https://nptel.ac.in/courses/117103063/

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

CO 1	Apply the knowledge of basic semiconductor physics and understand the working principles
CO 2	Analyze the characteristics of various electronic devices like diodes, transistor Etc
CO 3	Classify and analyze the various circuit configurations of transistor and MOSFETs
CO 4	Designing circuits for different applications using diodes
CO 5	Analyze the concept of stability and biasing of transistors
CO 6	Troubleshooting circuits which utilizes diodes, transistors

Assessment Method

Assessment Tool	Weekly tests/Assignments (In semester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING FIRST YEAR: SEMESTER-II

20EC1281	Basic Electronics Laboratory	PCC	0L: 0T: 3P	1.5 credits

Course LearningObjective

To get a hands-on experience on the concepts present in Basic Electronics Theory course and thereby developing practical knowledge in analysis of electronic circuits using Diodes, BJTs andMOSFETs

List of Experiments

1. Introduction to Lab Components and Electronicinstruments.
2. Soldering/De-soldering of components onPCB.
3. Characteristics of PN junction Diode, ZenerDiode.
4. Characteristics of LED,Photodiode.
5. Design of voltage regulators using ZenerDiodes.
6. Design of Half wave Rectifier, Full wave, Bridge wave rectifier with and without LC, RC filters.
7. Design and analysis of Clippers andClampers.
8. Design and analysis of VoltageMultipliers.
9. Design and analysis of analog gate and digitalgates.
10. Transfer characteristics ofMOSFETs.
11. Characteristics of Common Base, Common Emitter, Common collector configurations of BJTs.`1
12. Stability analysis and biasing of BJTCircuits.
13. Termproject.

Note: It is mandatory to perform experiment on any one of the EDA Tools before the experiment is performed on hardware. All experiments must be unique, design specifications should not be common in thelab.

Course outcome:

After the completion of this Laboratory course, the student will be able to

CO 1	Experimental verification of transfer characteristics of diodes and transistors
CO 2	Design voltage regulators using diodes
CO 3	Design multilevel clippers and clampers using diodes
CO 4	Design and troubleshooting circuits which utilizes diodes
CO 5	Experimental analysis of different configurations of transistor circuits

CO 6	Design of BJT circuits considering stability and biasing practically
CO 7	Implementing and analysing a practical prototype of Diode/BJT application

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ	*Term Projectand Viva-Voce	End SemesterLab Exam	Total
Weightage (%)	15%	15%	30%	40%	100%

*Term Project may be performed either on hardware or on any EDA tool (LT spice preferred) platform.

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING FIRST YEAR: SEMESTER-II

20EE1211	**Network Theory**	**BSC**	**3L: 1T: 0P**	**4 credits**

Course Learning Objective

1. To make the students capable of analyzing any given electricalnetwork
2. To equip students with network analysis tools like two port networks, Laplace transformations, and transientanalysis.

Course Content

Unit-I **(10hours)**

Basic concepts of Networks

Ohm's Laws and Kirchhoff's Laws, Open circuit and Short circuit, Current and Voltage division rule, Network Reduction Techniques Series, Parallel, Series Parallel, Star to- Delta or Delta-to-Star Transformations, Nodal Analysis and Mesh Analysis. Network theorem and applications. (Both Independent & Dependentsources).

Unit-II **(10 hours)**

Transient analysis of First order Circuits

Initial conditions (analysis & Problems) Natural and forced response of RL , RC Circuits, Transient analysis with different Excitations viz Step, Impulse and Sinusoidal.

Unit-III **(10 hours)**

Transient analysis of Second order Circuits

Initial conditions (analysis & Problems) Natural and forced response of RLC Circuits, Transient analysis with different Excitations viz Step and Sinusoidal.

Unit-IV **(10hours)**

Circuit Analysis Using Laplace Transform

Introduction to Laplace transform, Circuit element models, Circuit Analysis using Laplace-examples, Transfer functions, Solution of circuit differential equations using Laplacetransforms.

Unit-V **(12 hours)**

Two Port Network parameters.

Relationship of two port variables, Open circuit Impedance parameters, Short circuit Admittance parameters, Transmission Parameters, Hybrid Parameters, Relationship between parameter sets, Reciprocity and Symmetry, Interconnection of two port networks, ReciprocityTheorem.

Unit-VI **(8 hours)**

State Space Models For Electrical Networks

Concept of state, State equations, Equivalent source method, State space model and evaluation of state transition matrix, Application to electrical networks.

Learning Resources

Text Books

1. Charles K Alexander, Matthew N O Sadiku, '*Fundamentals of ElectricCircuits* ', McGrawHill – 5th edition.
2. William H. Hayt, Jack Kemmerly, Steven M. Durbin, *Engineering Circuit Analysis'*,TataMcgraw – Hill, 8th edition.

Reference Books

1. Valkenburg M.E. Van, *'Network Analysis*' , PrenticeHall.
2. N. C Jagan, CLakshmi Narayana, *'Network Theory'*, BSPublications

Web Resources

1. Prof S.C Dutta Roy NPTEL-IIT DELHI, '*CircuitTheory'*
   URL: https://nptel.ac.in/courses/108102042/
2. Prof T K Basu, NPTEL-IIT Kharagpur, *'Networks, Signals and Systems*'
   URL:http://nptel.ac.in/courses/108105065/

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

CO 1	Analyze the electric circuits using network theorems
CO 2	Deduce transient response for circuits
CO 3	Apply Laplace transformations for solving electric circuits problems
CO 4	Apply graph theory to obtain network theory solutions
CO 5	Analyze electric circuits using two port networks and relevant theorems
CO 6	Apply state space models for electric circuits

Assessment Method

Assessment Tool	Weekly tests/Assignments (in a semester)	Monthly tests (in a semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING FIRST YEAR: SEMESTER-I

20EC1203	**Signals and Systems**	**PCC**	**3L: 1T: 0P**	**4 credits**

Course Learning Objectives

1. To understand the fundamental characteristics of signal andsystems.
2. To understand signal and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspective provide.
3. To develop mathematical skills to solve problems involving convolution, filtering, modulation and sampling.

Course content

Course content

Unit- I **(10hours)**

Mathematical representations of a signal, Common signals in Engineering: Exponential and Sinusoidal signals, singularity functions- unit impulse function, unit step function , Transformations of the independent & dependent variables, size of a signal, absolutely integrable & square integrable functions, Characterization & Classification of Signals, Modeling of systems: input-output description, typical examples of systems, Characterization, Classification and properties of systems, Interconnections ofsystems

Unit- II **(10hours)**

System Response to Internal Conditions, The representation of CT signals in terms of impulses, the CT unit impulse response, system response to external input: convolution for CT LTI systems, Properties of Convolution, Properties of CT LTI systems: memoryless systems, stability, invertibility, causality; unit step response, Differential equation models & Solution of differential equations: Natural & Forced responses, ZIR & ZSR, stability in terms of natural response, System response to complex exponentialinputs

Unit-III **(12hours)**

Signals and Vectors, Signal comparison: correlation, Signal representation by orthogonal signal set, Trigonometric Fourier series, Wave Symmetry, exponential Fourier series, Convergence of the Fourier series and Gibbs Phenomenon, frequency spectra, Properties of Fourier series, Power representation using Fourier series, LTI system response to periodic inputs.

Unit-IV **(10hours)**

Development of CTFT of an aperiodic signal, Convergence of CTFT, CTFT of some useful functions, Magnitude and Phase representation of CTFT, The CTFT of periodic signals, Properties of CTFT, Frequency spectra of signals, Signal bandwidth, System bandwidth, Frequency response of LTI systems, Energy and Power DensitySpectra.

Unit-V **(12hours)**

The Laplace Transform, Region of Convergence, Laplace transform of elementary functions, Properties of Laplace Transform, The Inverse Laplace Transform, Response of LTI systems, System Functions, Relationship between Laplace Transform and Fourier Transform, Solution of differential and Integro-Differential Equations

Unit-VI **(6 hours)**

Periodic sampling, Sampling theorem, Pre filtering to avoid aliasing, Frequency domain representation of sampling, Reconstruction of a band limited signal from its samples**,** Sampling of band pass signals**.**

Learning Resources

Text Books

1. Alan V Oppenheim, Alan V Willsky, S. Hamid Nawab, '*Signals and Systems*', 2nd edition, Pearson/PHI,2015
2. B P Lathi, '*Principles of Signal Processing and Linear Systems*', 1st edition, Oxford University press,2009

Reference Books

1. SimonHaykin,VanVeen,'*Signals&Systems*',2ndEdition,WileyPublications,2007.
2. MahamoodNahvi,'*SignalsandSystems*',McGrawHillPublishers,1stedition,2015.

Web Resources

1. Prof. Alan V. Oppenheim, Massachusetts Institute of Technology (MIT), '*Signals and System*'URL: https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/
2. Prof. K S venkatesh, NPTEL- IIT Kanpur, '*Signals andSystems* ' URL: http://nptel.ac.in/courses/117104074/
3. Prof. V.G.K. Murti, NPTEL- IIT Madras, '*Networks andSystems* ' URL: http://nptel.ac.in/courses/108106075/

Course outcomes

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

CO 1	Analyze the spectral characteristics of continuous-time periodic and aperiodic signals using Fourier analysis.
CO 2	Classify systems based on their properties and determine the response of LSI system using convolution.
CO 3	Analyze system properties based on impulse response and Fourier analysis.
CO 4	Apply the Laplace transform for analyze continuous-time and discrete-time signals and systems.
CO 5	Understand the process of sampling and the effects of under sampling.

Assessment Method

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING SECOND YEAR: SEMESTER-I

20MA2101	**Probability and Random variables**	**BSC**	**2L: 1T: 0P**	**3 credits**

Course Learning Objectives:

1. To provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in signal processing and Communication Engineering
2. To introduce students to the basic methodology of "probabilistic thinking" and to apply it to problems.
3. To understand basic concepts of probability theory and random variables, how to deal with multiple random variables, Conditional probability and conditional expectation, joint distribution and independence, mean square estimation.
4 To understand the difference between time averages and statistical averages.
5. Analysis of random process and application to the signal processing in the communication system.
6. To teach students how to apply sums and integrals to compute probabilities, means and expectations.

Course Content:

Unit - I **(08 Contact hours)**

Probability introduction through Sets and Relative Frequency, Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Probability as a Relative Frequency, Joint Probability, Conditional Probability, Total Probability, Baye's Theorem and Independent Events.

Unit - II **(07 Contact hours)**

Definition of random variable, discrete and continuous random variables, independent random variables. Distribution function and its properties, probability mass function, probability density function and their properties. Expectation of a random variable and its properties. Variance of a random variable and its properties. Definition of bivariate random variable, discrete and continuous bivariate random variables, distribution function of a bivariate random variable , conditional probability mass function and conditional probability density function.

Unit-III **(10 Contact hours)**

Discrete distributions: Bernoulli, Binomial, Poisson, Negative Binomial, Geometric and hyper geometric distributions (Find their mean, variance and problems). Continuous distributions: Uniform, Exponential, Normal, Beta and Gamma distributions

Unit-IV:Functions of Random variables: (5 Contact hours)

Functions of one Random variable, functions of two independent random variables, Covariance, Correlation coefficient (Karl Pearson), Bi-Variate Normal Distribution.

Unit – V (07 Contact hours)

Markov's inequality, Chebyshev's inequality and Cauchy-Schwartz's inequality (with proofs). Generating functions: Moment generating function (M.G.F) and its properties, characteristic functions (C.F) and its properties, Cummulant generating function (C.G.F) and its properties, probability generating function (P.G.F) and its properties.

Unit – VI (08 Contact hours)

Order statistics, Sequence of Random Variables, Convergence of a Sequence of Random Variables, Convergence Theorems: WLLN (weak law of large numbers), SLLN (strong law of large numbers) and Central limit theorem.

Learning resources

Text book:

1. Peyton Z. Peebles,'*Probability, Random Variables & Random Signal Principles'*,TMH, 4Edition, 2001.

Reference Books:

1. George R. Cooper, Clave D. MC Gillem, '*Probability Methods of Signal and System Analysis',* Oxford,3 Edition,1999 .
2. S.P. Eugene Xavier, '*Statistical Theory of Communication'*, New Age Publications, 1997.
3. Athanasios Papoulis and S. Unnikrishna Pillai', *Probability, Random Variables and Stochastic Processes*', TMH, 4th Edition,.

Web resources:

1. https://nptel.ac.in/courses/117105085/
2. https://nptel.ac.in/courses/111106112/
3. https://nptel.ac.in/courses/111102111/
4. RGUKT Course Content

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

CO 1	Apply Simple probabilities using an appropriate sample space.
CO 2	Apply Simple probabilities and expectations from probability density functions.
CO 3	Apply problem-solving techniques to solving real-world events.
CO 4	Apply selected probability distributions to solve problems

CO 5	Apply Mean and covariance functions for simple random processes.
CO 6	Interpret and clearly present output from statistical analysis.

Probability and Stochastic Process		**Theory**		
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weight age (%)	10%	30%	60%	100%

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ENGINEERING SECOND YEAR: SEMESTER-I

20EC2185	**Internet of Things Lab**	**ESC**	**0L: 0T: 3P**	**1.5 Credits**

Course Learning Objectives

1. To assess the vision and introduction ofIoT.
2. To understand IoT Marketperspective.
3. To implement Data and Knowledge Management and use of Devices in IoT Technology
4. To indulge in designing of prototype hardware for different IoTapplication

Course Content

Exercise – I

Introduction & Overview of Internet of things

The Internet of things today and tomorrow, IoT architecture outline , Functional blocks of IOT , industrial IOT, IOT enabled Smart devices in market, Application areas for IOT, Challenges in IOT. Hardware and Software tools required for IOT application development, Overview of IOT based on Particle Hardware platforms and IDE's for development.

Exercise - II

Exploring the arduino board and its software IDE

The Arduino board, The command area, text area and message window area. Setup function, Controlling the hardware, loop functionality, verifying your sketch, uploading andrunningyoursketchandfinallymodifyingyoursketchaccordingtoyourrequirement.

Exercise - III

Introduction to sensors and displays

Interfacing sensors to Arduino boards about the sensor, the circuit connections, sketch (software program), Application.And interfacing displays to arduino board

Exercise - IV

Communication

Wireless communication, introduction to Bluetooth module, interfacing to Arduino in both one way communication and two way communication, controlling an LED in wireless mode, interfacing wifi module with arduino controlling things by using local network.

Exercise - V

Introduction to NodeMCU (ESP32 Wi-Fi SoC)

Controlling the things with Nodemcu using wifi communication in both ways and interfacing nodemcu with various peripheral devices. Compare Esp8266 with otherarduino boards

Exercise ~~V~~I

Introduction to Cloud platforms

IOT device to cloud storage communication Model, need of Cloud services in IOT, different Cloud storage services available today, Cloud Data processing and frame format, Role of Smart phones in IOT, Examples on Home automation and Smart city development, Introduction to clouds like Temboo, Blynk, Pubnubetc.

Exercise -VII

Introduction to GSM, GPS Module

Interfacing Arduino (uno) with Gsm, Module 2G communication and interfacing GPS module for tracking location.

Exercise ~~V~~III

Interfacing to External devices

Interfacing Arduino with External storage, Ex: SD card (reading,writing)Handling Interrupts and memory management and Ethernetcommunication.

Exercise ~~I~~X

Introduction to Rasberry pi

Features, Comparison with Arduino, Hardware details and Programming.

Exercise ~~X~~

App Inventor

Create apps with coding, Designing apps and interfacing with Arduino.

Exercise ~~X~~I

Any one of the project from the list below

Project -I

1. Home Automation with blue tooth and wifi and controlling the things with Mobile Apps
2. Designing water levelcontroller.

Project -II

1. Designing women safety system with GPS and GSMmodule
2. Designing secured car parking system using GPS and GSMmodule

Project -III

1. Uploading sensor information to cloud, operating andMonitoring
2. Designing Smart Hospital with IoTdevices.

Learning resources

Text Books:

1. Cuno Pfister, 'Getting started with the Internet of Things: Connecting sensorsand Microcontrollers to the Cloud', O'Reilly Media Inc. Publications
2. Daniel Kellmereit, Daniel Obodovski, 'The Silent Intelligence: The Internet of Things', DND Ventures LLC Publications

Reference Books:

1. Pethuru Raj and Anupama C. Raman , '*The Internet of Things: Enabling Technologies, Platforms and use cases ,*' CRCPress
2. Arshdeep Bahga and Vijay Madisetti, *'Internet of Things: A hands-onapproach* ', Universities Press

Web resources:

1. Prof Sudip Misra, NPTEL-IIT Kharagpur, *'Introduction to Internet of Things'*
URL: https://nptel.ac.in/courses/106105166/

Course outcomes: At the end of the course, the student will

CO1	Understand and analyze concepts of Internet of Things
CO2	Familiar with arduino board and its software
CO3	Interfacing sensors with arduino board and its working
CO4	Analyze basic protocols in wireless sensor network
CO5	Understand NodeMCUarduino board for global communication
CO6	Understand cloud platform to operate our devices through controller
CO7	Design IoT applications in different domain and be able to analyze their performance

Assessment Method:

Assessment Tool	(Internal Exam) Hardware Project submission	End Semester Lab Examination	Total
Weightage (%)	40%	60%	100%

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ENGINEERING SECOND YEAR: SEMESTER-I

20EC2101	**Analog Electronic Circuits**	**PCC**	**3L: 1T: 0P**	**4 credits**

Course Learning Objective

To make the students understand the concept of amplifier designs using BJTs and MOSFETs and comparison between similar designs

Course content

Unit-I **(10 hours)**

MOSFET Biasing and Its Small Signal Analysis

Regions of operation of MOSFET, Biasing, Large signal and Small signal models, Channel length modulation, Design of MOSFET amplifier in Common Source, Common Gate and Common Drain configurations. Calculating small signal resistances of different MOSFETcircuits.

Unit-II **(12 hours)**

Multi-Stage Amplifiers & Differential Amplifiers of MOSFET

Cascade Amplifiers, Millers theorem, and Cascode amplifiers, Frequency Analysis of Multi Stage Amplifiers, Calculation of lower & higher cutofffrequencies.

Operation of Differential Amplifier, Transfer characteristics of Differential amplifier, Biasing of Differential amplifiers, MOSFET differential amplifiers using resistive loads, Calculations of Differential gain, Common mode gain and CMRR. Step response of a Differential amplifier.

Unit-III **(8 hours)**

Current mirrors in MOSFETs

Design of various configurations MOSFET (CS,CG,CD) amplifiers using current mirrors. Design of a differential amplifier with MOSFET using active load using current mirrors. Design of Single stage and two stage opamp.

Unit-IV

CMOScircuits **(12hours)**

NMOS and PMOS inverter, NMOS inverter using active load; CMOS inverter, Pull up networkandPulldownnetwork(PUNandPDN),logicgatesusingCMOS,staticpower

and dynamic power, noise margin. Pass Transistor Logic, Transmission gates. Bistability principle, Latches, Flip flops.

Unit-V **(8hours)**

BJT- Configurations and Multi stage amplifiers

BJT - small signal analysis, Comparison between Large signal models and small signal models. and amplification and small signal resistances in different configurations (CE,CB and CC) and multi stage amplifiers.

Unit-VI **(10hours)**

BJT- Differential amplifiers and Current mirrors

Design of various configurations BJT (CE,CB and CC) amplifiers using current mirrors. Design of a differential amplifier with BJT using active load using current mirrors. Design of Single stage and two stageopamp.

Learning Resources

Textbooks

1. Behzad Razavi, '*Fundamentals of Microelectronics*',WileyPublications
2. Sedra and Smith, *'Microelectronics Circuits'*, Oxford Publications,6thEdition.

Reference Books

1. Boylestad R. L. and L. Nashelsky, *'Electronic Devices and Circuit Theory'*, 10/e or 11/e, Pearson, 2009.
2. Millman J. and C. Halkias, *'Integrated Electronics'*, 2/e, TMH,2010.
3. Neamen D., *'Electronic Circuit Analysis and Design'*, 3/e, TMH,2006
4. Spencer R. R. and M. S. Ghausi, *'Introduction to Electronic Circuit Design'*, Pearson, 2003

Web Resources

1. Prof.K.Radhakrishna Rao, NPTEL-IIT Madras, *'Electronics for Analog signal processing - I'*, URL:http://nptel.ac.in/courses/117106087/

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

CO 1	Understand the small-signal analysis and large-signal model for BJT circuits
CO 2	Design of BJT and MOSFET amplifiers in different configurations
CO 3	Design and analyze of multi-stage amplifiers
CO 4	Design and analyze differential amplifiers with active and passive loads

CO 5	Design and analyze feedback amplifiers in different configurations
CO 6	Use these engineering abstractions to analyze and design simple electronic circuits using EDA tools

Assessment Method

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING SECOND YEAR: SEMESTER-I

20EC2181	**Analog Electronic Circuits Laboratory**	**PCC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective

To make understand the concept of single stage and multistage amplifier design using BJTs andMOSFETs

List ofExperiments

1. Characterization ofMOSFET.
2. Design and Analysis of Single stage amplifier usingMOSFETs
   i. Common Source configuration.
   ii.Common Gate configuration.
   iii.Common drainconfiguration.
3. Design and Analysis of Multi Stage Amplifier usingMOSFETs
   i. Cascade Amplifier.
   ii.CascodeAmplifier.
4. Design of amplifiers using Currentmirrors.
5. Design and analysis of Single stage amplifier usingBJTs
   i. Common Emitter Configuration.
   ii.Common Collector Configuration.
   iii.Common BaseConfiguration.
6. Differential amplifiers with passive load (Designing a specified value of CMRR).
7. Step response of a differential amplifier and designing for a risetime.
8. Single tuned amplifier design.
9. Design of Class-B poweramplifier.
10. Design, build and test Public addressingsystem.
11. TermProject.

Note: It is mandatory to perform experiment on any one of the EDA Tools (LT spice tool) before the experiment is done on hardware. All experiments must be unique, design specifications should not be common in the lab

Course outcome

After the completion of this Laboratory course, the student will be able to

CO 1	Determine the characteristics BJT amplifiers in CE,CB,CC configurations
CO 2	Determine the characteristics of MOSFET amplifiers inCS,CG,CD configurations
CO 3	Determine the characteristics of Cascade and Cascodeamplfiers
CO 4	Designing feedback amplifiers with different configurations
CO 5	Design of differential amplifiers with active and passive loads
CO 6	Design and testing of public addressing system
CO 7	Design of a simple electronic circuit which uses multistage amplifiers

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING SECOND YEAR: SEMESTER-I

20EC2102	**Digital Logic Design**	**PCC**	**3L: 1T: 0P**	**4 credits**

Course Learning Objective

1. To discuss the concepts of Number systems and representations used in the computers, combinational design, sequential designs and complete system design at gate-levelabstraction
2. To discuss the important features of IC design like area, power anddelay.
3. To design a simple digital system at gate-level as per the designspecifications.

Course Content

Unit-I **(6hours)**

Number systems-Representations-Conversions, Boolean constants and variables, basic gates: operation and truth tables, describing logic gates algebraically, evaluating logic circuit outputs, implementing circuits from Boolean expressions, universality ofgates, Boolean theorems, Demorgan's theorems, alternate logic gate representations, I EEE/ANSI standard logic symbols.

Unit-II **(12 hours)**

Combinational circuit minimization using Boolean laws and Karnaugh maps, multi-level synthesis, timing hazards, logic levels and noise margins, Fan-out, Fan-in. Single bit adders and subtractors, multi-bit adders, BCD adder, multi-bit subtraction using adders, signed multiplier, unsigned multiplier, code converters, parity bit generators/checkers, magnitude comparator. Delay, Area and Power analysis in combinational circuit designs. Conversion of real-time statements into Boolean expressions and design of gate-level logic circuits.

Unit-III **(10 hours)**

Bistable elements, Latches and Flip-flops:S- R latch , S' – R' Latch, S R latch with enable, D latch, Race-around condition and elimination methods. Edge triggered D flip flop, Edge triggered D flip flop with asynchronous inputs, master-slave flip-flop, edge triggered J-K flip-flop with asynchronous inputs, T flip-flops. Excitation tables, Characteristicequations. Flip-flop timing consideration: set-up time, hold-time discussion using positive edge-triggered D-Flip flop.

Unit-IV **(14 hours)**

Frequency division and counting. Design and analysis of asynchronous counters, Delay considerations and limitations on maximum clock frequency, Design and analysis of synchronous counters. BCD counter, Ring counter, Johnson counters. State diagram overview (Present States, Next states, Present outputs, Present inputs). Serial / Parallel data transfer registers: PIPO register, SISO register, PISO register, SIPOregister.

Unit-V **(10hours)**

Decoders: Binary decoder, synthesis of logic functions using decoders, cascading binary decoders, seven-segment decoders, applications.

Multiplexers: synthesis of logic functions using multiplexers applications.

Demultiplexers: Realization, 1-4 and 1-8 line demultiplexers, demultiplexer tree. Encoders: Priority encoders. Implementation of functions using programmable logic devices: PAL, PLA,PROM.

Unit-VI **(8hours)**

Memory Structure and Timing: Static RAM, Dynamic Ram. Architecture: CPLD, FPGA Design and analysis of Digital circuits: Digital Clock, Digital calendar, Traffic light controller, Mobile number sequence generators and other relevant topics

Learning Resources

Text books

1. Ronald J Tocci, Neal S.Widmer, Gregory L.Moss, *'Digital systems'* Pearson10th edition.
2. John F.Wakerly, *'Digital Design'* , Pearson 4thedition

Reference books

1. Stephen Brown, ZvonkoVranesic, *'Fundamentals of Digital Logic with Verilog Design'*, TMH, 2ndedition.

Web Resources

1. Prof. Shankar Balachandran, NPTEL-IIT Madras, *'Digital Circuits &Systems'*
   URL: https://nptel.ac.in/courses/117106114/
2. Prof. S Srinivasan, NPTEL-IIT Madras, *'Digital Circuits andSystems'*
   URL: https://nptel.ac.in/courses/117106086/

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

CO 1	Apply the knowledge of simplification in obtaining optimal digital circuits
CO 2	Study and examine the SSI, MSI, LSI and Programmable elements
CO 3	Analyse the operation of synchronous and asynchronous state machines
CO 4	Design any combinational or sequential digital circuits to meet the given specifications
CO 5	Analyze any digital circuit and to debug such circuit
CO 6	Prototype a real time application on EDA tool

Assessment Method

Assessment Tool	Weekly tests/Assignments (in a semester)	Monthly tests (in a semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING SECOND YEAR: SEMESTER-I

20EC2182	**Digital Logic Design Laboratory**	**PCC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective

1. Expose the student to the concepts of Digital System Design and itsapplications
2. To understand the practical aspects of combinational and sequential circuitdesign
3. To design a prototype digital logic designsystem

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List of Experiments

1. Familiarization with l ogicgate, v0ltage-levels understand the concept of noise- margin. Troubleshooting digitalcircuits.
2. Design of code converters and comparators (8-bit) on breadboard.
3. Adder related experiments: Half adder , full adder , half subtractor, full subtractor , ripple carry adder, BCD adder, carry look ahead adder usingIC.
4. Design of a binary multiplier and displaying its inputs and outputs on seven segment displayunit.
5. Design and verification of SR, JK, D, T latch/flip-flops. Verification and elimination of Race AroundCondition.
6. Flip-flop conversions and Design of frequencydividers.
7. Design of synchronous counters (Up and Down) and displaying result on seven segment displayunit
    a. Design of Mod n counter design (total 8 states, design of mod6and mod7 with clear).
    b. Design and IC verification of Decadecounter.
    c. Cascading of counters.
8. Synchronous counter design and displaying result on seven segment displayunit
    a. Randomsequence.
    b. Ring counter/Johnsoncounter.
9. Familiarization with multiplexer, decoder, encoder. Design of Half adder, full adder, magnitude comparator and other examples using above familiarizedcomponents.
10. Design of a mobile number sequence generator in synchronous state machine design and in asynchronous state machinedesign.
11. Design of a digital clock in synchronous state machine design and in asynchronous state machinedesign.
12. Design ofgate-levelcircuit for generation of 2's complement, 1's complement and sign-magnitude form of a given 4-bit signed number.

13. Design and submission of termproject

Note:

1. It is mandatory to perform experiment on any one of the EDA Tools (Multisim) before the experiment is done on hardware. All experiments must be unique, design specifications should not be common in thelab

Course outcome: After the completion of this Laboratory course, the student will be able to

CO 1	Understand the practical aspects in working of discrete digital components
CO 2	Utilize the ICs of Decoder, Multiplexer, Seven segment display unit in combination circuit design
CO 3	Utilize the ICs of suitable Flip-flops in sequential circuit design
CO 4	Utilize the Programmable Logic devices in digital design
CO 5	Understand the concepts of setup time, hold time, propagation delays
CO 6	Design circuits with optimal features of Area, Power and delay
CO 7	Design and implement prototypes of complete digital systems

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ	*Term Projectand Viva-Voce	End SemesterLab Exam	Total
Weightage (%)	15%	15%	30%	40%	100%

*Term Project may be hardware implementation or on EDA (Multisim) platform

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ENGINEERING SECOND YEAR: SEMESTER-I

20EC2103	**Digital Signal Processing**	**PCC**	**3L: 1T: 0P**	**4 credits**

Course Objective

1. To understand the mathematical approach to manipulate discrete time signals, which are useful to learn digitaltelecommunication
2. To study the transformations on digitalsignals.
3. To understand the concepts of digitalfilters

Course Content

UnitI **(10hours)**

Introduction

A basic review of Signals and Systems, Basic elements of digital signal processing, Time domain representation of discrete time signals, Basic Operations on sequences including Sampling rate alteration, Classification of sequences. Discrete time systems, Time domain characterization of LTI DTS: Convolution sum, Impulse & Step Responses, Simple Interconnection schemes, Linear Constant Coefficient Difference Equations (of Finite-dimensional LTI DTS), Classification of LTI DTS: FIR & IIR, Recursive, & Non- recursive.

Unit-II **(10 hours)**

Discrete Time Fourier Transform (DTFT)

Introduction, Fourier Transform Representation of aperiodic Discrete-Time Signals, Periodicity-convergence of DTFT, Properties of DTFT, Signal Transmission Through LTISystems,IdealandPracticalFilters,energyspectralDensity,PowerspectralDensity.

Unit-III **(12 hours)**

Discrete Fourier Transform (DFT)

Sampling of DTFT, Discrete Fourier Transform(DFT) and its Inverse, DFT as a Linear Transformation, Properties of DFT, Linear Convolution Using the DFT, Filtering of Long Data Sequences Using DFT, Spectrum analysis Using DFT.

Fast Fourier Transform (FFT)

Introduction ,Computational Complexity of the Direct Computation of the DFT , Decimation-In-Time (DIT) FFT Algorithm, Decimation-in-Frequency (DIF) FFT Algorithm and their comparison, Inverse DFT using FFT Algorithm, A LinearFiltering

Approach to Computation of the DFT-The GoertzelAlgorithm ,The Chirp-z Transform Algorithm

Unit IV **(10hours)**

Z-transforms

Introduction ,Bilateral (Two-sided) Z-transform , Relationship Between Z-transform and DTFT,Z-Plane, Region-of-Convergence for Z-transforms and their properties, properties of Z-transform, Z-Transform of Causal Periodic Signals, Inversion of the Z-transform, Analysis and Characterization of LTI Systems using theZ-transform.

The Unilateral (One-Sided) Z-transform, Properties of unilateral Z-Transform. Transient Response and Steady-State Response Block Diagrams Representation. Applications of Z-Transform in Signal Processing

Unit V **(8hours)**

Filter Concepts

Introduction, Frequency Response and Filter Characteristics, Zero-Phase Filter, Linear phase Filter, simple FIR and IIR Digital Filter, All pass Filters, Minimum-Phase, Maximum-Phase and Non-minimum (Mixed) Phase Systems, averaging filter, comb filter, Notch filter.

Unit-VI **(10 hours)**

Realization Of Digital Filters

Introduction, FIR Filter, IIR Filter, Non-recursive and Recursive Structures, FIR Filter Structures, Basic Structures for IIR Systems , Lattice Structures for FIR and IIR systems.

Learning Resources

Text Books

1. A.V.Oppenheim and R.W. Schaffer, *Discrete Time Signal Processing* , 3rd edition, Pearson Education/PHI,2014.
2. John G. Proakis,Dimitris G.Manolakis, *'Digital Signal Processing, Principles, Algorithms, and Applications ',* 4th edition, Pearson Education / PHI,2007

Reference Books

1. Sanjit K Mitra, *Digital signal processing: A computer base approach* ,4thedition, Tata McGraw Hill,2013
2. B.P.Lathi, Roger Green, *'Essentials of DigitalSignalProcessing'*, Cambridge University Press,2014

Video Reference Links

1. Prof Alan V. Oppenheim, OCW- Massachusetts Institute ofTechnology(MIT), 'Digital Signal Processing'.
   URL:https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/index.htm
2. Prof S C DuttaRoy,NPTEL-IIT Delhi, 'Digital Signal Processing'
   URL:http://nptel.ac.in/courses/117102060/
3. Prof T KBasu,NPTEL-IIT Kharagpur, 'Digital Signal Processing'
   URL:http://nptel.ac.in/courses/108105055/

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

CO1	Interpret ,represent and process discrete/digital signals and systems
CO2	Understand the spectral analysis of signals
CO3	Design &analyze DSP systems like FIR and IIR Filter etc
CO4	Familiarize with multirate signal processing
CO5	Familiarize with applications of Digital Signal Processing

Assessment Method

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING SECOND YEAR: SEMESTER-II

20EC2183	**Digital Signal Processing Laboratory**	**PCC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective

1. To perform experimental analysis on mathematical tools of Digital Signal Processing using MATLAB and also on Digital SignalProcessors
2. To associate Digital Signal Processing to real timeapplications

List of Experiments

Part A: Experiments using MATLAB

1. Generation of various Continuous-time and discrete-timesignals, Study of various basic operations on discrete time signals (both dependent & independent variables)
2. DTFT and DFT, DFT SpectralAnalysis
3. Sampling, Convolution, LTI systems, and DifferenceEquations
4. Difference Equations, z-Transforms, Pole-Zero Diagrams, BIBO Stabilityand
5. QuantizationEffects
6. FIR Filter Design
7. IIR FilterDesign
8. TermProject

Part B: Experiments Using DSP Processor

1. To perform the linear convolution and circular convolution of the two given discrete sequences
2. To implement the FIR filters that meet the givenspecifications
3. To implement the IIR filters that meet the givenspecifications
4. To analyze the real time audio signal and extract variousfeatures
5. To analyze an image and extract variousfeatures
6. TermProject

Note: Above experiments will be implemented on Raspberry Pi boards also with python programming.

Course outcome: After the completion of this course, the student will be able to

CO 1	Generate continuous and discrete time signals
CO 2	Matlab implementation of DTFT and DFT
CO 3	Matlab implementation of Sampling and Convolution on LTI systems
CO 4	Utilizing Z-transforms on signal analysis
CO 5	Design of FIR and IIR Filters using Matlab
CO 6	Analysis of real time audio signals and image extraction using DSP Processors
CO 7	Design and analysis of a prototype application using DSP processor and simulation of the same using Matlab

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING SECOND YEAR: SEMESTER-I

20EC2104	**Control Systems**	**PCC**	**3L: 0T: 0P**	**3 credits**

Course Learning Objective

1. To explore the modeling of linear dynamic systems via differential equations and transfer functions utilizing state- pace and input-outputrepresentations.
2. Analysis of control systems in the time and frequency domains and using transfer function and state-spacemethods.
3. Study of the classical stability tests, such as the Routh-Hurwitz and Nyquist criterions, and design methods using root-locus plots and Bodeplots.

Course content

Unit – I **(6 hours)**

Introduction-Open loop and closed loop control systems- Transfer functions- Block diagrams and their reduction - Signal flow graphs -Mason's gainformula.

Unit – II **(6 hours)**

Mathematical modeling and transfer functions of electrical circuits and mechanical systems. Principle and operation of Servomotors and Steppermotors.

Unit – III **(8 hours)**

Standardtestsignals,stepresponseoffirstandsecondordersystems – Time response specifications – steady stateerror – static error and generalized error coefficients – response with proportional, derivative and integralcontrollers.

Unit –IV **(8hours)**

Concept ~~c~~haracteristic equation loc~~a~~tion of roots in the s-plane for stability Routh-~~–~~Hurwitz criterion Root lo~~cus~~ rules for ~~th~~e construction of root locus- construction of root locus usingMATLAB/SIMULINK.

Unit –V **(8hours)**

Introduction-Bodeplots – Gain margin and Phase margin - Polar plots - Nyquist stability criterion – Need for compensators - Lag and lead compensators in frequencydomain.

Unit-VI **(9 hours)**

Concepts of state, state variables and state model, derivation of State models from block diagrams,Diagonalization ,Solving the Time invariant state Equation, state transition Matrixandi t' s Properties ,Concepts of Controllability andObservability.

Learning Resources

Text Books

1. B.C.Kuo, *'Automatic Control systems'*, John Wiley and Sons, 8th edition,2003.
2. K.Ogata, *'Modern Control Engineering'*, Prentice Hall of India Pvt. Ltd., 5th edition,2010.

References

1. I.J.Nagrathand M.Gopal, *'Control system*, New Age International (P) Limited Publishers,5thedition,2007.
2. Norman S. Nise, *'Control system engineering'*, Wiley India, 5th edition2000.

Video Reference links:

1. Prof.MadanGopal,NPTEL- IIT Delhi, '*Control Engineering'*, URL:http://nptel.ac.in/courses/108102043/
2. Prof. S.D. Agashe, NPTEL- IIT Bombay, '*ControlEngineering* ', URL: http://nptel.ac.in/courses/108101037/
3. Prof.MadanGopal,NPTEL- IIT Delhi, '*Control Engineering*', URL: http://nptel.ac.in/courses/108102044/

Course outcomes: At the end of the course, the students will be able to

CO 1	Analyze controllability and observability of linear systems.
CO 2	Design state-space controller and appropriate (deterministic) observer.
CO 3	Design controller with frequency design methods.
CO 4	Apply root-locus method for analysis and synthesis.
CO 5	Apply pole placement controller design approach.
CO 6	Design linear quadratic regulator for discrete-time systems.

Assessment Method

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING SECOND YEAR: SEMESTER-II

20EC2285	**Robotics Laboratory**	**ESC**	**1L: 0T: 3P**	**2.5 credits**

Course Learning Objectives:

1. To differentiate different types ofrobots.
2. To analyze the components of robots, sensors,actuators.
3. To be exposed to coordinate transformations, I/O logic, wireless and wired communication.
4. To explore the applications of Arduino and Raspberry pi forRobotics
5. To get familiarization with aerial robotics:Drones

Course Content:

Exercise- I

Introduction to Robotics

What is robot and robotics, already designed robots, Manual and Autonomous robots, Different types of industrial ARM robots, and arm design, Coordinate transformations for more motor moments, Electrical connections of different boards and modules: How to connect closed circuit, digital and analog pins connections.

Exercise-II

Logic design, Actuators and sensors

Logic and binary math conversions: OR, AND, XOR, XNOR gates, binary and hexadecimal conversions, Introduction to Arduino, Actuators, Sensors, Wired and wireless communication, I/O communication through USB cable, Bluetooth HC05, RF modules, DTMF module, Xbeemodules.

Exercise-III

Basic robots and Raspberry Pi

Line follower: Line follower robot design and control with Arduino board, Obstacles avoider: Obstacle avoider robot with IR sensors and Arduino board, Mobile controller: Mobile controller robot with DTMF module and HC05 module, Introduction to Raspberry pi: What is raspberry and differences between Arduino and raspberry pi, Applications of robotics.

Exercise – IV
Introduction to Aerial robots and Drones

List of Experiments:

1. Introduction to Robotics: Study of different parts of arobot.
2. Study of various aspects with respect to on-board sensors, actuators, drivers and other peripherals.
3. Familiarization with 8051, 8052 micro-controllerboard.
4. Familiarization with Arduino Boards along with ActuatorTesting.
5. Building Line FollowerRobot.
6. Enhanced Line Follower Robot design using state machines and coding for state machines.
7. Introduction to Bluetooth, Wi-Fi module, DTMF and building a Mobile Controller Robot.
8. Introduction to RaspberryPi.
9. Usage of GPIO and Raspberry Pi Camera Module on Raspberry Piboard.
10. Colour Detection and Segmentation and building colour trackingRobot.
11. Introduction to Aerial Robots (Drones, UAVetc.)
12. Introduction to PixhawkAuto-Pilot.
13. Calibration of Drone and FlightTest.
14. Team Project.

TextBooks:

1. John J.Craig, *'Introduction to Robotics: Mechanics and Control* , Pearson Publications,2005.
2. Siegwart R and Nourbakhsh I.R, *Introduction to Autonomous Mobile Robots'*, Prentice Hall India,2005.

Reference Books:

1. Murphy Robin R, *Introduction to AI Robotics* , MIT Press, 2000.
2. MykePredko,"Programming Robot Controllers" – McGraw-Hill, 1stedition, 2003.

Video Reference:

1. Prof. Khatib, Stanford University, 'Introduction to Robotics'
   URL: https://see.stanford.edu/Course/CS223A

Course Outcomes:

CO1	Learners will be able to differentiate different types of robots.
CO2	Learners will be able to analyse the components of robots, sensors,actuators.
CO3	Learners will be able to explain the coordinatetransformations, I/O logic, wireless and wired communication
CO4	Learners will be able to analyse the Arduino and Raspberry pi usage in robotics
CO5	Learners will be able to design and control basic two-wheel robot model

Assessment Criteria:

Assessment Tool	(Internal Exam) Hardware Project submission	End Semester Lab Examination	Total
Weightage (%)	40%	60%	100%

ENGINEERING SECOND YEAR: SEMESTER-II

20EC2201	**Communication Systems-1**	**PCC**	**3L: 1T: 0P**	**4 credits**

Course content:

Unit -I **(12hours)**

The Stochastic Process, Concept of Stationary and Statistical Independence, Stationary Processes, Wide-Sense Stationary, Time Averages and Ergodicity, Mean-Ergodic Processes, Autocorrelation Function and its Properties, Cross-Correlation Function and its Properties, Covariance and itsProperties,

Unit –II **(12 hours)**

Power Spectrum: Properties, Relationship between Power Spectrum and Autocorrelation Function, Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function

Unit –III **(8hours)**

Review of signals and systems, Frequency domain representation of signals, Principles of Modulation Systems, Time domain and Spectral characteristics of modulated signals.

Unit –IV **(8 hours)**

Amplitude(Linear) Modulation: Amplitude modulation,Single sideband, Vestigial sideband, Coherent and non coherent demodulation, Super hetero dyne AM Receiver**Angle (Exponential) Modulation,** Bandwidth of Angle-Modulated Waves, Generation of FM Waves, Demodulation of FM, FM receiver.

Unit-V **(10hours)**

Quantization, Uniform Quantizers Midrise and Midtread, Quantization noise, Lloyd Max Quantization Algorithm, Non uniform Quantizers, Delta Modulation, Differential Pulse Code Modulation(DPCM).

Unit-VI **(10hours)**

Gaussian and white noise characteristics,Noise in amplitude modulation systems, Noise in Angle modulation systems, Pre-emphasis and Deemphasis, Noise considerations in PCM.Noise figure, sensitivity calculations, link budget

Learning Resources

Textbooks

1. Simon Haykins, '*Communication Systems'*, John Wiley & Sons, 4thEdition.
2. George Kennedy and Bernard Davis, '*Electronics & CommunicationSystem* ', McGraw Hill Education 2004.

Reference Books:

1. Thomas, '*Communication theory'*, McGraw-Hill Education. 2nd Edition.
2. R. P. Singh, S. D. Sapre, '*Communication Systems'*, McGraw-Hill Education,.
3. K.SamS hanmugam, '*Analog and DigitalCommunication*', Willey, 2005
4. Wayne Tomasi, '*Electronics Communication Systems'*, Person 2009,6th Edition.

Web Resources:

1. Prof. K.AdityaJaganathan, IIT Kanpur,'*Principles Of Communication System-1'*, URL: https://nptel.ac.in/courses/108104091/

Course outcomes: At the end of the course, the students will be able to

CO1	Able to analyze and design various modulation and demodulation analog systems
CO2	Understand the characteristics of noise present in analog systems.
CO3	Understand the Signal to Noise Ratio (SNR) performance, of various Analog Communication systems
CO4	Analyze and design the various Pulse Modulation Systems.
CO5	Understand the concepts of Multiplexing: Time Division Multiplexing (TDM) and Frequency Division Multiplexing (FDM).

Assessment Method

Assessment Tool	Weekly tests (in a semester)	Monthly tests (in a semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

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ENGINEERING SECOND YEAR: SEMESTER-II

20EC2281	**Communication Systems-1 Laboratory**	**PCC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective

1. Analyze and specify the fundamental parameters of a communicationsystem.
2. To strengthen the ability to identify and apply the suitable modulation techniques for the given real worldproblem.
3. To write and execute programs in MATLAB to implement various modulation techniques.

List of Experiments

1. Mathematical modeling of real time stochastic process usingMATLAB
2. Amplitude Modulation andDemodulation
3. Frequency Modulation andDemodulation
4. Sampling theorem verification
5. Pulse Width Modulation(PWM)
6. Pulse Position Modulation(PPM)
7. Delta Modulation
8. Pulse Code Modulation(PCM)
9. Termproject.

Course outcome

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

CO 1	Demonstrate understanding of various amplitude modulation and demodulation techniques.
CO 2	Demonstrate understanding of frequency modulation and demodulation technique.
CO 3	Analysis of real time communication systems
CO 4	Evaluate the advantages and disadvantages of communications systems, from the point of view analog modulations.
CO 5	To gain knowledge in practical applications of communication systems.
CO 6	To design a simple model of a communication system which uses analog modulation techniques

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab Project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

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ENGINEERING SECOND YEAR: SEMESTER-II

20EC2202	**Digital System Design**	**PCC**	**3L: 1T: 0P**	**4 credits**

Course Learning Objectives

To make understand the student to know the Datapath and control path design aspects in Digital System Design and also the design modeling using Hardware Description Language

Course content

Unit –I **(6hours)**

HDL for Digital System Designs

Verilog HDL modeling of Combinational circuits design: Code converters, Multiplexers, Decoders, multi-bit adders, subtractors, multipliers others. Timing control, Blocking and non-blocking assignments. Combinational Synthesis.

Unit-II **(6 hours)**

HDL for Digital System Designs

Verilog HDL modeling of Sequential circuits design: Flipflops, synchronous counters, asynchronous counters, registers. Sequential Synthesis.

Unit-III **(14hours)**

Finite State Machines

Mealy machines, Moore machines, Conversion of mealy machines to moore machines and vice-versa. Mealy and Moore model for serial-adder. Sequence detectors (overlap and non-overlap modeling techniques). Even parity and Odd parity detectors and generators using state machines.

Unit-IV **(8 hours)**

HDL for Finite State Machines

Verilog HDL modeling of Finite state machines (Mealy and Moore models), modeling of testbench.

Unit-V **(14 hours)**

Digital Systems modeling

Datapath design, controlpath design, GCD system design, Traffic light controller design, vending machine design. CPU Design and Test: SAYEH datapath and control path design

Unit-VI **(12 hours)**

HDL Modeling of USB Protocol Analyzer

Design overview: State machine and subcircuit partitioning.

Verilog modeling: Digital Phase-locked loop, NRZI to Binary converter, CRC Checker submodules, Packet ID recognizer, state machine subcircuit, Top-level module, Test bench for entire circuit, Simulation resultsanalysis.

Learning Resources

Text Books

1. Zainalabedin Navabi, 'Verilog Digital System Design', Mc Graw Hill publications, Second Edition.
2. Sunggu Lee, 'Advanced Digital Logic Design', Cengage Learning publications.

Reference Books

1. Samir Palnitkar, *'Verilog HDL - A Guide to Digital Design and Synthesis'*, Pearson Publications
2. Stephen Brown, ZvokoVranesic, *'Fundamentals of Digital Design usingVerilog'*, Mc Graw Hill publications
3. Ian Grout, *'Digital Systems Design with FPGAs andCPLDs'*,Elsevier-2008

Web Resources

1. Prof S Shankar Balachandran, NPTEL-IIT Madras, *'Digital circuits & Systems'*. URL:http://nptel.ac.in/courses/117106114/
2. Prof S Srinivasan, NPTEL - IIT Madras, *'Digital circuits and systems*' URL:https://nptel.ac.in/courses/117106086/
3. Deepak Kumar Tala, URL:http://www.asic-world.com

Course Outcomes

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

CO 1	Understand specifications of VLSI designs, Moore's Law
CO 2	Different VLSI Design flows - FPGA, ASIC
CO 3	Understand the concepts of Finite State Machines and its relevance in IC Design
CO 4	Modeling of digital designs using hardware description language

Assessment Method

Assessment Tool	Weekly tests/Assignments (in a semester)	Monthly tests (in a semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING SECOND YEAR: SEMESTER-I

20EC2282	**Digital System Design Laboratory**	**PCC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective

To get a practical exposure on the concepts present in Introductory to VLSI Theory course and thereby acquiring sufficient knowledge in designing basic analog and digital VLSI systems

List of Experiments

1. Familiarization with Xilinx software and Circuit level EDAtool.
2. Implementation of combinational and sequential circuits using Gate-level modeling of VerilogHDL
3. Implementation of combinational and sequential circuits using data flow modeling of VerilogHDL
4. Implementation of combinational and sequential circuits using behavioral modeling of VerilogHDL
5. Implementation of Finite State Machines using VerilogHDL
6. Implementation of Complex Finite State Machines using VerilogHDL
7. ASIC implementation of Digitalsystems
8. FPGA realizations
9. Term Project

***Circuit level EDA tool may be Mentor Graphics tool/ Cadence tools/Synopsys tools.**

References

1. Prof AnanthaChandrakasan, MIT- Opencourseware, 'Introductory Digital Systems Laboratory'. URL: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-111-introductory-digital-systems-laboratory-spring-2006/labs/

Course outcome

After the completion of this Laboratory course, the student will be able to

CO 1	Understanding and utilizing the VLSI CAD tools
CO 2	Describe digital systems using hardware description language: Verilog

CO 3	Efficient in writing Verilog HDL in different modeling techniques
CO 4	Implement digital designs on hardware : FPGA
CO 5	Implementing ASIC designs on Mentor Graphics/Synopsys/Cadence platform
CO 8	Design an simple analog or digital VLSI system

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ	*Term Project and Viva-Voce	End Semester Lab Exam	Total
Weightage (%)	15%	15%	30%	40%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

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ENGINEERING SECOND YEAR: SEMESTER-II

20EC2203	**Linear Integrated Circuits**	**PCC**	**3L: 1T: 0P**	**4 credits**

Course Learning Objectives

1. To study the basic principles, configurations and practical limitations ofop-amp.
2. To understand the various linear and non-linear applications ofop-amp
3. To analyze and deign op-amp oscillators, single chip oscillators and frequency generators
4. To understand the operation of the most commonly used D/A and A/D converter types and itsapplications

Course content

Unit-I **(10hours)**

Feedback Amplifiers

Feedback concept, General characteristics of Negative feedback amplifier, Different feedback amplifiers (Voltge-series feedback, Current-series feedback, Current-shunt feedback, Voltage-shunt feedback), Effect of negative feedback on input and output impedances, gain & bandwidth

Unit-II **(10 hours)**

Operational Amplifiers

Ideal op-amp parameters, non-ideal op-amp, opamp in negative feedback, bandwidth and slew rate on circuit Performance.

Op-amp applications- summing amplifier, integrator, differentiator, Instrumentation amplifier, V to I and I to V converter, comparator, precision Rectifier, log and antilog amplifier. Active filters.

Unit-III **(12 hours)**

Wave shaping circuits & Oscillators

Postive feedback concept, Barkhausen criterion and design of RC phase oscillators, Wien Bridge oscillator. Ring oscillator, LC oscillators and crystal oscillators, Multivibrators – Astable, Monostable and Bistable Multivibrators, Schmitt trigger, square and triangular waveform generators.

Unit-IV **(8 hours)**

DC-DC Converters

Introduction, Performance parameters of DC-DC converters, Frequency limiting parameters, Types of converters: Buck, boost andbuck-boost.

Unit-V **(10hours)**

PLL

Basic PLL topology and principle, Major building blocks of PLL- analog and digital phase detector, VCO, applications of PLL.

Unit-VI **(10 hours)**

Data Converters

Analog vs discrete time signals, Sample-and-Hold circuits, ADC architectures (Flash ADC, Successive Approximation ADC, Dual slope ADC. DACs(Binary weighted resistors, R-2R DAC and current steering DAC). INL &DNL

Learning Resources

Textbooks

1. Behzad Razavi, '*Fundamentals of Microelectronics*',WileyPublications
2. Sedra and Smith, *'Microelectronics Circuits'*, Oxford Publications,6th Edition.
3. R Jacob Baker, 'CMOS Mixed SignalCircuit Design', Wiley Publications

Reference Books

1. Boylestad R. L. and L. Nashelsky, *'Electronic Devices and Circuit Theory'*, 10/e or 11/e, Pearson,2009.
2. Millman J. and C. Halkias, *'Integrated Electronics'*, 2/e, TMH,2010.
3. Neamen D., *'Electronic Circuit Analysis and Design'*, 3/e, TMH,2006
4. Spencer R. R. and M. S. Ghausi, *'Introduction to Electronic Circuit Design'*, Pearson, 2003

Web Resources

1. Prof D Nagendra Krishnapura, NPTEL-IIT Madras, *'Analog Integrated Circuit Design'* URL:https://nptel.ac.in/courses/117106030/
2. Prof K Radhakrishna Rao, NPTEL-IIT Madras, *'Electronics for Analog Processing-II'*, URL:https://nptel.ac.in/courses/117106088/

Course outcomes: At the end of the course, the students will be able to

CO1	Infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques.
CO2	Elucidate and design the linear and nonlinear applications of an op-amp and special application ICs.
CO3	Explain and compare the working of multi vibrators using special application IC 555 and general purpose op-amp.
CO4	Classify and comprehend the working principle of data converters.
CO5	Illustrate the function of application specific ICs such as Voltage regulators, PLL and its application in communication.

Assessment Method

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING SECOND YEAR: SEMESTER-II

20EC2283	**Linear Integrated Circuits Laboratory**	**PCC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective

1. Experimentally demonstrate the frequency response of amplifiers
2. Practical knowledge on different types of multivibrators and theirapplications
3. Introductory designs on Analog to DigitalConverters
4. Practical exposure to CMOS circuit design especially operationalamplifiers
5. Familiarization with CAD tool for analog circuitdesign

List of Experiments

1. Design and analysis of Feedbackamplifiers.
2. Frequency response of inverting & non-invertingamplifier.
3. Design of an Instrumentationamplifier.
4. Schmitt trigger & Noise suppression using Bistablemultivibrator.
5. Monostable & Astable multivibrator usingopamp.
6. Design of amplifier using CMOSinverters.
7. Two – bit flash ADC design.
8. Design of a typical CMOS inverter(sizing) using EDA tool and finding transfer characteristics & finding the propagationdelay.
9. Design of a two input CMOS NAND & NOR gates (sizing) usingEDAtool.
10. Design of a fully differential single stage opamp using resistive loads using EDAtool
11. Design of a single stage opamp using diode connected load using EDAtool
12. Term Project(Designing Public AddressingSystem).

***EDA tool may be Mentor Graphics/Synopsys/Cadence tools**

Note: It is mandatory to perform experiments (1-7) on LTspice tool before the experiment is done on hardware. All experiments must be unique, design specifications should not be common in thelab.

Course outcome:

After the completion of this Laboratory course, the student will be able to

CO 1	To analyze the frequency response of amplifiers
CO 2	Experimentally know the noise suppression in bistable multivibrators
CO 3	Utilization of IC 555 timer
CO 5	Design of Analog to Digital Converters

CO 6	Design of CMOS circuits using CAD tool
CO 7	Design of operational amplifiers
CO 8	Design of a prototype project using the concepts of analog electronic circuits

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab Project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING SECOND YEAR: SEMESTER-2

20EC2204	**Electromagnetic waves and Guided media**	**PCC**	**3L: 1T: 0P**	**4 credits**

Course Learning Objective

1. Introduce the fundamental importance of electromagnetic theory and wave propagation phenomena for an electronics and communicationengineer.
2. Understanding guided media role for efficient power transmission in communication systems,between microwave subsystems, optical fiber systems.
3. Introduce to the higher order modes of propagation in guidingmedia.

Course Content

Unit-I **(6 hours)**

Introduction

Application, Review of vector algebra (dot product, cross product, scalar and vector components of vector), coordinate systems (rectangular, cylindrical, spherical coordinate systems), vector calculus(gradient, curl, divergence)

Review of Electrostatics, Magnetostatics, electrodynamics and Maxwell equations and boundary conditions.

Unit-II **(8 hours)**

Wave Propagation

Wave solution to Maxwell equations, Uniform plane wave solution, propagation constant , Propagation of uniform plane waves in perfect dielectric and in lossy medium (conductor, lossy dielectric), Wave polarization, Power and Poynting vector.

Unit-III **(8 hours)**

Wave propagation at interfaces

Reflection, refraction, Normal Incidence, Oblique Incidence ,effects of wave polarization in reflection and refractions, total internal reflection, Brewster angle, phase and group velocities.

Unit-IV **(8 hours)**

Transmission Lines: Parameters

Transmission Lines- Equations of Voltage and Current on TX line, Propagation constant , characteristic impedance, reflection coefficient and VSWR, Impedance Transformation, Power transfer on TX line, Smith chart.

Unit-V **(6hours)**

Waveguides-I

General solution of TEM, TE, TM waves, parallel plate waveguide, rectangular waveguide, circularwaveguide.

Unit-VI **(7 hours)**

Waveguides-II

Coaxial line, power handling capacity, strip line, microstrip, wave velocity and dispersion, RF connectors, excitation of waveguide.

Learning Resources

Text books

1. Matthew N.O.Sadiku, *'Elements of Electromagnetics'*, Oxford University Press , 6th edition,2014.
2. William H. Hayt Jr. and John A. Buck, *'Engineering Electromagnetics'*, 7th edition, 2006, TMH.

Reference books

1. 1.E.C.JordanandK.G.Balmain , *'Electromagnetic Waves and Radiating Systems'*, PHI, 2nd Edition,2000.
2. John Kraus and Daniel fleisch, *'Electromagnetics with applications'* ,McGraw-hill international edition ,5th edition ,1999.

Web Resource

1. Prof David Staeling,MIT- Opencourseware, 'Electromagnetics and Applications'. URL:https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-013- electromagnetics-and-applications-spring-2009/index.htm
2. Prof R K Shivgaonkar, NPTEL-IIT Bombay, *'Transmission Lines and EMWaves'* URL: http://nptel.ac.in/courses/117101056/
3. Prof Harish shankar Ramachandra, NPTEL-IIT Madras, *'ElectromagneticFields'* URL: http://nptel.ac.in/courses/108106073/

Course Outcomes

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

CO 1	Apply vector calculus to static electric-magnetic fields in different engineering situations.
CO 2	AnalyzeMaxwell'sequationindifferentforms(differentialandintegral)and

	apply them to diverse engineering problems.
CO 3	Examine the phenomena of wave propagation in different media and its interfaces and in applications of microwave engineering
CO 4	Analyze the concepts of electromagnetic wave polarization
CO 5	Understand the concepts of guiding media and its necessity at highfrequency
CO 6	Understand the usage of smith chart and its importance in impedance matching

Assessment Method

Assessment Tool	Weekly tests/Assignments	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING THIRD YEAR: SEMESTER-I

20EG3183	**English-II Laboratory**	**HSC**	**0L: 0T: 3 P**	**1.5 credits**

Course objectives:

1. To improve group discussion skills of the students
2. To help the students to write their CV and Internship application
3. To improve the telephonic etiquettes of the students
4. To help the students to take decision on their career

Course Content

UNIT-I: (06 Contact Hours)

Group Discussion - How to think and analyze - How to initiate a topic - How to continue a topic - How to support or reject a point-of-view - How to defend your position - Managing distractions and mediating between contenders - How to summarize & conclude

UNIT-II:
(06 Contact Hours)

Telephonic conversation & Etiquettes - How to introduce oneself - How to introduce the main issue - How to keep the other person engaged - How to convince the other person - How to complain without irritating. - Giving assurance and asking for clarification - How to end a formal telephonic conversation

UNIT-III:
(06 Contact Hours)

Career Planning & Job-Skill Analysis - ASK: Talking about one's Attitudes, Knowledge, & Skills - SMART goals - Reading & Analysis of Job Advertisements

UNIT-IV: (06 Contact Hours)

CV & Resume Writing - Difference between CV & Resume - Writing CV - Writing Resume - Writing Cover Letter

UNIT-V: (06 Contact Hours)

Application for Internship - Application for internship in Academic Labs - Application for internship in Industries - Follow up the Application with reminders and requests

UNIT-VI: (06 Contact Hours)

Interview Skills - Preparation for the Interview - Frequently asked questions - Dress Codes, Appearance, and Etiquettes. 6.4 Facing the Interview

References:

1. *Business Communication Today*, 12th Edition, Courtland L Bovee & John Thill, Pearson
2. British Council Material on Career Planning & Interviews
3. *Master the Group Discussion & Personal Interview - Complete Discussion on the topics asked by reputed B-schools & IIMs* by Sheetal Desarda, Notion Press
4. *Group Discussion and Interview Skills* by Priyadarshi Patnaik , Cambridge University Press India
5. *The Ultimate Guide to Internships: 100 Steps to Get a Great Internship and Thrive in It* by Eric Woodard
6. Telephone Etiquette by Robert DeGroot

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

CO 1	Get used to a variety of GDs to understand the principles, finer nuances, and intricacies of the art
CO 2	Get exhaustive information on how to prepare for internship and interview
CO 3	Write his/her CV to remain well-prepared for the interviews
CO 4	Take decision on his/her career goals and plans
CO 5	Attain professional speaking skills to enhance his/her employability skills.

Assessment Method:

Course Nature: LABORATORY

Internal Assessment (40 Marks)	**External Assessment (**60 Marks)
Record Writing – 10 Marks	Reading Comprehension – 15 Marks
Attendance – 10 Marks	Writing – 30 Marks
Continuous Assessment (Listening – 10 Marks + Oral Presentations – 10 Marks)	Speaking (Viva-Voce) – 15 Marks

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING THIRD YEAR: SEMESTER-I

20EC3102	**Computer Networks**	**ESC**	**3L: 0T: 0P**	**3 Credits**

Course Learning Objectives

1. To develop an understanding of modern network architectures from a design and performanceperspective.
2. To introduce the student to the major concepts involved in wide-area networks (WANs),local area networks (LANs) and Wireless LANs(WLANs).
3. To provide an opportunity to do networkprogramming
4. To provide a WLAN measurementideas.

Course Content

Unit -I **(8hours)**

Data communication Components: Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media,

Unit-II **(8 hours)**

LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spreadspectrum.

Unit -III **(8hours)**

Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back–N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA,CSMA/CD,CDMA/CA

Unit -IV **(8hours)**

Network Layer: Switching, Logical addressing IPV4, IPV6; Address mapping ARP, RARP, BOOTP and DHCP Delivery, Forwarding and Unicast Routingprotocols.

Unit -V **(7hours)**

Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Unit -VI **(6 hours)**

Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of cryptography.

Learning resources

Text book

1. Behrouz A.Forouzan *"Data Communications and Networking"*, 4e ,Tata McGraw Hill.
2. W. Stallings, "*Data and ComputerCommunication*", 8e, Pearson
3. Andrew S. Tanenbaum "*Computer Networks"*, 4e, PearsonEducation.

Reference Books

1. S.Kshev *"An Engineering Approach to Computer Networks "*, 2ndedition
2. W.A.Shay, Thomson *"Understanding Communications and Networks*",3rd edition,

Web resources

1. Prof Ajit Pal,NPTEL- IIT Kharagpur, 'Data Communications'.
   URL: https://nptel.ac.in/courses/106105082/
2. Prof Sujoy Gosh,NPTEL- IIT Kharagpur, 'Computer Networks'.
   URL:https://nptel.ac.in/courses/106105081/
3. https://www.tutorialspoint.com/computer_fundamentals/computer_networking

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

CO 1	Explain the functions of the different layer of the OSI Protocol.
CO 2	Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) describe the function of each block.
CO 3	For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component
CO 4	For a given problem related TCP/IP protocol Developed the network programming.
CO 5	Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open sourceavailable software and tools.

Assessment method

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING THIRD YEAR: SEMESTER-I

20EC3103	**Computer Organization and Architecture**	**ESC**	**3L: 1T: 0P**	**4 credits**

Course Learning Objectives:

To expose the students to the following:

1. How Computer Systems work & the basicprinciples.
2. Instruction Level Architecture and InstructionExecution.
3. The current state of art in memory systemdesign.
4. How I/O devices are accessed and itsprinciples.
5. To impart the knowledge on microprogramming.

Course Content

Unit – I **(10 hours)**

Architecture of 8086 microprocessor, special functions of general purpose registers,8086 flag register and function of 8086 flags, pin diagram of 8086,minimum and maximum mode of 8086 configuration and timing diagrams.Addressing modes of 8086, Instruction sets of 8086.

Unit –II **(12 hours)**

Introduction to MIPS architecture, MIPS Instruction Set Architecture, Procedures, Recursive Programs, Architecture Examples, Introduction to Assessing and Understanding Performance, CPU Performance and its Factors, Evaluating Performance, Benchmarks and the performance of recent IntelProcessors.

Unit –III **(12hours)**

Introduction to Processor: Data path and Control, Logic design Conventions, Building a Data path, Simple Implementation scheme, Multi-cycle Implementation, Exceptions, Microprogramming: Simplifying Control Design, Introduction to Digital Design Using a Hardware Design Language.

Unit –IV **(10hours)**

Introduction to Pipelining, A pipelined Data path, Pipelined Control, Data Hazards and Forwarding, Data Hazards and Stalls, Branch Hazards, Exceptions, Advanced Pipelining.

Unit –V **(8hours)**

Introduction to Memory Hierarchy, The Basic of Caches, Measuring and Improving Cache Performance, Virtual Memory, Common Framework for Memory Hierarchies.

Unit –VI **(10hours)**

Introduction to Storage, Networks and other Peripherals, Disk Storage and Dependability, Networks, Busses and other Connections between Processors, Memory and I/O Devices, Interfacing I/O Devices to the Processor, Memory and Operating System, I/O Performance Measures, Designing an I/O System.

Learning Resources

Text Books

1. DavidA.PattersonandJohnL.Hennessy*ComputerOrganizationandDesign* ', Morgan Kaufmann Publishers, 3rd Edition.

Reference Books

1. Ian McLoughlin '*Computer Architecture– An Embedded approach*',McGraw-Hill Education (Asia), 1stEdition.

Web resources

1. Prof AnshulKumar,NPTEL- IIT Delhi, '*Computer Architecture*' .URL:http://nptel.ac.in/courses/106102062/

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

1	Able to write recursive program in MIPS.
2	Able to construct cost effective computer system.
3	Able to differentiate different designs and organizations.
4	Able to handle design issues in the development of processor or other components that satisfies design requirements.

Assessment Method

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING THIRD YEAR: SEMESTER-I

20EC3101	**Communication Systems-2**	**PCC**	**3L: 1T: 0P**	**4 credits**

Course objectives

1. To understand the functional block diagram of Digital communicationsystem.
2. To understand the need for source and channelcoding.
3. To study various source and channel codingtechniques.
4. To understand a mathematical model of digital communication system for bit error rate analysis of different digital communicationsystems.

Course content:

Unit-I **(12 hours)**

Basic tools of Digital communication, Transmission Pulse Shaping, Power Spectral Density, Additive White Gaussian Noise (AWGN) Channel, Optimal Receiver Design, Signal-to-Noise Power Ratio (SNR), Matched Filtering(MF)

Unit-II **(8 hours)**

Maximum Likelihood (ML) Receiver, Probability of Error, Binary Phase Shift Keying and associated Prob. of Error, Amplitude Shift Keying (ASK) and Other Schemes.

Unit-III **(10hours)**

Signal Space Theory, Frequency Shift Keying (FSK), Quadrature Amplitude Modulation (QAM), M-ary Phase Shift Keying (MPSK) and associated Prob. of Error, Pulse Shaping Filter Design, Nyquist Pulse Shaping Criterion, Raised-Cosine Filter, Passband-Baseband Equivalence.

Unit-IV **(12 hours)**

Introduction to Wireless Communication, Performance of Digital Modulation in Fading Channels, Introduction to Information Theory, Channel Capacity.

Unit-V **(8hours)**

Source Coding, Entropy Codes, Huffman Coding, Linear Block Codes, Hamming Weight and Distance Properties, Syndrome Decoding,

Unit-VI **(10hours)**

Convolutional Codes, Trellis Structure and Decoding of Convolutional Codes.

Text books

1. S. Haykin, '*Communications system'*, Wiley, 4th Edition2009.
2. JohnG. Proakis, Masoud Salehi, '*Digital Communications'*, McGrawHill,2008, 5thEdition.

References books

1. Herbert Taub, Donald L Schilling, Principles *of Systems'*, *Communication* – Goutam Saha, McGraw-Hill, 2008, 3rd Edition.
2. Wayne Tomasi, '*Electroniccommunicati on systems'*, Pearson,5thedition.
3. R. P. Singh, S. Sapre, '*Communication Systems: Analog and* Digital', McGraw Education,2012.

Web References

1. Prof. Aditya K. Jagannatham, NPTEL-IIT Kanpur, '*Principles Of Communication Systems-II'*. URL: https://nptel.ac.in/courses/108104098/

Course outcomes: At the end of the course, the students will be able to

CO1	Understand basic components of Digital Communication Systems.
CO2	Design optimum receiver for Digital Modulation techniques
CO3	Analyze the error performance of Digital Modulation Techniques
CO4	Understand the redundancy present in Digital Communication by using various source coding techniques
CO5	Know about different error detecting and error correction codes like block codes, cyclic codes and convolution codes

Assessment Method

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING THIRD YEAR: SEMESTER-I

20EC3181	**Communication systems-2 Laboratory**	**PCC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective

1. To inculcate practical knowledge on various digital communicationtechniques
2. To understand the type of digital communication technique required for specific purposes

List of Experiments

1. Modulation and Demodulation of Amplitude Shift Keying(ASK)
2. Modulation and Demodulation of Frequency Shift Keying(FSK)
3. Modulation and Demodulation of Phase Shift Keying(PSK)
4. Simulation of BER performance of ASK over AWGNchannels
5. Simulation of BER performance FSK over AWGN channels
6. Simulation of BER performance PSK over AWGN channels
7. Simulation of BER performance of Digital modulation schemes over Rayleighfading.
8. Study and analysis of Digital Communication techniques in real time telecommunicationsystems
9. TermProject

Course Outcomes

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

CO 1	Understand the practical aspects of Pulse width modulation, pulse position Modulation
CO 2	Understand the practical aspects of Amplitude shift keying, Frequency shift keying and phase shift keying
CO 3	Differentiate the difference between different communication techniques
CO 4	Understand the difference between analog communication techniques and digital communication techniques
CO 5	Design a sample telecommunication system using digital communication Techniques

Assessment Method

Assessment Tool	Weekly tests/Assignments (In semester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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ENGINEERING THIRD YEAR: SEMESTER-I

20EC3182	**Microprocessors, Microcontrollers and Computer Networks Lab**	**PCC**	**0L: 0T: 3P**	**1.5 credits**

Course Learning Objective

1. Experimental exploration of features of microprocessors and microcontrollers and implementation of variousoperations
2. Interfacing microprocessors and microcontrollers with other electronics components like Display, Sensors, Actuatorsetc
3. Familiarizing with Networking protocols and coding for interfacingthem.

List of Experiments

8085 Programming and Interfacing

1. Arithmeticoperations
2. Interface 7 segment displays with 8085 using8255.
3. Interface 8279 Keyboard/Display IC with8085.
4. Generate square wave and saw tooth waveforms by using8085.
5. Interface ADC and DAC to8085.
6. Interfacing and programming of stepper motor and DC Motor speed control using 8085.

8051 programming and Interfacing

1. Basicprograms
2. Interfacing 8279 Keyboard/Display IC with8051
3. Interface ADC and DAC with8051.
4. Serial Communication using Serial Peripheral Interface (SPI) with8051.
5. Generate square wave and saw tooth waveforms by using8051.
6. Interfacing and programming of stepper motor and DC Motor speed control using 8051
7. Sensor Interfacing with8051

Computer Networks

1. To write a C/Python program to develop a DNS client server to resolve the given hostname.
2. To write a client-server application for chat usingUDP
3. To implement programs using raw sockets (like packet capturing andfiltering)
4. To write a C/Python program to perform slidingwindow
5. To get the MAC or Physical address of the system using Address Resolution Protocol.
6. To simulate the Implementing Routing Protocols using border gateway protocol(BGP)
7. To simulate the OPEN SHORTEST PATH FIRST routing protocol based on the cost assigned to thepath.

Course Outcome

After the completion of this Laboratory course, the student will be able to

CO 1	Design and implement programs using 8051 microcontroller
CO 2	Design and implement programs using 8085 microprocessor
CO 3	Interfacing with 8051 microcontroller
CO 4	Interfacing with 8085 microprocessor
CO 5	Comparison of microprocessor and microcontroller
CO 6	Exploring the features of advances microcontrollers and microprocessors over 8051 microcontroller and 8085 microprocessor respectively
CO 7	Programming and implementing network protocols
CO 8	Design and analysis of a prototype for a simple real time application

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING THIRD YEAR: SEMESTER-I

20EC3185	**RF and Microwave Engineering Laboratory**	**PCC**	**1L: 0T: 3P**	**2.5 credits**

Course Objective

1. Know about the behavior of microwavecomponents
2. Understand the radiation pattern of hornantenna

List of Experiments

1. Modeling of Rectangular waveguides using CADtools.
2. Measurement of guide wavelength and determination offrequency.
3. Measurement of directional coupler such as coupling, directivity,etc.
4. Modeling of Microwave components using CADtools
5. Measurement of S-parameters of waveguideT-junction.
6. Gunn oscillator measurements such as power versus frequency, I-Vcharacteristics
7. Reflex Klystron characteristicsmeasurement
8. Unknown Impedance Measurement using Smithchart.
9. Measurement of radiation characteristics of horn antenna such as radiation patterns andgain.
10. Term project using MMIC components

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	15%	40%
End Semester Examination weightage (%)			60%

Course outcome:

After the completion of this Laboratory course, the student will be able to

CO 1	Demonstrate the characteristics of Microwave sources
CO 2	Demonstrate the characteristics of directional Couplers
CO 3	To test the characteristics of microwave components

CO 4	To analyze the radiation pattern of antenna
CO 5	To measure antenna gain
CO 6	Practice microwave measurement procedures
CO 7	To design a prototype project using MMIC components

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ENGINEERING THIRD YEAR: SEMESTER-I

20HS3101	Indian Constitution	MC	1L: 0T: 0P	0 credits

Course Learning Objectives:

1. The basic objective of the course is to provide knowledge about institutions
2. It help to understands the processes to governing the society in a systematic way.
3. It helps to establish social Justice, Liberty, Equity and Fraternity.
4. The course will introduce the idea of political system in general
5. It provides idea about working process of constitutional institutions.
6. To create awareness about the functioning of the judicial system in India.

Course Contents:

UNIT I: **(5 hours)**

Introduction-Constitution' meaning of the term, Indian constitution sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and duties, Directive Principles of State Policy.

UNIT II: **(5 hours)**

Union Government and its Administration-Structure of the Indian Union: Federalism, centre-state relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok sabha, Rajya sabha.

UNIT III: **(5 hours)**

Election commission- Election commission: Role and functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

UNIT IV: **(3 hours)**

State Government and its Administration- Governor: Role and position, CM and Council of ministers, state secretariat: Organization, structure and functions.

UNIT V: **(7 hours)**

Local Administration-District's Administration head: Role and importance, Municipalities: Introduction, Mayor and role of Elected Representatives, CEO of Municipal Corporation, Panchayati raj: Introduction, PRI: Zilla Panchayat, Elected officials and their roles, CEO Zilla Panchayat: Position and role, Block level: Organizational Hierarchy (different departments), Village level: Role of elected and appointed officials, Importance of grass root democracy.

UNIT VI: **(5 hours)**

Union Judiciary-Establishment and constitution of Supreme court, Appointment of Judges, Establishment of State High court, Establishment of common High court for 2 or more states, WRITS, PIL(Public Interest Litigation).

Learning resources

Text book:

1. Durga Das Basu, *Constitutions of India*, 23rd ed, LexisNexis Publication.

Reference Books:

1. 'Indian Polity' by Laxmikanth
2.'Indian Administration' by Subhash Kashyap
4.'Indian Administration' by Avasti and Avasti
5.'Government and Politics of India' by W.H.Mrrison Jones
6.'Constitution of India' by J.C.Johari

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

CO 1	The students will understand their fundamental rules and duties.
CO 2	The students will learn the political system and the system of elections in India.
CO 3	It is to provide the students the institutions and processes to govern themselves in the manner they prefer.
CO 4	Students can also be able to utilize the laws and facilities provided by constution
CO 5	It will provide over all idea about our legal system.
CO 6	It will enable students more strong in terms of law and practice in day to day life.

Assessment Method

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	0	0	100%	%100

**** PASS/FAIL course**

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ENGINEERING THIRD YEAR: SEMESTER-II

20EG3284	**English-III Laboratory**	**HSC**	**0L: 0T: 3 P**	**1.5 credits**

Course objectives:

1. To improve interpersonal skills of the students
2. To help the students to write professional letters and reports
3. To practice the etiquettes to be used at workplace
4. To reward hands on experience on managing meetings
5. To imbibe leadership qualities in the students

Course Content

UNIT-I: (06 Contact Hours)

Professional Presentation - Collecting & Reading the materials to be presented - Analyzing the main points - Summarizing & concluding - Developing PPT - Delivery of the Presentation

UNIT-II: (06 Contact Hours)

Report Writing & Writing Professional Emails & Applications – Routine Reports – Investigative Reports - Professional Emails - Formal Letters and Applications

UNIT-III: (06 Contact Hours)

Agenda, Meetings, & Minutes - Setting the agenda for a meeting - Managing a meeting - Keynote address & vote of thanks - Publishing the minutes

UNIT-IV: (06 Contact Hours)

People skills and small talks (2 minutes) - Talking to professional executives - Talking to colleagues - Talking to the boss - Talking to your team - Talking to the media delegates

UNIT-V: (06 Contact Hours)

Corporate Etiquettes - How to introduce & greet - How to raise a question - How to clarify a doubt - How to say “yes” or “no” - Rapport building - Dining & winning - Counseling somebody - How to influence & motivate

UNIT-VI: (06 Contact Hours)

Life Skills - Leadership communication - Interpersonal communication - Stress management - Time Management

References:

***Business Communication Today*, 12th Edition, Courtland L Bovee & John Thill, Pearson**

1. British Council Material on communication
2. Training in Interpersonal Skills: Tips f: Tips for Managing People at Work by **Robbins and Hunsaker**
3. Soft Skills for Everyone, with CD Paperback –by Jeff Butterfield
4. Communication for business by Shirley Taylor, Pearson

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

CO 1	The art of professional presentation
CO 2	Write professional reports and letters
CO 3	Conduct a formal meeting
CO 4	Develop people skills and corporate etiquettes
CO 5	Gain the basic knowledge about leadership communication, stress management and time management

Assessment Method:

Course Nature: LABORATORY

Internal Assessment (40 Marks)	**External Assessment (**60 Marks)
Record Writing – 10 Marks	Reading Comprehension – 15 Marks
Attendance – 10 Marks	Writing – 30 Marks
Continuous Assessment (Listening – 10 Marks + Oral Presentations – 10 Marks)	Speaking (Viva-Voce) – 15 Marks

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING THIRD YEAR: SEMESTER-II

20BMXY01	**Product Design and Innovation**	**HSC**	**1L: 0T: 0P**	**1 credit**

Course Learning Objectives

1. To make awareness of the product designprocess.
2. This course will give an understanding of methods, tools and techniques applied in product design.
3. This course will enhance the overview of innovation, product design process.
4. Itwillhelptounderstandcompetitivebenchmarking,aspectsofhumanfactorsin product design, tools for creative concept.
5. one of the objective of this course is to explain lectures including case studies and hands-on exercises.
6. It will help students to generate creative ideas in to product design, considering human factorsaspects.

Course Contents

Unit I **(2hours)**

Need for Innovation and design ,user Innovation , introduction to product and Product design, difference between Product development and product design.

Unit II **(2hours)**

Need Problem Identification, user study by contextual enquiry, questionnaire study, Interview techniques, Persona and scenario mapping, product study and market study, design brief.

UnitIII **(2hours)**

Importance of human factors in product design, physical ergonomics, principles and issues, ergonomic assessment tool, Cognitive issues in product design.

UnitIV **(3 hours)**

Creative techniques and tools, concept generation, concept evaluation, concept design and presentations.

Unit V **(4hours)**

Product prototype, model making work flow for prototype, tools and techniques for model making and prototyping, introduction to prototype driven innovation.

UnitVI **(2 hours)**

Overview of materials and processes, Evaluation tools and techniques for User- Product interaction

Learning resources

Text Books

1. Eppinger, S., & Ulrich, K., '*Product design and development'*, McGraw-Hill Higher Education, 2015.

2. Green, W., & Jordan, P. W. (Eds.). *'Human factors in product design: currentpractice and future trends'*. CRC Press, 1999.

Reference Books

1. Sanders, M. S., & McCormick, E. J.,'*Human factors in engineering and design'*, Mcgraw-Hill book company, 1993.

2. Roozenburg, N. F., & Eekels, J., '*Product design: fundamentals and methods* (Vol 2). John Wiley &Sons Inc., 1995.

Web resources:

1. Dr. Debayan Dhar, NPTEL-IIT Guwahati , 'Product Design and Innovation'. URL:https://nptel.ac.in/courses/107103082/

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

CO 1	A student will be able to understand basic of production design
CO 2	This subject will provide implication facilities of methods, tools and techniques of production design.
CO 3	Students can be able to correlate human factor and competitive benchmarking in product design.
CO 4	Students can have practical experience by implementing theory in case studies.
CO 5	They can enhance their creativity in product design.
CO 6	They will be able to create their own product design with implementation of available theoretical knowledge.

Assessment Method

Assessment tool	Monthly Seminar	Report submission (End Semester)	Total
Weightage (%)	75%	25%	100%

*Note:

1. Industry personnel/start company founding personnel may be included in this course.
3. In Assessment Method, among one of the monthly seminars, the student is supposed to submit video recording of seminar and the same should be played in theclassroom.

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING THIRD YEAR: SEMESTER-II

20MC3201	**Career Development Course**	**MC**	**2L: 0T: 0P**	**0 credits**

Course Learning Objectives

To enhance holistic development of students and improve their employability skills

To instill confidence in students and develop skills necessary to face the challenges of competitive exams and placements

Course Contents

Unit I **(1.5hours)**

Number system: Base System, Exponents, Factorials, LCM & HCF, Properties of Numbers, Remainders, SuccessiveDivisions

Sequence & Series: Arithmetic Progression, Harmonic Progression, Geometric Progression

Programming in C

Unit II **(8hours)**

Arithmetic: Averages, Clocks & Calendars, Simple Interest &Compoud Interest, Mixture &Alligations, Percentages, Profit, Loss & Discounts, Ratio & Proportion, Speed, Time & Distance, Time &Work

Algebra: Binomial Theorem, Complex Numbers, Functions, Higher Degree Equations, Inequalities , Linear Equations, Logarithm, Quadratic Equations

Programming in C

UnitIII **(6hours)**

Geometry: Mensuration, Lines & Angles, Circles, Polygons, Triangles, Co-ordinate Geometry, Trigonometry

Probability & Statistics: Mean, Median&Mode, Permutation & Combination, Probability Set Theory & VennDiagram

Programming using Data Structures

UnitIV **(7 hours)**

Logical Reasoning: Logical Sequence, Premise, Assumption & Conclusion, Binary Logic, Blood Relations, Linear & Matrix Arrangement, Seating Arrangement, Coding & Decoding, Statements & AssumptionsPuzzles.

Analytical Reasoning: Course of Action Fact, Inference &Judgement, Logical Deduction, Statement & Assumption, Strong & Weak Arguments, Syllogism

Programming inPython

Unit V **(4.5hours)**

Data Interpretation: Charts (Column, Pie & Bar), Tables Graphs (Line & Area), Venn Diagram, Data Sufficiency.

Programming using JAVA

Reading Comprehension

UnitVI **(3 hours)**

Verbal Ability: Cloze TestErrorSpotting, Fill intheblanks, Sentence Correction, Word Usage, Para jumbles, Paragraph Completion, ParagraphSummary

Programming using JAVA

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Learning resources

Text book

1. Sarvesh K Verma, *'Quantitative Aptitude Quantum CAT'*, arihantpublications
2. Arun Sharma, Meenakshi Upadhyay, *' Verbal Ability and ReadingComprehension'* , McGraw Hill publications
3. Arun Sharma, *'Data Interpretation'*, McGraw Hillpublications
4. Arun Sharma, *'Logical Reasoning'*, McGraw Hillpublications

Reference books

1. Nishit K Sinha, 'Logical Reasoning and Data Interpretation', Pearsonpublications
2. Arun Sharma, *'Quantitative Aptitude'*, McGraw Hillpublications

Web resources

1. https://unacademy.com/
2. https://www.tutorialspoint.com/
3. https://www.indiabix.com/

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

CO 1	Improve aptitude, problem solving skills and reasoning abilities
CO 2	Improve Verbal ability skills, Data interpretation skills
CO 3	Understand the basic techniques required for solving Reading Comprehension
CO 4	Familiarize with the written tests of competitive exams, campus placements and PSUs
CO 5	Collectively solve problems in teams and group
CO 6	Adopt and acquire new techniques in solving problem

AssessmentMethod

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

**** Pass/Failcourse.**

Note: All examinations will be only of objective type. CDPC team assistance is to be taken in preparation of question papers. For Monthly tests, negative marking may also be introduced.

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ENGINEERING FOURTH YEAR: SEMESTER-I

20BE4101	**Environmental Studies**	**MC**	**2L: 0T: 0P**	**0 credits**

Course Learning Objectives:

1. To provide knowledge about multidisciplinary nature of environment, various sources of natural energy.

2. Understanding of ecosystem structure and function etc.

3. Knowledge of biodiversity and conservation

4. Understanding of problems caused by pollution and its impact

5. Understanding about the various social issues related to environment.

6. Awareness for the Environment and human health

Course Content:

UNIT-I: The Multidisciplinary Nature of Environmental Studies and Natural Resources (9 hours)

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

Natural Resources: Renewable and Non Renewable Resources

Natural resources and associated problems.

a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resoureces for sustainable lifestyles.

UNIT-II: Ecosystems (4 hours)

Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers,Energy flow in the ecosystem,Ecological succession, Food chains, food webs and ecological pyramids,Introduction, types, characteristic features, structure and

function of the following ecosystem:-a. Forest ecosystem, b. Grassland ecosystem, c. Desert ecosystem, d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

UNIT-III: Biodiversity and It's Conservation (4 hours)

Introduction – Definition: genetic, species and ecosystem diversity, Biogeographical classification of India,Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, National and local levels, Inida as a mega-diversity nation, Hot-sports of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT-IV: Environmental Pollution (6 hours)

Cause, effects and control measures of:-a. Air pollution, b. Water pollution, c. Soil pollution, d. Marine pollution, e. Noise pollution, f. Thermal pollution, g. Nuclear hazards, Solid waste Management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Disaster management: floods, earthquake, cyclone and landslides.

UNIT- V: Social Issues and the Environment (4 hours)

From Unsustainable to Sustainable development Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rahabilitation of people; its problems and concerns. CaseStudies, Environmental ethics: Issues and possible solutions.• Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. Wasteland reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public awareness.

UNIT-VI: Human Population and the Environment (3 hours)

Population growth, variation among nations, Population explosion – Family Welfare Programme, Environment and human health, Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health, Case Studies.

Learning Resources

Text Book:

1. Erach Bharucha, '*Textbook of Environmental studies'*, UGC

Reference Books:

1. Clark RS, '*Marine Pollution'*, Clanderson Press, Oxofrd (TB).

2. De AK, '*Environmental Chemistry'*, Wiley Eastern Ltd.

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

CO1	Well understanding about their surrounding natural resources and their conservation
CO 2	Able to understand the ecosystem food chain and habitat.
CO 3	Develop the practices for conservation of biodiversity
CO 4	To well understand the pollution courses, impact and prevention from pollution
CO 5	Able to bring about an awareness of a variety of environmental concerns.
CO 6	It attempts to create a pro-environmental attitude and a behavioral pattern in society that is based on creating sustainable lifestyles.

For Theory Courses Only:

Course Nature		**Theory**		
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100 %

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PROGRAM ELECTIVE COURSES

20ECXY01	Advanced Digital Communications	PEC	3L: 0T: 0P	3 credits

Course Learning Objectives

1. To know the concepts of probability analysis in view of different communication systems
2. To make understand the students the different types of errors, noise and fading for different communicationsystems
3. Students should able to calculate different types of fading for different systems by using MATlab.

Course Content

Unit -I **(6hours)**

Review of probability basics-Random variable–probability density function, cumulative distribution function, Momentgenerating function –Markov's inequality–Chebyshev's inequality –function of one random variable-function of two random variables- Central limittheorem.

Unit -II **(8hours)**

Error rate analysis- Bit error rate for BPSK modulation, Symbol error rate for QPSK and 4-QAM modulations, Symbol error rate for 4PAM, Symbol error rate for 16 QAM, Symbol error rate for16PSK

Unit -III **(8hours)**

System Performance Measures- Average Signal-to-Noise Ratio (SNR) , Outage Probability,AverageBitErrorProbability(ABER),channelcapacity,AmountofFading ,coefficient of variation, Average Outage Duration

Unit -IV **(8 hours)**

Fading Channel Characterization and Modeling - Characteristics of Fading Channels, Fading models- Rayleigh, Nakagami-*q* (Hoyt), Nakagami-*n* (Rice), Nakagami-*m* ,Chi square, gamma, weibull, Generalized-k ,k-u and H models, Composite fading and shadowingmodels

Unit -V **(10hours)**

Digital communication over fading channels: Bit error rate analysis of ASK, PSK and FSK schemes over different fading channels. MATLAB Assignments on bit error rate analysis of various modulationschemes.

Unit -VI **(5 hours)**

Design and analysis of communication systems using MATLAB

Learning Resources

Text Books

1. Simon Haykins *Digital Communication Systems* " John Wilsey & Sons, fourth edition
2. A.B Carlson,P B Crully,JC Rutledge *"Communication Systems"* fourth edition McGrawHill

Web Resources

1. Prof,S.sengupta *Advanced digital Communication*, IIT KHARGPUR, URL:http://nptel.ac.in/courses/117105081/2

Course outcomes: On successful completion of the course students will able to

CO 1	Learn the fundamental results in information theory and probability
CO 2	Understand how to use the results in information theory in communication system design
CO 3	Design and calculate the SNR of different digital communication methods
CO 4	Understand the different types of fading 's used in communication systems
CO 5	Understand the bit error rate of different communication methods
CO 6	Design a simple communication system model in considering the probability analysis

Assessment Method

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

20ECXY02	**Antennas and Radio wave propagation**	**PEC**	**3L: 0T: 0P**	**3 credits**

Course Learning Objectives

1. Understand basic terminology and concepts of Antennas andradiation.
2. To attain knowledge on the basic parameters for antenna design process and the analysis of design
3. Analyze the electric and magnetic field emission from various basic antennas with mathematical formulation of theanalysis.
4. To have knowledge on antenna operation and types as well as their usage in real timefield.
5. Awareness of the wave spectrum and respective band antenna usage and also to know the propagation of the waves at different frequencies through different layers in the existing layered free space environmentstructure.

Course Content

Unit-I **(6 hours)**

Fundamental concepts of antennas

Physical concept of radiation, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Antenna Noisetemperature,Frii's transmission equation, radiation integrals and auxiliary potential functions.

Unit-II **(8 hours)**

Wire and Loop antennas

Infinitesimal Dipole, Small Dipole, Finite Length Dipole, Half wave length Dipole, monopole, Small Circular loop and loop antenna.

Unit-III **(9 hours)**

Microstrip antennas

Basic characteristics of micro strip antennas, feeding methods, methods of analysis, design of rectangular patch, Reflector antenna

Unit-IV **(8 hours)**

Broad Band antennas and Horn antennas

Concept of Broad Band, Log-Periodic Antennas , E-plane Sectoral Horn, H-plane Sectoral Horn, Pyramidal Horn, and their properties.

Unit-V **(6 hours)**

Array antennas

Introduction to array, Two-Elemental Array, Array Factor, N-Element Linear Array: Uniform Amplitude and Spacing, Broad Side and End-Fire Array

UnitVI **(8 hours)**

Radio wave Propagation

Antenna located over earth, field diffraction zones and losses, surface wave propagation, ionospheric propagation, microwave and millimeter wave propagation, scattering by rain, tropospheric scatter propagation, propagation into sea water, atmosphere ducts

Learning Resources

Text Books

1. C.A Balanis, "*Antenna TheoryandDesign* ", John Wiley& Sons, 3rd Ed,2015.
2. R.E.Collin, '*Antenna andRadiowavePropagation* ', McGraw-Hill, New York, 1985.

Reference Books

1. John D.Kraus, '*Antennas*' McGraw-Hill series ,2nd edition,1988 W LStutzman, and G.A Thiele, '*Antenna TheoryandDesign* ',John Wiley &sons, 2ndEd, 1998
2. R.S.Elliot, '*Antenna Theory and Design*', Revised edition,Wiley IEEE-Press.,2003.
3. E.Jordan and K.Balmain,*Electromagnetic Waves and RadiatingSystems* ', Prentice-hall, New York, 1968.
4. R Garg, ' *Design ofMicrostipAntenna* ', McGraw-Hill, New York,1991

Web resources

1. Prof. R.K. Shevgaonkar, IIT Bombay,*Lecture series on Transmission Linesand EM Waves* (antenna related videos). URL: http://nptel.ac.in/courses/117101056/
2. Dr.AmalenduPatnaik,IIT Roorkee, *Web course on 'Advanced Antenna Theory and Design'*, URL:http://nptel.ac.in/courses/117107035/

Course outcomes: At the end of the course, the students will be able to

CO1	Define various antenna parameters
CO2	Analyze radiation patterns of antennas
CO3	Evaluate antennas for given specifications
CO4	Illustrate techniques for antenna parameter measurements

CO5	To understand the various applications of antennas

Assessment Method

Assessment Tool	Weeklytests (Insemester)	Monthlytests (Insemester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

20ECXY03	Co-operative Communications	PEC	3L: 0T: 0P	3 credits

Course Learning Objectives

1. To understand cooperation among modern communication networks that aids in achieving maximum networkefficiency.
2. To learn various multi-relayanalysis.
3. To learn exact and approximated versions of SERanalysis.

Course Content

Unit-I **(8 hours)**

Diversity Techniques

Types of Diversity and Advantages of Diversity techniques, Bit error rate analysis of digital modulation schemes for different diversity techniques. Diversity Technique over Fading Channels in the presence ofInterference.

Unit-II **(8 hours)**

Cooperative communications

Relay channels, Basics of cooperative communication protocols-Amplify and forward and decode and forward, hybrid decode amplify and forward protocols.

Unit-III **(8 hours)**

Cooperative communications with single relay

System model , Probability density function, cumulative distribution function and moment generating function for harmonic distribution and minimum of exponential, and gamma variants, Exact and Approximate SER analysis .

Unit-IV **(8 hours)**

Multi-node cooperative communications

Multi-node amplify-and-forward system model, dual hop-multi relay analysis, multi-hop& multi relay. Bit error rate analysis.

Unit-V **(8 hours)**

Cooperative communications in the presence of Interference

System models, Exact and Approximate SER analysis .Asymptotic analysis of single and multi-hop systems. Optimization: optimum power allocation, optimum relay positioning schemes.

Unit-VI **(5 hours)**

Analysis of co-operative communications in the field of telecommunication system and other relevant domains

Learning resources

Text book

1. K.J. Ray Liu et al, *'Cooperative Communications and Networking'*, Cambridge University Press

Reference book

1. Y.W. Peter Hong et al, *'Cooperative Communications and Networking'*, Springer Publications

Web resources

1. Prof Adithya K Jagannatham, NPTEL-IIT Kanpur, 'Applied Optimization for Wireless, Machine Learning, Big Data', URL:https://nptel.ac.in/courses/108104112/

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

CO 1	Use modern coding techniques such as network coding for improving the co-operation gains
CO 2	Mathematically analyze the performance of cooperative communications System
CO 3	Apply co-operative techniques to modern networks like mobile, edge, cloud

Assessment Method:

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

20ECXY04	**Design of Microwave systems**	**PEC**	**3L: 0T: 0P**	**3 credits**

Course learning objectives

1. To introduce the student to microwave analysis methods and designtechniques.
2. To understand the Scattering parameters to characterize devices and system behavior.
3. To study the passive and active devices commonly utilized in microwave subsystems
4. To understand the design procedures along with methods to evaluate device performance.
5. To understand the free space communication link and equations developed to determine the link carrier-to-noise ratio performancefactor.

Course Content

Unit -I **(6 hours)**

Introduction

SystemAspects of Antenna, Radio Receiver Architecture, Friis's Noise in Microwave Circuits, Dynamic Range and Intermodulation Distortion, Noise Characterization of a Microwave Receiver, MicrowavePropagation

Unit –II **(8 hours)**

Matching Networks

Smith chart, Admittance chart, Matching condition and maximum power transfer condition, matching networks with lumped elements, single stub matching, quarter wave transform.

Unit –III **(8hours)**

Microwave amplifier design

Two-Port Power Gains, Stability, Stability Circles, Single-Stage Transistor Amplifier Design, Low-Noise Amplifier Design, Broadband Transistor Amplifier, Balanced Amplifiers, Distributed Amplifiers

Unit – IV **(8 hours)**

Power amplifier design

Power Amplifiers Characteristics of Power Amplifiers and Amplifier Classes, Characterization of Transistors, Design of Class-PowerAmplifiers.

Unit – V **(8 hours)**

Oscillators and Mixers

Microwave Oscillators, Transistor Oscillators, Oscillator Phase Noise, Frequency Multipliers. Mixer Characteristics, Single-Ended Diode Mixer, Single-Ended FET Mixer, Balanced Mixer Image Reject Mixer, Other Mixers.

Unit –VI **(7hours)**

Microwave filter design

Filter Design by the Insertion Loss Method, Filter Transformations, Filter Implementation, Richard's Transformation, Kuroda's Identities, Impedance and Admittance Inverters, Stepped-Impedance Low-Pass Filters, Coupled Line Filters

Learning Resources

Text Books

1. David M Pozar, '*Microwave Engineering'*, John Wiley, 3rd Edition,2005.
2. R.E. Collin, '*Foundations for Microwave Engineering'*, IEEE Press, JohnWiley, 2nd Edition, 2002.

Reference Books

1. Guillermo Gonzalez, *'Microwave Transistor AmplifiersAnalysis, and Design'* Prentice hall, 2nd Edition,1997.
2. Joseph F.White, *'High Frequency Techniques : An introduction to RF and Microwave Engineering'*, IEEE Press ,John Wiley & sons,2004

Web Resources

1. Prof. JayantaMukherjee,NPTEL- IIBombay,*Microwave IntegratedCircuits* ', URL: http://nptel.ac.in/courses/117101119/

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

CO1	Recognize different aspects of antenna and microwave concepts like microwave propagation, microwave circuits etc.
CO2	Work with smith chart and finding parameters of microwave circuits by using them.
CO3	Design and differentiate microwave amplifiers.
CO4	Know the characteristics of power amplifiers and design them.
CO5	Define different microwave oscillators and mixers.
C06	Recognize and design different microwave filters.

Assessment Method

Assessment Tool	Weeklytests (Insemester)	Monthlytests (Insemester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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20ECXY05	Detection and Estimation Theory	PEC	3L: 0T: 0P	3 credits

Course Learning Objectives

The objective of this course is to make the students conversant with those aspects of statistical decision and estimation which are indispensable tools required for the optimal design of digital communicationsystems

Course Content

Unit-I **(8 hours)**

Review of Gaussian variables and processes; problem formulation and objective of signal detection and signal parameter estimation in discrete-time domain. Bayesian, mini-max, andNeyman-Pearson decision rules, likelihood ratio, receiver operating characteristics, composite hypothesis testing, locally optimum tests, detector comparison techniques, asymptotic relativeefficiency.

Unit-II **(8 hours)**

Matched filter detector and its performance; generalized matched filter; detection of sinusoid with unknown amplitude, phase, frequency and arrival time, linearmodel.

Unit-III **(8 hours)**

Estimator-correlator, linear model, general Gaussian detection, detection of Gaussian random signal with unknown parameters, weak signal detection.

Unit-IV **(8 hours)**

Detection in the absence of complete statistical description of observations, sign detector, Wilcoxon detector, detectors based on quantized observations, robustness ofdetectors

Unit-V **(8 hours)**

Minimum variance unbiased estimation, Fisher information matrix, Cramer-Rao bound, sufficient statistics, minimum statistics, complete statistics; linear models; best linear unbiased estimation; maximum likelihood estimation, invariance principle; estimation efficiency; Bayesian estimation: philosophy, nuisance parameters, risk functions, minimum mean square error estimation, maximum a posterioriestimation.

Unit-VI **(5 hours)**

Linear Bayesian estimation, Weiner filtering, dynamical signal model, discrete Kalman filtering.

Learning resources

Text books

1. H. V. Poor, *'An Introduction to Signal DetectionandEstimation '*, Springer, 2/e, 1998.
2. H. L. Van Trees, '*Detection, Estimation and Modulation Theory: Part I, II, and III*', John Wiley, NY, 68-89

Reference Books

1. S. M. Kay, *'Fundamentals of Statistical Signal Processing:Estimation Theory '*, Prentice Hall PTR, 1993.
2. S. M. Kay, *'Fundamentals of Statistical Signal Processing: DetectionTheory '*, Prentice Hall PTR, 1998.

Web Resources

1. Dr. Rohith Sinha,NPTEL-IIT Guwahati, ' Signal Detection and Estimation Theory', URL:https://nptel.ac.in/courses/117103018/

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

CO 1	Study the qualitative problems of detection and estimation in the frame work of statistical inference.
CO 2	Summarize the fundamental concept on Statistical Decision Theory and Hypothesis Testing
CO 3	Gain an understanding of, and develop the ability to design automated systems for detection and estimation.
CO 4	Write down hypothesis tests and estimation schemes for typical problems of interest.
CO 5	summarizer with Bayesian parameter estimation (minimum mean square error (MMSE), minimum mean absolute error (MMAE), maximum a-posterior probability (MAP) estimation methods
CO 6	compare optimal filtering, linear estimation, and Wiener/Kalman filtering.

Assessment Method:

Assessment Tool	Weekly tests (In semester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

20ECXY06	**Error Correcting Codes**	**PEC**	**3L: 0T: 0P**	**3 credits**

Course Learning Objectives

1. To provide a comprehensible and practical introduction to error control coding by means of MATLAB implementations of Galois field arithmetic, Viterbi decoder design, RS decoder design, and MAP architecture andothers.
2. To understand the essence of typical design issues involved in design of architectures for Error correcting codes by studying the algorithm of its design structure

Course content

Unit-I **(6 hours)**

Error Control Coding at a glance, Channel Capacity and Shannon's Theorem, Considerations when selecting coding schemes, MATLAB implementations

Unit-II **(6 hours)**

Elementary algebraic structures, Galois Field and its arithmetic , Implementation of GF (2^m) Arithmetic, A special case: Inversion, MATLABimplementations

Unit-III **(8 hours)**

Linear Block Codes: Code construction and properties, Decoding Methods, Performance, Encoder and Decoder designs, Hamming Codes. Cyclic Codes : Basic principles, Shift Register based Encoder and Decoder , Shortened cyclic codes and CRC. BCH Codes: Introduction, BCH Bound and Vander monde Matrix, Decoding BCH codes MATLAB implementations

Unit-IV **(8 hours)**

Introduction to RS codes , Prelude: Non binary BCH codes , Reed-Solomon codes, Decoding of RS codes , determining the Error location polynomial , Frequency-Domain decoding, Error and Erasure decoding , RS decoder: From algorithm to architecture, Standardized RS codes, MATLAB implementations

Unit-V **(8 hours)**

Fundamentals of convolutional codes : Code generation and representations. Decoding of Convolutional codes: Optimum convolutional decoding and Viterbi algorithm, Sequential decoding. Designing Viterbi decoder: Typical design issues, Design for high performance. MATLAB implementations

Unit-VI **(9 hours)**

Turbo codes: Code concatenation, concatenating codes in parallel: Turbo code, Iterative decoding of Turbo codes, Implementing MAP. Low-Density parity-check codes : Codes with sparse parity-check matrix , decoding and encoding algorithms, High-level architecture design for LDPC decoders. MATLABimplementations

Learning Resources

Text books

1. Yuan Jian, *'A practical guide to Error Control Coding using MATLAB'* , Artech House publications
2. Lin, Shu, D. J. Costello, Jr., *'Error Control Coding: Fundamentals and Applications*', Prentice Hall, 1983

Reference books

1. Peterson, W. W. and E.J. Weldon, Jr., *'Error-Correcting Codes'* , the M.I.T. Press, Cambridge, MA1970
2. Shu Lin, *'An Introduction to Error-Correcting Codes'* ,Prentice-Hall

Web resources

1. Prof P Vijay Kumar, NPTEL- IISc Bangalore, *'Error CorrectingCodes* ', URL: http://nptel.ac.in/courses/117108044/
2. Nagi El Naga, *'Error Detecting and Correcting Systems Design'* , Lecture Notes, ECE Department, California State University,Northridge.

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

CO 1	Analyze error control coding techniques in digital communication systems and in digital storage systems
CO 2	Understand and implementation of Galois Field Arithmetic
CO 3	Understand and implement linear block codes, cyclic codes and BCH codes
CO 4	Implementation Reed-Solomon codes
CO 5	High performance convolution decoders design methodology analysis
CO 6	Understanding of modern codes used in digital communications

Assessment Method

Assessment Tool	Weeklytests (Insemester)	Monthlytests (Insemester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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20ECXY07	Information Theory and Coding	PEC	3L: 0T: 0P	3 credits

Course Learning Objectives

The course aims to introduce to the students the concepts of amount of information, entropy, channel capacity, source coding, error detection, error correction, block coding, convolution coding, transform coding andquantization

Course Content

Unit -I **(8 hours)**

Definition of Information Measure and Entropy, Extension of an Information Source and Markov Source, Adjoint of an Information Source, Joint and Conditional Information Measure, Properties of Joint and Conditional Information Measures and a Morkov Source, Asymptotic Properties of Entropy and Problem Solving in Entropy

Unit -II **(8hours)**

Block Code and its Properties, Instantaneous Code and Its Properties, Kraft-Mcmillan Equality and Compact Codes, Shannon's First Theorem, Coding Strategies and Introduction to Huffman Coding, Huffman Coding and Proof of Its Optimality, Competitive Optimality of the ShannonCode.

Unit -III **(8 hours)**

Non-Binary Huffman Code and Other Codes, Adaptive Huffman Coding, Shannon-Fano-Elias Coding and Introduction to Arithmetic Coding, Arithmetic Coding, Information Channels, Equivocation and Mutual Information.

Unit -IV **(8 hours)**

Properties of Different Information Channels, Reduction of Information Channels, Properties of Mutual Information, Channel Capacity, Calculation of Channel Capacity, Shannon's Second Theorem, Error Free Communication, Noisy Channel, Continuous Sources and Channels

Unit -V **(8hours)**

Differential Entropy and Evaluation of Mutual Information for Continuous Sources and Channels, Channel Capacity of A Band Limited Continuous Channel, Introduction to Rate-Distortion Theory, Definition and Properties of Rate-Distortion Functions, Calculation of Rate-Distortion Functions, Computational Approach for Calculation of Rate-DistortionFunctions.

Unit –VI **(5hours)**

Introduction to Quantization, Lloyd-Max Quantizer, Compounded Quantization, Variable Length Coding and Problem Solving in Quantizer Design, Vector Quantization, TransformCoding

Learning Resources

Text books

1. Raymond W. Yeung, 'Information Theory and Network Coding'', Springer, 2008.
2. John RPierce , *'An Introduction to Information Theory: Symbols, Signalsand Noise'*.

Reference books

1. Thomas M. Cover, Joy A. Thomas, *'Elements of Information Theory'*, 2nd Edition, John Wiley & Sons,2006
2. David J. C. MacKay, *'Information Theory, Inference, and Learning Algorithms'*, Cambridge UniversityPress.

Web Resources:

1. Prof S N Merchant, NPTEL- IIT Bombay, *'Information Theory and Coding'* , URL:http://nptel.ac.in/courses/117101053/
2. Prof Adrish Banerjee, NPTEL-IIT Kanpur, *'An Introduction to Information Theory'*, URL:https://nptel.ac.in/courses/117104129/

Course Outcomes: Students should able to

CO 1	Derive equations for entropy mutual information and channel capacity for all types of channels
CO 2	Formulate the basic equations of block codes
CO 3	Explain the various methods of generating and detecting different types of error correcting codes.
CO 4	Distinguish between the different types of error correcting codes based on probability of error and noise ratio
CO 5	Derive equations for entropy mutual information and channel capacity for all types of channels
CO 6	Ability to understand the different types of quantization methodsand transformation coding

Assessment Method

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

20ECXY08	**Millimeter wave Technology**	**PEC**	**3L: 0T: 0P**	**3 credits**

Course Learning Objectives

1. Clarify the key ideas deriving mm Wave advancements andapplications
2. Balance mm Wave arrangement with Microwave interchangesorganization
3. Talk about different mm Wave keysegments
4. Rundown key estimation, examination, and recognizable proof ideas of physical parameters, and factual portrayals of mm Wave engenderingchannel.

Coursecontent

Unit –I **(8 hours)**

Introduction to Millimeter Wave Technology

Introduction , Millimeter Wave Applications, Phase and Group Velocity, Slow and Fast Waves, Skin Depth, Boundary Conditions, Challenges in Millimeter Wave Technology, Material Properties at Millimeter Wave Frequencies, Substrate Losses.

Unit –II **(8 hours)**

Guiding Structures

Dielectric Loss, Conductor Loss, Radiation and Surface Wave Loss, EM Waves in Transmission Lines, Surface Waves Wave-guiding Structures, High Power Limitation, Planar Transmission Lines, Conductor-Backed Coplanar Waveguide, Surface-Integrated Waveguide, Surface-Integrated Waveguide, Fabrication of PCB Circuits Dielectric Guides

Unit –III **(8hours)**

Antennas at Millimeter Wave Frequencies

Antenna Parameters, Printed Millimeter Wave Antennas, Printed Millimeter Wave Antennas, Waveguide Slot Arrays, On Chip Antennas, Dipole and Slot Antennas, Loop Antennas, Fabrication of On Chip Antennas, Leaky Wave Antennas.

Unit –IV **(8hours)**

Millimeter wave Components

Dielectric Resonators, Filters, Determination of Quality Factor and Coupling Coefficient, Power Dividers and Couplers, Matched Termination, Active Devices: Solid-State Devices, Field Effect Transistors: High-Electron-Mobility Transistor, Electronic Switches.

Unit – V **(8 hours)**

Noise and Link Budget

Millimeter Wave Propagation, Frii's Transmission Equation,ink Budget, Digital Modulation and Bit Error Rate ,Channel Performance at 60 GHz, Millimeter Wave Link Budget, Thermal Noise, Noise Temperature, External Sources ofNoise

Unit –VI **(5 hours)**

Millimeter Wave Systems

Antenna and Source Noise, Receiver Noise, Receiver Noise Factor, Receiver Noise Factor, Operating Noise Factor, Noise Figure for Cascaded System Elements, Receiver Noise Calculation, Passive Imaging, TransceiverArchitectures.

Learning Resources

Text books

1. DuixianLiu et al, '*Advanced Millimeter-wave Technologies: Antennas,Packaging and Circuits'*, Wiley.
2. Sergey M et al, *'Handbook of RF, Microwave, and Millimeter-Wave Components'*, Artech House Microwave Library.

Reference books

1. Kao-Cheng Huang, Zhaocheng Wang, *'Millimeter Wave Communication Systems'*, Wiley.
2. ShibanK.Koul, *'Millimeter Wave and Optical Dielectric Integrated Guides and Circuits'*, Wiley.
3. David M. Pozar, *'Microwave and RF Design of Wireless Systems'*,Wiley.

Web Resources

1. Prof. Mrinal Kanti Mandal, NPTEL- IIT Kharagpur, '*Millimeter wavetechnology* ', URL: https://nptel.ac.in/courses/117105139/

Course Outcomes: At the end of the course, the students will be able to

CO1	Understand mm wave advancement and applications
CO2	Recognizing different guiding structures in mm wave technology and fabricating PCB circuits.
CO3	Understand different millimeter wave antennas and waveguide slot arrays.
CO4	Illustrating millimeter wave components and different electronic switches.

CO5	Understanding noise parameters and millimeter wave link budget.
CO6	Understand millimeter wave systems and factors of noise.

Assessment Method

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

20ECXY09	**Optical Communications**	**PEC**	**3L: 0T: 0P**	**3 credits**

Course Learning Objectives

1. the functionality of each of the components that comprise a fiber- optic communicationsystem
2. the properties of optical fiber that affect the performance of a communication link and types of fiber materials with their properties and the losses occur infibers.
3. the principles of single and multi-mode optical fibers and theircharacteristics
4. working of semiconductor lasers, and differentiate between direct modulation and external electro-opticmodulation.
5. Analyze the operation of LEDs, laser diodes, and PIN photo detectors (spectral properties, bandwidth, and circuits) and apply in opticalsystems.
6. Analyze and design optical communication and fiber optic sensorsystems.

Course content

Unit-I **(8 hours)**

Overview of optical fiber communication

Historical development, The general system, advantages of optical fiber communications. Optical fiber wave guides- Introduction, Ray theory transmission, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays, Cylindrical fibers- Modes, V-number, Mode coupling, Step Index fibers, Graded Index fibers, Single mode fibers- Cut off wavelength, Mode Field Diameter, Effective Refractive Index, Related problems

Unit-II **(8 hours)**

Fiber materials

Glass, Halide, Active glass, Chalgenide glass, Plastic optical fibers. Signal distortion in optical fibers-Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses, Information capacity determination, Group delay, Types of Dispersion:- Material dispersion, Wave-guide dispersion, Polarization-Mode dispersion, Intermodal dispersion, Pulse broadening in Graded index fiber, Related problems

Unit-III **(8 hours)**

Optical fiber Connectors

Connector types, Single mode fiber connectors, Connector return loss, Fiber Splicing- Splicing techniques, Splicing single mode fibers, Fiber alignment and joint loss- Multimode fiber joints, single mode fiber joints

Unit-IV **(8 hours)**

Optical sources

LEDs, Structures, Materials, Quantum efficiency, Power, Modulation, Power bandwidth product. Injection Laser Diodes- Modes, Threshold conditions, External quantum efficiency, Laser diode rate equations, Resonant frequencies, Reliability of LED&ILD, Optical detectors- Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors,Related problems.

Unit-V **(8 hours)**

Source to fiber power launching

Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Laser diode to fiber coupling, Optical receiver operation- Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration, Digital receiver performance, Probability of Error, Quantum limit, Analog receivers

Unit-VI **(5hours)**

Optical system design

Point-to- point links- Component choice and considerations, Link power budget, Rise time budget with examples, Line coding in Optical links, WDM, Necessity, Principles, Measurement of Attenuation and Dispersion, Eye pattern

Learning resources

Text Books

1. Gerd Keiser, '*OpticalFiberCommunications* ', McGraw-Hill International edition, 3rdEdition,2000.
2. John M. Senior, '*OpticalFiberCommunications* ', PHI, 2nd Edition,2002

Reference Books

1. D.K. Mynbaev , S.C. Gupta and Lowell L. Scheiner, *'Fiber Optic Communications'*, PearsonEducation,2005.
2. S.C.Gupta, *'Optical Fiber Communication and its Applications'*, PHI,2005.

Web resources

1. Prof. Pradeep Kumar K, NPTEL-IIT Kanpur, '*Optical Communications* ', URL: http://nptel.ac.in/courses/117104127

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

CO 1	Recognize and classify the structures of Optical fiber and types.
CO 2	Discuss the channel impairments like losses and dispersion
CO 3	Analyze various coupling losses
CO 4	Classify the Optical sources and detectors and to discuss their principle
CO 5	Familiar with Design considerations of fiber optic systems
CO 6	the models of analog and digital receivers

Assessment Method

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

20ECXY10	**Principles of Radar**	**PEC**	**3L: 0T: 0P**	**3 credits**

Course Learning Objectives

1. To understand the basic concept of Radar and itsapplications
2. Understand the different Radar performancefactors.
3. To explain the operation of MTI & Pulse DopplerRadar.
4. To explain the principle involved in radarsystem.
5. To know the various types of radar and areas ofapplications.
6. To compute radar parameters & solve problems relating toradar.

Course Content:

Unit – I **(8 hours)**

Radar Basics

Radar and Radar Equation: Introduction, Radar block diagram and operation, frequencies, applications, types of displays, derivation of radar equation, minimum detectable signal, probability of false alarm and threshold detection, radar cross-section, system losses

Unit – II **(8 hours)**

CW Radar

Doppler Effect, CW Radar, FM-CW Radar, Range and Doppler Measurement, altimeter, Multiple Frequency CW Radar.

Unit – III **(8 hours)**

MTI and Pulse Doppler Radar

Pulse Doppler radar, MTI Radar, Delay Line Cancellers, Blind Speeds, Staggered PRFs. Range Gated Doppler Filters, Limitations, MTI versus Pulse Doppler radar.

Unit – IV **(8hours)**

Tracking Radar

Sequential lobbing, conical scanning, mono pulse, phase comparison mono pulse, tracking in range, comparison of trackers.

Unit – V: **(8 hours)**

Detection of Radar signals in Noise

Matched Filter Receiver, Cross-correlation Receiver, Efficiency of Non-matched Filters, Matched Filter with Non-whiteNoise.

Unit – VI **(5 hours)**

Synthetic aperture radar (SAR)

Fundamentals, cross-range resolution in radar, synthetic aperture viewpoint, Introduction to polarimetric and interferometricSAR

Learning Resources

Text Books

1. Merrill I. Skolnik, '*Introduction to Radar Systems*', , Tata McGraw-Hill,2001, 3rd Edition
2. Peebles, Jr., P.Z., '*RadarPrinciples* ' Wiley, New York, 1998.
3. Byron Edde, '*Radar Principals, Technology, Applications'*, PearsonEducation, 2004

Reference Books:

1. Hovanessian, S.A., '*Radar System Design and Analysis'*, Artech House1984.
2. Harger, R.O., *'Synthetic Aperture Radar Systems: TheoryDesign'*, Academic Press, NY (1970).
3. Schleher,D.C., *'MTI and Pulse Doppler Radar'*, Artech House1991
4. Richards, M.A., *'Fundamental of Radar SignalProcessing'*, Tata McGraw-hill. 2005
5. Sullivan, R.J., *'Radar Foundations forImagingConcepts'*, Advanced Prentice-Hall of India. 2004
6. Mott, H., *'Remote Sensing with Polarimetric Radar'*, IEEE Press.2007

Web Resources:

1. Dr. Robert M. O'Donnell, ' MIT –OCW, *Introduction to radar* ', URL: http://www.ll.mit.edu/workshops/education/videocourses/introradar/index.html
2. Dr.RobertM.O'Donnell,IEEEAerospaceandElectronicSystemsSociety, '*Lecture seriesonRadar* ', URL: http://aess.cs.unh.edu/radar%20se%20Li

Course Outcomes: At the end of the course, the students will be able to

CO1	Understand the essential principles of operation of radar systems
CO2	Classify different CW Radars and can define doppler effect.
CO3	Recognize tracking radars and comparison between them
CO4	Define and recognize MTI and pulse radar.
CO5	Detect the noise in radar signals and eradication of noise.

CO6	Understand the principles of Synthetic Aperture Radar, its use in geophysical remote sensing and surveillance applications, and the digital processing used to form SAR images

Assessment Method

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

20ECXY11	**Radio Frequency and Microwave Engineering**	**PEC**	**3L: 0T: 0P**	**3 credits**

Course Objective

1. Introduce limitations of lumped analysis and lumped components at high frequency and introduce to the design of microwave components at high frequency.
2. Introduce analysis of Microwave networks using two portparameters.
3. To study about Microwave Solid-State Microwave Devices and Microwave Tubes and insight into Microwave MeasurementTechniques.

Course Content

Unit – I **(6 hours)**

Introduction

Applications of microwave engineering ,Distinguishing features of high frequency electromagnetic, RF behavior of passive components at high frequencies.

Unit-II **(8 hours)**

Microwave Network Analysis

Impedance and equivalent voltages and currents , Z-matrix, ABCD matrix, S-matrix, properties of S-matrix , signal flow graphs.

Unit-III **(8 hours)**

Power divider and couplers

Resistive and junction power dividers , Wilkinson power divider, directional couplers, quadrature hybrid, 180 degree hybrid , waveguide magic tee.

Unit-IV **(7 hours)**

Microwave Components

Non reciprocal devices: faraday's rotation,isolator and circulator,Microwave resonators, RF diodes : PIN diode , Schottkydiode.

Unit-V **(8 hours)**

Microwave Sources

Limitations of conventional tubes ,classification of microwave tubes.Reflex klystron, Magnetron, Travelling Wave tubes,Transferred Electron Device's ,Ridely-Watkins-Hilsun (RWH) Theory , Gunn diode.

Unit-VI **(8 hours)**

Antenna parameters

Radiation concepts, Basic antenna principles, Near field and far field regions, Antenna parameters :radiation intensity , gain, directivity, Effective area, radiation pattern , Frii's Equation.

Learning Resources

Text Books

1. David M Pozar , "Microwave Engineering", John Wiley, 3rd Edition, 2005
2. Samuel Y. Liao , "Microwave Devices and Circuits" ,PHI, 3rd Edition,1994

Reference Books

1. R.E. Collin, Foundations for Microwave Engineering , IEEE Press, John Wiley, 2nd Edition,2002.
2. Reinhold Ludwig,GeneBogdanov , 'RF Circuit Design theory and applications ' PHIpublications.
3. Clayton RPaul, 'Introduction to Electromagnetic Compatibility ', Wiley, 2nd edition,2006.

Web Resources

1. Dr. Amitabha Bhattacharya,NPTEL-IIT Kharagpur, 'Basic Tools of Microwave Engineering'. URL: http://nptel.ac.in/courses/117105122/
2. Dr. Amitabha Bhattacharya,NPTEL-IIT Kharagpur, 'Basic Tools of Microwave Engineering'. URL: http://nptel.ac.in/courses/117105130/
3. Prof. Sharma, RGUKT content, 'Microwave engineering'.

Course outcomes: At the end of the course, the students will be able to

CO1	Understood RF behavior of passive components at high frequency.
CO2	Use S-parameter terminology to describe circuits and Design microwave transmission lines.
CO3	Describe and analyze different impedance matching techniques and Design impedance matching networks for specific application.
CO4	Use microwave components such as isolators, couplers, circulators and Know principles of Microwave devices.
CO5	Understand basic design parameters of antennas

CO6	Know principles of Microwave tubes and microwave devices and about different Microwave Measurement techniques.

Assessment Method

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

20ECXY12	**Satellite Communications**	**PEC**	**3L: 0T: 0P**	**3 credits**

Course Objectives

1. Determine the orbital parameters of asatellite
2. Determine the azimuth and elevation angles and visibility of a geostationary satellite from an earthstation
3. Create link budgets for an uplink and a downlink, and determine carrier to noise ratio (C/N) at an earth terminalreceiver
4. Calculate the baseband signal-to-noise ratio or bit error rate for a satellitelink
5. Design a communications satellite system to meet specified objectives for signal to noise ratio (S/N) in an analog baseband or BER in a digital link using appropriate multiple accesstechniques

Course Content

Unit-I **(8 hours)**

Intro and Orbital Mechanics, Launchers

Developing the Equations ofthe Orbit, Kepler's Three Laws of PlanetaryMotion, Describing the Orbit of a satellite, Locating the in the Orbit, Locating the Satellite with Respect to the Earth. Orbital Elements, Look Angle Determination, The Sub satellite Point, Elevation and Azimuth angle Calculations, Specialization to Geostationary Satellites, Visibility Test, Orbital Perturbations, Orbit Determination, Launches and Launch Vehicles, Doppler Shift, Range Variations, Solar Eclipse, Sun Transit Outage.

Unit-II **(8 hours)**

Satellite Subsystems

Attitude and Orbit Control System, Telemetry, Tracking, Command and monitoring, Power Systems, Communication Subsystems, Transponders, Satellite Antennas, Equipment Reliability and Space Qualification,Redundancy.

Unit-III **(8 hours)**

Satellite Link Design

Introduction, Basic Transmission Theory, System Noise Temperature and G/T Ratio, Noise Figure and Noise Temperature, G/T Ratio for Earth stations. Design of Downlinks, Link Budgets, Uplink Design, Designs for Specified C/NRatios.

Unit-IV **(8 hours)**

Multiple Access Techniques

Introduction, FDMA, TDMA, CDMA, Intermodulation, Calculation of C/N with Intermodulation TDMA Frame Structure, Demand Access Multiple Access(DAMA), Spread Spectrum Transmission andReception.

Unit-V **(8hours)**

Propagation Effects and their Impact on Satellite-Earth Links

Introduction, Quantifying Attenuation and Depolarization, Atmospheric Absorption, Cloud Attenuation, Troposphere Scintillation and Low Angle Fading, Faraday Rotation in the atmosphere, Ionospheric Scintillation, Rain and Ice Effects, Antenna Noise, Propagation ImpairmentCountermeasures.

Unit-VI **(5 hours)**

Practical aspects of Satellite communication systems, Balloon-based Communication systems. Antenna fundamentals, Linear Wire and Loop Antennas

Learning Resources

Text Books

1. Satellite Communications 2nd Edition, by T Pratt, C.W.Bostain, J.EAllnutt.John Willey sons2003.
2. Satellite communications systems: Systems, Techniques, and Technology 5thEdition by G Maral, M.Bousquet, Z.Sun , John WillySons.
3. Gary D Gordon and Walter L Morgan, Principles of Communication satellites, John Wiley& Sons,1993.

Web resources

1. Dr. Kalyankumar Bandopadhyay, NPTEL- IIT Kharagpur, 'Satellite Communication Systems'. URL: http://nptel.ac.in/courses/117105131/

Course outcomes

CO1	Able to learn the dynamics of the satellite.
CO2	Able to understand the communication satellite design.
CO3	Able to understand how analog and digital technologies are used for satellite communication networks.
CO4	Able to learn the design of satellite links.
CO5	Able to study the design of Earth station and tracking of the satellites.

Assessment Method

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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20ECXY13	**Wireless Communications**	**PEC**	**3L: 0T: 0P**	**3 credits**

Course Learning Objectives

1. To get an understanding of mobile radio communication principles, types and to study the recent trends adopted in cellular and wireless communication system standards.
2. Develop a relationship between re-use ratio and cluster size or re-use factor for hexagonal cellgeometry
3. Study co-channel interference, adjacent channel interference and hand off strategies.

Course Content

Unit-I **(7 hours)**

Cellular concepts: frequency reuse, Cell Sectoring, Cell Splitting, traffic analysis, trunking efficiency, call blocking probability, Blocked calls cleared system, blocked calls delayed system, hard handover and Soft handover.

Unit-II **(8 hours)**

Introduction to radio wave propagation, free space propagation model, Antenna fundamentals, received power calculations, Friis Free Space equation, Fraunhoper distance, Path loss exponent, Indoor Path loss Models, Two-Ray Model, Receiver sensitivity.

Unit-III **(8 hours)**

Diffraction, Fresnel Zones, Fresnel-Kirchhoff Diffraction Parameter, Shadow fading, Log-Normal Distribution, Boundary Coverage Probability, Percentage of Area Coverage. Distance Dependent Path loss Models: Okumura and Hata models.

Unit-IV **(8 hours)**

Small Scaling Fading: Multipath Propagation, Envelope Fading, Rayleigh and Rician Fading, Doppler Effect, Time Dispersion, Frequency Dispersion, Frequency Flat and Selective Fading, Slow and Fast Fading, Coherence Time & Coherence Bandwidth.

Unit-V **(8hours)**

Diversity: Introduction to MIMO systems, Receive Diversity, Selective combining, Maximal ratio combining (MRC), Equal gain combining, Transmit Diversity, Alamouti Scheme, Zero forcing and MMSE equalizers.

Unit-VI **(6 hours)**

Multiple Access techniques: Code Division Multiple Access, RAKE Receiver, WCDMA, Orthogonal Frequency Division Multiplexing, Cyclic Prefix, Design of OFDM systems.

Learning Resources

Text Books

1. Theodore, S. Rappa port, *'Wireless Communications Principles Practice'*, 2nd Ed., 2002, PHI.
2. Andrea Goldsmith, '*Wireless Communications'*, 2005 Cambridge UniversityPress.
3. Gottapu Sasibhushana Rao, '*Mobile CellularCommunication*', Pearson Education, 2012.

Reference Books

1. Kaveh Pah Laven and P. Krishna Murthy, *'Principles of WirelessNetworks* ', 2002, PE.
2. Kamilo Feher, '*Wireless Digital Communications'*, PHI.
3. William Stallings, '*Wireless Communication and Networking'*,PHI.
4. Upen Dalal, '*Wireless Communication'*, Oxford Univ. Press.

Web resources

1. Prof David Koilpillai, NPTEL-IIT Madras, *'Introduction to Wireless and Cellular Communication System',* URL:https://nptel.ac.in/courses/106106167/

Course Outcomes: At the end of this course student will able to

CO 1	Apply the knowledge of basic communication systems and its principles. Describe the cellular concept and analyze capacity improvement Techniques.
CO 2	Mathematically analyze mobile radio propagation mechanisms.
CO 3	Mathematically analyze small scale fading and multi path mechanisms.
CO 4	Summarize diversity reception techniques.
CO 5	Assess the standard wireless technologies
CO 6	Study and analyze the real-world wireless communication system models

Assessment Method

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

20ECXY14	Advanced Digital Signal Processing	PEC	3L: 0T: 0P	3 credits

Course Learning Objectives

1. To understand multi-rate systems and differentwavelets.
2. To learn about both CWT andDWT.
3. To understand variants of the wavelet transform and itsimplementation

Course Content

Unit -I **(6 hours)**

Need for multi resolution / multi-scale analysis, time-frequency analysis and generation of wavelets

Unit-II **(8 hours)**

Piece-wise constant approximation-the Haar wavelet, dyadic multi resolution analysis (MRA), relating dyadic MRA to filter banks, elements of multi-rate systems, two-band filter bankdesign

Unit-III **(8 hours)**

Orthogonal and bi-orthogonal wavelets, Daubechies family of wavelets, Vanishing moments and regularity, Conjugate Quadrature Filter banks (CQF), Data compression- fingerprint compression standards JPEG-2000standards.

Unit-IV **(8 hours)**

The uncertainty principle and its implications: Gaussian function, the Gabor transform and its generalization in time, frequency. Continuous wavelet transform (CWT).

Unit-V **(8 hours)**

CWT to the DWT discretization, discretization of scale, discretization of translation, discretization of time, Going from piecewise linear to piecewise polynomial, the class of spline wavelets.

Unit-VI **(7 hours)**

Variants of the wavelet transform and its implementation structures, the wave packet transform, Computational efficiency in realizing filter banks-polyphase components, the lattice structure, the lifting scheme applications.

Learning resources

Text books

1. Howard L. Resnikoff, Raymond O.Wells, *'Wavelet analysis :The Scalable Structure ofInformation* ', Springer,1998.
2. StephenWelstead,*Fractal and Wavelet Image CompressionTechniques* ', PHI publications

Web resources

1. Prof V.M.Gadre,NPTEL- IIT Bombay, *Advanced'Digital SignalProcessing* ', URL: http://nptel.ac.in/courses/ 117101001

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

1	Know the analysis of discrete time signals.
2	Analyze multirate DSP systems.
3	Determine coefficients for perfect reproduction filter banks and wavelets.
4	Choose parameters to take a wavelet transform, and interpret and process the result.
5	To analyze the different wavelet transformation techniques
6	Apply the algorithms for wide area of recent applications

Assessment Method

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

20ECXY15	**Artificial Neural Networks**	**PEC**	**3L: 0T: 0P**	**3 credits**

Course Objectives

1. Principles of neuro computing with artificial neuralnetworks.
2. Supervised and unsupervisedlearning.
3. Connectionistarchitectures.

Course content

Unit -I **(6 hours)**

Introduction to Artificial Neural Networks

Artificial Neura Networks and Applications, ANN usefulness and capabilities, Equivalent electrical model, Artificial Neural Model and Linear Regression, Gradient Descent Algorithm, Nonlinear activation units and learning mechanisms, Basic learning rules, Leaning Mechanisms(Hebbian, Competitive, Boltzmann), classifications of Synaptic modification.

Unit-II **(8 hours)**

Associative Memory and Dimensions

Stochastic learning algorithm, Characteristics of associative memory, Associative memory model, Matrix Memory, Condition for Perfect recall, Statistical aspects of learning, properties of regressive model, Neural measure of effectiveness, V.C dimension, Shattering, Importance of V.C dimensions.

Unit-III **(8 hours)**

Perception and Baye's classifier

Single layer perception, Gauss- Newton's method, Linear filter, Ergodic process, Least Mean Square Algorithm, Convergence Consideration in LSM algorithm, Perceptron Convergence Theorem, Bayes classifier and Perceptron, Bayes classifierfor Gaussian distribution, Comparison between Baye's classifier and perceptron, Multilayer perceptron.

Unit-IV **(8 hours)**

Back propagation algorithm

Back propagation algorithm, practical consideration in back propagation algorithm, Modes of training, Solution of Non-Linearity separable problems using MLP, Heuristics for Back Propagation, Mean and Variance induced local field, Multi-Class classification using Multilayered perceptrons.

Unit-V **(7hours)**

Radial Basis Function networks

Cover's Theorem, RBF networks, separability and interpolation, types of phases, RBF as ill-posed surface reconstruction, Regularization, Solution of regularization equation : greens function, Use of greens function in regularization networks, Generalized RBF, Comparison between MLP and RBF, Learning mechanisms in RBF.

Unit-VI **(8 hours)**

Introduction principle components and analysis

Dimensionality Reduction Using PCA, Types of transformation, Hebbian-Based principle component analysis, Generalized Hebbian Algorithm, Introduction to Self organizing maps, Essential process in the formation of self organizing maps, Cooperative and adaptive processes in SOM, 2-D lattice, Vector quantization using SOM, Optimum encoder anddecoder.

Learning resources

Text Books

1. Laurene V. Fausett ,*'Fundamentals of Neural Networks: Architectures, Algorithms and Applications'*, Pearson publications.

Reference Books

1. S. Sivanandam, *'Introduction to Neural Networks using MATLAB'*, Tata McGraw Hillpublications.

Web Resources

1. Prof.S.Sengupta, NPTEL-IIT Kharagpur, ' *Neural Networks'*. URL:http://nptel.ac.in/courses/117105084

Course Outcomes:

The students will be able to

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CO1	Neuro computing with artificial neural networks widely used for addressing real-world problems such as classification, regression, pattern recognition, data mining, time-series modeling, etc..
CO2	Unsupervised learning is studied using Kohonen networks. Recurrent networks of the Hopfield type are briefly covered.
CO3	There are offered contemporary parameter training techniques for all these

	connectionist architectures
CO4	Program implementations of the studied neural networks are provided inMatlab, and applied to classification, regression and time seriesdata.

Assessment Method:

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

20ECXY16	Bio Medical Signal Processing	PEC	3L: 0T: 0P	3 credits

Course Objectives:

1. Fundamental tools that are used to describe, analyze and process biomedical signals.
2. Fundamental principles in the analysis and design of filters, power spectral density estimation and non-stationary signal processing techniques with applications to biomedical signals will betaught.

SYLLABUS:

Unit –I **(6hours)**

Human body as a system, Building blocks, Biomedical signal origin & dynamics. (EEG, EMGetc.)

Unit-II **(8 hours)**

Filtering for Removal of artifacts Statistical Preliminaries; Time domain filtering (Synchronized Averaging, Moving Average). Filtering for Removal of artifacts contd. Time domain filtering (Moving Average Filter to Integration, Derivative-based operator), Frequency Domain Filtering (NotchFilter)

Unit-III **(8 hours)**

Filtering for Removal of artifacts contd. Optimal Filtering: The Weiner Filter. Filtering for Removal of artifacts contd. Adaptive Filtering Selecting Appropriate Filter

Unit-IV **(8 hours)**

Event Detection Example events (viz. P, QRS and T wave in ECG) Derivative based Approaches for QRS Detection Pan Tompkins Algorithm for QRS Detection. Event Detection contd. Dicrotic Notch Detection Correlation Analysis of EEG Signal.

Unit-V **(8 hours)**

Waveform Analysis Illustrations of problem with case studies Morphological Analysis of ECG Correlation coefficient The Minimum phase correspondent and Signal Length. Waveform Analysis contd. Envelop Extraction Amplitude demodulation The Envelogram Analysis of activity Root Mean Square value Zero-crossing rate Turns Count, Form factor.

Unit-VI **(7 hours)**

Frequency-domain Analysis Periodogram. Frequency-domain Analysis Averaged Periodogram Blackman-Tukey Spectral Estimator Daniells Spectral Estimator Measures derived from PSD.

Learning Resources

Text books

1. R M Rangayyan "Biomedical Signal Analysis: A case Based Approach", IEEE Press, John Wiley & Sons. Inc, 2002
2. Willis J. Tompkins "Biomedical Digital Signal Processing", EEE,PHI, 2004

Reference books

1. D C Reddy "Biomedical Signal Processing: Principles and Techniques", Tata McGraw-Hill Publishing Co. Ltd, 2005
   J G Webster "Medical Instrumentation: Application&Design", John Wiley & Sons Inc., 2001
3. C Raja Rao, S K Guha "Principles of Medical Electronics and Biomedical Instrumentation", Universities Press, 2001

Web References

1. Prof.Sudipta Mukhopadhyay, NPTEL-IIT Kharagpur '*Biomedical signal processing*', URL:https://nptel.ac.in/courses/108105101/

Course Outcomes

The students will be able to

CO 1	Analyze the design techniques involved for digital filters
CO 2	Identify the bio-signals
CO 3	Understand special techniques like Heart rate variability Analysis

Assessment Method

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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20ECXY17	**Digital Image Processing**	**PEC**	**3L: 0T: 0P**	**3 credits**

Course Learning Objectives

1. Students should able to understand fundamental technologies for digital image compression, analysis andprocessing.
2. Student should able to learn necessity of digital image and reconstruction of digital image
3. Student should able to know how to transform the images by using image transformation techniques
4. Student should able to understand the need for image transforms and their image enhancement.
5. Students should able to know the colour image processing techniques and their image segmentationmethods.

Course Content

Unit -I **(7 hours)**

Introduction to Digital image Processing and Image Digitization

Need of Image processing, Applications, Introduction to Video Sequence processing, Image compression, Image representation, Steps in Digital Image processing, Need of digitization, Image as matrix of Numbers, Sampling, Signal Reconstruction from Samples, Convolution, 2D sampling, Image Quantization, Quantization error, Quantizer, Design. Relationships between pixels.

Unit -II **(8hours)**

Basic Transformations and Image Interpolation

Translation, rotation, scaling, Camera Model and Image Geometry, Camera Calibration and Stereo Imaging, Stereo Image modeling, Interpolation and Resampling, B-spline interpolation Functions, Constant interpolation, Image Transformation, DCT Basis Images, Walsh Transform, HadamardTransform

Unit-III **(7 hours)**

Image Transforms

Image Transformation, Basis Images, Fourier Transformation, Discrete Cosine Transform, Walsh Transform, Hadamard Transform. K- L Transform.

Unit-IV **(7hours)**

Image Enhancement and Image Restoration

Necessity of Image Enhancement, Spatial Domain Operations, Frequency domain operations, Power law transformation. Image Enhancement frequency. Image Restoration and Restoration techniques, Image Registration.

Unit-V **(8 hours)**

Colour Image Processing and Image Segmentation

Primary and Secondary Colours, Chromaticity diagram and its use, RGB color model, HIS color model, Conversation from one model to another, Pseudo Color Image processing, Colour and intensity modifications, Image Segmentation, Linking of edge points, Threshold Technique, Region basedSegmentation.

Unit-VI **(8 hours)**

Mathematical Morphology and Object Representation and Description.

Morphological Image processing Techniques: Dilation, Erosion, Opening, Closing. Applications Hit or Miss Transform, Image under Standing Techniques, Boundary based Descriptions, Region based Descriptions, Recognition techniques: Using shape number, Feature based Techniques, Neural basedTechnique.

Learning Resources

Text books

1. Rafel C. Gonzalez and Richard E. woods, '*Digital Image Processing*', Pearson publishers

Referencebooks

1. Anil K. Jain , '*Fundamentals of Digital ImageProcessing* ', Prentice Hall (1989).

Web Resources

1. Prof. P.K Biswas, NPTEL-IIT Kharagpur, *'DigitalImageProcessing'*, URL:http://nptel.ac.in/courses

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

CO 1	The course will cover techniques and tools for digital image processing, and finally also introduce image analysis techniques in the form of image segmentation.
CO 2	The course is primarily meant to develop on-hand experience in applying these tools to process these images. Hence the programming assignments form a key component of this course

CO 3	The students would be encouraged to develop the image processing toolsfrom scratch, rather than using any image processing library functions.
CO 4	Students will also get an opportunity to familiarize with Open CV image processing library.
CO 5	Emphasis will be to develop engineering skills and intuitive understanding of the tools used in Image Processing.
CO 6	Select feature extraction techniques for image analysis and recognition.

Assessment Method:

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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20ECXY18	**Digital Voice and Picture Communication**	**PEC**	**3L: 0T: 0P**	**3 credits**

Course Learning Objectives

1. To understand speech model and different quantizationmodels.
2. To understand Digital TV (picture signal) communication, characteristics, and coding.
3. To study applications of: Low resolution TV, mobile TV, audio/ video conferencing, video telephony.

Course Content

Unit-I **(6 hours)**

Speech production model, Speech coding, Sampling of speech, Quantizers for speech signal, Uniform and non-uniform quantizer, Mew law and optimum quantizer, Adaptive quantizer, Differentialquantization.

Unit-II **(8 hours)**

Linear delta modulation and adaptive delta modulation, Differential PCM, Adaptive prediction, Linear prediction of speech, Computational aspect of LPC (Linear Predictive Coding) parameters, Cholasky decomposition, Lattice formulation of LPC coefficient, Linear predictive synthesizer, LPC vocoder.

Unit-III **(8 hours)**

Introduction to image and video coding, Lossy image compression, Discrete cosine transform (DCT), DCT quantization and limitations, Theory of wavelets, Discrete wavelet transform, Multi resolution analysis, DWT on the images and its encoding, Embedded zero tree waveletencoding.

Unit-IV **(8hours)**

Introduction to video coding, Basic building blocks in video coding, Conventional video and streaming video, Hybrid video coding, video decoding, Motion estimate technique, Fast motion estimationtechnique.

Unit-V **(8 hours)**

Video coding standards, Advanced coding aspects, Profile and levels, Macro blocks, Slice and slice types, Audio coding basic concepts, Audio coding AC-3 techniques, AC-3 decoding techniques, MPEG-1 audio coding and decoding techniques.

Unit-VI **(7 hours)**

Introduction to VOIP, VOIP signal processing (H.323 protocol), H.323 call controls and enhancements, Interworking with PSTN limitations and solution, Multiplexing schemes, H.323 multiplexing, Header compression and BW, ISDN video conferencing, SIP protocol, 4G multimediaconferencing.

Learning resources

Text books

1. L.R. Rabiner, Digital Processing of SpeechSignals
2. Kondoz, Digital Speech: Coding for low bit rate communication systems; John Wileypublication

Reference Books

1. Jacob Benesty, M. Mohan Sondhi, Yiteng Huang, Handbook of Speech Processing, Springer
2. K.R. Rao, Z. S. Bojkovic, D. A. Milovanovic, Introduction to Multimedia Communications Applications, Middleware, Networking, Wileypublication.

Web resources

1. Prof S Sengupta, NPTEL-IIT Kharagpur,*Digital Voice And Picture Communication*', URL: http://nptel.ac.in/courses/117105081

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

CO 1	Extract data form the lossy images.
CO 2	Differentiate between different audio and video standards.
CO 3	Analyze the image in different aspects.
CO 4	Analyze the video and audio vide codecs
CO 5	Analyze modulation techniques
CO 6	Analyze advanced voice and video protocols

Assessment Method

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

20ECXY19	Estimation of Signals and Systems	PEC	3L: 0T: 0P	3 credits

Course Objectives

1. Signal detection and estimation is the area of study that deals with the processing of information-bearingsignals.
2. Applications of the theory of signal detection and estimation are in many areas, such as communications, automatic control, radar/ sonar, speech and image processing and medical signalprocessing.
3. In general, detection and estimation applications involve making inferences from observations that are distorted or corrupted in somemanner.
4. Cast detection and estimation problems in a probabilistic framework in which unknown behavior is assumed to berandom.

Course Content

Unit –I **(6hours)**

Introduction, Probability Theory, Random Variables, Function of Random Variable Joint Density, Mean and Variance.

Unit-II **(7 hours)**

Random Vectors Random Processes, Random Processes and Linear Systems, Some Numerical Problems, Miscellaneous Topics on Random Process, Linear Signal Models.

Unit-III **(8 hours)**

Linear Mean Square Error Estimation, Auto Correlation and Power Spectrum Estimation-Transform Revisited Eigen Vectors/Values, The Concept of Innovation, Last Squares Estimation Optimal IIR Filters.

Unit-IV **(8 hours)**

Introduction to Adaptive Filters, State Estimation, Kalman Filter-Model and Derivation, Estimator Properties

Unit-V **(8hours)**

The Time-Invariant Kalman Filter, Kalman Filter-Case Study, System identification Introductory Concepts, Linear Regression-Recursive Least Squares, Variants of LSE

Unit-VI **(8 hours)**

Least Square Estimation, Model Order Selection Residual Tests, Practical Issues in Identification, Estimation Problems in Instrumentation and Control Conclusion

Learning resources

Text Books

1. H. L. Van Trees, "*Detection, Estimation and Modulation Theory: Part I, II and III*", John Wiley, NY,1968.
2. H. V. Poor, "*An Introduction to Signal Detection and Estimation*", Springer, 2/e, 1998.

Reference Books

1. S. M. Kay, "*Fundamentals of Statistical Signal Processing: Estimation Theory*", Prentice Hall PTR,1993.
2. S. M. Kay, "*Fundamentals of Statistical Signal Processing: Detection Theory*", Prentice Hall PTR,1998.

Web resources

1. Prof S Mukhopadhyay,NPTEL-IIT Kharagpur, 'Estimation of signals and systems'. URL: https://nptel.ac.in/courses/108105059/

Assessment Method:

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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20ECXY20	**Medical Image analysis**	**PEC**	**3L: 0T: 0P**	**3 credits**

Course Learning objectives

1. To provide students with an overview of the computational and mathematical methods in medical imageprocessing.
2. To learn medical image data analysis (CT, MRI, PET andUltrasound).
3. To learn current methods used to enhance and extract useful information from medicalimages.

Course content

Unit – I **(6 hours)**

Introduction to Medical Image analysis

Medical Image analysis and overview

Unit-II **(6 hours)**

Imaging and Clustering

X ray and CT Imaging, Magnetic Resonance Imaging, Ultrasound Imaging, Optical Microscopy and Molecular Imaging, Texture in Medical Images, Region Growing and Clustering.

Unit-III **(6 hours)**

Image Segmentation

Random Growing and Clustering, Random Walks for Segmentation, Active Contours for Segmentation, Systematic Evaluation and Validation, Decision Trees for Segmentation and Classification, Random Forests for segmentation andClassification.

Unit – IV **(10hours)**

Neural Networks for Segmentation

Simple neuron, Neural network formulation, Learning with error back propagation, Gradient checking and optimization.

Unit-V **(12hours)**

Medical Image Analysis

Medical Image processing using MATLAB

Case study: Finding parasitic infections with MATLAB: Explore and manage a range of real-world image sets, Solve challenging image processing problems with user interfaces, Develop familiarity with simple to advanced image segmentation approaches, Classify parasitic infections using machine learning techniques

Unit-VI **(5 hours)**

Applications

Retinal Vessel Segmentation, Vessel Segmentation in Computed Tomography Scan of Lungs, Tissue Characterization in Ultra sound.

Learning Resources

Text books

1. Atam P. Dhawan, '*Medical imageanalysis*', IEEE Press Series onBiomedical Engineering.
2. G. Dougherty, '*Medical Image Processing*', *Springer*, 2011.

Reference Books

1. K.D.Toennies,'*Guide to Medical Image Analysis*',Springer, 2012.
2. T. M. Deserno, '*Biomedical Image Processing*', *Springer*,2011.
3. A. Criminisi, J. Shotton, '*Decision Forests for Computer Vision and Medical Image Analysis*', Springer,2013.

Web resources

1. Prof. Debdoot Sheet,NPTEL- IIT Kharagpur,*Medical ImageAnalysis* ', URL: http://nptel.ac.in/courses/108105091
2. URL:https://www.mathworks.com/videos/medical-imaging-workflows-with-matlab-81850.html
3. URL:https://www.mathworks.com/videos/medical-image-processing-with-matlab-81890.html

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

CO 1	Exposure to a variety of radiological diagnostic scenarios with examples
CO 2	Analyze medical image outputs of X-Ray, MRI scan, CT scan etc
CO 3	Analyze image segmentation mechanisms
CO 4	Application of specific image processing techniques for medical diagnosis
CO 5	Application of Neural networks for medical image analysis
CO 6	Application of MATLAB for medical image analysis

Assessment Method:

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

20ECXY21	**Pattern Recognition and applications**	**PEC**	**3L: 0T: 0P**	**3 credits**

Course Learning Objectives

1. To understand the mathematical approach for patternrecognition.
2. To apply neural networks for patternrecognition.
3. To learn to apply pattern recognition for resolving real timeproblems

Course content

Unit-I **(7 hours)**

Polynomial curve fitting The curse of dimensionality - Decision theory- Information theory - The beta distribution - Dirichlet distribution-Gaussian distribution The exponent family: Maximum likelihood and sufficient statistics -Non-parametric method: kernel- density estimators - Nearest neighbormethods.

Unit-II **(8hours)**

Linear models for regression and classification: Linear basis function models for regression -Bias variance decomposition-Bayesian linear regression - Discriminant functions- Fisher's linear discriminant analysis(LDA)- Principal ComponentAnalysis (PCA) - Probabilistic generative model - Probabilistic discriminative model.

Unit-III **(8 hours)**

Kernel methods: Dual representations-Constructing kernels-Radial basis function networks-Gaussian process-Maximum margin classifier (Support Vector Machine) – Relevance Vector Machines-Kernel-PCA,Kernel-LDA.

Unit-IV **(8 hours)**

Mixture models: K-means clustering - Mixtures of Gaussian - Expectation-Maximization algorithm- Sequential models: Markov model, Hidden-Markov Model (HMM) - Linear Dynamical Systems (LDS).

Unit-V **(8 hours)**

Neural networks: Feed- forward Network functions-Network training - Error Back propagation - The Hessian Matrix - Regularization in Neural Network - Mixture density networks – Bayesian NeuralNetworks

Unit-VI **(6 hours)**

Applications: Speech recognition, Character and handwriting recognition. Analysis of biological sequences

Learning Resources

Text Books

1. C.M.Bishop, *'Pattern recognition and machine learning'*,Springer,2006
2. J.I.Tou& R.C. Gonzalez, *'Pattern Recognition Priciples'*, Addsion –Wesley Publishing company

Reference books

1. Richard O. Duda, Peter E. Hart and David G. Stork, "*Pattern Classification*", John Wiley & Sons,2001.
2. EarlGose, Richard Johsonbaugh and Steve Jost, "*Pattern Recognition and Image Analysis*", Prentice Hall,1999.

Web resources

1. Prof.P.K.Biswas, NPTEL- IIT Kharagpur, '*Patternrecognition* ', URL: http://nptel.ac.in/courses/117105101

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

CO 1	summarize the various techniques involved in pattern recognition
CO 2	identify the suitable pattern recognition techniques for applications
CO 3	apply performance evaluation methods for pattern recognition, and critique comparison of techniques
CO 4	apply pattern recognition techniques to real-world problems such as document analysis and recognition.
CO 5	implement simple pattern classifiers, classifier combinations, and structural pattern recognizers.
CO 6	summarize the artificial neural network based pattern recognition techniques

Assessment Method:

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

20ECXY22	Analog IC Design	PEC	3L: 0T: 0P	3 credits

Course Learning Objectives

1. To learn basics of negative feedback amplifiers and itscharacteristics
2. To learn broad coverage in the field that is relevant linear circuits using opamps.
3. Understand the applications ofop-amps
4. To learn the different noises present in transistors andresistors
5. To learn how to design single endedop-amps

Course Content

Unit –I **(8 hours)**

Negative feedback systems and stability

Negative feedback amplifier using an integrator, Frequency and time domain behavior, Loop gain and its implications, Negative feedback amplifier realization, Finite DC gain, Increasing DC gain, Effect of multiple poles, Negative feedback systems with multiple poles and zeros in the forward path, Stability analysis using Nyquist criterion, Nyquist criterion, Loop gain-Bode plot and time domain interpretation, Significance of 60 degree phasemargin

Unit –II **(8 hours)**

Opamp at the block level: Frequency compensation

Concept of the opamp for realizing negative feedback circuits, Realizing a multi stage opamp-frequency compensation-miller opamp, Realizing a multi stage opamp, feed forward compensated opamp, Opamp as a general block, unity gain compensation, non idealities-swing limits, slew rate, offset, dc negative feedback aroundop-amps

Unit –III **(8hours)**

Opamp amplifiers

Amplifiers using Miller compensated opamp, Effect of input capacitance, gain bandwidth product, Transimpedance amplifier, lead-lag compensation, Inverting and non inverting amplifiers-CMRR and its importance

Unit –IV **(5hours)**

Noise in resistors, MOS transistors and matching

Noise models, Noise calculations, Noise scaling, IC components and their models, Mismatch, Layout considerations. Body effect in basic amplifier stages, Frequency response of a common sourceamplifier

Unit –V **(8hours)**

Single ended opamp design

Realizing a single stage opamp-diff pair, small signal ac analysis, Single stage opamp-mismatch and noise, Single stage opamp-telescopic cascode, Replica biasing a cascode, Single stage opamp-folded cascode, Two stage miller compensated opamp, Three stage opamp, CMRR of an opamp and opamp circuits.

Unit –VI **(8hours)**

Fully differential opamp design

Fully differential opamps, Differential and common mode half circuits, common mode feedback, Fully differential miller compensated opamp-common mode feedback loop and its stability, Fully differential single stage opamp, Fully differential telescopic cascodeopamp, Fully differential feed forward compensatedopamp.

Learning Resources:

Text book

1. Behzad Razavi, '*Design of Analog CMOS Integrated Circuits'*,McGraw-Hill

Reference books

1. Jim Williams, Newnes*"Analog Circuit Design*: Art, Science and Personalities (EDN Series for Design Engineers) (Paperback),, Reprint edition,1991.
2. David Johns and Ken Martin *"Analog Integrated Circuit Design*, , John Wiley & Sons,1997.

Web Resource

1. Prof S Aniruddhan, NPTEL-IIT Madras, *'Analog IC Design'*, URL:https://nptel.ac.in/courses/108106105/
2. Prof Behzad Razavi, *'Lecture series on Analog Electronics-2'* URL:https://www.youtube.com/playlist?list=PLO4mxQzfcml_56XSGcA8ULOv7qEtZd0Hy

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

CO 1	How to design negative feedback systems
CO 2	How to draw the frequency response of op amp.
CO 3	Design the applications of op amp.
CO 4	Identify different noises present in analog circuit design
CO 5	Design of single ended opamp
CO 6	Design of differential amplifier

Assessment Method

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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20ECXY23	Digital IC Design	PEC	3L: 0T: 0P	3 credits

Course Learning Objectives

The objective of the course is to provide students with a basic understanding of the integrated circuit devices namely combinational and sequential circuits by using CMOS

Course Content

Unit -I **(3 hours)**

A Historical Perspective, Issues in Digital Integrated Circuit Design, Quality Metrics of a Digital Design, Cost of an Integrated Circuit, Functionality and Robustness, Performance, Power and Energy Consumption.

Unit -II **(5hours)**

Introduction, Interconnect Parameters Capa~~cit~~tance, Resistance, and Inductance, Capacitance, Resistance, Inductance, Electrical Wire Models, The Ideal Wire, The Lumped Model, The Lumped RC model, The Distributed RC Line, The Transmission Line

Unit -III **(10hours)**

Introduction, The Static CMOS Inverter An I~~ntu~~itive Perspective, Evaluating the Robustness of the CMOS Inverter: The Static Behavior, Switching Threshold, Noise Margins, Performance of CMOS Inverter: The Dynamic Behavior, Computing the Capacitances, Propagation Delay: First-Order Analysis, Propagation Delay from a Design Perspective, Power, Energy, and Energy-Delay, Dynamic Power Consumption, Static Consumption

Unit -IV **(8 hours)**

Introduction, Static CMOS Design, Complementary CMOS, Rationed Logic, Pass-Transistor Logic, Dynamic CMOS Design , Dynamic Logic: Basic Principles, Speed and Power Dissipation of Dynamic Logic , Issues in Dynamic Design, Cascading Dynamic Gates, Perspectives, Designing Logic for Reduced Supply Voltages

Unit -V **(10hours)**

Introduction, Timing Metrics for Sequential Circuits, Classification of Memory Elements, Static Latches and Registers, The Bistability Principle, Multiplexer-Based Latches, Master-Slave Edge-Triggered Register, Low-Voltage Static Latches, Static SR Flip- Flops Writing Data ~~by~~ Pure Force, Dynamic Latches and Registers, Dynamic Transmission-Gate Edge-triggered Registers, C2MOS A Clock-Skew Insensi~~tive~~

Approach, True Single-Phase Clocked Register (TSPCR), Alternative Register Styles, Pulse Registers Sense-Amplifier Based, Registers , Pipelining: An approach to optimize sequential circuits, Latch- vs. Register-Based Pipelines, NORA-CMOS A Logic Style for Pipelined Structures, Non-Bistable SequentialCircuits

Unit –VI **(9hours)**

Introduction, Memory Classification, Memory Architectures and Building Blocks, The Memory Core, Read-Only Memories Nonvolatile Read-Write Memories, Read-Write Memories (RAM), Contents-Addressable or Associative Memory (CAM), Memory Peripheral Circuitry, The Address Decoders, Sense Amplifiers Voltage References, Drivers/Buffers, Timing and Control, Memory Reliability and Yield, Signal-To-Noise Ratio, Memory yield, Power Dissipation in Memories, Sources of Power Dissipation in Memories, Partitioning of the memory, Addressing the Active PowerDissipation.

Learning Resources

Text Books

1. Jan M. Rabaey ,AnanthaChandrakasan and Borivoje Nikolic *'Digital Integrated Circuits'*- A Design Perspective (Second Edition)

Web Resources

1. Prof Jan Rabaey,*Digital Integrated Circuits Jan Rabaey Lecture series'*,URL: https://www.youtube.com/playlist?list=PLB3i9IKhwBX8EEkgSy0AjaRFCmY2gBiQc

Course outcomes: At the end of this course student will able to

CO 1	Understand the practical aspects of Digital IC Design
CO 2	Understand the concepts of Static and Dynamic CMOS logic design
CO 3	Understand the timing issues of design
CO 4	Analyse the power dissipation issues in circuits
CO 5	Optimize the design considering the concepts of pipelining
CO 6	Understand the concept of memory cell design at transistor level abstraction

Assessment Method

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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20ECXY23	Digital VLSI System Design	PEC	3L: 0T: 0P	3 credits

Course Learning Objectives:

1. To learn how to formulate ASM charts for sequential and combinationalcircuits.
2. To learn how to design thememories
3. To learn pipelining and parallelism concepts of differentarchitectures
4. To learn how to design the DCTQprocessor.
5. To learn implementations using FPGAdevice

Course Content:

Unit -I **(8 hours)**

Algorithmic State Machines: Components of ASM Chart, ASM for Binary Multiplier, ASM for weighing machine, ASM for Bus Arbiter, Arithmetic Mean, Sort operation

Unit -II **(6hours)**

Design of Memories

On-Chip dual address ROM Design and Verilog implementation, Single Address ROM Design and Verilog implementation, On-Chip Dual RAM Design

Unit -III **(8 hours)**

Design of Arithmetic Circuits

Principle of pipelining, partitioning of a design, serial signed adder design, parallel signed adder design , parallel and pipelined multiplier design and Verilog implementations

Unit -IV **(8 hours)**

Design of a Discrete Cosine Transform and Quantization Processor

DCTQ processor block diagram, Signal description of DCTQ processor , Architecture of DCTQ processor, Verilog code for DCTQ Datapath and Control path, verification of DCTQ processor

Unit -V **(10hours)**

RT Level Design

Sequential Multiplier -shift and add multiplication process , sequential multiplier design , multiplier testing, Von Neumann Computer Model-processor model specification, designing the adding CPU, design of data path and control path, testing adding CPU, CPU Design and Test- details of processorfunctionality.

Unit –VI **(5hours)**

Hardware Implementations using FPGA and I/O Boards

FPGA board features, features of Digital Input/output board, Traffic light controller design and implementation on FPGA, Real Time clock design and implementation on FPGA, Projects for implementation on FPGA.

Learning resources

Text book:

1. S.Ramachandran, '*Digital VLSI SystemsDesign* ', Springer Publications.
2. Zainalabedin Navabi, '*Verilog Digital SystemDesign* '

Web Resources:

1.P rof S Srinivasan, IIT Madras, '*VLSI Circuits*'.
URL: http://nptel.ac.in/courses/117106092

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

CO 1	Formulation of ASM charts for digital systems
CO 2	Demonstrate the computer memories and implementing on FPGA board
CO 3	Understanding the RTL guidelines in digital system design
CO 4	Design of DCTQ processor using FPGA
CO 5	FPGA implementation of memory systems
CO 6	Practical aspects involved in FPGA design of digital systems

Assessment Method

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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20ECXY25	Electronics Systems Packaging	PEC	3L: 1T: 0P	4 credits

Course Learning objectives

1. Students shall learn about the packagingevaluations
2. Students shall learn about the current trends inpackaging
3. Students shall learn about the electrical issues and routing techniques
4. StudentsshalllearnaboutCADtoolsandPCBfabricationtechniques
5. Students shall learn about the designissues
6. Students shall learn about the thermal design considerations in thepackaging

Course Content

Unit-I **(6hours)**

Introduction, history of semiconductors, Packaging aspects of handheld products, Case studies in applications, Wafer fabrication, inspection and testing, Wafer packaging, Packaging evolution; Chip connection choices, Wire bonding, TAB and flip-chip.

Unit-II **(7 hours)**

Introduction, Single chip packages or modules (SCM), Commonly used packages and advanced packages; Materials in packages, Advances packages (continued); Thermal mismatch in packages; Current trends in packaging, Multichip modules (MCM)-types; System in package (SIP);Packaging roadmaps; Hybrid circuits.

Unit-III **(8 hours)**

Electrical Issues- Resistive Parasitic, Capacitive and Inductive Parasitic, Layout guidelines and the Reflection problem, Interconnection. Introduction to DFM, DFR & DFT, Components of a CAD package and its highlights, Design Flow considerations, Beginning a circuit design with schematic work and component layout, examples of layout and routing; Technology file generation from CAD; DFM check list and design rules; Design for Reliability

Unit-IV **(8hours)**

Review of CAD output files for PCB fabrication; Photo plotting and mask generation, Process flow-chart, PWB substrates, Substrates continued, Video highlights; Surface preparation, Photo resist and application methods, UV exposure and developing, printing technologies for PWBs PWB etching; Resist stripping, Screen-printing technology, Through-hole manufacture process steps; Panel and pattern plating methods, Video

highlights on manufacturing,Solder mask for PWBs;Multilayer PWBs; Introduction to microvias, Microvia technology and Sequential build-up technology process flow for high-density interconnects, Conventional Vs HDI technologies; Flexible circuits; Tutorial session.

Unit-V **(8hours)**

SMD benefits, Design issues; Introduction to soldering, Reflow and Wave Soldering methods to attach SMDs, Solders; Wetting of solders; Flux and its properties, Defects in wave soldering, Vapour phase soldering, BGA soldering and Desoldering/ Repair, SMT failures, SMT failure library and Tin Whisker, Tin-lead and lead-free solders, Phase diagrams; Thermal profiles for reflow soldering; Lead-free alloys, Lead-free solder considerations; Green electronics; RoHS compliance and e-waste recycling issues.

Unit-VI **(8 hours)**

Thermal Design considerations in systems packaging, Introduction to embedded passives; Need for embedded passives; Design Library; Embedded resistor processes, Embedded capacitors, Processes for embedding capacitors; Case study examples; Summary of materials in packaging.

Learning resources

Textbooks

1. Rao R. Tummala, '*Fundamentals of Microsystems Packaging*', McGraw Hill, NY, 2001.

Reference books

1. William D.Brown, '*Advanced Electronic Packaging*', IEEE Press,1999.
2. William Trimmer, '*Micromechanics and MEMS: Classic and Seminal Papers to 1990*' by, IEEE Press, IEEE Number PC4390, ISBN 0-7803-1085-3, NewYork.

Web resources

1. Prof G V Mahesh, NPTEL-IISc Bangalore, 'An Introduction to Electronics Systems Packaging', URL:http://nptel.ac.in/syllabus/108108031/

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

CO 1	Understand the evaluation of the packaging techniques
CO 2	Understand the underlying concepts in the current trends in the packaging
CO 3	Understand the underlying concepts in the electrical issues in the packaging
CO 4	Understand the underlying concepts in the PCB fabrication
CO 5	Understand the underlying concepts in the Design issues
CO 6	Understand the underlying concepts in the thermal issues in the packaging

Assessment Method:

Assessment Tool	Weekly tests/Assignments (In semester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

20ECXY26	Embedded Systems	PEC	3L: 0T: 0P	3 credits

Course Learning Objectives:

1. Students shall learn about evaluation of embeddedsystems
2. Students shall learn about PICUnit
3. Students shall learn about ARMprocessors
4. Students shall learn about DSPprocessors
5. Students shall learn about software limitations in embeddedsystems
6. Students shall learn about networking of embeddedsystems

Course Content

Unit –I **(6hours)**

Overview of Embedded Systems, Embedded System Architecture, Processor examples: ARM,PICetc, Introduction to Embedded Hardware, Overview of micro controller and micro-processor, Vonnueuman Architecture, Hardvard Architecture, Advanced Hardvard Architecture, Introduction to PIC microcontroller.

Unit-II **(10 hours)**

Instruction format, Addressing modes, Instructions, Data transfer instructions, Arithmetic and Logical instructions, Bit oriented instructions, Control instructions, Assembly language programming, Interrupts in PIC, Interrupts timing, PIC input output pins, PIC timers, Watchdog timer, PWM mode in PIC, PIC peripherals, PICexamples.

Unit-III **(10hours)**

History, ARM Architecture and its versions, Basic ARM organization, Registers and its organization, Processor modes, Memory Organization, ARM Instruction set, ARM Data types, ARM interrupt processing, Stack organization, ARM input output system, Pipeline operation in ARM, Simple ARM based systems.

Unit-IV **(8 hours)**

Features of digital signal processors, DSP applications and DSP algorithms, DSP memory, Instruction sets and parallel instructions, System on chip, Memory, Memory organization, Virtual memory, Memory management Unit, BUS structure, Serial interfaces, Power awarearchitecture.

Unit-V **(6 hours)**

Requirement and features of software for embedded systems, Usage of C and java and its limitations, Fundamentals of embedded operating systems, Scheduling policies, Resource management, Embedded OS.

Unit-VI **(5 hours)**

Network embedded systems, Distributed embedded systems and its Architecture, Multi-processor networks, Ethernet and its features, Hardware modules, Protocols.

Learning Resources:

Textbooks

1. Wayne Wolf, *'Computers as components: Principles of Embedded Computing System Design'*, Morgan Kaufman publication, 2000.

Reference books:

1. Andrew Sloss, Dominic Symesm Chirs Wright, *'ARM System Development's Guide Designing and Optimizing System Software '*, Morgan kaufman publication, 2004.
2. JohnB.Peatman, *'Design with PIC microcontroller'*, Pearson Education Asia,2002.
3. Tim Wilmshurst,*'The DesignofSmall –Scale embedded systems'*, Palgrave2003
4. Marwedel, *'Embedded System Design'*, Peter, Kluwer Publisher,2004

Web resources:

1. Dr. Santanu Chaudhury, NPTEL-IIT Delhi, 'Embedded Systems', URL: https://nptel.ac.in/courses/108102045/

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

CO 1	Understand evaluation of embedded systems
CO 2	Analyse the PIC Unit
CO 3	Analyse the ARM processors
CO 4	Analyse the DSP processors
CO 5	Understand the software limitations in embedded systems
CO 6	Understand the networking of embedded systems

Assessment Method

Assessment Tool	Weekly tests/Assignments (In semester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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20ECXY27	Embedded System Software Testing	PEC	3L: 0T: 0P	3 credits

Course Learning Objectives

1. Students shall learn about Embedded Systems softwaretesting
2. Students shall learn about software testing methods
3. Students shall learn about software testing matrices
4. Students shall learn about Embedded Systemsintegration
5. Students shall learn about SCMactivities
6. Students shall learn about Embedded Systems software testingtools

Course Content

Unit-I **(8hours)**

Introduction of embedded systems and software testing, Marketing drivers, Role of testing, Key process elements for embedded software testing, Typical life cycle phase, Embedded C environment, Embedded testing setup, Prerequisites for embedded system testing, Test case design and procedures, Test standards, Depicting levels of testing, Software life cycle, Embedded V model life cycle, Nested V model life cycle, Master test planning.

Unit-II **(8 hours)**

Dynamic testing, Dynamic testing types, Black box testing, White box testing, Coverage aspects, Equivalance partitioning, State transition testing, State transition fault categories, Model based testing, Grey box testing, Testing tools-life cycle, Test automation and techniques, Risk based testing.

Unit-III **(8 hours)**

Static testing, Static vs dynamic testing, Static analysis, Static analysis tools, Coding standards, Sample rule, Stack overflow, Program inspection walkthrough and reviews, Test metrics, Test metrics life cycle and types, Software testingmetrics.

Unit-IV **(8 hours)**

Software integration goals and objectives, Top down integration and testing, Integration considerations, Integration strategy comparison, Bottom up testing, Layer integration, Client server integration, Collaboration integration, Integration testing environment, Generating test cases, Regression testing, Case diagram, Test casemaintenance.

Unit-V **(7 hours)**

Depicting levels of testing, Configure management elements, SCM activities, SCM phases, Different types of test processes related to software remodel, Introduction to EST and fundamentals oftesting.

Unit-VI **(6 hours)**

LDRA unit testing tool introduction, Static analysis tool by using C or C++, Target based testing, Level testing, Identification of test cases, Test line work flow.

Learning Resources

Textbooks

1. Bart Broekman and Edwin Note boom, '*Testing Embedded Software'*, Addison-Wesley.

Web Resources

1. Seer Akademi, NPTEL -MoU, IIT Madras, 'Embedded software Testing', URL: http://nptel.ac.in/courses/117106112

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

CO 1	Understand the embedded system software testing
CO 2	Understand the software testing methods
CO 3	Understand the software testing matrices
CO 4	Understand the embedded systems integration
CO 5	Understand the SCM activities
CO 6	Understand the embedded system software testing tools

Assessment Method

Assessment Tool	Weekly tests/Assignments (In semester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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20ECXY28	FPGA based System design	PCC	3L: 0T: 0P	3 credits

Course Objectives

1. Getting to know how to make an idea of digital system usingFPGA.
2. Exploring FPGA for different practicalapplications.

Course content

Unit-I **(6 hours)**

Introduction to FPGAs, difference b/w synthesizable and non-synthesizable constructs, learning different elegant Verilog styles and etc. and design of Digital clock on FPGA.

Unit-II **(6 hours)**

Image processing on FPGA: acquisition of image on to FPGA board, performing different simple image processing operations on FPGA.

Unit-III **(12 hours)**

Game Design: Various interconnections with FPGA i.e. Keyboard, UART communication, VGA and etc. How to create an animated picture on Display through FPGA and introduction to variousP-mods.

Unit-IV **(6 hours)**

CORDIC implementation: Learning how to implement CORDIC algorithm on FPGA and Discrete Fourier Transform, Fast Fourier Transform.

Unit-V **(7 hours)**

Machine learning Algorithms on FPGA: synthesizing machine learning algorithms using IEEE 754 floating point representation.

Unit-VI **(8 hours)**

Robotics Application: Replacing Arduino and RasPI with FPGA board for effective processing.

Learning resources

Textbooks/Reference books

1. FPGA Prototyping by Verilog examples: Xilinx Spartan 3 Version by Pong chu.

Course Outcomes:

CO1	Student will able to design digital systems independently on FPGA.
CO2	Student would be able to implement image processing, signal processing architectures on FPGA board.
CO3	Students would be able to implement game design algorithms along with audio, graphics integration.
CO4	Students would be able to implement machine learning algorithms and use them for robotics applications.

Assessment Method:

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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20ECXY29	Low Power Circuits and Systems	PEC	3L: 0T: 0P	3 credits

Course Content:

Unit-I **(6 hours)**
Basics of MOS circuits
MOS Transistor structure and device modeling , MOS Inverters, MOS Combinational Circuits

Unit-II **(6 hours)**
Sources of Power dissipation
Dynamic Power Dissipation, Short Circuit Power, Switching Power, Glitching Power, Static Power Dissipation, Degrees ofFreedom

Unit-III **(8 hours)**
Supply Voltage Scaling Approaches
Device feature size scaling, Multi-V_{dd} Circuits, Architectural level approaches: Parallelism, Pipelining, Voltage scaling using high-level transformations, Dynamic voltage scaling, PowerManagement

Unit-IV **(10hours)**
Switched Capacitance Minimization Approaches
Hardware Software Tradeoff, Bus Encoding, Two's complement Vs Magnitude, Architectural optimization, Clock Gating, Logicstyles

Unit-V **(8 hours)**
Leakage Power minimization Approaches
Variable-threshold-voltage CMOS (VTCMOS) approach, Multi-threshold-voltage CMOS (MTCMOS) approach, Power gating, Transistor stacking, Dual-Vt assignment approach (DTCMOS)

Unit-VI **(7 hours)**
Special Topics
Adiabatic Switching Circuits, Battery-aware Synthesis, Variation tolerant design, CAD tools for low powersynthesis

Learning resources

Textbooks

1. AjitPal, *'Low-Power VLSI Circuits and Systems'*, Springer publications.

2. Anantha P. Chandrakasan and Robert W. Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publishers,1995.

Reference books

1. Kaushik Roy and Sharat C. Prasad, Low-Power CMOS VLSI Design, Wiley-Interscience,2000.

Web resources

1. Prof AjitPal,NPTEL- IIT Kharagpur, 'Low Power VLSI Circuits & Systems'. URL:http://nptel.ac.in/courses/106105034/

Assessment Method:

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

20ECXY30	MEMS and Microsystems	PEC	3L: 0T: 0P	3 credits

Course Learning Objectives:

1. Students shall learn about the Importance of Micro Electronics & Micro sensors and Materials used.
2. Student shall learn about the clean roomtechnology.
3. Students shall learn about different fabricationsteps
4. Students shall learn about the different micro depositiontechniques
5. Students shall learn about the fabrication of discrete electroniccomponents
6. Students shall learn about different applications of microsensors.

Course Content

Unit-I **(6 hours)**

Introduction to Nano Technology & Nano Materials. Evaluation of Micro Electronics and Micro Sensors, Materials for Micro Electronics & Micro sensors, Electrical, Physical, Chemical, Optical and Thermal Properties of a materials used for Micro Electronics & Micro Sensors.

Unit-II **(6 hours)**

Silicon wafer manufacturing process, Wafer orientations, Electrical, physical, chemical, thermal and optical properties for different orientations. Clean room classifications, Clean room protocols.

Unit-III **(8 hours)**

Fabrication process flow: cleaning, oxidation, ion implantation, diffusion of atoms, patterning, different photo-resists, Mask Alignment, Lithography-types, etching-types.

UnitIV **(7 hours)**

Different deposition techniques: Spin coater, Sputtering unit, Thermal Evaporation, Atomic vapour deposition, LPCVD, CVD, Metallization, Waferbonding.

Unit V **(10hours)**

Fabrication of MOS capacitor, BJT, FET, PMOS, NMOS and CMOS.

UnitVI **(8 hours)**

Micro Machining techniques, Different Micro sensors, Different applications of Micro Electronics & Micro Sensors.

Learning Resources

Textbooks

1. Stephen D. Senturia, '*Microsystem Design'Kluwer*',Academic Publishers, 2001.

Reference books

1. Marc Madou,*Fundamentals ofMicro fabrication'*, CRC Press, 1997, ISBN 0-8493-94511.
2. Richard S. Muller, Roger T.Howe, Stephen D. Senturia, Rosemary L. Smith, and Richard M. White, '*Microsensors*', IEEE Press, IEEE Number PC 0257-6,ISBN 0-87942-254-9, New York, 1991.
3. M.H. Bao,*Micromechanical Transducers: Pressure sensors, accelerometers, and gyroscopes*', Elsevier, New York, 2000.
4. GregoryKovacs, *'Micro-machined Transducers Sourcebook'*, WCB McGraw-Hill, Boston, 1998, ISBN0-07-290722-3.
5. William Trimmer, '*Micromechanics and MEMS: Classic and Seminal Papers to 1990*' by, IEEE Press, IEEE Number PC4390, ISBN 0-7803-1085-3, New York.

Web resources

1. Prof SantiramKal, NPTEL-IIT Kharagpur, 'MEMS and Microsystems' URL:https://nptel.ac.in/courses/117105082/
2. Prof Shantanu Bhattacharya, NPTEL-IIT Kanpur, ' BioMEMS and Microfluids', URL:http://nptel.ac.in/courses/112104181/

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

CO 1	Understand about the importance of Micro Electronics
CO 2	Analyse the underlying fundamentals in Clean Room Protocols
CO 3	Understand the underlying fundamentals in Micro-fabrication procedures
CO 4	Understand the underlying fundamentals in Micro-fabrication procedures
CO 5	Apply the fabrication procedures for developing the discrete electronic components
CO 6	Analyse the different applications of Micro Electronics & Micro Sensors

Assessment Method

Assessment Tool	Weekly tests/Assignments (In semester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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20ECXY31	RF IC Design	PEC	3L: 0T: 0P	3 credits

Course Learning objective

This course will develop electronic circuits for radio frequency applications, specific to CMOS integrated circuits. Course will be specific to CMOS integrated circuits, and specific to radiofrequencies.

In particular, the course will focus on circuits for radio front-ends for mobile phone handsets. The course will cover low noise amplifiers, mixers, power amplifiers, frequency synthesizers (and phase locked loops). The course will also cover several modern radio architectures.

Course content

Unit –I **(6hours)**

RF systems –basic architectures, Transmission media and reflections, Maximum power transferPassive RLC Networks , Parallel RLC tank, Q , Series RLC networks, Matching, Pi match, T match , Passive IC Components , Interconnects and skin effect , Resistors, capacitors , InductorsReview of MOS Device Physics , MOS devicereview

Unit –II **(7 hours)**

Distributed Systems , Transmission lines, reflection coefficient , The wave equation, examplesLossy transmission lines ,Smith charts plotting gamma

Unit –III **(8hours)**

High Frequency Amplifier Design, Bandwidth estimation using open-circuit time constantsBandwidth estimation using short-circuit time constants, Risetime, delay and bandwidth ,Zeros to enhance bandwidthShunt-series amplifiers, tuned amplifiers Cascadedamplifiers

Unit –IV **(8hours)**

Noise ,Thermal noise, flicker noise review ,Noise figure ,LNA Design ,Intrinsic MOS noise parameters , Power match versus noise match , Large signal performance, design examples & Multiplier based mixers ,Subsampling mixers , RF Power Amplifiers, Class A, AB, B, C amplifiers , Class D, E, F amplifiers RF Power amplifier designexamples

Unit –V **(8hours)**

Voltage controlled oscillators, Resonators, Negative resistance oscillators, Phase locked loops, Linearized PLL models , Phase detectors, charge pumps , Loop filters, PLL design examples

Unit –VI **(8hours)**

Frequency synthesis and oscillators, Frequency division, integer-N synthesis, Fractional frequency synthesis ,Phase noise ,Radio architectures ,GSM radio architectures ,CDMA, UMTS radio architectures.

Learning resources

Text Books

1. The Design of CMOS Radio-Frequency Integrated Circuits by Thomas H. Lee. Cambridge University Press, 2004.
2. RF Microelectronics by Behzad Razavi. Prentice Hall,1997.

Reference Books

1. Joseph F. White , "High Frequency Techniques : An introduction to RF and Microwave Engineering " ,IEEE press ,John Wiley & sons ,2004.
2. Christopher Bowick ,"RF Circuit Design", Newnes, ,2nd Edition,2007.ISBN number:0750685182.

Web resources

1. Shouribrata Chatterjee,NPTEL- IIT Delhi, 'RF Integrated Circuits'. URL: http://nptel.ac.in/courses/117102012/

Assessment Method

Assessment Tool	Weekly tests/Assignments (In semester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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20ECXY32	System Verilog	PEC	3L: 0T: 0P	3 credits

Course Learning objectives

1. Learn the important concepts in SOC/ASIC/VLSI design verificationflow
2. Be ready and qualified for a Verification job in semiconductorindustry
3. Be able to code, simulate and verify SystemVerilogTestbenches
4. Learn the System Verilog language for Functional Verificationusage

Content

Unit-I **(8 hours)**

Data types: Built-in data types, Fixed-Size and Dynamic arrays, Queues, Associated arrays, Linked list, Enumerated Data types, Constants, Strings, Nettypes

.

Unit-II **(8 hours)**

Procedural statements and routines: Tasks, Functions and Void functions, Routine arguments, Local data storage and Time values.

Unit-III **(7 hours)**

Test Bench and Design, Interface construct, Stimulus timing, Top-Level scope, Module interactions, System verilog assertions, the FOUR PORT ATM Router, directed test for the LC3 fetchblock.

Unit-IV **(8 hours)**

OOP: class, objects, Static and Global Variables, Class routines, Public vs Local and Building test bench, inheritance, factory patterns, type casting and virtual methods, copying an object, callbacks.

Unit-V **(7 hours)**

Threads and inter process communication: working with threads, disabling threads, inter process communication, events, semaphores, mail boxes, building a test bench with threads andITC.

Unit-VI **(7hours)**

Virtual interfaces with ATM router, connecting to multiple design configurations, procedural code in an interface.

Introduction to Verification, Verification Plan, Directed testing, Functional coverage, Layered Test bench, Maximum code reuse.

Learning resources

Text book/Reference books

1. Chris Spear, '*SystemVerilog for Verification*', Springer Publications 3rd edition.

Web resources

1. Ramdas Mozhikunnath M, 'SoC verification using Systemverilog.
   URL: https://www.udemy.com/soc-verification-systemverilog/

Assessment Method:

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

20ECXY33	**VLSI DSP**	**PEC**	**3L: 0T: 0P**	**3 credits**

Course Learning Objectives:

1. To make an in-depth study VLSI implementation of DSParchitecture.
2. To enable students to design VLSI system with high speed and lowpower.
3. To make the students to implement DSP algorithm in an optimizedmethod.

Course content:

Unit I **(6hours)**

Typical DSP Algorithms, DSP Application Demands and scaled CMOS Technologies, Representations of DSP algorithms, Dataflow graph representations, loop bound and iteration bound, iteration bound of Multirate data-flow graphs

Unit II **(8hours)**

Pipelining of FIR Digital Filters, Parallel processing, pipelining and parallel processing for low power, retiming techniques, Unfolding: algorithm, properties, critical path, applications , Folding: transformation, register minimization in folding architectures, folding of multiratesystems

UnitIII **(7hours)**

Systolic array design methodology, FIR systolic arrays, selection of scheduling vector, matrix multiplication and 2D systolic array design, cook-toom algorithm, winograd algorithm, iterated convolution, cyclic convolution, design of fast algorithm by inspection

UnitIV **(8 hours)**

Parallel FIR filters, Discrete Cosine Transform and Inverse DCT, Parallel architectures for rank-order filters, pipeline interleaving in digital filters, pipelining in 1^{st} order IIR Digital filters, pipelining in higher-order IIR digital filters, parallel processing for IIR filters, low-power IIR filters

Unit V **(8hours)**

Parallel multipliers, interleaved floor-plan and bit-plane-based digital filters, bit-serial multipliers, bit-serial filter design and implementation, canonic signed digit arithmetic, distributed arithmetic, redundant number representations, carry-free radix-2 addition and subtraction, hybrid radix-4 addition, data format conversion, redundant to non-redundant converter

UnitVI **(8hours)**

Synchronous pipelining and clocking styles, clock skew and clock distribution in bit-level pipelined VLSI Designs, wave pipelining, constraint space diagram and degree of wave pipelining, implementation of wave-pipelined systems.

Learning Resources

Textbooks:

1. K. K. Parhi, '*VLSI DSP Systems*', Wiley,2003
2. U.Meyer- Baese, '*DSP withFPGA* ', Springer, 2004.

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

CO 1	Understand the overview of DSP concepts.
CO 2	Implementing DSP architectures using VLSI algorithms
CO 3	Improve the speed of digital system through transformation technique.
CO 4	Improve the speed of digital system through transformation technique.
CO 5	Perform pipelining and parallel processing in FIR systems to achieve high speed and low power.

Assessment Method:

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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20ECXY34	VLSI Physical Design	PEC	3L: 0T: 0P	3 credits

COURSE OBJECTIVE:

1. Understand the concepts of Physical Design Process such as partitioning, Floorplanning, Placement andRouting.
2. Discuss the concepts of design optimization algorithms and their application to physical designautomation.
3. Understand the concepts of simulation and synthesis in VLSI DesignAutomation
4. Formulate CAD design problems using algorithmicmethods

Course Content

Unit-I **(8 hours)**

Introduction, Design representations, various design styles, VLSI physical design automation, Partitioning, Floor planning and various floor planning algorithms, pin Assignment and Placement.

Unit-II **(7 hours)**

Grid routing, Global routing, detailed routing and clock design.

Unit-III **(7 hours)**

Clock network synthesis, Power and ground routing, Time closure concept and time driven placement.

Unit-IV **(8 hours)**

Time driven placement, Physical synthesis, Performance-Driven Design flow, various miscellaneous approaches to timing optimization. Interconnect modelling, Design rule check and Layoutcompaction.

Unit-V: **(7 hours)**

Testing of VLSI circuits, Fault modelling, Fault simulation, Test pattern generation, Design for testability, Boundary Scan standard,BIST.

Unit-VI: **(8 hours)**

Low power VLSI design, Techniques to reduce power, Gate level design for Low Power, other low power techniques, Algorithmic level Techniques for Low Power Design.

*As this is a Industry relavant course, the syllabus may vary as per the needs.

Learning resources

Text books

1. S.H. Gerez , *"Algorithms for VLSI Design Automation"*, John Wiley,1998.
2. N.A.Sherwani, *"Algorithms for VLSI Physical Design Automation", (3/e),* Kluwer,1999.

Reference books

1. *S*.M. Sait , H. Youssef, *"VLSI Physical Design Automation"*,World scientific, 1999.
2. M.Sarrafzadeh, *"Introduction to VLSI Physical Design"*,McGraw Hill (IE), 1996.

Web resources

1. Prof Indranil Sengupta,NPTEL- IIT Kharagpur, 'VLSI Physical design'. URL: https://nptel.ac.in/courses/106105161

Course outcomes:

CO1	Students are able to know how to place the blocks and how to partition the blocks while for designing the layout for IC.
CO2	Students are able to solve the performance issues in circuit layout.
CO3	Students are able to analyze physical design problems and Employ appropriate automation algorithms for partitioning, floor planning,placement and routing
CO4	Students are able to decompose large mapping problem into pieces, including logic optimization with partitioning, placement and routing
CO5	Students are able to analyze circuits using both analytical and CAD tools

Assessment Method:

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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20ECXY35	**VLSI Testing and Verification**	**PEC**	**3L: 0T: 0P**	**3 credits**

Course Objectives

To get familiarized with the concepts of integrated circuits verification and testing methodologies .

Content

Unit-I **(6 hours)**

Introduction, Overview of VLSI Design Flow, High Level Synthesis (HLS) Overview, Scheduling in High Level Synthesis (HLS), Resource Sharing and Binding in HLS

Unit-II **(7 hours)**

Logic Synthesis, Physical Design, Introduction to formal methods for design verification, Temporal Logic: Introduction and Basic Operations on Temporal Logic

Unit-III **(7hours)**

Syntax and Semantics of CTL, Equivalences between CTL Formulas, Introduction to Model Checking, Model Checking Algorithms, Model Checking with Fairness

Unit-IV **(7hours)**

Binary Decision Diagram: Introduction and Construction, Ordered Binary Decision Diagram (OBDD), Operation on OBDD, OBDD for state Transitionsystem

Unit-V **(8 hours)**

Symbolic model checking, Introduction to Digital VLSI Testing, Functional and Structural Testing, Fault Equivalence, Fault Simulation

Unit-VI **(10hours)**

Testability Measures (SCOAP) , Introduction to Automatic Test Pattern generation(ATPG) and ATPG Algebras, D-Algorithm, ATPG for synchronous sequential circuits, Scan Chain based Sequential circuit testing, Built in Self Test(BIST)

Learning resources

Textbooks

1. Miron Abramovici, Melvin A. Breuer and Arthur D. Friedman, "Digital Systems Testing and Testable Design," Revised, IEEE Press (1990)
2. SamihaMourad and Yervant Zorian, "Principles of Testing Electronic Systems", Wiley(2000)

3. Michael L. Bushnell and Vishwani D. Agrawal, "Essentials of Electronic Testing, for Digital, Memory and Mixed- Signal VLSI Circuits", Kluwer Academic Publishers (2000)

Web resources

1. Prof Arnab Sarkar, 'NPTEL-IIT Guwahati', 'VLSI Design verification and test'. URL: http://nptel.ac.in/courses/117103125

CourseOutcomes: The student will be ableto

CO1	Analyse the use of various algorithms for verification of VLSI systems.
CO2	Understand High level synthesis and resource sharing.
CO3	Understand the concepts of VLSI testing such as DFT, ATPG etc.
CO4	Understanding the difference between testing and verification

Assessment Method:

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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OPEN ELECTIVE COURSES

Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

20ECXY50	**Artificial Intelligence**	**OEC**	**3L: 0T: 0P**	**3 credits**

Course Learning objectives

1. Artificial Intelligence is a major step forward in how computer system adapts, evolves and learns. It has widespread application in almost every industry and is considered to be a big technological shift, similar in scale to past events such as the industrial revolution, the computer age, and the smart phonerevolution.
2. This course will give an opportunity to gain expertise in one of the most fascinating and fastest growing areas of Computer Science through classroom program that covers fascinating and compelling topics related to human intelligence and its applications in industry, defence, healthcare, agriculture and many otherareas.
3. This course will give the students a rigorous, advanced and professional graduate-level foundation in ArtificialIntelligence.

Course content

Unit-I **(3 hours)**

Introduction

Concept of AI, history, current status, scope, agents, environments, Problem Formulations, Review of tree and graph structures, State space representation, Search graph and Search tree.

Unit-II **(8 hours)**

Search Algorithms

Random search, Search with closed and open list, Depth first and Breadth first search, Heuristic search, Best first search, A* algorithm, Game Search.

Unit-III **(8 hours)**

Probabilistic Reasoning

Probability, conditional probability, Bayes Rule, Bayesian Networks- representation, construction and inference, temporal model, hidden Markov model.

Unit-IV **(8 hours)**

Markov Decision process

MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs.

Unit-V **(8hours)**

Reinforcement Learning

Passive reinforcement learning, direct utility estimation, adaptive dynamic programming, temporal difference learning, active reinforcement learning- Q learning.

Unit-VI **(5 hours)**

Programming (Python)

1. Write a programme to conduct uninformed and informedsearch.
2. Write a programme to conduct gamesearch.
3. Write a programme to construct a Bayesian network from givendata.
4. Write a programme to infer from the Bayesiannetwork.
5. Write a programme to run value and policy iteration in a gridworld.
6. Write a programme to do reinforcement learning in a gridworld.
7. Mini Projectwork.

Learning resources

Textbooks/Reference books

8. StuartRusselland Peter Norvig, "Artificial Intelligence: A Modern Approach" , 3rd Edition, PrenticeHall
9. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill
10. Trivedi, M.C., "A Classical Approach to Artifical Intelligence", Khanna Publishing House, Delhi. 4. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011
11. DavidPoole and Alan Mackworth, "Artificial Intelligence: Foundations for Computational Agents", Cambridge University Press 2010.

Webresources

1. https://nptel.ac.in/courses/106105077
2. https://nptel.ac.in/courses/106106126
3. https://aima.cs.berkeley.edu https://ai.berkeley,edu/project_overview.html (for Programming)

Course learning outcomes: After undergoing this course, the students will be able to:

CO1	Build intelligent agents for search and games
CO2	Solve AI problems through programming with Python
CO3	Learning optimization and inference algorithms for model learning
CO4	Design and develop programs for an agent to learn and act in a structured environment

Assessment Method:

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

*Note: In view of practicals programming concepts involved in the course, Monthly Test-3 examination may also be assessed based on Mini-project work submitted by the student.

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20ECXY51	Computational Science and Engineering using Python	OEC	3L: 0T: 0P	3 credits

Course Learning objectives

1. To introduce Python programming language as a tool forcomputation.
2. To solve numerical algorithms covering interpolation, integration, differentiation, ODE and PDE solvers and basic linear algebra usingPython.

Course content

Unit-I **(6hours)**

About computers, Python- Variables, assignments, Numpy arrays, Control structures.

Unit-II **(8hours)**

Python packages, programming , plotting, Errors, Non dimensionalization, Data I/O and Mayavi.

Unit-III **(8hours)**

Lagrange interpolation , interpolation in 2D, Splines.

Unit-IV **(8hours)**

Numerical integration: Newton- Cotes, Gaussian quadratures.

Unit-V **(8hours)**

Numerical differentiation, ODE solvers

Unit-VI **(7hours)**

Fourier transform, PDE solver: Diffusion equation in Spectral method, using finite difference. PDE solver: Wave equation using finite difference, Liner algebra Ax=B solver.

Learning resources

Textbooks

1. Mark Newmann, ' Computational Physics with Python', 2nd Edition
2. J.M. Stewart, 'Python for Scientists', Cambridge Univ. Press (2014)

Reference books

1. M.Lutz, 'Learning Python', O'Reilly, 5th Edition(2013)
2. J.H Ferziger, 'Numerical Methods for Engineering Applications', John Wiley & Sons(1998)

Web resources

1. Prof Mahendra K Verma,NPTEL- IIT Kanpur, 'Computational Science and Engineering using Python'.

   URL: https://nptel.ac.in/courses/115104095/

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

CO 1	Use python as a computational tool.
CO 2	Understand Python packages
CO 3	Use python programming for solving ODE, PDE
CO 4	Use python programming for solving integration
CO 5	Use python programming for fourier transforms
CO 6	Use python programming for linear algebra

Assessment Method

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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20ECXY52	Linux programming and Scripting	OEC	3L: 0T: 0P	3 credits

Course Objectives

1. The goal of the course is the study of scripting languages such as PERL, TCL/TK , Python andBASH
2. Creation of programs in the Linuxenvironment
3. The study of the principles of scriptinglanguages

Content

Unit-I **(6 hours)**

Introduction to Linux, File System of the Linux, General usage of Linux kernel & basic commands, Linux users and group, Permissions for file, directory and users, Searching a file & directory, zipping and unzippingconcepts.

Unit-II **(8hours)**

Introduction to Networking in Linux, Network basics & tools, File transfer protocol in Linux, Network file system, Domain Naming Services, Dynamic hosting configuration Protocol & Network information Services.

Unit-III **(8 hours)**

Introduction to Perl Scripting, working with Simple Values, Lists and Hashes, Loops and Decisions, Regular Expressions, Files and Data in Perl Scripting, References &Subroutines, Running and Debugging Perl, Modules, Object-OrientedPerl.

Unit-IV **(8 hours)**

Tcl Fundamentals, String and Pattern Matching, Tcl Data Structures, Control Flow Commands, Procedures and Scope, Evel, Working With UNIX, Reflection and Debugging, Script Libraries, Tk Fundamentals, Tk by Examples, The Pack Geometry Manager, Binding Commands to X Events, Buttons and Menus, Simple Tk Widgets, Entry and Listbox Widgets Focus, Grabs andDialogs

Unit-V **(8hours)**

Python scripting: Introduction to Python, Using the Python Interpreter, More Control Flow Tools, Data Structures, Modules, Input and Output,Errors and Exceptions, Classes, Brief Tour of the Standard Library.

Unit-VI **(8 hours)**

Projects using Perl, Tcl and Python in Linux environment.

Learning resources

Textbooks

1. Python Tutorial by Guido van Rossum, and Fred L. Drake, Jr., editor, Release 2.6.4
2. Practical Programming in Tcl and Tk by Brent Welch , Updated for Tcl 7.4 and Tk 4.0

Reference books

1. Teach Yourself Perl 5 in 21 days by DavidTill.
2. Red Hat Enterprise Linux 4: System Administration Guide Copyright 2005 Red Hat,Inc

Web resources

1. Anand Iyer,NPTEL- IIT Madras 'Linux Programming & Scripting'.
   URL: https://nptel.ac.in/syllabus/117106113/

Assessment Method

Assessment Tool	Weeklytests (Insemester)	Monthlytests (Insemester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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20ECXY53	**Machine Learning**	**OEC**	**3L: 0T: 0P**	**3 credits**

Course Learning Objectives

1. Toprovideabroadsurveyofapproachesandtechniquesinmachinelearning.
2. Todevelopadeeperunderstandingofseveralmajortopicsinmachinelearning.
3. Todevelopthebasicskillsnecessarytopursueresearchinmachinelearning.

Course Content

Unit-I **(6hours)**

Introduction, Different types of Learning, Hypothesis space and Cross-Validation, Linear Regression, Introduction to decision trees, learning decision trees, over fitting, Python exercise on decision trees and linear regression

Unit-II **(7 hours)**

K-Nearest neighbour, feature selection, feature extraction, collaborative filtering, python exercise on Knn and PCA.

Unit-III **(8hours)**

Bayesian Learning, Naïve Bayes, Bayesian Network, Python exercise on Naïve Bayes

Unit-IV **(8 hours)**

Logistic regression, Introduction to Support Vector Machine, SVM: The Dual formation, SVM: maximum margin with noise, nonlinear SVM and Kennel function, SVM: solutions to the dual problem, Python exercise onSVM.

Unit-V **(8hours)**

Multilayer Neural network, neural network and back propagation algorithm, deep neural network, python exercise on neural network.

Unit-VI **(8 hours)**

Introduction to computational learning theory, sample complexity: finite hypothesis space, VC Dimension, Introduction to Ensembles, Bagging and Boosting, Clustering, means clustering, agglomerative hierarchical clustering, python exercise on clustering.

Learning Resources:

Text Books

1. Tom Mitchell, '*MachineLearning* ', McGraw- Hill, 1997, 1st Edition.
2. EthemAlpaydin, '*Introduction toMachineLearning* ', Phi, 2nd Edition.

Web resources

1. Prof Sudeshnasarkar, NPTEL- IIT Kharagpur,*Introduction To Machine Learning*'. URL:http://nptel.ac.in/courses/106105152/

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

1	Understand the fundamental issues and challenges of machine learning like data, model selection, and model complexity.
2	Understand strengths and weaknesses of many popular machine learning approaches.
3	Design and implement various machine learning algorithms in a range of real world applications.

Assessment Method:

Assessment Tool	Weeklytests (Insemester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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20ECXY58	**Robotics Operating System:Drones**	PCC	**3L: 0T: 0P**	**3 credits**

Course Learning Objectives:

1. Introduction to AerialRobotics.
2. To analyse the components of aerial robots their sensors andactuators.
3. To be exposed to dynamic models ofquadrotor.
4. To be able to develop linear control for the quadrotormodels.
5. To be able to sense and estimate the state of thequadrotor.
6. Learn to use Robotic Operating System(ROS).

Content

Unit I
Introduction to ROS
ROS architecture & philosophy, ROS master, nodes, and topics, Console commands, Catkin workspace and build system
Launch-files, Gazebo simulator, Programming Tools.

Unit II
ROS Packages
ROS package structure, Integration and programming with Eclipse, ROS C++ client library (roscpp), ROS subscribers and publishers, ROS parameter server, RViz visualization.

Unit III
ROS Services
TF Transformation System, rqt User Interface, Robot models (URDF), Simulation descriptions (SDF),ROS services
ROS actions (actionlib), ROS time, ROS bags, Debugging strategies

UNIT IV
Introduction to Aerial Robotics
Unmanned Aerial Vehicles, Quadrotors, Key Components of Autonomous Flight, State Estimation, Applications, Basic Mechanics, Dynamics and 1-D Linear Control, Design Considerations, Design Considerations, Agility and Manoeuvrability.

Unit V

Planning and Control

Quadrotor Control, 3-D Quadrotor Control, Time, Motion, and Trajectories, Time, Motion, and Trajectories, Motion Planning forQuadrotors.

Unit VI

Practicals

1) Introduction to Robotic Operating System(ROS).
2) Introduction to ROS master, ROS nodes and ROStopics.
3) Building Catkin workspace andcmake.
4) Introduction to Gazebosimulator.
5) ROS packagestructure.
6) Introduction to ROS Python (rospy) and ROS C++ library(roscpp).
7) Using ROS subscribers andpublishers.
8) ROS parameter server and rVizvisualization.
9) Introduction to ROS action, ROS time, TOSbags.
10) Using Hector Drone simulator.
11) Term Project.

Learning resources

Text Books

1. Effective Robotics Programming with ROS, Third Edition - by Anil Mahtani, Luis Sanchez, Enrique Fernandez, Aaron Martinez

Reference Books

1. Smart-Programming Robots with ROS_ A Practical Introduction to the Robot Operating System-O'Reilly Media Morgan Quigley,Brian Gerkey, William D.

Web resources

1. Prof MarcoHutter,ETH- Zurich, 'Programming for Robotics-ROS'. URL: http://www.rsl.ethz.ch/education-students/lectures/ros.html

Course outcomes: After the completion of this course, the students gets acquainted with the following

CO 1	Knowledge on Aerial Robotics
CO 2	To analyse the components of aerial robots their sensors and actuators
CO 3	To be exposed to dynamic models of quadrotor

CO 4	To be able to develop linear control for the quadrotor models.
CO 5	To be able to sense and estimate the state of the quadrotor
CO 6	Learn to use Robotic Operating System (ROS)

Assessment Method

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

*Note: As this course is a practical oriented in nature, Monthly Test-3 assessment may be done based on the Term project submitted by the students.

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MINIPROJECT-I/MINIPROJECT-II/SUMMER INTERNSHIP/PROJECT-I/PROJECT-II & DISSERTATION

Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING THIRD YEAR: SEMESTER-I

20EC3190	**Mini Project -I (Socially Relevant Project)**	**PROJ**	**0L: 0T: 2P**	**1 credits**

Course Learning Objective

1. To introduce the student to the existing real-time societalproblems.
2. To make the student to identify a problem with the help of staffmembers.
3. To see that students can propose elaborately and try attempting to solve the problem to greatextent.

List of Experiments

1. Identifying real-time societalproblems.
2. Idea proposal of multiple-solutions for the problem identified anddiscussion.
3. Prototype design for an optimalsolution.

Note: The student is supposed to use the latest advancements of IOT/AI and general understanding on science and technology for identifying solution to a problem.

Course outcome: After the completion of this Laboratory course, the student will be able to

CO 1	To understand the problems the society facing at present specifically at University/Institute/ Locality etc level.
CO 2	Shortlist some of the problems and do an exercise to choose a problem to solve
CO 3	Form a group with classmates and peers (worldwide), local authorities and understand deeply the roots of the problem and start initiation of solving it.
CO 4	Propose a solution method and prepare either hardware or software models depending upon the problem demands
CO 5	See his/her solution impact on the society and see or submit/suggest the models to the authorities for further implementation after approvalsatisfying he IP rights of RGUKT.

Assessment Method

Assessment Tool	Literature survey (Internal)	Seminar on observed case-studies (Internal)	Hardware/Software prototype development for identified problem (External)	Final Presentation and Viva-Voce (External)
Weightage (%)	20%	20%	40%	20%

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ENGINEERING THIRD YEAR: SEMESTER-II

20EC3291	**Mini Project -II**	**PROJ**	**0L: 0T: 3P**	**1.5 credits**

The object of Mini Project-2 is to enable the student to extend further the investigative study taken up under EC3190 or undertake a new project, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normallyinclude:

1. Survey and study of published literature on the assignedtopic.
2. Working out a preliminary approach to the Problem relating to the assignedtopic.
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/ Feasibility.
4. Preparing a Written Report on the Study conducted for presentation to the Department.
5. Final SeminarPresentation.

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING FOURTH YEAR: SEMESTER-I

20EC4192	**Summer Internship**	**PROJ**	**0L: 0T: 6P**	**3 credits**

The objective of the course is that:

1. Students should opt for summer internship that would provide to gain ample field knowledge in the relevant field of engineering such that theoretical knowledge gained in the class can be applied to solve the practical/ fieldproblem.
2. Students should take a challenging task, may be small portion, and apply the knowledge gained to solve it. Summer internship can also involve data collection from different sources including generating experimental data, collection of data from field etc. Later on the student is required to analyze the data collected and arrive at meaningfulconclusions.
3. Summer internship shall be aimed at solving some of the problems of the society/ local region that should have practical applications and benefit thesociety.
4. Preparing a Written Report on the Study conducted for presentation to the Department;
5. Final SeminarPresentation.

Note: Summer Internship project duration shall be defined separately by the Institute.

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ENGINEERING FOURTH YEAR: SEMESTER-I

20EC4193	**Project-I**	**PROJ**	**0L: 0T: 8P**	**4 credits**

The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under EC3190 or EC3291 or EC4192 or undertake a new project, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

1. Survey and study of published literature on the assignedtopic.
2. Working out a preliminary approach to the Problem relating to the assignedtopic.
3. Conducting preliminary analysis/modelling/simulation/experiment/design/ Feasibility
4. Preparing a Written Report on the Study conducted for presentation to the Department.
5. Final SeminarPresentation.

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Rajiv Gandhi University of Knowledge Technologies - AP

Department of Electronics & Communications Engineering

ENGINEERING FOURTH YEAR: SEMESTER-II

20EC4294	**Project-II & Dissertation**	**PROJ**	**0L: 0T: 12P**	**6 credits**

The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under EC3190 or EC3291 or EC4192 or EC4193 or undertake a new project, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normallyinclude:

1. In depth study of the topicassigned.
2. Review and finalization of the approach to the Problem relating to the assigned topic.
3. Preparing an Action Plan for conducting the investigation, including teamwork.
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed.
5. Final development of product/process, testing, results, conclusions and future directions.
6. Preparing a paper for Conference presentation/Publication in Journals, ifpossible.
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final SeminarPresentation.

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COURSES OFFERED TO OTHER DEPARTMENTS

20ECXX10	Digital Logic Design	ESC	3L: 0T: 0P	3 credits

Course Learning Objective

1. To discuss the relevance of Digital Logic Design with Computer Science and Engineeringcourse
2. To discuss the concepts of Number systems and representations, combinational design, sequential designs and complete system design at gate-level abstraction in computer Design.
3.To discuss the important features of IC design like area, power anddelay.

Course Content

Unit-I **(8 hours)**

Number systems-Representations-Conversions, error detection and error correction, Boolean constants and variables, basic gates: operation and truth tables, describing logic gates algebraically, evaluating logic circuit outputs, implementing circuits from Boolean expressions, universality of gates, Booleantheorems.

Unit-II **(8 hours)**

Combinational circuit minimization using Boolean laws and karnaugh maps, multilevel synthesis, logic levels and noise margins. Single bit adders and subtractors, parallel adders, multi-bit subtraction using adders, signed multiplier, unsignedmultiplier.

Unit-III **(8 hours)**

Decoders, Encoders, Multiplexers, Demultiplexers. Realization of various functions using Decoders, Multiplexers. Priority encoders.
Implementation of functions using programmable logic devices: PAL,PLA,PROM

Unit-IV **(8 hours)**

Bistable elements, Latches and Flip-flops : S-R latch, D latch, J - K Flipflop, D Flipflop, master/slave flip-flop, edge triggered J-K flip-flop with asynchronous inputs, T flip-flops. Excitation tables, Characteristic tables, Characteristic equations.

Unit-V **(8 hours)**

Frequency division and counting. Design and analysis of synchronous counters, asynchronous counters.

Unit-VI **(5 hours)**

Registers: SIPO, PISO, PIPO, PISO. State diagrams for D-flipflop, T-Flip flop, J-K Flip flop, Mealy machines and Moore machines.

Learning Resources

Text books

1. Ronald J Tocci, Neal S.Widmer, Gregory L.Moss,'Digital systems' Pearson 10th edition.
2. Stephen Brown, ZvonkoVranesic,'Fundamentals of Digital Logic with Verilog Design', TMH, 2nd edition

Reference books

1. John F.Wakerly, 'Digital Design' , Pearson 4th edition

Web Resources

1. Prof. Shankar Balachandran, NPTEL-IIT Madras, *'Digital Circuits &Systems'*
URL: https://nptel.ac.in/courses/117106114/

2. Prof. S Srinivasan, NPTEL-IIT Madras, 'Digital Circuits and Systems'
URL:https://nptel.ac.in/courses/117106086/

Course Outcomes

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

CO 1	Apply the knowledge of simplification in obtaining optimal digital circuits
CO 2	Employ Boolean algebra to describe the function of logic circuits
CO 3	Design circuits which represent digital logic expressions. Specifically, design a gate-level digital circuit to implement a given Boolean function
CO 4	Study and examine the SSI, MSI, LSI and Programmable elements
CO 5	Analyse the operation of synchronous and asynchronous state machines
CO 6	Design any combinational or sequential digital circuits to meet the given specifications
CO 6	Analyse any digital circuit and to debug such circuit
CO 7	Prototype a real time application on EDA tool

Assessment Method

Assessment Tool	Weekly tests/Assignments (In semester)	Monthly tests (In semester)	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

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20ECXX80	Digital Logic Design Lab	ESC	0L: 0T: 3P	1.5 credits

Course Learning Objective

1. To expose to the concept of Digital knowledge and itsapplications
2. To understand Combinational and Sequentialcircuits
3. To design a prototype digital logicdesign

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List of Experiments

1. Familiarization with logic gate IC's and Arduino kits
2. Design of code converters and comparators (8-bit) on breadboard
3. Adder related experiments: Half adder , full adder , half subtractor, full subtractor , ripple carry adder, BCD adder, carry look ahead adder usingIC
4. Design of a binary multiplier and displaying its inputs and outputs on seven segment displayunit
5. Familiarization with multiplexer, decoder, encoder. Design of Half adder, full adder, magnitude comparator and other examples using above familiarizedcomponents
6. Bi-stable multi-vibrator design. Design and verification of SR,JK,D,T latch/flip-flops. Verification and elimination of Race AroundCondition
7. Flip-flop conversions and Design of frequencydividers
8. Design of synchronous counters (Up and Down) and displaying result on seven segment displayunit
    a. Design of Mod n $\leq 2^n$counterdesign(total8states,designofmod6and mod7 with clear
    b. Design and IC verification of Decadecounter
    c. Cascading of counters
9. Synchronous counter design and displaying result on seven segment displayunit
    a. Randomsequence
    b. Ring counter/Johnsoncounter
10. Design and submission of term project based on 'C' coding or Python coding.

Note:

1. All the above experiments (except few exceptional cases) are to be implemented on Arduino kits also.

2. It is mandatory to perform experiment on any one of the EDA Tools before the experiment is done on hardware. All experiments must be unique, design specifications should not be common in thelab.

Course outcome

After the completion of this Laboratory course, the student will be able to

CO 1	Understand the implementation of discrete digital components
CO 2	Utilize the ICs of Decoder, Multiplexer, Seven segment display unit in combination circuit design
CO 3	Utilize the ICs of suitable Flipflops in sequential circuit design
CO 4	Utilize the Programmable Logic devices in digital design
CO 5	Understand the concepts of setup time, hold time, propagation delays
CO 6	Design circuits with optimal features of Area, Power and delay
CO 7	Design and implement prototypes of complete digital systems

Assessment Method

Assessment Tool	Experiments	Report/Viva-Voce/ Quiz/MCQ/Lab Project	Total
Weightage (%)	25%	15%	40%
		End Semester Examination weightage (%)	60%

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Rajiv Gandhi University of Knowledge Technologies

COURSE STRUCTURE AND DETAILED SYLLABI FOR THE B.TECH PROGRAM (MINOR DEGREE IN MACHINE LEARNING) IN ELECTRONICS AND COMMUNICATION ENGINEERING

(EFFECTIVE FROM THE BATCHES ADMITTED IN 2019-20)

Index

Introduction & Background

Artificial Intelligence is the simulation of the human process by machines. Artificial intelligence and machine learning are rapidly changing our world and empowering the Fourth Industrial Revolution. ML can solve many real world problems in the fields of Computers, Electronics, communications, signal processing to name a few. Since the last decade it is receiving growing attention globally both from industries and academia. Hence there is a need to introduce and make expertise in this domain to the students to compete with the contemporary world with the help of this trending technology.

Our goal with minor in ML is to:

1. Train the students to get expertise in the relevant areas of MLand make them industry ready.
2. Increase the placements by targeting the ample number of industries working with AI & ML
3. Contribute towards Research through publications in ML, as most of the accepted research works in EC and CS are based on AI and ML.
4. Establishing research labs in collaboration with industries and MoUs with other reputed national and international institutions.
5. Encourage Innovation and entrepreneurship in AI.

The objective of this Request for Proposal is to locate a source that will provide the best overall value to RGUKT RK Valley.

Course Structure

S.No	Title of the course		credits	Prerequisite
E3 Semester-I				
1	20ECM101	Mathematical foundations for ML	4	Probability theory(20MA2101)
E3 Semester-II				
2	20ECM102	Foundations of programming for ML	4	PDS(20CS1109)
3	20ECM103	Machine Learning	4	
E4 Semester-I				
4	20ECM104	Introduction to Deep learning	4	
E4 Semester-II				
5	20ECM1xx	ML Elective-1	4	
		Total credits	20	

Eligibility

- All the students who opted ECE, CSE, Mechanical or Civil engineering as their major.
- Minor in ML may be offered with a minimum number of registrations not less than 20.
- A maximum limit of 70 students can be enrolled. The final list of registrations are based on their performance in maths and programming courses (Discrete maths, Probability, Python, C etc) that they have done in previous semesters.

Syllabus

1. Mathematical foundations for Machine Learning

Unit-I:

Linear algebra, inner products, orthogonality and linearly independent vectors, Vector spaces, Null spaces, Eigenvalues and Eigen vectors. **6 hours**

Unit-II:

Data interpretation, matrix factorization: singular value decomposition, Principal component Analysis. **6 hours**

Unit-III:

Probability theory: Review, Bayesian analysis, Random variables, Expectations. **8 hours**

Unit-IV:

Gaussian distribution, Multiple random variables and random processes. **8 hours**

Unit-V:

Differential calculus review, Optimization techniques: min-max analysis. Lagrange's multiplier. **8 hours**

Unit-VI:

Discrete mathematics, discrete time signals representation and Frequency analysis. **6 hours**

References:

1. SK Guptha&Sanjjev Kumar: NPTEL Mooc on Essential Mathematics for Machine learning.
2. Gilbert strang: Linear algebra
3. Jain &iyengar: Higher engineering Mathematics

2. Programming for Machine Learning

Unit-I:
Principles of programming, data types, Flow of Control and Simple Functions. **6hours**

Unit-II:
Data structures, structures and unions, classes and objects and file handling. **8 hours**

Unit-III:
Numerical python with linear algebra, pandas data frames. **8 hours**

Unit-IV:
Web scraping : HTML parsing, data collection tools, APIs. **6 hours**

Unit-V:
Data visualization and plotting, scatterplots: Matplotlib **6 hours**

Unit-VI:
Mathematical and Machine learning packages in python: scipy, librosa, PIL, scikit learn **8 hours**

3. Machine Learning: Same as 20ECXY53

4. Introduction to Deep Learning

Unit-I:
Introduction to Machine Learning: linear regression, classification. Datasets bias and Variance.
6 hours

Unit-II:
Introduction Neural Networks: The inspiration for neural network comes from biology. What is a neuron(and it's similarity to a biological neuron),the architecture of a feed-forward neural network, activation functions and weights. Training feed-forward neural network: calculate the loss and adjust weights using a technique called BackPropagation, techniques to improve training speed and accuracy. The pros and cons of using Gradient Descent, Stochastic Gradient Descent and mini-batches.
8 hours

Unit-III:

Build a basic neural network using Keras with Tensorflow as the backend. Regularization to prevent overfitting. Penalized cost function, dropout, early stopping, momentum and some optimizers like Ada Grad and RMS Prop that help with regularizing neural networks. **6 hours**

Unit-IV:

Introduction to Convolutional Neural Networks. Build a CNN by choosing the grid size, padding, stride, depth and pooling. Apply all of the CNN concepts learnt from the MNIST (Modified National Institute of Standards and Technology) dataset for handwritten digits. **8 hours**

Unit-V:

Text Word Vectors, convert words into numerical values. Recurrent Neural Networks (RNN) and their application to Natural Language Processing (NLP). Developing a RNN & math of RNNs. Long Short Term Memory (LSTM) RNNs. **8 hours**

Unit-VI:

Introduction to GANs, Transformer models and other latest architectures. **6 hours**

References:

1. Deep Learning, An MIT Press book By Ian Good fellow, YoshuaBengio and Aaron Courville.
2. Make Your Own Neural Network Tariq Rashid, Create Space Independent Publishing Platform, 2016

Web resources

3. Prof Prabir Kumar Biswas, IIT Kharagpur, NPTEL, DeepLearning' https://nptel.ac.in/courses/106/105/106105215/
4. http://neuralnetworksanddeeplearning.com/index.html by Michael Nielsen
5. https://karpathy.github.io/ by Andrej Karpathy

5. ML Elective-1

Name of the Course	Prerequisite
a. Natural Language Processing b. Computer Vision c. Speech systems d. Data analytics e. Signal Processing for Machine Learning f. Reinforcement Learning g. Optimization theory h. Data mining information retrieval i. Machine Translation j. Network security and informatics k. Representation Learning l. Advanced Deep Learning architectures m. Machine Learning with TensorFlow on Google Cloud Platform n. Applications of AI: Healthcare, Agriculture and BioInformatics	Machine Learning